CNS2024 TORONTO

April 13–16 | 2024

Poster Session A

Saturday, April 13, 2024, 2:30 – 4:30 pm, Sheraton Hall ABC

A1 - The encoding of task-irrelevant but not relevant acoustic events depends on the pre-stimulus phase of alpha oscillations

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The phase of alpha oscillations has been associated with perceptual fluctuations in visual attention. In the auditory modality, however, neural phase and perception seemed uncorrelated in the absence of acoustic rhythms. Here, we hypothesized that this difference reflects the dynamic nature of audition: The momentary change in acoustic input renders it costly to lose the information that coincides with the low-excitability neural phase. We hypothesized that the brain employs constant (i.e. non-phasic) attention to upcoming task-relevant acoustic targets to avoid such information loss. In contrast, the perception of to-be-ignored task-irrelevant acoustic events would still be subject to the pre-stimulus neural phase. In this electroencephalography study, 29 human participants (21F) performed a target-in-noise detection task, wherein pure tones at two pitches were randomly presented amidst a continuous noise. Participants were instructed to detect the tone at one pitch and ignore the other. In line with our hypothesis, we found that neural response to the tone depends on the pre-stimulus alpha phase (9 – 12 Hz) only when the tone is task-irrelevant. The strongest phase dependence was evident in fronto-central and occipital sensors. Perceptual sensitivity was further associated with pre-stimulus alpha phase extracted from central sensors. These results demonstrate that rhythmic perception is restored in the face of task-irrelevant events in the auditory modality.

Topic Area: ATTENTION: Auditory

A2 - Neurophysiological correlates of auditory attention in monolinguals and bilinguals

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Previous research suggests that the cognitive differences between monolinguals and bilinguals may lie in their attention abilities, especially in the auditory domain. In the present study, we investigated the neurophysiological correlates of attention using brain oscillations, pupil dilation, and heart rate in monolingual and bilingual adults. We aimed to answer two questions: (1) what are the effects of language experience and cognitive load on the neurophysiological measures of attention; and (2) how are these measures modulated by participants' individual language and cognitive abilities. We tested 70 English speakers (35 monolingual, 35 simultaneous bilingual; 18-25 years old) and simultaneously collected their EEG, eye movement and heart rate data while they completed two active listening tasks that varied in cognitive load levels (low vs. high). Participants listened to short passages (spoken in a familiar or unfamiliar language) in the linguistic task and musical sounds (composed of fewer or more instruments) in the nonlinguistic task. We assessed participants' language and cognitive abilities via Clinical Evaluation of Language Fundamentals and Test of Nonverbal Intelligence, respectively. We observed no language experience effects but significant cognitive load effects on measures like pupil size and mean heart rate across task domains. These findings suggest that bilingualism as a categorical variable (monolingual vs. bilingual) does not predict participants' neurophysiological measures whereas cognitive load (low vs. high) does. Overall, this neurophysiological approach to assessing monolingual and bilingual cognitive profiles can contribute to advancing current theoretical models.

Topic Area: ATTENTION: Auditory

A3 - Speech reconstruction of higher formant and dispersion dynamics predicts listeners' ability to resolve multispeaker scenarios

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Speaker identification cues are readily available for listeners in the rich spectrotemporal information content of the human voice. It is not clear whether encoding the dynamics of its spectral modulations may assist the processes of speech intelligibility and selective attention. Here, we hypothesize that formant information, broadcasted by the speaker's laryngeal system configuration during vocal production, can be tracked by (and reliably decoded from) cortical networks during speech listening. In addition, we address whether any such encoding may impact listener behavior in a 'cocktail-party' task. For this, we investigate cortical activity in electroencephalogram (EEG) signals using the stimulus reconstruction technique, measuring how much can instantaneous formant (F1-F5) and related formant dispersion (delta-F) variations be decoded from the EEG. Participants (N=73) listen to brief (~9 s), independent solo speech presentations from dozens of different of speakers while undergoing EEG. The neural representation of vocal modulations in the single-trial data is addressed by measuring decodability of formant dynamics from the EEG headset. Our results show above-chance performance of listener decoders for the vocal spectral features corresponding to higher formants F4 and F5, as well as delta-F. Furthermore, a multidimensional index of performance measures, constructed across the three spectral features, characterized participants' success in selecting and understanding speech in additional 'cocktail-party' task settings. Our results suggest that decoding of these important vocal identity-related modulations from electrophysiological activity may add to the battery of objective measures of speech listening, in naturalistic conditions.

Topic Area: ATTENTION: Auditory

A4 - Selective attention towards and away from trigger sounds in misophonia: a fMRI study

Marie-Anick Savard[1], Heather A. Hansen[1], Randa El Chami[1], Mickael L.D. Deroche[1], Emily B.J. Coffey[1]; [1]Concordia University

Misophonia is a disorder in which specific trigger sounds elicit strong negative emotional reactions. It is surprisingly prevalent (up to 18% of the population), and can significantly impact well-being. Although higher-level cognitive processes have been shown to play a role in misophonia, little is known about how they could be used to modulate misophonic responses. Attentional processes are particularly interesting in misophonia. Individuals with misophonia often report experiencing hyper-attention to trigger sounds once they are detected, and also report attending to music as a coping mechanism, for example to get through a class in which trigger sounds are present in the environment. In the current study, we used functional magnetic resonance imaging (fMRI) to measure brain activity of individuals with misophonia during an auditory selective attention task. While in the scanner, participants with misophonia listened to two sound streams played simultaneously through ear inserts. In one ear, they were presented with trigger or neutral sounds; in the other ear, they heard unfamiliar musical excerpts. During each trial, participants were asked to focus on a specific sound stream (either sound or music). We present preliminary results revealing insights into the modulation of brain activity in misophonic individuals with selective attention. This neuroimaging perspective enhances our understanding of misophonic reactions, providing crucial insights into the specific brain regions involved during attention modulation of trigger sounds, which will contribute to the development of targeted interventions aimed at alleviating misophonic distress, thereby improving the overall quality of life for those affected.

Topic Area: ATTENTION: Auditory

A5 - Listeners Detect Deviant Beats Better in Musical Rhythm Contexts with Fewer Subdivision Levels: an MMN and Behavioral Study

Julia Yu[1], Aditi Tuli[1], Naomi Shi Yan Gong[1], Takako Fujioka[1]; [1]Stanford University

In rhythm perception, patterns with fewer subdivisions allow listeners to extract the underlying beat structure more easily via sequential processing, whereas increased levels of subdivisions require hierarchical processing. We hypothesized that different subdivision levels would influence listeners' ability to detect deviant beats, as reflected in higher behavioral performance as well as a larger amplitude of mismatch negativity (MMN). We recorded EEG while participants passively listened to a variety of rhythms. Each 2/4 rhythm contained a prime part and subsequent steady beats. We used four different primes; (prime1) two quarter notes, (prime2) two 8th and one quarter note, (prime3) four 8th notes, and (prime4) a dotted 8th and a 16th note pattern twice repeated, where the subdivision level increased from one (prime1), two (prime2&3), to three (prime4). The subsequent pattern was always the same, consisting of three quarter notes in standard trials, or the final note occurring an 8th or 16th note earlier in

deviant trials. Afterwards, participants also determined whether two rhythms were the same or different. The MMN was primarily evident in the frontocentral electrodes. Deviant 8th elicited a significantly larger MMN than deviant 16th across all primes. Behaviorally, listeners also more easily detected the larger deviation of 8th than 16th. When primes contained more subdivisions such as the dotted pattern, behavioral accuracy significantly decreased, indicating a Prime x Deviant interaction. These results support our hypothesis that different subdivision levels affect one's ability to extract beats, pointing to the interplay between sequential and hierarchical processing.

Topic Area: ATTENTION: Auditory

A6 - P3b Auditory Processing Differences in Adults With and Without Self-Reported Attentional Deficits

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Attention Deficit Hyperactivity Disorder (ADHD) is a developmental disorder that is diagnosed and studied in children. ADHD often persists into adulthood but the underlying mechanisms are vastly understudied in this group. Previous research has shown that difficulties in attentional processing are linked to atypical activation of specific cortical neuronal networks. Electroencephalogram (EEG) and event-related potentials (ERP), specifically the P3b, can be used to assess differences in patterns of neuronal activity underlying attention. Using an oddball paradigm with auditory stimuli under active and passive attentional conditions, we examine differences in neural activation in adults with and without ADHD. As expected, robust P3b (ca. 385-485 ms) peaks were identified in all adults in central regions, albeit these components were more right lateralized and less well defined in the ADHD group. Within the ADHD group, the presentation and processing of the target stimuli elicited a greater response than the standard stimuli ($F1,9 = [6.949\text{-}15.094]$, $p < 0.05$), however responses to standard stimuli appeared later than responses to target stimuli across both conditions. The active condition also elicited a more robust response than the passive condition ($F1,9 = [4.907\text{-}5.620]$, $p < 0.05$). The control group (n=24) had greater amplitudes across all conditions and stimuli when compared to individuals with ADHD. This may involve an increase in the amount of neuronal network activation involved in processing in the control group.

Topic Area: ATTENTION: Auditory

A7 - Cortical circuit dynamics contributing to spatially directed attentional control in complex auditory environments.

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The ability to segregate specific sound features from statistically competing sound sources is essential for extracting meaningful information in a complex sound environment. However, how auditory cortex represents spatial sound information at the cortical level remains poorly understood. In this study, our goal was to characterize how sound location is represented across cortical layers and how attention might alter sensory processing representation in the primary auditory cortex. To address this question, we collected local field potential and single-unit recordings across cortical layers from fourteen mice in a multi-speaker environment. During the task, mice were presented with auditory stimuli from speakers arranged along the azimuth at four locations. The experiment was divided into a passive block, where locations were not relevant, and an active block, where one of the locations were associated with reward. Our results reveal an enhancement in frequencies in the alpha/beta range (8-16 Hz) and delta range (1-4 Hz) for relevant locations during the active block. This suggests a top-down contribution to the modulation of alpha-beta and delta frequencies during active spatial auditory attention. We further discovered these changes were associated with changes in physiological measures of attentional load including location specific changes in pupil diameter. Our preliminary findings indicate that changes in these frequency bands emerge differentially across cortical layers, and we are currently exploring how these changes in rhythms contribute to the discriminability of sound location at the level of single neurons in the auditory cortex.

Topic Area: ATTENTION: Auditory

A8 - Event Processing during Story Listening in Background Noise

Ryan Panela[1,2] (ryan.panela@utoronto.ca), Alexander Barnett[2], Morgan Barense[1,2], Björn Herrmann[1,2]; [1]Rotman Research Institute, Baycrest Academy for Research and Education, [2]Department of Psychology, University of Toronto

Investigations into speech-comprehension difficulties often focus on the intelligibility of short, disconnected, sentences, possibly limiting the generalization to everyday listening. Novel approaches to understanding naturalistic speech listening are critical to gaining insight into impaired speech processing. Event cognition research research reveals that continuous environmental information is perceived, encoded, and recalled as temporally-extended, discrete events—demarcated by event boundaries, signifying distinct units of perception. However, this research has not been leveraged to understand speech comprehension under acoustic challenges. In the current study, participants (18-38 years) listened to or read three 10-minute stories. Spoken stories were overlayed with a twelve-talker babble in three conditions ranging from easy to difficult speech intelligibility: clear, +2 dB SNR, and -4 dB SNR. Participants were instructed to identify event boundaries and subsequently recall the narrative. Results show that speech intelligibility decreased with decreasing SNR, as expected, whereas recall only decreased for the -4 dB SNR condition, relative to clear and +2 dB SNR. Event boundary placement was more consistent during reading compared to listening under all speech-masking conditions, suggesting that listening, makes segmenting information more challenging. Critically, event boundaries were more consistently placed for the +2 dB SNR and clear conditions compared to the -4 dB SNR. These results suggest that background noise may hinder the cognitive ability to organize and structure speech, resulting in evident encoding and recall are impediments. Our results reveal a crucial link between background noise and event processing during speech listening.

Topic Area: ATTENTION: Auditory

A9 - Neural Markers of Conscious and Non-conscious Speech Processing

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The processing of stimuli subjects are unaware of is highly debated, with studies focusing mostly on visual perception. As auditory inputs are profoundly different from visual, and rely on different processing streams, processes, and brain areas, examining audition is likely to bring novel insights and inform theories of consciousness. Using a new paradigm, we conducted two EEG experiments (total N=67; the second preregistered) in which participants performed a difficult visual task (1-back) while an ongoing stream of pseudowords was played. Single meaningful words, with lexical properties matched to the pseudowords, were embedded in this stream, and we tested awareness of word presence. In the second experiment, we added a manipulation for the relevance of word detection: before introducing the word detection task, participants performed only the visual task without informing or asking them about the presence of words. Our analyses revealed a late (>600 ms) frontal positivity evoked for undetected words vs pseudowords, reflecting non-conscious processing: the participants experienced nothing, yet the signal showed lexical processing. This response was significant for subjectively unaware trials in which participants were objectively incorrect regarding word category, weakening the possibility of unreported weak conscious processing. When word detection was irrelevant, the lexicality response disappeared. This result shows that words can be processed even though subjects are subjectively as well as objectively unaware of their presence. It also highlights that auditory unconscious processes are not mandatory, but goal-dependent: if we need to hear something relevant, we may process it even when it evades consciousness.

Topic Area: ATTENTION: Auditory

A10 - Early auditory stream formation of simultaneous musical objects

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Our brains evolved to parse multiple simultaneously-sounding objects into representative streams, based on spectral, temporal, and spatial information. In the case of multiple talkers, we form a stream for each person, and these streams cannot typically be combined if sematic meaning is to be retained. In music, on the other hand, different streams (e.g., instruments) can be combined meaningfully. Here we investigated the

role of attention on early integration of streams in music. In particular, we trained a model to reconstruct the stimulus from the measured EEG response to test whether initial early stream formation occurs automatically regardless of attention aimed at stream integration. Participants (n=22) were presented with two sources of naturalistic piano music (presented 30 degrees to the right and left) that could be perceived as two separate pieces or combined into a meaningful whole. They were instructed to attend to one and ignore the other (segregate the pieces) or to attend to both (integrate). We analyzed how well their EEG tracked each of the two pieces independently as well as the combined mixture of sound. We found that the brain tracked the spectro-temporal modulation of each piece independently in the early processing stage (lag of 50–80 ms between sound and the corresponding EEG response), not only when they aimed their attention to segregate, but also to integrate the two pieces. This suggests that stream formation for music occurs automatically at an early stage of processing, regardless of overt attention to actively segregate or integrate the streams.

Topic Area: ATTENTION: Auditory

A11 - Dynamics of the Multiple Demand Network Connectivity Under Varied Speech to Noise Ratios

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Speech listening engages the domain-general Multiple Demand (MD) network, which does not appear to reflect operations required for speech understanding, but rather a general increase in effort. The MD network includes the cingulo-opercular network (CON) and the frontoparietal network (FPN). Within the CON, the anterior insula (AI) appears responsible for performance monitoring and salience signaling (Menon and Uddin, 2010; Shenhav et al., 2013) while the dorsal anterior cingulate cortex (dACC) appears involved in effort allocation. If listening conditions worsen, we hypothesize that the AI will increasingly signal the dACC, which coordinates with the FPN to implement cognitive control mechanisms (Kerns et al., 2006; Dosenbach et al., 2008). It is unclear if the MD regions covary together or separate into differentiable systems as listening to speech becomes effortful. The current study examines the impact of a varying signal-to-noise ratio (SNR) during story listening on the dynamics of the MD network. Healthy adults (N = 44, 19 – 34 years) listened to three stories, each approximately 10 to 13 minutes long, whilst undergoing functional MRI scanning. Each story contained a 12-talker babble masker and the SNR pseudo-randomly varied every 30 to 33 seconds across five SNRs: clear, +12, +7, +2, and – 3 dB. We will employ a generalized psychophysiological interaction (gPPI) analysis to investigate how functional connectivity is modulated by SNR between the implicated regions of the MD network. We expect that the functional connectivity within the CON, and between the CON and FPN, will increase as SNR declines.

Topic Area: ATTENTION: Auditory

A12 - Sound Focus

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The purpose of this study is to assess the efficacy of using specific frequencies bands of auditory signal to facilitate focused and sustained attention in college-aged adults while studying. Stochastic resonance theory suggests that one can amplify, and correctly identify, a signal in the midst of specific frequencies and intensities of noise thus enhancing the signal to noise ratio (SNR). In humans this serves to facilitate attention to the signal and inhibit attention to irrelevant stimuli. Research suggests spectrums of sounds most reliably shown to increase focused attention are white (all frequencies audible to the human ear at equal intensity), pink (lower tones, intensity decreases at a specific rate) and brown noise (variable frequency and intensity). 107 college-aged students (88 females, 10 with ADD) were randomly assigned to 1 of 4 conditions (no noise, white, pink or brown noise) and asked to listen to the spectrum via headphones as they read a passage and responded to comprehension questions or solve math problems. Environmental sounds such as “conversations” or music were also piped in during the session. Results suggest that usage of any three of the frequencies provides an increased level of concentration, but those who used brown noise felt the most focused compared to the rest of the population.

Topic Area: ATTENTION: Auditory

A13 - Neural timescales of attention switching during speech listening

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Speech perception in the real-world often involves noisy scenarios with simultaneous speech streams. Previous research has shown that neural signals encode attended and ignored speech streams in a different manner, enabling the robust identification of the attended speaker from non-invasive electroencephalography (EEG) and magnetoencephalography signals. In naturalistic multi-talker scenarios, listeners can both sustain their attention to a particular speaker and also rapidly re-orient their focus of attention. Previous studies have examined speech attentional switching across spatially separated speakers and in the context of real-time attention decoding. However, the neural underpinnings of attentional switching remain to be understood. Our study investigated how attention switching unfolds across different stages of the speech processing hierarchy (envelope and word surprisal), addressing two central questions: 1) How rapidly can attention switching be detected from EEG signals? 2) How much longer does this mechanism take for more abstract linguistic features? EEG signals were recorded from twenty-four native English speakers who were instructed to switch attention between two spatially separated speech streams upon a visual cue. Using the multivariate Temporal Response Function and Canonical Component Analysis, we examined the timescales of the cortical tracking of acoustic and semantic information, as participants disengaged from one speech stream and engaged with the other. Our analyses indicate that redirecting attention during speech listening is underpinned by rapid envelope tracking dynamics, followed by a slower emergence of semantic processing, offering a novel insight into naturalistic speech listening dynamics.

Topic Area: ATTENTION: Auditory

A14 - Unheard Surprises: Attention-Dependent Neocortical Dynamics Following Unexpected Omissions Revealed by Intracranial EEG

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Neocortex may encode and relay sensory input as Bayesian surprisal, or prediction error (PE). By this view, unexpected sensory absence results in PEs that mirror prior expectations. Predictive processing is, however, multi-layered, and knowledge on how attentional states influence hierarchical integration of endogenously generated PE is limited. To address this gap, we used intracerebral field potentials to investigate the interplay between expectation and attention following auditory omissions. Methods: Stereo-electroencephalography (SEEG) was recorded from 20 patients with drug-resistant epilepsy undergoing presurgical evaluation. Sound sequences containing predictable and surprising omissions were played during attentive listening and a distraction task. Population-activity (HFBA, 65 - 250 Hz) was extracted from channels in auditory cortex (AC) along with temporal, cingulo-opercular, and frontoparietal cortices, Results: Responses to unexpected omissions depended on attentional state. When unattended, responses were primarily limited to AC, although notable modulations occurred in frontal operculum (Fop). In the attended state, responses were broadly distributed, with short-latency responses in AC and cingulo-opercular network (CON), followed by long-latency, sustained activity in frontoparietal and somatomotor networks (FPN/SMN). Conclusions: Macroscale neural dynamics induced by PEs are strongly determined by selective attention. Early integration in AC is followed by prominent modulations in Fop; the latter more dependent on attentional state than the former. In contrast, responses in FPN and SMN are fully determined by attention. In line with previous work, the results suggests a three-stage model of sensory deviance processing where PEs are monitored by the CON which implements network transitions based on estimated task relevance.

Topic Area: ATTENTION: Auditory

A15 - Connectome-based modelling reveals ketamine's modulatory effects on thalamocortical connectivity during auditory attention processing

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This study investigates the impact of ketamine, an NMDA receptor antagonist and pharmacological model for schizophrenia, on brain dynamics during sensory learning. Using EEG data from a placebo-controlled, crossover design study, we analyze auditory mismatch negativity (MMN) brain responses using a connectome-based neural mass modelling framework, focusing on the physiology of cortico-striato-thalamo-cortical (CSTC) circuits. Auditory responses are introduced to the network via auditory cortex regions, and EEG signals are generated from regional neural activity using a leadfield matrix. The model is implemented within the Whole-Brain Modelling in PyTorch (WhoBPyT) library (github.com/griffithslab/whobpyt), allowing simulation and automatic differentiation-based estimation of neurophysiological model parameters. We focus here on parameters describing connection strengths both within the cortex and across the CSTC circuit, comparing ketamine's effects against placebo during the oddball task. Partial least squares analysis revealed significant differences between ketamine and placebo conditions in standard and deviant tone responses. Analysis of fitted model parameters showed greater connection gains from pyramidal-to-inhibitory populations and thalamus-to-D1 connection gains in the placebo condition, indicating more pronounced inhibition within nodes and stronger thalamic inhibition across nodes compared to the ketamine condition. Additionally, under ketamine, increased D2 connection gains were observed in specific brain regions, along with altered thalamocortical connectivity patterns. These results highlight substantial changes in brain connectivity patterns under ketamine, particularly in thalamus to D1 and cortex to D2 connections. These findings provide insights into the neural mechanisms of schizophrenia spectrum disorders, emphasizing the significant alterations in neural pathways induced by ketamine, affecting cortical intra-connections and thalamocortical interactions.

Topic Area: ATTENTION: Auditory

A16 - Impact of Familiar and Unfamiliar Music on Brain Network Reconfigurations

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Music is a powerful influencer of mood, cognition, and overall mental well-being, contributing to network reconfigurations that underscore its impact on cognitive processes. This study aims to explore how brain networks reconfigure while listening to music that varies in properties such as genre, pace, and familiarity. We analyzed a publicly available dataset where EEG from twenty participants was recorded as they engaged in listening to twelve songs from different genres and scored familiarity and enjoyment. We filtered the EEG into Delta, Theta, Alpha, and Beta bands and divided each song into early, middle, and late time blocks to identify the temporal sequence of music-driven changes. To assess network reconfigurations following music exposure, as a function of familiarity and enjoyment, we estimated functional brain connectivity using weighted phase lag index (wPLI) and extracted several features of the connectivity matrices within each time block and frequency band. Our initial findings indicate that the most significant changes arise during the middle time block where we observed higher network connectivity in the Delta and Theta frequency bands for less familiar music. Simultaneously, we observed a reduction in modularity—the tendency of networks to separate into distinct modules with high connectivity within and low connectivity between. We propose that these changes in network properties indicate brain network reconfigurations triggered by the unfamiliarity of music and may be utilized in therapeutic interventions. In our ongoing research, we investigate network reconfigurations, focusing on their spatial localization, to further understand how music familiarity impacts brain connectivity and dynamics.

Topic Area: ATTENTION: Auditory

A17 - Age Modulates the Effect of Attentional States on Affect in Adults with ADHD

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Unintentionally engaging in mind-wandering (MW), characterized by having thoughts unrelated to the ongoing task, consistently predicts more negative affective outcomes. Given both age and attention-deficit/hyperactivity disorder (ADHD) negatively impact attentional capacity, an older ADHD population may be particularly more susceptible to MW-related disruptions. In the present study, we asked whether the relationship between MW and affect differs across age in ADHD subsamples with clinical levels of Inattention (N = 49; age range = 20 – 69 years, M_age = 41.37) and Hyperactivity (N = 35; age range = 21 – 79 years, M_age = 40.63). Using naturalistic thought-sampling, we had participants report their instantaneous attention state (on-task/unintentional MW/intentional MW), and affective valence, 6 times daily for one week. In the Inattentive group, unintentional MW predicted significantly lower affect. In the Hyperactive group, we found (1) significantly lower affect during unintentional MW, compared to intentional MW, across all ages, as well as (2) a crossover interaction between age and attentional states, such that affect during unintentional MW was significantly lower than affect on-task (and during intentional MW) until around 40 years of age, but affect on-task was significantly lower than affect during both types of MW by around 60 years of age. Finally, older age also predicted less frequent unintentional MW compared to on-task states, and less frequent intentional MW compared to unintentional MW, in the Hyperactive group. Our findings suggest that age modulates the effects of attention states on affective valence in adults with clinical levels of Hyperactivity in ADHD.

Topic Area: ATTENTION: Development & aging

A18 - Associations Between Socioeconomic Stress, Engagement in Joint Attention, and Infant Neurodevelopment in 24- to 36-Month-Old Infants

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Explorations of joint attention (JA) have highlighted how the quantity and quality of interactions between infants and their caregivers shape infant neurodevelopment and scaffold essential socioemotional skills (e.g., language, socioemotional cognition) (Mundy & Jarrold, 2010). However, it is unknown whether early life stress might disrupt early neurodevelopment via reductions in the quantity or quality of JA interactions. The current study explores associations between caregiver socioeconomic stress (SE-stress) at 6 months, dimensions of engagement in JA at 24 months, and baseline neural activity in 24- to 36-month-old infants. Caregiver-infant interactions during free play, self-reported caregiver SE-stress and infant baseline EEG were obtained from 116 mother-infant dyads from predominantly low-income backgrounds. Free-play videos were coded for dimensions of JA (i.e., duration, frequency, type of initiation, type of termination and type of JA) and computed into quantity and quality composite scores. Theta and alpha power and frontal-central-parietal alpha functional connectivity were extracted from baseline EEG. Multiple regression will test whether caregiver SE-stress at 6 months will be associated with a) less and lower quality engagement in JA at 24 months, b) lower EEG power in theta and alpha frequency bands, and c) lower alpha functional connectivity during baseline at 24 and 36 months. A moderation analysis will test whether the quality and quantity of engagement in JA during play can buffer against negative effects of SE-stress on infant neural mechanisms underlying JA. This analysis plan has been pre-registered using the Open Science Framework (https://doi.org/10.17605/OSF.IO/5AJVG). Ongoing analyses will be complete by March 2024.

Topic Area: ATTENTION: Development & aging

A19 - Neural correlates of semantically driven visual search in naturalistic scenes in older adults.

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Context plays a pivotal role in the cognitive processing of natural scenes, with previous research emphasizing the influence of semantic salience in determining attentional priorities, regardless of immediate perceptual features. While extensive work has delved into the neural correlates of context perception in healthy young adults, to our knowledge, none have ventured into examining this phenomenon in healthy aging,

where declines in attention occur. In this study, we employed functional MRI to identify the neural regions associated with semantically driven attentional bias during a visual search task involving context-relevant objects within complex naturalistic scenes. Forty-one older adults (mean age = 63 years) viewed words representing a target object followed by an indoor scene image and were instructed to press a button when the target object was located within the scene. Half of the target objects were contextually congruent with the scene, while the other half were incongruent. Behavioral findings revealed slower response times for congruent compared to incongruent objects, suggesting that additional attentional resources are required when searching for objects that do not emerge from the scene (i.e., contextually-incongruent objects). Consistently, increased activation within the fronto-parietal attention network and occipital brain regions was observed when searching for congruent vs. incongruent objects. This underscores an attentional effort to localize objects that seamlessly blend within the scene context, contrasting with the prioritization that emerges when objects are contextually-incongruent. These initial insights in healthy aging will be further investigated through a comparative analysis with young adults.

Topic Area: ATTENTION: Development & aging

A20 - Locus Coeruleus Impact on Memory Variability in Older Adults

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The locus coeruleus (LC) is the primary source of norepinephrine (NE) in the brain and has been linked to cognitive processes such as attention and memory, which decline with age. NE plays a key role in arousal, therefore dysregulation of the LC-NE circuit may result in disrupted attention, which has been shown to negatively affect working memory performance (Unsworth & Robison, 2017). Disrupted attention could also influence variability in memory performance, which has not yet been examined. To address this gap, the present study examined the impact of LC structural integrity on memory variability in healthy older adults (n=55; 60-85 years). Participants completed a magnetic resonance imaging (MRI) session, with a neuromelanin sequence to estimate signal intensity in the LC, and a diffusion-weighted sequence from which multi-compartment diffusion metrics (intracellular, free) were obtained from the LC. Participants also completed a free recall task involving three distinct wordlists, each comprising 10 unique words, from which average recall and variability across the 3 trials was calculated. Our analyses revealed that there were no effects of age or sex on recall performance. However, higher intracellular diffusion in the LC related to less variability in recall, but not to average recall. LC signal intensity and free diffusion did not relate to recall performance. These findings are consistent with the notion that memory variability is more sensitive to LC-NE attentional lapses than average memory performance, and that LC diffusion is more sensitive than the more commonly used signal intensity metric.

Topic Area: ATTENTION: Development & aging

A21 - Neural synchrony as a mechanism for broader attention in childhood?

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The ability to selectively attend to “targets” and ignore “distracters” develops slowly into early adulthood, and recent work suggests that this may allow children to attend more broadly and learn more about distracters. But what are the brain mechanisms underpinning broader attention in childhood? Could children’s broader attention arise from the more equal propagation of target and distracter information through neural synchrony? To answer this question, we are using magnetoencephalography to measure brain activity in 6- to 30-year-old participants while they selectively attend to either objects or faces in an n-back task. We expect adults to show greater neural synchrony (measured as the weighted phase lag index) between the object-selective lateral occipital complex (LOC) and other regions in the ventral stream when the target category is objects as compared to faces, and greater synchrony between the face-selective fusiform face area (FFA) and other regions in the ventral stream when the target category is faces as compared to objects. In children, we expect neural synchrony levels to be less influenced by the target category. Preliminary analyses (n = 7 children and youth) on a subset of connections (the LOC and FFA with the hippocampi and V1) found no effect of target category in either the low or high gamma bands after false discovery rate correction. If this pattern is observed in the full child sample, then less selective neural synchrony patterns may be one way in which the developing brain equips children to process the multitude of information available to them.

Topic Area: ATTENTION: Development & aging

A22 - Reduced Integrity of White-Matter Tracts in Adolescents with ADHD: A Symptom Specific, Longitudinal Investigation

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Attention-deficit/hyperactivity disorder (ADHD) is an executive function disorder characterized by deficits in attention, hyperactivity, and impulsivity. ADHD is prominent among children and may cause cognitive and behavioral effects. The pathophysiology of ADHD in adolescents remains unclear due to its heterogeneous symptoms and atypical development. We aim to uncover structural connectivity deficits in adolescents. We utilized the Adolescent Brain Cognitive Development (ABCD) study to examine white matter tracts in adolescents. ADHD was assessed using caregiver report on the Child Behavior Checklist (CBCL). Demographics and internalizing symptoms were also reported by caregiver, while impulsivity and motivation were self-reported. Cross-sectional analyses were run at baseline (mean age = 9.9) on test and re-test cohorts. Participants were followed for 2 years for longitudinal analyses. 27 white-matter tracts from previous literature were analyzed in a cross-sectional linear mixed-effects model (LMM) resulting in 5 Bonferroni significant tracts in test & re-test cohorts. The symptom-specificity of those 5 were analyzed at baseline and showed the strongest relationship with inattention. A subsequent longitudinal LMM was ran to investigate if changes in ADHD symptoms correspond with changes in structural connectivity. Only 1 tract was nominally significant in the test cohort and did not replicate. However, baseline ADHD symptoms failed to predict longitudinal in structural connectivity, and did not show any sex-specific effects. Here we show a relationship between ADHD symptom severity and structural connectivity in adolescents that can be broken down by symptom. Furthermore, we provide limited evidence for unique developmental trajectories in ADHD, calling for more longitudinal studies.

Topic Area: ATTENTION: Development & aging

A23 - Tracking the Transition from Stimulus-Specific Object Representations to Category-Level Abstractions During Visual Search

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Search performance becomes more efficient with repeated exposure to the same target. Here, we were interested in 1) whether individuals similarly benefit from category-based repetitions of target stimuli when such information is sufficient for visual search and 2) whether this benefit corresponds to a gradual change in the neural representation of such stimuli from stimulus-specific exemplars to category-level abstractions. We developed a category-repeating search paradigm where, on each trial, individuals were cued to encode greyscale images of real-world objects chosen from eight unique categories. Participants were required to search for the cued targets within four-item search arrays. During exemplar search blocks, nontarget items were chosen from the same category as the target, whereas during category search blocks, all nontarget items were categorically distinct from the target. Importantly, for both conditions, the basic-level category of the target images (e.g., birds) was always held constant for five to seven consecutive presentations, while the specific exemplars that defined the targets never repeated within a given run (e.g., robin, finch, sparrow, etc.). As expected, search performance was better overall in the category-search condition relative to the exemplar-search condition. Importantly, this category-search benefit increased linearly with each consecutive category repetition. This behavioral finding was mirrored in our electroencephalographic data, where we used the contralateral delay activity to quantify the stimulus-specific maintenance of the target: less exemplar-specific information was encoded with each category repetition during category search. Thus, we provide a neural index that tracks the movement of target representations from stimulus-specific exemplars to categorical abstractions.

Topic Area: ATTENTION: Nonspatial

A24 - Neural correlates of temporal orienting of attention in dynamic stimuli

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Temporal expectations have been shown to support selective prioritization of task-relevant stimuli when combined with foreknowledge about stimulus locations and associated motor responses. Yet, it remains unclear whether and how temporal expectation can independently guide adaptive perception and influence brain activity, devoid of spatial and motor predictions. To investigate this, we employed electroencephalography (EEG) during a visual search task where participants reported the location of a target embedded in dynamic visual streams. Each target had a distinct onset probability distribution, with certain targets more likely to appear at specific times within streams. Targets appeared equiprobably at two locations, making spatial and motor response patterns unpredictable. In each trial, only one target was cued and became task relevant. Participants demonstrated increased speed and accuracy in detecting temporally expected stimuli compared to unexpected ones, highlighting the behavioral advantage conferred by temporal anticipation. At the neural level, a pronounced P300 response was observed for anticipated trial-relevant targets along with a distinct N2pc potential contralateral to expected targets. This pattern was not observed for trial-irrelevant targets, reflecting enhanced attentional modulation and perceptual selection of task-relevant stimuli by temporal expectations. Furthermore, contingent negative variation (CNV) in the pre-stimulus period was more prominent for temporally expected targets, underscoring the anticipatory neural activity associated with temporal expectation. Collectively, these results provide compelling evidence for the distinct role of temporal expectation in visual perception and behavior.

Topic Area: ATTENTION: Nonspatial

A25 - Exploring the Relationship Between Self-Reported Mind-Wandering and Executive-Functioning

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We commonly experience moments where our minds shift away from the task at hand to task-unrelated thoughts, sometimes referred to as mind-wandering (MW). Although MW can lead to positive outcomes, it is often associated with less desirable outcomes, including decrements on task performance. The potential negative impacts of MW on daily functioning highlight the importance of understanding how we can regulate MW. One suggested regulatory mechanism is executive-functioning (EF), which are higher-order cognitive processes that modulate one's thoughts and behaviours. The relationship between MW and EF has been studied using a variety of experimental tasks. This study expands prior work using self-report questionnaires, which can provide important information not captured in experimental settings. In this study, we examined the relationship between MW and EF using the Mind Excessively Wandering Scale (MEWS) to measure excessive levels of MW, and the Barkley Deficits in Executive-Functioning Scale-Long Form (BDEFS-LF) to measure EF in terms of sub-dimensions of executive dysfunction. In 81 participants (age 17-36 years; M=19) we found that total scores on the MEWS were strongly positively correlated to BDEFS-LF total score, as well as BDEFS-LF subscale scores. Results from the partial correlation analysis revealed similar findings; however, a negative partial correlation was found between MEWS scores and BDEFS-LF self-motivation subscale scores, when accounting for all other subscales. Overall, the results suggest that individuals self-reporting higher levels of excessive MW report higher levels of executive dysfunction, but EF sub-dimensions may overlap in their explanation of this relationship.

Topic Area: ATTENTION: Nonspatial

A26 - Subjective and pupillometric markers of arousal during movie viewing

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Introduction: The relationship between subjective and physiological measures of arousal during naturalistic experiences is poorly understood. This study aimed to bridge this gap by combining subjective arousal annotations and objective pupillometry measurements during movie watching of varying arousal levels. Methods: Participants (n=21; mean age 28.1 ± 6.5) viewed 5-minute clips from "21 Grams" (negative) and "Son's Room" (neutral) in counterbalanced order, undergoing Functional Magnetic Resonance Imaging and pupillometry. Post-scanning, participants re-watched both clips, providing continuous arousal annotations. Linear mixed effects modeling was used to assess the emotional context's influence on inter-individual alignment. Results: Inter-individual synchronization of both pupil size and subjective annotations was significantly higher during the emotionally charged clip compared to the neutral clip. However, a notable mismatch occurred between synchronization peaks of pupil size and subjective measures during both movies, as no significant association was observed between inter-individual synchronization of pupil size and subjective annotations. Discussion: This study reveals that emotionally evocative movies induce cross-participant synchronization of objective and subjective measures of arousal, although each has unique temporal dynamics. This suggests there is a complex relationship between objective and subjective. The study unveils shared emotional experiences across participants watching the same movie. Conclusion: Analyzing emotional experiences through both lenses contributes to integrating subjective and objective measures in emotional arousal research.

Topic Area: ATTENTION: Nonspatial

A27 - The attentional template is adaptively updated by learned associations

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If you are going to search for a target, you must hold some representation (or "template") of that target in memory. Most models make the implicit assumption that this search template is composed of target features. However, in complex search environments, the target is often difficult to discriminate directly. Under these conditions, it may be that attention is guided first by easier to discriminate "proxy" objects that predict the target location, but are not the target itself. Here, we tested this hypothesis using a task in which participants first learned about a face-scene category associations, and then participated in a visual search task. On each trial, a cue face followed by the target and a similar looking distractor face. The target was superimposed on an image from the associated scene category on 75% of trials. There was a clear validity effect such that RT was shorter and accuracy higher when the target appeared on an associated scene image. Multivariate pattern analysis of fMRI data showed a double dissociation between the presence of face vs. scene information in the cue vs. delay periods. The target face was decoded in FFA, SPL, and dLPFC during the cue period but not the delay period; in contrast, scene information was only decoded in PPA and IFJ during the delay period. These results demonstrate the dynamic nature of cortical engagement in the visual search process and provide novel insight into the adaptive representations within the target template that support efficient attentional guidance during visual search.

Topic Area: ATTENTION: Nonspatial

A28 - Temporal predictions dynamically modulate attentional capture by expected target features during visual search

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We use temporal regularities in everyday environments to predict when relevant events will occur. Such temporal predictions may help us to find targets within busy, dynamic scenes. Consider searching for multiple visually distinct targets in a continuously changing environment, like finding friends in a crowded street. If each target appears with predictable timing, then selectively guiding attention in a time-dependent manner towards features of the anticipated target is more efficient than continuously attending to features of all targets equally. However, it remains unclear if we can exploit temporal regularities to dynamically shift feature-based attention. We investigated this across two experiments using a novel dynamic visual-search task. Participants searched continuously evolving displays for two transiently appearing targets amongst distractors. Stimuli were colour-shape combinations. Targets shared neither shape nor colour; distractors shared zero or one feature with each target. Critically, targets appeared at one of two times during trials. Although exact timings varied across experiments, one target always most likely appeared earlier (early target) and the other later (late target).

Targets were unpredictable in spatial location. Participants' performances were consistent with having utilised the temporal regularities. At each appearance time, participants were significantly more likely to identify the temporally-expected target than the temporally-unexpected target. Further, eye-tracking measures indicated that participants' attention was captured more by distractors sharing their colour with the early target than those sharing their colour with the late target, only for distractors appearing early during trials. This work provides initial evidence for temporal predictions guiding feature-based attention during search.

Topic Area: ATTENTION: Nonspatial

A29 - Intracranial Neural Dynamics of Selective Attention in Rapid Visual Recognition

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Selective attention enables the flexible direction of neural resources towards behaviorally relevant stimuli. The neural substrate of attention is proposed to be oscillatory coupling between task-relevant brain regions, indexed by activity in distinct frequency bands. Rapid visual recognition involves activation in category-selective regions of the ventral occipitotemporal cortex (vOTC), however prior work has found vOTC activation to scale with task demands, suggesting a task-driven recruitment of amodal substrates. To probe these dynamics, we utilize intracranial electroencephalographic recordings in 25 patients (14 female) performing a task where visual attention is directly modulated. In this task, visual stimuli of different categories (Faces, Words, Scenes, or Animals) were presented. Across different trial blocks, patients tracked and responded to one specific feature: a color change of a central fixation point, repetition of a stimulus (i.e. a one-back task), or the category the stimulus belonged to (e.g., the category "fruit or vegetable words" for which an exemplar is "apple"). This task design enables the isolation of attentional dynamics when the same stimuli are presented, but task demands shift. Through implementing a d-prime selectivity analysis on broadband high gamma activity (70-150Hz), we identified electrodes that exhibit significant category-selectivity. We found significant sustained increase in BGA in frontal regions as task demand increased. We identified significant task-based modulation of bidirectional alpha-band Granger causality between vOTC and frontal cortex. Through quantifying information flow between these regions, we identify a potential mechanism by which the frontal cortex modulates vOTC activity based on selective attention.

Topic Area: ATTENTION: Nonspatial

A30 - Being out of the zone: Brain oscillatory dynamics during decreased sustained attention

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Sustained attention enables individuals to concentrate on relevant stimuli over an extended time period. Notably, this form of attention is marked by performance fluctuations, alternating between a state of consistent and effective behavior (being "in the zone") and another one characterized by increased performance variability and susceptibility to errors ("outside the zone"). Little is known about the differences between these states in terms of oscillatory brain dynamics during challenging sustained attention tasks, which was our objective. Thirty young adults performed the Gradual-onset continuous performance task, during which their EEG and responses were recorded. States of sustained attention (in the zone vs. out of the zone) throughout the task were identified based on the variability of reaction times to correct stimuli. As expected, being outside the zone correlated with heightened commission errors and reduced task sensitivity. Additionally, being outside the zone showed a significant decline in theta oscillations in prefrontal regions. The extent of this decline predicted commission errors, reduced task sensitivity, and reaction time variability. Moreover, variability in theta rhythm along the task was associated with reaction time variability. Finally, participants exhibiting greater theta variability showed a more pronounced decline in task sensitivity when being outside the zone compared to those with lower variability. Our results suggest that diminished sustained attention is characterized by a reduction in frontal theta activity, and the fluctuation in this rhythm serve as predictor of execution consistency. These findings hold significance for activities where attentional fluctuations play a crucial role.

Topic Area: ATTENTION: Nonspatial

A31 - Longitudinal trajectories of neural activity change distinguish training of different mindfulness skills

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Prior research suggests that mindfulness training (MT) improves cognitive functioning and psychological well-being. Nevertheless, there is surprisingly sparse evidence that links these beneficial outcomes to neural changes associated with longitudinal MT effects and to enhanced subjective quality of activated mindfulness states. Additionally, much of the prior work conflates different mindfulness techniques, including open monitoring (OM) and focused attention (FA), despite increasing evidence that each practice has distinct neural correlates and functional effects. To address these gaps, we conducted a rigorous within-subject longitudinal MT study involving time-intensive electroencephalogram (EEG) sampling of both FA and OM practices. Across 8 training weeks, participants complete 20 minutes each of FA and OM meditation practice 3 days per week in the laboratory, for a minimum of 120 minutes of weekly meditation practice during which EEG data is collected. In each session, participants also complete self-report measures of mindfulness practice quality, and of mood, motivation, and stress. Longitudinal analyses provide strong evidence that mindfulness quality increases throughout the course of training and is predicted by corresponding decreases in theta power. Follow up analyses show that theta activity during FA and OM is associated with distinct facets of mindfulness quality at both the individual and group levels. Our overarching goal is to bridge 1st and 3rd person methodological approaches to better characterize the neural, subjective, and functional trajectories of FA and OM training.

Topic Area: ATTENTION: Other

A32 - Investigating relationships between mind-wandering subtypes and spontaneous EEG activity at rest

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Mind-wandering is a complex phenomenon varying on numerous dimensions and may be best considered a multidimensional construct. In the present study, we examined spontaneous electrophysiological activity in relation to several of the most prominent theorized dimensions of mind-wandering. We recorded spontaneous EEG activity from N = 41 healthy adult participants while they engaged in a wakeful eyes open resting-state (i.e., simple visual fixation) condition with intermittent experience-sampling. During experience-sampling prompts, they were presented with thought probes consisting of several questions related to the content and nature of their thoughts at random intervals between 15-45 seconds after the onset of each trial. We compared the spectral and spatial features of their EEGs on two mind-wandering dimensions of interest: whether their attention was more focused on their thoughts (mental) or sensing the world (physical) and whether their thoughts were more freely moving or unmoving. EEG recordings were preprocessed and epoched into 5-s windows prior to the thought probe onset, then time-frequency transformed and converted into scalp x frequency (1 – 30 Hz) SPM images. Comparison of mental, relative to, physical trials revealed several broadband clusters that did not survive statistical correction. Comparison of trials labeled freely moving, relative to unmoving, revealed a significant cluster of beta-band activity (17Hz) over the left temporoparietal region which survived statistical correction. These results may contribute to our understanding of the dynamic nature of attention during spontaneous cognition.

Topic Area: ATTENTION: Other

A33 - Examining Intra-Individual Associations between Mind Wandering and Response Time Variability as a Function of Time-on-Task

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There has been recent interest in the role of mind wandering, having off-task thoughts during an ongoing task or activity, on characteristic patterns of worsening performance with greater time-on-task, referred to as the vigilance decrement. Yet, little is known about intra-individual associations between mind wandering and task performance during ongoing task performance. Herein, mind wandering and response time variability were evaluated as a function of time-on-task across two studies (Exp 1, N=310; Exp 2, N=144) in which participants performed the Sustained Attention to Response Task (SART) with task-embedded probes to index mind wandering. Rates of probe-caught mind wandering were found to increase with greater time-on-task during performance of both 10-min (Exp 1) and 20-min (Exp 2) versions of the SART. Similarly, response time variability increased with greater time-on-task. To examine the relation between mind wandering and performance, we evaluated covariance between within-task changes in individuals' rates of mind wandering and response time. In both studies, bivariate growth curve modeling revealed that increases in mind wandering were reliably associated with increases in response time variability. In addition, self-reported task motivation was found to moderate both mind wandering and response time variability. Individuals with higher (vs. lower) motivation demonstrated reductions in the deleterious impact of time-on-task on both mind wandering and task performance. These results provide support for models that directly implicate mind wandering in worsening behavioral performance with greater time-on-task in continuous performance tasks requiring sustained attention.

Topic Area: ATTENTION: Other

A34 - Rhythmic stimulation with wearables improves sustained attention and increases arousal

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Rhythmic auditory and visual stimulation can influence brain function and improve cognition by inducing rhythms at specific frequencies in the brain (sensory entrainment). These findings suggest that wearable sensory entrainment devices could be a novel and useful method to improve cognition and treat brain disorders. Using a within subjects-design with 20 participants, we tested whether rhythmic stimulation with wearables could improve performance on the Sustained Attention to Response Task (SART) and alter brain and autonomic physiology. Participants performed the task in two-minute blocks with a different stimulation modality and frequency in each block. Modalities were visual (pulsed diffuse red light across the visual field from a pair of smart glasses), audio (pulsed tones from smart glasses), combined audio+visual, and vibration (from a vibration device on the wrist). For each modality, we stimulated at both 10 Hz and 40 Hz. A control condition with no stimulation was also included. We measured EEG as well as heart rate, electrodermal activity, and skin temperature from the finger. Stimulation improved SART performance compared to control, but there was no effect of frequency or reliable driving of oscillations at the target frequency, suggesting the effect did not depend on entrainment. Stimulation caused desynchronization of the EEG and altered physiological measurements consistent with increased arousal. Thus, benefits for attention may have resulted from increased arousal rather than entrainment. Our results suggest sensory stimulation with consumer wearables is a promising neuromodulatory technique with the potential to modify cognitive and autonomic nervous system function.

Topic Area: ATTENTION: Other

A35 - Magnetoencephalography highlights the relationship between alpha power and patterns of ongoing thought

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Patterns of thought vary across situations and change with time and within an individual. Electroencephalography (EEG) studies suggest alpha power is a useful way to distinguish between different thought patterns, however, the spatial organization of the oscillatory dynamics and how these relate to different thought patterns remains poorly understood. We recorded magnetoencephalography (MEG) data from 47 volunteers and combined the MEG recordings with multidimensional experience sampling (mDES) to assess the spatial organization of oscillatory dynamics underlying different patterns of ongoing thought. Our task included two conditions which varied on their reliance on external attention. A principal component analysis (PCA) of the mDES data revealed four ongoing thought patterns including two off-task states (social thoughts related to future and self vs. past and others) and two on-task states (imagery vs. verbal cognition). The oscillations were quantified as power of different frequency bands for cortically reconstructed 400 sources that were averaged to 17 Yeo networks. Alpha power was stronger in the lateral temporal, visual, and posterior medial cortex areas during the easier task that relied less on external attention. Further, alpha power in areas that corresponded to visual, dorsal attention, control and default mode networks were linked to the occurrence of thoughts with episodic-social features in the easy task. These results support a role of increased alpha power to the emergence of self-generated thoughts that transcend the here and now.

Topic Area: ATTENTION: Other

A36 - How Spontaneous Exploration of the Dynamic Repertoire at Rest Shapes Behavioural Performance

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There has been a growing interest in the relationship between resting state networks and behaviour. However, most of this research focused on static resting state networks. This study expands on prior research by examining how exploration of the brain's "dynamic repertoire" (i.e., the set of possible resting state network configurations) shapes human behaviour and cognition. Previous researchers proposed that exploring the dynamic repertoire lets the brain rehearse functional configurations (i.e., brain states) and optimize neural networks in anticipation of future stimulation. We tested this hypothesis using a sliding time window approach. We grouped functional connectivity matrices across this sliding window with K-means clustering to identify distinct brain states participants spontaneously entered while at rest. These resting state data were then compared to functional connectivity and performance on Go-Nogo and 2-Back tasks. We predicted a positive correlation between task performance and the frequency of certain brain states during rest and that the brain state most correlated with task performance would most resemble functional connectivity exhibited during task performance. Results were partially consistent with the hypothesis. As expected, the resting brain state most associated with Go-Nogo task performance most resembled the task-based Go-Nogo FC matrix. However, this was not the case for the 2-Back task. These findings lend plausibility to the exploration hypothesis, though it may not apply equally to all cognitive domains. Some neural circuits may benefit more from this spontaneous rehearsal than others. Future studies may expand these findings using a wider variety of neurocognitive tasks.

Topic Area: ATTENTION: Other

A37 - On the role of prefrontal and parietal cortices in mind wandering and dynamic thought

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Mind wandering is a prevalent phenomenon in everyday life and can have both adaptive and detrimental effects on many cognitive functions. Self-reported task unrelated thought is the most common operationalisation of mind wandering. However, a dynamic framework has recently been proposed to characterise the heterogeneity of internal thoughts, suggesting there are three distinct thought types – freely moving thought, deliberately constrained thought, and automatically constrained thought. While previous research applying transcranial direct current stimulation (tDCS) has causally implicated the prefrontal cortex and inferior parietal lobule in mind wandering, there is currently very little evidence on how the dynamic thought types are causally represented in the brain. To that end, the current large scale registered report applied anodal high definition tDCS (HD-tDCS) to the left prefrontal, right inferior parietal, and occipital cortices to investigate the causal neural substrates of the dynamic thought types, in 228 individuals. This research utilised a behavioural task designed to measure periods of internal thought and changes in executive functioning, alongside four dynamic thought probes presented throughout the task. The findings suggest stimulation did not modulate overall reporting of task unrelated thought. However, freely moving thought was reduced after prefrontal cortex stimulation, relative to sham stimulation. Furthermore, deliberately constrained, or goal orientated, thoughts were found to be reduced following parietal stimulation, relative to sham stimulation. Collectively, these findings provide evidence of anodal HD-tDCS affecting the frequency of the dynamic thought types, with distinct effects across different brain regions for freely moving and deliberately constrained thoughts.

Topic Area: ATTENTION: Other

A38 - Is Working Standing up Better? A Comparative Analysis of Work Posture on Sustained Attention.

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With work from home opportunities becoming increasingly popular, the transition potentially spurred the opportunity to make the couch, or even bed a workstation. Moreover, traditional office work means remaining seated, many hours a day for millions of people. It's natural to wonder if this is actually the best posture for optimal work performance. Previous literature has evaluated the significance of posture on performance using paradigms such as the Stroop task, visual search, and task switching. Inconclusive results raise the rationale to re-test the hypothesis using a different paradigm, the Sustained Attention to Response Task. Three posture conditions, lying supine, sitting upright, and standing were measured within-subjects, and counterbalanced between-subjects. 70 participants completed testing, 60 were analyzed; data acquisition error, failure to comply with procedures, and technical difficulties accounted for 10 subjects being removed from analysis. A repeated-measures ANOVA and confirmatory paired samples t-tests were implemented to investigate the correlation between posture and participant performance in both accuracy and speed. The repeated-measures ANOVA produced significant results of go-trial RT between supine-standing and sitting-standing posture conditions. Additionally, there were significant differences in omission errors between the supine-sitting posture. There were no significant results between commission errors and posture conditions. Our findings suggest that focus is altered depending upon posture and that standing is predominantly leading to an increased workload with less error caused by mindlessness.

Topic Area: ATTENTION: Other

A39 - Attention-based Practices for Migraineurs: An Investigation of How Neurofeedback Mindfulness Improves Migraine Experience.

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Migraine sufferers are found to have an attentional impairment even in their headache-free phase. This knowledge urges investigating the efficacy of attention-based nonpharmacological alternatives for migraines in more details. In this longitudinal randomized controlled trial (RCT), we introduce neurofeedback mindfulness (NM) as a technology-based nonpharmacological treatment for migraines and compare it with a controlled relaxed attention routine. We used a portable EEG headband (MUSE) to collect information from participants' daily home-based practices. 101 migraineurs were randomized in two groups of NM (n=49) and controlled relaxed attention (n=52). Both groups used MUSE and went through a daily 10 minute-practice for 8 weeks. While the migraineurs in the NM group received real-time neurofeedback, the control group listened to an audiobook and received their EEG-based feedback followed by each practice. After attritions, 61 subjects remained in NM (n=34) and control groups (n=27) for data analysis. Although both groups had a decreased headache disability (MIDAS), headache severity (HIT-6), and anxiety (BAI) ($p<.05$), the increase in headache management self-efficacy (HMSE) over time was more significant in the NM group ($p<.05$). This RCT is the first novel investigation of putting attention on the spotlight for migraine treatment. We found that the emerging portable EEG headbands are interactive tools that facilitate the consistency and adherence in nonpharmacological treatments i.e., neurofeedback and meditation. Future directions could investigate which data access and technological advancements help migraineurs to improve their lifestyle and coping strategies more efficiently. Additionally, more information is required on the process of attentional modulations in migraines.

Topic Area: ATTENTION: Other

A40 - Adolescent brain development and the impact of adversity and peers: longitudinal insights from the ABCD study

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Adolescence is a sensitive period marked by biological and social changes, with over two-thirds of young people globally facing adverse experiences before reaching eighteen years of age. The mechanisms through which adversity shapes development, especially during adolescence, are not fully understood. Potential pathways include neurodevelopmental changes, where exposure to adversity may influence neurobiological mechanisms. Research suggests a complex interplay between trauma, brain development, and mental health issues. This study explores the impact of two adverse experiences on brain connectivity during adolescence: family conflict and youth-perceived neighbourhood safety. We will use a random intercept cross-lagged panel model (RI-CLPM) to investigate these relations using the longitudinal Adolescent Brain Cognitive Development study (ABCD, $N \approx 12.000$). We hypothesize that (1) there will be a cross-lagged/spillover effect of adversity to brain connectivity and from brain connectivity to youth issues. We predict (2) autoregressive/within-person carry-over effects of each individual variable. The results of the analysis are currently being analyzed. Preliminary results indicate that family conflict and youths' internal and external mental health issues are highly correlated across ages 10 to 14. Youth issues and brain development appear predictive of the perception of neighbourhood safety. In this study, we highlight the complex interplay of adversity, brain development and youth mental health, shedding light on adolescence as a sensitive period during which adverse experiences may significantly impact development.

Topic Area: EMOTION & SOCIAL: Development & aging

A41 - Do Psychosocial Factors Interact with ApoE Status to Predict Cognitive Decline in African Americans?

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African Americans are disproportionately affected by cognitive decline, yet underrepresented in studies examining biopsychosocial factors related to decline. The present study examines whether psychosocial factors including cognitive activities (e.g., reading, games) and social engagement (e.g., participating in social groups) interact with biological factors (ApoE) to predict cognitive decline in African Americans. This study included 734 African American adults from the Minority Aging Research Study (MARS), aged 65 and older, who underwent annual cognitive testing across 10 years. At baseline, they completed genetic testing and reported on their level of cognitive activities and social engagement. Structural equation modelling was used to examine the effects of cognitive activities and social engagement on cognitive decline, and the moderating role of APOE alleles over the ten-year period. Results showed that cognitive activities were not associated with cognitive decline, but less social engagement predicted greater cognitive decline. ApoE (the number of ε4 or ε2 alleles) did not moderate the effects of cognitive activities and social engagement on cognitive decline. However, APOE alleles had an independent additive effect on cognitive decline, such that a greater number of ε4 alleles was associated with greater cognitive decline, whereas a greater number of ε2 alleles was associated with less cognitive decline. Results highlight the importance of social engagement and number of ε2 alleles for delaying cognitive decline in African Americans.

Topic Area: EMOTION & SOCIAL: Development & aging

A42 - The unique contribution of tau pathology in the amygdala on depressive symptoms in cognitively normal older adults

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Early tau accumulation in medial temporal lobe includes the amygdala, although many studies focus on regions such as the entorhinal cortex. Accumulation of tau in the amygdala may contribute to the notable changes in emotional regulation that often precede Alzheimer's disease. We analyzed cognitively normal older adults (60–94 years, baseline Geriatric Depression Scale, GDS<=6) from the Alzheimer's Disease Neuroimaging Initiative. 441 participants had at least one tau PET scan and a subset had an Aβ PET scan (n=436), APOE ε4 status (n=403), and longitudinal GDS scores (n=377). APOE ε4 carriers and Aβ positive individuals had the highest levels of

amygdala tau (APOE t(400)=4.81, p<.001, Aβ t(433)=5.73, p<.001), as well as the greatest longitudinal increases in amygdala tau over time (n=178, APOE t(173)=3.64, p<.001, Aβ t(175)=3.73, p<.001). There were no direct relationships between cross-sectional or longitudinal amygdala tau and longitudinal GDS (cross-sectional r=.07, p=.139, longitudinal r=.03, p=.675). However, higher baseline amygdala tau predicted worsening GDS in APOE ε4 carriers (t(353)=2.66, p=.012) and in females (t(371)=2.22, p=.027), even when adjusting for entorhinal tau burden. Longitudinal amygdala tau also interacted with sex (t(167)=2.20, p=.029) and marginally interacted with APOE status (t(165)=1.78, p=.077) to predict longitudinal GDS, again including adjustments for entorhinal tau slopes. No interactions were found with cross-sectional (t(369)=0.27, p=.787) or longitudinal (t(167)=1.19, p=.237) amygdala tau and Aβ status. These results suggest that amygdala tau contributes to changes in depressive symptoms - particularly in those at a higher risk for developing Alzheimer's Disease – independent of the effects of entorhinal tau.

Topic Area: EMOTION & SOCIAL: Development & aging

A43 - A cross-modal social-semantic space explains patterns of social-knowledge impairment in semantic dementia

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Identifying loved ones, peers, and social groups hinges on the semantic organization of social concepts. Studies of patients with semantic impairments can therefore illuminate how social knowledge is structured in the mind and brain. In this study, we analyze error patterns from a social word-picture matching test conducted on 21 patients diagnosed with semantic dementia (SD), and compare these results to a semantic organizational map of the same test items captured from a separate group of age- and culture-matched individuals. The patient word-picture matching data suggests that SD patients exhibit more robust retention of gender compared to age information, with age-related errors correlating with linear age distance from concept words. Are these error patterns consistent with semantic similarity accounts of concept degradation? To generate a conceptual space for comparison, 49 older adults in the UK completed a triadic judgment task on the same set of test words and images. From these judgments we computed a two-dimensional embedding representing the relative similarity of each item. Distances between items in the embedding reflect error patterns in SD: gender-matched items are closer to probed concept words than age-matched items, and age-related items become increasingly distant from concept words as semantic age increases. Overall, we demonstrate that for a set of social items, patterns of information degradation in SD are such that patients retain gender information over age information, age information degrades with distance in age, and this relationship observed in patient data corresponds to distances within a conceptual space computed from healthy adults.

Topic Area: EMOTION & SOCIAL: Development & aging

A44 - Influence of Emotional Context on the Perception of Neutral Stimuli: An ERP Study

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This study investigates how emotionally neutral items are perceived within negative and positive emotional contexts, exploring two potential outcomes: assimilation into the context's valence or contrast against it. We focused on the examination of Event-Related Potentials (ERPs) elicited by neutral pictures presented alongside either negative or positive images. Our findings revealed that emotional pictures in both contexts generated significant Late Posterior Positivity (LPP) when compared to neutral images. Notably, the LPP effect was more pronounced and enduring for negative pictures. A differential analysis, involving a comparison wave generated by subtracting the ERPs of neutral pictures in positive contexts from those in negative contexts, showed an early LPP akin to that induced by positive pictures in positive contexts. However, over an extended duration and range, it resembled the LPP triggered by negative pictures in negative contexts. These results suggest that the emotional impact on neutral stimuli is not governed by a singular process but rather by a dual mechanism of assimilation and contrast. Further analysis using Independent Component Analysis (ICA) identified distinct source components of these ERPs, varying in response to positive and negative pictures. These components reflect the nuanced differentiation of neutral pictures under different emotional valences, corroborating the observed ERP findings. This study sheds light on the complex interplay between emotional context and neutral stimuli perception, highlighting the roles of both assimilation and contrast mechanisms.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A45 - Functional Connectivity Patterns Reveal A Role for Interoceptive Processing in the Representation of Emotion Concepts

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Conceptual knowledge about emotions is inherently associated with sensation, particularly interoceptive signals regarding physiological states (e.g. high heart rate, accelerated breathing). It is unknown whether and to what extent individual differences in the ability to sense and interpret these interoceptive signals affect the long-term representations of emotion concepts. To test whether participant-specific semantic memory structure for emotion concepts is mediated by interoceptive sensibility, we administered an established version of a semantic relatedness judgment task using novel stimuli (i.e., emotion concepts) and constructed semantic networks based on the participant-specific relatedness judgment ratings. These semantic networks were statistically tested for differences based on participants' interoceptive sensibility as assessed by a self-report scale. We also obtained functional magnetic resonance imaging data as participants performed the relatedness judgments, allowing us to assess how patterns of functional connectivity may mediate differences in the emotion-specific semantic network structure. In line with increasing evidence for a constructionist approach to emotion, our results provide tentative evidence that emotion concepts exhibit some modality-specificity in their grounding, as participants draw on the same neural resources used to process interoceptive signals to access and evaluate generalized knowledge about emotions.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A46 - Misophonia severity predicts cognitive impairment in the presence of trigger sounds

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Misophonia is a disorder involving an extreme aversion to specific ordinary sounds, such as chewing and breathing. These "trigger" sounds are easily ignored by typically developed listeners, but elicit negative emotional reactions, physiological stress, and cognitive impairment in people with misophonia. Although misophonia is characterized by distress and impairment, it is not yet classified as a psychological disorder in diagnostic manuals, largely because it is unclear how it should be defined and assessed. The current study recruited participants with and without misophonia (N=140) to 1) evaluate the psychometric properties of the English-translated MisoQuest - a self-report measure of misophonia severity, and 2) determine the extent to which symptom severity is related to cognitive impairment. We first established that the English-translated MisoQuest has excellent internal consistency, strong test-retest reliability, and that scores specifically tap misophonia symptom severity rather than generalized anxiety or broader sensory sensitivities. Importantly, we also demonstrated that MisoQuest scores are meaningfully associated with cognitive impairment. More specifically, participants with higher MisoQuest scores (indicating worse misophonia severity) had poorer reading comprehension than those with lower MisoQuest scores when chewing sounds played in the background during the task. MisoQuest scores did not predict performance in the presence of generally aversive sounds or in silence, suggesting that misophonia is characterized by stimulus specific cognitive impairments. Overall, this study indicates that the MisoQuest is a reliable and useful measure for identifying misophonia in English-speaking individuals and that scores on this measure are related to clinically relevant outcomes.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A47 - Impaired scene construction ability in adolescents with symptoms of post-traumatic stress

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Introduction: Post-traumatic stress disorder (PTSD) is associated with structural and functional hippocampal (HPC) impairments. HPC differences are less consistently noted in adolescent PTSD, however symptom severity may predict hippocampal volume loss in adulthood. Previously, we have found that performance on a generative scene

construction task was impaired in adults with PTSD, which was correlated with symptom severity and smaller HPC volumes. Here we aimed to explore this in adolescence. Methods: Twenty-seven adolescents conjured-up then described novel scenes: 15 were exposed to trauma with varying degrees of PTSD symptom severity, and 12 non-trauma-exposed controls. We examined the relationship between symptom severity and scene construction as a continuous measure using linear regressions, regardless of group membership. Results: Intrusive recollections negatively predicted overall scene construction performance. Notably, there were trends of avoidance symptoms and overall distress positively predicting and depression severity negatively predicting performance. This was driven by differences in detail generation rather than qualitative aspects of the scenes. Discussion: Those who experienced greater intrusive recollections performed worse at the scene construction task. Although with a limited sample size, these results align with previous research finding that individuals with PTSD are impaired at scene construction and perhaps compensate by generating more person-related details, regardless of being in adolescence or adulthood. Additionally, these trends provide insight into the nuanced relationship within post-traumatic symptomatology, in that intrusive re-experiencing and avoidance may have an inverse impact on memory processing.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A48 - Influence of emotional information on cognitive flexibility

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Research has shown extensively that emotion can impact cognition. Relative to neutral stimuli, positive and negative stimuli tend to enhance and impair performance respectively. The goal of the current study was to test the effect of emotional stimuli on behavioural performance and electrophysiological activity on cognitive flexibility. This study addresses the influence of emotional valence and its interaction with task relevance, which is relatively unexplored in existing literature. Participants (N = 70, 17-25 years) completed a switching task, wherein they had to switch between two non-emotional tasks (age vs gender with task irrelevant emotion) or switch between a non-emotional task and an emotional task (age vs emotion expression with task relevant emotion). Emotional valence manipulated as positive, negative, or neutral, with positive and negative faces occurring in separate blocks. Preliminary analyses of behavioural data revealed that responses were slower on switch trials than repeat trials regardless of emotional valence or task relevance. We also found that participants responded faster to negative faces than neutral faces only when emotion was relevant to the task However, accuracy was lower when switching from the non-emotional to the emotional task (under task relevant conditions), regardless of valence. Our findings suggest that emotions when relevant to the task can indeed modulate task switching, and a possible speed-accuracy trade-off while switching. The analyses of the EEG data are still on-going.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A49 - Functional organization of lateral prefrontal cortex during time-emotion integration

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The capacity to respond to dynamic emotional events in a time-and-context-sensitive manner is paramount to emotional wellbeing. Extant research underscores a critical role for the lateral prefrontal cortex (LPFC) in the temporally organized control of behavior, but mechanistic studies of LPFC function in emotion are lacking. Here, we examined LPFC's functional organization during the representation of time-emotion integrated control signals. Participants viewed negative and positive images over a 12-s period, which yielded predominantly positive vs. negative emotional sequences with varying amounts of temporal evidence (Δtime: 1200ms vs. 1800ms). Participants were asked to indicate the predominant emotional valence after each sequence. A contextual cue indicated the mapping between valence and action goal (left vs. right) and signaled an action preparation epoch, followed by action execution. Greater temporal evidence benefitted time-emotion integration performance. During action preparation, emotional valence and temporal evidence were decodable from anterior LPFC (frontal pole, FP), whereas contextual-action goal was decodable from mid-LPFC. Critically, temporally-integrated emotional signals in FP informed mid-LPFC action-goal representations: greater emotional-valence decoding in FP during emotional-sequence processing predicted greater contextual-action goal decoding in mid-LPFC during action preparation. Moreover, LPFC representations tracked behavior in a time-and-valence-dependent manner: during emotional-sequence processing, higher emotional-valence decoding predicted better temporal integration for negative-longer (vs. positive-longer) sequences, whereas temporal-evidence decoding predicted better performance for stronger (vs. weaker) temporal-evidence trials. Collectively, these findings provide novel insights into the role of LPFC in representing temporally-organized control signals during dynamic emotional experiences, and suggest a rostro-caudal axis of time-emotional integration for context-sensitive action.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A50 - Lateral frontal pole tracks emotion metacognitive assessments during anticipatory threat

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Metacognitive assessments of emotion, which are thought to promote context-adaptive action under duress, require integrating across experiential and bodily emotion channels. However, whether and how threat impacts the integration of physiological and experiential systems for emotion metacognition is unknown. Moreover, it remains unclear whether prefrontal regions previously implicated in perceptual metacognition– such as the lateral frontal pole (FPl)– support emotion metacognition. Here, we assessed sympathetic nervous system responding and self-reported emotion to examine how threat modulates emotion metacognition. In the MRI scanner, participants (n=50, 39F) underwent a threat-of-shock paradigm that orthogonally manipulated shock intensity and controllability. Anticipatory threat was induced via a prolonged countdown to shock administration, after which participants provided emotional-intensity and confidence ratings. Cardiac contractility data were collected continuously, providing a high-resolution index of sympathetic drive. To estimate trial-wise coherence between sympathetic and experiential emotion systems, we computed the concordance between intensity ratings and sympathetic drive. We found that sympathetic drive was positively associated with subjective ratings of emotional intensity (β=0.19, t=4.13, p<0.001). Moreover, participants' confidence in their subjective experience was lowest when system coherence was lowest (F=213.9, p<0.001). Neural activation during threat anticipation was parametrically modulated by participants' confidence reports, such that higher confidence predicted greater FPl activation during the anticipation of unpleasant (vs. mild) threat (t=2.73, p=0.006). Together, these results suggest that coherence between sympathetic and experiential emotion systems shape metacognitive judgments of emotion, and that FPl function supports emotion metacognition.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A51 - Art therapy and emotion regulation: A rigorous investigation of creative engagement's impact on mental health

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Art therapy is a form of psychotherapy that utilizes creative activities, such as painting or sculpting, to aid in emotion regulation (ER). While commonly accepted in clinical settings and often considered an empirically validated technique, research on art therapy efficacy has suffered from small samples and inadequate control groups. Consequently, uncertainty remains about the effectiveness of art therapy in facilitating ER. To evaluate art therapy with a more rigorous methodology, we conducted a pre-registered, three-day, within-subjects study (N = 99) assessing the effect of abstract painting on ER. While wearing Fitbits to track heart rate (HR), participants (Ps) randomly completed each condition on separate days: in the art task, Ps were asked to paint a non-representational artwork with provided materials for 20 minutes. In the non-creative control task, Ps had 20 minutes to solve printed mazes. Before and after each condition and on the third day, we measured state anxiety, emotional distress, and mood disturbance with validated questionnaires. Relative to maze-completion, abstract painting produced a significant, though short-lived (<1 day) reduction in anxiety only. Previous artistic experience and expert-rated creativity of the paintings did not moderate this effect, suggesting that the anxiety-reducing benefits of art therapy can be achieved by artists at any skill level. Lastly, HR data revealed higher physiological engagement throughout the art task compared to the control task, as measured by average and peak-

to-trough values. This study reveals that art therapy offers a short-lived but significant decrease in anxiety, highlighting its potential for facilitating ER.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A52 - Investigating Emotional Lateralization Biases with Verbal and Nonverbal Stimuli

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The treatment of mood disorders has been informed by a theoretical division of labour between the brain hemispheres in processing emotions. However, lateralization of emotional function remains unclear, with two major competing theories emerging. The Right Hemisphere Hypothesis proposes that emotional perception and expressions are primarily processed by the right hemisphere, whereas the Valence Hypothesis suggests that positive emotions are processed in left brain regions and negative emotions in the right. Although studies have come forward in support of either theory, the degree of lateralization becomes more complex when emotional stimuli engage with functions lateralized across hemispheres, such as language and face perception. The current study addresses the cognitive processing of emotional information across the two hemispheres, specifically examining the competing hypotheses by using different stimuli types to compare differences in hemispheric performance. Our online study employed the divided visual field paradigm and two valence judgment tasks with words and faces. We observed left hemisphere dominance in word processing, but no significant lateralization for face stimuli. Although there was increased accuracy for negative words and for positive faces, there were no interaction effects between visual field and valence, thus no support for either hypothesis of emotional lateralization. The observed asymmetry in the neural control of emotion may be a product of asymmetrical control of these functional lateralization biases for specific stimulus modalities. An improved understanding of hemispheric interactions when processing emotional stimuli can elucidate and inform the effectiveness of the treatment of mood disorders using non-invasive brain stimulation.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A53 - Pre-lecture Social Interaction Affects Teacher-Student Neural Coupling and Eye Movement Synchronization during Lecture

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Lack of teacher-student interaction in online learning hampers students' learning experience and outcomes as indicated by post-pandemic surveys (e.g., Reed, 2020). Existing research highlights the impact of perceived social closeness on teacher-student neural synchrony during face-to-face lectures (Bevilacqua et al., 2019), a factor linked to learning success (Nguyen et al., 2022). Yet, the effect of social interactions on teacher-student neural synchrony and learning outcomes in online settings remains uncharted. This research aims to address this gap. The teacher's audio, eye movement and neural responses were recorded in the scanner when delivering a 17-minute lecture. A corresponding video lecture was created with the extracted audio. Two groups of college students (N=26) participated in video learning in the MRI scanner where their real-time neural responses and eye movement were also simultaneously recorded. Before viewing, one group underwent a five-minute structured social interaction session with the teacher, while the control group did not. Intersubject correlation analysis was applied to the neural and eye movement data. Learners with pre-lecture interaction outperformed their peers in answering complex but not easy questions. We further observed increased teacher-student eye movement synchronization in this group, correlating with better learning outcomes. This group also exhibited greater teacher-student and student-student neural synchrony, particularly in brain regions implicated in social cognition and language, including the right superior/middle temporal gyri and the right inferior/middle frontal gyri. These findings suggest that even brief social interactions before online lectures can positively impact learning by tuning students' visual attention allocation and enhancing teacher-student neural coupling.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A54 - Emotion impacts the entrainment of concurrent visual stimuli

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Faces are ubiquitous social cues which signal motivationally relevant information, such as others' intentions or environmental variables. Prior work has indicated that emotional compared to neutral expressions attract attention and evoke heightened visual cortical activity. However, the precise brain regions involved in such biasing of visual cortical activity by emotional expressions are not well characterized. Thirty adults (17 female; mean age=31 years) underwent magnetoencephalography (MEG) while viewing Gabor patches that were superimposed on a distracting face that was either angry, neutral, or happy. Both stimuli were flickered on-and-off at distinct frequencies (18.5 and 34.2Hz, respectively) to entrain neural populations. The MEG signals at the entrainment frequencies were extracted in the frequency domain and subsequently imaged using a beamformer. Both stimuli elicited strong entrainment in primary visual cortices. Face entrainment was strongest for angry and happy relative to neutral faces in the inferior parietal cortex (F2,58=8.00, p=.001), suggesting that this region may enhance the processing of emotional expressions amid ongoing task-driven attention. In contrast, Gabor entrainment in the cuneus was weaker in the presence of angry and happy compared to neutral faces (F2,58=7.77, p=.001), indicating that emotional content diminishes the processing of task-relevant visual information in this occipital cortical region. In addition, angry compared to happy expressions entrained more strongly in the calcarine fissure (t29=3.18, p<.01), pointing to a role of early visual cortices in facilitating the processing of negative expressions in particular. These results are consistent with work implicating canonical attention regions in processing emotional content conveyed through facial expressions.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A55 - Investigating the influence of deadlines and target agreements on cognitive control in a color discrimination task using the EEG

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Approaching deadlines and comparing one's own performance against an agreed upon target are major stressors in everyday working life. Apart from being a potential health hazard in the long term, performance pressure induced by these stressors might also have immediate effects on cognitive processing. In an EEG study, we investigate these effects using a color-discrimination task. Periodically, participants receive predefined visual feedback about how their performance compares to a performance goal. They are also informed about how much time is left until the end of the block. The feedback manipulates whether the performance is feedbacked as being close to, clearly above, or clearly behind the target. If the performance target is missed when the end of the block is reached, a bipedal cold pressor test is triggered automatically. A separate control group receives the cold-water exposure at the end of random blocks to control for effects of the aversiveness of the deadline. Preliminary results suggest that performance is affected the most if the feedback indicates that the performance is lagging clearly behind the target performance. A reduced CNV amplitude during the cue target interval suggests that this performance decrement is due to a reduced deployment of proactive cognitive control. This effect is modulated by the time left in the block, with stronger differences between the feedback conditions closer to the deadline.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A56 - Emotion regulation and salivary cortisol in Top 100 esports competitors

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Achieving expert-level skill in high-performance domains requires excellent emotion regulation. The emerging field of esports, or professionalized competitive gaming, provides an avenue for studying self-regulatory processes in experts. We suggest that competitors use emotion regulation to support performance by coping with negative emotions. Additionally, we suggest that physiological stress markers such as cortisol awakening response (CAR) reflect successful regulation. We surveyed players at 12 national-level Super Smash Bros tournaments. Players ranked in the Top 100 (top 0.1%) also completed 1) a salivary cortisol sampling protocol to measure CAR on one competition and non-competition day and 2) a semi-structured interview. 133

participants, including 28 elite, completed surveys. 18 elite players completed cortisol sampling and 12 gave interviews. Players who engaged in fewer maladaptive emotion regulation strategies had better performance ($F(1,132) = 18.4$, $p < .01$, $R2 = 0.12$), even controlling for rank and hours of practice ($F(4,126) = 19.7$, $p < .01$, $R2 = 0.39$). In domain-specific surveys, emotion regulation was a separate factor from other facets of skill like sensorimotor ability. CAR was blunted on competition days which may indicate poor coping. Finally, inductive coding of interviews revealed common themes: 1) elite players modulate bodily responses to achieve optimal performance, 2) they adapt growth mindsets to maintain resilience, and 3) they strategically manage social feedback. In conclusion, for elite competitors, the psychological demands of tournament competition are high, but they utilize several adaptive strategies – even if those strategies do not necessarily result in "normal" physiological stress on competition days.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A57 - Exploring the interplay of divergent creative thinking, smartphone use, mindfulness, and stress symptoms: A three-year cross-sectional study.

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Creativity, frequently highlighted in art therapy for its stress-reducing benefits, still lacks robust empirical evidence linking this cognitive process to negative psychological states. Concurrently, as smartphone usage has soared globally, particularly during the COVID-19 pandemic, so too have stress levels. This trend suggests that smartphones, depending on their use, could either bolster or hinder creativity, potentially impacting stress. The current cross-sectional research examines relationships between divergent creative thinking, smartphone use, mindfulness, and stress among undergraduate student cohorts (N = 1153) from 2020 to 2023. Our study, spanning three years, investigates how smartphone usage and mindfulness affect the links between divergent thinking and negative psychological states. We evaluated smartphone usage through the Smartphone Addiction Scale, screen time, and social media engagement. Mindfulness was gauged using the Mindful Attention and Awareness Scale. We measured divergent thinking, a process involving cognitive control and novel idea generation, through fluency and originality in Alternative Uses Task responses. The Perceived Stress Scale assessed negative emotionality. Results revealed less novel, $p < .001$, yet more, $p = .002$, creative responses generated since 2020. Overall, smartphone use was linked to less creative responses, $p = .039$, however recent cohorts show increasingly positive associations between smartphone use and creativity $p = .008$. In contrast, mindfulness evidenced negative links with idea generation quantity over time, $p = .042$. This research examines relationships of technology on mental health and cognitive abilities, particularly in the academic context. Findings provide insights into how creativity and mindfulness are linked to smartphone use and stress.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A58 - Electrophysiological Dynamics of Emotion Regulation under the Two-Dimensional Model of Adult Attachment: An Event-Related Potential Study

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Emotional regulation is the process by which individuals modulate their emotional experiences and expressions. While literature on the subject expands, a clear understanding of the electrophysiological dynamics at play, particularly within the framework of attachment theory, remains elusive. This theory elucidates the profound impacts of our initial relationships on our subsequent interpersonal dynamics and emotional regulation strategies. In this study, the brain activity of 59 Latin American participants was recorded via EEG while they performed an emotional regulation task involving the attendance, reappraisal, or suppression of emotions triggered by unpleasant images taken from IAPS. Additionally, the ECR-12 scale measured attachment anxiety and avoidance. The results revealed a higher emotion regulation index of cognitive reappraise measured using the Late Positive Potential (LPP) during emotion regulation and natural conditions. This index correlates with reduced arousal elicited by the unpleasant images. Additionally, a higher attachment anxiety score was associated with higher levels of arousal during cognitive reappraisal and a reduced level of emotion regulation index. Finally, a group of people with lower levels of attachment-anxiety exhibited higher levels of emotion regulation index during reappraisal compared to those with higher levels of attachment-anxiety. This study provides novel insights into the relationship between attachment orientations and emotional regulation, as evidenced by EEG-based measurements of the LPP. The findings indicate that individuals with higher attachment anxiety display distinct electrophysiological responses during emotional regulation tasks, particularly in cognitive reappraisal scenarios.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A59 - Examining the neural correlates of error and moral processing

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Error processing is a critical human mechanism. Classical psychological tasks have identified neural activities linked to error awareness for objective errors. Yet, our understanding of how humans subjectively discern right from wrong in moral contexts remains limited. In this study, 31 participants are asked to observe a series of actions and then mentally simulate themselves performing these behaviors, which are categorized as morally right and morally wrong. These simulations will be conducted while the participants are under EEG and MRI scanners. Although no differences were observed in the early ERP component (error-related negativity, ERN) across different scenarios, variations in the ERN amplitudes of the subjects successfully predicted individual differences in their proneness to guilt. Furthermore, later components exhibited greater negativity in immoral scenarios. The subjects' activity in the anterior cingulate cortex was correlated with both their late negativity (LN) amplitude and self-reported guilt ratings in morally-wrong trials. Activity in the amygdala, ventromedial prefrontal cortex, and temporoparietal junction also showed correlations with the subjects' LN amplitude. Consistent with the moral dynamic framework, our findings demonstrate individual variability in the widespread functional neural networks associated with moral judgments. These results suggest that individual differences in error awareness may be reflected in both objective and subjective perceptions of wrongness, and may further predict feelings of guilt related to these perceptions.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A60 - Brain Activity During Emotion Regulation Predicts Working Memory Performance

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Working memory (WM) ability may be a crucial cognitive process underpinning emotion regulation. Previous research has found that working memory is associated with emotion regulation ability (Hendricks & Buchanan, 2016; Opitz et al., 2014; Schmeichel and Tang, 2015). The purpose of this study is to identify whether brain activity associated with emotion regulation can be used to predict individual differences in WM. We predicted that brain activity associated with reappraising negative images compared to viewing negative images would be observed in regions typically associated with WM and that activity in these regions would be related to individual differences in WM. One-hundred-one participants completed an emotion regulation fMRI task followed by the WAIS-IV, with performance on WM tasks being of interest. A standard univariate whole brain analysis contrasting the reappraise negative - view negative BOLD response found greater activity in parts of lateral frontoparietal networks typically associated with reappraisal, including the dorsolateral prefrontal cortex (dlPFC). A subsequent covariate analysis revealed that whereas covarying for individual differences in WM removed all significant whole brain effects, the right dlPFC positively covaried with individual differences in WM (cluster threshold, $z > 3.1$; whole brain cluster corrected $p < .05$). Multivariate analyses further demonstrated the ability to predict individual differences in WM from brain activity during emotion regulation. It is likely that working memory and emotion regulation are at least partially underpinned by similar neurocognitive mechanisms.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A61 - Human brain activity at event boundaries and emotion changes in naturalistic videos

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Continuous experience may be divided into discrete events (event segmentation) when changes in the ongoing situation cause predictions about what will happen next to break down. Though the moments that separate one event from the next (event boundaries) have long been tied to a variety of situation changes (e.g., changes in spatial location, actor goals, and object interactions), changes in a core feature of experience, emotion, has been generally overlooked. In a prior study, we showed that participants identified emotion changes in movie content and event boundaries at similar times. However, it is unclear whether discrete changes in the emotional content of a movie are spontaneously processed in the brain, and whether brain regions that are sensitive to event boundaries are also sensitive to emotion changes. We analyzed a publicly available fMRI dataset collected while participants freely viewed an episode of Sherlock (Chen et al., 2017) and collected data to identify normative event boundaries and emotion changes in the episode. Replicating previous results, participants agreed with each other about when emotion changes occurred, and these changes correlated with event boundaries. Importantly, a network of brain regions that increased in activity around event boundaries was also sensitive to changes in the movie's emotional content. Conversely, the amygdala, a region associated with processing emotional salience and threat, transiently increased in activity around event boundaries. Together, the findings provide initial evidence suggesting that emotional information may be tracked by event processing regions to mediate segmentation.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A62 - Investigating Spatio-Temporal Dynamics in Emotion-Cognition Interactions: A Multivoxel Pattern Analysis Approach

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This study explored spatio-temporal associations between emotion and cognition neural systems – specifically, the ventral affective processing system (VAS) and the dorsal executive system (DES), which overlap with the ventral attention network (VAN) and dorsal attention network (DAN), respectively. While prior research has underscored that emotion-cognition interactions are facilitated through communication among these systems/networks, the link between their temporal and spatial aspects is not well understood. Here, we involved a modification to the multivoxel pattern analysis (MVPA) approach for analysing simultaneously collected EEG and fMRI data acquired from twenty-two young adults, who participated in an emotional oddball task. A linear support vector classifier was employed to identify spheres with a 2-voxel radius, whose patterns of activity accurately predicted the presented stimuli (targets, sad distractors, and fearful distractors). Several regions, including those within VAS (e.g., ventrolateral prefrontal cortex) and DES (e.g., dorsolateral prefrontal cortex) were identified. Then, different event-related potential (ERP) components (including P100 and P300) were computed for each trial and incorporated into the classifier, and the performance of each of these classifiers was subsequently compared with that of the original classifier. As predicted, in general, the addition of information led to improved classifier performance, which was particularly significant over dorsal regions when augmented with P300 measures. Overall, these findings underscore the convergence of brain activity measures across diverse spatio-temporal resolutions. This approach supports the feasibility of employing MVPA techniques to analysing multi-modal brain imaging, to understand neural mechanisms underlying emotion-cognition interactions among large-scale functional networks at various spatio-temporal scales.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A63 - Title: Emotion Recognition and Autistic Traits: A Pupillometry Study

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Autistic individuals commonly exhibit difficulties with emotion recognition, difficulties that contribute to social issues in Autism. Both emotion recognition and social abilities are distributed along a spectrum in Autism and the general population. We explored this relationship between emotional processing, as measured via physiological response, and autistic traits, specifically social abilities. We presented participants with dynamic, audiovisual stimuli of actors uttering a semantically neutral phrase. These utterances were expressed with either neutral tone of voice and facial expression, or with angry, fearful, disgusted, sad, or surprised tone and expression. Each emotion was presented with high- and low-intensity depictions. Participants were asked to identify the emotion and rate its intensity. Participants' pupillary responses were recorded during viewing. Social abilities were measured through a battery of self-report scales, including the Autism-Spectrum Quotient, the Broad Autism Phenotype Questionnaire, the Repetitive Behaviours Questionnaire, and the Social Responsiveness Scale. Social related subscales from each were normalized and averaged to calculate an overall index of social ability. Overall social ability and individual subscales were then related to pupillary response to emotional stimuli via Pearson correlation. Not surprisingly, high-intensity emotions induced larger pupillary responses than low-intensity emotions. Individuals with higher autistic traits also exhibited smaller overall responses. Interestingly, many social traits correlated with physiological responses to low-intensity emotional presentation, but not when the emotion was high-intensity. This reflects previous studies suggesting that Autistic individuals show more pronounced difficulties with emotion recognition when emotional expression is more subtle.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A64 - Mental Imagery and Fear Generalization

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Mental imagery is believed to be a weaker form of perception, which may result in a more ambiguous, or "fuzzy", mental impression as compared to the impression from a visual stimulus. If correct, the acquisition of fear may be less specific for imagined fears in comparison to perceptual fears. This lack of specificity could facilitate broader fear generalization. To test this idea, two groups of participants underwent differential fear conditioning (N = 100) such that a specific Gabor patch orientation (CS+) was paired with mild shock while a second Gabor patch of orthogonal orientation (CS-) was never paired with shock. Critically, one group imagined the Gabor patches during conditioning and the other group viewed the Gabor patches. Next, both groups were presented visual Gabor patches of similar orientations (GCS) to the CS+. Participants' fear conditioning and generalization was measured via self-report and the skin conductance response (SCR). Self-report findings demonstrated successful fear conditioning toward the CS+ and CS-. Further, self-reported findings suggested that there was no difference in the broadness of fear generalization between the two groups. Corroborating these findings, SCR results also did not show a significant difference between the groups. However, differing from the self-report, SCR results appeared more consistent with the phenomenon of lateral inhibition such that the most similar stimuli to the CS+ showed an inhibited fear response. These potentially dissociable findings between the two measures will be discussed.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A65 - Influence of anxiety and threat on cognitive map learning

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Adaptive behavior often requires using structured internal representations about the external world, such as bringing to mind relevant side-streets when encountering a detour on your way home from work. These internal representations are collectively referred to as cognitive maps. Given their fundamental importance to representing spatial, temporal, and conceptual relationships, surprisingly little is known about factors that modulate map learning. Here, we tested how cognitive map learning is influenced by threat and anxiety. We developed a novel drag-and-drop network leaning task involving images of either threat or neutral valence. Our aim was to uncover how subject-level trait anxiety and image valence impacted three key metrics of map learning: number of attempts until correct placement during the drag-and-drop map learning task;

detection of "invalid" network transitions during a post-learning random walk sequence; and accuracy during a post-learning odd-one-out image community classification task. We found that there was no difference in whether threat or neutral images were learned first in the drag-and-drop task, and no significant difference between anxiety levels or image valence for odd-one-out classification accuracy. However, participants with high trait anxiety were better at detecting invalid network transitions for both image valences, and detection of invalid transition was overall better when they involved threat images. These novel findings indicate that emotionally salient locations are prioritized when people build mental representations of their environment, and that high trait anxiety promotes cognitive map learning.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A66 - The Impact of Potentially Morally Injurious Content on Reasoning and Its Neural Correlates: Data from the Canadian Armed Forces (CAF)

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Recently, there has been considerable interest in understanding the causes and consequences of moral injury—defined as significant and enduring psychological, behavioural, social, and spiritual distress in the aftermath of events that involve violations of deeply-held beliefs and expectations about right and wrong. Research on the neurobiology of moral injury has revealed changes in brain function involving regions that underlie emotions, cognitive control, somatosensory processing, and internally-oriented cognition. However, to date, no study has examined the impact of moral injury on reasoning or its neural correlates. We hypothesized that the presence of potentially morally injurious content would impair reasoning compared to otherwise structurally identical arguments with neutral content, and that the former would engage structures associated with memory and/or emotion. We tested this hypothesis by administering arguments that included neutral content or content adapted from items in the Moral Injury Outcome Scale (MIOS) to reference peers, leaders, and/or institutions to a sample of neurologically healthy Canadian Armed Forces members (n = 46) in the fMRI scanner. Compared to neutral items, reasoning was impaired on items with potentially morally injurious content. Furthermore, reasoning about potentially morally injurious content was correlated with greater activation in the parahippocampus, and parahippocampal activation explained 13% of the variance specifically on reasoning trials with potentially morally injurious, but not neutral, content. Given the parahippocampus' role in processing contextual associations, the results suggest that the presence of potentially morally injurious content may impair reasoning by activating contextual associations that interfere with the reasoning system.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A67 - Not just disgust: Network-based and seed-to-voxel insular connectivity distinguishes misophonia from disgust sensitivity and related clinical measures

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Misophonia, a newly-defined disorder of extreme aversion to certain sounds, affects roughly 20% of the general population. Recent neuroimaging evidence has reported patterns of abnormal activity and connectivity in the insula in misophonic individuals, suggesting potential differences in underlying attentional or emotional-disgust processes. How does the insula connect to other functional networks while at rest, and does this pattern of connectivity lend insight into misophonia's relationship to other disorders? To address this question, we analyzed resting-state data from 22 adults assessed for misophonia, disgust sensitivity, OCD, depression, and stress. Whole-brain region-to-region network-based connectivity revealed an increase in connectivity between the left and right insula as misophonia level increased, supporting the role of the insula in misophonia symptom presentation. Next, we used the insula as a seed for a whole-brain seed-to-voxel connectivity analysis and observed that misophonia level was significantly related to connectivity from the insula to a cluster extending to the operculum, putamen, and Heschl's gyrus. To investigate whether this pattern matched that of putatively related clinical disorders, we performed the same analysis for disgust sensitivity, OCD, depression, and stress. None of these individual measures produced significant clusters overlapping the regions found using misophonia level. These results support and replicate the importance of the insula in understanding misophonic aversion and additionally provide tentative evidence that misophonia is a discrete disorder. Understanding the neural basis of misophonia could not only inform treatment, but also lead to new insights into the function of the insula in health and disorder.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A68 - COGNITIVE FLEXIBILITY AND PUPIL RESPONSE DURING SOCIAL NEGOTIATIONS UNDER ACUTE STRESS

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Executive functions, such as decision-making and cognitive flexibility, are influenced by acute stress. Social bargaining, a specialized form of decision-making, requires individuals to pay attention to the intentions and reactions of others in order to make adjustments aligning with personal goals. We explored the effects of acute stress on social negotiation and pupil dilation, a marker of noradrenaline system activity and attentional processes. Forty-two participants were randomly assigned to either a stress or control group and subjected to the Maastricht-Acute-Stress-Test, with measurements of salivary cortisol. Participants assumed the role of proposers in a repeated Ultimatum Game, engaging with simulations representing either humans (social context) or computers (non-social context). Changes in their game strategy and pupil size were analyzed. Results indicated a significant statistical difference between groups, where only the non-stressed adapted their offers and increased earnings in the non-social context, whereas stressed participants did not adapt in either context. Interestingly, negative feedback elicited higher pupil dilatation in stressed participants than controls, particularly in the social context. Stress has been associated with reduced cognitive reappraisal of emotions, possibly amplifying the saliency of negative feedback for stressed individuals. Recent evidence suggests that pupil size increases in response to stimuli with high negative emotional valence, implying that social rejection may carry heightened negative emotional valence for stressed individuals. These findings shed light on the intricate interplay between acute stress, social negotiation, and physiological responses, offering valuable insights into the underlying mechanisms that influence decision-making and attentional processes in stressful social scenarios.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A69 - Enhancement of emotion perception through transcranial random noise stimulation over the inferior frontal gyrus

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The human mirror neuron system (hMNS) is a prominent brain network encompassing sensory and motor areas that has been implicated in action perception and more recently, emotion perception. We applied transcranial random noise stimulation (tRNS) to the inferior frontal gyrus (IFG; a major node of the hMNS) to assess the neural and behavioural effects. Participants were randomly assigned to receive either sham tRNS or active tRNS and completed emotion perception tasks during an electroencephalogram (EEG) recording. EEG was used to measure hMNS activity through event-related desynchronization of the mu-rhythm (mu-ERD). For greater ecological validity, the emotion perception tasks included dynamic audio-visual portrayals of emotions in addition to images. We replicated a previous study such that active tRNS improved task accuracy on an emotion perception task with static stimuli, compared to sham tRNS. There was no group difference on the control task. Moreover, when perceiving dynamic audio-visual stimuli in an emotion perception task, active tRNS led to greater mu-ERD, faster response times and marginally better accuracy compared to sham. Our interpretation of these findings is that tRNS over the IFG leads to an enhancement of embodied responding to emotional stimuli. Overall, this research highlights the potential of brain stimulation to further our understanding of the role of motor areas in emotion perception.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A70 - Fault Lines and TikTok: How Social Media Influences Emotional Decisions

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Easy accessibility to social media equates to increased access to emotionally charged materials. Research shows correlations between social media use and emotional modulations (Christensen, 2018; Mugg, 2005), with TikTok presenting highly-emotional content to maintain engagement (Kin, 2017). Inductions using such platforms have demonstrated concurrent changes in physiological markers of arousal (Siedlecka, 2018) and cognition (Forgas, 1998). To investigate TikTok's influence on emotional induction, physiology, and fault attribution, 34 undergraduates were randomly assigned to watch either positive or negative clips. Afterward, participants completed a fault-attribution questionnaire (AIQH; Combs, 2007); where higher scores mean higher fault rates. Physiological measures of heart rate (HR) and skin conductance (GSR) were collected throughout. We hypothesized higher fault attribution rates for the negative group, as well as higher physiological arousal. An independent samples t-test did not reveal differences in fault attribution rates between groups, t(32)=0.26,p= 0.79. A mixed model 2x2x3 ANOVA investigated potential interactions between the groups during fault/no-fault attributions, extracting measures at 3 time points (Pre=5 seconds before, At decision=upon fault attribution, Post=3 seconds after). The negative group showed increased HR "At decision" (F(32)=0.904, p= 0.035) and at "Post" (F(32)=5.938, p= 0.021). Further investigation is required for GSR, which did not achieve significance. In conclusion, while negative TikTok induction did not increase fault attribution rates, higher heart rate was apparent when making these decisions, and afterward upon rumination. This may explain the covert burden of emotional media content, where outward behaviors are maintained but the cognitive load is increased.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A71 - Drivers of epistemic curiosity in younger and older adults: The role of knowledge confidence and future value

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Epistemic curiosity – the drive to acquire new information – benefits cognitive engagement, subjective well-being, and physical health across the lifespan, but little is known about adult age differences in factors that drive curiosity. This pre-registered study examined the role of prior knowledge and future utility in epistemic curiosity. Younger and older participants (total N = 100) viewed a series of trivia questions and rated their curiosity as well as their knowledge confidence for each question. Participants then had the opportunity to reveal answers at the cost of waiting 10 seconds per answer, before completing an exit quiz. Some participants were told that all items were equally likely to appear on the quiz, so that the future value of each item was unpredictable (uniform condition). Other participants were told that high-confidence items were more likely to be on the quiz, so that the future value of each item was predictable (confidence condition). In the uniform condition, curiosity (operationalized as answer reveal probability) was maximal for low-confidence items. In contrast, in the confidence condition, curiosity was maximal for moderate-confidence items. Although overall curiosity was higher in older adults, the effects of knowledge confidence and future value on information seeking were similar in both age groups. These findings are consistent with the rational model of curiosity (Dubey et al., 2020, Psych Rev), according to which curiosity serves to maximize cumulative knowledge value. Implications for theories of motivation-cognition interactions in aging are discussed.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A72 - Associations Between the Late Positive Potential and PTSD, Anxiety, and Depressive Symptoms Among Trauma-Exposed Undergraduates

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Trauma-exposure can contribute to maladaptive attentional processes that are associated with symptoms of anxiety, depression, and PTSD. The amplitude of the late positive potential (LPP), an event-related potential in the EEG, reflects allocation of neural attentional resources to a stimulus. Research on the associations between the LPP and psychopathology have been mixed, and few studies tested these relationships with positive and neutral stimuli. Clarifying these relationships can allow for a better understanding of the neural underpinnings of trauma-related disorders. Participants were seventy-three trauma-exposed undergraduates (56.2% female) with a range of clinical symptoms. Self-report measures assessed recent PTSD, anxiety, and depressive symptoms. Participants viewed a series of negative, positive, and neutral images and LPP amplitude to each stimulus type indexed neural allocation of attention. Hierarchical linear modeling tested the effects of valence and symptoms on LPP amplitude, as well as associations between the LPP psychopathology. The LPP amplitude to negative images was higher than that to neutral images, b=0.699, SE=0.233, t=2.999, p=0.003; however, there were no differences between LPP amplitude to positive and neutral images, b=0.321, SE=0.233, t=1.376, p=0.169, nor negative and positive images, b=0.378, SE=0.233, t=1.622, p=0.105. Greater depressive symptoms were associated with higher LPP amplitude to neutral images, b=-0.223, t=-2.896, p=0.005, but not to negative, b=0.124, t=1.391, p=0.169, nor positive, b=0.116, t=1.342, p=0.184, images. There were no relationships with anxiety nor PTSD symptoms. Depressive symptoms might be related to diminished attention to neutral stimuli among trauma-exposed undergraduates. Further investigation of the relationship between the LPP and psychopathology is needed.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A73 - Depressive Symptomology and Gray Matter Integrity of Interoceptive Networks in Remitted Depressed Outpatients

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Introduction: Interoception, the sense of the body's internal state, is increasingly recognized for its importance for mental health. Major Depression Disorder (MDD), while characterized by melancholia and anhedonia, is also marked by somatic comorbidities. Furthermore, MDD recurrence has been related to dysphoria-evoked inhibition of somatomotor regions, suggesting that interoceptive dysfunction may constitute an enduring biomarker of episode return. It remains unclear whether morphologic changes underlie these functional effects to help explain individual differences in MDD vulnerability. Method: A prior study (N=85) investigated the relationship between dysphoric reactivity and depression vulnerability over a two-year follow-up period. Here, we present secondary analysis of structural (T1) data not included in the original report. Gray matter volume was regressed onto future MDD status, residual symptom burden, and two composite measures of interoception: somatic anxiety (SomAnx) and lack of body awareness (Unaware). Whole brain and planned region of interest (ROI) analyses of sensory cortices were performed. Results: Future relapse/recurrence was not related to whole-brain gray matter volume. However, relapse was linked to greater cortical thickness in ROI analysis of interoceptive (insula) and visual (occipital) regions. Residual symptoms and SomAnx were linked to greater volume in the left inferior circular sulcus of the insula, and residual symptoms and Unaware were linked to greater volume in the right occipital pole. Conclusion: Residual symptoms and interoceptive dysfunction were associated with greater gray matter volume in sensory cortices. This contributes to a growing recognition of the relationship between depression vulnerability and sensory representation in relapse-remitted depressed outpatients.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A74 - Can you still HAND-le these emotions? A continued investigation on hemispheric dominance with exposure to visual stimuli.

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Similar to language, emotional processing may be lateralized in the brain according to handedness. Right-handers predominantly present left-hemisphere language dominance (Knecht, 2000), while left-handers show more variable laterality (Bidula, 2017). Furthering the literature on hemispheric dominance, emotional processing mechanisms have been suggested through two theories. First, the right-hemisphere-hypothesis suggests that emotional stimuli are perceived more efficiently by the right hemisphere (Smith & Bulman-Fleming, 2005). Second, the valence-hypothesis suggests that positively-judged emotions are left dominant, while negatively-judged are right dominant (Palomero-Gallagher, 2021). The current study furthers our understanding of emotional hemispheric lateralization using fNIRS (https://nirx.net/). We hypothesize higher left PFC activity in right-handers during emotional judgments. Thirty-seven undergraduates (31=right) completed valence-judgements of happy, sad, anger, disgust and fear faces (FEVA) and a handedness inventory. Preliminary behavioral data did not reveal accuracy differences between right and left handers when judging facial valence ($p>0.05$) and each emotion-type revealed expected valence ratings ($p<0.01$). Imaging analyses revealed higher HbO levels for right-handers when completing

valence-judgements for all 5 emotion types. This right dominance supports the Right Hemisphere Hypothesis (Borod, 1998). Meanwhile, left-handers revealed variable hemispheric dominance: right for sad/disgust, left for anger/fear, and bilateral for happy. Hence, handedness may modulate hemispheric dominance when judging emotional faces, with right and left handers revealing different hemispheric activity for happy, anger, and fear. Overall, there presents hemispheric lateralization of emotional facial processing, which may be modulated by handedness. Such findings inform affective research and develop clinical interventions and surgery planning.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A75 - Alpha-frequency Transcranial Alternating Current Stimulation Attenuates Anxiety-induced Salience Network Hyperconnectivity

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Anxiety and stress are common in society and have been linked to many neuropsychiatric illnesses. The understanding of anxiety has come to include network-level pathologies, with hyperfunctioning of the salience network (SN) being increasingly recognized. The SN, anchored on two cortical hubs (the dorsal anterior cingulate cortex/dACC and anterior insula/AI) and a subcortical hub (the amygdala), orients the brain to salient stimuli and coordinates defensive responses via other functional networks. Previous research from our lab has shown that network-level connectivity and anxious mood can be modulated by non-invasive brain stimulation, specifically alpha-frequency transcranial alternating current stimulation (alpha-tACS). In this study, we aimed to examine the efficacy of alpha-tACS in blunting heightened SN functioning in anxiety. Resting-state fMRI was recorded from 40 participants before and after anxiety induction, during which participants were randomly assigned to receive alpha-tACS or sham stimulation. Seed-based functional connectivity analysis revealed increases in SN connectivity (primarily between the amygdala and the dACC as well as the AI), confirming anxiety-related SN hyperfunctioning. Importantly, this effect was significantly modulated by group assignment, mainly present in the sham (vs. tACS) group. Therefore, alpha-tACS attenuated anxiety-induced SN hyperconnectivity, specifically between the amygdala and the cortical nodes. Taken together, these findings suggest that tACS may serve as an effective therapeutic that mitigates SN hyperfunctioning in anxiety by normalizing functional connectivity between the subcortical and cortical nodes.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A76 - Untangling the Threads of Motivated Memory: Independent Influences of Reward and Emotion

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Despite the close link between reward motivation and emotion, their effects on memory have been studied in separate lines of research. The current study takes a novel approach to manipulate motivational and emotional influences orthogonally, and within the same task, to test their interplay on intentional memory formation. If emotion and motivation are tightly linked, they may rely on overlapping cognitive and neural mechanisms, thus we would not expect emotion and reward to interact in memory. Alternatively, they could be distinct constructs and therefore would boost memory when both are included in the same experimental trial, above and beyond additive effects. To test these competing predictions, in Experiment 1, participants (n = 180) completed a recognition task with emotional and neutral words intentionally encoded with high or low reward anticipation cues. In Experiment 2, participants (n = 159) encoded emotional and neutral words with a high or low reward cue, but memory was tested with free recall using study-test blocks. Across studies, there were main effects of emotion and reward in hypothesized directions, but no significant interaction between these factors. Their combination within a trial does not boost memory above and beyond either of these factors alone, in line with the hypothesis that these constructs have similar cognitive and neural mechanisms. Correlational analyses indicated individual differences in reward responsivity or emotional state could not account for reward or emotion effects on memory, perhaps indicating that similar mechanisms may be related to general memory abilities rather than motivational or affective processing.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A77 - Moderate effect of social anxiety tendency in the influence of prior social information on emotional attribution bias

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Social anxiety disorder (hereinafter "SAD") is a disorder in which fear and anxiety in social and interpersonal situations and avoidance of these situations interfere with daily life. In prior research, attention bias has been identified as one of the factors influencing the onset and maintenance of SAD. However, to the author's knowledge, little research has been conducted on how contextual factors affect the attentional bias of SAD. This study explores the cognitive processing mechanism of anxiety in individuals with SAD, focused on social information about others as contextual factors. We investigated how prior social information about others affects emotion attribution in individuals and how SAD tendencies moderate the effect using behavioral experiments (emotion label and emotion match task). We found that individuals with higher SAD tendencies exhibited an emotional attribution bias in detecting emotion in the facial recognition of others, becoming slow in the situation. They recognized negative information about others in advance, and while they did not have an emotional attribution bias in the situation, they did not recognize negative information about others. This result suggests that the attentional bias, which has been considered a factor maintaining anxiety in socially anxious individuals in previous studies, does not occur in certain situations and may be reduced by adjusting environmental factors. This investigation is crucial for developing targeted interventions and improving diagnostic accuracy in SAD. Future research should focus on using a larger sample size to understand further emotion attribution biases in SAD and their impact on daily life.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A78 - The Prediction Accuracy of Enjoyment is Influenced by a History of Peer Victimization

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We often underestimate how much our conversation partners enjoy initial interactions - a phenomenon known as the liking gap. It is unclear what features of a conversation, or prior social experiences of the people involved in it, influence the liking gap. To test this, 23 gender-matched dyads (46 female) who varied in exposure to peer victimization completed a conversation that included three randomly ordered positive, neutral, and negatively-valanced prompts (nine total) about their opinions and experiences. Following the conversation, participants rated their own enjoyment and predicted their partner's enjoyment, both for the overall conversation, and for individual prompts. Consistent with the liking gap, participants underestimated their partner's overall enjoyment (Mactual = 6.3; Mpredicted = 5.5; SDboth = 0.9; $t = -5.642$; $p < 0.001$) as well as enjoyment for most individual questions (t's > 2.505; p's <.01). Conversational features such as prompt order (i.e., primacy and recency effects) and valence did not predict the overall liking gap. However, more severe peer victimization was associated with a larger liking gap ($t = -2.724$; $r = -.38$; p <.01). Unpacking this finding in further detail, while we found there was no relation between peer victimization and participant's own enjoyment ($t = -0.556$; $r = -.08$), more severe peer victimization was associated with more negative predictions about one's partner ($t = -2.621$; $r = -.37$; p <.05). This suggests the liking gap is susceptible to individual differences in prior social experiences, and that these social experiences largely influence predictions about peer enjoyment.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A79 - Investigating the Use of Speech Analysis as a Diagnostic Tool for Treatment-Resistant Depression

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Background: Objective markers of depression are needed to enhance personalized clinical management. Here, we examined whether a validated speech assessment could detect speech differences between individuals with treatment-resistant depression (TRD) and healthy controls, and whether speech variables correlated with depression severity, as measured by the Hamilton Depression Rating Scale (HAMD). Methods: 50 patients with TRD (mean age=44.0±14.3, 44% female, mean HAMD=21.1±4.1) and 16 non-depressed participants (mean age=46.6±19.5, 81% female) completed a validated speech assessment developed by Winterlight Labs. Participants were asked: "Tell me how you're feeling today." Acoustic and linguistic features were computed with natural language processing libraries. Speech outcomes of interest included fundamental frequency (mean, variance), vocal intensity, pause duration, speech rate, and affective content of speech (valence, arousal, dominance). ANCOVAs assessed group differences and linear regression models assessed associations between speech characteristics and HAMD scores in patients. Analyses adjusted for age, sex, and English proficiency. Results: Compared to controls, individuals with TRD exhibited lower fundamental frequency ($p=0.03$, $\eta2=0.07$), longer pause duration ($p=0.04$, $\eta2=0.07$), slower speech rate ($p=0.007$, $\eta2=0.12$), and more emotionally arousing ($p=0.007$, $\eta2=0.12$) and negatively valenced language ($p=0.02$, $\eta2=0.09$). There were no group differences in fundamental frequency variability, sentiment dominance or vocal intensity. There were no significant associations between speech characteristics and HAMD scores. Conclusions: Several speech variables differed between individuals with TRD and controls but did not correlate with HAMD scores. As such, these speech metrics may capture phenotypic characteristics of TRD. Further research is needed to validate these findings and assess their clinical utility.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A80 - Common and distinct patterns of intrinsic whole-brain functional connectivity in unipolar and bipolar depression: A voxel-based meta-analysis

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This poster presents meta-analytic findings of convergent and divergent patterns in whole-brain resting-state functional connectivity (rsFC) correlated with unipolar and bipolar depression. We conducted a systematic literature search and applied eligibility criteria, which revealed 50 articles fit for inclusion in our meta-analysis. We used the QUADAS-2 to assess article quality, which showed that our sample comprised high-quality articles. Our meta-analysis revealed convergent whole-brain rsFC in the R putamen, R PCC, R SMG, and R lingual gyrus among individuals with unipolar and bipolar depression. Our meta-analysis also revealed differential whole-brain rsFC between different default mode network nodes. We also found distinctly increased rsFC in subregions of the cerebellum in bipolar depression. Our meta-regression showed differential rsFC when factoring in symptom duration and test scores from symptomatological measures. All meta-analyses used Egger's test of random effects to determine the risk of publication bias across all studies in our review sample (all $p > .05$). Our results may suggest that unipolar and bipolar depression differ considerably with respect to rsFC, especially across the default mode network.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

A81 - Gradients of Time, Action and Memory in Frontal, Parietal and Temporal Cortices Supporting Cognitive Control

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Cognitive control describes a composite set of multifaceted processes that adaptively align intentional behaviors with internal goals and dynamic contexts. Cognitive control is supported by frontal and parietal areas, but how these areas contribute to cognitive control is poorly understood. Previously, we demonstrated that frontal and parietal areas are organized along a gradient wherein somatomotor proximal areas are sensitive to the present, while somatomotor distal areas are sensitive to the future (Nee, 2021, eLife). However, in that work, timescale (present/future) was confounded with focus (action/memory) as present-oriented control processes were also action-oriented, and future-oriented control processes were also memory-oriented. Here, we directly contrasted future/action-oriented processes (episodic control) with future/memory-oriented processes (temporal control), along with present/action-oriented processes (sensorimotor control). Gradients of control were observed in frontal, parietal, and previously undescribed lateral temporal cortices. Multidimensional scaling revealed that these areas could be explained by an abstraction gradient wherein areas at one end of the gradient were sensitive to action, regardless of timescale, while areas on the other end of the gradient were sensitive to the future regardless of focus. Interestingly, areas in the middle of the gradient conjunctively coded future action demonstrating non-linear, over-additive sensitivity to episodic control. We hypothesize that such conjunctive coding supports adaptive cognitive control that synthesizes processing at each end of the gradient to proactively prepare control for the future.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A82 - Temporal Dynamics of Parametric Task Switching

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Deficits in cognitive flexibility and task switching are found in a wide range of common mental disorders such as anxiety, depression, OCD, and ADHD (Park et al., 2017; Gu et al., 2008). Successful task switches require resolving the interference from the old task and/or reconfiguring the representation of the new task, both of which rely on how task representations are organized in the brain. Here we leverage the high temporal resolution of electroencephalography (EEG) and a parametric task switch paradigm (Bustos et al., 2023) to investigate the temporal dynamics of task reconfiguration to provide a metric of the geometry of task representations (i.e., how tasks are organized in relation to one another). We hypothesize that neural task presentations are organized based on their similarity. In the context of task switching, shifting between similar tasks will incur reduced task reconfiguration and task switch costs. To test this hypothesis, we acquired EEG data from 40 subjects. Preliminary results show increased correlation between task similarity using EEG measures and conceptual task similarity during the time course of task execution. Furthermore, we expect that the EEG measures capture the reconfiguration of task representation from the previous to the current task and that the reconfiguration is longer for task switch between more distinct tasks. These data will reveal the temporal dynamics of task switch within a given trial in a fine-grained manner.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A83 - Decoding Composition and Generalization of task representations in hierarchical task learning

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Humans have remarkable abilities to learn and perform many tasks in ever-changing life. This ability is in part supported by the hierarchical organization of task representations. For example, the task of making Latte is composed of two simpler tasks of making espresso and steaming milk. Compositions sharing the same simple tasks further facilitate generalization to new compositions. For instance, knowing latte = espresso + milk and hot chocolate = milk + chocolate syrup help form a new task to combine espresso and chocolate to make mocha. Using electroencephalographic (EEG) data (n = 40), we tested the hypothesis that learning a complex task relies on reinstating the simple tasks involved. In the training stage, participants learned six simple tasks (coded as A-F) and then complex tasks consisting of two simple tasks (e.g., AB, BC). In the test staged, subjects performed new complex tasks that can be generalized from learned complex tasks (e.g., AC from AB and BC). We successfully replicated the behavioral generalization effect. In the EEG data, reinstatement was operationalized as decoding encompassed simple tasks from a complex task (e.g., A from AC, termed composition effect) and decoding the unpresented shared simple task (e.g., B from AC, termed generalization effect). Composition effect manifested during the training stage of complex task, while generalization effect became evident during the test stage. This finding was further supported by two correlations: (1) between behavioral and EEG generalization effects and (2) between EEG composition effect in training stage and EEG generalization effect in test stage.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A84 - Multi-level dynamics of task representation during learning

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While humans can rapidly learn new tasks, the underlying task representation is less known. We hypothesize that a task can be represented at different levels that may change with learning. For instance, cooking can be represented as a holistic event (event level), as an array of independent subtasks (subtask level), or as subtasks

organized with meaningful orders (order level). We designed a delayed matching paradigm. On each trial, participants needed to memorize a five-feature stimulus and choose matching options of a cued feature after a delay. Five trials form a sequence, each having a fixed order of cued features. A good sequential memory can predict the feature to be cued and reduce memory load. We tested the prediction that learning intensity influences the representational level by training participants with one/three/eight sequences within three sessions of equal length. Behavioral analysis (n = 10) examined whether reaction time (RT) was influenced by the experience of learned sequence and orders as well as memory loads, each reflecting a representation level. Results showed an increase in order-level RT modulation during the first session, followed by a rapid decrease in the second session, persisting until the third session. The subtask-level modulation effect showed an opposite trend. EEG data revealed above-chance decoding of cued features before cue was presented, and the decoding accuracy showed a decreasing trend with time, potentially suggesting a decrease in event-level representation and an increase in subtask-level representation. In summary, our findings underscore the dynamic changes in task representation during learning.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A85 - Intracranial dynamics of Reward Positivity associated with Impulsive Choice

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Reward positivity (RewP) is an event-related potential (ERP) component occurring around 250ms after a rewarded outcome. RewP amplitude is dependent on reward outcome feedback, including the expected value of reward and prediction error related to the reward outcome. RewP amplitude has been shown to vary based on impulsivity level, with greater reward sensitivity in more impulsive (MI) individuals. However, the interactions between RewP and impulsivity have not been disentangled utilizing spatially precise intracranial recordings. We used the Balloon Analog Risk Task to assess ERP, frequency dynamics, and neural encoding associated with intracranial RewP (200-400ms), recorded from 49 drug-resistant epilepsy patients. Using the Kullback-Leibler divergence between active and passive balloon inflation times as a measure of impulsive choice, we clustered subjects into more- or less-impulsive choosers, to further scrutinize potential group-level differences between RewP characteristics in specific brain regions. We saw increased delta activity and decreased theta activity encoding for MI choosers for rewarded vs unrewarded trials compared to LI choosers (Delta, MI: 237, LI: 213; $\chi2$ =6.72, p =0.009; Theta, MI: 138, LI: 115; $\chi2$ =6.35, p =0.012). For MI choosers, Delta-band activity was uniquely encoded in middle frontal gyrus (MFG) (17%), while theta-band activity was uniquely encoded in Anterior Cingulate Cortex (9%) and MFG (22%). We extend previous win-related delta and loss-related theta frequency findings differentiating between impulsivity groups and highlighting unique RewP encoding in the brain for MI individuals. Future work will scrutinize the neural underpinnings of reward and examine RewP relative to temporal difference modeling.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A86 - Task Preparation is Reflected in Neural State Space Dynamics

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We can flexibly reconfigure our neural information processing to accommodate a wide array of different tasks. These task switches are increasingly being modeled as dynamical transition between task representations, however the empirical evidence informing these theories is controversial or incomplete. Here, we explore how the putative cognitive dynamics during task switching are reproduced in whole-brain neural dynamics. To study whole-brain neural dynamics, we re-analyzed a recent EEG experiment on task-switching by Hall-McMaster and colleagues (2019). Before each trial, human participants were cued to whether they would need to respond to the color versus the shape of a compound stimulus (50% switch rate). Borrowing emerging methods from systems neuroscience, we fit 'latent state space' models to whole-brain EEG activity during this pre-trial epoch. These models infer the linear recurrent neural dynamics and task encoding that gives rise to multivariate timeseries of electrode voltages. Fitting this model to trial-level EEG (N=30), we found that our approach was highly accurate at predicting EEG activity on single held-out trials. Moreover, our state space models extended traditional multivariate encoding analyses by revealing rich interactions between task encoding and system recurrence. Standard 'controllability' analyses revealed that the spread of task information throughout the brain was elevated in conditions that placed demands on cognitive control (e.g., switch trials). This experiment provides preliminary support for the dynamical systems approach to modeling task reconfiguration. Moreover, it provides a new empirical basis for developing richer process models of how our brains support cognitive flexibility.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A87 - Understanding dietary regulatory success as weight status-dependent changes in large-scale cortical organization.

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Individuals differ in their ability to regulate their diets. Why? Our study tested the notion that flexible, goal-consistent dietary choices result from adopting – and shifting – large-scale cortical brain states in a multi-dimensional space of principal dimensions of brain variation (gradients). These gradients were originally determined from the decomposition of resting state data from the Human Connectome Project and suggested to constitute a core organizing axis of the brain. We tested if shifts in brain states along established large-scale cortical gradients predict short-term regulatory success in an established fMRI food choice task (N=123). We also examined how weight status moderates this link (captured in individuals' body mass index, BMI). Participants made choices under a non-constrains (NC) and health-focused condition (HC) in the food task. We projected task-evoked brain states measured under both choice conditions in a three-dimensional space of established gradients of large-scale cortical organization. Shifts in task-based brain states between natural and regulatory food choices (NC and HC) predict variance in people's dietary regulated behavior (r2=0.328, p=0.015). Results also revealed a significant interaction effect between the magnitude of these neural shifts in the gradient space and BMI (β=3.12, p=0.016). Leaner participants showed smaller shifts to achieve regulatory success, suggesting that their natural and regulatory dietary brain states are more similar. We show that variance in dietary success across people can be understood as changes along neurocognitive functional hierarchies. Our results indicate how dietary control might emerge from the cortex through varying similarities along established macroscale patterns of organization.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A88 - Prefrontal Cortex and Hippocampus Jointly Guide Flexible Working Memory

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A crucial role of working memory (WM) is the flexible manipulation of memories to guide behavior. Extensive research links WM to the prefrontal cortex (PFC), and more recently intracranial recordings in humans have also suggested a role for the hippocampus. Their roles in the flexible manipulation of WM are unclear. We explored this question by recording intracranial electroencephalography from the hippocampus and PFC of epileptic patients. Participants performed a match-to-sample task that required holding two visual stimuli in WM. On each trial, one of the stimuli was cued as the target. On consecutive trials, participants were cued to either the same (repeat trial) or the other stimulus (switch trial), requiring rapid reprioritization of the uncued memory. On switch vs. repeat trials, accuracy was lower for mismatch trials whose probe matched the cued stimulus in the previous trial. Match vs. mismatch conditions could be decoded from high-frequency (70-150 Hz) neural activity in both the PFC and the hippocampus. Our findings are consistent with hippocampal involvement in WM for adaptive memory-guided behavior. PFC dynamics during WM-guided decision-making may therefore hinge on accurate memory reinstatement in the hippocampus.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A89 - Sustained neural mechanisms of proactive control in a novel task-switching color-word Stroop fMRI paradigm

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The color-word Stroop task is one of the most widely studied paradigms for investigating cognitive control, yet the neural mechanisms that enable individuals to meet the control demands of incongruent trials are still poorly understood. We have utilized the Dual Mechanisms of Control (DMC) theoretical framework to suggest that Stroop interference can be flexibly regulated by either proactive or reactive control mechanisms. In prior work, we found evidence of reactive control in terms of a consistent reduction in event-related activity among 35 parcels within the fronto-parietal and cingulo-opercular networks. Here, we utilize a novel vocal response fMRI design which intermixes Stroop color naming and word reading blocks and manipulates proportion congruency across scanning runs, while holding diagnostic stimuli constant, to orthogonally vary proactive and reactive control. In preliminary results from our on-going study (current N=20), we replicate prior findings that Stroop interference is stronger in color naming than word reading, and that list-wise proportion congruent blocks impact proactive control behavioral indices, while item-specific proportion congruent blocks impact reactive control indices. In the same set of 35 prespecified fronto-parietal and cingulo-opercular parcels, clear event-related incongruency effects are observed, but do not differentiate between color naming and word reading or proactive and reactive control. In contrast, sustained activity in these regions is significantly and selectively increased during proactive color naming blocks. These results support prior hypotheses associating proactive control with sustained activation, while suggesting that such effects may be more prominent when the color naming task-set is salient (i.e., task-switching conditions).

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A90 - Interactive ocular motor set-shifting task evoked distinct electrophysiological markers for stages of cognitive flexibility

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Detecting changes in the environment and adjusting subsequent actions are important steps of cognitive flexibility. Set-shifting tasks, for example the Wisconsin Card Sort Task (WCST), provide behavioral quantification for these functions, but their complex task demands: counting, color or shape differentiation, button presses, etc. invoke confounding brain activities in neuroimaging studies. Ocular motor potentials are well-known and routinely removed from electroencephalography (EEG) data as artifacts; this property, when leveraged in paradigm design, may allow better neural marker isolation through eliminating task-related confounds. In the present EEG study, 26 healthy young adults (16 females) completed a novel ocular motor paradigm which switched between prosaccade, inhibition (maintain fixation), and antisaccade response sets. Each set lasted 5-8 trials, and 48 set switches were administered, totaling 332 trials. A screen-based eye tracker assessed subjects' gaze locations in real time, and post-trial feedback was provided ("correct" or "incorrect") based on the ongoing set and the subject's chosen gaze location. All-sensor event-related potentials (ERPs) time-locked to feedback onset revealed stronger, left-lateralized feedback-related negativity (FRN) and parietal P3 specific to switch trials, reflecting subjects' registration of context change. Stronger beta power was observed in the left frontal region 200-400ms after negative feedback onset, similar to recent findings on reward processing. Lateralized frontal late positive potential (LPP) was only found after switch trial feedback. It might correspond to behavioral adjustment planning for the subsequent trial but requires further investigation. These results support ocular motor set-shifting as an effective paradigm to capture cognitive flexibility markers.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A91 - Selective attention to prior knowledge modulates default network activity in support of cognitive control

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The default network (DN) has traditionally been considered a task-negative large-scale functional network that decreases its activity during cognitively demanding tasks, such as those requiring working memory. Recent research, however, found increased DN activation when successful cognitive control benefited from access to long-term memory. Here, we investigated whether selective attention to prior knowledge modulates DN's contribution to cognitive control. In an fMRI study, 31 healthy young adults engaged in an N-back task involving working memory for famous (linked to prior knowledge), and anonymous, faces/places. Participants were instructed to focus exclusively on famous stimuli in certain task blocks and on anonymous stimuli in others. Consequently, famous stimuli were task-relevant in the former blocks and task-irrelevant in the latter. At the whole-brain level, multivariate partial least squares analyses revealed greater activation of DN and control regions in response to task-relevant (compared to task-irrelevant) stimuli, regardless of stimulus fame. However, multivoxel pattern analyses showed that local DN activation patterns distinguished between both task-relevant and irrelevant stimuli, and between famous and anonymous stimuli. Cross-decoding analyses showed that the activity patterns distinguishing the fame of task-relevant stimuli differed from those distinguishing the fame of task-irrelevant stimuli, suggesting inter-dependence between representations of fame and task goal information within DN regions. These results demonstrate that DN activity is shaped by the interplay between prior knowledge and top-down attentional constraints. They support DN's active involvement in orchestrating both long-term memory access and task goal representation, challenging its traditional task-negative characterization and endorsing its pivotal contribution to executive control.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A92 - The Influence of Task Demands and Object Feature Dimensions on Saccade Target Selection.

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Previous work has shown that similarity between a target and distractor in a delayed match-to-sample (DMtS) task can influence the curvature of the saccade (Giuricich et al, 2023; Kehoe & Fallah, 2023; Kehoe, Lewis & Fallah, 2021). Unresolved competition between target and distractor items produces saccade trajectories which curve towards the distractor, while resolved competition produces inhibition of the same distractor resulting in curvature away. Varying target-distractor similarity produces object-based effects on saccade metrics during the discrimination phase of competition, but no non-spatial influence once competition has been resolved. However, past research used stimuli which was sparce in object feature dimensions. By increasing the complexity and relevance of non-spatial visual characteristics required to resolve target-distractor competition, we explored the influence of feature versus bound object representations on saccades. Modifying the DMtS task to incorporate Wisconsin Card Sorting Task requirements, participants generated saccades to a target stimulus which matched on one object feature dimension (colour, shape or numerosity) with the probe. Distractors items varied on non-relevant object dimensions with the target item. If distractor suppression is not object-based, varying the number of features that are shared between the target and distractor should have no influence on saccade trajectories. However, we find evidence of feature-based influences, suggesting that competition in the oculomotor system is driven by non-spatial object representations. This work has implications for understanding the priority maps underlying target selection in a motor system under dynamic task and visual feature conditions.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A93 - Decoding congruency effects: Insights from reach actions and electroencephalography (EEG)

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Behavioral performance in congruency tasks has provided important insights into the mechanisms of cognitive control. The present work aims to shed light on the neural basis of these mechanisms by evaluating the neural dynamics underlying reach actions in an Eriksen flanker task. Specifically, we collected electroencephalography (EEG) data while healthy adult participants reached to specific locations depending on the direction of an arrow embedded within a field of congruent or incongruent distractors. Then, we employed EEG pattern analysis to decode specific stimulus and response properties: current stimulus congruency (i.e., whether the target was congruent or not with the distractors), the congruency of the preceding trial and response type (i.e., whether participants responded with the same or different action relative to the previous trial). Overall, all properties could be decoded above chance, though current congruency was more robustly decoded that the other two. Importantly, combinations of properties could also be decoded reliably (e.g., current congruency when preceded by a congruent or by an incongruent trial). Further, the temporal profile of decoding was investigated across

stimulus-locked patterns, with current congruency spanning an extensive interval of above-chance decoding between roughly 200ms to 750ms and peaking around 300ms after stimulus onset. This analysis was complemented by decoding of initiation-locked EEG patterns, which yielded convergent results. In summary, the current work characterizes the neural dynamics of cognitive control and paves the way for elucidating its relationship with behavioral performance.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A94 - The neural dynamics of sequence-specific behavior in obsessive-compulsive disorder

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Humans naturally organize tasks into sequences, where a rule dictates the sequential structure rather than individual task identity (e.g., in the sequence of making a cup of coffee, beans could be swapped for grounds). Differences in such abstract sequence processing could in part underlie behavior in obsessive-compulsive disorder (OCD), such as repeating tasks and sequential rituals, and lead to delays in completing everyday tasks. We tested the hypothesis that OCD symptoms result from differential abstract sequence representation. Previously, we established that increasing activation ('ramping') in the rostrolateral (RLPFC), but not rostromedial, prefrontal cortex was necessary for abstract sequence performance in healthy controls (HCs) (Desrochers et al., 2015; 2019). Using the same abstract sequence task during fMRI in patients with OCD, we observed unique ramping activity in medial PFC that did not occur in HCs. These neural differences were present despite minimal behavioral differences (Doyle et al., 2023). Ramping did not differ between the groups in the RLPFC. However, in the OCD group, RLPFC ramping did correlate positively with obsessive-compulsive severity ($r = 0.43$, $p = 0.037$) and medial PFC ramping correlated negatively with feelings of incompleteness ($r = -0.42$, $p = 0.041$), suggesting differential roles for these regions in mediating OCD symptomatology. Together, these findings suggest a novel and dynamic involvement of medial PFC and RLPFC in the performance of abstract task sequences in patients with OCD. These could inform potential treatments for OCD in the future to aid disruptions in daily life due to sequencing errors.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A95 - Distinct prefrontal area contributions to rule-guided decision-making in primates: mechanistic insights from multi-area e-phys. and neurostimulation.

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Lesion studies have previously shown that different prefrontal cortex (PFC) areas contribute in distinctly different ways to rule-guided behaviour in the context of a Wisconsin Card Sorting Test (WCST) analog for macaques. Yet we do not understand how these functional specializations relate to intrinsic neuronal activities nor the extent to which these neuronal activities differ between different prefrontal regions. Here we present new data from our studies using multi-area multi-electrode recording techniques in NHPs. 'Utah arrays' were chronically implanted in dorsolateral PFC, ventrolateral PFC, orbitofrontal cortex, and frontopolar cortex (FPC) of two macaques, allowing us to simultaneously record single and multiunit activity, and local field potential (LFP), from all regions while the monkey performs the WCST analog. Rule-related neuronal activity was widespread in all areas recorded but it differed in degree and in timing (task-epoch) between different areas. Decoding analyses and inter-area coherence measures applied to rule-related neuronal activities confirmed dynamic task-epoch related activities and inter-area interactions that differ between prefrontal regions. Moreover, after observing modulation of LFPs within beta and gamma bands in FPC tracked reward and unchosen rule value, we used single-trial-specific causal interventions in that frequency range (electrical microstimulation via arrays) to FPC to significantly enhance and impair animals' WCST performance in WCST functionally relevant ways. All results are therefore consistent with an emerging picture of regional functional specialization within a distributed network of interacting and interconnected PFC regions, about which the combination of electrophysiology and neurostimulation provides mechanistic insights.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A96 - CLOCKΔ19 mouse model elucidates cognitive deficits in bipolar disorder

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Bipolar disorder (BD) is a neuropsychiatric disorder characterized by rapid mood cycling, fluctuations in energy, mania, and depressive episodes. The accompanying cognitive deficits of BD, however, are most predictive of patient psychosocial outcomes. Deficits in recognition memory and cognitive flexibility are two understudied symptoms that could potentially help refine BD endophenotypes. The CLOCKΔ19 transgenic mouse model has good construct, face, and predictive validity for BD and, notably, exhibits regular mood cycling between manic and euthymic behavior over 24 hours. The current study seeks to characterize various cognitive domains in CLOCKΔ19 mice. We compare the performance of 6 experimental groups (n=6 per group) on several tasks, with sex (male, female) and genotype (wildtype [+/+], homozygous [-/-], heterozygous [+/-]) as independent variables. The cognitive battery includes an open field maze (OFM), novel object recognition (NOR), novel object location (NOL), and attentional set-shifting tasks (AST). Preliminary data from OFM, NOR, and NOL show trends toward impairments similar to those observed in the human population. For example, a significant main effect of genotype was found in NOL. In AST, we have yet to discern any clear behavioral patterns with our limited sample size, although this is not surprising considering the complexity of the task. In upcoming experiments, we will also be testing these cognitive domains longitudinally to assess disease progression. These results will help elucidate the role of the clock gene in cognition and serve to further validate the model for translational studies of cognition in BD.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A97 - Intracranial EEG Correlates of Concurrent Demands on Cognitive Stability and Flexibility

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Two core capacities of cognitive control are conflict-control, the ability to focus attention on task-relevant stimuli while ignoring distracters (cognitive stability); and task-switching, the ability to shift between different rule-sets to guide behavior (cognitive flexibility). Whether they arise from distinct or overlapping neural mechanisms remains unclear as prior studies investigated these capacities in isolation and used only macroscale neural data (fMRI, scalp EEG). Here, we obtained mesoscale neural data (iEEG) from 8 epilepsy patients while they completed a local/global Navon letter task. The task independently varied demands on conflict-control (congruent vs. incongruent stimuli) and task-switching (repeating vs. switching tasks between trials), allowing us to analyze neural activity associated with congruency, task switching, and their interaction. Patients demonstrated robust behavioral congruency effects and switch costs. Prior work suggests the lateral prefrontal cortex (LPFC) is a primary neural substrate for cognitive stability and flexibility. We examined high-gamma activity within individual LPFC electrodes (N=71), focusing on the electrodes that had significant task-related activity (N=22, 31%). Most of these task-sensitive electrodes were sensitive to at least one effect of interest (N=15, 68%), mostly emerging ~500ms post-stimulus-onset. About half of these effect-sensitive electrodes displayed exclusive effects of congruency or task switching (N=8, 53%), while the others exhibited additive or interactive effects (N=7, 47%). We are currently probing the mechanisms that produce this partial overlap by analyzing adaptation in cognitive stability and flexibility to changing congruent/switch proportions. These results suggest concurrent demands on conflict-control and task-switching have both distinct and overlapping mesoscale neural substrates in LPFC.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A98 - Both stimulus-control state associations and stimulus-response associations contribute to item-specific proportion congruency effect

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Cognitive control coordinates our thoughts and actions with internal goals. The cognitive control system is adaptive when conflict conditions change. Item-specific proportion congruent (ISPC) effect is a classic phenomenon of the adaptative conflict effect. It means when participants unconsciously experience 50% congruent condition and 50%

incongruent condition overall while mostly congruent (MC) condition for one set of stimuli and mostly incongruent (MI) condition for another set of stimuli, the conflict effect (i.e., performance in incongruent condition compared to congruent condition) in the MI condition decreases compared with that in the MC condition. Many studies have been done to explore the mechanisms of the ISPC effect. ISPC effect is believed to be triggered by the learning of the stimulus-control state (SC) associations and/or contingency learning of the stimulus-response (SR) associations. The current consensus is that SC and SR associations learning will dominate the ISPC effect under different situations. However, it is currently unknown whether the learning of both SC and SR simultaneously contribute to the ISPC effect. We try to address this question by decoding the SC and SR associations from Electroencephalogram (EEG) data in a 4-key Stroop task with ISPC manipulations (n = 12). The behavioral results repeated the classic ISPC effect. Preliminary EEG results showed both SC and SR associations can be decoded early following stimulus onset. Therefore, our study provides initial evidence for concurrent contributions of SC and SR learning in cognitive control.

Topic Area: EXECUTIVE PROCESSES: Goal maintenance & switching

A99 - Investigating the congruency sequence effect: A behavior meta-analysis and an fMRI study

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The congruency sequence effect (CSE) refers to a smaller congruency effect after incongruent trials compared to congruent trials in the conflict task. The CSE reflects the dynamics of cognitive control in a transient manner. An ongoing debate between top-down vs. bottom-up has existed about the underlying mechanisms of CSE. By conducting meta-analysis of all relevant CSE literature in the past (from 1992 to 2023), the current study suggested that 1) CSE is larger for studies that included bottom-up confounds, 2) CSE is still robust and significant for confound-minimized studies, 3) CSE is larger within a task than between tasks, which supports task-specific control, 4) the advantage of using the prime-probe task in CSE studies. In addition, we conducted an fMRI study, employed the confound-minimized prime-probe task, to examine the neural correlates of the CSE. The results showed robust brain activation in the conflict-related regions for the congruency effect but less distinct activation for the control-related regions for the CSE. Together, the present study provides converging evidence from the past CSE studies and highlights for future research.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A100 - Motor inhibition and switching in variant stop signal tasks

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Motor switching involves interruption of a prepotent but inappropriate response and execution of the desired response. Previous research studying motor inhibition and switching used paradigms with high working memory demand, in which subjects learned to associate responses with different stopping/switching cues in a same session. To reduce working memory and goal maintenance, in the current experiment subjects completed the stop signal task (SST) and the stop signal response task (SSTr) in an fMRI scanner, with the order counter-balanced across subjects, on two separate days. In the SST, subjects were required to press a button quickly to a frequent “go” stimulus but withhold the response when the go was followed by a “stop” stimulus, which appeared in 1/3 of all trials. A non-responded stop trial was a stop success (SS) while a responded stop trial was a stop error (SE). In the SSTr, subjects were instructed to press their right index finger to the “go”, but to press their middle finger (without pressing their index finger) if the go was followed by the “stop” stimulus. SS indicated pressing with middle finger while SE indicated pressing with index finger on the stop signal. Hence, the SS>Go Success (GS) contrast in the SST examined inhibitory control while SS>GS in the SSTr examined motor switching between fingers. SS>GS showed greater activations in the supplementary motor area (SMA), left precentral gyrus, and right cerebellum in the SSTr than in SST. These results suggest the role of the SMA in updating motor plans to switch actions.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A101 - Out-of-phase transcranial alternating current stimulation modulates prestimulus EEG theta and alpha power

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Transcranial alternating current stimulation (tACS) is a non-invasive neuromodulation technique used to enhance human cognitive function. This study aimed to investigate the effects of individualized-theta tACS delivered in-phase and out-of-phase between the left dorsolateral prefrontal cortex (lDLPFC) and dorsal anterior cingulate cortex (dACC) during inhibitory control performance. Twenty-four healthy participants were recruited for this study. The participants engaged in a Stroop task with the treatment of phase-lagged theta tACS over individually optimized high-density electrode montages targeting the lDLPFC and dACC. The tACS was exposed for 9 minutes per session: one for the in-phase (0 degree) and the other for the out-of-phase (180 degree) between the lDLPFC and dACC. We compared the reaction times and the prestimulus EEG theta and alpha power between the in-phase and out-of-phase conditions. The out-of-phase stimulation during the incongruent condition resulted in significantly reduced reaction times and enhanced prestimulus fronto-central theta and alpha activity. These findings imply that out-of-phase theta tACS potently modulates top-down preparatory inhibition, supporting the feasibility of employing phase-lagged tACS to enhance inhibitory control performance.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A102 - Physical Activity on Impulsivity Control in Pediatric ADHD

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Attention Deficit Hyperactivity Disorder (ADHD), a neurodevelopmental disorder characterized by inattention, hyperactivity, and impulsivity, significantly affects daily functioning (American Psychological Association, 2013). While intervention research suggest that physical exercise may reduce symptoms and improve cognitive performance in children with ADHD, much is still unknown regarding the relationship of daily physical activity behavior with impulsivity control, a core cognitive underpinning of ADHD (Etnier et al., 1997). Using the Adolescent Brain Cognitive Development study baseline data, a multiple linear regression analysis was conducted exploring the relationship between self-reported physical activity, ADHD diagnosis, and Stop- Signal performance. We hypothesized that ADHD diagnosis will be associated with worse Stop- signal performance, and that increased weekly physical activity will be associated with enhanced Stop-Signal response accuracy. During the Stop-Signal task, participants aged 9 to 10 were assessed on their ability to withhold responses to "Stop" stimulus following a "Go" stimulus. ADHD diagnosis was confirmed through the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS) computerized parent report, while weekly physical activity was assessed using the Sports Activities Involvement Questionnaire. After excluding participants with comorbidities and non-stimulant neuropsychiatric medications, the analysis included 434 participants with ADHD and 3,966 typically developing children. As expected, ADHD diagnosis was associated with decreased Stop-signal accuracy. Notably, increased weekly physical activity predicted better Stop-signal accuracy. Findings of the current analysis suggest the potential of physical activity to fortify impulsivity control in ADHD.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A103 - Modeling of control over task-switching and cross-task interference supports a two-dimensional model of cognitive stability and flexibility

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Reading a book in a busy coffee shop requires the ability to focus on the task at hand while ignoring task-irrelevant distractions, referred to as cognitive stability. Setting aside the book to answer a phone call requires the ability to switch tasks, referred to as cognitive flexibility. Theories of cognitive control have conceptualized stability and flexibility as opposing ends of a one-dimensional stability-flexibility continuum, necessitating a “stability-flexibility trade-off”: increasing stability (prioritizing task focus) reciprocally reduces flexibility (a readiness to switch task sets), and vice versa. Recent evidence, however, has supported a two-dimensional stability-flexibility relationship, whereby stability and flexibility can both be maintained at high levels simultaneously when necessary. Here, we adjudicate between the one- and two-dimensional accounts by fitting competing models to behavioral data from a cued task switch experiment that manipulated the proportion of task switch trials (driving contextual adjustments in

flexibility) and cross-task congruency effects (driving contextual adjustments in stability). The two-dimensional stability-flexibility model had a superior model fit, and it was also the only model capable of reproducing key behavioral phenomena in the original data set. We next considered the contribution of various drift diffusion model parameters, including drift rate, boundary separation, and non-decision time, to switch costs and congruency effects, and show that we can dissociate flexibility and stability-related components in the evidence accumulation process. Finally, we replicate the superior fit of the two-dimensional stability-flexibility model in additional samples, demonstrating the robustness of our results across data sets.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A104 - The effect of surprise on cognitive flexibility and motor control: an EEG study

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Inhibitory control is a pivotal cognitive function necessary to flexibly adapt one's behavior to an ever-changing environment (Yu et al., 2023). Under conditions requiring quick decisions, such as piloting an aircraft, failures in inhibitory control, and cognitive flexibility at large, can result in slowed responses and/or errors. Unexpected rare events are known to capture attention (e.g. Horstmann, 2002) and generate surprise, which can lead to global action inhibition (Wessel & Aron, 2013, 2017). Moreover, surprising events influence the electrophysiological brain's response (Mousavi et al., 2020, 2022) and differently so, depending on their probability of appearance (Gomez et al., 2019). However, little is known about how the relative frequency of task-(ir)relevant events affects decision making and motor control. In this EEG study, 16 participants performed a modified version of the Task Switching paradigm, while oculomotor, behavioural and EEG data were collected. Behavioural results show that rare task-irrelevant stimuli affect performance differently, depending on whether task instructions forced participants to pay attention to them or not. Reaction times are affected by cognitive flexibility, enhanced on task switch trials, and, interestingly, by its interaction with motor control, necessary when a different hand was required, compared to the previous trial, to execute the response (effector switch). Finally a 3-way interaction between cognitive flexibility (trial type), surprise (task-irrelevant stimulus frequency) and motor control (effector switch) suggests that surprise negatively affects decision making performance, especially when a conflict arises between cognitive and motor control. Oculomotor and EEG results will be discussed.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A105 - The influence of incentives on performance generalizes across cognitive control tasks

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To understand how people vary in their range of cognitive control engagement, researchers often measure differences between performance on trials that are more versus less control-demanding (e.g., congruency effects). However, recent work shows that congruency effects for a given participant are poorly correlated across tasks, calling into question the utility of these tasks for indexing variability in control engagement. We sought to test whether these validity concerns may center on congruency effects (which also index stimulus-driven effects) rather than the tasks themselves. We predicted that the motivational impact of incentives on performance (which indexes top-down control allocation) would better generalize across tasks. We had 80 participants complete two tasks: a color-word Stroop task and a random dot motion variant of a Simon task. Both tasks varied response congruency (incongruent vs. congruent), the reward per correct response, and the penalty per error ($0.01 or $0.10). Consistent with past work, responses in both tasks were slower and less accurate for incongruent trials; faster for larger rewards; and slower and more accurate for larger penalties (ps < .001). Controlling for overall performance, congruency effects were weakly correlated across tasks (accuracy: robust regression B=0.20, p=.03, RT: p =.84). Incentive effects, however, demonstrated stronger cross-task correlations, especially in the case of reward-related speeding (B = 0.39, p=.001) and penalty-related slowing (B=0.27, p=.004). Together, the generalized incentive effects suggest that motivational factors hold promise as a more stable index of individual differences in control engagement across contexts.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A106 - Alcohol Sensitivity, Approach Bias, and Inhibitory Control in Young Adult Binge Drinkers

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Binge drinking is a prevalent alcohol consumption pattern in young adults and may portend future health consequences. This risky health behavior has been framed within dual-process theories of addiction, positing that individuals characterized by heightened incentive salience to alcohol cues coupled with weak regulatory control may be at particular risk for alcohol-related consequences. The aim of this study was to examine alcohol sensitivity, inhibitory control, and approach bias in a sample of young adults who endorse binge drinking. Eighty-two young adults (57 females; Mage=20.7 years) recruited as part of a larger study completed two alcohol-cued tasks (Oddball and Go/No-Go) while electroencephalography was recorded. The no-go N2 and context updating P3 event-related potential (ERP) components were isolated to assess inhibitory control and approach bias, respectively. Regardless of sensitivity, no-go N2 was more negative to alcohol relative to non-alcohol cued trials (g=.18) while context updating P3 to target alcohol images was larger in neutral relative to positive and negative contexts (ηp2=.11, p<.05). Additionally, context updating P3 was blunted in low relative to high sensitivity groups, particularly within neutral contexts (g=.35). Findings suggest that alcohol cues elicit marked inhibitory control conflict and approach bias in young adult binge drinkers, and those of low sensitivity exhibit sensitized reactivity in the context of salient alcohol cues.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A107 - The Connection Between Cravings and Food-Related Inhibitory Control: Observations from an Event-Related Potential (ERP) Study

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Individuals who experience high cravings are likely to engage in overeating. Addiction literature demonstrates that craving level may mediate the relationship between impulsivity and substance consumption. However, it's unclear in the food literature if higher cravings coincide with lower levels of food-related inhibitory control. We utilized event-related potentials (ERPs) to test if people with high cravings show lower levels of food-related inhibition, as measured by ERPs. N2 and P3 ERPs were used to observe levels of inhibitory control, whose amplitudes get larger (i.e., more negative or positive, respectively) for higher levels of inhibitory control. 147 participants (Mage: 26.37; SDage: 9.79; 53.7% female) completed two food go/no-go tasks, one where responses were withheld to images of high-calorie foods, and one where responses were withheld to images of low-calorie foods, while EEG data were recorded. Participants also completed the Food Cravings Questionnaire (FCQ) State Scale, a 39-item measure of frequency and intensity of food cravings. Results indicated a negative correlation of r= -.186 (p=.024) between the N2 difference amplitude during the high-calorie task and the FCQ. Relationships between the N2 difference amplitude during the low-calorie task and the FCQ, and the P3 difference amplitude during the high and low-calorie tasks and the FCQ were non-significant (ps>.15). Results indicate individuals with higher cravings exhibit heightened food-related inhibition towards high-calorie foods, exemplified by the larger N2 amplitude and higher FCQ score. Ultimately, individuals with higher cravings may need greater food-related inhibitory control to decline high-calorie foods.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A108 - Anxiety and Depression Affect Frontal Theta Power in Response to Threatening Stimuli

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Frontal midline theta (FMT) oscillations (4-8Hz) play a key role in cognitive control and emotional processing through signaling adaptive changes in behavior in response to error or uncertainty. Anxious and depressed individuals tend to display suboptimal cognitive control, particularly in the face of threatening stimuli due to these individuals allocating more attentional resources towards threatening stimuli. This attentional threat bias comes at the cost of attending to the task at hand, resulting in poorer performance. However, the role of FMT in attentional threat bias and how it might be impacted by anxiety and depression, is yet unstudied. To clarify the impact of threatening stimuli on attention for trait anxious and depressed individuals, we recorded neural oscillatory data using a 32-channel EEG net while participants completed an emotional go/no-go task with happy, neutral, and fearful faces. We found that fearful faces produced lower accuracy and reaction times across all participants. High anxiety and high depression participants showed a trend where fear no-go trials had greater FMT compared to happy or neutral no-go trials. However, this FMT power was correlated with worse performance, indicated by lower accuracy and higher reaction time – a pattern not present for happy or neutral stimuli, nor for low anxiety or low depression participants. Rather, low depression participants showed more central theta during fear no-go trials, which correlated with better performance. Our data suggest that anxiety and depression alter the adaptive role of FMT in cognitive control tasks when faced with threatening stimuli.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A109 - Task-Related Interference in Older Adults: Behavioural and Electrophysiological Correlates of On- and Off-Task Thoughts

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Mind wandering is typically characterized as a failure of attentional control, yet despite age-related executive function deficits, older adults typically report less mind wandering than younger adults during cognitive tasks and in daily life. Self-reported mind wandering episodes usually result in similar behavioural detriments in younger and older adults (e.g., greater reaction time variability, more task errors). However, the relatively few studies investigating the neural correlates of mind wandering and aging have revealed mixed findings, possibly because they typically rely on infrequent thought probes and therefore, few trials for neural analyses. In the current study, we propose a method to recover more task data by categorizing trials from a commonly used sustained attention to response task (SART) according to reaction time variability. Behavioural data (n=49 younger; n=40 older) revealed that compared to younger adults, older adults reported fewer mind wandering episodes, but showed similar behavioural impacts thereof. Further, in both age groups, subjective reports of mind wandering predicted the more objective sorting of trials into "on-" and "off-task" according to reaction time variability. Using these objectively sorted trials, we investigated two commonly reported EEG measures of mind wandering (diminished P1 and P3 amplitude) in 26 younger and 24 older adults and found that while neither group showed the expected P1 effect, the P3 was diminished in both age groups (albeit significantly less in older adults). Therefore, despite differences in the frequency and type of mind wandering in older adults, its behavioural and neural impacts appear to be similar.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A110 - Title: Youth with Elevated ADHD or Lower Inhibitory Control are at Increased Risk Following TBI in Early Adolescence

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Background: Traumatic Brain Injuries (TBIs) have been associated with ADHD, but specific symptoms remain understudied. Inhibitory control, critical in early adolescence, shows impairment in ADHD. This study aims to explore the impact of TBIs on neurocognitive abilities, focusing on ADHD symptoms and inhibitory control. Methods: Data from the Adolescent Brain and Cognitive Development (ABCD) study were utilized. Caregivers reported youth TBI history, ADHD symptoms, internalizing symptoms, and demographics at baseline (ages 9-10) and a 2-year follow-up. Mixed models, considering family structure and study site, analyzed relationships between youth TBI history, ADHD symptoms, and neurocognition at baseline (N=11,518). Additional models assessed the impact of new TBIs, baseline ADHD symptoms, baseline inhibitory control, and their interaction on longitudinal changes in ADHD symptoms (N=7,862). Results: TBI prior to baseline correlated with increased ADHD symptom severity (B=1.51, p<0.001), but not inhibitory control (B=0.65, p=0.302). New TBIs predicted a rise in ADHD symptoms, notably in youth with higher pre-existing ADHD symptoms (B=0.13, p=0.034) and poorer baseline inhibitory control (B=-0.07, p=0.02). White matter tracts, measured by mean diffusivity in specific tracts, did not mediate these effects. Conclusion: ADHD symptom severity and inhibitory control emerge as unique risk factors for worsening post-TBI symptoms in early adolescence. Despite statistical significance, effects are small and necessitate replication. The ABCD study offers an opportunity for longitudinal exploration. Investigating neural mechanisms underlying these risk effects is crucial for a comprehensive understanding of post-TBI symptomatic changes, especially in inhibitory control across various metrics.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A111 - The ERN-Anxiety correlation: a closer examination with robust statistics

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The error-related negativity (ERN) and error positivity (Pe) are Event-Related Potentials (ERPs) associated with error monitoring. The ERN is characterized by a more negative amplitude following erroneous responses than correct responses, representing heightened error sensitivity. The Pe is more positive in amplitude for errors that an individual is aware of than unaware errors, reflecting conscious error processing. Prior work suggests a correlation between the error enhancement of the ERN and trait anxiety scores in clinical and non-clinical populations. In contrast, the correlation between Pe enhancement and anxiety is generally non-significant. However, previous studies have used classic analyses of ERPs that focus on pre-selected electrodes and time windows, inflating Type I and II error rates. The present study examined the ERN and Pe enhancement and their correlations with trait anxiety using robust mass-univariate (MU) statistics, which examines all time points at all electrodes while controlling for Type I and II errors. Eighty-two (82) neurotypical adults completed a classic flanker task. Response-locked ERPs were subjected to classic and MU analyses. In addition, we examined the effects of trial numbers, anxiety scale type, and depression severity. The classic and MU approach replicated the ERN and the Pe error enhancement. However, no association was found between the error enhancement and trait anxiety scores with either analysis for either ERP. These results question the reliability of the anxiety-ERN correlation and challenge the utility of the ERN as a vulnerability neuro-marker for anxiety.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A112 - Does screentime impact response inhibition in neurdiverse children?

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The aim of this study was to examine response inhibition using a gamified version of the Stroop task in a heterogeneous cohort of neurodiverse and neurotypical children, and to identify key risk and resilience factors (including screen time) associated with performance-based measures of cognition. A total of 229 participants ages 3-16 (89 neurotypical children [54% boys] 90 children with ADHD [51% boys], and 50 children with ASD [72% boys]) were recruited to the study. Using a validated online cognitive screener, participants completed the Stroop task. Parents completed questionnaires regarding children's screen time use (passive TV watching, social media, video games), sleep, daily/weekly physical activities, socializing, reading and extracurricular activities. Very few children in the study met national guidelines for screentime, regardless of their neurodiagnostic group (X2=3.71, p=0.16). Based on a multivariate model, performance on congruent and incongruent trials on the Stroop task were comparable between the groups, however autistic children were more likely to make more attempts on the tasks (F=4.35, p=0.014), indicative of reduced impulse control. In a subsequent model, examining screen time and other lifestyle factors in relation to performance on the Stroop task, increased video game use was a significant predictor of more attempts. An interaction analysis revealed that only autistic children who spent more time playing video games used more attempts on the Stroop task (B=0.095, p<0.001). Findings indicate that screen time use, particularly video games, may be a modifiable risk factor for impaired response inhibition processes in autistic children.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A113 - Improved anti-saccade performance in major depression following repetitive transcranial magnetic stimulation of the dorsolateral prefrontal cortex

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Repetitive transcranial magnetic stimulation (rTMS) of the dorsolateral prefrontal cortex (DLPFC) is an effective treatment for refractory major depressive disorder (MDD). However, the mechanisms by which mood symptoms improve with rTMS remain unclear. One possibility is that rTMS enhances cognitive control by modulating the central executive network. To test this hypothesis, we used a well-characterized eye-tracking task: the interleaved pro/anti-saccade task (IPAST). On pro-saccade trials, participants look at a peripheral stimulus, yielding a measure of processing speed. On anti-saccade trials, participants suppress the reflex to look at the stimulus and instead look away, yielding a measure of cognitive control. 29 patients with MDD (mean age=44.9 years, 48% female) completed the IPAST before and after 4 weeks of rTMS. 19 non-depressed control participants (mean age=38.9 years, 58% female) completed the task at corresponding time points. Mixed ANOVAs assessed between- and within-group differences in pro- and anti-saccade reaction time (SRT). Pro-saccade SRT did not differ between groups ($F(1,46)=0.20$, $p=0.66$) or over time ($F(1,46)=0.64$, $p=0.43$), nor was there a group-by-time interaction. However, anti-saccade SRT was significantly longer in individuals with MDD compared to controls ($F(1,46)=5.98$, $p=0.02$), and decreased significantly across participants over time ($F(1,46)=11.58$, $p=0.001$). The group-by-time interaction approached significance ($F(1,46)=2.36$, $p=0.13$), with ANTI SRT decreasing over time to a greater degree in individuals with MDD compared to controls. These findings suggest a selective improvement in cognitive control following rTMS of the DLPFC in patients with MDD. Future work will examine differences between patients who respond to rTMS versus those who do not.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A114 - Behavioural response and event-related potential for a novel 3D virtual reality-based Go/No-go (bWell): Validation with a classical 2D Go/No-go

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Introduction: Go/No-go, an experimental paradigm to study cognitive inhibition, is classically administered to participants as visual or audio stimuli in 2D and their behavioural responses and event-related potentials (ERPs) measured. Virtual reality (VR)-based cognitive exercises (in 3D) have the capability for sensory immersion with tight experimental control, and are useful for standardized cognitive assessments and interventions. We therefore set out to design and validate a novel 3D VR-based Go/No-go by comparing the behavioural responses and ERPs with a classical 2D Go/No-go. Methods: In this ongoing study, five participants were recruited (within-subject design) who completed a 2D and 3D Go/No-go task. 2D Go/No-go was performed in 'Presentation' software whereas 3D Go/No-go was completed in our VR-platform 'bWell', and electroencephalogram (EEG) signals were collected using an Enobio-8 channel EEG system, synchronously via Lab Streaming Layer (LSL). Results: Comparison of behavioural responses between 2D and 3D Go trials revealed a significant positive correlation for reaction time ($r = 0.94$, $p = 0.01$) and accuracy ($r = 0.88$, $p = 0.04$). For both 2D and 3D Go/No-go, we observed larger amplitude of P3 (300-600 ms) for No-go compared to Go. On comparing 2D vs 3D grand average ERPs, we observed that 2D has larger P3 for Go and No-go especially for frontal regions. Conclusion: Preliminary results from our ongoing study indicate that the behavioural responses and ERPs of our 3D VR-based Go/No-go correspond to those of 2D Go/No-go. Trials are currently ongoing to increase the sample size for statistical analysis.

Topic Area: EXECUTIVE PROCESSES: Monitoring & inhibitory control

A115 - Multimodal Imaging of Reward Processing in Major Depressive Disorder

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Anhedonia represents a deficit in reward processing in Major Depressive Disorder (MDD) that can manifest as diminished pleasure from reward and diminished motivation to seek reward, though these phenotypes are often conflated. In this study we use multimodal imaging to examine the neural correlates of the emotional, pleasure-related deficits of depressive anhedonia. Magnetoencephalography (MEG) and functional magnetic resonance imaging (fMRI) data were collected for 52 participants with MDD and 38 healthy controls. A principal components analysis (PCA) of depression and anxiety questionnaires was used to create composite symptom scores for each participant. Participants completed a probabilistic selection task during the MEG scan and a pseudorandomized doors task during the fMRI. PCA derived three symptom components, correlating with emotional and consummatory anhedonia, anxiety and diminished mood, and apathy/motivational deficits. Spatiotemporal permutation clustering tests of MEG source estimates found significant clusters in ventromedial prefrontal cortex (vmPFC), anterior midcingulate cortex, and bilateral insulae for reward activation greater than punishment. Of these three regions, only vmPFC showed significantly greater activation for healthy controls, compared to MDD individuals. Correlation of this region with composite anhedonia scores showed a significant positive correlation between anhedonia and vmPFC activation within MDD. fMRI showed a significantly larger response to reward, relative to punishment, in vmPFC and nucleus accumbens (NAcc), though this response was diminished in the MDD group. Again, vmPFC activation was positively correlated with anhedonia scores. These findings show convergent validity of complex neural deficits associated with the emotional component of anhedonia.

Topic Area: EXECUTIVE PROCESSES: Other

A116 - Temporal dynamics of integrative processes that construct task representations

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The human brain consists of distributed subunits encoding diverse sources of information. To flexibly guide behavior, the brain must be capable of integrating multiple streams of information. We have previously proposed a framework where integration is achieved by creating a joint distribution that encodes multiple task-relevant features to guide goal-directed behavior. In this framework, the degree of integration can be quantified by the statistical properties of this joint distribution. The goal of the current study is to determine the temporal dynamics of this integration computation. We collected electrophysiology data from 18 participants performing a paradigm requiring them to integrate perceptual (color) information with non-observable state information to execute a task. Trials started with a red and yellow dot array, in which the dominant color informs the task (face or scene judgement) subjects should perform, and the mapping between color and task randomly switched between two non-observable cognitive states. We used a Bayesian generative model to investigate integrative processes. This model estimates, on a trial-by-trial basis, subjects' probabilistic belief on the cognitive state and dominant color. Critically, the model integrates these two probabilistic distributions into a joint distribution encoding the correct task to perform (and outperforms non-probabilistic control models in terms of higher prediction accuracy of task and lower BIC score). Our results show that statistical properties of the joint distribution most strongly correlate with transient delta-theta band (2-8Hz), revealing the functional role these electrophysiology signals play in integrating information to construct task representations.

Topic Area: EXECUTIVE PROCESSES: Other

A117 - Exploring the neural organization of cognitive control using dense neuroimaging

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Cognitive control, the ability to regulate thoughts and actions in accordance with internally represented goals, is essential to human behavior. Two approaches are often taken to studying the neural organization of cognitive control; one that focuses on linking processes to fixed and specialized brain regions and one that assumes that control regions dynamically reorganize themselves in response to task demands. Yet despite a

wealth of neuroimaging research on cognitive control, there is still much we don't know about its neural underpinnings. One factor that may have hindered progress is a reliance on group-averaged imaging methods that implicitly assume that neural organization is fixed across different individuals. Instead, we use dense neuroimaging, a precision neuroimaging approach combined with a large task battery, to explore the neural organization of cognitive control. We scanned two individuals for approximately nine hours while they completed 18 cognitive control tasks. Exploratory factor analysis revealed latent factors that were strongly associated with individual tasks, consistent with task-based reorganization. Confirmatory factor analysis confirmed that a model with latent variables representing tasks fit group and individual data better than a model with latent variables representing cognitive control processes (shifting, inhibition, and working memory). We then replicated these results in an independent, 55-subject dataset. These results highlight the importance of task set in the functional organization of cognitive control as well as the potential of precision and dense imaging approaches to improve our understanding of the neural architecture underlying cognition.

Topic Area: EXECUTIVE PROCESSES: Other

A118 - The effects of photobiomodulation treatment on cognitive functioning and symptomatology in mild Traumatic Brain Injury: A pilot study

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Traumatic brain injuries (TBI) are among the most common acquired brain injuries in individuals under the age of 45. Cognitive deficits are often observed and reported through neuropsychological testing following TBI. Despite that TBI is among the most common acquired brain injuries, there are no known standard-of-care treatment approaches for TBIs. Photobiomodulation (PBM) is an emerging low-level laser therapeutic application that is known to provide pain relief and inflammation relief following an injury, however the effectiveness that this treatment has on cognitive functioning and symptomatology in mild TBI has not been well-characterized. The aim of this pilot study was to investigate if PBM treatment promotes recovery of function within individuals who have recently suffered a mild TBI. In a randomized double-blind pilot study, individuals with a mild TBI were assigned to either PBM treatment or placebo control group, across six sessions, within three months of injury. Before and after the intervention, all participants completed a battery of neuropsychological tests and self-reported symptoms across multiple categories. Findings indicated that PBM treatment resulted in a more pronounced improvement in fatigue, sensory, cognitive, and mental functioning symptoms compared to the placebo group. The analyses also indicated that, compared to the placebo group, individuals who had received PBM treatment showed more pronounced improvement on multiple neuropsychological tests. These findings provide preliminary evidence that PBM can help reduce the burden of symptoms and improve cognition after a mild TBI, supporting the notion that PBM can be used as a potential treatment approach for TBIs.

Topic Area: EXECUTIVE PROCESSES: Other

A119 - Neurocognitive rsfMRI Network Connectivity changes after Bariatric Surgery

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Obesity is one of the most significant health concerns of the twenty-first century. Lowered neurocognitive performance in obesity has been reported to affect planning, decision making, self-control and regulation, executive function and processing speed. One of the most efficacious mechanisms to reduce body weight is the sleeve gastrectomy. The aim of this study is to analyze the postoperative cognitive, behavioral and anatomical changes 6 months after sleeve gastrectomy (SG) in Hispanic females (HF). Eyes open resting state functional MRI (rs-fMRI) and an anatomical scan were acquired using a 3 T Siemens-Skyra scanner. rs-fMRI data analysis was performed in BrainForge. The resulting ICA components were entered into MANCOVAN software to perform comparisons between 'pre' and 'post' scanning sessions via a paired t test. Power of Food Scale were administered prior and 6 months following the gastric sleeve surgery. There were changes in brain connectivity in Hispanic females 6 months following the SG. Significant changes notable between the subcortical network and the cognitive control networks, areas of the brain known to regulate behaviors associated with food intake and feelings regarding fullness. These changes in connectivity were correlated with changes in response to the Power of Food scale where subjects reported reductions in concerns associated with body weight and reductions in the sensation of 'guilt' associated with eating. Our results indicate SG in Hispanic females creates measurable changes in connectivity following bariatric surgery in areas that are associated with self-referential processing and executive control which supports the reversibility of obesity-related neurocognitive detriment.

Topic Area: EXECUTIVE PROCESSES: Other

A120 - Beyond Words: Bilingual Experience Modulates Executive Function Development in Preschool-Aged Children

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Despite the prevalence of bilingualism, its cognitive impact on young children remains a subject of ongoing debate. Early studies of child bilingualism led to the belief that second language use was a social plague and detrimental to intelligence. More recent studies have focused on the influence of bilingualism on higher-level cognitive processes regulating emotions and behavior, known as executive function (EF), yielding conflicting findings. The objective of this study was to assess the effects of bilingualism on EF skills in 3-5-year-old children. To do this, children were assessed using a comprehensive battery of tests of EF, language, social competency, and motor function. EF evaluation included tasks such as grasp-to-construct, animal Stroop, Dimensional Change Card Sort, and backward digit span. Language was assessed through the Peabody Picture Vocabulary Test, social competency through dyadic social play with LEGO and motor ability via grasp-to-construct and Froot Loops task. Caregivers completed subjective surveys which include the Behaviour Rating Inventory of Executive Function in Preschoolers (BRIEF-P), Language Experience and Proficiency Questionnaire, Ages and Stages Questionnaire, and the Adverse Childhood Experiences Questionnaire. The results showed better EF performance among bilingual children during the Dimensional Change Card Sort and social competency in the dyadic social play with LEGO. Notable distinctions were also observed in emotional control, flexibility, and inhibitory self-control as indicated by the BRIEF-P. These findings support the idea that bilingualism may elicit experience-dependent brain plasticity beyond language-specific processes.

Topic Area: EXECUTIVE PROCESSES: Other

A121 - Trauma symptomatology among people with HIV scales with altered theta-gamma dynamics underlying executive dysfunction

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Despite effective antiretroviral therapy, cognitive impairment remains prevalent among people with HIV (PWH), and decrements in executive function are particularly prominent. Furthermore, PWH experience more adverse childhood experiences (ACEs) and suffer from elevated trauma symptomatology compared to seronegative controls, which have also been associated with executive dysfunction. However, the relative contributions of HIV-infection and increased trauma exposure to executive dysfunction among PWH remains unclear. Herein, participants (n=141) between the ages of 29-76 years performed an executive function task during magnetoencephalography (MEG) and completed the ACE questionnaire and PTSD Checklist for DSM-5 (PCL-5) to assess trauma symptomatology. Our analyses focused on the relationship between trauma symptomatology and oscillatory theta (4-8 Hz) and gamma (74-98 Hz) activity among PWH (n=68) and seronegative controls (n=73). Our results indicated that PWH had significantly elevated ACEs and trauma symptomatology relative to controls. Across all participants, trauma symptomatology was associated with stronger theta and weaker gamma oscillations in the left anterior cingulate cortex (ACC). We then computed theta-gamma coupling in the left ACC and behavioral inverse efficiency scores. We found a significant interaction effect in which stronger theta-gamma coupling in the left ACC scaled with poorer inverse efficiency in PWH, while this relationship was not present among controls ($F=6.82$, $p=0.010$). These findings support the concept of interactions between trauma symptomatology and HIV-status on the neural oscillatory dynamics serving executive function. Future work should elucidate the long-term trajectory and impact of ACEs and trauma on the neural oscillatory dynamics serving this and other cognitive processes in PWH.

Topic Area: EXECUTIVE PROCESSES: Other

A122 - A meta-analysis of language and cognition in the developing bilingual brain: From infancy to adolescence

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While the number of studies investigating the neural mechanisms of language and cognition in bilingual children is still few, it has been steadily growing. This systematic review and exploratory meta-analysis of functional magnetic resonance imaging (fMRI) and functional near-infrared spectroscopy (fNIRS) studies aimed to identify brain regions involved in bilingual children's task-based language and cognition. We focused on peer-reviewed, primary articles that involved both bilingual and monolingual participants <18 years of age, reporting brain activations (fMRI: [x,y,z] coordinates) for language and/or cognitive tasks, and excluding literacy-related processes. A coordinate-based, exploratory meta-analysis of fMRI studies with activation likelihood estimation was used to examine the brain regions involved. However, fNIRS studies were too heterogeneous in their data reporting standards. Most fNIRS papers did not report sufficient statistical and methodological information for a meta-analysis. Out of the 27 studies that met inclusion criteria, six fMRI studies could be included in the exploratory meta-analysis. Our synthesis and meta-analyses suggest that: (1) young bilinguals' neural correlates of language and cognition recruited classic language and control networks involving the frontal (prefrontal cortex, inferior frontal gyrus), parietal (inferior parietal lobule), temporal (superior temporal gyrus) cortices; (2) functional differences between bilinguals and monolinguals were identifiable through meta-analysis, notably in left inferior frontal gyrus Findings suggest bilingual children and adults share similar networks for language and cognition; however, more studies are needed to understand how bilingualism influences the brain's functional organization and lateralization depending on the bilingualism-related factors and level (e.g., speech segment, continuous speech) of processing.

Topic Area: LANGUAGE: Development & aging

A123 - Age-Related Alterations in Alpha and Beta Oscillatory Dynamics During Grammar Processing in Youth

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Language processing is served by a series of complex spatiotemporal neural oscillatory dynamics. Unfortunately, research on the development of the network-level oscillatory activity serving language function remains scarce, and this is especially true in the case of morphosyntactic (i.e., grammar) processing. Grammar ability is a crucial skill that has been shown to predict narrative storytelling, reading, and other developmental language milestones. This study sought to determine the effects of age on the neural dynamics of grammaticality judgement in typically-developing youth aged 7-15 years old. Participants performed a grammaticality judgement task during magnetoencephalography (MEG), where they listened to a sentence and were instructed to determine whether the last (target) word was grammatically correct. Artifact-free trials were decomposed into the time-frequency domain and significant neural responses were imaged using beamforming. We found significant age-related improvements in both accuracy and reaction time. While we found significant oscillatory responses in multiple bands, age-related changes were restricted to alpha-beta frequencies. Specifically, we found age-related decreases in parietal alpha activity during target processing ($p < .005$, corrected). We also found significant age-related decreases in beta activity throughout the left language network during target processing, including inferior frontal, superior temporal, and parietal regions, as well as the anterior cingulate and left dorsolateral prefrontal cortex ($p < .005$, corrected). Finally, we found significant decreases in beta activity in the temporoparietal junction during sentence processing with age ($p < .005$, corrected). These data provide new evidence of the neural dynamics serving age-related improvements in grammar processing in youth.

Topic Area: LANGUAGE: Development & aging

A124 - Predicting Literacy in Emergent Readers in Rural Côte d'Ivoire: A Longitudinal fNIRS Study

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We will present preliminary results from a longitudinal intervention in 135 5th-graders in rural Côte d'Ivoire, utilising fNIRS to probe print and speech processing in the brain in L2 learners of Ivorian-French. Much of the study of the neural underpinnings of literacy has focused on populations from high-income countries. Côte d'Ivoire, a low-middle income country with literacy rates <50%, provides a very different perspective. Children growing up in rural Côte d'Ivoire typically speak one over 60 local languages as their L1, and only begin acquiring literacy skills in L2 French in school. Children vary greatly in the age at which they begin school, and can begin as late as 12. This presents a unique window into L2 language and literacy acquisition, both in that here, literacy is acquired relatively late and in parallel with spoken language, and without prior L1 literacy skills. Such a situation is far from rare from a global perspective, but is largely lacking from the literature. Preliminary results show that both left- and right-hemisphere activity during print processing predicts longitudinal literacy, partially mediated by attentional processes. Children who started school at a later age showed less left-lateralisation in print processing, and less neural distinction between word and pseudoword processing, even when controlling for spoken language proficiency. Furthermore, the extent of convergence of the neural activation for print and speech was highly predictive of literacy two years later. These results are discussed in the context of neurocognitive models of literacy and contextual modulators of its development.

Topic Area: LANGUAGE: Development & aging

A125 - Infant Communication Outcomes Relate to Language Network Connectivity In Utero

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There is evidence that the language network begins to develop in utero, however whether connectivity strength can predict later language outcomes is unknown. Using resting-state functional magnetic resonance imaging (rs-fMRI) data, we examined the FC of the language network with cognition-related brain regions in utero, and how it relates to developmental outcomes. The goals of this study were to: 1) use rs-fMRI data to evaluate FC patterns between the primary auditory cortex and the frontal and temporal lobes of the brain and 2) assess interhemispheric connectivity between these regions. 25 mothers were scanned using MRI during the third trimester and completed the ASQ, a validated screening tool for identifying developmental delays in infants and young children when their infant was 3 months. Infants were divided into high and low communication groups based on the communication sub-scale of the ASQ using a median split. Left Heschl's gyrus showed enhanced connectivity with the precentral, superior frontal, and middle frontal gyri in the high communication group. Furthermore, in infants with strong communication skills, critical language-processing areas such as the pars triangularis and pars opercularis, exhibited robust connectivity not only within the same hemisphere but also across hemispheres. The enhanced connectivity observed in high-communication infants suggests a more efficient and widespread neural network supporting language skills, emphasizing the importance of early childhood development in shaping subsequent communication abilities. Identifying specific FC patterns associated with communication skills may inform targeted interventions for infants at risk of language delays.

Topic Area: LANGUAGE: Development & aging

A126 - A longitudinal research of exploring neural mechanisms of morphological processing in the brains of young Chinese-English bilinguals

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This longitudinal research aims to explore the long-term influence of bilingualism on children's morphological processing. Since the brain utilizes the ventral pathway to process Chinese words and the dorsal pathway to process English words, bilingual children may develop unique neural patterns for the language transfer effect. Moreover, children begin to specialize in the temporal and frontal lobes when processing language at the age of 7 and utilize more specific brain regions by the age of 9, so it is crucial to conduct longitudinal research to discover the transfer effect across languages in bilinguals' brains. We recruited 6-7 years old children, 43 Chinese-English bilinguals and

25 Chinese monolinguals, to conduct a morphological judgement task, using fNIRS (functional near-infrared spectroscopy). The subjects heard three words and decided which word shared the same compound root or derivational affix as the first word. After 2 years of bilingual education for bilinguals, both groups conducted the task again in 8-9 years old. The neuroimaging results showed that bilingual children developed the dorsal inferior frontal gyrus and the inferior parietal lobule to process Chinese compared to English. Furthermore, the bilingual group recruited more of the dorsal inferior frontal gyrus, the superior temporal gyrus, and the inferior parietal lobule when processing Chinese than monolinguals. Overall, the findings revealed the English to Chinese transfer effect, as the dorsal pathway was more activated in the process of Chinese in bilingual children, and that young bilinguals developed distinctive neural patterns for reading due to the long-term effect of bilingualism.

Topic Area: LANGUAGE: Development & aging

A127 - Feasibility study of a multidomain cognitive assessment in adolescent girls in rural Ethiopia

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BACKGROUND: A brief assessment of cognition was developed as an outcome for a clinical trial measuring the effectiveness of a micronutrient-fortified flour on cognitive health in adolescent girls in rural Ethiopia (NCT06100146). Here, we evaluated feasibility of a battery of culturally-adapted cognitive measures including a novel digital tool. METHODS: Data collection was planned in Arba Minch, Ethiopia, in November 2023, with participants completing two sessions to determine test-retest reliability. Girls aged 13-19 from three schools were enrolled. Seven tests were evaluated: word and sentence recognition, arithmetic, digit span (forward, backward), Brief Test of Attention (BTA), Symbol Digit Modalities Test, Matrix Reasoning, Brief Visuospatial Memory Test. In a separate pilot, a subset of girls completed the Language & Memory Test (LMT), a novel app-based composite cognitive test. RESULTS: 48 girls completed the battery at baseline; 46 (95.8%) at one-week follow up. Mean age was 15.98 ±1.96 years. Mean administration time for each test was recorded, test-retest reliability was calculated using intraclass correlation coefficient (ICC), tolerability was noted. All tests had acceptable test-retest reliability (all ICC≧0.6 except digits backward, ICC=0.5). Mean time for completion of the full battery was 40 minutes, which was deemed acceptable. Final battery excluded one trial of BTA for redundancy, and Matrix Reasoning for lack of alternate forms. CONCLUSIONS: Cognitive outcomes selected for inclusion in the final battery represent a reliable, well-tolerated assessment of cognitive function suitable for two timepoint data collection in non-English speaking adolescent girls in rural Africa.

Topic Area: LANGUAGE: Development & aging

A128 - Exploring the Links Between Lexical Production and Track-Weighted Imaging in Middle-Aged Adults

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Healthy cognitive aging manifests with a gradual decline in lexical production (LP) beginning in middle age. Previous research showed that LP decline is not solely attributed to domain-specific mechanisms (e.g., language) but also involves domain-general factors like executive functioning. Moreover, while disruptions in functional connectivity have been linked to age-related LP decline, the structural correlates remain unclear. Therefore, this study aims to investigate structural modifications in conjunction with cognitive scores to elucidate LP decline among middle-aged adults. We analyzed seven LP-related cognitive scores alongside diffusion MRI data from 155 healthy adults aged 45-60 from the CAMCAN cohort. Mrtrix3 was used for preprocessing diffusion MRI data and whole-brain tractography (SIFT2). Specifically, we quantified structural alteration using Track-Weighted Fractional Anisotropy (TW-FA), enabling a more sensitive analysis at crossing fiber locations. Finally, we employed machine learning (PLS) to jointly examine the multivariate links between TW-FA values and cognitive scores in middle-aged adults. Our findings indicate that the onset of LP decline occurs around age 56, with prominent structural alterations in the right frontotemporal and cerebellar white matter. Interestingly, enhanced integrity observed in the left temporal white matter, linked to semantic performances, demonstrates a potential mitigating effect on these deteriorations. Furthermore, our study reveals that this mitigation is more effective in middle-aged adults exhibiting high executive functioning. These results provide empirical support for the recently introduced LARA model (Lexical Access and Retrieval in Aging), suggesting that the age-related decline in LP may stem from poorer cognitive control over semantic representations.

Topic Area: LANGUAGE: Development & aging

A129 - Does connectivity between frontotemporal areas at age 7 predict specialization for phonological and semantic processing at age 9.

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The Interactive Specialization Model (ISM) proposes that cognitive development hinges on selective strengthening of inter-regional connections, giving rise to specialized functional systems. This pre-registered study examines whether early connectivity between frontotemporal areas in spoken language processing predicts later specialization. We explore whether connectivity (a) between opercularis Inferior Frontal Gyrus (opIFG) and posterior Superior Temporal Gyrus (pSTG) at age 7 predicts phonological specialization at age 9, and (b) between triangularis Inferior Frontal Gyrus (trIFG) and posterior Middle Temporal Gyrus (pMTG) at age 7 predicts semantic specialization at age 9. Longitudinal data from 32 participants at age 7 and age 9 are analyzed based on pre-registration criteria, utilizing fMRI data from auditory rhyming and semantic judgment tasks. Phonological and semantic specialization are indexed using average beta estimates from top 100 voxels within anatomical masks, and task-modulated connectivity coefficients are determined through generalized psychophysiological interactions (gPPI). Hierarchical regression analyses were conducted to predict specialization at age 9 from connectivity at age 7, controlling for task accuracy and specialization at age 7. Results show that overall fronto-temporal connectivity is not a significant predictor. However, phonological specialization in pSTG at age 7 predicts specialization at age 9 ($\beta = 0.46$, $p<0.05$), while semantic specialization in pMTG at age 7 predicts specialization in trIFG ($\beta = 0.33$, $p<0.05$) and pMTG at age 9 ($\beta = 0.61$, $p<0.01$). Conclusively, early temporal specialization significantly predicts later fronto-temporal specialization, prompting follow-up analysis exploring whether connectivity of temporal areas within a broad language mask at age 7 predicts later specialization.

Topic Area: LANGUAGE: Development & aging

A130 - Characterizing neural signatures of dyslexia and co-occurring math learning difficulties (MLD) with machine learning

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Approximately 10% of children face persistent learning disabilities in reading and math. The most prevalent is developmental dyslexia, among which 40% of children concurrently experience math learning difficulties (MLD). This study aims to investigate the multifactorial nature of dyslexia through the neural mechanisms of dyslexia and MLD. Using a machine learning approach, we analyzed MRI data from 272 children including cortical/subcortical and diffusion tract metrics. All children completed an extensive battery of neuropsychological testing and a novel math battery designed to diagnose MLD. Children were diagnosed as dyslexia-only (n=126), control (n=50), and dyslexia with MLD (n=96). A repeated, 5-fold cross-validated model comparison identified the most effective composite model: Recursive Feature Elimination with a Linear Support Vector Classification (LinearSVC) estimator, followed by LinearSVC for classification. We achieved 67.4% accuracy in differentiating children with dyslexia-only from controls. Permutation feature importance analysis highlighted significant neural markers, such as the superior longitudinal fasciculus IP and right superior temporal gyrus, consistent with established language processing research. Furthermore, we reached 57.6% accuracy in distinguishing dyslexia-only from dyslexia with MLD, emphasizing regions such as the left temporal pole, right fusiform gyrus, and left middle

temporal gyrus. These regions, implicated in language, semantic memory, and numeral processing, correspond with common struggles in arithmetic fact retrieval and calculation procedures found in children with MLD. Our findings corroborate known neural markers of dyslexia and reveal additional brain areas implicated in MLD, underlining the need for intervention strategies tailored to the unique neural patterns associated with specific learning challenges.

Topic Area: LANGUAGE: Development & aging

A131 - Brain-behavior Support for the Role of Morphology in Child Word Reading

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Reading is a crucial skill for all young children to develop. Proficient readers can recognize long and complex words quickly and accurately by segmenting those words into familiar units or syllables. These syllables can be meaningless as in po-ta-to, or be meaningful morphemes such as un+like+ly. This research aims to investigate the role of morphology in child word reading using functional Near Infrared Spectroscopy (fNIRS) neuroimaging. We asked: do meaningful units of language, or morphemes, support word recognition? Children heard one word, saw a different word, and decided whether the word that they saw was a real word. (N = 12, ages 7-10) In this priming task, the primes and targets were related morphologically (e.g., teacher-teach), phonologically (e.g., spinach-spin), or semantically (e.g., mouse-rat). The behavioral results showed that children were the fastest during the morphology condition, followed by the semantic and then the phonological conditions. This result is consistent with that of adult readers, showing maximal facilitation by morphology in word reading. The neuroimaging results showed that along the language network, the morphology condition elicited less activation than the semantic condition but stronger activation than the phonology condition. These preliminary neuroimaging findings suggest that during the morphology condition, meaning processing is more automated, yet word structure (sound and grammar) processing is more effortful in comparison to the stand-alone meaning and sound conditions. This study speaks to the importance of systematic morphological literacy instruction, which is often overlooked in educational settings.

Topic Area: LANGUAGE: Development & aging

A132 - Does regular physical exercise mitigate age-related decline in word production?

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With healthy ageing there is a well-documented decline in cognitive abilities, including difficulties in word finding. A phenomenon known as "tip-of-the-tongue" becomes more prevalent, where individuals struggle to retrieve a known word. Cross-sectional studies (Segaert et al., 2018) suggest that higher aerobic fitness levels correlate with a lower occurrence of tip-of-the-tongue states in older adults, even after accounting for age and vocabulary size differences. These states have been linked to structural integrity of the insula region (Shafto et al., 2007; 2010) and functional activation in an extended network of language-related areas (Diaz et al., 2014). In the FAB project (https://osf.io/6fqg7), we evaluated 61 older participants in a tip-of-the-tongue (definition) task-fMRI session pre- and post-intervention (i.e. controlled six-months home-based exercise intervention which increased fitness only in the exercise group). With this, we examined the impact of a physical exercise intervention on language abilities and underlying neurobiology. Whole brain analyses revealed regions for tip-of-the-tongue vs know response including precuneous, angular, cingulate and superior frontal gyri. There were no whole brain effects of the intervention (no interaction between pre- vs post- and exercise vs control groups). Previous studies have found that only the association between performance and connectivity, not activity, differed with age (Tsvetanov et al., 2018), and this may extend to lifestyle-modulated effects of age. Connectivity changes are thus the focus of the ongoing analyses. Overall, our research contributes to understanding the nuanced relationship between physical exercise, language abilities, and the underlying neural mechanisms over time in aging individuals.

Topic Area: LANGUAGE: Development & aging

A133 - The complex relationship between hand preference, language, executive function, and social competence in preschool children

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Vocabulary acquisition is an important lateralized skill that predicts academic success in preschool children. Previous research indicates that vocabulary has a complex relationship with hand-preference, executive function, and social competence. The purpose of this study was to assess the relationship between these functions in a sample of 82 preschool children in Southern Alberta, Canada. The results replicated previous work where right-hand use for pointing predicted greater vocabulary accuracy. Further, we used regression analyses to establish a reciprocal connection between vocabulary and social competence as well as executive function and social competence, but not vocabulary and executive function. These results highlight the efficacy of interventions targeting a single skill and benefitting multiple areas of development in preschool children.

Topic Area: LANGUAGE: Development & aging

A134 - Comparison of functional connectivity networks during movie-viewing vs. resting-state with whole-head fNIRS

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Extensive fMRI data has revealed the presence of intrinsic functional connectivity networks (FCNs) that can predict a variety of phenotypes (e.g., individual variations in attention: Rosenberg et al., 2016). However, these FCNs are state-dependent, showing reliable differences between resting-state and movie-viewing (Sanchez-Alonso et al., 2021), even though these two states share extensive network commonalities (Greene et al., 2020). Although differences in FCNs between resting-state and movie-viewing are present in children as young as 5 years of age (Sanchez-Alonso et al., 2021), we know very little about FCNs in younger children and infants, in part because fMRI data collection during movie-viewing in children under 4 years of age is challenging (e.g., head motion can lead to spurious FC measures). To set the stage for studies of FCNs in infants and young children, we collected resting-state and movie-viewing data from 42 adults using whole-head fNIRS. Our goal was to determine whether fNIRS has sufficient spatial resolution and SNR to capture reliable FCN differences between resting-state and movie-viewing. All participants viewed three 3.5-minute video clips from the movie Despicable Me and also provided a 10-minute, fixation-cross resting-state run. Whole-head, 105-channel fNIRS data, with short-channel regression of surface vascular noise, generated two group-level FC matrices (resting-state and movie-viewing) of all pairwise channel correlations. A Spearman rank-order correlation confirmed that these two FC matrices were reliably different ($rho=-0.576$, $p<0.001$), replicating the fMRI findings from Sanchez-Alonso et al. (2021) and providing support for the utility of fNIRS for studies of FCNs in infants and young children.

Topic Area: LANGUAGE: Development & aging

A135 - The Impact of interrupted schooling on the functional connectivity for reading in resettled refugee children.

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Reading, a complex cognitive ability, emerges from dynamic interactions among multiple brain regions, not supported by innate dedicated neural circuits.. A significant gap in our understanding, however, lies in comprehending how the timing of literacy instruction affects the development of reading networks. Current literature predominantly focuses on children who commence reading instruction concurrently with their formal schooling, leaving a gap in understanding about how delayed or interrupted literacy instruction impacts the neural underpinnings of reading. We investigate the impact of educational interruptions on the functional connectivity within the developing reading network, specifically in the context of recently resettled refugee children. This population, often experiencing disrupted schooling and delayed literacy development, presents a unique opportunity to explore the trajectory of reading network development. We examined the resting-state functional connectivity of the reading network using fNIRS in a cohort of 54 resettled Syrian refugee children (age 8-17), who have encountered varying durations

of educational interruptions at different ages. The study correlated the observed neural connectivity with standardized reading assessment scores to examine how the age and duration of educational interruptions affect the functional connectivity of the reading network. Our preliminary results suggest that the younger the age at which the interruption occurred and its duration, the more variable the changes are on the reading network. Specifically, some connectivity measures were positively associated with the interruptions, while others showed a negative association, particularly within the dorsal and ventral streams of the reading network and additionally these children performed worse on reading assessments.

Topic Area: LANGUAGE: Development & aging

A136 - White matter integrity in the Frontal Aslant Tract and language production in ageing

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Aging is often associated with word retrieval difficulties, and older adults describe these as one of their most frustrating experiences. However, fewer studies have examined the neural bases of these effects. Diffusion Tensor Imaging (DTI) studies have linked language production differences to dorsal white matter integrity. Here, we focus on the Frontal Aslant Tract (FAT), which connects posterior inferior frontal gyrus to more dorsal frontal and motor regions, and has been implicated in lexical retrieval and executive function aspects of language production. Specifically, a domain specialization has been proposed in which left FAT is strongly associated with speech initiation, stuttering, and verbal fluency, while right FAT is associated with domain-general executive function. In a large sample of individuals (N=83, aged 20 – 80), we examined how language performance (i.e., verbal fluency and speech elicitation tasks) and executive function (i.e., working memory and Stroop) differs across adulthood and how the Frontal Aslant Tract (FAT) contributes to this. We also examined these relationships in a control tract (corticospinal tract (CST). Behaviorally, our results showed age-related differences in language production (semantic VF switching, percent pauses in speech) and Stroop effect in accuracy, but not in working memory. DTI showed age effects in bilateral FAT and left CST. Importantly, white matter integrity in bilateral FAT was negatively related to percent pauses. However, both FAT and CST were not related to working memory and Stroop effect. Overall, our results showed bilateral FAT was related to language but did not contribute to executive function.

Topic Area: LANGUAGE: Development & aging

A137 - How does the aging brain respond to acoustically challenging speech? Insights from simultaneous EEG, pupillometry and memory outcomes

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As we age, the impact of acoustic challenge on speech processing and memory increases but older adults may engage in strategies that help them compensate for these demands. In the current study, older adults listened to sentences—presented in quiet or in noise—that were high constraint with expected or unexpected endings ("He shouted at the top of his lungs/staircase") or low constraint with unexpected endings ("She was nervous to see the new staircase"). On average, we found a pattern replicating prior work in younger adults: in noise—compared to quiet—there was an increase in pupil size, ERP responses were delayed and reduced, and memory performance decreased. Recent work in younger adults has found that when listening in noise, a larger pupillary response predicted a recovery of the N400, at the cost of poorer memory performance. However, the results from the noise condition in the current study show that, while older adults had similar decreases in memory performance with increases in pupil size, they did not have the associated recovery of their ERP responses. Instead, in quiet, we found that increases in pupil size were associated with delays in ERP onset latencies and increased recognition memory performance. In conclusion, while older adults on average appear to be affected similarly by acoustic challenge, transient changes in arousal (measured via pupillometry) lead to tradeoffs in ERP and memory outcomes that emerge in quiet. While in noise, there is still the cost associated with transient increases in arousal without the corresponding benefits.

Topic Area: LANGUAGE: Development & aging

A138 - Speech Perception in Noise Through Hearing Aids: An fNIRS Investigation of Age-Related Hearing Loss

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This study explores the benefits of hearing aid use on speech perception in adults with ARHL using functional Near-Infrared Spectroscopy (fNIRS). Twelve participants (mean age = 80.3) with bilateral sensorineural hearing loss were asked to listen and repeat sentences in the presence of multi-talker babble noise at challenging Signal-to-Noise Ratios (SNRs), both with and without hearing aids. fNIRS data were recorded from 44 channels, focusing on parasylvian cortex. Linear mixed-effects models were constructed for the dependent variables of speech perception accuracy and fNIRS beta values. The independent variables were Hearing aids (aided vs unaided), SNR (3, 6, 9 dB), and regions of interest (ROI) (left dorsolateral prefrontal cortex-LDLPFC, superior temporal gyrus-STG, and inferior parietal lobule-IPL). Accuracy was greater with hearing aids and when SNR's were greater (less noise). fNIRS results revealed significantly greater neural activation in IPL and STG, but significantly less activation in LDLPFC. SNR levels negatively affected beta values, suggesting noisy conditions reduced neural activity in all three ROIs. There was also a significant main effect for hearing aid use, indicating subtle changes in neural activity during challenging noisy conditions. Specifically, wearing hearing aids may enhance temporal lobe activity associated with speech processing while reducing frontal lobe activity. This may indicate that the hearing aid is improving their ability to understand speech in noise, while the reduced frontal lobe activity may suggest that hearing aid is reducing cognitive effort to comprehend speech.

Topic Area: LANGUAGE: Development & aging

A139 - Modelling the developmental lateralization of MEG event-related beta oscillations during auditory verb generation

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In adults performing verb generation in magnetoencephalography (MEG), we observe a distinct pattern of left-lateralized event-related desynchrony (ERD) and right-lateralized event-related synchrony (ERS) in the low beta band (13-23 Hz). In young children, low beta ERD and ERS are distributed bilaterally, with lateralization by adolescence. In this study, we investigate the developmental lateralization of these task-related oscillatory changes to unravel the neural mechanisms governing language hemispheric dominance. Utilizing the Whole-Brain Modelling in PyTorch (WhoBPyt) library (github.com/griffithslab/whobpyt), we fit individual connectome-based neural mass models, constructed from multi-shell diffusion-weighted MRI tractography, with trial-averaged MEG time series representing the early (-100-400ms) auditory evoked response in a verb generation task. Fitted brain network models accurately replicated the individual temporal dynamics of sensory-evoked activity in young children (4-7 years old; n=12) and adolescents (15-18 years old; n=10). Individual models were then used to simulate 1200ms epochs, and power spectral densities (PSDs) were computed using Welch's method for the 700-1200ms time window that, critically, was not used for fitting. Notably, adolescent models predicted the late (700-1200ms) lateralized beta oscillatory responses in language-related high-order regions observed in the empirical data. Our findings suggest that language hemispheric dominance is encoded in the interaction between the structure and the dynamics of early sensory responses to language stimuli that predicts the lateralization of late event-related beta oscillations.

Topic Area: LANGUAGE: Development & aging

A140 - Tiny changes: exploring bilingualism through NODDI and insights into microstructural plasticity

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Bilingualism leads to macrostructural gray matter changes in the brain, however, the ability to quantify changes in microstructural gray matter has been limited. Here, we use Neurite Orientation Dispersion and Density Imaging (NODDI), a multi-shell diffusion Magnetic Resonance Imaging (MRI) technique, to estimate dendritic complexity in bilinguals. This method can directly test the Dynamic Restructuring Model (DRM), which

proposes that dendritic reorganization occurs during language learning, followed by pruning once the language is mastered. Additionally, microstructural changes can be used to explore bilingualism-induced cognitive reserve in aging. To date, twenty-three (n=23) English-French bilinguals have been assessed using language and cognition measures and scanned using 3T MRI. Preliminary results using Partial Least Squares Correlation revealed that the Orientation Dispersion Index (ODI), a proxy for dendritic branching, was associated with 3 latent variables capturing 1) second language proficiency and age of acquisition (AoA); 2) cognitive performance; and 3) an exploratory domain of speech perception in noise. Lower AoA and higher proficiency were associated with reduced ODI in multiple language-related regions, consistent with the DRM and neural efficiency. Conversely, higher cognition was associated with reduced ODI in memory-related regions, but increased in sensory regions. Further analyses will include additional NODDI metrics, including free water and neurite density indices, to gain a more complete picture of cortical composition and myelination. Together, these metrics should provide insight into the subtleties of language-related neuroplasticity. The results are part of a planned, multi-phase longitudinal study to assess the impact of bilingualism on cognition in aging.

Topic Area: LANGUAGE: Development & aging

A141 - Neural entrainment as a measure of speech segmentation in infants

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A first step in language acquisition is breaking down the continuous stream of sounds of speech into individual words, a process called speech segmentation. While traditional end state measures of speech segmentation are informative at a group level (e.g. determining what an age group can do), they might not capture individual differences effectively (Aslin, 2007; Pérez-Edgar et al., 2020). For instance, standard looking preference measures have large within subject variability (DeBolt et al., 2020). There is also an increased risk that related cognitive abilities may confound segmentation based on end state measures (Kabdebon et al., 2022). As an alternative, neural entrainment (NE) can measure speech segmentation while infants discover word boundaries in real-time (Choi et al., 2020; Kabdebon et al., 2015, 2022). The current study investigates whether NE, captured with electroencephalogram, accurately measures speech segmentation in infants. Eight to 9-month-old infants complete two testing sessions 5-7 days apart. Each session includes two experiments that test different cues to word boundaries: transitional probability and stress pattern. Each experiment consists of a 3.6-minute stream of an artificial language followed by 32 test trials in which words and part-words are presented in isolation. NE is quantified from familiarisation phase data while ERP analysis is performed on the test phase data. This study will evaluate NE's reliability, compare it with ERPs and vocabulary to determine whether NE can be used to study individual differences in speech segmentation. Data collection and analysis is ongoing (40% of target sample collected); preliminary results will be presented.

Topic Area: LANGUAGE: Development & aging

A142 - The Effect of Social Network Composition and Frequency of Contact on Lexical Retrieval in Older Adults

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The social isolation that often accompanies aging leads to a reduction in speaking opportunities and exacerbates lexical retrieval difficulties. Although substantial advances have been made in our understanding of social isolation and its influence on cognition in aging, we do not yet know the effects of reduction in communication due to social isolation on word retrieval. This ongoing study examines the role of the amount of social communication across various social network domains on word-finding difficulties seen in induced tip-of-the-tongue (TOT) experiences. The current methodological approach will be discussed, including the selection of a TOT-inducing set of common and proper nouns, the TOT elicitation paradigm, and a novel modification of the Social Network Index (SNI; Cohen et al., 1997) that uniquely takes into account opportunities for communicative exchanges ("contact frequency"). To date, 9 healthy older adults (mage=73.56; meducation=18.00) completed a TOT task composed of 90 nouns and a modified Social Network Index (SNI; Cohen et al., 1997). Spearman rank correlation was used to calculate coefficients of each SNI predictor (size, diversity, contact frequency) with TOT occurrences. Preliminary findings indicate that there were no statistically significant associations (p >.05) between age and TOT rate with SNI predictors. Age: size (r = -0.7), diversity (r = -0.5) and frequency (r = -0.5); TOT rate: size (r = -0.3), frequency (r = -0.2), and diversity (r = 0.04). Most associations were non-significant but there was a trend (p = 0.06) whereby age negatively correlated with social network size; however, testing is ongoing.

Topic Area: LANGUAGE: Development & aging

A143 - Assessing the links among malnutrition, brain functional connectivity, and behavioral outcomes in young Bangladeshi children.

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In Bangladesh, acute malnutrition affects millions of children under 5 years (UNICEF, 2019). Malnutrition has profound consequences especially in infancy, when the brain networks supporting the development of cognitive and social-emotional skills are formed. Recent evidence has begun unveiling the impact of malnutrition on brain development (Xie et al., 2019). Thus, early nutritional deficiencies may affect cognition and behavior throughout childhood, possibly extending into adulthood (Prado & Dewey, 2014). To date, only few studies have explored the mechanisms linking malnutrition, behavior, and brain development in low- to middle-income countries. Our work examines these links and the effects of a nutritional intervention, in young Bangladeshi children. We collected longitudinal brain functional connectivity data (using functional near-infrared spectroscopy) and cognitive/behavioral data (e.g., Bayley scales of infant and toddler development) from 140 acutely malnourished and 70 well-nourished children. Testing occurred at two time points: once at 1 year of age (pre-intervention) and again at 2 years of age (following one year of intervention). While data from the second-year visit is still undergoing processing, we performed preliminary analyses on the 1-year-old data (pre-intervention). Our results indicate differences between functional connectivity patterns of acutely malnourished and well-nourished children. Additionally, the well-nourished group shows positive associations between functional connectivity and language measures (Bayley scales). No significant correlation was observed for the malnourished group, suggesting that malnourishment may suppress the brain-behavior associations found in well-nourished children. Further analyses, incorporating data from 2-year-olds, will explore potential intervention effects on behavioral and brain connectivity measures of the malnourished group.

Topic Area: LANGUAGE: Development & aging

A144 - Decoding lexical and supralexical processes in American Sign Language comprehension

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Neural research on sign language comprehension has implicated a widespread frontotemporal network in processing the linguistic structure of signed input, but neural differences between lexical and supralexical (i.e., sentence level) processing have not been clearly delineated. We scanned fifteen deaf American Sign Language (ASL) signers as they passively observed sign lists and ASL sentences. Half of the sign lists consisted of nouns and half were verbs, allowing us to compare activation for nouns versus verbs. The sentences were matched to the sign lists in the number of content words and their psycholinguistic properties (frequency, iconicity, and phonological neighborhood density). We conducted multivoxel pattern analyses (MVPAs) using a whole-brain searchlight approach and a Support Vector Machine (SVM) classifier to distinguish brain regions that differentiate between (1) sentences and word lists, and (2) nouns and verbs. We decoded the neural activity patterns for each subject, then performed a group-level analysis on the results of the single-subject MVPA analyses. Regions that discriminated between nouns and verbs included bilateral (but left lateralized) superior temporal cortex, left angular gyrus, and bilateral occipital cortex. In contrast, only small regions within bilateral inferior frontal gyri discriminated between sentences and sign lists. Our results suggest that lexical information is robustly represented in the sign language network, whereas the representation of combinatorial

syntax/semantics is limited to a small pair of homologous regions in bilateral inferior frontal cortex. These results cohere with recent research suggesting that lexical, rather than supralexical, information is more robustly represented in the spoken language network.

Topic Area: LANGUAGE: Lexicon

A145 - The neural associations between fingerspelling, print, and signs: An ERP study of deaf readers

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Fingerspelling ability is a leading predictor of reading skill in deaf readers who use American Sign Language (ASL). Fingerspelling provides an additional code for English orthography because fingerspelling handshapes represent English letters. However, the neural relationship between these different systems of orthographic representations remains relatively unexplored. We used event-related potentials (ERPs) to investigate how fingerspelled words and ASL signs modulate priming effects for printed English words. Twenty-four skilled deaf adult readers completed a Go/No-Go semantic categorization task (press to animals) while viewing English word targets preceded by unmasked related and unrelated primes in one of three conditions: English words, ASL signs, or fingerspelled words. We anticipated similar N400 priming effects (reduced amplitude for target words with related vs unrelated primes) for fingerspelled and English word primes because of the orthographic overlap between English letters and fingerspelling handshapes. ASL signs were also expected to prime English words but perhaps with a later time-course than for fingerspelled words, due to the absence of orthographic overlap. Results were generally consistent with these predictions. There were strong N400 priming effects in all three conditions; however, effects were graded, with the largest priming effect in the English prime condition, followed by fingerspelled words and then signs. Importantly, these priming effects started earlier for fingerspelled and English prime words compared to signs. These findings highlight the unique relationship between fingerspelling and written English and underscore the importance of implementing fingerspelling literacy to promote skilled deaf readers.

Topic Area: LANGUAGE: Lexicon

A146 - Embedding the past and the future into speech perception

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How we perceive current speech is shaped by past and future information. While numerous studies have independently demonstrated the influence of preceding contextual information and subsequent tasks on speech perception, it remains unclear how the brain integrates these two types of information to modulate the perception of current speech. Here, we used MEG to record responses from participants engaged in a speech perception task, where they were instructed to determine whether the tones (tone task, subject n = 30) or consonants (consonants task, subject n = 19) of the two preceding and following syllables were the same. Using the multi-voxel pattern analysis method, we separately analyzed the neural signals when participants listened to the first and second syllables. By comparing the tone task and consonant task, we uncovered that phonemic representations are adapted in response to the speech perception task at hand. Specifically, when perceiving the second syllable, the task-related phonemic features of the first syllable, such as the tone feature in the tone task, will be automatically reactivated. Furthermore, we used representational similarity analysis combined with multidimensional scaling analysis to explore the representation of the second syllable. Our results revealed that the brain actively aligns the second syllable to the task-relevant phonemic features of the first syllable, with the second syllable being reassembled to match the tone/consonant features of the first syllable for the tone/consonant task. Overall, our results indicate that the perception of current speech is adapted to more efficiently match subsequent tasks based on preceding phonemic information.

Topic Area: LANGUAGE: Lexicon

A147 - Signal coherence reflects changes in predictive processing for bilinguals in L2: an EEG study

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Bilingualism is common throughout the world. However, its effects on language prediction are still not well understood, compared to monolinguals. It is well established that monolinguals predict upcoming words in highly constraining contexts, thereby facilitating processing. Effects of prediction in L2 of bilinguals have shown mixed results. In the present study we examined L2 prediction in 30 Spanish-English bilinguals using a word-pair prediction paradigm. Participants were asked to predict the second word of each pair, which had a 50% forward association, and indicate if the word they predicted matched the target word. A typical N400 effect of successful prediction was found. Additional analyses were done to derive a measure of aperiodic activity from the EEG. Aperiodic activity is inversely proportional to the frequency of oscillatory activity. A steeper slope in aperiodic activity is suggestive of higher processing demands, and prior research found that anticipation of predictable words resulted in a steeper aperiodic slope. Results of a mixed-effects model demonstrated that, while there was no significant difference in aperiodic slope before word onset, participants showed a steeper aperiodic slope when anticipated words differed from target words ($t(26) = 2.805$, $p = .009$). This may indicate the increased demands of processing unpredicted words. Correlation analyses showed that a steeper aperiodic slope before target word onset was associated with larger N400 prediction effects to the targets ($r = .19$). Together, these results suggest that bilinguals anticipate upcoming target words in L2, and that this facilitates processing relative to unpredicted targets.

Topic Area: LANGUAGE: Other

A148 - Learning Through Song: Assessing Neural Tracking, Engagement, and Comprehension in the Classroom

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Learning from song can be more effective compared to learning from speech. Indeed, neural tracking is greater for sung than spoken words, perhaps due to the greater predictability of song features, such as rhythmic regularity. However, two crucial gaps need to be filled to examine how music can be used in real-world learning environments, like the classroom. First, no one has directly compared neural tracking and behavioural outcomes - such as comprehension and listening effort - when learning from song. Second, most research has been conducted in laboratory settings, where participants typically sit alone in a small room. This is very different from real-world dynamics, which often involve social interaction. In a two-stage approach, we will examine the beneficial effects of learning through song versus speech, using mobile EEG in laboratory and classroom contexts. In Experiment 1, participants will listen to controlled as well as naturalistic stimuli in both speech and song modalities in a laboratory setting. Experiment 2 will move toward an ecologically valid classroom context, where we will collect multiple mobile EEG measurements (hyperscanning) of students and teachers. We hypothesise that neural tracking of features from incoming information (e.g., acoustic envelope, assessed via cerebro-acoustic phase coherence) will be greater in song stimuli, which would positively correlate to comprehension, engagement, and learning in the classroom. This work will provide an important extension of our fundamental knowledge of cognitive neuroscience into natural environments, and has the potential to inspire interventions for effective teaching and learning.

Topic Area: LANGUAGE: Other

A149 - Large Language Model Alignment with Brain Representations during Language Production

Roger Beaty[1], John Patterson[1], Elisa Kwon[2], Kosa Goucher-Lambert[2]; [1]Pennsylvania State University, [2]University of California, Berkeley

Recent work has demonstrated that representations from Large Language Models (LLMs) accurately align with human neural responses for the same linguistic inputs. This alignment suggests far-reaching uses for LLMs in both neuroengineering and basic research, if sufficiently general. However, brain-LLM alignment has scarcely been tested beyond language reception; the circumstances under which LLMs align with human neural representations during language production, and under different task goals, remains an open question. In this work, we explore how LLMs align with human neural representations on a language production task under two distinct goals, within-subject. To investigate the impact of different goals, human subjects were asked to produce word associations that were either appropriate (bench - sit) or novel (coin - veil) in response to cue nouns (bench/coin) during fMRI. To relate brain representations to model-based ones, we obtained language representations from Llama-2, a contemporary 7B-parameter LLM that is architecturally similar to, but improved over, leading models of

human language reception (e.g. GPT-2). We then assessed how task goals shape brain-LLM alignment during language production using representational similarity analysis. Specifically, we compared the representational geometries from the brain and LLM that resulted from each goal. We hypothesized the appropriate goal would produce greater brain-LLM alignment relative to the novel goal—as common associates are more likely to be present in training corpora—but our findings suggest a more nuanced relationship. We conclude by discussing future directions and implications for neuroscience and neuroengineering.

Topic Area: LANGUAGE: Other

A150 - Chunking Language: Phase-Locked Oscillations or Evoked Responses?

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Our ability to cognitively integrate immediate sensory information may be confined to a time window of 2–3 seconds. In language, this window may constrain the grouping of individual words into larger multi-word chunks, which is required for comprehension. Chunk boundaries are accompanied by a characteristic event-related potential, the Closure Positive Shift (CPS). More recently, frequency-domain analyses have found neural oscillations in the delta band (< 4 Hz) to predict chunking; we have argued that their preferred wavelength could explain the endogenous time limit. Hence, we here tested whether the CPS might consist of underlying neural oscillations, with increases in evoked amplitude resulting from increased phase-locking of oscillations across trials. We recorded participants' magnetoencephalogram while they listened to globally ambiguous sentences in which the choice between two possible interpretations would be biased by a single chunking decision. Chunking was not externally imposed, but we hypothesized that temporal limits of integration windows would influence chunk termination and consequently, interpretation. Accordingly, we manipulated the sentence duration up to the potential chunking decision point to range between ~2–4 seconds in order to increase the likelihood of chunk termination, a CPS, and delta-band phase locking. Preliminary results indicate an evoked response at the chunk boundary that is influenced by sentence duration. This evoked response correlates with delta-band phase-locking. In conclusion, we tentatively suggest that the CPS may reflect the time-domain equivalent of phase-locked delta-band oscillation. We are currently working on localizing the neural sources of this endogenous, time–/wavelength-driven chunking mechanism.

Topic Area: LANGUAGE: Other

A151 - Predicting the next sentence (not word) in pretraining: What model-brain alignment tells us about discourse-level comprehension

Shaoyun Yu[1] (shaoyun.yu@polyu.edu.hk), Chanyuan Gu[1], Kexin Huang[1], Ping Li[1]; [1]The Hong Kong Polytechnic University

In large language models (LLMs), word prediction is a backbone task for pretraining, and it has also been examined empirically and theoretically in models of human language processing (Goldstein et al., 2022). However, recent studies highlighted the limitations of relying on this task (Arana et al., 2023). Crucially, human language is acquired and represented at multiple levels, and the language user needs to integrate the meanings of words and sentences to achieve a full understanding of discourse (Li & Clariana, 2019). This study models language comprehension beyond word prediction to use next sentence prediction (NSP; Devlin et al., 2019) to investigate mechanisms of discourse-level comprehension. Two independent fMRI datasets about sentence reading were used (Li et al., 2022; Pereira et al., 2018). We found that discourse-level pretraining using NSP enhances a model's alignment with brain data (evaluated with RSA). In particular, increased model-brain alignment was mainly observed in the right hemispheric homologues of core language regions (IFG, IFGorb, ATG) and in the multiple-demand network (left MFG, ACC, right SFG, MFGorb, PrecG), highlighting the contributions of non-classical language regions to high-level language understanding. NSP also enabled the model to better capture subjects' comprehension speed (Caucheteux et al., 2022) and to better encode contextual information (Toneva & Wehbe, 2019). We discuss these findings in light of current neurolinguistic theories (MacGregor et al., 2022; Yang et al., 2019). This study supported NSP's cognitive plausibility, and demonstrated that model-brain alignment can be a viable approach to addressing outstanding questions in the neuroscience of language.

Topic Area: LANGUAGE: Other

A152 - Impact of Passive Second Language Exposure on Speech Segmentation and Word Learning

Amiya S. Aggarwal[1] (aaggar7@uwo.ca), E. Rae Hoeppner[1], Laura J. Batterink[1]; [1]University of Western Ontario

Previous studies have shown that statistical learning (SL), the process of becoming sensitive to patterns in the environment, occurs simply through exposure to input, without explicit training, effort, or intention. Studies using miniature artificial languages have shown that the ability to detect syllable co-occurrence patterns through SL supports wordform learning. However, it is not yet clear whether SL can scale up to support word learning in a fully natural language. In the current study, we tested whether passive, multi-week exposure to a novel spoken second language facilitates both word segmentation and the subsequent ability to map words to meaning in monolingual English-speaking adults. EEG responses to natural, continuous Italian speech were recorded before and after a three-week exposure period, during which they listened to either Italian podcasts (experimental group) or English podcasts (control group) for an hour a day. We quantified participants' sensitivity to word boundaries by deriving the multivariate temporal response function (mTRF) to word onsets, and their word mapping abilities for Italian words and non-words using an associative learning task. We hypothesize that passive exposure will facilitate second language word learning, resulting in an enhanced EEG word onset response to continuous Italian speech and differential word mapping rates for the Italian words and non-words after the exposure period for participants in the experimental group. This result would provide evidence that SL facilitates the discovery of word boundaries in continuous speech in a fully natural language and further promotes object label mapping.

Topic Area: LANGUAGE: Other

A153 - Harnessing Implicit Learning to Support the Discovery of Second Language Phoneme Patterns in Adult Learners

Emilie Rae Hoeppner[1] (ehoeppne@uwo.ca), Amiya S. Aggarwal[1], Laura J. Batterink[1]; [1]The University of Western Ontario

Research in adult second language (L2) learning has predominantly concentrated on explicit, or effortful, learning, where learners dedicate time to focused study. However, laboratory studies support the idea that passive exposure may be sufficient to acquire certain aspects of language. In these studies, learners presented with a continuous speech stream featuring repetitive words gradually develop sensitivity to the patterns of syllable co-occurrence within the stream, using this information to discover word boundaries. This process is known as statistical learning and provides a mechanism by which patterns in the environment can be learned without the need for conscious effort. The current project investigates the role of statistical learning mechanisms in acquiring phonemic patterns within a natural L2 context. For 21 days, adult English speakers listened to either Italian podcasts (L2 exposure group) or English podcasts (control group) for one hour daily while going about everyday activities. EEG responses to naturalistic Italian speech were recorded before and after this period of passive exposure. Employing the multivariate Temporal Response Function, a mathematical model aligning predetermined, time-locked markers for linguistic measures with the continuous EEG signal, we plan to examine neural responses to phonemic co-occurrence patterns in the continuous speech stream. We hypothesize that participants in the L2 exposure group will develop sensitivity to L2 phonemic patterns, as evidenced by an increased neural response to less expected (more surprising) phonemes in Italian speech at post-test. Such results would provide compelling evidence that passive exposure to spoken second languages can foster sound pattern acquisition.

Topic Area: LANGUAGE: Other

A154 - Dynamic Neural Interactions in Word and Discourse Processing: insights from fused fMRI/EEG

Clair Min Kyung Hong[1] (min.kyung.hong@vanderbilt.edu), Katherine Aboud; [1]Vanderbilt University

Reading comprehension requires the precise identification and decoding of individual words (word-level processing; WL) and the extraction of coherent meaning from text

(discourse-level processing; DL). In this study, we investigate how these two processes interact and are represented in the brain by examining the brain's spatiotemporal dynamics during WL and DL using a fused fMRI-EEG analysis. We examined typical adults reading single words and medical passages in MRI sessions, and in a separate session, while EEG data was collected. Using joint Independent Component Analysis, we identified distinct neural networks and their dynamic interactions during WL and DL processing. For WL processing, we observed early signals associated with left occipitotemporal and middle temporal regions for visual and orthographic processes, followed by a frontotemporal semantic network (N400). For DL processing, an inferior frontal network for semantic syntactic reappraisal and nodes of the default mode network for conceptual integration (P600) were identified. These findings underscore the brain's processing of larger text structures and inferential reasoning in discourse comprehension. In summary, our study illuminates the dynamic neural interplay between word and discourse processing, providing insights into how the brain navigates different levels of language comprehension. These findings offer a deeper understanding of reading proficiency and potential avenues for addressing reading difficulties.

Topic Area: LANGUAGE: Other

A155 - Semantic Richness & Conflict Effects in Discourse-Level Referential Processing

Nathan Caines[1] (ncaines@ucsc.edu), Megan Boudewyn[1]; [1]University of California Santa Cruz

Language comprehension involves rapidly creating a meaningful and accurate mental representation of discourse context. The Nref refers to a frontally distributed sustained negative-going event-related potential (ERP) waveform observed in response to referential ambiguity (Nieuwland & Van Berkum, 2006a). The difficulty of connecting pronouns to their antecedents (referential processing) depends on factors like the presence of ambiguity or ease of antecedent retrieval (Karimi et al., 2018). Here, we manipulated the semantic richness of 2 noun phrases (NPs) introduced in the first sentence of two-sentence written stories. An ambiguous pronoun in sentence 2 served as our target word. We hypothesized that referential ambiguity effects at the target word would depend on the activation level of a referent in memory. Specifically, we expected that the semantic richness of Sentence 1 NPs would serve as a cue biasing the interpretation of Sentence 2 target pronouns. We were particularly interested in examining whether semantically rich Sentence 1 NP2s would lead to the most processing difficulty at the Sentence 2 targets by creating a bias towards NP2 pronoun interpretation that is in conflict with the NP1 bias typically seen in English. Results (N=20) showed a significantly larger Nref amplitude for Sentence 2 targets following sentences with semantically rich NP2s than bare NPs (p=0.041). These results support the hypothesis that retrieval difficulty is increased when a candidate antecedent's prominence conflicts with a representationally richer possible antecedent option.

Topic Area: LANGUAGE: Other

A156 - Behavioral and cortical profiles for family history of dyslexia using binary, continuous, and genetic kinship approaches

Oliver Lasnick[1] (oliver.lasnick@uconn.edu), Fumiko Hoeft[1]; [1]University of Connecticut

This poster showcases work conducted on the unique contributions of family history of dyslexia/reading disorder (RD) to (a) reading-related skills and (b) cortical surface area (SA) in regions of the brain's reading/language network. We use a diverse sample derived from 8 datasets of up to N=664 children aged 6-16 years (M=9.22, SD=2.01) to analyze the effects of both binary and continuous family history on single word-reading/decoding, phonological processing, receptive vocabulary, and cortical SA in three regions of interest (ROIs): the inferior frontal gyrus (IFG), the superior temporal gyrus (STG), and the supramarginal gyrus (SMG). We show that (1) RD family history predicts poorer outcomes in word-reading and vocabulary (but not — counterintuitively — phonological processing); (2) children with family history show different cognitive profiles relative to controls, with an increased correlation between vocabulary and word-reading and decreased correlation between vocabulary and phonological processing; (3) family history is associated with reduced cortical SA in the bilateral SMG of the brain's reading network, while lower socioeconomic status (coded based on annual income, with the lowest level <20K/yr and the highest >100K/yr) appears to drive reduced cortical SA in the IFG and STG; and (4) parental severity of past RD is the most predictive form of family history for childrens' untimed word reading ability, while the degree of genetic similarity between children and their relatives with RD is the most predictive form of family history for cortical SA across nearly all analyzed cortical regions.

Topic Area: LANGUAGE: Other

A157 - On the Neural Bases of the Interface between Reading and writing: Implications of Lesion Data from English and Japanese speakers

Venu Balasubramanian[1,4] (venugopal.balasubramanian@shu.edu), Kaitlyn Weber[1,4], Sarah Zimmer[1,4], Ava Amiano[1,4], Jayashree Balaraman[2,4], Maha Aldera[3]; [1]Seton Hall University, IPHS campus, Nutley, NJ, [2]Rensslaer Polytechnic Institute, NYC, [3]Princess Nourah University, Riyad, Saudi Arabia, [4]Communication Neuroscience and Aphasia Research Laboratory (CNARL)

Introduction. The syndrome of alexia with agraphia (AWA) was reportedly caused by the loss of optical images of letters (DeJerine, 1890). Thus, the study of AWA syndrome might potentially contribute to our understanding of the neural bases of the interface between reading and writing. The phonology-orthography relation in French and English is similar, but in Japanese it is quite complex because of the presence of Kana (phono-syllabic) and Kanji (whole word) systems. Hence, a comparative study of AWA in English and Japanese speakers will offer new insights into the nature of the neural interface. Method. A systematic scoping review was done. AWA case reports from both linguistic groups, but published in English between 1980 and 2023, were identified (English=20, Japanese=8). Procedure: 1. Analyses of the sites of lesions associated with AWA syndromes in English and Japanese subjects, and 2. Characteristics of alexia-agraphia combination in each case. Results and conclusions: Nine different sites of lesions were found in English speakers with AWA. Multiple lesion sites support the view that the components of the neural circuitry that subserves the interface between reading and writing are spatially distributed, within the ventral and dorsal stream-related structures, as well as in thalamus and cerebellum. The data from Japanese AWA cases are very limited. AWA for Kanji is reported following left hippocampal and left posterior inferior temporal cortex hyper perfusion. Further studies using appropriate imaging methods (fMRI, DTI), might throw light on the influence of writing systems on the interface between reading and writing.

Topic Area: LANGUAGE: Other

A158 - Statistical learning of radical configuration in Chinese character recognition

Tzu-shin Lin[1,2] (ts.lin@g.ncu.edu.tw), Chia-ying Lee[1,2,3]; [1]Academia Sinica, [2]National Central University, [3]National Chengchi University

Chinese characters are comprised of radicals within a constant square-shaped space. Previous studies have demonstrated that statistical learning is the core mechanism for extracting orthographic regularities, such as radical position, radical combinability, and phonetic consistency, in learning to read Chinese. However, radicals can be arranged with different spatial configurations. This study analyzed the distribution of radical configuration and found that 60% of compound characters contain two radicals, which are horizontally arranged from left to right (i.e., 柏). However, only 20% of them are vertically arranged from top to bottom (i.e., 空). Participants were invited to perform a lexical decision task in a priming paradigm to examine whether readers would process the radical configuration information in Chinese character recognition. The prime character would either be the dominant (left-right) or non-dominant (top-bottom) configurations. The target would either be a real character or a pseudo-character with a congruent or incongruent configuration with the prime. The event-related potentials (ERPs) to the target characters indicate an interaction between configuration dominancy and congruency on N170 with posterior sites and P200 with frontal regions, in which incongruent condition elicits greater amplitude than congruent condition for the non-dominant configuration. Meanwhile, a three-way interaction effect is found on N400 with posterior sites, revealing that pseudo-characters show a greater N400 negativity than real characters at incongruent conditions in targets with the dominant configuration. These findings support that the radical configuration also serves as an important orthographic information for Chinese character recognition.

Topic Area: LANGUAGE: Other

A159 - Beyond language abilities: Subtle qualitative impairments in semantic networks and atypical multisensory processes in 8-year-old very preterm children

Marion Décaillet[1,2] (marion.decaillet@chuv.ch), Micah M. Murray[1,2,3], Alexander P. Christensen[4], Laureline Besuchet[1,2], Cléo Huguenin-Virchaux[1,2], Céline J. Fischer Fumeaux[1], Solange Denervaud[1,3], Juliane Schneider[1,2]; [1]Lausanne University Hospital and University of Lausanne, Switzerland, [2]The Sense Innovation and Research Center, Lausanne and Sion, Switzerland, [3]CIBM Center for Biomedical Imaging, Lausanne, Switzerland, [4]Vanderbilt University, Nashville, TN, USA

Very-preterm children (VPT; <32 weeks gestational age) present more language weaknesses, measured through quantitative tools, compared to full-term children. However, qualitative aspects such as semantic memory organization remains unstudied. Arguably, it is during childhood that the greatest number of concepts are acquired, the way they are organized allows children to make associations and retrieve information more readily. Therefore, some cognitive deficits observed in VPT children may stem from altered semantic networks. Here, we assessed the semantic network of 38 VPT schoolchildren compared to 38 full-term schoolchildren using a verbal fluency task. While we observed no differences between VPT and full-term children regarding the distance between concepts and their modularity (i.e., vocabulary enrichment), VPT children exhibited a lower interconnected semantic network at a local level. Therefore, with these less embedded concepts, information is more difficult to retrieve. Additionally, as language and memory impairments are known to be linked to multisensory difficulties, we completed these alterations with metrics of multisensory integration. Based on data from a subset of 25 VPT children who performed a simple detection task with auditory, visual, and audiovisual stimuli, we found that VPT children were slower and that their multisensory gain was not explained by integrative processes, unlike full-term children. These findings provide one of the first evidence that VPT children demonstrate subtle impairments in the organization of semantic network alongside atypical multisensory profiles. It supports the adaptation of the support and education they receive by focusing more on meaning and integrating new words while engaging multiple senses.

Topic Area: LANGUAGE: Other

A160 - Optimization of Cognitive Behavioral Tasks for CLOCKΔ19 mouse model of Bipolar Disorder

Eden Fraatz[1] (efraatz570@g.rwu.edu), Simrat Dhillon[1], Dennis Arruda[1], Giana Guerra[1], Brittany Martin[1], Samantha Soares[1], Victoria Heimer-McGinn[1]; [1]Roger Williams University

Cognitive deficits are a trait symptom of bipolar disorder (BD) and are predictive of disease outcome and quality of life. However, they remain understudied and undertreated, largely due to difficulties developing animal models that reproduce the mood fluctuations that characterize BD. One emerging model is the ClockΔ19 transgenic mouse line, which exhibits regular mood cycling between manic and euthymic behavior over 24 hours. In this study, we (1) corroborate the known phenotypic characteristics of ClockΔ19 and (2) tailor cognitive behavioral tasks for the model using male and female wildtype and homozygous mice. For the first goal, an open field maze (OFM) evaluating locomotion revealed that both male and female ClockΔ19 mice display increased hyperactivity. For the second goal, we used novel object recognition (NOR), novel object location (NOL), and attentional set shifting (AST) tasks. In AST, we observed enhanced discrimination in ClockΔ19 mice accompanied by shorter latencies. Since AST uses food rewards with high sugar content, and the ClockΔ19 model displays increased reward-seeking behavior, we piloted the use of natural food rewards. We find that modifying the food reward increases latency times while maintaining performance levels. In NOR/NOL, we observe trends toward impairments that mirror the human population. However, we have had to modify specific object pairings and layouts that are better suited for this model. Our results will validate the use of these cognitive tasks with the ClockΔ19 mouse, which will help us validate the ClockΔ19 mouse for use in translational studies of cognitive function in BD.

Topic Area: METHODS: Other

Poster Session B

Sunday, April 14, 2024, 8:00 – 10:00 am, Sheraton Hall ABC

B1 - Cognitive-Behavioral Predictors of Individual Variability of Functional Connectivity in Healthy Young Adults

Colin Hawco[1,2] (colin.hawco@camh.ca), Julia Gallucci[1,2], Justin Ng[1,2], Teodora Secara[1,2], Ju-Chi Yu[1]; [1]University of Toronto, [2]Centre for Addiction and Mental Health

While stable patterns of fMRI task-evoked brain activity and functional connectivity (FC) exist at the population level, a growing body of research emphasizes that variability exists across individuals. It is these differences which define the critical differences in cognition and behavior across individuals that make us unique. We examined a range of cognitive-behavioral predictors of heterogeneity of FC in a large sample of young adults. Resting state fMRI from the 987 participants (ages 22 to 37) from the Human Connectome Project young adults. Functional connectivity was calculated between the 360 regions. Variability was defined using mean correlational distance (MCD) between participants, a measure of how far each individual is from the 'average' connectivity pattern. Hierarchical regression was used to determine potential predictors of variability in FC, including demographics, motion, cognition (crystalized and fluid cognitive scores), emotional valiance, personality variables, and fitness. The final model explained 11.8% of variance in FC variability, included cognition, emotional valiance, and personality. Low variability was associated with higher BMI, greater crystallized cognitive scores, more positive emotional valence, and Neo Agreeableness. Greater variability was associated with age, brain volume, and Neo Extroversion. Model residuals were non-normal, as the model underestimated variability in the most variable participants. These results suggested benefits for a connectivity pattern which is more similar to the group average, raising the possibility that the group average represented the 'optimal' connectivity pattern.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B2 - Differential Neural Correlates of Perceived and Predicted Social Feedback

Ga In Shin[1], Camille R. Johnston[1], Megan Quarmley[1], Johanna M. Jarcho[1], Vishnu P. Murty[1]; [1]Temple University

In this study, we investigated brain regions involved in supporting memory for perceived and predicted social feedback, differentiating between actual feedback received and feedback participants believed they had received. Our hypothesis suggested that the ventromedial prefrontal cortex (vmPFC) and hippocampus would exhibit patterns supporting perceived social feedback memory due to schema-based enhancement, while the ventral striatum would not show such patterns. Utilizing parametric regression analysis, we examined six independent variables: memory for selected faces, memory for non-selected faces, actual social feedback received, perceived feedback, predicted feedback, and the magnitude of bias. Functional MRI data from the encoding phase revealed activations in the perirhinal cortex associated with the magnitude of bias, alongside activations in the ventral striatum linked to predicted feedback response. These results imply that while the vmPFC and hippocampus may facilitate memory processes concerning perceived social feedback, the ventral striatum is predominantly involved in processing predicted feedback responses. The involvement of the perirhinal cortex suggests that social feedback memory during this phase might not involve hippocampal processing but instead rely on other mechanisms, possibly within the perirhinal cortex. These outcomes support our hypothesis regarding the distinct roles of brain regions in differentiating between memory for perceived and predicted social feedback, with the ventral striatum playing a significant role in processing predicted feedback responses. This study enhances our understanding of the neural underpinnings of social feedback processing and memory, contributing to the broader comprehension of social cognition and its neural substrates.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B3 - Investigating the impact of affiliative touch on visual emotional appraisal

Oluwaseun D. Olusanya[1] (oolusany@lakeheadu.ca), James H. Kryklywy[1]; [1]Lakehead University

Many traditional theories of emotional appraisal hold that emotional meaning is gained only after a stimulus is relayed through the primary sensory cortices and other association areas (centralized appraisal). However, accumulating evidence from non-visual modalities show that the valence of a stimulus can be discerned the moment contact is made with the basic sensory organs (decentralized emotional appraisal). However, it remains unknown how decentralized signals of valence influence traditional emotional-appraisal mechanisms. The current work aims to address this gap in understanding, specifically focusing on how affiliative touch influences the visual appraisal. Participants will be presented with either affiliative touch, neutral touch, or no

touch while viewing emotional scenes, and required to rate either the visual or tactile stimuli for its valence and arousal. Affiliative touch is operationalized as brush strokes on the arm (3cm/s). Visual stimuli will include scenes from the International Affect Picture System (IAPS). We expect that affiliative touch will increase valence and arousal ratings for neutral and positive scenes compared to other touch conditions. By contrast, we predict that affiliative touch will reduce arousal ratings of negative scenes compared to other touch conditions but will not impact valence perception. We do not expect visual imagery to impact emotional rating of touch stimuli. This study will further our understanding of how affectively salient stimuli from non-visual modalities influence our emotional appraisal of visual information. Results will help to shape affective haptic technologies both in research and the clinical treatments.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B4 - Investigating the relationship between imagery strength and features of depression and anxiety

Cara Allardice[1] (callardi@lakeheadu.ca), James H. Kryklywy[1]; [1]Lakehead University

While the influence of visual mental imagery on emotional processing and psychopathology is well-established, the mechanism by which imagery strength manifests in psychopathologies remains unclear. Individual differences in imagery vividness for emotional stimuli can impact physiological responses; weak imagers exhibit dampened responses and strong imagers exhibit heightened responses. Imagery strength also varies across emotional valence and diagnostic groups, suggesting that imagery may have distinct impact in different pathologies unique. To address this possibility, we will examine cognitive and physiological responses to both imagined and observed emotional stimuli. Participants will complete an emotional appraisal task, wherein they will be presented with blocks of either images or imagery cues and subsequently asked to rate the emotional valence of each stimulus. During imagery trials, participants will also rate the vividness of each mental image produced. Electrodermal activity (EDA) will be collected to assess physiological arousal during the task. Task performance will be compared to scores on standardized measures of depression and anxiety. We predict that increased anxiety will be associated with greater vividness for affectively negative imagined stimuli while increased depressive features will be associated with reduced vividness for affectively positive imagined stimuli. We further predict EDA activity to reflect both emotion and imagery vividness in an interactive manner. This work aims to provide physiological and cognitive evidence for affect-specific imagery dysfunction in depression and anxiety. Such findings will have significant clinical implications on assessment and treatment protocols, as well as disorder conceptualizations broadly.

Topic Area: EMOTION & SOCIAL: Emotion-cognition interactions

B5 - The future is uncertain - The influence of threat uncertainty on fear generalization

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Fear generalization seems altered in anxiety-related disorders, but underlying mechanisms remain unclear. We explored whether threat uncertainty and a threatening context but also intolerance of uncertainty as a personality trait influence fear generalization. The studies employed a differential threat conditioning paradigm with generalization test using two female faces as conditioned stimuli (CSs) and a 90 dB female scream as the unconditioned stimulus (US). For the generalization test, four morphs were created as generalized stimuli resembling the CSs in 20% increments. Participants' fear responses were recorded by means of affective and US-expectancy ratings, skin conductance responses and steady-state visual evoked potentials. In Study 1 and 2, threat uncertainty was manipulated in three groups with different reinforcement schedules for the CS+. Results showed that despite successful acquisition, uncertainty did not affect fear generalization, but higher individual intolerance of uncertainty was associated with wider generalized responses in the US-expectancy. In Study 3, threat context was manipulated with two-minute presentations of the CSs against a gray background with different arrays of geometrical shapes representing either the safe (CTX-) or the threatening (CTX+) context. Only CS+ in CTX+ was reinforced. During acquisition, responses were generally heightened in CTX+, while affective ratings were not sensitive to the contextual information. Participants did not show differences in generalization, suggesting that threatening context did not significantly influence generalization. Overall, both studies suggest that threat uncertainty and context have limited direct influence on fear generalization, but they impact fear learning which can indirectly affect generalization.

Topic Area: EMOTION & SOCIAL: Emotional responding

B6 - Looking past the past: Adverse Childhood Experiences' Impact on Hostile Attribution and Negative Attentional Bias

Carole Scherling[1] (carole.scherling@belmont.edu), Savannah Campbell[2], Molly Georgas[3], Awen Rolinitis[4], Michael Oliver[5]; [1]Belmont University

Adverse childhood experiences (ACEs) affect nearly half of all children living in the USA. Research demonstrates that higher ACEs correlate with negative biases and higher physiological activity (Deighton et al., 2018). The current study investigated differences in fault-attribution biases between high and low ACEs in 117 undergraduates (age=19.60[1.51]). Participants first completed the Ambiguous Intentions Hostility Questionnaire, where they attributed fault/no-fault to the protagonist in 15 scenarios. Psychophysiological measures of pulse and skin conductance provided event-related benchmarks of task engagement. It was hypothesized that ACEs would increase fault attribution rates, while also presenting higher concurrent pulse and skin conductance responses. Second, a DotProbe investigated emotional biases of happy or angry faces, hypothesized to show faster reaction times for negative stimuli in those reporting ACEs. A Spearman revealed a positive relationship such that higher ACEs demonstrated higher fault attribution rates, $r(111)=0.204$, $p=0.032$. A main effect indicated higher pulse amplitude for high ACEs vs. low ACES, regardless of fault attribution, $F(1, 44)=5.66$, $p=0.022$. Last, a main effect revealed slower DotProbe reaction times for both emotion types in individuals reporting ACEs (413.7[11.11]) compared to no ACEs (377.8[12.5]), $F(2,44)=4.61$, $p=0.038$. Overall, high ACEs revealed higher rates of fault judgments, presented with concurrent increased pulse reactivity. As well, reporting at least 1 ACE may modulate attentional engagement of facial stimuli, as indicated by slower reaction times during the DotProbe. Investigating the burden of ACEs on both behavior and biology is important to emphasize the importance of early childhood experiences and to develop relevant support mechanisms.

Topic Area: EMOTION & SOCIAL: Emotional responding

B7 - Identifying Emotions Par Formats: Intra-brain EEG-Connectivity during Emotion Recognition in Human Faces, Emoji Faces, and Stick Figures

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Evidence suggests humans recognize emotions, not just in other humans but also in inanimate objects. This study aims to demarcate the differences in intra-brain connectivity during recognition of embodied emotions using stick figure configurations as opposed to that in emoji faces and human faces. Fifteen young, healthy adults attempted a visual search paradigm-based experiment in which they recognized positive, negative, and neutral emotions depicted in three formats. Simultaneously, 32-channel EEG recordings at a 1000 Hz sampling rate were acquired, and using Brainstorm software, preprocessed epochs were analyzed using Phase Transfer Entropy. Statistical comparisons for recognition of positive emotions in stick figures, as opposed to negative emotions, revealed weaker connections from P3 to frontocentral areas and strong Cz to F7 connections in the delta band, unlike in positive emoji and human faces conditions, implying reduced need for cognitive control and unique decision making. Weaker frontal to parieto-occipital (FP2 to Pz and O1) connections in the beta band observed during the positive emoji condition imply visual and emotion processing, while a distinctive pattern of weaker T8 to F3 and stronger O2 to T8 connections observed during the positive stick figure condition. Further, in the gamma band, P8 to FP1 and O2 to CP3 connections are found to be stronger during positive emoji faces whilst Pz to Fz connections are strong during positive stick figures. Overall, the findings highlight intra-brain connections during the recognition of embodied emotions involving both unique and comparable differences from human and emoji faces.

Topic Area: EMOTION & SOCIAL: Emotional responding

B8 - The Second Database of Emotional Videos from Ottawa (DEVO-2): Over 1300 Brief Video Clips Rated on Valence, Arousal, Impact, and Familiarity

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We introduce an updated set of video clips for research on emotion and its relations with perception, cognition, and behavior. These 1380 higher-resolution, brief video clips each portray realistic episodes; many are paired with similar alternatives from the same source to serve as foils on a recognition memory test. Undergraduate students rated the videos on Valence, Arousal, Impact, and Familiarity. As expected, Valence and Arousal ratings were related in a U-shaped function, and Arousal and Impact were positively linearly associated with one another. Ratings of Familiarity were near zero on average, verifying that the clips came from obscure sources. Hierarchical cluster analysis revealed that they could be grouped by Valence, Arousal, and Impact for selection of subsets for future studies. The videos can be used in similar ways to static images but have the advantage of being dynamic and thus more ecologically valid.

Topic Area: EMOTION & SOCIAL: Emotional responding

B9 - Your voice is music to my ears

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Comparative studies of music and speech perception suggest that prosodic and musical features, such as melodic contour, dynamics and rhythm, function analogously, providing comparable structural and expressive cues in the two domains. Here, we explore these functional analogies using a novel music production paradigm. In Experiment 1, 17 professional pianists were asked to improvise along two readings of a poem: a slower, softer version (Reading 1), and a faster, louder one (Reading 2). We hypothesized that improvisations based on each reading would differ both along acoustic parameters common to speech and music (such as sound intensity) and along exclusively musical features (such as mode). As hypothesized, improvisations based on Reading 2 displayed acoustic parameters more similar to those observed for Reading 2 than for Reading 1. Improvisations also differed along dimensions not directly comparable to speech parameters. For instance, improvisations based on Reading 1 predominantly used the minor mode, while those based on Reading 2 were generally in major. Results suggest that musicians recreate affective and structural dimensions of speech both by emulating prosodic features and through exclusively musical means, conceived as functionally analogous to prosodic features. In Experiment 2, we tested whether naive listeners would respond differently, in terms of felt emotions, to the improvisations produced for each reading in Experiment 1. Listeners rated improvisations based on Reading 1 as significantly less arousing and pleasant than those based on Reading 2, suggesting that musicians had effectively captured the salient prosodic features of the readings and transduced them into music.

Topic Area: EMOTION & SOCIAL: Emotional responding

B10 - Intracranial neurophysiological mechanisms underlying rumination

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Rumination is uncontrollable, self-reflective, and repetitive thinking about the distress and its possible causes and consequences (Watkins & Roberts, 2020). A wealth of studies has linked it to major depressive disorder (MDD) and indicated its pivotal role in the psychopathology of MDD (Lyubomirsky et al., 2015). Accordingly, a better understanding of its neural basis may pave the way for the next-generation treatment of MDD. Existing evidence from studies using functional magnetic resonance imaging (fMRI) has shown that brain regions of the default mode network (DMN) are involved in active rumination (Zhou et al., 2020). Our previous study further highlighted the enhanced functional connectivity between two subsystems of DMN (i.e., core subsystem and medial temporal lobe (MTL) subsystem) in the neural mechanism underlying the rumination (Chen et al., 2020). To date, no research has investigated the electrophysiological organization underlying the existing functional neuroimaging evidence. Here, leveraging the intracranial electroencephalogram (iEEG) recordings from a group of patients with epilepsy engaging in an active rumination state, we intended to delineate the electrophysiological features of two key nodes from the core subsystem (precuneus) and the MTL subsystem (parahippocampal gyrus). We found dissociated power changes in the precuneus and parahippocampal gyrus during a continuous rumination state as compared to the control condition. Our results unveiled the electrophysiological mechanism underlying the functional coupling between the core and MTL subsystems of DMN during an active rumination state.

Topic Area: EMOTION & SOCIAL: Emotional responding

B11 - Enhancing Resilience: A Novel Fear Conditioning Intervention for Mitigating Social Anxiety in Undergraduate Students

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Social anxiety disorder (SAD) is a highly prevalent anxiety disorder characterized by overwhelming fear in social situations, and it affects ~12% of the population. To reduce anxiety in this population, we used a fear conditioning paradigm to determine the efficacy of the addition of novel tone to replace the unconditioned stimulus during extinction, compared to standard extinction procedures whereby nothing occurs to replace the unconditioned stimulus. Forty undergraduates from UConn who met the criteria for moderate to severe social anxiety were recruited for this study. In a paradigm adapted from Dunsmoor et al., (2015), participants were conditioned to fear one of two angry faces by pairing one of the faces with aversive electrical stimulation to the forearm. Participants then underwent a standard extinction protocol (shock omission) or an augmented extinction protocol (shock omission + novel tone). Physiological fear measures were obtained via electrodermal response. Initial analyses indicate that participants in both groups underwent similar extinction. However, during reinstatement, participants in the novelty-based extinction condition showed significantly enhanced fear reduction to the fearful face compared to participants in the standard extinction condition ($p < 0.001$). These results suggest that the addition of a novel innocuous stimulus to replace the unconditioned stimulus may be beneficial in increasing extinction efficiency, and extensions of this protocol to exposure therapy might be helpful in improving SAD outcomes.

Topic Area: EMOTION & SOCIAL: Emotional responding

B12 - Neural Signatures of Dynamic Emotional Engagement and Disengagement Generalize across Negative Narratives

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Most neuroimaging research of emotional responses relies on discrete emotional stimuli, which fails to capture how emotional experiences dynamically evolve. Movie viewing designs are often considered for their potential to capture these temporal dynamics of emotion. However, they are also known for potentially being confounded by movie idiosyncratic (emotion-unrelated) aspects and thus require generalization across different narratives. We aimed to assess whether dynamic functional connectivity (dynFC) patterns generalize across negative narratives from two independent studies. In Study 1, participants viewed a 5-minute negative and a 5-minute neutral movie clip during Functional Magnetic Resonance Imaging. In Study 2, participants watched a different 10-minute negative movie clip. Participants annotated emotional intensity while rewatching movie clips outside the scanner. We derived two group-based emotional time courses reflecting collective emotional engagement and disengagement during movie viewing. Support vector regression evaluated if dynFC patterns in one movie clip could predict emotion group responses for independent

subjects watching a different narrative. Results show successful prediction of disengagement group responses in one negative movie clip using a model trained on dynFC patterns from individuals in a different study. Cross-predictions failed for the neutral movie clip, suggesting specificity to the negative context. In contrast, engagement responses displayed less consistent results and were also predicted by models trained on individuals watching the neutral clip. Predictions of disengagement across negative narratives and inconsistencies in predicting engagement highlight the intricate dynamics of connectivity and subjective experiences during movie viewing. This work may aid in studying naturalistic emotions' dynamic challenges.

Topic Area: EMOTION & SOCIAL: Emotional responding

B13 - Well, this is awkward! The effects of non-normative behavior during emotional clip viewing

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Emotions are widely known to be universal and self-manifested, but rely on external cues to increase or decrease experiences. Previous work demonstrates the innateness of external influences, even showing microexpressions when watching others emote (Hirsh, 2018). However, what happens to emotional reactivity when emotional displays do not align with expectations? The current study investigated the impacts of non-normative emotional displays on emotional experiences. All participants viewed 2 videos, a first clip with normative confederate behavior (ex: laugh/smile during positive video) and a second clip with non-normative behavior (ex: laugh/smile during negative video). Participants were randomly assigned a viewing order based on valence (positive-negative or negative-positive). Behavior was measured around each video's emotional moment, with pre and post measures of self-reports (valence), pulse and GSR. A 2x2x2 mixed model ANOVA first revealed successful valence manipulations at baseline (normative), with higher self-reports for positive videos (p=0.01). For the non-normative sessions, increased GSR was shown (9.669 vs. 8.869; p=0.035) and self-reports of valence converged towards the mean (p=0.063). These findings indicate increased arousal with unexpected confederate behavior, in association with decreased experience of video valence. Further, non-normative behavior during positive video sessions (vs. normative negative) yielded notable increases in GSR levels (p=0.009), which was not revealed when comparing positive normative to negative non-normative sessions. Overall, non-normative behaviors during viewing sessions influenced both self-reports and physiological reactivity, with a potentially stronger influence when non-normative behaviors present during positive experiences.

Topic Area: EMOTION & SOCIAL: Emotional responding

B14 - Fast auditory and pupillary responses to high temporally modulated sounds suggest the existence of a human magnocellular auditory pathway for threat

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Neural models for emotional processing in vision suggest the existence of an ultrafast magnocellular route to the amygdala, which allows for efficient detection of threat and subsequent adaptive behavior in humans. This route is known to mediate coarse visual processing, eliciting differential responses to threat than other more fine-grained pathways. In the auditory domain, animal evidence suggests the existence of a similar route for threat detection, but it remains unknown in humans. We investigated, with fear conditioning, a procedure that depends on amygdala response, whether a magnocellular pathway to the amygdala, particularly sensitive to high temporal modulations, mediates auditory and pupillary responses to threat that may differ from a parvocellular pathway, sensitive to low temporal modulations. We recorded electroencephalography and pupillometry of 28 healthy participants while they detected voices. Voices were either paired (conditioned) or unpaired (not conditioned) with an unpleasant white noise, which determined their threatening significance. Results suggest that fear conditioning was effective, and threatening stimuli at high temporal modulations elicited earlier auditory and pupillary responses than those presented at low temporal modulations. In turn, early auditory threat responses to high amplitude modulated sounds correlated with response time in higher anxiety participants. These results are compatible with faster cortical responses to threat when encoded through magnocellular inputs to the amygdala, and suggest the existence of an auditory route for threat detection in humans, similar to that in vision.

Topic Area: EMOTION & SOCIAL: Emotional responding

B15 - Identifying direct subcortical pathways of the amygdala within the human auditory system using diffusion weighted imaging tractography

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Quick and efficient detection of threat is critical for survival. To serve this ability, a visual subcortical pathway, is believed to function in humans as a shortcut to the amygdala (a key structure for threat detection), with direct neural projections from the retina, superior colliculus and the pulvinar of the thalamus. Similarly, evidence from non-human animals suggest the existence of a homologous subcortical pathway in audition, but this pathway remains unknown in humans. To address this question, we applied probabilistic streamline tractography and Fixel Based Analysis to diffusion-weighted images obtained from the Human Connectome Project, reconstructed candidate auditory subcortical pathways and correlated their metrics with behavioral data available. Similarly, we examined the existence of an additional subcortical output pathway from the amygdala to the inferior colliculus, previously only described in bats. Our findings suggest the existence of white matter tracks directly projecting to the amygdala from the medial geniculate body of the thalamus and the auditory and audiovisual portions of the pulvinar (i.e. anterior and medial) showing left-right asymmetries. Interestingly, individuals with greater fiber density and number of streamlines in these pathways show a better hearing ability in noise and stronger feelings of fear and anxiety, respectively. These results point to the existence of a human auditory pathway for fast threat detection that may be homologous to that in the visual system. Finally, our evidence suggests the existence of a subcortical pathway connecting the amygdala with the inferior colliculus in humans, which may impose emotional content into sensory stimulus processing.

Topic Area: EMOTION & SOCIAL: Emotional responding

B16 - Decoding Neural Threat Representations Using Shock Prediction Modelling in Women with PTSD Undergoing an Exposure Therapy Task

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Multivariate pattern analysis (MVPA) with support vector machines (SVM) has previously been utilized to decode distributed neural representations unique to threat presentation (i.e., electric shock) and demonstrate that those threat representations reactivate during approach-avoidance decision-making and predict decisions to avoid (Moughrabi et al., 2022). Here, we extended shock prediction modelling to test the hypothesis that traumatic memory recall reinstates neural representations of threat in individuals with posttraumatic stress disorder (PTSD). Women between the ages of 21-50 years old (N = 40) diagnosed with PTSD created personalized traumatic memory and neutral memory narratives. Participants then completed an analogue exposure therapy task, in which they read and listened to these narratives while undergoing fMRI, with four repetitions to each memory narrative. A threat decoder was trained on a separate dataset of participants completing an approach-avoidance task with an electric shock threat stimulus. This threat decoder was then applied to the voxel activity during the trauma vs neutral narratives, allowing us to test whether trauma memory recall engages neural representations of threat. When this decoder was trained within a specific anterior insula/inferior frontal gyrus network, resulting threat predictions were significantly higher for trauma compared to neutral narratives, $t(1560) = 3.3$, $p < .001$. When the threat decoder was trained on all grey matter voxels, there was less robust evidence for greater threat predictions in trauma vs neutral narratives, $t(1560) = 2.04$, $p = 0.045$. These findings shed light on the neural mechanisms underlying exposure therapy, offering novel insights to improving PTSD treatment strategies.

Topic Area: EMOTION & SOCIAL: Emotional responding

B17 - Unraveling the Fear Circuit: A Novel Computational Model of Fear Acquisition, Extinction, and Subsequent Recovery

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Animals gradually lose fear responses they had previously acquired toward a stimulus. Such fear extinction is both context-specific and temporary – the fear returns immediately if the animal is placed in a new context (Renewal), or after a long delay within the extinction context itself (Spontaneous Recovery). Since exposure therapy in anxiety-based disorders relies primarily on fear extinction mechanisms, understanding these mechanisms is fundamental to ensuring long-term and context-general solutions for these disorders. Using recent findings about the fear circuit in animal brains as reference, we propose a novel computational model of fear acquisition, extinction, and subsequent return. The key features of our model include [1] Distinct pathways to process cue (sensory cortex to Basolateral Amygdala (BLA)) and context information (Hippocampus to Basolateral Amygdala (BLA)) [2] Cue and context inputs connecting to distinct BLA populations (negative and positive reward-responsive regions) [3] Competition between these BLA populations to determine the final fear response. [4] Connection weight updates based on the presence and valence of external reward and stored BLA responses to presented stimulus based on previous trials (memory engrams). [5] Distinct learning rates and thresholds for cue and context pathway weight updates. And [6] Decay of context-pathway connections. This model produces both Spontaneous Recovery and Renewal effects and also demonstrates differences between different kinds of extinction by changing extinction contexts or pairing the conditioned stimulus with a positive reward. The model also provides novel, testable hypotheses about how fear extinction is implemented in the brain.

Topic Area: EMOTION & SOCIAL: Emotional responding

B18 - Would I eat this? Event related potentials to appropriate and inappropriate food combinations

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The rejection of an item as food is central to the concept of disgust, including substances that are considered inappropriate. While certain foods may be acceptable to eat as they are, they may become inappropriate when paired with other items (i.e., the combination itself is disgusting). This study used event-related potentials (ERPs) to measure the neural responses to appropriate (e.g., cheese & crackers) and inappropriate food combinations (e.g., bananas & ketchup). It was predicted that relative to appropriate combinations, inappropriate food combinations would capture attention and elicit avoidance-related tendencies, which should be reflected in ERP amplitudes and distributions. Eighteen undergraduates (6 males) viewed pairs of food words and indicated their willingness to eat the combination while EEG was monitored. Inspection of averaged ERP waveforms revealed a frontocentral positivity peaking between 275-425 ms corresponding to the P3a, the peak amplitudes and latencies for edibility judgments to appropriate vs. inappropriate pairs were examined. Analyses revealed that while latencies of the P3a did not differ as a function of condition; $F(1,17) = 0.64$, $p > .05$), P3 peak amplitudes were higher for inappropriate food pairings relative to appropriate ones; $F(1,17) = 5.89$, $p < .05$, such that P3a amplitudes were more positive for inappropriate vs. appropriate pairings ($M = 9.02$ vs. 7.91 μV respectively). Although preliminary, these results support interpretations of the P3a as an index of salience (larger for unexpected and inappropriate food combinations) and may also be sensitive to motivational processes recruited in self-relevant judgments.

Topic Area: EMOTION & SOCIAL: Other

B19 - Brain networks underwriting face pareidolia

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Face pareidolia is a tendency to seeing faces in non-face images such as waves or landscapes that reflects high tuning to a face scheme. Yet studies of the brain networks underwriting face pareidolia are trickle and rather controversial. Here, we analyzed the time course and dynamic topography of gamma oscillatory neuromagnetic activity while non-face images resembling a face were presented either with canonical orientation or with display inversion that heavily impedes face pareidolia. At early processing stages, the peaks in gamma oscillatory responses (35-45 Hz) for images triggering face pareidolia or not originated mainly from the right medioventral and lateral occipital cortices, rostral and caudal cuneus gyri, and medial superior occipital gyrus. Yet the difference occurs at later processing stages (beyond 600 ms) in the higher-frequency range of 80-85 Hz over a set of the areas constituting the social brain such as the right posterior superior temporal sulcus (STS) and insular gyrus communicating with each other. The findings speak for a relatively late-established neural network playing a decisive role in face pareidolia.

Topic Area: EMOTION & SOCIAL: Other

B20 - Heightened E/I ratio associated with PTSD and alpha-frequency dysconnectivity between the Visual Cortex and Default Mode Network

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Deficiency in power of alpha oscillations in the default mode network (DMN) and visual cortex (VC) and in alpha-frequency directed connectivity between the two systems has been associated with posttraumatic stress disorder (PTSD) (Clancy, et al., 2017 & 2021). However, the mechanism of this deficiency has not been elucidated. To address that gap in the literature, we investigated cortical excitation and inhibition (E/I) balance in patients with PTSD (N=25) and its association with alpha power and alpha-frequency connectivity for key areas of the DMN and the visual cortex VC, relative to two control groups [patients with generalized anxiety disorder (GAD; N=24) and healthy controls (HCs; N=20)]. High-density electroencephalogram (hdEEG) was recorded in a standard eyes-open resting state (S-RS) and a modified resting state (M-RS) of passively viewing salient images, from which aperiodic (1/f-like) exponent of resting-state EEG power spectrum (indexing E/I balance) and source-level alpha connectivity (Granger causality) was extracted using the exact low-resolution electromagnetic tomography(eLORETA). Our findings revealed that PTSD patients exhibited a significantly higher E/I ratio during S-RS compared to control groups. Additionally, diminished alpha-frequency connectivity from VC to the posterior hub of the DMN (posterior cingulate cortex/PCC) and from the anterior hub of the DMN (medial prefrontal cortex/mPFC) to PCC was observed in individuals displaying higher E/I ratios across both S-RS and M-RS. These results suggest an association between heightened cortical excitation or weakened cortical inhibition and reduced connectivity to PCC. Results also highlight the potential role of elevated E/I ratio as a mechanistic biomarker of PTSD.

Topic Area: EMOTION & SOCIAL: Other

B21 - Resting rhythmic activity and anxiety

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The need to find an objective, physiological marker for anxiety processes and disorders is paramount to both Neuroscience and Psychiatry. We examined whether resting state rhythmic electrophysiological (EEG) activity could predict anxiety and serve as a biomarker. EEG was recorded during rest (two cycles alternating 1-minute eyes open and 1-minute eyes closed). The EEG signal was analyzed for oscillations using the oscillation detection method, BOSC (Better OSCillation detection; Whitten et al., 2011). Anxiety was assessed according to the State/Trait Anxiety Inventory, Ten-Item Personality Inventory, and BIS/BAS scale. Linear regression was conducted to ask if anxiety scores are predicted by theta (4-8 Hz), alpha (8-13 Hz) or beta (12-27 Hz) oscillations recorded at the mid-frontal (Fz) electrode. The model predicting the BIS anxiety scale and all three frequency bands during both eyes open and eyes closed states was significant and driven by theta ($t(45)= 2.409$, $p=0.021$) and alpha oscillations ($t(45)= -3.202$, $p=0.003$) during the eyes-open condition. With Bayesian analysis, there is substantial evidence that theta and alpha oscillations during eyes open and only alpha oscillations during eyes closed should be included in the model as reliable predictors of anxiety. To our knowledge, this is the first report of frontal midline resting alpha and theta oscillations predicting personality measures of anxiety, and the results suggest avenues for biomarker development.

Topic Area: EMOTION & SOCIAL: Other

B22 - Cerebellum-Midbrain Reward Circuitry in Humans: an in vivo dissection with implications for socio-affective functioning

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Emerging research in non-human animals implicates cerebellar projections to the ventral tegmental area (VTA) in social and reward driven behaviors, but the circuits have not been characterized in humans. In this study, we mapped the cerebello-VTA structural connectivity in humans. We visualized and measured the structural connections by performing probabilistic tractography on diffusion weighted imaging data from the Human Connectome Project (HCP). We uncovered the topographical organization of the connections by separately tracking from parcels of cerebellar lobule VI, crus I/II, vermis, paravermis, and cerebrocerebellum. The results revealed that afferents from the cerebellum to the VTA predominantly originate in medial aspects of the right cerebellum and terminate mostly in ipsilateral VTA. The paravermis of Crus I, traveling through the interposed nucleus, sent the most connections to the VTA compared to the other lobules. Next, we examined the role in these tracts in social and affective functions by taking the tracts with the highest density, computing microstructure, and correlating with measures of affect, social functioning, and personality traits. We identified robust associations across multiple socio-affective domains. Taken together, we produced detailed maps of cerebello-VTA structural connectivity for the first time in humans and showed that this network plays a key role in driving socio-affective dysregulation in a normative sample.

Topic Area: EMOTION & SOCIAL: Other

B23 - The Neural Architecture of Interpersonal Cultural Conflicts

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Culture shock is an experience a person may have when she/he interacts with others having different cultural backgrounds. Although culture shock is ubiquitous in all cross-culture interactions, its neurocognitive mechanism remains elusive. In this study, we addressed this issue by asking 31 American and Chinese participants with limited other-culture experiences to freely discuss a topic. Their brain activities were simultaneously collected using functional near-infrared spectroscopy (fNIRS) hyperscanning. Here we used the dissimilarity in multi-dimensional cognitive representation to index culture conflicts. Through combining natural language processing (NLP) and behavioral assessment, we identified two aspects of culture-relevant cognitive conflicts, one at the level of semantic representation and the other at the level of cultural value representation. Moreover, we calculated Interpersonal Neural Synchronization (INS) between interlocutors for both within- and across-culture interaction, revealing decreased INS in across-culture interaction than in within-culture interaction. Additionally, by applying Interpersonal Representational Similarity Analysis (IP-RSA), INS between the medial prefrontal cortices of both individuals (mPFC-mPFC) was found to be associated with cultural value conflict, while that between the right middle temporal gyrus of Chinese and the left temporoparietal junction of American (rMTG-lTPJ) was found to be associated with semantic conflict. Finally, using Granger Causality Analysis (GCA), we found a bottom-up flow of the cultural conflict from the level of semantic representation to the level of cultural value representation. Together, these findings indicated a multi-layer hierarchy for the cognitive representation of cultural shock, with redacted INS between different brain regions of interlocutors supporting this distinct cognitive hierarchy.

Topic Area: EMOTION & SOCIAL: Other

B24 - Comparative Analysis of Social Cognitive Performance Across Autism Spectrum and Schizophrenia Spectrum Disorders

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Social cognitive deficits, notably in low-level emotion processing and high-level mental state attribution, are central to both autism spectrum disorder (autism) and schizophrenia spectrum disorders (SSDs). Research in this area is marked by heterogeneity and small sample sizes, limiting a comprehensive understanding of these overlapping impairments. This transdiagnostic study evaluated social cognitive performance in 100 individuals with autism (16-35 years), 276 with SSDs, and 209 typically developing controls (16-55 years). Assessments included an established battery of low-level (Penn Emotion Recognition Test, ER-40; Reading the Mind in the Eyes Test, RMET) and high-level (The Awareness of Social Inference Test, TASIT; Empathic Accuracy Task, EA) social cognitive measures. Kruskal-Wallis and Dunn's tests with FDR corrections were employed for between-group comparisons. Significant between-group differences were noted in all tasks (all $p<0.001$). SSDs consistently scored lower than controls (all $p<0.001$), whereas autistic-control differences were found for TASIT-1, TASIT-2-Simple/Paradoxical-Sarcasm and TASIT-3-Lies (all $p<0.01$), and ER-40 ($p<0.01$). Autistic individuals outperformed those with SSDs on most tasks (all $p<0.001$), except TASIT-1, TASIT-3-Lies, and ER-40. Different social cognitive patterns emerged among the groups. Compared to controls, SSDs showed broad impairments, aligning with prior findings of low and high-level social cognitive impairment, while autism exhibited more selective impairments on specific emotion recognition and mental-state attribution tasks. This research highlights shared, and disorder-specific patterns related to social cognitive challenges in our transdiagnostic sample, suggesting the potential efficacy of similar interventions across both disorders. Further research is needed to explore factors contributing to these differences, such as IQ and neurocognitive performance.

Topic Area: EMOTION & SOCIAL: Other

B25 - Harnessing Visual Unawareness in the Modulation of Fear

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Anxiety and fear-related disorders are prevalent mental health problems. Exposure therapy is an evidence-based intervention for modulating fear and anxiety. However, negative emotional responses might be elicited during exposure and pre-mature dropouts are common. There is evidence suggesting that emotional processing and learning can take place without conscious awareness. Using a Pavlovian Conditioning model, the current study examined whether acquired threat could be modulated outside of visual awareness and the relevant neural mechanisms. In this 2-day fMRI study, participants learned to associate an aversive scream (unconditioned stimulus, US) to female faces (conditioned stimuli, CS) followed by extinction of the threat association on Day 1 and a test of return of fear on Day 2. Continuous flash suppression was employed to manipulate visual awareness during extinction, with moving circles presented to the dominant eye and the CS presented to the non-dominant eye in the unaware condition. Pupil dilation was recorded during the acquisition phase, whereas event-related bold signals were collected during the extinction and re-extinction phase. Results of the pupillary response indicated successful fear learning in the acquisition phase. In the extinction phase, enhanced activation in the dorsolateral prefrontal cortex (dlPFC) was observed during the presentation of CS+ compared to the trials of CS-, either within or outside of visual awareness. Our findings suggested that conditioned threat responses might be modulated outside of visual awareness, with the involvement of dlPFC.

Topic Area: EMOTION & SOCIAL: Other

B26 - Ideological brains: mapping individual variations in national ideology on variations in brain dynamics during a naturalistic viewing paradigm

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Since the mid-20th century, the complex interplay of two distinct ideologies, especially regarding the China-Taiwan relationship, has been prominent among individuals who live in Taiwan. This study investigates how Greater Chinese and Taiwanese Refinement ideologies influence brain dynamics and subjective experiences in two independent studies. In Study 1, 52 participants (22 males, 30 females; mean age 21.15) watched a Pro-China video. Those with a stronger Greater Chinese ideology reported higher liking

(r = 0.516, p < 0.001) and feelings of resonance (r = 0.426, p = 0.001), while Taiwanese Refinement ideology had no significant effect on these feelings (liking: r = -0.019, p = 0.894; resonance: r = 0.070, p = 0.622). Study 2 involved 60 participants (28 males, 32 females; mean age 22.05) undergoing fMRI while viewing the same video. Intersubject representational similarity analysis showed that Greater Chinese ideology corresponded with similarity in brain dynamics in areas related to executive control processing, including the dorsal anterior cingulate cortex (dACC), dorsolateral prefrontal cortex (DLPFC), supplementary motor area (SMA), and insula, as well as areas involved in reward processing, such as the orbitofrontal cortex (OFC) and nucleus accumbens (NAcc). No significant brain dynamic associations were found for Taiwanese Refinement ideology. This research demonstrates that national ideologies significantly impact subjective experiences and neural processing when exposed to ideologically congruent stimuli. It highlights the profound effects of individual ideological differences on cognitive processing in response to ideologically charged content, indicating a complex relationship between personal ideology and brain dynamics.

Topic Area: EMOTION & SOCIAL: Other

B27 - Interbrain visual entrainment induces increases in dyadic cooperation

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Most hyperscanning studies show that individuals synchronize their brain activities when they engage in social interactions, posing such inter-brain synchrony as a mechanism supporting social activity. However, as social interactions afford similar stimulation for the involved subjects, it has proven difficult to test whether the observed synchrony corresponds to a genuine neural mechanism or is rather spurious due to similar stimulation. To address this problem, we implemented for the first time an interbrain sensory entrainment paradigm, which allowed us to manipulate brain synchrony between interacting partners in terms of frequency and phase. We added flickering stimuli to a classical cue-target cooperation task to visually entrain twelve same-sex dyads in four blocks. At each block, participants were entrained at 16 Hz or 40 Hz, and either synchronously or asynchronously (delayed flickering onset) between them. Sixteen same-sex control dyads performed the same task without any flickering. We found that: i) overall cooperation rates were significantly higher for the entrained group compared to control group; ii) cooperation rates under 16 Hz synchronous entrainment was significantly higher than under 16 Hz delayed-onset and iii) 40 Hz entrainment protocols had no effect over cooperation rates. Additional permutation tests against shuffled pseudo-dyads further confirm the observed differences. Using fine-controlled, rhythmic sensory stimulation, we demonstrate that affecting the degree of neural synchrony between interacting partners yields clear changes in their interpersonal behavior, thus supporting the notion that inter-brain synchrony is not a spurious phenomenon and, conversely, is a genuine neural mechanism supporting social interactions.

Topic Area: EMOTION & SOCIAL: Other

B28 - Lower Rate of Default Mode Network Functional State Changes are Associated with Greater Psychological Resilience

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Globalization and modernization amplify psychological challenges, posing a substantial mental health obstacle. Understanding how to maintain resilience in human brain processes is crucial in this context. This study evaluates a biomarker of psychological resilience using brain functional state changes measured with resting-state functional magnetic resonance imaging (rs-fMRI). 336 healthy subjects (165 females) completed a rs-fMRI scan, the Connor-Davidson Resilience Scale (CD-RISC), Brief Resilience Scale (BRS), and Resilience Scale for Adults (RSA). We define psychological resilience as a dynamic state of mind maintaining stable neurocomputational functioning despite external fluctuations. Moreover, we expected stability in overall mental states to particularly manifest within the Default Mode Network (DMN). Thus, to quantify DMN stability, activities of all DMN voxels for each time point were projected onto a 2-D space using multidimensional scaling (MDS) to represent mental state transitions over time. Individual indices of DMN stability (DMNmV) were then derived from the average distances between state coordinates at consecutive time points. Behaviorally, principal components analysis (PCA) was applied to the resilience scales across participants, such that PC1 captured fundamental resilience features common to all three scales, while PC2 captured resilience derived more from personal abilities than interpersonal resources. Across many analyses of reliability, validity, and head-motion concerns, we found that DMNmV negatively correlated with PC2 (r = -0.18**), suggesting that individuals relying on personal abilities for resilience have higher DMN functional stability. This approach holds promise as a reliable objective biomarker of mental health that might contribute to development of targeted interventions for mental well-being.

Topic Area: EMOTION & SOCIAL: Other

B29 - Low-level acoustic feature perception differs across affective prosody

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Affective prosody, encompassing intonation, stress, and rhythm, plays a pivotal role in conveying emotional information in speech. Impaired perception of affective prosody is associated with several psychiatric conditions. It remains unclear how speaker emotion might affect the perception of subtle differences in low-level acoustic features like loudness and pitch. This study investigated participants' (n = 40 (12 male), mean age = 18 years (18-24)) ability to perceive pitch and loudness manipulations in recordings of semantically neutral sentences spoken in affective prosody (angry, happy, neutral). Accuracy in perception of acoustical feature variation was influenced by prosodically conveyed affective state for both loudness ($F(1,74) = 4.3$, $p < .017$, partial $\eta 2 = 0.1$) and pitch ($F(1,74) = 8.2$, $p < .001$, partial $\eta 2 = 0.18$). Participants were more sensitive to loudness for angry and neutral (both $p = .033$) compared to happy prosody. Pitch sensitivity was higher for neutral compared to affective prosody (angry $p = .002$; happy $p < .001$). Exploratory correlation analyses suggested associations between pitch sensitivity and socially relevant psychopathology traits: participants with higher levels of social anxiety and autistic social symptoms showed higher accuracy. In conclusion, our findings suggest that speaker emotion affects the ability of humans to hear low-level acoustical structure of speech. Additionally, perceptual accuracy may be indicative of differences in social functioning with relevance for psychopathology. Future studies, currently underway, will investigate specificity to acoustic features independent of affective prosody, individual differences in larger samples, relevance for psychiatric diagnosis, and underlying neurobiological mechanisms.

Topic Area: EMOTION & SOCIAL: Other

B30 - Sharing Goals with Human and Non-Human Agents: A Neurofunctional Investigation

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Motor interactions imply relating to another human (social dimension) whose contribution is needed to achieve a goal that could otherwise not be achieved (goal-related dimension). We explored whether these two dimensions characterizing collaborative exchanges modulate the neuro-cognitive processes recruited by agents when an interaction partner makes a mistake. In an event-related functional magnetic resonance imaging experiment, 24 young and healthy participants played sequences of notes in turn-taking with a co-actor that was believed to be either another participant or the computer (Human vs. Non-Human co-actor, social manipulation) during an Interactive and Non-Interactive context. While in the Non-Interactive context the partner's performance was irrelevant, in the former the participant and the partner together accumulated points when performing the correct sequence (manipulation of the goal-related dimension). In 50% of the trials, the co-actor made a mistake. The partner's accuracy (Correct action vs. Error) modulated the neural activity in areas responsible for action monitoring (including fronto-parietal and fronto-opercular regions) in both contexts and with both co-actors. However, while neural activity in the posterior medial frontal cortex and right frontal operculum (responsible for own action monitoring) predicted the agents' post-error behavioral adaptations in the Interactive context, in the Non-Interactive context they correlated with the parietal activations responsible for exogenous attention. Moreover, only in the Interactive context, the activation patterns of error-related neural activity enabled to decode the partner's (human vs. non-human) nature. Altogether, these data suggest that the social and goal-related dimensions of joint actions concur in determining neurocognitive responses to a partner's behavior.

Topic Area: EMOTION & SOCIAL: Other

B31 - Audience effects are associated with widespread prefrontal activity and physiological changes

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Being watched causes changes in performance on many tasks, both social and non-social, but the cognitive and neural mechanisms underlying these audience effects are not yet fully understood. This study aims to elucidate the neural and physiological correlates of audience effects in naturalistic face-to-face settings. Wearable fNIRS brain imaging (22 channels over prefrontal cortex), ECG and behavioural data were collected while 49 participants completed easy or hard mental arithmetic tasks in three within-participant conditions: no audience, mere presence (two people with their back to the participant) and visible audience (two people watching the participant). Results showed a large effect of being watched (compared to mere presence or no audience) across prefrontal cortex, with more brain signal in 16 of 22 channels ($p<0.05$, Bonferroni corrected). These effects were stronger in the easy task blocks than the difficult task blocks. When being watched, heart rate increased and heart-rate variability decreased, indicating more arousal. Behavioural task performance varied between participants and, on average, was unchanged across audience conditions. Facial motion was higher in both visible audience and mere presence conditions compared to no audience. These results indicate that both arousal and the desire to manage one's reputation in the presence of others impact on brain activity patterns when participants are being watched. We discuss the results in terms of theories of audience effects and the importance of studying real-world social interactions.

Topic Area: EMOTION & SOCIAL: Other

B32 - Examining the Neural Correlates of mTBI-related PTSD and Symptom Severity

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Posttraumatic Stress Disorder (PTSD) disrupts lives and carries high social, health, and economic burdens for individuals and society. PTSD is more prevalent in certain subgroups including military service personnel (MSP). Extant findings indicate that PTSD is associated with worse biological, psychological, and social outcomes after a mild traumatic brain injury (mTBI). Here we aim to examine the neural correlates of mTBI-related PTSD in this population to elucidate the pathophysiology of both conditions and to build predictive models to identify MSPs most at risk of developing persistent symptoms. We used PubMed, EMBASE, and ScienceDirect to conduct a systematic search for recent studies using resting-state functional magnetic resonance imaging in mTBI-related PTSD. Our systematic review processes yielded 33 studies for our review sample with 2,983 participants. Article quality was assessed using the QUADAS-2 instrument. Our forest plot meta-analysis showed that PTSD/mTBI had a more significant effect on trauma symptom severity than PTSD alone ($g = 1.82$). Effects between mTBI subgroups were explored. Our ALE meta-analysis identified numerous dissociable nodes of hyper- and hypoconnectivity at rest between both groups. Our linear regression identified a significant correlation between increased symptom severity and functional connectivity among MSPs with PTSD/TBI. Our funnel plot also indicated that our review sample presented a minimal risk of publication bias ($p = .710$). Our findings may contribute to prediction models for symptom severity and treatment.

Topic Area: EMOTION & SOCIAL: Other

B33 - Increased reward generalization underlies risky social decision-making in adolescents

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Adaptive learning hinges on accurate credit assignment—our ability to bind observed outcomes to the appropriate cause so that behavior can be flexibly tailored to a specific context. Our prior work suggests that the prefrontal cortex (PFC) allows such differentiation to unfold by selectively binding observed outcomes to the appropriate source in memory. In the current study, we compared how adolescents—a population characterized by increased sensitivity to social feedback and less matured PFC circuitry—assign credit in social situations. We used a cross-sectional design (N = 28 adults, N=26 adolescents) to examine how the development of key PFC pathways impacts learning in a trust task that requires careful differentiation between trustworthy and untrustworthy partners. A Reinforcement Learning model that quantities how precisely an individual updates their knowledge of each partner showed that adults are more precise when assigning credit for rewarding outcomes (i.e., carefully matching one's trust behavior to each partner) compared to losses which were attributed to all partners. The precision of credit assignment was also mirrored in the distinctiveness of partner-specific neural representations in the PFC. In contrast, adolescents were less precise than adults at assigning credit, particularly for rewards, which were more likely to be attributed to all partners. This pattern was accompanied by riskier investments in the trust task and less differentiated neural representations in the PFC. These results provide initial evidence that the protracted development of prefrontal circuits may underlie reduced specificity of credit assignment in adolescents, facilitating a pattern of risky social decision-making.

Topic Area: EMOTION & SOCIAL: Other

B34 - Covert and spontaneous brain to brain interactions during memorization of simultaneous images

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Many times, science starts by reporting facts that cannot be explained. This is the aim of the present work. With methods that have been refined for 10 years our goal is to see whether one can definitely confirm surprising facts. Two previous works report that the event-related brain potentials (ERPs) that are evoked by presenting a picture to a participant can be modulated by simultaneously and privately presenting a picture to a partner. A reprocessing of the data of these works showed that these modulations existed only, or mostly, in precise circumstances, which were then copyrighted. A new experiment was thus run only in those circumstances to make sure simple and robust effects can be replicated in those precise circumstances. We recorded the ERPs evoked by presenting, at each trial, the photograph of a face to the participants. Simultaneously and again, privately, we presented the same face or a different one to the partner. (S)he was in an adjacent room and could not communicate with the participant. The ERPs of these partner-participants were found to strongly depend on the sameness of the two photographs, unbeknownst to them. These joint processing effects (JPEs) confirm that a simple and robust method can be used to study the sensitivity of the human brain to the brain activity of another person. This should help future works answering the many questions raised by this sensitivity, starting with the nature of the physical phenomenon at stake.

Topic Area: EMOTION & SOCIAL: Person perception

B35 - Attraction is Altered via Modulation of the Medial Prefrontal Cortex: A Novel Application of Repetitive Transcranial Magnetic Stimulation

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Previous studies have demonstrated that an individual's physical attraction fluctuates based on numerous factors including varying neural activations. By utilizing rTMS, we assessed if individuals who underwent rTMS were rated more attractive. In Phase 1, subjects (N=10) who received rTMS and had their photographs taken after each of 5 stimulation conditions in addition to making self-ratings across a number of variables including attractiveness. Phase 2 participants (N=430) rated 5 pictures of each of the Phase 1 individuals on attractiveness. It was found that there was no significance in self-assessment between any of the brain regions after being stimulated in terms of response (Phase 1). Attractiveness ratings differed significantly in Phase 2. There was a significance between 10 Hz TMS to the MPFC ($p<0.001$) in that the individual were rated as less attractive. Furthermore, 1 Hz TMS to the MPFC increased the number of 'Most Attractive' ratings while 10Hz TMS decreased the number of 'Most Attractive' ratings ($p's<.001$). These results suggest that the MPFC plays a role in attractiveness to others. These data also support research that one's own feelings of attractiveness may not be indicative of others' perceptions. To our knowledge, no investigations have examined how brain stimulation may influence one's attractiveness.

Topic Area: EMOTION & SOCIAL: Person perception

B36 - Autism and Social Affiliation Choices: Structural Neuroimaging Insights into the role of Similarity Judgments

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Autism spectrum disorder (ASD) is characterized by social interaction difficulties and limited connectivity. This study explored social affiliation in ASD, using a 'choose-your-own-adventure' game during neuroimaging sessions with 70 high-functioning ASD adults and 78 typically developing (TD) peers. The game involved decisions indicating social affiliation, like sharing information. We examined the correlation between participants' subjectively perceived similarity with game characters and their affiliation choices, finding a significant difference in ASD versus TD groups ($p = 0.018$). In ASD individuals, perceived similarity is closely linked to social affiliation, a pattern not observed in the TD group. This association explains about 20% of the variance in affiliation choices in ASD and is consistent across demographics. Online studies using the Broad Autism Phenotype Questionnaire replicated this result ($p = 0.020$), suggesting individuals with autism phenotype prefer interactions with those they perceive as similar, likely due to a need for predictability. Structural neuroimaging analysis reveals significant effects in the mentalizing network, particularly the anterior cingulate cortex (ACC) and right superior temporal sulcus (STS), indicating distinct social processing strategies in ASD. In ASD, a larger ACC volume is associated with less perceived similarity (significant interaction of group and ACC on similarity, $p = 0.01$). STS volume shows a similar interaction pattern (interaction $p = 0.032$). Since ACC and STS are associated with prediction error signals in social learning and perspective-taking, these findings highlight unique cognitive processes in ASD for similarity judgments in social contexts, warranting further investigation.

Topic Area: EMOTION & SOCIAL: Person perception

B37 - Happy and angry facial expressions are processed independently of task demands and context congruency – An ERP Mass Univariate Analysis

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Neural decoding of others' facial expressions is a critical first step in social interactions. Whether this decoding is influenced by task demands and by context remains debated. A previous study from our lab investigated these potential modulations using event related potentials (ERPs). We presented neutral faces paired with negative or positive situational sentences, followed by the same individuals' faces expressing happiness or anger, as if reacting to the situation in a congruent or incongruent way. In this within-subjects design, participants discriminated between the two expressions (emotion task) and identified if the situation and emotional expression matched (congruency task). The original publication analyzed ERP data following expression onset with a classic approach, focusing on specific electrodes and time points, an approach known to inflate type I and type II statistical errors. The present project re-analyzed these data across the entire epoch and scalp using LIMO EEG, a robust hierarchical Mass Univariate Analysis toolbox. We found significant effects of expression during the N170-P2 interval (113-234ms), and a main effect of congruency around a P3 or LPP-like component (236-398ms). Congruency interacted with task, being significant in the congruency task only, suggesting a limited and task-dependent influence of semantic context. Importantly, emotion did not interact with any factor, suggesting facial expressions were decoded automatically, regardless of context or task demands. The results and their discrepancies with the original findings will be discussed in the context of ERP statistics and the replication crisis.

Topic Area: EMOTION & SOCIAL: Person perception

B38 - Activity in default mode network discriminates between personally familiar and experimentally familiar faces in older adults

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The ability to recognize a personally familiar face, such as a loved one, is a cognitive function used in everyday life. However, adults diagnosed with Alzheimer's disease (AD) experience an impairment of this ability, which contributes to the negative impact AD has on quality of life. Here, we used functional magnetic resonance imaging (fMRI) to characterize differences in neural activity related to face recognition in older adults with and without indications of mild cognitive impairment (MCI), a clinical precursor to AD. Specifically, we examined differences in brain activity evoked by recognition of personally familiar (PF) faces, experimentally familiar (EF) faces of strangers, and novel faces of strangers. Participants used a digital camera to capture standardized images of people they deemed personally familiar. EF faces were learned in a series of lab-based encoding tasks. Participants were asked to discriminate between the three categories of faces (PF, EF, and novel) during functional neuroimaging. We hypothesized discernible differences in neural activity for the different face categories. Our results revealed a differentiation for PF and EF faces in the default mode network (DMN). Specifically, medial parietal cortex, medial prefrontal cortex, and lateral temporal cortex were significantly more active for PF than either EF or novel faces. No significant differences were observed between EF and novel faces at the level of whole-brain univariate activation profiles. These results align with the role of the DMN in self-referential processing and the cognitive processes involved in person identity recognition.

Topic Area: EMOTION & SOCIAL: Person perception

B39 - Neural mechanisms of BeMim: copying of choices leads to liking and temporoparietal brain activity

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Being mimicked (BeMim), the state of having your own actions copied by another person is believed to lead to liking and affiliation. To understand the neural and cognitive mechanisms behind this effect, we used fNIRS to track brain activity in two groups of participants experiencing different types of mimicry. Choice BeMim participants pointed to a painting and then saw a confederate who liked the same/different painting. Motor BeMim participants pointed to a painting and then saw a confederate make the same/different arm movement to another painting. Brain activity in the temporal and parietal cortex was recorded throughout using fNIRS. Behavioural findings demonstrated a robust liking effect for Choice BeMim, providing evidence that mimicking choices yields significant benefits in social perception. This effect was also reflected by the activation patterns within the temporoparietal junction (TPJ) during BeMim trials compared to No-BeMim trials. Additionally, we observed increased activation in the Mirror Neuron system (MNS) during Choice BeMim trials compared to the baseline and Choice No-BeMim trials. These activation patterns suggest that the MNS plays a role in interpreting the decisions of a Choice mimicker across the interaction. Conversely, for Motor BeMim, we identified a subtle behavioural liking effect with no activation in TPJ or MNS. These outcomes suggest that mimicking choices may be a more influential factor in likability judgments than mimicking motor movements.

Topic Area: EMOTION & SOCIAL: Person perception

B40 - Faces and their race and emotional expressions influence investment choices.

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Human faces relay social information and implicitly shape choices in a variety of scenarios. Prior research has begun investigating the influence of faces during experimental exchange tasks. However, it is unclear if facial features such as race or expression influence economic decisions across different levels of investment opportunities. We examined the impact of facial features of race and expression on viewers' evaluation of and choice to invest in funds that systematically varied in their past performance. During each trial of an online investment task, 25 participants sequentially viewed information about investment funds, rated each fund's potential for return, and decided whether or not to invest in the fund. Each fund was paired with a manager's face that varied in race (Black or White) and expression (Neutral or Smiling). Participants rated each fund's potential for return and chose whether to invest (Yes/No). We predicted that faces would influence investment decisions, and specifically (1) smiling versus neutral faces, and (2) own- versus other-race faces increase fund ratings and investment. We found that past performance influenced participants' ratings and

choice of investment as predicted. Meanwhile, facial expressions interacted with race and funds' past performance in modulating investment decisions ($P < 0.001$), as positive expressions promoted investment in higher-performing, Black-led funds. These findings extend work on faces in the context of economic exchange tasks by indicating that facial features such as race and emotional expression influence choice to invest in financial funds. Future work will test the separate contributions of race and expression.

Topic Area: EMOTION & SOCIAL: Person perception

B41 - Are Facial Motion Cues Sufficient for Recognizing Facial Expressions?

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Our ability to extract meaning from facial expressions is critical for our social interactions. Recent work has proposed a third visual pathway specialized for motion processing, which may be vital for understanding facial expressions. While prior research on facial expression perception has typically used static facial expressions, dynamic facial motion, particularly of eyes and mouth, has recently been shown to improve recognition of facial expressions. Thus, we are interested in examining whether facial motion cues—in the absence of underlying facial features—are sufficient for recognizing facial expressions. To answer this question, we converted dynamic video stimuli of various facial expressions into random dot kinematograms (RDKs) using the underlying optic flow information in the videos. These videos include seven facial expressions—happy, sad, angry, disgusted, fearful, surprised, and neutral—across 22 actors. In a pilot experiment, participants were shown each of the 154 RDK stimuli and asked to label the facial expression. Preliminary analyses of these data revealed above-chance labeling accuracy for most expressions. Results from this study will provide insight into how we recognize facial expressions from facial motion cues in the absence of facial features. In a future experiment, RDK videos will also be used to examine the decoding of movement in facial expressions using functional magnetic resonance imaging (fMRI) or magnetoencephalography (MEG).

Topic Area: EMOTION & SOCIAL: Person perception

B42 - The impact of social acceptance on the self-referential processing across different domains: an fMRI study

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Being accepted by others is a fundamental need, which drives people to alter their behavior. Previous studies found that people positively or negatively evaluated themselves across different social values and valence. These biases in self-evaluation may stem from interpersonal strategies aimed at gaining acceptance. However, the association between the neural mechanism of self-evaluation in different domains and the sense of acceptance is unclear. Forty-five healthy young adults were instructed to rate themselves or a celebrity using adjectives from four domains, combining social values (morality and competence) and valences (positive and negative). To measure individual differences in social acceptance, participants completed the Sense of Acceptance scale. Results showed that during self-referential processing ([self > other]), sense of acceptance was positively associated with activation in temporoparietal junction (TPJ) and precuneus for positive moral words and was negatively related to ventral medial prefrontal cortex (VMPFC) for negative moral and competence words. The activation of TPJ and precuneus may indicate that individuals with higher sense of acceptance are more likely to mentalizing during self-evaluation of morality. While activation of VMPFC suggests that individuals with lower sense of acceptance are more likely to regulate emotion. We speculate that people who perceive being accepted mentalize others' beliefs when evaluating morality and people who do not perceive being accepted need to regulate their emotion during evaluating negative words. These findings provide crucial evidence for the impact of social acceptance on self-evaluation.

Topic Area: EMOTION & SOCIAL: Self perception

B43 - Yours is mine: Neural self-partner representation overlap is associated with support, relationship satisfaction, and well-being

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The self-expansion model of love posits that romantic partners are perceived as an extension of the self and psychological interdependence is an emergent property of adult attachment relationships. Although considerable behavioral work investigates self-other overlap, relatively little neuroscientific research investigates neural-level self-partner overlap in romantic relationships. Here we evaluate neural-level self-partner representation overlap during positive and negative social feedback in relation to a comprehensive set of outcomes among romantic partners. Fifty-one heterosexual romantic couples (N = 102) completed fMRI scans while processing positive or negative social feedback directed to themselves and their partners. Using representational similarity analysis and the actor-partner interdependence model, findings indicate that during positive feedback, (1) males' self-partner representation overlap in ventral medial prefrontal cortex (VMPFC) and amygdala are positively associated with their daily support provision, but overlap in anterior insula (AI) exhibits negative correlation with their partner's daily support; (2) males' self-partner overlap in VMPFC is positively related to both partners' reports of relationship satisfaction; (3) females' self-partner representation overlap in amygdala is positively associated with their partner's depression. During negative feedback, we find that (1) males' self-partner representation overlap in AI is positively correlated with their partner's relationship satisfaction; (2) females' self-partner representation overlap in amygdala exhibits negative and positive associations with their partner's relationship satisfaction and depression, respectively. These findings unveil gender-specific association patterns between neural self-partner overlap and daily support, relationship satisfaction, and depression, suggesting that neural representational overlap may serve as a marker of support, relationship satisfaction, and well-being in close relationships.

Topic Area: EMOTION & SOCIAL: Self perception

B44 - The Mind as a Mirror: Rendering Mental Self-Images

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Self perception plays a crucial role in human cognition and behaviour, impacting self-esteem, self-concept, and everyday social interactions. While facial images are commonly used for individual recognition, there is limited understanding of how accurately mental representations of one's own face align with their actual facial appearance. To handle this challenge, the present study employed a behavioral-based image reconstruction approach as applied to facial similarity data. Specifically, a cohort of female Caucasian adults (N=28) evaluated the resemblance between pairs of female face images, including images of their own faces. Participants were also tasked with recalling a mental image of their own face and rating its similarity to a set of visually presented face stimuli. Image reconstruction was then applied to both sets of data to generate a visual representation of each participant's self separately from perception and memory. Accuracy was gauged by comparing reconstructions with the participants' actual images. Our investigation unveiled successful levels of reconstruction accuracy for both perceptual and memory-based representations as well as a clear relationship between the two. Additionally, we examined and depicted systematic distortions in self-image across participants. Finally, we linked these distortions to visual recognition abilities and measures of self-esteem.

Topic Area: EMOTION & SOCIAL: Self perception

B45 - Intracranial recordings of the human orbitofrontal cortical activity during self-referential episodic and valenced self-judgments

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Direct recordings were obtained from the orbital (oPFC) and ventromedial (vmPFC) regions of the orbitofrontal cortex (OFC) in 22 epilepsy patients who were undergoing intracranial electroencephalography (iEEG) during an experimental task. These patients participated in a task that evaluated the accuracy of self-referential autobiographical statements (self-episodic) and emotional self-judgment. During these processes, high-frequency activity (HFA) in both areas increased significantly, and the intensity of HFA varied depending on the nature of the statements that involved self-reference. Notably, the power of HFA increased more quickly in the vmPFC than in the oPFC. Among the 11 patients who underwent depression assessments, those with higher depression scores had lower HFA in the OFC when processing positive self-assessments. However, there was no correlation between HFA response and depression scores during negative self-assessments. These findings provide new insights into the timing and involvement of specific OFC subregions during tasks that involve personal memory and self-evaluation. Furthermore, this provides evidence for a hypothesis in depression pathology, suggesting that reduced neural responses to positive self-evaluation, as opposed to increased responses to negative self-judgment, may contribute to the condition's neural mechanisms.

Topic Area: EMOTION & SOCIAL: Self perception

B46 - Interoception and Sleep: the role of insula cortex across adult lifespan

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Interoception, the perception of internal bodily signals, is multi-faceted and varies with age. Connections between brain regions linked to interoception and sleep have been suggested, yet the relationships among interoception, brain volume, and sleep are not fully understood. This study investigates the brain regions associated with different interoceptive dimensions and sleep and the interrelations among these factors across ages. Seventy-six healthy adults (aged 18-79) underwent T1-weighted MRI scans. We analyzed gray matter volumes in four bilateral regions: the anterior cingulate cortex, insular cortex, hippocampus, and medial prefrontal cortex. Interoceptive accuracy was assessed with a heartbeat tapping task and interoceptive sensibility was measured via a questionnaire. Sleep patterns were monitored using actigraphy for 7 days. The results show age was positively related to interoceptive sensibility scores. A larger insular cortex volume was associated with greater interoceptive sensibility across all ages. Furthermore, as age increases, a larger insular volume was associated with increased sleep discontinuity as well, which correlated with higher interoceptive. Regardless of age, those with higher anxiety and more sleep discontinuity showed higher interoceptive accuracy. In conclusion, the findings underscore the insula's pivotal role in interoception throughout the adult lifespan. As individuals age, the insula is more associated with both interoceptive sensibility and accuracy as well as sleep quality, suggesting a potential role for the insula in the interplay between interoception and sleep.

Topic Area: EMOTION & SOCIAL: Self perception

B47 - Migraine patients recruit a pain-responsive claustrum circuit during pain-free cognitive task performance

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Executive dysfunction and aberrant cognitive network activity are established features of chronic pain, but their mechanisms require elucidation. Difficult cognitive tasks and acute pain have been observed to elicit responses in the human claustrum, which is hypothesized to modulate cortical network activity for cognitive control. fMRI data from healthy participants (n = 35) and migraine patients (n = 112) during cognitive task and acute pain conditions were analyzed to see if claustrum activity is associated with activation of cognitive control network regions, and if this association is altered in chronic pain. Greater intensity and wider spatial spread of BOLD signal increases during cognitive task performance were observed in patients than controls, and a region was identified in the right dorsolateral prefrontal cortex recruited only by patients. Pain scan data revealed this region to be pain-responsive in healthy participants and to display significantly greater pain-induced activity in patients. Increased pain-induced activity in patients was also found in the right claustrum. Human Connectome Project diffusion weighted imaging (n = 174) verified structural connectivity between these right claustrum and right dorsolateral prefrontal cortex nodes. Dynamic causal modeling indicated bidirectional connectivity in this circuit during acute pain in both groups and increased effective connectivity during difficult cognitive task performance in patients compared to controls, consistent with a causal influence of the claustrum on activity in a pain responsive region during cognitive task processing in migraine patients.

Topic Area: EXECUTIVE PROCESSES: Other

B48 - The Impact of Cognitive Fatigue on Ongoing Processing Speed Task Performance in People with Multiple Sclerosis

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Multiple Sclerosis (MS) is a neurodegenerative, demyelinating disorder. People with MS (PwMS) often report experiencing mental or cognitive fatigue, which can significantly disrupt their performance in tasks of daily living. Cognitive fatigue can be thought of as the exacerbation of fatigue over time while engaging in cognitively demanding activities. In the present study, we identified novel indices of cognitive fatigue during ongoing performance of a processing speed task in PwMS. We hypothesized that PwMS would demonstrate a steeper decline in cognitive performance as a function of time-on-task in comparison to healthy control participants. Study participants completed a computerized Symbol Digit Modalities Test (SDMT), which is a well-validated, sensitive measure of processing speed in MS. Response speed was recorded for each trial, and event-related brain potentials (ERPs) were derived from ongoing electroencephalographic (EEG) data recorded during task performance. Analyses indicated a gradual slowing of response speed over the course of task performance in PwMS, whereas response speed became faster and stabilized with increased time-on-task in healthy controls. These findings suggest a task-learning effect for control participants that was counteracted by the influence of cognitive fatigue with increased time-on-task in the MS group. ERP analyses also indicated that individual differences in neural activity in PwMS were associated with behavioral indices of cognitive fatigue. The findings provide preliminary evidence that cognitive fatigue diminishes the benefits of task learning in PwMS. The results have implications for the interpretation of neuropsychological test performance and development of strategies for improving aspects of daily living in PwMS.

Topic Area: EXECUTIVE PROCESSES: Other

B49 - Dynamic relationships between brain networks and trait mind-wandering

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Mind wandering is defined as ongoing mental activity unrelated to the task at hand and one's attention is focused internally. Though this has previously been considered maladaptive, it may be an adaptive trait. The fluctuation from externally to internally focused attention relies on several brain networks. The default mode network (DMN) and task positive network (TPN) are regions of the brain implicated in internal and external focused attention, respectively. The TPN consists of the dorsal attention network (DAN), which mediates top-down task-oriented attention, and the frontal parietal network (FPN), which mediates executive control. Changes in correlations of these networks over time can be extracted. They typically show anticorrelation between the DMN and TPN over roughly 20 secs. This is called the quasi-periodic pattern (QPPs). This study investigates the relationship between the QPPs and a tendency to mind wander in everyday life. Subjects were given the Mind Wandering Questionnaire to measure trait-level mind wandering and functional and anatomical fMRI scans were taken during rest. The scans were then processed and QPPs were extracted and analyzed in groups of low, medium, and high mind wandering levels. The results showed that while activity in all networks was consistent across subjects and DMN/TPN correlation remained consistent between groups, the DMN/FPN correlation decreased as the propensity to mind wander increased at the group level. Because the FPN is believed to be a hub for cognitive control, these findings suggest that those with lower levels of trait level mind wandering have higher levels of cognitive control.

Topic Area: EXECUTIVE PROCESSES: Other

B50 - Exploring the neurophysiological underpinnings of cognitive readiness with the trail making test B

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Non-invasively measuring cognitive readiness may be valuable in occupational applications where failure could have serious repercussions. Cognitive neuroscientists have investigated whether measures of cognitive engagement or inter-areal coherence can serve as indices of cognitive readiness. However, the efficaciousness of such measures and whether they outperform other forms of cognitive assessment remains unclear. We had 34 healthy adults take the trail maker test (TMT) B, undergo an hourlong safety training followed by a quiz, while their brain activity was recorded via 32ch wireless EEG. We explored the validity of TMT B performance, prefrontal engagement, and prefrontal-occipital envelope coherence in theta, alpha, and beta bands to predict quiz performance. Linear regression of TMT B time and prefrontal-occipital coherence during training was most significantly predictive of quiz performance ($R = .553$, $F(4,29) = 4.801$, $p = .004$). However, TMT B times were the primary driver of this result ($\beta = -.593$, $p < .001$). Theta and beta coherence predictors trended in the same direction, but not significantly so ($\beta = -.250$ and $-.232$, respectively). A model using prefrontal engagement with TMT B times performed similarly, with engagement making an insignificant contribution. Interestingly, a model based on TMT B times and TMT B prefrontal-occipital coherence performed the worst. The neurophysiological indices targeted were vastly outperformed by the TMT B at predicting quiz performance. This points to the utility of the TMT B not only as a cognitive readiness metric, but also as a relevant task for further investigation of neurophysiological activity underlying cognitive readiness.

Topic Area: EXECUTIVE PROCESSES: Other

B51 - Individual differences in anxiety and perfectionism interact with instructed task goals to shape reinforcement learning behavior and memory

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Motivations to learn reflect distinct goal structures and neural mechanisms, influencing outcomes in behavior and subsequent memory. Imperative motivation helps us address urgent goals and threats, whereas interrogative motivation helps us explore and plan for longer-term goals. Here, we examined whether individual differences in anxiety and perfectionism bias motivational states with downstream consequences for learning and memory. Participants (N=61) were randomly assigned to read a cover story to induce either imperative or interrogative motivation, then completed the same reinforcement learning task in which they repeatedly chose among four doors to reveal a trial-unique image and its value. The next day, we assessed memory for the images and associated reward values. We found that within the interrogative group, high trait perfectionism predicted greater maximization of rewards during reinforcement learning, suggesting that even in a learning context without urgent goals, perfectionists exhibit behaviors aligned with imperative motivation. Across both interrogative and imperative groups, higher state anxiety correlated with better recall of values that were worse-than-expected (generating negative prediction errors) during reinforcement learning, compared to values that were better-than-expected (generating positive prediction errors). These results suggest that, even in contexts intended to promote exploratory learning, the bias to avoid risk during learning (associated with perfectionism) or to remember negative outcomes (associated with anxiety) may oppose the learning context, and potentially give rise to maladaptive goal-pursuit. More broadly, this work illustrates how psychological states may determine the behavioral and cognitive impact of incentives and goals, highlighting their interplay in goal-directed behavior.

Topic Area: EXECUTIVE PROCESSES: Other

B52 - A pilot study evaluating the feasibility, safety, and efficacy of transcranial photobiomodulation (tPBM) in mild cognitive impairment (MCI)

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Background: Mild Cognitive Impairment (MCI) is a precursor to Alzheimer's dementia, with a monthly progression rate of about 1%. Recent research highlights the link between mitochondrial dysfunction and amyloid beta accumulation, emphasizing the potential of targeting mitochondrial function for treatment. Accordingly, our objective was to investigate the effectiveness of transcranial photobiomodulation (tPBM), a non-invasive technique that utilizes near-infrared (NIR) light specifically absorbed by mitochondria, on cognitive functions (memory, executive functioning), and brain metabolites in individuals with MCI. Methods: Ten participants diagnosed with MCI were randomly assigned to active or sham groups, with intentionally indistinguishable tPBM active and sham devices. Over six weeks, participants received daily home-based tPBM treatment (5 active, 5 sham). In conjunction with the treatment, participants underwent cognitive assessments, as well as Proton Magnetic Resonance Spectroscopy (H-MRS) to analyze changes in brain metabolites before and after treatment. Results: Preliminary findings reveal significant improvements in Montreal Cognitive Assessment (MoCA) scores in the active vs sham group ($p < 0.05$). Although time to complete the Trail Making Test B (TMT-B) was shorter, and free recalls in California Verbal Learning Test (CVLT) scores were improved in the active vs. sham group, it did not reach statistical significance. In H-MRS, a significant decrease in total levels of creatine, choline, N-acetyl-aspartate, and myo-inositol in the brain was noted in the active vs. sham group ($p < 0.05$). Conclusions: Our preliminary results on tPBM treatment in MCI are promising. H-MRS findings hint at potential inflammation reduction. However, drawing firm conclusions requires larger sample sizes.

Topic Area: EXECUTIVE PROCESSES: Other

B53 - Neurochemical predictors of generalized learning induced by brain stimulation and training

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Methods of cognitive enhancement are most impactful when they generalise across tasks. However, the extent to which such "transfer" is possible via interventions is widely debated. In addition, the contribution of excitatory and inhibitory processes to such transfer is unknown. Here, in a large-scale neuroimaging individual differences study, we paired multitasking training and non-invasive brain stimulation (transcranial direct current stimulation; tDCS) over multiple days and assessed performance across a range of paradigms. In addition, we varied tDCS dosage (1.0 mA and 2.0 mA), electrode montage (left or right prefrontal regions), and training task (multitasking versus a control task) and assessed GABA and glutamate concentrations via ultra-high field 7T magnetic resonance spectroscopy. Generalised benefits were observed in spatial attention, indexed by visual search performance, when multitasking training was combined with 1.0 mA stimulation applied to either the left or right prefrontal cortex. This transfer effect persisted for ~30 days post-intervention. Critically, transfer benefit associated with right prefrontal tDCS was predicted by pre-training concentrations of glutamate in the prefrontal cortex. Thus, these combined stimulation and training protocols appear to be linked predominantly to excitatory brain processes.

Topic Area: EXECUTIVE PROCESSES: Other

B54 - A Cognitive and Neural Framework for Cognitive Flexibility: Perspectives from Traumatic Brain Injury

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Cognitive flexibility reflects our ability to respond to changes and obstacles in our environment with novel response strategies. Although this description is generally accepted among cognitive neuroscientists, the precise definition of cognitive flexibility, and its integration within other aspects of cognitive regulation, remains understudied. To address this question, we examined an alternative framework for cognitive flexibility that includes four proposed subfunctions—salience detection, inhibition, set-shifting, and creative thinking— and examined its validity using behavioral data from traumatic brain injury (TBI) patients and healthy control subjects. The neurological profile of TBI presents an opportunity to investigate potential dissociations between these proposed subfunctions of cognitive flexibility. Cognitive deficits of set-shifting and inhibition commonly follow a TBI, and severe injuries can result in salience detection impairments, whereas little deficits of creative thinking have been documented following a TBI. Patients with TBI and matched control participants, between 25 and 45 years old, completed six tasks measuring cognitive flexibility and each of its proposed

subfunctions. The results revealed dissociable response profiles between the two groups. Additionally, TBI participants were significantly impaired on tasks specifically measuring executive functions (inhibition and set-shifting), and less impaired on tasks not reliant on increased PFC-mediation (salience detection and creative thinking). These findings offer support for the proposed alternative framework for cognitive flexibility and for the dissociation between cognitive flexibility and other cognitive processes.

Topic Area: EXECUTIVE PROCESSES: Other

B55 - Multitasking training improves the quality of information processing in perceptual decision making

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Multitasking training using a video game-based intervention can lead to improvements on cognitive tasks outside of the treatment (i.e. task transfer) that involve cognitive processes such as sustained attention and perceptual decision making (Anguera et al, 2013). However, the cognitive mechanisms associated with the improved task performance have not been established. Here, we leverage a well-established class of cognitive models (drift diffusion models or DDMs; Ratcliff and McKoon, 2008) to quantify the cognitive processes that mediate the improvements in task performance on a continuous performance task (Test of Variables of Attention, TOVA®) separate from the intervention. Participants completed baseline TOVA, then trained for 4 weeks on the multitasking or a single tasking intervention, and finally completed a second round of TOVA (see Anguera et al, 2013). We fit the pre/post-training TOVA data using a Bayesian hierarchical DDM (Wiecki et al, 2013). We found that the parameter controlling the rate of evidence accumulation (i.e. drift rate) which tracks cognitive processing speed was significantly greater after multitasking training, but not after single task training or in a no contact control group. There were no significant changes in other model parameters (bias, boundary and non-decision time). Furthermore, participants whose data was best explained by an improvement in drift rate also had the largest improvements in response speed on the TOVA task. These results suggest that multitasking training improves the efficiency of information processing (i.e. evidence accumulation), a core cognitive function that could lead to benefits in many cognitive and real world tasks.

Topic Area: EXECUTIVE PROCESSES: Other

B56 - Estimation of the cognitive resources necessary for the correct use of exoskeletons. A multidisciplinary and mixed reality approach.

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Reducing the risk of work-related musculoskeletal disorders (WMSD) is a crucial objective of occupational research. Upper-limb exoskeletons are the most explored solutions in manufacturing contexts where workers are mainly exposed to biomechanical overloads (e.g., manual load handling activities). However, the changes required in the motor control to handle an exoskeleton can lead to cognitive overload. This could affect not only the ability to perform simple motor tasks, thus leading to exacerbate WMSD risks, but also the alertness to prioritize salient stimuli, thus increasing safety risks. By means of a novel paradigm that pairs a dual motor-cognitive task and mixed reality (MR) technology, the ongoing study investigates how the use of exoskeletons impacts on attention skills. The motor task consists in manual handling of loads from pelvis level to shoulder height executed by wearing an exoskeleton, while the cognitive task consists in the detection of visual targets presented by the MR system. Concurrently with the motor task, participants have to move eyes from a central fixation cross to a peripheral visual target appearing among distractors. Multiple experimental sessions are administered on different days to study the learning to use the exoskeleton, as assessed by biomechanical measures. The variables obtained from ocular responses (i.e.: rate of central fixations; rate and latency of saccades to target; rate of saccade omissions; rate of saccades to distractors) will be analyzed to extract objective indexes for the estimation of the cognitive load required to handle exoskeletons for the first time and after a few learning sessions.

Topic Area: EXECUTIVE PROCESSES: Other

B57 - "Repulsive-followed-by-attractive" past-present neural interactions underlie serial dependence

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Current perception tends to be spontaneously influenced by the previous trial, namely serial dependence. This has been posited to arise from a perceptual temporal continuity field or a two-stage process. Hence, examining how past reactivation interacts with current information throughout various stages within each trial, i.e., encoding and decision-making, is essential to tackling the question. Here we performed two spatial perception tasks with electroencephalography (EEG) and magnetoencephalography (MEG) recordings. In Experiment 1, participants memorized the location of a dot within a 2-D continuous space (encoding stage) and reproduced it later (decision-making stage). In Experiment 2 with attentional modulation added, participants memorized locations of two dots and recalled the cued dot location later. Behaviorally, both experiments showed attractive serial bias, i.e., spatial perception is biased toward the previously reported location. Importantly, past-trial reactivation co-occurs with current-trial information during both the encoding and decision-making stages, signifying past-present interactions. Most interestingly, the past-present neural interactions exhibit a two-stage dynamic profile: repulsive interactions during encoding and attractive interactions during decision-making, arising in the visual cortex and orbitofrontal cortex (OFC), respectively. Finally, only the late attractive interaction is modulated by attention and correlates with serial bias behavior, while the early repulsive interaction is task-irrelevant. Overall, our study provides novel neural evidence supporting that serial dependence involves a repulsive-followed-by-attractive two-stage process, wherein past information first repulses present processing during sensory encoding in a task-irrelevant way and is then integrated with it in OFC based on task modulation during decision-making.

Topic Area: EXECUTIVE PROCESSES: Working memory

B58 - Music-type rhythms facilitate auditory working memory

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Rhythm, which refers to the structured organization of events in time, is a basic and prominent feature of music. Rhythm is known to facilitate auditory perception and working memory (WM), yet previous research mainly focused on isochronous rhythms (1:1) and largely neglected other types of rhythms rich in natural music, such as small integer ratios (1:2 or 1:3) and hierarchical structures (local rhythmic patterns nested in global rhythmic patterns). Here we conducted two behavioral experiments combined with computational modelling to examine whether music-type rhythms would facilitate auditory sequence WM. In Experiment 1, human subjects retained in WM a sequence of 9 piano tones presented in music-type (1:2 or 1:3) or non-music-type rhythms (1:1.5 or 1:2.5). During recalling, a 9-tone sequence with one tone altered in pitch was played, and subjects reported whether the pitch was higher or lower than the original one. Hierarchical drift diffusion model (HDDM) fitting of behavioral results reveals that the music-type rhythm condition is associated with a lower response boundary in perceptual decision-making than the non-music-type rhythms. In Experiment 2, subjects performed the same auditory sequence WM task but with 12 tones organized in either hierarchical (2:1:1 nested in 1:1) or non-hierarchical (1:1) rhythms. Compared to the non-hierarchical rhythm condition, hierarchical rhythm had a faster reaction time (RT) and a smaller response boundary. Overall, our results provide converging evidence supporting that music-type rhythms facilitate auditory WM, which might arise from humans' innate preferred temporal structure that manifests itself in music.

Topic Area: EXECUTIVE PROCESSES: Working memory

B59 - Brain and Behavioral Differences in Working Memory Updating Between Healthy Young and Older Adults

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Deficits in working memory (WM) contribute to age-related cognitive declines, but the sources of these deficits remain unclear. The aim of the present study was to determine if there are neural (EEG/ERP decoding) and behavioral (n-back performance) indices of WM updating that differ between healthy young adults (YAs) and healthy older adults (OAs), and whether these indices can be used to predict age-related cognitive declines. More specifically, we aimed to test whether YAs and OAs retain information during a WM updating task via active or passive maintenance mechanisms during the delay period. To address these questions, two age groups [YA: N = 48, mean (SD) age = 19.9 (1.07); OA: N = 47, mean (SD) age = 70.68 (7.35)] performed a 1-back task during EEG recording. Preliminary decoding analyses of voltage ERPs, theta, alpha, beta, and low-gamma oscillations show that neither YAs nor OAs demonstrated sustained, active maintenance of attended WM representations throughout the duration of the delay period. Both groups showed passive retention, consistent with observations of "activity-silent" WM maintenance and the Synaptic Theory of WM. OAs showed slightly more sustained decoding accuracy during the delay period than YAs, and OAs' delay period decoding accuracy was negatively correlated with their fluid intelligence scores, suggesting that OAs who were experiencing greater cognitive decline engaged in more active WM maintenance, perhaps to support their performance, consistent with a compensatory recruitment account of age differences in WM.

Topic Area: EXECUTIVE PROCESSES: Working memory

B60 - The effect of sleep quality on dynamic network connectivity during rest and n-back task performance

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Quasi-periodic patterns (QPPs) play an important role in the functional connectivity between Default Mode (DMN) and Task Positive Networks (TPN). Research indicates that fluctuations in attentional focus and arousal impact QPPs during both rest and task (Abbas et al., 2019). Arousal levels have also been shown to be affected by the individual's sleep duration with daytime sleepiness reducing DMN connectivity in young adults (Ward et al., 2013), thereby producing altered connectivity between the DMN and the TPN. Additionally, arousal may play a role in the differences in QPP connectivity in patients with ADHD (Abbas et al., 2019). Here we examined how sleep quality affects healthy college-age students during both rest and working memory tasks. Participants' sleep quality and duration were measured for three days prior to scanning. During scanning, they performed rest, 0-back, and 2-back blocks. Participants were then categorized into good or poor sleepers based on a tertiary split of sleep quality scores. Good sleepers were observed to be faster and more accurate than poor sleepers in both n-back tasks. During rest, differences in QPPs within the frontoparietal control network (FPCN) of the TPN were observed between good and poor sleepers. Poor sleepers had lower FPCN amplitude and a lower positive correlation with DMN. In the 0-back task, in addition to lower amplitude, FPCN was also positively correlated with DMN in poor sleepers. These data suggest that the relationship between QPPs and brain networks changes with arousal and relates to task performance. *authors contributed equally.

Topic Area: EXECUTIVE PROCESSES: Working memory

B61 - Representations of spatial location by aperiodic and alpha oscillatory activity in working memory

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Alpha oscillations in human visual cortical electrophysiology (EEG) coordinate population codes that retain the visual working memory (WM) content, with non-spatial feature storage bound to location irrespective of location's task relevance. Alpha power tracks the specific spatial location of WM items, even when spatial position is task-irrelevant. However, these results rely on conventional spectral analyses, such as narrowband filtering within a predetermined frequency range, that conflate dynamic and task-related modifications in non-oscillatory, aperiodic activity as changes in oscillatory activity, even in the absence of actual oscillations. Through parameterization of both aperiodic and alpha oscillatory activity, we aim to disentangle the roles of aperiodic and alpha oscillatory activity in visual WM. We trained separate inverted encoding models on 112 total participants across 7 different, extant EEG datasets to assess the extent to which aperiodic and alpha oscillatory activity represent spatial location. We found that aperiodic-adjusted alpha power—more likely reflecting true oscillations—represents spatial location during the delay period across all seven tasks, confirming its role in maintaining the spatial location of the stimulus in WM. While aperiodic activity also represents spatial location, it does so primarily in the first 400 milliseconds following stimulus presentation, dropping significantly during the WM delay period. This suggests an automatic, stimulus-independent encoding of spatial location by aperiodic activity regardless of task-relevance. The differential time courses for spatial location representation by aperiodic and alpha oscillatory activity imply novel, unique contributions of aperiodic and alpha oscillatory activity to the encoding and maintenance of stimulus feature representations during visual WM.

Topic Area: EXECUTIVE PROCESSES: Working memory

B62 - White matter microstructure in the superior longitudinal fasciculus predicts alpha modulation during visuospatial working memory encoding

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Working memory (WM) is a neurocognitive function affected in ADHD, and studies have shown aberrant alpha modulation to be related to these deficits. The second branch of the superior longitudinal fasciculus (SLF-II) is thought to have a functional role in visuospatial processing, making it a structure of interest. This analysis investigates the underlying white matter structure contributing to aberrant alpha modulation during visuospatial WM encoding in children with ADHD. We hypothesize that the white matter microstructure in the SLF-II will predict mid-occipital alpha (8-12 Hz) event-related decreases (ERD) during WM encoding. 107 children (7-15 years, 10.49±2.1, 65.4% males) with EEG and diffusion MRI were identified from participants who enrolled in research studies at the TRECC Center, including typically developing children (n=36) and children with ADHD (n=71). Forty-channel EEG was recorded while participants performed a visuospatial WM task. A mid-occipital alpha component derived from ICA decomposition was extracted from a previously published analysis. Diffusion MRI was preprocessed using FSL, and tractography was performed using FreeSurfer's TRACULA. Average fractional anisotropy (FA) and mean diffusivity (MD) measures were extracted from the SLF-II tract. Two separate linear regressions were performed to test if average DTI measures (FA and MD) predict mid-occipital alpha ERD. Both average FA (β=-0.30, p=0.046) and average MD (β=0.41, p=0.011) significantly predict alpha ERD. Group by DTI measures were not significant. Results indicate that the microstructure of the SLF-II predicts visuospatial WM encoding as measured by alpha ERD. These results provide insights into the structure-function relationship involved in visuospatial WM encoding.

Topic Area: EXECUTIVE PROCESSES: Working memory

B64 - High-frequency broadband activity demonstrates slow theta phase preference for sequential order in working memory maintenance

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Neurons representing place and time in the hippocampus (HPC) encode information through cell specificity and theta phase preference. Dominant models of working memory (WM) propose a theoretical framework for theta-phase-coding of slots for stimuli representations. Previous findings support these models by demonstrating slowing theta with increased WM load, allowing more neuronal spikes representing information to fit within one theta cycle. Additionally, the orbitofrontal cortex (OFC) has been causally implicated in representing temporal order in humans. Here, we use macro- and micro-wire stereotactic EEG to uncover mechanisms of maintaining temporal order in humans. We analyze 20 WM delayed match-to-sample datasets (7F; aged 30.65 ± 11.15) wherein patients memorized sequences of three shapes (sample), followed by a 2-s delay and presentation of three more shapes (match). Slow theta oscillations slowed from the sample to match in HPC (p=0.004) and OFC (p=0.01), and we found evidence for HPC-OFC synchrony during maintenance of the sample. We observed phase-amplitude coupling between slow theta and high-frequency broadband activity – a measure of multiunit activity – in HPC (p=0.04) with a trimodal distribution of

phase preference, suggesting that sequential order is slow theta phase-coded. We then isolated 152 HPC neurons from a subset of 10 patients (88 micro-wires) and estimated stimulus preference based on maximum firing rate. We identified 11.0% of neurons with stimulus 1 preference, 8.5% with stimulus 2 preference, and 9.2% with stimulus 3 preference. Further analyses will formally test phase-coding of HPC neurons by extracting the instantaneous theta phase at spike times during maintenance.

Topic Area: EXECUTIVE PROCESSES: Working memory

B65 - Interrupting working memory: The time available for primary task resumption influences attentional control processes following an interruption

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Dealing with task interruptions requires the flexible use of working memory and attentional control mechanisms. Here, we investigated to which extent the time available for task resumption after an interruption can support these mechanisms. This was done based on a visual working memory task which was randomly interrupted by an arithmetic task. After the phase with or without an interruption, a retro-cue indicated which out of two stimulus orientations had to be reported. In trials without interruption, the delay phase before retro-cue presentation was either short (2300ms) or long (3300ms). The interruption task had to be completed within 1800ms and it was followed by either a short (500ms), long (1500ms) or self-determined (indicated by button press) resumption phase. While primary task accuracy (i.e., the precision of orientation report) was reduced by a preceding interruption, it was not modulated by the time available in the resumption phase. However, primary task response times benefited from longer resumption phases, especially when the length of the resumption interval was self-determined. At the EEG level, theta oscillatory power (4-7Hz) at frontal sites and the suppression of posterior alpha power (8-14Hz) were used as correlates of attentional control processes after retro-cue presentation. Both theta power and alpha power suppression were reduced after an interruption, but the suppression of alpha power was also stronger with longer resumption phases. These results indicate that attentional control processes at the level of working memory are facilitated when there is more time available to resume the primary task after an interruption.

Topic Area: EXECUTIVE PROCESSES: Working memory

B66 - Working memory deficit in high schizotypy: ERP but no power differences

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Individuals with schizophrenia spectrum disorders exhibit working memory (WM) impairments. Here, we tested WM performance in subclinical schizotypy to examine the effects of symptom load on cognition without the onset of psychosis and to identify a biomarker of WM deficits. We recorded EEG while 21 controls and 14 undergraduates high in schizotypy completed an auditory 2-back WM task. Participants listened to a sequence of digits (0-9) presented via earphones and reported whether stimuli matched or mismatched the digit presented two prior. The behavioral data revealed that WM accuracy was impaired in the high schizotypy group (M=83%) compared to controls (M=91%; t(33)=2.15, p=.04). To understand the underlying mechanism, we conducted time-frequency analyses to probe altered power (1-30 Hz) across the delay period. The cluster-based permutation test indicates no differences between the groups (p>.05). Next, we evaluated amplitude differences (averaged over a frontal electrode cluster) in the event-related potentials. Results show significant group-level differences when applying a sliding window (20 ms bin width, non-overlapping). Past literature shows the P300, a neural signature reflective of WM processes, is reduced in schizophrenia. However, our results show no group differences in the P300 (p=.76, Mann-Whitney test). These results suggest there may be alternative biomarkers of WM deficits, besides the canonical P300. Although WM performance may be associated with symptom load, a robust neural mechanism explaining this deficit remains elusive. Further research is needed to identify the neural mechanism of WM impairment in high schizotypy.

Topic Area: EXECUTIVE PROCESSES: Working memory

B67 - A Comparison of Musicians and Nonmusicians from a Functional Connectivity Perspective

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It has been theorized for decades that musical training as a child can increase mental capabilities in many areas and has been shown to influence structural changes in the brain as well. Music has a profound impact on the human psyche and can be a powerful anti-amnestic. It has found use in musical therapy where music can not only temporarily jog memories of patients with dementias such as Alzheimer's disease, but also augment the patient's emotions for hours or days after they have forgotten the encounter with their therapist. Since music has such a profound effect on the human mind, there is logic to posit that there may be a connection between musical training and cognitive development and structure. Utilizing a 32-electrode EEG cap, 20 subjects: 10 musicians and 10 nonmusicians were scanned during an oddball paradigm to elicit ERP waveforms. Each subject listened to two noise conditions: white noise and classical music. wPLI adjacency matrices were created for each condition. A difference between conditions were taken after for each population to perform statistical analyses on the difference in functional connectivity levels. It is hypothesized that musicians will display higher activation levels in functional connectivity between the conditions compared to the nonmusicians because musicians activate and engage more portions of their brains during musical perception. Data on each population's characteristic path lengths, clustering coefficient, centrality, and assortativity will also be addressed.

Topic Area: EXECUTIVE PROCESSES: Working memory

B68 - Single Pulses of TMS to Visual Cortex Have Persistent Effects on Visual Working Memory

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Neuroimaging studies of visual WM have identified that delay-period neural signals such as the N2pc ERP, frontal theta oscillations and hemispheric alpha asymmetry are correlated to performance (Schneider et al., 2018; Zickerick et al., 2021). However, the exact contribution of these neural components to WM behavior remains unclear. To assess their causal roles in WM, this study administered a two-item, double-retrocue WM task with single-pulses of TMS applied to a retinotopically-mapped region of participants' left visual cortex during the delay periods while EEG was recorded. Single-pulse transcranial magnetic stimulation (spTMS) is a neurophysiology probe that can be used to "ping" the cortex and detect activation state of items in working memory (WM). Previous studies suggest that spTMS typically does not induce changes in brain activity or behavior that last beyond the stimulation period (Klomjai et al., 2015). Analyses suggested that spTMS had hemisphere-specific effects: WM performance was significantly better, and had larger improvements as a function of task difficulty (measured by angular difference between target and probe), on TMS-targeted (right-cued) trials than on control (left-cued) trials; following the first retrocue, TMS abolished the N2pc component on right-cued, but not left-cued trials; following the second retrocue, TMS selectively abolished hemispheric alpha asymmetry in the delay period on the TMS-targeted hemisphere. Collectively, the findings indicate carry-over effects of spTMS that have selective effects on lateralized neural and behavioral indices of performance. The current finding that visual cortex stimulation does affect visual working memory is consistent with the sensory recruitment hypothesis of WM.

Topic Area: EXECUTIVE PROCESSES: Working memory

B69 - Action planning renders objects in working memory more attentionally salient

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A growing body of work suggests that working memory is fundamentally action-oriented. Recent studies, for example, indicate that attention is biased more by visual working memory (VWM) representations that are also the target of an action plan. Using EEG and eye tracking, we investigated how action planning in VWM biases selective attention. Participants (n=36) were presented with a geometric shape for a subsequent VWM test. At test, a probe was presented along with a secondary stimulus. In the action condition, participants had to grip the probe if it matched the memorized shape, while in the control condition, they had to grip the secondary stimulus. Crucially, during the VWM delay, participants engaged in a visual selection task (VST), in which they located a target as fast as possible. The memorized shape could either encircle the target

(congruent trials) or a distractor (incongruent trials). Analysis of gaze bias during the VST replicated previous findings: attention was captured more by a VWM-matching stimulus when it was the direct target of an action plan. Moreover, in the action condition, the VWM-matching shape elicited (1) a stronger Ppc, signaling greater attentional saliency, (2) a larger inverse (i.e., positive) SPCN in incongruent trials, possibly signifying increased suppression of the memorized shape when this was a distractor, and (3) a positivity over right prefrontal and left motor regions, suggesting enhanced response inhibition of the action-relevant hand. Overall, these results suggest that action planning renders objects in VWM more salient, supporting the notion of selection-for-action in working memory.

Topic Area: EXECUTIVE PROCESSES: Working memory

B70 - The influence of top-down control and storage dynamics on interactions between items held in working memory

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Although some frameworks portray working memory (WM) as a state in which items are shielded from interference, it is well-documented that items currently in WM can interact with each other. How might the strength of these interactions vary as a function of top-down control? Concurrent with EEG recording, subjects performed two tasks. For double serial retrocuing (DSR), two gratings were presented serially, then the item to be recalled was cued on two successive occasions with a digit referring to ordinal position ("1" or "2;" 100% valid cues, each with 50% probability). For single retrocuing (SR), the cue was uninformative ("0") with a digit ("1" or "2") accompanying the recall dial (i.e., these were "load of 2" trials). In both experiments, on each trial the memoranda could differ in orientation by 0, 22.5, 45, or 67.5 degrees. Behavioral performance revealed an attractive inter-item bias that was positively related to angular difference. Importantly, the bias was smaller for DSR trials than for SR trials, thereby revealing a shielding effect of prioritization. To explore neural correlates of inter-item interactions, we applied demixed PCA to the EEG data from the post-cue delay period. For the DSR task, trial-by-trial variability in the efficacy of the priority-based transformation of the uncued item was found to be larger on trials with larger inter-item bias. For the SR task, trial-by-trial variability in the efficacy of context coding (i.e., the transition to a "1st item" subspace) was larger on trials with larger inter-item bias.

Topic Area: EXECUTIVE PROCESSES: Working memory

B71 - Working memory binding failures and abnormal cortical neural oscillations in Alzheimer's disease

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Background: Associative binding is key to normal memory function and, within dementia, is specifically impaired in Alzheimer's disease (AD). Electrophysiological abnormalities are frequently reported in AD including during associative binding tasks. We investigated the binding of distinct visual features (object and location) in working memory in AD patients. We test the hypothesis that misbinding in AD is related to electrophysiological abnormalities, as we have shown previously in traumatic brain injury (TBI). Methods: 40 AD patients and 30 healthy age-matched controls (HC) were tested with a precision spatial working memory paradigm requiring the association of object and location information. High-density EEG was used to assess changes in power across frequency bands. Results: AD patients showed impairment in working memory function and made significantly more misbinding errors ($p<0.001$) than HC indicating that working memory recall was abnormally biased by the spatial locations of distractor items. AD patients demonstrated significant reductions in global alpha and increases in global theta, represented by the theta-alpha ratio ($p<0.01$; TAR). Channel-wise analysis revealed significant clusters of decreased power in AD across parietal channels in alpha and beta bands ($p<0.01$), and increase in the theta band ($p<0.05$) in frontal channels. In AD, TAR showed significant negative correlation with identification ($p<0.01$) and localisation accuracy ($p<0.05$). Conclusions: These results offer further support for a deficit in working memory binding being a sensitive cognitive biomarker of AD. Pathological changes to cortical neural oscillations, including increased TAR, may offer mechanistic insight into the profound working memory impairments seen in AD and TBI.

Topic Area: EXECUTIVE PROCESSES: Working memory

B72 - Abstract and Concrete Sequences Rely on Separable Working Memory Resources

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Daily life involves accomplishing overarching abstract goals (e.g., be productive) with subordinate tasks (e.g., running a participant). Typical working memory (WM) tasks involve the retention and manipulation of sensory stimuli themselves. A newer paradigm, abstract cognitive task sequences (ACTS), requires participants to retain a series of instructions to apply to stimuli. These are operations to apply independently of the specific stimuli. Here, we alter the task design to test whether abstract and concrete sequences are maintained in separate stores. An ACTS-WM modification doubled WM demands: participants maintained instructions and stimuli. Participants encoded a four-item instruction sequence and applied them to sequentially presented pictures, reporting answers after stimulus presentation. If the abstract instructions and concrete stimuli are maintained uniformly, increasing demands would impair performance. WM capacity limits would limit both if maintained in the same store. Undergraduates (n = 64) completed ACTS and ACTS-WM tasks. Accuracy was significantly higher for the ACTS-WM task ($p < 0.001$). To probe further, we examined errors. WM maintenance of the concrete stimuli and the abstract sequence were similar between tasks ($p = .42$), suggesting separable storage. However, 67% of errors were in the sequence, whereas 22% were stimulus errors ($p < 0.001$). These findings suggest both abstract and concrete sequences were maintained independently, and the abstract representations were disrupted more easily.

Topic Area: EXECUTIVE PROCESSES: Working memory

B73 - Statistical regularity improvements to visual working memory capacity depend on subjective awareness

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Chunking increases effective working memory capacity by encoding multiple items into a single chunk. This strategy can be applied when multiple stimuli regularly co-occur in specific patterns, allowing statistical learning. A previous study has found that benefits from co-occurrence depend on explicit awareness and rely on retrieval of chunk components from long-term memory (LTM), reflected in longer retrieval times when using the LTM-dependent strategy. This study aimed to replicate and extend previous work on the critical role of awareness and the need for LTM-based retrieval mechanisms. In a delayed visual feature report task, features could be presented together in predefined pairs (patterned condition, e.g., red square next to black square, 80% of trials) or random pairs (random condition, 20%). A post-experiment questionnaire assessed participant awareness of the regularities in the patterned condition. Participants who were explicitly aware of the pairs (N=16) demonstrated 22% better performance in the patterned condition, compared to random trials ($p<0.001$). Participants without full awareness (N=14) showed no improvement ($p=0.427$). Decision times were no longer in the patterned condition, calling into question whether the benefit depends on an additional time-consuming LTM retrieval step. We suggest that promoting metacognitive awareness is key to enhance the effectiveness of working memory strategies.

Topic Area: EXECUTIVE PROCESSES: Working memory

B74 - Neural representations of visual categories generalise across tasks and adapt to cross-task interference

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The brain's ability to group stimuli into relevant categories is a fundamental cognitive process. The neural basis of categorisation is not completely understood, with some studies suggesting the presence of multitasking neurons (encoding for multiple category distinctions), and others suggesting highly specialised neurons (encoding for a single category). This differentiation may be due to task demand, as less multitasking has been shown when two different category distinctions are in conflict. This suggests that neurons multitask by default but become specialised for one task in the presence of cross-task conflict. Little is known about this distinction in humans as most studies have examined non-human primates. This study investigated this proposal in humans using

electroencephalography (EEG). Participants learned to perform two visual categorisation tasks on stimulus sets drawn from distinct parts of a continuous three-dimensional feature space (no conflict), but were later introduced to new stimuli in both tasks, creating conflict between the two categorisation rules. Category-specific neural patterns generalised across tasks for the no-conflict condition, suggesting the presence of multitasking neurons. In contrast, neural patterns became more independent across tasks when new stimuli were introduced in both tasks (conflict condition). Unexpectedly, the previously learned stimuli continued to be represented by the same generalised patterns. Taken together, our findings suggest that reduction in multitasking may be a general principle of interference resolution in neural coding.

Topic Area: EXECUTIVE PROCESSES: Working memory

B75 - Spatio-temporal Dynamics of EEG Microstates during Visuo-Spatial Working Memory Task as a Trait Marker for Patients with Schizophrenia

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OBJECTIVE: To study qEEG microstates and their cortical sources during Visio-Spatial Working Memory (VSWM) task in patients with schizophrenia as compared to healthy subjects. BACKGROUND: Spatio-temporal parameters of the quasi-stable EEG functional microstates and their intracranial generators can potentially be a state and trait marker for different cognitive and diseased states. Working memory deficits, a stable aspect of schizophrenia, tested by computer administered VSWM task with simultaneous dense array EEG acquisition to assess large scale brain networks can contribute to better diagnostic accuracy. METHODS: 30 patients diagnosed with schizophrenia (as per DSM-5 criteria) and 30 age-matched controls were administered questionnaires (Edinburgh Handedness Inventory, Hindi MMSE, SAPS, and SANS). Thereafter, 128 channel EEG, ECG, and GSR (Galvanic Skin Resistance) were recorded during eyes closed, eyes open, and VSWM task performance. Epoch wise data from each experimental condition was extracted and subjected to microstate analysis. Statistical analysis was done to compare temporal microstate parameters (Global explained variance, number of time frames, mean duration, time coverage, and segment count density) and cortical sources of each microstate map across the groups. RESULTS and CONCLUSIONS: Significantly lower accuracy and higher search time in VSWM task along with altered stress reactivity in patients with schizophrenia was noted. Temporal EEG microstates parameters during pre-re-encoding and pre-response period showed significant differences in patients with schizophrenia associated with hypoactivation in cortical areas subserving working memory domain, which could potentially be a trait marker for schizophrenia.

Topic Area: EXECUTIVE PROCESSES: Working memory

B76 - Thalamic contributions to working memory

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The cortical substrates of working memory (WM) have been extensively investigated. However, less research has investigated the role of the thalamus and thalamocortical pathways in WM in humans. This could be due to the lack of detailed probabilistic atlases of the human thalamus or the small size of the thalamic nuclei as compared to regular voxel sizes. In the present MRI study, twenty participants performed a variation of a standard WM task with maintenance and manipulation components. In this task, participants were presented with a sequence of three images and were asked to remember them either in 'forward' or in 'backward' order. Using individual-subject analysis, we investigated the involvement of thalamic nuclei and to what extent thalamocortical functional and structural connections were related to WM abilities. Our results revealed mediodorsal and pulvinar thalamic nuclei engagement during encoding and maintenance. Moreover, results of a hierarchical regression analysis showed that thalamocortical-related indexes explained a significant proportion of the variance in WM abilities, beyond that explained by cortical (functional/structural) neuroimaging indexes alone. These findings highlight the relevance of the thalamus and thalamocortical connectivity in models of human WM.

Topic Area: EXECUTIVE PROCESSES: Working memory

B77 - Maintenance suppression reduces the accessibility of visual working memories regardless of their normative valence

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Prior work has shown that suppressing the maintenance of neutral images in working memory can impair access to that information in immediate and delayed memory tests. Here, we explored whether maintenance suppression has the same impact on negatively valenced images. Intrusive thinking (e.g., rumination) often involves negative thoughts that persist as individuals attempt to push them out of mind. Given the emotional nature of intrusive thoughts, it is important to understand how an item's valence affects the ability to remove it. We hypothesized that suppressing negative information from working memory would be more difficult compared to positive information because of attentional capture caused by the stimuli's increased salience. To test this prediction, participants (N = 88) completed a working memory removal experiment using group-normed images with positive or negative valence. Participants encoded two images of the same valence on each trial, were cued to either suppress or maintain one of them, and then responded to a memory probe after a brief delay. Our results demonstrate that participants were faster to endorse an item that had been cued for maintenance, and slower to endorse an item that had been suppressed, regardless of its valence. This demonstrates that maintenance suppression is successful in reducing the accessibility of negative information, and therefore could be an effective tool in the fight against intrusive thinking.

Topic Area: EXECUTIVE PROCESSES: Working memory

B78 - Decreased working memory capacity in the chronic phase of concussion

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Despite increasing recognition of the significance of concussion (mild traumatic brain injury, mTBI), the long-term cognitive outcomes following injury remain poorly understood. To date, studies exploring cognitive performance in the chronic stage of mTBI remain inconclusive. Some limitations within this literature include the use of measures that lack sensitivity to detect subtle cognitive impacts of mTBI and failure to consider individual differences in cognitive outcomes. Additionally, while it is well documented that a significant number of injuries go unreported, studies investigating individuals with a history of mTBI that capture these unreported injuries remain lacking compared to hospital-based samples. In this preregistered study, we used a range of complex behavioural tasks to investigate cognitive performance in a large sample of individuals with self-reported history of mTBI (n=82) and a control group (n=88). We also explored whether individual differences in injury-related factors predict cognitive performance in the mTBI group. The findings revealed poorer verbal working memory performance in mTBI participants compared to controls. No group differences were observed on tasks assessing visual working memory, multitasking ability, cognitive flexibility, attentional control, visuospatial ability, or information processing speed. Furthermore, the individual differences analyses suggest that factors such as time since injury, age when the injury occurred, and length of unconsciousness may predict performance on verbal working memory, multitasking, and visuospatial ability measures. Overall, these findings indicate that mTBI may have lasting impacts on verbal working memory ability and highlight the importance of using sensitive, complex measures to investigate cognitive outcomes following injury.

Topic Area: EXECUTIVE PROCESSES: Working memory

B79 - Compressive learning of knowledge network

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Knowledge is acquired by learning how isolated data in a network relate to each other, yet typical learning relies on inefficient random-walk explorations. We propose that

higher-order associations in networks serve a key role in conveying relational knowledge and could be leveraged to facilitate network learning. We examined the hypothesis in two large-scale behavioral experiments and one magnetoencephalogy (MEG) study. Human subjects learned the transitional probabilities among 16 images by trial and error, with the transitional links comprising lattice, random, small-world, or scale-free networks. First, the scale-free network, endowed with strong inhomogeneous higher-order properties, displayed the highest learnability. Second, we developed a novel pre-learning HubToLeaf path that schematizes inhomogeneous higher-order network properties to facilitate subsequent network learning. Third, the HubToLeaf pre-learning path elicits stronger neural representations of the learned network in human brains, encoded in the anterior cingulate cortex (ACC). Finally, we built a computational model incorporating hypergraph theories to characterize higher-order structures and their impacts on network learning. Taken together, network learning benefits from higher-order network structures, emphasizing which would establish a 'compressive' scaffold for knowledge networks to develop.

Topic Area: EXECUTIVE PROCESSES: Working memory

B80 - Cognitive ability, arousal, and synchronization of brain networks

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A crucial aspect of optimal cognitive functioning involves the coordination of neural activity across large-scale brain networks. Notably, a study (Majeed et al., 2011) has unveiled periodic low-frequency fluctuations characterized by an anti-correlation between the default mode network and the dorsal attention network. Employing a novel technique, the Quasi-Periodic Pattern, we discovered that periodic low-frequency fluctuations in the fronto-parietal control network shifts from synchronizing with the default-mode network at rest, to synchronizing with the dorsal attention network during a cognitively demanding task. Moreover, the synchronization of these brain networks was found to be related to high state-level performance and trait-level attention control ability. Despite these findings, the underlying mechanisms governing these low-frequency fluctuations remain unclear. Prior research (Raut et al., 2021) has proposed a potential link between these fluctuations, arousal, the locus coeruleus-norepinephrine system, and cognitive abilities (Tsukahara & Engle, 2021). In this study, we investigate how low-frequency fluctuations in these brain networks are related to activity in the locus coeruleus, state-level indicators of arousal and performance, and to higher-order trait-level cognitive abilities.

Topic Area: EXECUTIVE PROCESSES: Working memory

B81 - Primary Role of the Right Cerebral Hemisphere in Working Memory Updating: A Connectome-based Lesion-Symptom Mapping Study

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Working Memory (WM) is a cognitive system crucial for temporarily holding and manipulating information. Neuroimaging evidence suggests that verbal WM is typically associated with left hemisphere function while the processing of visuospatial information in WM more specifically activates the right hemisphere. In contrast, lesion evidence provides contradictory findings indicating the involvement of prefrontal and posterior parietal cortex of both hemispheres. Using connectome-based lesion-symptom mapping on data from 90 participants with focal brain damage (69 right damaged, 21 left damaged), we examined how gray and white matter disconnections affect WM updating in an N-back task, while considering task modality (verbal, spatial) and cognitive load (1-back, 2-back). Behavioral outcomes indicated that right brain damage patients showed more pronounced deficits in WM updating compared to left brain damage patients, regardless of task modality or difficulty. This observation is supported by whole-brain voxel-based analysis, revealing associations between WM deficits and gray matter clusters exclusively in the right hemisphere, such as the superior temporal gyrus for verbal and the middle temporal gyrus for spatial information. Additionally, white matter analyses also identified severely impacted tracts in the right hemisphere, predicting deficits in both verbal and spatial WM. Our findings highlight the primary role of the right cerebral hemisphere in mental manipulation of both verbal and spatial information. Behavioral and neuroanatomical evidence suggests that the updating component of WM predominantly relies on the integrity of the right cerebral hemisphere, irrespective of the specific type of information held in mind.

Topic Area: EXECUTIVE PROCESSES: Working memory

B82 - The Immediate Impact of Moderate Exercise on Working Memory Capacity

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Physical Exercise (PE) is widely acknowledged for its positive impact on cognition and specifically on short-term memory. However, the precise neurophysiological mechanisms of performance improvements are unclear. We developed an MEG-compatible pedal exercises – mimicking walking – to explore PE's impact on working memory (WM). In simultaneous MEG/EEG recordings participants carried out an N-back task with varying WM loads across blocks and either rested or walked during 2-min-breaks between blocks. PE improved target detection, heightened EEG-spindle activity. MEG ripples (80-150Hz) displayed consistent cortical distribution, with the highest ripple occurrences detected bilaterally across MEG sensors covering the medial temporal lobe (MTL) region. Ripple likelihood correlated with the N-back levels and predicted individual target detection performance. Importantly, PE increase in ripple-spindle coupling, which plays a crucial role in memory consolidation. In summary, our study shows working memory improvement with PE through enhanced ripple-spindle coupling.

Topic Area: EXECUTIVE PROCESSES: Working memory

B83 - The Effects of Binaural Beats on the Brain's Functional Connectivity

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Music and rhythmic tones have been used historically to alter mood and cognitive performance. Recent research shows that music is proven to help manage stress and change brain functions to the same extent as medicine. Binaural Beats (BB) are rhythmic tones used to alter one's mental state; BB are an illusionary, perceived third tone created by the brain when two different but similar pure tones (frequencies) are played in separate ears through earphones. This difference in tones is small, and cannot be transcribed by the brain and is instead tuned, making a completely new third tone. This experiment aims to answer if BB stimulation can elicit unique functional connectivity (FC) patterns in the brain by utilizing electroencephalography (EEG) data and graph theory analysis (GTA) in analyzing FC between anatomically separate regions of the brain. The hypothesis is that a singular 10-minute session of BB listening through earphones will modulate the brain's FC. After BB stimulation, indications of increased and decreased cognitive performance between BB frequency groups should be seen. A distinguishable pattern of FC elicited by BB stimulation will be determined for both BB frequency groups. Noticeable change between subjects pre and post-BB EEG recording sessions is expected, more so with the lower frequency BB group; changes in state of balance are assessed using GTA. Differences and similarities in FC and GTA results are also expected when comparing BB frequency groups. A strong association between right and left temporal regions in GTA post-BB can be expected to be seen.

Topic Area: EXECUTIVE PROCESSES: Working memory

B84 - Subjective time and context changes improve working memory in young and older adults

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Theories of memory emphasize correct identification of what we have experienced, and tend to overlook the importance of correctly rejecting what we have not experienced. Beyond its importance in daily life, correct rejection may also provide unique insights into memory mechanisms. Jang et al. (2022) varied the retention interval (4 vs 16 seconds) in a Sternberg working memory task and found higher correct rejection of non-presented ("new") probes after the longer retention interval. This effect was larger in older adults. Notably, drift diffusion modeling indicated that the primary driver of these effects was in the drift rate parameter, rather than a shift in bias. This finding is not easily explained by conventional theories of forgetting during recognition memory, like interference or decay. Instead, it might be explained by theories integrating the role of temporal context in memory. In this pre-registered study, we test the context effect explanation using the same Sternberg working memory task, but fixing the retention interval (RI) at 12s, and manipulating RI context by varying the speed of change of a visual stimulus presented during the RI. The high-change condition is designed to both introduce more contextual change and increase the speed at which participants feel time is passing. As predicted, we found higher correct rejection rates in the high-change

condition, and this effect was larger in older adults. These findings add to evidence supporting temporal context theories of memory and generate questions about how reliance on context may affect memory performance in the aging brain.

Topic Area: EXECUTIVE PROCESSES: Working memory

B85 - Tracking the emergence of concrete and abstract working memory representations guiding future cognition in the intraparietal sulcus and visual cortex

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Working memory (WM) sustains the recent past to guide future cognition. The sensory recruitment hypothesis posits that WM is supported by persistent sensory codes. However, evidence for sensory recruitment comes largely from paradigms which focus retrospectively on the past, rather than prospectively on the future. To examine prospective WM, we tested participants with a sequence memory task wherein they determined whether the currently presented stimulus sequentially followed from the last stimulus presented in the same visual field. On each trial, participants maintained a spatial location in each of the left and right visual fields. An arrow cue indicated whether a forthcoming probe would appear in the left or right visual field. We hypothesized that during the cue-probe delay, participants would generate a prospective code of the next item in the sequence (NIS). Furthermore, we hypothesized that the prospective code would be informed by abstract sequence knowledge over-and-above concrete field-specific sensory information. Analysis of fMRI signals in the intraparietal sulcus (IPS) and visual cortex (VC) revealed that the neural representation of the previously presented stimulus transitioned into that of NIS in both regions. Furthermore, we found that location representations in IPS generalized across visual fields, indicating an abstract representation of position in the sequence over-and-above concrete sensory information. Such abstract representation was not clearly present in VC. Taken together, these results indicate that the IPS stores abstract codes to guide future cognition indicating contributions to WM beyond sensory recruitment.

Topic Area: EXECUTIVE PROCESSES: Working memory

B86 - Dentate nucleus activity reflects prediction errors during language processing

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The cerebellum uses internal models to predict and facilitate sensorimotor, and possibly cognitive, outcomes. We recorded activity from the dentate nucleus and scalp during a semantic priming task to test the hypothesis that cerebellar activity is modulated by predictive context during language processing. Participants were eight patients with middle cerebral artery strokes enrolled in a clinical trial of dentate stimulation to treat motor impairment. Participants viewed 440 prime-probe word pairs in a LOW-expectancy condition (72% of pairs were unrelated words to deter predictive processing) followed by a HIGH-expectancy condition (73% of pairs were related words to encourage predictive processing). Eighty word-symbol pairs served as low-frequency (15% probability), non-semantic control stimuli. Scalp EEG time-locked to probe words revealed the typical N400 semantic potential at centro-parietal sites to words but not symbols. The N400 was largest to unrelated probe words in the HIGH condition, consistent with prior studies. Debiased weighted phase lag index analysis and cluster analysis revealed alpha band phase coherence between the dentate and frontal and parietal regions. Granger causality analysis revealed greater bidirectional signaling in the HIGH condition when predictions were violated (unrelated/symbols) relative to the LOW condition; cerebellar-to-parietal signaling was greater early in the trial (up to 400ms) while parietal-to-cerebellar signaling was greater during the N400 window. Dentate-to-frontal signaling was present between 500-700ms when predictions were violated (unrelated/symbols) in the HIGH condition. These findings suggest that the cerebellum is selectively engaged when predictions regarding upcoming semantic content are violated but does not respond to semantic content, per se.

Topic Area: LANGUAGE: Semantic

B87 - Supporting again the N400 ERP inhibition hypothesis and seeing that being alone vs. with a friend modulates the (self) P2, rather than the social N400

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The presence of a (previously unknown) confederate can induce an increase of the amplitude of the N400 event-related brain potential (ERP). This so-called social N400 has recently been proposed to index the sidelining of the privileged information that the stimulus may activate in the participants so that they can focus on the ground that is common with an unknown person. Confirming this social N400 sidelining interpretation, we observed no social N400s here, where the confederate was a friend of the participants and thus, a person with whom common grounds had already been built and with whom it may be detrimental to set aside privilege information that could enrich the relationship. Unexpectedly, P2 ERPs were smaller, particularly at the central electrode-site. These smaller P2s were tentatively related to a modulation of the binding of the stimulus representations with the representations of the self when participants were in the presence of a well-known friend who was perceiving the stimuli at the same time as they were. Noteworthy, short stories ending predictably, unpredictably, or equivocally were used as stimuli. Interestingly, results fit the N400 inhibition hypothesis, which sees N400 processes as preventing some information from entering working memory and thus, from enlarging the amplitudes of the late positive potentials (LPPs). Indeed, participants who had larger N400s to equivocal than to predictable endings did not have larger LPPs for these endings than for the predictable ones whereas such larger LPPs were observed in participants who had smaller N400s for equivocal than for predictable endings.

Topic Area: LANGUAGE: Semantic

B88 - Affect, eye-gaze and reference

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The social cue of eye-gaze can convey a range of useful information—including contextual support for demonstrating reference in sentences. In an online study, we presented 84 monolingual English speaker participants with emotionally neutral Caucasian faces with direct vs. averted gaze. Each face was followed by a sentence where direct objects were indicated to have either non-specific (The kid climbed a tree…) vs. specific reference (The kid climbed that tree…) Participants made judgments regarding the naturalness of each sentence on a scale of 1-7, and we investigated whether eye-gaze direction impacted those judgments. We also wanted to know whether dispositional affect would modulate responses. Results revealed that participants rated sentences exhibiting non-specific reference as more natural than those with specific reference. Furthermore, an interaction of specificity and gaze direction was found. Based on previous work from our lab, we split the participants into high vs. low positive affect groups. The findings indicated that individuals with high positive affect were, in fact, the drivers of the interaction. That is, low positive affect individuals were insensitive to gaze direction. These results are consistent with previous findings where we hypothesized that high positive affect individuals were more motivated to interpret sentences for meaning vs. low positive affect individuals who were more concerned with task-level requirements.

Topic Area: LANGUAGE: Semantic

B89 - Decoding the time course of predictive feature activation during speech comprehension from EEG

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There is a large body of research providing evidence that prediction facilitates language comprehension. However, less is known about which features are retrieved during predictive processing of imminent words in speech. Predictive coding theory suggests that top-down predictions are made continuously and are compared to bottom-up sensory input to generate prediction error. Thus, features of predicted upcoming words in constraining sentence contexts should be present prior to encountering these words and, as the process is top-down, higher-level features should be predicted prior to lower-level features. This assumption is examined in the present EEG study. Thus far

univariate measures of EEG have not shown evidence of a temporal hierarchy in the retrieval of conceptual, lexical and length features prior to the onset of predictable words. Machine learning classification allows us to decode the content of potentially pre-activated features in EEG and to decode the time course by which these features are retrieved. The present study uses a support vector machine (SVM) learning algorithm to decode these features from EEG data. EEG will be recorded when participants listen to sentences in which the predictability of critical nouns is manipulated. EEG will be decoded for animacy, phonological neighborhood and length in a 2000ms epoch, starting 1000ms prior to critical noun onset. If predicted features are pre-activated in a top-down fashion, then animacy features should be reliably decodable before critical nouns are heard, and they should be decodable before lexical and length features. This pattern of results would support predictive coding theory.

Topic Area: LANGUAGE: Semantic

B90 - The influence of memory reactivation during sleep on vocabulary and grammar rule learning

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Two essential components of language learning include vocabulary learning, the mappings between words and meaning, and rule generalization – the ability to extract regularities from input and apply them to novel instances. During sleep, recently encoded information is reactivated, leading to the consolidation and strengthening of both item-specific and abstract memory representations. However, within the context of language learning, it is unclear whether sleep-based memory consolidation influences both vocabulary and regularity-based knowledge to a similar degree, or whether one type of knowledge is preferentially consolidated over the other. In the current project, we will test whether externally-induced memory reactivation, known as targeted memory reactivation (TMR), boosts both vocabulary and grammar knowledge to a similar degree. Participants will learn an artificial language comprised of individual vocabulary items along with a hidden suffix rule that denotes the word's noun class (e.g. human versus animal). Learning will be followed by a 90-minute nap opportunity, during which a subset of the words will be covertly presented during slow wave sleep. Participants will then be tested on their knowledge of the words and the suffix rule upon awakening. We hypothesize that TMR will benefit both vocabulary and rule generalization, such that a boost in performance will be observed for both cued words and non-cued words in the cued grammatical noun class. These findings will allow us to better understand how sleep-based memory consolidation contributes to different aspects of language learning, and could produce insights leading to the development of new methods to support language learning.

Topic Area: LANGUAGE: Semantic

B91 - Predictive brain activity shows congruent semantic specificity in language comprehension and production.

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Sentence fragments strongly predicting a subsequent specific meaningful word elicit larger pre-word slow waves, Prediction Potentials (PP), than unpredictive contexts. To test current predictive processing models, EEG data from both sexes was collected to examine whether (i) different semantic PPs are elicited in language comprehension and production, and (ii) whether these PPs originate from the same specific 'prediction area(s)' or rather from distributed category-specific neuronal circuits reflecting the meaning of the predicted item. Larger slow waves after predictable than unpredictable contexts were present both before subjects heard the sentence-final word in the comprehension experiment and before they pronounced the sentence-final word in the production experiment. Crucially, cortical sources underlying the PP were distributed across several cortical areas and were specific to the semantic category of the expected words. In both production and comprehension, anticipation of animal words was reflected by sources in posterior visual areas, whereas predictable tool words were preceded by sources in frontocentral sensorimotor cortex. In both modalities the PPs were functionally linked with behavioural measures of predictability (i.e., Cloze probability, Reaction Times), whereas significant positive correlations between the PPs in the two modalities along with their similar latencies, polarities and topographies suggest that both signals reflect semantic predictions. These results sit comfortably with theories viewing distributed semantic-category-specific circuits as the mechanistic basis of semantic prediction in the two modalities.

Topic Area: LANGUAGE: Semantic

B92 - Kilo-picture naming: An event-related potential (ERP) study

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The neural processes implicated in effortlessly identifying and ascribing meaning to the visual objects we recognize are not fully understood. Previously, researchers have investigated the processing of various linguistic stimuli (e.g., visual words, auditory words, and sign language stimuli) in ERP megastudies with large participant samples and huge stimuli sets. In recent years, we investigated visual object recognition using picture stimuli, but with different task directives (i.e., object decision; semantic classification) and participants. The present study utilizes the ERP megastudy paradigm to explore the neural mechanisms of visual object recognition during naming. EEG has been collected for 40 right-handed English speakers. The current experiment employs a verbal production task wherein participants name 900 real-world objects. A variety of objects were presented to enable differential classification and comparison of ERP components. We expected ERPs generated would demonstrate modulation to visual and semantic variables that parallel effects in previous megastudies. Here we discuss differences between ERPs to objects high and low in complexity, objects high and low in familiarity, and animals and tools. The high and low complexity contrast showed higher P1 and N1 amplitudes, with trends persisting into the N300 and N400 time epochs. For the high and low familiarity dichotomy, low familiarity images displayed larger central-anterior N300s and central-posterior N400s when compared to high familiarity images. Tools (relative to animals) demonstrated greater bilateral posterior negativity in the N300 and N400 epochs. Alternatively, animals (relative to tools) elicited increased left anterior negativity only in the later N400 epoch.

Topic Area: LANGUAGE: Semantic

B93 - Pathways to Word Retrieval revealed by Inferential and Referential Naming

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Several types of input can trigger semantically driven word retrieval. Inferential tasks rely on input such as verbal descriptions ("a household pet that fetches"), whereas referential tasks rely on sensory referents with a clear name (an image of a dog, the sound of barking). Previous research has found distinct stimulus-locked ERP patterns in inferential versus referential naming, particularly picture-naming and visual descriptive naming, hypothesized to represent dissociable semantic processing components. It is unknown whether that dissociation represents a difference in semantic processing components or rather differences in the temporal course of semantic information retrieval mandated by the different tasks and modalities of cueing. We developed a multimodal naming task incorporating picture naming, auditory inferential naming (descriptive naming), and auditory referential naming (naming from typical sounds). The presentation of crucial semantic information was temporally isolated using a gating paradigm borrowed from speech production literature. This task was administered to healthy participants and Phase II epilepsy monitoring unit (EMU) patients with intracranial Stereo-EEG electrodes. Analysis of the behavioral data revealed a main effect of task, with descriptive naming slower than sound naming, and sound naming slower than picture naming – both in healthy participants and in SEEG patients. We then verify similar broad-band gamma and LFPs in speech motor areas across naming types. Finally, we demonstrate that inferential and referential naming tasks produce similar response patterns in the left STS when similarly locked to temporally extended stimuli. These findings show dissociated time courses of word retrieval during inferential and referential naming tasks.

Topic Area: LANGUAGE: Semantic

B94 - Disentangling the semantic interference effect: an ERP picture word interference study in bilinguals

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Picture Word Interference (PWI) tasks are insightful for understanding the intricacies of lexical selection. Much like monolinguals in identity conditions, bilinguals in translation conditions (e.g., the word "DOG" with a picture of a dog to be named in Spanish - "perro") typically show N400 priming (reduced N400s) and behavioral facilitation (faster RTs) for related compared to unrelated pairs. In semantically-related conditions (e.g., the word "CAT" with a picture of a dog) both monolinguals and bilinguals typically show N400 priming (reduced N400s) but behavioral inhibition (slower RTs). It is unclear why ERPs do not show the same inhibitory pattern as the behavioral data in the semantic condition, referred to as the Semantic Interference (SI) effect. This study observes the SI effect on the N400 in Spanish-English bilinguals using a novel scheme of grouping trials for analysis. Participants were shown English word primes that were either unrelated, semantically related, or direct translations of the target picture to-be-named in Spanish. While RT data and traditional ERP analysis replicated previous results our novel scheme revealed a different pattern for the semantic condition. Including only the trials that showed behavioral facilitation there was strong N400 priming (reduced N400s). Interestingly, when including only the trials that showed behavioral inhibition there was a reversal in the priming effect (increased N400s to the semantically related pictures). This polarity reversal indicates there is indeed an electrophysiological manifestation of semantic inhibition, but it can be obscured in typical ERP analyses that mix trials showing behavioral facilitation and inhibition.

Topic Area: LANGUAGE: Semantic

B95 - Beta oscillations are critical for semantic processing and predict behavioral performance

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The neural mechanisms underlying automatic facilitation in the setting of semantic priming are well characterized, however, most studies have focused on tasks during which semantic processing is implicit. Few studies have investigated neural processing during explicit semantic relatedness judgements. Here, 33 participants (18 females; Mage: 27.16) completed a semantic relatedness judgement task during magnetoencephalography (MEG). MEG data were transformed into the time-frequency domain and significant task-related oscillatory responses were source-imaged using a beamformer. Whole-brain paired-sample t-tests were conducted to evaluate conditional differences in neural recruitment. Further, whole-brain subtraction maps were computed and correlated with conditional differences in reaction time (RT). Behaviorally, participants had significantly shorter RT in related trials compared to unrelated trials ($t[32]=-8.90$, $p<.001$). Regarding the MEG data, we observed robust neural responses in alpha and beta frequency bands in bilateral occipital, and left temporo-parietal cortices. Whole-brain condition-wise analyses revealed significant differences in alpha activity in bilateral temporoparietal cortices ($p<.005$, corrected), as well as significant conditional differences in beta activity in the left temporal and medial occipital regions ($p<.005$, corrected). These differences were such that stronger decreases in power were observed in related trials as compared to unrelated trials. Further, we found that conditional differences in beta oscillatory activity in the left inferior frontal gyrus (IFG) significantly predicted RT differences ($p<.001$). These data suggest that there is bilateral recruitment of temporoparietal cortices and medial occipital regions during judgements of semantic relatedness. Additionally, these data promote the role of left IFG beta activity in the executive control of semantic judgements.

Topic Area: LANGUAGE: Semantic

B96 - Neural decoding of semantic representations from novice sign language learners reflects newly-acquired vocabulary

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How is newly-learned information reflected in the brain? Prior work has found that data-driven neuroimaging methods such as multivariate representational similarity analysis (RSA) can be used to characterize the emergence of newly-learned concepts over the course of learning in a number of domains. Furthermore, studies of semantic processing suggest that the same concept presented in two different modalities, such as homologous words in two different languages which participants speak fluently, can evoke similar neural patterns associated with underlying semantic meaning. In the present study, forty hearing English speakers with no prior experience in American Sign Language (ASL) completed a series of short online learning modules followed by an fMRI scan during which they viewed video clips of both previously-studied and new, unstudied words in ASL. Using multivariate pattern analysis methods including RSA and support vector machine (SVM) classification, we identified brain regions that were reflective of categorical distinctions between the stimuli in English which also tracked semantic relationships between the studied (but not unstudied) ASL words at the group level. We further investigate the ability of individual-level neural patterns to predict student performance on a recall quiz immediately before the scan as well as one week later. Our results provide evidence for the ability of multivariate neuroimaging analysis approaches to detect shifts in understanding even in the earliest stages of language learning.

Topic Area: LANGUAGE: Semantic

B97 - The neurocognitive basis of semantic reading in stroke alexia

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Semantics' role in reading is controversial. The imageability advantage, whereby imageable words (e.g., "car") are read faster and more accurately than non-imageable words (e.g., "justice"), is a measure of semantic influence on reading aloud. Imageability advantage changes in stroke-induced alexia could result from either a nonverbal semantic representation impairment, or from an impairment in semantic-phonology (SP) mappings. We leverage lesion symptom mapping and behavioral testing of the imageability effect to identify the neural and computational basis of semantic influence on reading. We performed voxel-based (VLSM) and structural connectome lesion-symptom mapping (CLSM) on the imageability advantage in 56 left hemisphere stroke survivors. Participants read aloud 200 single words varying in frequency, regularity, and imageability. Averaged accuracy on yes/no auditory category judgement and Pyramids and Palm Trees was used to assess nonverbal semantic representation. Averaged picture naming and word-to-picture matching accuracy assessed SP mappings. Left posterior superior temporal sulcus (lpSTS) lesions were associated with reduced imageability advantage. CLSM analyses showed that structural disconnections to the lpSTS reduced the imageability advantage (voxel/edgewise $P<0.005$, cluster FWER $P<0.05$). Participants' accuracy on imageable words was predicted by SP mapping ability, but not nonverbal semantics. VLSM of the SP score implicates left superior temporal cortex, partially overlapping with the lpSTS imageability advantage result. Lower SP mapping scores were associated with disconnections in a left-lateralized language and semantic network. Our results suggest that the lpSTS underlies the influence of semantics on reading, and that reduced imageability advantage reflects impairment of SP mappings rather than impairment of semantic representation.

Topic Area: LANGUAGE: Semantic

B98 - Hippocampal involvement in reading

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The cortical substrates of skilled reading have been extensively investigated. However, more research is needed to understand the involvement of subcortical regions in language processing. Reading requires phonological and visuospatial short-term memories, computations that are typically mapped onto the hippocampus. In the present work, we analyzed three functional MRI reading datasets using single-word and sentence processing reading tasks to investigate the contribution of different hippocampal sections (i.e., head, body and tail) to reading. Results revealed that across

the three datasets hippocampal engagement was stronger in the left than in the right hemisphere, specially in the hippocampal body. Moreover, also in all the datasets, the left hippocampal body was more strongly recruited during reading than the hippocampal head or tail. Functional connectivity analyses revealed that also across the three datasets the left hippocampal body and head showed tighter functional coactivation with nodes along the ventral reading network compared with nodes along the dorsal network, suggesting a role of the hippocampus in semantic rather than phonological reading processes. In sum, our study consistently underscores the involvement of the left hippocampal body in skilled single-word and sentence reading, confirming the importance of unveiling the role of subcortical regions in current and future neurobiology of reading models.

Topic Area: LANGUAGE: Semantic

B99 - Antipsychotic placebo increases electrophysiological indices of stimulus processing and accelerates reaction times on a particular semantic task

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When we are consciously perceiving a stimulus we are also aware that it is us who is perceiving it. This means that the representations activated by the stimulus are bound to representations of the self. The impact of this binding on the processing of the stimulus remains unclear. To examine this, we manipulated self-representations by using an antipsychotic placebo, as taking this may add a layer of self-representation. Indeed, with it, participants may represent themselves both as they usually do and as being under the influence of a drug. Two tasks were used to explore the effects of that manipulation on stimulus processing: a classical semantic categorization task and a control self-referential task that focused only on the usual self of the participant. In the semantic task, participants of the antipsychotic placebo group (N=43) displayed greater P2- and late positive potential- (LPP) event-related potential (ERPs) amplitudes, as well as faster reaction times than the participants of the no-pill group (N=43). No such differences were found in the control task, whereas the amplitude of the N400 ERP was significantly reduced by the placebo in both tasks. As a fully deceptive antipsychotic placebo was used, our results may have an impact on the understanding of the cognitive deficits of schizophrenia patients and on the placebo aspect of the effects of the medications they are taking. Further research in this area should focus on these patients whose self-representations have been hypothesized to be fragmented.

Topic Area: LANGUAGE: Semantic

B100 - Prefrontal Cortex Activity When Processing Concrete and Abstract Words: A fNIRS Study

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People process concrete words (e.g., table) faster than abstract words (e.g., peace). The dual-coding theory posits concrete words are stored in a verbal format and a pictorial format (both hemispheres), whereas abstract words are stored only in a verbal format (left hemisphere). Recently, individual differences in mental imagery skill have come to light. One question is whether people with low mental imagery still show an advantage for concrete words and if they also use both hemispheres to access information about concrete words. Twenty-eight participants (68% female, 18-22 years) judged the similarity of concrete words while frontal lobe activity was monitored using functional near-infrared spectroscopy (fNIRS). Participants also completed the Vividness of Visual Imagery Questionnaire (VVIQ) to evaluate the vividness of their mental imagery. Participants were faster when judging concrete words than abstract words, $F(1, 27) = 23.67$, $p < .001$. For abstract words, participants judged similar words faster than dissimilar words, $t(27) = -3.68$, $p < .001$. Participants also judged similar concrete words to be more similar in meaning than similar abstract words, $t(27) = 2.85$, $p = .008$. In inferior prefrontal cortex, oxygenated hemoglobin was lower while rating concrete words than abstract words; however, there was no difference in oxygenated hemoglobin for superior prefrontal cortex, $F(1, 26) = 7.46$, $p = .01$. Vividness of mental imagery was not correlated with reaction time or oxygenated hemoglobin levels in the prefrontal cortex (all ps > .10). Mental imagery skills do not appear to affect how people process concrete and abstract words.

Topic Area: LANGUAGE: Semantic

B101 - Acute effects of antipsychotics on healthy volunteers: An ERP study using meaningful stimuli with self-referential task and placebo controls

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Antipsychotics, like risperidone, are still the mainstay of treatment for schizophrenia. Today, we know that they can improve certain clinical symptoms of patients fast, even within an hour. However, studies of their cognitive impact have not controlled for placebo effects. One work reports that antipsychotic-placebo effects decrease the amplitude of the N400 event-related brain potentials (ERPs) while increasing those of the central P2 and of the LPP (late positive potential). These two ERP increases have tentatively been related to the binding of stimulus representations with particular additional self-representations. Namely, with the temporary representations of oneself as being under the effect of a psychoactive drug. Here, to isolate the chemical effects of risperidone, we tested 47 healthy participants who received 1 mg of risperidone and 47 matched others who had a fully deceptive antipsychotic-placebo. After 90 minutes, all performed a semantic categorization task and a particular self-referential task explicitly focusing on long-term self-representations. Relative to the placebo, a further increase of the P2 and of the LPP amplitudes was found in the risperidone group in the semantic task but not in the control self-referential task. In contrast, the risperidone left N400 amplitudes unchanged. These results suggest that risperidone may have a rapid and distinctive influence on early and late binding with self-representations. Associated with a fast decrease of clinical symptoms, such acute cognitive improvements may predict the efficacy of a medication at rehabilitating a patient on the long run.

Topic Area: LANGUAGE: Semantic

B102 - Semantic Embodiment: Decoding Action Words through Topographic Neuronal Representation within Brain-Constrained Network

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Previous neuroimaging research suggests that action related words semantically related to actions typically performed with the upper or lower extremities, e.g. “grasp” vs “kick”, activate different parts of the cortical motor system consistent with the somatotopic representation of these body parts. This differential activation could reflect differences in semantic processing between symbol types or, alternatively, epiphenomenal activity related to but following semantic processing, for example imagining a scene related to symbol meaning. To address this controversy, we here simulate semantic learning of action words in real world environments where word meaning is grounded in bodily experiences. We find that a brain constrained network with area structure imitating cortical motor, language and connector hub areas builds neuronal circuits, or cell assemblies (CAs), with different distributions for arm and leg related words. Activation of specific word forms replicates the differential activity of dorsolateral motor areas known from neurometabolic (fMRI) and the fast spreading of activity shown by related neurophysiological (MEG/EEG) studies. Our results indicate that these differential activations are not “epiphenomenal” but reflect fast access to semantic memory circuits that store symbol forms together with their meaning.

Topic Area: LANGUAGE: Semantic

B103 - Using ATL-optimized fMRI to investigate speech perception challenges

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Speech perception relies on a network of brain regions known as the core speech network. When faced with challenges such as background noise or semantic ambiguity, we see activation extend into the multiple demand network with different types of challenges leading to different patterns of brain activation. A key region for semantic cognition, the anterior temporal lobe (ATL), is often not shown to be active in fMRI studies, due in part to significant distortions and signal dropout within this region. Recent fMRI techniques, however, have been able to retrieve signal from the ATL. The present study employed ATL-optimized fMRI to investigate acoustic and semantic challenges in the brain. The stimuli consisted of 116 sentences with or without homophones. Half these sentences were presented clearly and half in background noise. Sentence trials

were intermixed with trials of silence and signal correlated noise (SCN). We found that the left ATL was active during all speech conditions relative to SCN and silence, however, we found no differences in the ATL across speech conditions. Acoustic ambiguity led to increased activation in bilateral insula, anterior cingulate, and inferior frontal gyrus. Semantic ambiguity led to increased activation in left inferior frontal gyrus. Results for semantic and acoustic ambiguity were consistent with previous findings. The ATL activation we found is consistent with its role as a semantic hub and suggests a non-selective involvement in semantic processing of naturalistic speech. That is, the left ATL appears to be active for semantically rich auditory stimuli, regardless of listening challenges.

Topic Area: LANGUAGE: Semantic

B104 - The structure of lexical semantic representations as revealed by semantic verification

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A long-standing issue is whether conceptual representations are organized in the brain by semantic category, sensorimotor modality of knowledge, or jointly by both dimensions. Semantic verification, which is widely used to study conceptual representations, requires participants to decide the validity of short descriptive attribute-object pairs (e.g. "a wallet holds money", "a wallet is used for cleaning"). We report a series of experiments using a new semantic verification task with four matched categories (animals, fruits/vegetables, tools, and manipulatable objects) orthogonally crossed with six semantic attributes (function, behavior, visual surface, visual form, typical location, thematic association). In Experiment 1, participants were presented with an attribute, followed by an object name, and indicated (button push) whether the attribute was true/false of the object. In Experiment 2, with identical stimuli and timing of presentation, participants responded verbally by reading the object name aloud if the presented attribute was true, or saying 'false' otherwise. Experiment 3 normed all attributes and object names for reading time, allowing us to partial out trial-level variance in processing time in Experiments 1 and 2. We found that (putatively) preferred attribute types were not associated with faster verification times for their respective categories (e.g., function attributes for tool, surface/color attributes for fruit/vegetables), for either manual or verbal responses, after partialling out processing times for attributes and objects. These findings suggest that neither category nor modality holds priority in verification judgements, contrary to the long-proposed alignment between knowledge types and categories with this task.

Topic Area: LANGUAGE: Semantic

B105 - Fixation-Related Potentials Reveal Multiple Effects of Context across the Visual Field in Natural Reading

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During reading, it is unclear how and when central attention gets allocated across the visual field to extract and integrate semantic features of words. The co-registration of eye-movements with electroencephalography (EEG) allows for the estimation of fixation-related brain potentials (FRPs) in ecologically-valid visual tasks, including reading. While FRP studies have begun to chart the time-course of semantic processing, for example showing N400 modulations by plausibility and predictability, no studies have simultaneously examined anterior (linked to predictive processing) and posterior (linked to semantic integrations) post-N400 positivities in natural reading. We recorded simultaneous eye movements and EEG while participants read constraining sentences with expected, unexpected (but plausible), and anomalous target words (e.g., When the power went out the house became dark/cold/half like last time). When time-locking fixations to the pre-target word, we observed a parafoveal N400 that was largest to anomalous words, followed by unexpected, and then expected words. The N400 was facilitated when the word was subsequently fixated, suggesting trans-saccadic integration of semantic features. At target fixation, we also observed a late anteriorly distributed positivity to unexpected target words, an effect that was not present at the pre-target word. Lastly, we observed a late posteriorly-distributed positive component that was stronger when time-locked to the pre-target word compared to the target word, suggesting that some integrative processes may begin in parafoveal vision in natural reading. Collectively, these findings suggest that readers can begin accessing semantic information in parafoveal vision, but that higher-level semantic processing requires the orchestration of parafoveal and foveal representations.

Topic Area: LANGUAGE: Semantic

B106 - Is prediction automatic or adaptive during speech comprehension? An EEG decoding study

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Prior studies suggest that speech processing is facilitated by prediction of imminent input. But it is unclear if predictive processing is automatic, as assumed by Bayesian models, or adaptive, as assumed by rational models. We examine this by manipulating the predictability of animacy of critical nouns in spoken sentence contexts (high or low constraint) and the proportion of sentences that reliably predict animacy (80% or 20%). If prediction is automatic, then animacy information should be retrieved in the high constraint condition prior to the critical nouns, regardless of the proportion manipulation. Activation of animacy features will be examined by decoding EEG prior to critical nouns. Facilitated processing of critical nouns as a function of (pre)-activation will be examined by comparing ERP animacy effects. EEG will be decoded in a 1000ms silence period prior to the critical nouns. If prediction is automatic, we expect significant above-chance decoding accuracy of animacy features for high constraint sentences in both probability conditions. If pre-activation of animacy features automatically facilitates processing of critical nouns, the constraint manipulation will modulate the size of the N400 animacy effect in both proportion conditions as well. However, if facilitated processing of the target nouns depends on the reliability of prediction in the global context of the experiment, we expect a reduced N400 animacy effect for high constraint sentences in the 80% relative to the 20% condition. This latter pattern of results would provide evidence that pre-activation of animacy features is automatic, but facilitation from prediction is not.

Topic Area: LANGUAGE: Semantic

B107 - Motor Representation and Semantic Control: Examining Embodiment of Action Verb in First and Second Language

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Converging evidence on embodied cognition suggests that semantic processing relies not only on a representation system closely linked to sensory-motor structures but also on a semantic control system. However, little is known about whether and how these two systems interact during the embodied semantic processing of a less embodied and less proficient second language (L2). In our study, we investigated the brain activation of 31 late Chinese-English bilinguals during a verb-verb semantic similarity judgment task in both first language (L1) and L2. We observed the widely-reported delay in reaction time for same-effector unrelated pairs (e.g., kick, run) compared to different-effector unrelated pairs (e.g., kick, grasp) exclusively in L1, an effector-triggered interference attributable to semantic control of embodied information. The results revealed that, in L1, bilateral superior temporal gyrus (STG), bilateral middle temporal gyrus (MTG), bilateral supplementary motor area (SMA), right precentral and postcentral cortex were involved in different-effector pairs versus baseline (none-effector pairs); the left inferior frontal gyrus (IFG), left middle frontal gyrus (MFG), and left inferior parietal lobule (IPL) in same-effector pairs versus baseline, suggesting an active interaction between the representation system (motor regions) and the control system (IFG, MTG, IPL) during verb similarity judgment. When comparing the activation patterns across languages, we found greater activation in the left ventral and dorsal premotor cortex (vPM, dPM) in L1 over L2. These findings suggest that L2 recruits control and representation systems similar to L1 to process embodied words, and observed behavioral differences might be attributed to varying degrees of embodiment.

Topic Area: LANGUAGE: Semantic

B108 - A computational approach to creativity: Fostering success and equity in college admissions

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Creativity, defined as the ability to generate novel and useful ideas or works, plays a pivotal role in fostering innovation and facilitating problem-solving. Existing literature reports that creativity can predict the future academic success of students, while less being biased by sociodemographic factors. However, the broader application of creativity, particularly in college admissions, has been limited due to challenges surrounding the inefficiency and subjectivity inherent in human creativity assessments. In this study, we explore the potential of computational creativity metrics—extracted from college applications—to better predict students' success and to foster equity in college admissions. To overcome assessment challenges associated with human ratings, we leverage state-of-the-art Large Language Models (BERT, GPT, and Llama2) to compute creativity metrics from college application essays. We then test how computational creativity metrics are associated with college admission results and future academic performance (i.e., GPAs). Using a pilot sample of 1,000 applicants, we found that computational creativity metrics positively predicted future academic performance in college, but not admission results—even after controlling for standardized test scores and socio-demographic factors. This suggests that creativity is an important factor in college success that may not be adequately considered in the admissions process. Moreover, unlike standardized test scores, creativity was not related to socio-demographic factors, suggesting creativity may be a less biased feature. We conclude with limitations and future directions, including a forthcoming multi-university, big-data replication with over 300,000 admission essays.

Topic Area: LANGUAGE: Semantic

B110 - Alpha and beta dynamics support task-based word production

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Brain oscillations support a wide range of linguistic processes, from lexical retrieval to attention and prediction on word- and sentence-level processing. However, little is known about the role of brain rhythms in task-based word production, which is key to semantic cognition. We constructed a novel paradigm in which participants produced an alternative exemplar or a feature of a target word embedded in spoken sentences (e.g., for the word tuna an exemplar from the same category —seafood— would be shrimp, and a feature would be pink). A visual cue indicated the task —exemplar or feature. Magnetoencephalographic data were analyzed during thinking, before participants verbalized their answer. We found that, compared to exemplars, participants were slower, gave more variable and more semantically distant (from the target word) answers, suggestive of increased association strength for exemplars. Word frequency was positively correlated with semantic distance for features, while higher semantic distance was associated with more original answers for exemplars, reflective of differential lexical processing between tasks. Furthermore, linear mixed models revealed that alpha-beta power positively correlated with reaction times, in line with the role of those rhythms in facilitating task performance by regulating inhibition. Critically, semantic distance negatively correlated with alpha and beta power in left-hemispheric regions, potentially associated with cognitive control, showing however a differential spatiotemporal pattern for features compared to exemplars. We conclude that the generation of semantic associations relies on top-down mechanisms reflected in alpha and beta dynamics, providing evidence for the role of those oscillations in word production.

Topic Area: LANGUAGE: Semantic

B111 - Is it a dog or an animal? Differential responses in reaction times and pupil sizes to basic and superodinate categories.

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Objects can be categorized at different levels of specificity; for example, a dog can be a dog (basic level category), or an animal (superordinate category). Previous work generally finds a basic-level category advantage, with faster processing of basic-level categories (e.g., Iordan et al., 2016; Rosch et al., 1976; Murphy, 2016), though some work (e.g., Mace et al., 2009) has shown that superordinate categories are processed faster. Here we built on studies (e.g., Kuipers et al., 2018) showing faster responses to congruent word-image pairs by investigating the category level on reaction times and pupil responses. Participants saw label-picture pairings that differed on congruency (e.g., hearing cat before seeing a cat; hearing apple before seeing a cat) and category level (e.g., the basic word cat versus the superordinate word animal). Because larger pupil sizes are found when tasks require more cognitive processing (e.g., van der Wel, & Van Steenbergen, 2018), we expected larger pupil sizes when trials were incongruent and when labels were superordinate. Study 1 (N = 30) found robust reaction time differences with faster responses for congruent compared to incongruent and for basic compared to superordinate trials, but no differences in pupil sizes. To account for the possibility that the required response effort masked potential pupil differences, Study 2 (N = 60) used a passive task. Results showed larger pupil sizes for incongruent trials compared to congruent trials, as predicted, but found larger pupils for basic level trials compared to superordinate level categories, in contrast to our predictions.

Topic Area: LANGUAGE: Semantic

B112 - Cognitive abilities predicting semantic tracking of speech

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Previous work from our lab has shown that tests sensitive to fluid intelligence and working memory predict speech intelligibility in noise – that is, the ability to report words from sentences masked by multi-talker babble noise. Here, we examine whether these cognitive domains also predict speech comprehension, by studying their relation to semantic tracking of speech. Participants completed a matrix reasoning task (test of fluid intelligence) and a backward digit span task (test of working memory), followed by EEG recording (16 channel) during a sentence comprehension task. Participants listened to 144 sentences, half presented clearly, and half presented with multi-talker babble (+4 dB signal-to-noise ratio). Each spoken sentence (e.g., "The competition ended as a draw") was followed by two text phrases that shared no words with the sentence (e.g. game was tied and match finished early). Participants chose the phrase that best semantically matched the sentence (i.e., game was tied). We plan to use semantic temporal response functions (sTRFs) as an index of semantic tracking. TRFs represent a linear mapping between the EEG signals and, in this case, semantic features of each spoken sentence derived from the GLoVE language model (Pennington et al., 2014). The magnitude of the TRF deflection indicates the degree to which semantic context is encoded in the brain. We anticipate that individuals scoring higher on our cognitive measures will show greater semantic tracking, especially for sentences with background noise. This would show that these cognitive abilities are important for naturalistic speech comprehension, beyond word report.

Topic Area: LANGUAGE: Semantic

B113 - Cross-modal examinations of narrative structural processing in autistic individuals

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Understanding the structure, or narrative arc, of a story is critical for narrative comprehension, whether a narrative is presented verbally (e.g., written or spoken stories) or pictorially (e.g., comics). Our previous work finds that autistic adults show reduced sensitivity to narrative structure in comics, which could help explain oft-reported differences in narrative comprehension by autistic individuals. Here, we extend that work to explore structural processing in written and pictorial narratives and compare between modalities. In an electroencephalography (EEG) study with autistic and non-autistic adults, we manipulated the presence of narrative grammar in comics and written stories. "Structural-only" narratives contained narrative structure but no comprehensible meaning. These were created by shuffling sentences (in written narratives) or comic panels (in visual narratives) across stories but maintaining their relative positions. "Scrambled" narratives were created by shuffling sentences/panels across stories and positions, thus eliminating both structure and meaning. Preliminary analyses (n=8) showed effects of condition in both modalities, with scrambled conditions eliciting more negative amplitudes than structural-only conditions. Written narratives also showed interactions of condition with level of autistic traits as measured by the Autism Quotient (AQ) questionnaire. Interestingly, the directionality of this effect was opposite to our previous findings on comics processing: in written stories, higher levels of autistic traits were associated with larger amplitude differences between scrambled and structural-only conditions. These preliminary data suggest that autism affects the processing of narrative grammar, which could contribute to narrative comprehension differences in this population.

Topic Area: LANGUAGE: Syntax

B114 - Parafoveal and foveal sensitivity to semantic and syntactic violations in deaf and hearing readers: An ERP study

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When investigating sentence comprehension, ERP studies typically use an RSVP design where words are flashed on the screen one at a time. This method has substantial differences from typical reading and has been criticized for lack of ecological validity. The current study utilized an "RSVP with flankers" design where three words are presented and appear to slide into the central point of fixation. This design more closely resembles natural reading while maintaining a word-by-word presentation format allowing us to investigate effects when the critical word is in the fovea and parafovea. Currently, we have tested 24 hearing and 24 deaf readers in a sentence violation identification task with three violation types: semantic, verb agreement, and word order. For foveated words, hearing readers showed a strong P600 for agreement and word order violations. As found previously, deaf readers did not show P600 effects for agreement violations (perhaps because this type of violation is not possible in ASL), but they did exhibit a robust P600 for word order violations. For semantic violations, deaf readers showed a stronger N400 effect than hearing readers for foveated words, and neither group exhibited strong sensitivity to semantic violations in the parafovea. Importantly, only deaf readers displayed an effect in the parafovea for word order violations, indicating they are able to detect this type of anomaly prior to fixation. This finding is consistent with evidence that deaf readers have enhanced attention in the visual periphery and a larger reading span compared to hearing readers.

Topic Area: LANGUAGE: Syntax

B115 - Decoupling speech acoustics and linguistic representations

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Speech tracking is assumed to rely on the temporal alignment of neural oscillations to low-frequency (<10 Hz), quasi-rhythmic amplitude modulations of the speech sound carrier between 3 and 5 Hz, supporting the hypothesis that humans are endowed with a neural oscillator tuned to narrow-band speech rhythmic fluctuations. Recently, it has been proposed that also higher order linguistic units, such as syntactic phrases, segregate to narrow-band acoustic rhythms, so that dedicated neural oscillators would capture their temporal distribution. Two rarely discussed, but almost invariably implicit assumptions ground such hypothesis: 1) Speech and language units are unimodally distributed; 2) The overlap in duration across the hierarchy of speech and language units is negligible. We modelled the temporal distribution of multiple speech and syntactic units extracted from two audiobook chapters, and show that: 1) key speech units such as words and sentences, and syntactic units such as Noun Phrases are bimodally distributed: a neural oscillator would not capture their variance profile; 2) Speech units and syntactic categories largely overlap in time, making it effectively impossible to temporally segregate linguistic representations. We conclude that the temporal dimension of speech acoustics vastly underspecifies the time scales of speech and syntactic processing. To test such conclusion, we run a time-resolved mutual information analysis of EEG data recorded from 23 participants listening to the audiobook chapters, and demonstrate that information extraction using vectors based on hierarchical linguistic annotations outperforms information analyses using vectors based on speech acoustics.

Topic Area: LANGUAGE: Syntax

B116 - Exploring Parallel Syntactic Processing in Reading: Insights from ERP Studies

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To what extent can skilled readers extract higher-order lexical information from multiple words in parallel? The answer to this question has remained controversial with regards to how our brain deals with processing incoming visual information. On the one hand, both eye-tracking and behavioral studies consistently found an effect of parafoveal stimuli on the processing of the fixated foveal stimulus. On the other, effects of higher-order lexical information such as syntax, semantics and grammar have remained elusive. In this project, I will present data from two experiments which used event-related potential (ERP) recordings to investigate the timeframe of how higher-order lexical information impacts ongoing word and sentence recognition. In the first experiment, we used the lexical flanker paradigm in which participants had to classify foveal target words as either being a noun or an adjective. Targets were flanked by either syntactically congruent or incongruent words (e.g.; noun noun noun vs. adjective noun adjective), or syntactically compatible or incompatible words (e.g., adjective noun verb vs. verb noun adjective). The second experiment employed the same stimuli as the latter condition, with participants now tasked to judge the sentence grammaticality instead. Results showed a significantly reduced amplitude in the N400 component (thought to reflect the mapping of word identities to lexical representations) for the syntactic compatible condition and for the sentence grammaticality judgements. These indicate that our reading system can extract and process syntactic information from multiple words in a short timeframe, and that syntactic units are integrated as a single (i.e., sentence) unit.

Topic Area: LANGUAGE: Syntax

B117 - Exploring the Impact of Motivation and Working Memory on Second Language Sentence Processing: An ERP Study

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Individual differences in motivation and working memory significantly contribute to variation in second language (L2) learning outcomes. However, it remains unclear whether these factors can account for variation in the electrophysiological correlates of L2 sentence processing. In the current study, EEG was recorded while 30 English-speaking learners of Spanish completed a sentence reading task. A battery of individual measures was administered to assess motivation and working memory and to take into account variation in language experience. The question was whether these factors would help explain differential reliance on lexical/semantic (N400) or repair/reanalysis (P600) mechanisms during L2 semantic and grammar processing. Preliminary results showed that higher working memory capacity was related to increased P600 effects during grammatical processing. Lower working memory capacity was related to N400 effects during both semantic and grammatical processing. Finally, an exploratory analysis on interactions between working memory and motivation revealed that learners with lower working memory capacity, but higher motivation, utilized more repair/reanalysis (P600) mechanisms when processing grammatical violations. These results suggest that both cognitive and affective resources contribute to variation in the electrophysiological correlates of L2 sentence processing.

Topic Area: LANGUAGE: Syntax

B118 - Investigating Working Memory Capacity Processes in the Prefrontal Cortex of Marmosets

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Working memory is a critical cognitive process for short-term information retention and manipulation. Additionally, it is a capacity-limited system, as only a certain number of items can be retained without deterioration. There has been substantial interest in using animal models to study the neurophysiology underlying working memory function and capacity in cognitive neuroscience. In this regard, the common marmoset (Callithrix jacchus) has emerged as a particularly valuable model, with its lissencephalic cortex characterized by a lack of folds (gyri), providing an ideal platform for studying cortical processing layers during cognitive tasks. Our research delves into the neural mechanisms of working memory capacity in marmosets. We conducted a behavioural and physiological examination of working memory capacity in these animals. Specifically, we trained four marmosets to engage in a delay non-match to location task. This task involves presenting the marmosets with a progressively increasing array of stimuli at different locations, challenging their working memory capacity. We then implanted two marmosets with multi-shank "volume" probes (N-form array, Plexon Inc.). Our findings reveal neurons selectively responsive to the correct target location, demonstrating persistent firing during the delay phase – a hallmark of working memory. Furthermore, through decoding analysis, we discovered that the memory load (the

number of stimuli a marmoset retains) can be accurately decoded from the activity of single neurons. This study enhances our understanding of working memory capacity in a novel animal model and opens avenues for more advanced research into the neural basis of memory processing.

Topic Area: EXECUTIVE PROCESSES: Working memory

B119 - Longitudinal Changes of Hippocampal Subfield Volumes from Middle Childhood to Late Adulthood

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The hippocampus is crucial for memory function across all ages and is comprised of distinct subfields: dentate gyrus (DG), cornu ammonis sectors (CA1-3), and subiculum. The direction and magnitude of age differences in hippocampal subfield volumes vary over the lifespan. Yet, the evidence on change and variability in lifespan developmental trajectories is sparse. We examined lifespan trends in subfield volumes and age-group differences in change in a large sample (n=474 at baseline, n=189 at follow-up, two occasions, mean delay=2.5 years) of healthy children (ages 5-18.9 years), adults (ages 19-49.9 years) and older adults (ages 50-73.9 years). The association of age with magnitude and direction of change in CA1-2 and subiculum volumes differed among age groups but was comparable in DG-CA3 volumes. In childhood, subfield volumes did not significantly change on average, but change in subiculum volumes linked to age with a shift from volume gain to shrinkage towards adulthood. In adulthood, CA1-2 volumes increased, but the volumetric gain attenuated towards shrinkage evident by age 50 years. DG-CA3 and subiculum volumes shrunk in old adulthood and evinced a trend for acceleration towards the age 70 years. Differential longitudinal changes of subfield volumes across the lifespan likely reflect different neural processes depending on the period of life from development to aging. This may have implications for constructing theoretical models of lifespan memory development. Building on these results, a planned longitudinal study of memory will provide insight into functional relevance of lifespan changes in subfield volumes.

Topic Area: LONG-TERM MEMORY: Development & aging

B120 - Effects of Emotion and Age on Subjective and Objective Memory Measures

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We examined how older age and emotional valence affect relationships between subjective ratings of memory vividness and objective measures of remembered visual salience. Participants (n = 37 older adults; n = 34 young adults) studied emotionally negative and neutral images that varied in color saturation and luminance, and reconstructed the visual salience of the images in a subsequent memory test (Cooper et al., 2019). We calculated salience bias (mean salience error) and precision (SD of salience error), which we compared with participants' subjective ratings of memory vividness for each image. We found correlations between subjective memory vividness and objective measures of remembered visual salience were reduced in older adults (main effects of age: F(1,69)=5.9-7.4, p=.008-.02). Older adults reported higher subjective memory vividness than young adults (F(1,69)=16.9, p=.0001) but lower measured memory precision (F(1,69)=10.9, p=.002). We found age-by-emotion interactions consistent with accounts that memory benefits for negative emotional stimuli are reduced in older adults. We found enhanced subjective memory vividness and objective memory precision for negative images in young, but not older adults (age*emotion: F(1,69)=7.9-8.10, p=.006-.008). Significant age effects and interactions were limited to precision measures and were not observed for salience bias. Notably, this study represents an independent replication of the previously-described "memory-fading effect" whereby images were recollected as less visually salient than they were encoded for both groups (negative salience bias). Together these findings suggest dissociations in which qualities of memory are altered across the lifespan, with consistent age-group differences and effects of emotion on precision and vividness measures.

Topic Area: LONG-TERM MEMORY: Development & aging

B121 - Exploring the impact of healthy aging on temporal duration sequence memory

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Functional MRI (fMRI) and focal lesion patient studies have suggested that the hippocampus is critical for memory for temporal duration information in the context of event sequences. Consistent with this idea, recent behavioural data have revealed that healthy older adults possess poorer temporal duration sequence memory compared to young adults, although age-related dysfunction of frontal regions may also be contributing to this impairment. To explore this, the current study used fMRI to scan young (n = 24, age range 18-30) and older (n = 15, age range 60-75) participants during a delayed-match-to-sample task in which participants compared the durations of a series of brief scene images presented at the encoding and retrieval phases of each trial. Replicating previous findings in the literature, analysis of the young adult data revealed greater hippocampal activity during the retrieval phase of match trials compared to mismatch trials. Preliminary between-group analyses revealed that older adults exhibited differential patterns of activity compared to young adults in several regions, for instance, decreased prefrontal and hippocampal activity during match trials. Our data provide novel insight into how healthy aging impacts the neural mechanisms underlying memory for temporal durations within event sequences.

Topic Area: LONG-TERM MEMORY: Development & aging

B122 - Age-related neural dedifferentiation: Unveiling the role of functional connectivity and network reorganization

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'Age-related neural dedifferentiation', the finding that neural representations of information are less distinctive in older adults compared with younger adults, has been reported to underly age differences in memory performance. However, little is known about how brain-wide neural changes in old age contribute to age-related neural dedifferentiation. Here, we explored whether age-related differences in functional network organization explain neural dedifferentiation in category-selective visual regions. In this study, 35 younger and 34 older adults viewed blocks of faces and houses in the fMRI scanner. Using multivoxel pattern analysis, we identified age differences in the distinctiveness (operationalized as the difference between within-category and between-category similarity) of face processing in the fusiform gyrus (FG) and house processing in the parahippocampal gyrus (PHG). Using background connectivity, we found that younger adults had greater connectivity between the FG and the visual network than older adults. Crucially, interindividual differences in connectivity were related to neural distinctiveness, suggesting that age-related disruptions in communication between category-selective regions and the visual network may explain dedifferentiated category representations. Furthermore, we observed age differences in global network structure, defined as the functional segregation of the visual network from the default mode network. Older adults exhibited less coherent network structures than younger adults, a phenomenon referred to as network-level dedifferentiation. Finally, we found a relationship between dedifferentiated category representations and dedifferentiated network structure. Thus, we provide evidence supporting the idea that senescent reorganization of functional networks and differences in connectivity to category-selective regions may be an underlying cause of age-related neural dedifferentiation.

Topic Area: LONG-TERM MEMORY: Development & aging

B123 - Examining how retrieval goals shape memory recall in younger and older adults

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Episodic memory changes are a hallmark of cognitive aging. A recent neurocognitive framework describes these age-related changes as qualitative distinctions in how younger and older adults recollect events—when younger adults prioritize accurate recall, older adults emphasize recalling events more broadly, for socially-oriented reasons. Based on this proposal, we investigated (1) whether age-related deficits in

episodic recollection result from age-specific goals of retrieval and (2) if aging affects the ability to adapt memory recall based on retrieval goals. To these ends, we conducted a between-group experiment involving younger and older participants (N = 120). All participants encoded an audiovisual movie and later recalled it with one of two retrieval goals—one emphasizing accuracy and another emphasizing a social goal. Comparing the number of recalled details from the movie between the goal (accuracy, social) and age groups (younger, older) revealed that both younger and older adults recalled fewer details under the social goal. Additional analysis showed that older adults incorporated more 'movie asides' compared to younger adults in their recall, regardless of goal. Next, we employed a natural language processing model to gauge content similarity across recollections based on goal and age group. We found that, compared to younger adults, older adults exhibited higher similarity in their recollections across goals, indicating an age-related deficit in adapting memory content to align with their goals. These results suggest that goal related modulation of memory content is impaired in older age, which manifests in the absence of age differences in memory accuracy.

Topic Area: LONG-TERM MEMORY: Development & aging

B124 - Context reactivation in CA1 is linked to age differences in memory for object-context associations

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Associative memory decline is typical for normal aging and proposed to depend on impaired binding of information in memory. Accordingly, the hippocampus has been linked to age differences in associative memory. However, its different subfields supports distinct functions in service of memory, and it's unknown how they contribute differently to age related declines in associative memory. To assess this, we had older and younger adults perform an associative memory task where they associated objects with a scene image serving as context. Before and after learning, participants viewed the objects and scenes individually, while performing a cover task in the scanner. Finally, their memory for objects and object-scene pairs were tested behaviorally. To investigate age differences in spontaneous context reactivation following learning, we computed representational similarity between objects in the post-learning scan and their associated scenes in the pre-learning scan. We hypothesized objects subsequently remembered and accompanied by correct pair memory to show stronger context reactivation relative to objects later remembered but accompanied by incorrect pair memory. Reduced pair memory performance in older adults were accompanied by reduced context reactivation in CA1 relative to the younger adults. Interestingly, single-trial fluctuations in context reactivation predicted later pair memory performance in younger adults only. Furthermore, inter-individual differences in context reactivation correlated with inter-individual differences in pair memory performance across both age groups. These results were unique to CA1, implicating its role in representing contextual information bound in memory. Crucially, age related declines in associative memory may be driven by changes in CA1 function.

Topic Area: LONG-TERM MEMORY: Development & aging

B125 - Investigating the influence of proximity on unitization within the associative memory network

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Although associative memory has been shown to decline in aging, memory for single items remains relatively intact in older adults. Unitization is a cognitive process that has been demonstrated to enhance associative memory by creating a single ensemble from discrete items, thereby ameliorating age-related deficits in associative memory. Although it has been suggested that unitization enhances associative memory by allowing item pairs to be processed as a single item, the neural basis of this hypothesis has yet to be tested empirically. The current study aimed to test this claim by comparing memory for item pairs encoded using a unitization-based presentation to both item pairs in a non-unitized condition and single items. Results showed that a presentation intended to promote unitization, which entailed presenting item pairs in close proximity to one another (proximal condition), enhanced associative memory in both younger and older adults compared to item pairs presented at a distance (distal condition). Pattern similarity analyses (PSA) for both encoding and retrieval showed greater overlap in patterns of neural activity underlying the single item and proximal configurations compared to the proximal and distal configurations in frontal-parietal regions and in subsets of voxels within the hippocampus. However, the opposite pattern was found in the parahippocampal cortex. Results suggest that although proximity aids in associative memory by creating neural representations of item pairs that are more similar to single items than two separate items, this shift in processing is nuanced, and there is a need for additional investigation, particularly within the MTL.

Topic Area: LONG-TERM MEMORY: Episodic

B126 - Categorical stimuli bias episodic memory: Evidence from behavior, lesion patients, and neuroimaging

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Categorical stimuli can bias episodic memory in interesting ways. When categories can be used to chunk information, memory improves. Conversely, when remembering multiple category exemplars, intrusion errors are common. To assess category bias and the supporting neural corelates in associative/relational memory, we conducted a series of studies using a spatial reconstruction task where on each trial, stimuli came from two distinct categories. Both hippocampus and ventral prefrontal cortex (vPFC) support relational memory, but their contributions to category-bias effects are unknown. In Experiment 1, we characterized category bias in spatial relational memory demonstrating that when two categories of stimuli are present, healthy young participants make significantly more within-category misplacement errors than between-category misplacement errors, despite 50% more opportunities for between-category errors. These data suggest that memory representations were organized to prioritize keeping distinct categories separate and deprioritize resolution of same-category stimuli. In Experiment 2, individuals with bilateral hippocampal or vPFC lesions completed this task. Individuals with vPFC damage made equal numbers of within- and between-category misplacement errors suggesting that their memory was not biased in the same way as comparison individuals. Individuals with hippocampal damage were globally impaired. In Experiment 3, fMRI was used to assess the neural contributions to this behavior in healthy individuals. During study, activity on two-category vs. single-category trials revealed significant activity in the vPFC further implicating this region's role in organizing relational memory representations when multiple stimulus categories are present. Together these data support the role of vPFC in organizing relational memory representations.

Topic Area: LONG-TERM MEMORY: Episodic

B127 - Visual details guide gaze reinstatement during recognition memory

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Memories are retrieved more easily when contextual cues from encoding are reinstated during retrieval. This basic principle is evident in individuals' eye movement patterns during retrieval, such that reinstatement of encoding-related gaze patterns is associated with better memory outcomes. However, it remains unclear what kind of visual information drives gaze reinstatement and its effects on memory. In this study, we investigated how changes in the availability and spatial configuration of visual details during recognition memory affected gaze reinstatement. Retrieval probes were either identical to their encoding counterparts, horizontally flipped from encoding, or blurred to obscure their visual details. Across all retrieval conditions, there was evidence that eye movement patterns from encoding were reinstated during recognition. Although blurring the visual details of the retrieval probe significantly reduced gaze reinstatement, changing the spatial orientation of the probe also flipped the pattern of eye movements, leading to equivalent levels of adjusted gaze reinstatement in the flipped compared to intact condition. Furthermore, gaze reinstatement was related to memory only when the scene's spatial orientation was flipped between encoding and retrieval. Our results suggest that the resampling of detailed visual features, regardless of their spatial configuration, accounts for the memory benefits of gaze reinstatement, informing the potential mechanisms connecting eye movements to memory processes.

Topic Area: LONG-TERM MEMORY: Episodic

B128 - Exit light, enter night: Investigating sleep and long-term memory in SDAM

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Severely Deficient Autobiographical Memory (SDAM) is a developmental syndrome whereby healthy individuals lack subjective re-experiencing of episodes from their past, although factual learning and everyday functioning is intact. Comparison of autobiographical memory recall across groups is hampered by lack of control over memory selection. In the present study, participants with SDAM and matched comparison participants (N = 9 per group) completed an audio-guided, staged museum-like tour of artworks and installations at Baycrest Hospital. True/ False recognition memory for the sequences (order) and features (perceptual details) of tour items was serially tested via four independent online recognition memory tests across time (immediately, 12 hours, 1 week, 1 month). The neural correlates of sleep-related memory transformation were examined by overnight polysomnography between the first two assessments, yielding measures of sleep macrostructure (duration) and microstructure (spindles, slow-waves, phase coupling). People with SDAM had normal or higher memory performance over the first two test sessions, including sleep-related mnemonic enhancement, followed by a steep decline after one week, especially for sequence memory. This mirrors prior findings in which autobiographical memory deficits in SDAM were most reliably observed for remote time periods. We did not observe any significant group differences in sleep neurophysiology. These results suggest that the mnemonic impairment of SDAM is characterized by accelerated forgetting following intact initial processing of real-life events.

Topic Area: LONG-TERM MEMORY: Episodic

B129 - Spatial updating in amnesia using an eye movement analog of path integration

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Path integration (PI) allows organisms to navigate home by updating their location in reference to the route's starting point. The entorhinal cortex (ERC), involved in PI, is modulated similarly by whole-body and eye movements. We previously demonstrated a PI-like process in eye movements using an eyetracking version of commonly used PI tasks. While looking at a computer screen, participants' eyes were guided by onsets of visual targets, presented one-by-one, at different locations on the screen; following presentation of the last target, participants returned their gaze to the starting point. Akin to whole-body PI, younger and older adults either continuously updated gaze position with respect to the starting location, or maintained an internal map, computing the path only when required. Older adults showed reduced accuracy and more trials with gaze revisits to enroute location(s), indicative of more map-based updating strategies. As the medial temporal lobe (MTL), encompassing the ERC, is implicated in updating self-position via whole-body PI, we investigated its role in updating gaze position. Two amnesic cases, DA and BL, were tested on our eyetracking PI-analog task. DA's more extensive damage includes the ERC, whereas BL's hippocampal damage is confined to the dentate gyrus. DA and BL had comparable accuracy relative to neurologically intact controls, but DA showed a notable lack of gaze revisits to enroute locations when returning to the start location. These findings suggest that despite MTL damage, updating gaze positions remains feasible, albeit with potential alterations in the information maintained and/or the manner of execution.

Topic Area: LONG-TERM MEMORY: Episodic

B130 - Semantic clustering and semantic path length: Two measures of free recall organization with different functional properties

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In free recall studies, the order in which words are recalled provides important insight into how memories are organized. Semantic organization is often measured via a clustering score in which the semantic distance of each recall transition is ranked against all possible distances given the entire set of not-yet-recalled words. One potential limitation is that this measure assumes that all items presented during the study phase were equally available for encoding, which may not be the case for very long study blocks or other situations in which attention is likely to fluctuate. Here, we introduce an alternate "path length" measure that involves computing the overall distance "traveled" during a recall attempt and standardizing it against a null distribution created from random permutations of only the set of words that were actually recalled, while disregarding the non-recalled words. To compare the functional properties of these measures, we applied them to free recall data obtained in two experiments in which acute anxiety was manipulated during study. In Exp. 1, participants studied two blocks of 72 unrelated words, while Exp. 2 included two blocks of 48 words from four categories. Although the path length and clustering measures were highly correlated across participants, path length showed a consistently stronger relationship to recall accuracy. In addition, acute anxiety during study significantly impacted path length but not semantic clustering. These results suggest that semantic path length and semantic clustering scores provide distinct and complementary information about the role of semantic processing in episodic memory organization.

Topic Area: LONG-TERM MEMORY: Episodic

B131 - A computational model of replay-facilitated retroactive memory effects

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It is adaptive to prioritize the retention of salient information in long-term memory. However, we often only discover the value of given information through later, related experiences. Prior work has shown that exposure to salience cues (e.g., threat, reward) can retroactively enhance memory for conceptually related, but previously neutral content after a delay (Dunsmoor et al., 2015; Patil, Murty et al., 2017). The delay-dependent nature of this effect suggests it may be driven by consolidation-related mechanisms, such as replay, yet this hypothesis remains untested. Here, we adapted the Context Maintenance and Retrieval model (CMR, Polyn et al., 2009), to examine if reactivating memories during replay facilitates the retroactive spread of salient signals. To simulate prior behavioral work, inputs to the model were coded as two categories of stimuli which were encoded in two phases: a neutral "pre-conditioning" followed by a "conditioning" phase, in which one category was paired with a shock, simulated as an increase in learning rate. Memory was tested immediately or following a replay-filled delay, modeled as multiple cycles of iterative recall. Simulations using multiple variants of the model architecture showed that replay facilitated retroactive memory benefits when the model included context layers representing temporal context as well as a source context for stimulus category. In contrast, a model that included only temporal context did not lead to retroactive benefits. This work provides evidence for mechanisms by which the brain can tag and subsequently retain conceptually related content to facilitate adaptive functions of memory.

Topic Area: LONG-TERM MEMORY: Episodic

B132 - Aesthetic Experience is Supported by Spontaneous Autobiographical Memory Recollection

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What mental representations and processes support moving aesthetic reactions? We argue that the elicitation of autobiographical memories enables viewers to appreciate abstract art through an individualized understanding. In three experiments, we gave participants the opportunity to associate personal memories with works of art and measured how aesthetically moved they felt while viewing. We found that participants were significantly more moved by paintings that they could associate with a specific time and place in their life (Experiment 1). This effect replicated across all experiments and was present, albeit weaker, whether the memory was cued before or after their aesthetic judgment was made (Experiment 2). However, the positive effect of memory association on aesthetic experience disappeared when participants were asked to associate memories with all paintings (Experiment 3). These findings suggest that memory recollection enhances aesthetic experience when it arises spontaneously during art viewing.

Topic Area: LONG-TERM MEMORY: Episodic

B133 - Age-Related Differences in Memory Encoding: The Impact of Schematic Knowledge

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Schema, or prior contextual knowledge, facilitates subsequent perception, interpretation, and memory of associated items. Behavioral studies have found memory benefits for objects that are either highly schema-congruent (e.g., office – stapler) or highly schema-incongruent (e.g., kitchen – basketball). Neurocognitive theories attribute schema-related effects on memory to the interaction between the medial prefrontal cortex (mPFC) and medial temporal lobe (MTL), predicting increased mPFC activity but decreased MTL activity with increased congruence. However, less is known about how memory encoding in the presence of schema differs between healthy older adults (OAs) and younger adults (YAs). Given reduced perceptual acuity but enhanced crystallized world knowledge, OAs may rely more on schematic information to remember objects, thereby showing larger congruency-related differences in mPFC-MTL connections than YAs. We designed an fMRI study where YAs (n=35) and OAs (n=30) encoded 114 pairs of a real-world scene and an object, and performed an old/new object recognition test one day later. Comparing hit rates for objects in congruent, neutral, or incongruent pairs, we found that OAs show a congruence-related improvement whereas YAs show an incongruence-related deficit. Univariate activity in the mPFC shows a congruency-related main effect in the expected direction, while there was a congruency-by-memory interaction in parahippocampal cortex activity for OAs. Finally, hippocampal functional connectivity patterns with the mPFC and occipitotemporal regions showed novel age-related shifts in the contributions of schematic and perceptual information for successful memory encoding. Collectively, these results broaden our understanding of age-related changes in memory encoding in context.

Topic Area: LONG-TERM MEMORY: Episodic

B134 - Imperative and Interrogative motivations shape decision-making and long-term memory via distinct neural routes

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Motivation influences decision-making and memory. Imperative motivation is performance-oriented and urgency-focused, leading to sparse, decontextualized memory. In contrast, interrogative motivation is learning-oriented and supports both present and future goals, which encourages exploration and enhances memory for details. We used fMRI (N=59) to investigate the underlying neural mechanisms for imperative and interrogative motivations. Participants were randomly assigned to imperative or interrogative motivation group, where they imagined executing or planning a museum heist. Next, all participants completed the same reinforcement learning task where they repeatedly chose among four doors (choice phase) to reveal a trial-unique painting along with its reward value (feedback phase). Cumulative rewards earned were converted to monetary bonus to be paid on the next day, after a surprise memory test for paintings. Replicating our prior behavioral findings, participants in the imperative group made more optimal choices during reinforcement learning while participants in the interrogative group showed better incidental memory for paintings. Model-based analyses found more exploitation for the imperative group, and more directed exploration to resolve uncertainty for the interrogative group. fMRI results during the choice phase showed, for the imperative group, dorsal striatal activation predicting exploitation and, for the interrogative group, greater representation of uncertainty in the vmPFC. During the feedback phase, reward representation in the VTA was stronger in the interrogative group than in the imperative group, for whom amygdala activation predicted memory success. In sum, we show that motivational states shift the balance between exploitation and exploration during decision-making and pave distinct routes to long-term memory.

Topic Area: LONG-TERM MEMORY: Episodic

B135 - Rate of context change at encoding influences hippocampal autocorrelation and temporal clustering of free recall

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Retrieved context models posit that when an item is presented during study, it is stamped into a slowly drifting internal context representation. In humans, this context drift is thought to critically determine how memories are organized during recall—in particular, the tendency to recall items according to the temporal order in which they were encoded (i.e., temporal clustering). While the hippocampus is thought to be essential for encoding contextual information, there is surprisingly little evidence linking hippocampal context representations to temporal clustering in free recall. In an fMRI experiment (n=38), we actively manipulated the rate of context change in order to test whether this produced parallel changes in hippocampal 'drift' during encoding and temporal clustering during recall. The context change manipulation consisted of switching background scenes at different switch rates during the encoding of a list of words. Afterwards, subjects freely recalled as many words as possible. While context switch rate had no effect on the total number of words that were recalled, it significantly influenced the degree of temporal clustering in recall. Specifically, temporal clustering was inversely related to switch rate, with the least temporal clustering occurring when switch rate was highest. Strikingly, this qualitative pattern of data was mirrored by autocorrelation (drift) in the hippocampus: autocorrelation significantly decreased when switch rate increased. Collectively, these findings suggest that switching between contexts at a high rate disrupts internal context representations in the hippocampus, thereby weakening temporal clustering during subsequent recall.

Topic Area: LONG-TERM MEMORY: Episodic

B136 - Visual perspective reorients how autobiographical memories are recollected

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Autobiographical memories (AM) can be retrieved from own eyes and observer-like (i.e., seeing oneself in the memory) perspectives. Visual perspective is associated with neural recruitment of posterior parietal cortices, which contribute to behavioral changes in how memories are recollected. Here we explore whether presenting visual perspective cues prior to AM recall influences memories by biasing retrieval (i.e., retrieval orientation). In the current fMRI study, participants recalled 72 AMs while adopting an own eyes and observer perspective, when compared to a control task in which they were asked to merely retrieve the memory. To isolate retrieval orientation effects, we used a cue-probe technique in which retrieval cues (Own Eyes, Observer, Retrieve) were followed by the presentation of an event title associated with the recall of specific AMs. The fMRI findings revealed that neural recruitment in the precuneus was greater for own eyes cues in preparation for AM recall, whereas the precuneus was recruited for observer-like perspectives only during AM recall. Together, these findings suggest that AM content is required to create observer-like perspectives during retrieval. The current findings provide a novel insight into how visual perspective biases neural recruitment during AM retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

B137 - Neural mechanisms of perceptual curiosity and associated memory enhancement

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Perceptual curiosity promotes the perception of unknown stimuli and intrinsically facilitates information acquisition. It remains unclear how perceptual curiosity is represented in the brain during the anticipation and outcome phases, and to what extent it improves general and detailed memory. In this study, perceptual curiosity was manipulated by object pictures with varying levels of blur. Subjects first viewed blur pictures and rated levels of confidence in object identification and levels of curiosity about them. Subsequently, they rated levels of satisfaction when clear versions of the pictures were presented. A mnemonic similarity task was used to test their memories for clear pictures 10 minutes later. The results revealed that sustained activation in the amygdala was associated with the incentive salience of curiosity during both the anticipation and outcome phases. However, the cingulate cortex, linked to cognitive salience, was associated with confidence. The activation of the reward system was specifically modulated by the satisfaction of curiosity during the outcome phase. Regarding memory, confidence enhanced both general and detailed memory through heightened activation of the perirhinal cortex (PRC). Curiosity, on the other hand, enhanced detailed memory by activation of the posterior hippocampus, PRC, and the lateral occipital cortex. Furthermore, satisfaction of curiosity enhanced both general and detailed memory through increased activation in the reward system and the anterior and posterior hippocampus, respectively. These results highlighted a unique neural mechanism of incentive-salience-related amygdala underlying perceptual curiosity, and

the role of the long-axis of hippocampus in facilitating general and detailed memory by satisfaction of curiosity.

Topic Area: LONG-TERM MEMORY: Episodic

B138 - Threat of punishment restructures free recall dynamisc

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Prior research has shown that threat can distort memory. For example, associating neutral memoranda with threat enhances item memory but conversely impairs item-context binding. Yet, little research has characterized how threat changes the way these events are organized in memory. One way to unpack the latent structure of memory organization is to have participants freely recall memoranda, and then assess free recall dynamics. In this study, participants learned 50 words in either a high or low motivation condition, and then freely recalled the words either immediately or at ~24-hour delay. In a threat group, the high motivation condition was associated with the threat of punishment for forgetting (i.e., an aversive sound blast); while in a control group, the high motivation condition was associated with an instruction to "try harder" to learn. In both groups, participants had better memory for items appearing in the high versus low motivation condition; however, in the threat group this enhancement only appeared after a 24-hour delay (three-way interaction: $p<0.001$). Regarding free recall dynamics, while there were no significant differences in the utilization of temporal context across conditions in either group, the threat group showed more out of category transitions then the control group, and these differences became more prominent after a 24-hour delay (three-way interaction: $p=0.02$). Together these findings suggest a model in which item memory is strengthened after a period of consolidation, but this may be associated with a disruption in the overarching organization structures of memory.

Topic Area: LONG-TERM MEMORY: Episodic

B139 - Emotional enhancement of memory extends to subsequent memory formation

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Emotional information is recalled more accurately compared to non-emotional information, known as the emotional enhancement of memory. However, it is not fully clear if the emotional enhancement of memory carries over to improve recollection of subsequent neutral events. We conducted two behavioural experiments to assess (1) if the emotional enhancement of memory impacts recall for subsequent neutral events, and (2) whether the presence of this carryover effect is determined by conceptual overlap between events. In Experiment 1 ($N = 66$, mean age = 20.18, $SD = 1.35$), participants viewed neutral and emotional video clips from the same series. One group viewed the neutral video before the emotional video, and the other viewed the neutral video after the emotional video. When participants recollected the videos, we observed an interaction between the emotion of the video and testing order. All participants recalled more details from the emotional compared to the neutral video. However, the neutral video was recalled better by the group that viewed it after, compared to before the emotional video. To test if this effect was dependent on conceptual overlap between the videos, Experiment 2 ($N = 64$, mean age = 21.58, $SD = 2.63$) replicated Experiment 1, using a conceptually unrelated neutral video from another movie. In Experiment 2, we found an emotional enhancement of memory across both groups, but not an interaction between the emotion of the video and testing order. Together, these experiments provide insight into how the emotional enhancement of memory impacts recollection of subsequent events.

Topic Area: LONG-TERM MEMORY: Episodic

B140 - How do we evaluate others' memories?

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Humans have the highly adaptive ability to learn from others' memories. However, because memories are fallible, for others' memories to be a valuable source of information, we need to assess their veracity. Surprisingly little is known on how this is done. Previous studies have shown that information conveyed in self-reported memory justifications holds information which can be used to distinguish true from false recollections by modelling linguistic features of the text. But do humans process this information in the same way a model does? To address this question, we used justifications' data collected by Dobbins & Kantner (2019), in which memory for word lists was examined using a yes/no recognition test, followed by written justifications for each recognition decision (e.g., "I remember repeating DOCTOR in my head because I remembered I had a doctor appointment"). These justifications, corresponding to Hits and False-Alarms, were presented to participants in a pre-registered, online study. Participants were asked to assess whether the witness's recognition was correct or incorrect based on the memory justifications. Results show that human raters can discriminate Hits from False Alarms, above chance levels, based on these justifications. In doing so, raters rely on markers of recollective experiences in witnesses, having learned that these experiences (in themselves) signal accurate memory. Finally, results of this study show that features generated from humans' assessments can augment machine-learning language models trained to classify memories.

Topic Area: LONG-TERM MEMORY: Episodic

B141 - Temporally dissociable engagement of mesolimbic and hippocampal circuits supports memory formation during the resolution of uncertainty

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The engagement of the dopaminergic circuits in anticipation of uncertainty resolving information has been shown to enhance memory formation. However, studies in humans have primarily relied on paradigms where uncertainty is resolved instantaneously by an expected outcome (e.g. trivia), and it is unclear how midbrain activity may be influenced by changing informational states. Here we investigated the interaction between the midbrain and the hippocampus during a line-drawing task where information evolves over time. During fMRI scanning, participants were shown videos of single-line drawings that may (Real) or may not (Scribble) resolve into interpretable objects over 20 secs. Participants made a button press when they had a guess for what the object could be, and when they were certain of the object identity. Videos were divided into an Early and a Late phase, delineated by the button presses. Recognition test conducted 24hrs later showed that participants were more likely to recognize the real videos than the scribbles, and the recognized real videos were associated with greater activation in mesolimbic regions and the hippocampus during the initial viewing. While BOLD activity in the hippocampus and the midbrain were greater for real videos compared to scribbles, this was observed in different phases, whereby hippocampal activation was greater in the Early phase, and midbrain activation was greater in the Late phase. Our findings suggest that activation in the midbrain may reflect the expectation for outcome resolution, and this build up of expectation may be supported by early engagement of the hippocampus during exploration.

Topic Area: LONG-TERM MEMORY: Episodic

B142 - Systematic cognitive load and its influence on episodic memory

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Accumulating evidence suggests that hippocampal replay during sleep and rest supports memory consolidation. Recent research indicates that post-encoding rest benefits long-term memory more than task engagement. These "offline" states involve increased activity in the Default Network (DN), known for its role in both retrieving past experiences and simulating future events. The DN exhibits functional opposition with the Dorsal Attention Network (DAN), hypothesized to direct cognitive resources towards external stimuli. A plausible explanation for this phenomenon suggests that active task engagement via DAN might suppress DN, including the hippocampus, a critical component of memory processing. Consistent with this claim, we find that hippocampal activity systematically decreases with increasing cognitive load using existing data from various N-back levels. We then investigate whether this reduction in hippocampal activity impairs memory consolidation. Participants completed a brief N-back task or rested after an incidental encoding task, with memory assessed immediately and one day later. Our results support the idea that higher post-encoding cognitive load disrupts memory processes. The rest group, however, showed no advantage over task groups. Preliminary results suggest that self-reported thoughts during rest relate to individual memory performance: thinking about the encoding task improved memory, while unrelated thoughts had a detrimental effect. These findings highlight the intricate

relationship between cognitive load, rest, and memory consolidation, emphasizing the role of post-encoding cognitive states in shaping memory outcomes. Furthermore, they underscore that rest is not invariably passive, as spontaneous thought processes may engage working memory systems or tax memory retrieval, moderating consolidation in complex ways.

Topic Area: LONG-TERM MEMORY: Episodic

B143 - Amygdala-hippocampal interactions predict temporal memory precision

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Our episodic memories are not faithful replicas of the past. Burgeoning behavioral evidence indicates that temporal aspects of episodic memory–such as remembering when an event occurred–are sculpted by emotional states (McClay et al, 2023; Li and Lapate, 2023; Palombo and Cocquyt, 2020; Wang and Lapate, 2023). However, the neural bases of the influence of emotion on temporal memory remain unclear. Functional MRI studies have shown that the similarity of hippocampal multivariate patterns over time reflects the fidelity of temporal memory, with greater similarity linked with less precise temporal memory estimates (Jenkins and Ranganath, 2010; Hsieh et al., 2014; Ezzyat and Davachi, 2014). Given the centrality of amygdala function in emotion, as well as the robust anatomical connections between the amygdala and hippocampus, we examined whether trial-wise amygdala activity during emotional processing modulates the trial-wise similarity of hippocampal patterns. Participants performed a task that manipulated emotional valence and action goals and used trial-unique emotional pictures. After the experiment, participants performed a surprise temporal memory task, in which they were asked to estimate when during the experiment each emotional picture was shown. Replicating previous findings (Jenkins and Ranganath, 2010), higher hippocampal pattern similarity was associated with worse temporal memory–a finding particularly pronounced in the posterior hippocampus. Critically, trial-wise amygdala activation predicted greater hippocampal pattern similarity, an association that was present throughout the longitudinal axis of the hippocampus. Collectively, these results underscore the interconnectedness of amygdala and hippocampal processes, and suggest a mechanism through which amygdala-engaging emotional events may sculpt temporal memory.

Topic Area: LONG-TERM MEMORY: Episodic

B144 - The influence of practice experience on neural networks during successful memory retrieval

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By repeated retrieval practice (RP) and feedback (FB), the errors could be corrected and a stable representation is eventually established, which involve the salience-executive control networks (S-ECN) and default mode network (DMN) separately. According to the practice experience, different items could be distinguished as those that are correct all the time, that have errors but been corrected through FB. Whether these items differ in brain network activations during successful memory retrieval is unclear. In this study, twenty-nine participants learned 120 Swahili-Chinese words associations followed by two RP-answer FB cycles (i.e., RP1, FB1, RP2, FB2), then they took the final test 10-min and 24-h later. The items were divided into different types (i.e., item type, CCC, ICC, IIC III) based on participant's performance (correct or incorrect, C or I) during the two RPs and the final test. The results showed that compared to IIC items, successful retrieving CCC and ICC items elicited stronger activation in the DMN regions, while successful retrieving IIC items had the strongest activation in the S-ECN regions. Successful retrieving CCC items further had stronger activation in the dorsomedial prefrontal cortex (dmPFC) and posterior insula (PI) than ICC items. The anterior insula (AI) had dynamic interactions with the ECN and DMN regions to support retrieval success of different types of items. Our results suggest that previous RP-FB experience is important for subsequent successful memory retrieval, as cognitive control network and the insula continues to monitor the memory retrieval process even after errors are corrected. .

Topic Area: LONG-TERM MEMORY: Episodic

B145 - Cortical Hubs of Highly Superior Autobiographical Memory

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Highly Superior Autobiographical Memory (HSAM) is a rare form of enhanced memory in which individuals demonstrate an extraordinary capacity to remember details of their personal lives with high levels of accuracy and vividness. Neuroimaging studies have identified brain activation in cortical midline regions -specifically, key nodes within the default network- associated with remembering events from one's past. Extending this research on the neural underpinnings of autobiographical memory, the present study utilizes graph theory analyses to compare functional brain connectivity in a cohort of HSAM (n=12) and healthy controls (n=29). We perform seed-based analysis based on resting-state fMRI data to assess how specific cortical regions within the autobiographical memory network are differentially connected in HSAM individuals. Additionally, we apply a whole-brain connectivity analysis to identify differences in brain hub-network topology associated with enhanced autobiographical memory. Results show converging patterns of increased connectivity involving cortical midline areas in HSAM. Whole-brain analysis also reveals enhanced connectivity across prefrontal and posterior cingulate cortices in HSAM individuals. Together, these results extend prior research, identifying essential cortical hubs within the default network associated with enhanced autobiographical memory.

Topic Area: LONG-TERM MEMORY: Episodic

B146 - 'Memento' Memory: Effects of Non-Linear Narrative Structures on Memory

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Free recall often shows temporal contiguity, or clustering of information presented nearby in time at encoding. However, this contiguity also appears flexible - it can be reduced by other forms of structure like semantic relationships among stimuli or exacerbated by linear, causal narratives. Here, we asked how tensions between temporal and causal structure affects recall by having subjects watch a narrative with non-linear causal structure between events (the movie, Memento, in which one part of the storyline is presented in reverse). Three groups of subjects were asked to recall the movie in different ways: (1) freely, (2) in the narrative order (how it was presented), or (3) in chronological order. Subjects leaned on both narrative and chronological strategies to guide their recall – with a modest bias towards the strategy we instructed them to use. However, chronological order was the dominant organizing characteristic in all groups. Intriguingly, whereas temporal contiguity in recall typically shows a forward bias in time, here there was a backward bias, aligning with how the dominant Memento storyline progressed in reverse. Additionally, we separately collected ratings of causal connections between each pair of scenes, and we found that causal network properties like betweenness centrality and in-bound connections predicted scene memorability. Overall, we replicated findings that non-temporal forms of structure affect recall, reducing the strength and even reversing the direction of contiguity effects from standard laboratory experiments and showing that time is a weak form of structure when others are salient.

Topic Area: LONG-TERM MEMORY: Episodic

B147 - Incidental learning enhances auditory signal detection

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Incidental memory can bias attention to enhance perception at retrieval. We tested the hypothesis that both the degree of neural instantiation at learning and explicit memory at retrieval facilitate signal detection. First, participants listened to everyday sounds (e.g., cityscape soundscape) either played alone (neutral-cue) or paired with a lateralized suprathreshold target tone (memory-cue). To track learning-related changes, we measured the acoustic change complex (ACC), using high-density electroencephalography (EEG). At test, every soundscape contained a lateralized tone

that was very faint. Memory-cue trials were paired with a faint tone that appeared on the same side as it did during learning, while neutral-cue trials were paired with a tone that appeared on a pseudo-random side. Participants detected the faint tone as quickly as possible and indicated whether they had an explicit memory for each soundscape. Reaction time for detecting the target tone was faster for memory-trials compared to neutral ones. Detection accuracy for memory-cue trials was associated with greater ACC amplitudes, suggesting that greater sensitivity to acoustic changes at the level of the auditory cortex at learning may facilitate associative memory encoding for later use at test. Further, detection was related to explicit memory for the soundscape. Together, larger ACC amplitudes may enhance associative memory formation at encoding, while explicit memory for the soundscape may support general processing efficiency to aid target detection at retrieval. These results refine our model of memory-biased perception by demonstrating that incidental exposure to soundscapes can produce associative representations robust enough to enhance perception.

Topic Area: LONG-TERM MEMORY: Episodic

B148 - Behavioral Manipulation of the Consolidation of Specific and General Memory Traces

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Memories are not a perfect snapshot of everyday life; they can be influenced, making them prone to distortions. Previous work has explained that newly formed, episodic memories can be integrated with prior semantic knowledge, causing a systematic distortion in their retrieval (Tompary & Thompson-Schill 2021). Here, we investigated whether consolidation mechanisms could be manipulated to prioritize the retention of specific episodic details or more general semantic information contained in individual memories. We developed a 1-back task as a post-encoding manipulation to cue the resolution of memory (i.e. specific or general) for participants to prioritize for consolidation, aiming to retroactively tag newly learned episodic memories, similar to past retroactive tagging manipulations (Patil et. al., 2016). Preliminary analyses suggest that the novel manipulation selectively impacts memory after a 24-hour delay. We found that memories for images with locations spatially consistent with category members were more precise than spatially inconsistent images, a replication of previous behavioral findings by Tompary and Thompson-Schill (2021), and that the precision of memories more congruent with prior knowledge was retained over a delay, consistent with prior work (Richter et. al, 2019, Tompary, Zhou, & Davachi 2020). Although these preliminary results appear to be promising, it is important to note that the findings were based on a sample of seven pilot participants (n = 7), and further work is necessary to probe the interactions between idiosyncratic details and semantic knowledge that comprise newly formed episodic memories during consolidation.

Topic Area: LONG-TERM MEMORY: Episodic

B149 - Sleep is associated with preserved autobiographical memory richness

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Sleep plays a role in the consolidation of episodic memories, yet little is known about how the very first night of sleep impacts autobiographical memories. In the current study, participants recorded one morning and one evening memory from their everyday lives on a smartphone application over the course of two weeks. They also completed two memory tests per day (one in the morning and one in the evening) that assessed the memory from 12 hours prior (i.e., the evening memory test pertained to the morning memory and the morning test pertained to the evening memory from the night before). Preliminary data indicated that following a sleep delay, compared to a wake delay, memories were more vivid, $t(532.45) = -3.74$, $p < .001$, easier to recall, $t(534.05) = 4.82$, $p < .001$, and felt closer in time, $t(534.76) = 5.88$, $p < .001$. We also found that dreaming about a memory was associated with an increased feeling of recency, such that evening memories that were dreamt about were reported as feeling significantly closer in time compared to memories that were not dreamt about, $t(71) = 3.05$, $p = .003$. Overall, our findings provide evidence that sleep preserves autobiographical memory vividness, ease of recall, and felt recency. We also provide the first evidence that dreaming about an autobiographical memory impacts felt recency, suggesting that hippocampal replay during dreaming may play a role in this meta-memory feature.

Topic Area: LONG-TERM MEMORY: Episodic

B150 - Positive Emotion Enhances Impaired Hippocampal Functioning

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Pattern separation, the neurobiological process of making overlapping memory representations more distinct, critically depends on sparse firing in the dentate gyrus (DG), while pattern completion, and the more general ability to retrieve previously learned information, has been shown to depend on CA1. The classic and well-validated finding that episodic memory is enhanced for emotional content has been demonstrated in cases with lesions to the hippocampus, but it is unknown whether this enhancement extends to pattern separation, and if it can survive lesions to specific hippocampal subregions. Here we examine if pattern separation is rescued by emotional content in the face of bilateral DG lesions. Two unique individuals with selective bilateral hippocampal lesions, affecting the DG in case B.L. and the CA1 subfield in case B.R., were tested on a behavioural measure of pattern separation requiring the mnemonic discrimination of positive, negative, and neutral scenes. When their memory for negative and neutral stimuli was compared to that of controls, B.L. and B.R. showed significantly worse mnemonic discrimination and recognition memory, respectively. Despite having lesions that would be expected to interfere with these processes, neither patient was impaired compared to controls when tested on positive stimuli. Findings that otherwise impaired hippocampal processes may be preserved for positive content may reflect the conceptual organizing properties of positive stimuli, whereas negative content, which typically leads to overall enhanced memory following bilateral hippocampal lesions, is not sufficient to restore mnemonic discrimination or retrieval when the dentate gyrus and CA1 subfield, respectively, sustain extensive damage.

Topic Area: LONG-TERM MEMORY: Episodic

B151 - Cross-participant neural alignment of attentional states during encoding is linked to better memory in adults and children

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Attending to specific details improves memory. Yet, whether different individuals enjoy such a memory boost through the same (cohesive) or different (idiosyncratic) neural means remains unknown. Here, participants (N=42 adults) attended to either specific (item) or general (category) aspects of scenes during fMRI scanning followed by a surprise recognition memory test. As expected, participants' memories were more precise for item- than category-attended scenes. To understand the neural basis of this memory difference, we used a pattern similarity searchlight to identify regions that coded for attentional states at encoding (within > across state similarity). A widespread network of regions showed reliable state coding across the group, including frontoparietal, medial temporal, and lateral occipital cortices. Participants exhibited neural cohesion as a group, with individual differences in the degree of cross-participant alignment relating to memory for item-attended scenes. Given the protracted development of both attention and memory, we additionally investigated the emergence of such cohesion in children (N=42, 7-9 years), testing the competing possibilities that they would (a) exhibit their own unique, beneficial state, or (b) be idiosyncratic as a group and increasingly align with adults over maturation. Consistent with the latter, children showed no reliable cross-participant correspondence in attentional states. However, their alignment to adults increased with age and predicted memory for item-attended scenes. These findings suggest that a cohesive neural approach to detail orientation supports memory in adulthood. Development unfolds as children—initially each approaching the task in their own way—gradually adopt adult-like states across middle childhood, benefitting memory.

Topic Area: LONG-TERM MEMORY: Episodic

B152 - The relationship between mnemonic discrimination and relational memory impairments in Traumatic Brain Injury

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Memory complaints are common after Traumatic Brain Injury (TBI), with recent work suggesting such deficits may be greatest for relational memory. Relational memory, the ability to bind together and retrieve relational representations, is critically mediated by

the hippocampus, suggesting that TBI may result in hippocampal dysfunction. However, the hippocampus also subserves mnemonic discrimination, the ability to distinguish between highly similar, but distinct information in memory. Currently, it is unknown whether TBI impairs both hippocampal functions and, if so, whether such deficits are related. In the present study, 50 individuals with moderate-severe TBI and 50 neurotypical comparison (NC) participants completed relational memory and mnemonic discrimination tasks. In the relational memory task, participants studied triplets of abstract items and were asked to remember a target piece of information about them: either item identity, spatial arrangement, temporal order, or group membership. In the Mnemonic Similarity Task (MST), participants studied a series of nameable objects and, at test, determined which objects were Old (exactly the same as study), New (unstudied), or Similar (similar to a studied object but unique). Relative to NC's, individuals with TBI were impaired on all domains of relational memory, but only showed deficits on similarity discrimination on the MST, with intact item memory. Similarity discrimination was also significantly correlated with performance on all of the relational memory domains in TBI. Taken together, results show that relational memory and mnemonic discrimination are both impaired in TBI, and that such impairments may be tied to a shared underlying deficit in hippocampal function.

Topic Area: LONG-TERM MEMORY: Episodic

B153 - Menstrual cycle and perceived stress predict performance on the mnemonic similarity task

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A growing body of literature demonstrates strong effects of ovarian hormones on the hippocampus and adjacent structures. However, resulting impacts on human cognition remain unclear. Addressing this gap, we examine pattern separation ability, a core hippocampal process, across the menstrual cycle using the mnemonic similarity task as a behavioral index (N = 209). We find a non-linear effect of the menstrual cycle, with pattern separation performance peaking in the high-estradiol, late follicular phase and reaching its lowest point during the mid-luteal phase, which is characterized by moderate estradiol and high progesterone levels. Additionally, we find that perceived stress may facilitate pattern separation performance. These results point to the importance of ovarian hormones for human cognition, reveal novel effects of perceived stress on mnemonic similarity task performance, and provide preliminary evidence of possible effects of menstrual cycle phase on neural pathways involved in pattern separation.

Topic Area: LONG-TERM MEMORY: Episodic

B154 - Predicting Effects of Brain Stimulation from Observational Data

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Improving memory through neuroscientific interventions requires understanding of the neural activity that causes behavior. While decades of work have shown associations between specific neural activity and subsequent memory performance, it remains unclear whether these conclusions from observational data reflect causes of successful memory encoding. In this project we analyze a dataset of intracranial electroencephalography recordings of 140 subjects performing a delayed free recall task. We account for confounders of causal effects left unaddressed in the majority of prior work on the neural correlates of recall performance, including item and serial position effects. We compare results from these models with more traditional unadjusted models to find that accounting for these variables results in different conclusions about the relevant neural activity. We then validate the inferences of our model using a separate dataset of 20 subjects who received randomized neural stimulation while performing the free recall task. If neural activity better predicts behavioral outcomes after adjusting for behavioral confounders, we hypothesize that those deconfounded model predictions may better reflect an endogenous state of memory performance rather than the features of the presented stimuli. Such a model should in turn better predict the behavioral effects of brain stimulation. We find that electrophysiological activity after controlling for experimental variables predicts cognitive performance significantly better than task features alone. These results suggest that intracranial EEG provides unique information for understanding and modulating cognition that cannot be trivially explained by exogenous factors.

Topic Area: LONG-TERM MEMORY: Episodic

B155 - Memory-in-a-Box: Assessing Age-Related Differences in Memory Function using a Novel Online Staged Event

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Naturalistic paradigms are important for better capturing real-world memory function. In some studies memory is tested for complex, multimodal events experienced at encoding. Such experimenter-designed "staged events" mimic naturalistic experiences, while providing control over encoding materials. However, aggregating results across previous studies has been challenging due to the idiosyncratic nature of the staged events used. Standardization of the events can enable such comparisons. Here, we developed an online staged event as a standardized test of naturalistic memory. Healthy younger and older adults completed two video call sessions, one week apart. The staged event included six planned activities such as watching a video and playing word games. Memory was tested immediately following the event (immediate test), and in Session 2 (delayed test). Using recognition and recall tasks, item and associative episodic, and semantic memory was tested. Recall of semantic facts, and episodic memory accuracy in the recognition task was lower in the delayed than the immediate test, but was matched between groups. However, during recall, older adults exhibited poorer memory for episodic item and associative detail relative to younger adults, particularly at delayed test. Finally, in older adults, associative recall, but not recognition performance, correlated with Montreal Cognitive Assessment scores, indicating that such naturalistic tasks may capture meaningful variations in cognition. These results suggest that age-related differences in memory manifest differently depending on how and what type of memory is probed, highlighting the importance of using ecologically valid stimuli that permit testing of different aspects of memory for the same event.

Topic Area: LONG-TERM MEMORY: Episodic

B156 - Dorsomedial Prefrontal Cortex (DMPFC) Prioritizes Social Consolidation at Rest

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Sociality is a defining feature of the human experience: we rely on others to ensure survival and cooperate in complex social networks to thrive. Are there brain mechanisms that help ensure we quickly learn about our social world to optimally navigate it? We tested whether portions of the brain's default network engage "by default" to quickly prioritize social learning during the memory consolidation process. To test this possibility, participants underwent functional magnetic resonance imaging (fMRI) while viewing scenes from the documentary film, Samsara. This film shows footage of real people and places from around the world. We normed the footage to select scenes that differed along the dimension of sociality, while matched on valence, arousal, interestingness, and familiarity. During fMRI, participants watched the "social" and "non-social" scenes, completed a rest scan, and a surprise recognition memory test. Participants showed superior social (vs. non-social) memory performance and the social memory advantage was associated with neural pattern reinstatement during rest in the dorsomedial prefrontal cortex (DMPFC), a key node of the default network. Moreover, it was during early rest that DMPFC social pattern reinstatement was greatest and predicted subsequent social memory performance most strongly, consistent with the "prioritization" account. Results simultaneously update 1) theories of memory consolidation, which have not addressed how social information may be prioritized in the learning process and 2) understanding of default network function, which remains to be fully characterized. More broadly, the results underscore the inherent human drive to understand our vastly social world.

Topic Area: LONG-TERM MEMORY: Episodic

B157 - Overlap among neural representations of similar memories triggers repulsion in verbal recall

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Recent fMRI and behavioral studies have shown that highly similar memories can trigger a "repulsion" effect wherein subtle differences between memories become exaggerated. These repulsion effects are thought to be a direct reaction to representational overlap (interference) during learning. Here, we tested this idea by comparing fMRI-based

measures of representational structure during the encoding of highly similar natural scene images to verbal recall measures of representational structure after extensive learning. Participants (N=19) learned 18 face-scene associations across six fMRI encoding runs. In order to create interference, scenes were grouped into three categories (e.g., pools, libraries, stadiums) with six exemplars per category. After scanning, participants were cued with each face to recall and type a description of the corresponding scene. For fMRI analyses, we focused on scene-selective cortex (PPA) and hippocampus, and measured representational structure within and across each of the visual categories during encoding. For verbal recall, we used a Natural Language Model to convert each memory into a semantic embedding. Within PPA, there was robust coding of category-level information during encoding, which was positively related to category-level representations during subsequent verbal recall. However, scene-specific (within-category) representational structure in PPA was inversely related to representational structure during recall—consistent with repulsion. In the hippocampus, category representations were weaker than in PPA, but within-category representational structure was more positively related to the structure of verbal recall. These findings provide novel evidence that representational overlap during memory encoding (here, in PPA) triggers repulsion of corresponding behavioral expressions of memory.

Topic Area: LONG-TERM MEMORY: Episodic

B158 - Neuronal ensemble states in CA1 of the freely-moving macaque exhibit temporal drift while maintaining sequential-task structure.

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Hippocampal activity in rodents shows stable spatiotemporal representations of the environment that may serve as cognitive map, while also allowing for systematic drift. How place cells in rats and mice translate to abstraction of cognitive maps in humans, however, is unclear, due in part to uncertainty about the relevant representational spaces the hippocampal ensembles of anthropoids. We assessed this by recording ensembles of hippocampal single units from two freely moving macaques as each performed item-in context sequences in a touchscreen-paneled enclosure. Two sequences, one new and one learned weeks earlier, were located in opposite corners of the environment, crossing paths only on sequence completion, to obtain reward delivered on the opposite side. We used contrastive supervised (CEBRA) and unsupervised (UMAP) methods on 500ms-segments of neural ensemble activity (N= 34 – 84units per session), for both 4-item sequences. Despite stable unit recordings, UMAP revealed a drift and increase in the state space coverage across trials. We ran a multi-session CEBRA on five sessions and found that the test samples were decodable across the two sequences (CEBRA f1: 0.756618). We tested for allocentric representations at the small overlapping portion of the sequences, and found that both CEBRA and UMAP had separable representations of the common space (CEBRA f1: 0.84; UMAP f1: 0.748). By labeling only time, we recovered separable sequences in addition to time, revealing both temporal drift and the underlying sequence structure. Both new and remotely-learned sequences showed drift, consistent with models of continuous temporal context signals in the hippocampus.

Topic Area: LONG-TERM MEMORY: Episodic

B159 - Reactivating specific memories during sleep in conjunction with a suppression context

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Recently acquired memories are reactivated during sleep, leading to their strengthening. Reactivation can be biased using odor and sound presentations during sleep to benefit associated memories (targeted memory reactivation). For example, when a rose odor served as context during object-location learning and was later presented during sleep, location recall improved. Likewise, sounds linked with individual objects and unobtrusively presented during sleep also improved recall. We hypothesized that joint reactivation of odors and sounds may create synergistic effects. In addition, we hypothesized that odors could enhance memory suppression. Participants first engaged in an odor-based directed-forgetting task, whereby one odor was linked with instructions to remember and another with instructions to forget. A third odor was not used and functioned as a control. During a nap, each of the three odors were presented concurrently with sounds previously linked with object-location learning. Spatial recall was tested after sleep. Objects reactivated with the control odor showed memory-strength-dependent improvement, as in previous targeted-memory-reactivation studies. Contrary to prediction, concurrent presentation of remember or forget odors with object sounds did not clearly impact spatial recall. Furthermore, sleep spindles were more frequent following control-odor presentation than for the other two odors, suggesting that reactivation of spatial memories was only effective in the control condition. Overall, results parallel prior findings showing that two sound cues presented in rapid succession during sleep block consolidation. We posit that conjoint presentation of a sound with a meaningful odor nullifies the benefits of reactivation.

Topic Area: LONG-TERM MEMORY: Episodic

B160 - Hidden Markov Modelling of Viewing Behaviors Reveals Discrete “Encoding States” During Visuospatial Memory Formation

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Visuospatial memories can include information about item details, inter-item relations, and/or relations that involve the bounds of the display space. Item and relational encoding rely on distinct neurocognitive processes, but little is known about how learners balance these encoding goals from moment to moment. We used hidden Markov models to examine whether eye movements made during intentional study can be parsed into discrete "encoding states" that emphasize different types of information. Participants (n=60) studied visual displays containing six abstract items for 16 seconds each in preparation for either a spatial reconstruction task or an item recognition task. Each gaze transition (“visit”) made to one of the display items during study was an observation in the model, and two variables—number of fixations made during the visit and mean fixation duration— served as emissions. Based on measures of model fit, we identified three states, one of which was consistent with item encoding and one with relational encoding. Task type (spatial versus item) interacted with state probabilities, with more time spent in the item state during the item versus the relational task and vice versa. In both tasks, memory errors were associated with insufficient time spent in the item state, particularly toward the beginning of a trial. Multistate modeling of eye movements is promising avenue for memory research that can be easily extended in to map gaze-defined encoding states onto concurrently obtained neural data.

Topic Area: LONG-TERM MEMORY: Episodic

Poster Session C

Sunday, April 14, 2024, 5:00 – 7:00 pm, Sheraton Hall ABC

C1 - Accurate predictions facilitate robust memory encoding separately from stimulus probability for schematic memory

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We can use knowledge distilled from prior experiences (schemas) to make predictions about how an event will unfold, which can impact how event memories are encoded and later reconstructed. Existing paradigms for studying prediction, however, are largely unable to separate effects of prediction accuracy from effects of stimulus probability: likely outcomes are assumed to be predicted, while unlikely outcomes are assumed to cause prediction errors. Here we use a novel approach in which we can independently manipulate prediction success and stimulus probability, by using real-time eye-tracking when viewing moves in a board game. The moves can be consistent or inconsistent with a participant’s predictions (assessed via fixation patterns) and can be also be likely or unlikely to be played by a strategic player. By decorrelating these two measures, we found that both probability and prediction accuracy boost memory separately. Next, by looking at how consistent participants' eye movements were with the probability of the moves at retrieval, which is associated with making schema-based inference and less precise memory, we revealed separate mechanisms for memory benefit for predicted and probable moves. Accurately predicted moves were remembered more precisely, with participants exhibiting eye movements at retrieval that relied less on general schematic knowledge about move probabilities. On the other hand, probable moves were recalled less precisely, with more reliance on schematic eye-movement at retrieval. The results provides new insights on how schema-consistent information are better remembered, and challenge the idea that prediction errors can enhance event memories.

Topic Area: LONG-TERM MEMORY: Episodic

C2 - Predicting the future comes at a cost to encoding the present

Craig Poskanzer[1] (crp2170@columbia.edu), Hannah Tarder-Stoll[1,2], Raheema Javid[1], Mariam Aly[1]; [1]Columbia University, New York, NY, [2]Rotman Research Institute, Toronto, ON

Forming new memories requires a focus on the external world, whereas retrieving old memories requires attention to our internal world. The hippocampus plays a central role in resolving the tension between encoding new information and retrieving existing memories to make predictions about the future. Computational models suggest the hippocampus balances these processes by alternating between states in which it prioritizes memory encoding vs. memory retrieval. Although previous studies have examined switching between these hippocampal states, they have not concurrently probed encoding and prediction in behavior. Here, we ask whether the discrete encoding and retrieval states in the hippocampus can be detected as a behavioral trade-off between forming new memories vs. using old memories to make predictions. Participants learned a sequence of scene categories (e.g., beaches, castles, forests). After sequence learning, they completed a simultaneous encoding and prediction task. They were shown trial-unique category images and asked to make predictions about upcoming scene categories. Finally, they were given a surprise memory test for the trial-unique images. This allowed us to measure whether there was competition between encoding of the trial-unique images and prediction about upcoming images. As hypothesized, individuals (n = 31) showed a trade-off between encoding and prediction: memory encoding of trial-unique images suffered when prediction was correct vs. incorrect. These preliminary findings suggest that the trade-off between encoding and prediction in hippocampal computations can be observed even at the scale of behavior unfolding over many seconds.

Topic Area: LONG-TERM MEMORY: Episodic

C3 - Cross regional coordination of activity in the human brain during autobiographical self-referential processing

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For the human brain to operate, populations of neurons across remote anatomical structures must coordinate their activity. While neuroimaging studies have highlighted the presence of cross-regional interactions over slower time periods, our understanding of ultra-fast interactions at the sub-second time window has remained limited. Here, to address this gap of knowledge, we recorded directly from the hippocampus (HPC), posteromedial cortex (PMC), ventromedial/orbital prefrontal cortex (OFC), and anterior thalamus (ANT) – a set of structures within the default mode network (DMN) – during two experiments of autobiographical memory processing in 31 patients. We found that the presentation of memory retrieval cues elicited a significant increase of slow frequency (LF, < 6Hz) activity followed by cross-regional phase coherence of this LF-activity before select populations of neurons within each region showed increase of high-frequency (HF >70Hz) activity. The power of HF activity was modulated by memory content and its onset followed a specific temporal order of ANT->HPC/PMC->OFC. Further, we probed cross-regional causal effective interactions with repeated electrical pulses and found that HPC stimulations cause the greatest increase in LF-phase coherence across all regions whereas the stimulation of any region caused the greatest LF-phase coherence between that particular region and ANT. These observations support the role of ANT in gating, and the HPC in synchronizing, the activity of cortical midline structures when humans retrieve self-relevant memories of their past. Our findings offer a fresh perspective, with high temporal fidelity, about the dynamic signaling and underlying causal connections among DMN regions.

Topic Area: LONG-TERM MEMORY: Episodic

C4 - Investigating recollection network activation during personal memory retrieval in women with chemotherapy-treated breast cancer

Kristina D. Munelith-Souksanh[1] (kmune008@uottawa.ca), Imola X. MacPhee[2], Chloé Cateaux[1], Amira Boukhelif[1], Julyane Gelinas[1], Megan Bennett[1], Isabelle Poirier[1], Annick F. N. Tanguay[3], John A. E. Anderson[2], Melanie J. Sekeres[1]; [1]University of Ottawa, [2]Carleton University, [3]Vanderbilt University Medical Center

Chemotherapy is an integral treatment for breast cancer patients (BCP), yet it is neurotoxic to the hippocampus - a key structure for event memory processing. This suggests chemotherapy treatment may interfere with memory recollection network activity during complex event memory processes. However, this has not been well investigated in BCP. This study evaluates network activation in a preliminary sample of chemotherapy-treated BCP (n=11) relative to healthy controls (n=11) using functional Magnetic Resonance Imaging (fMRI) with a naturalistic Autobiographical Memory Task (AMT). Before fMRI scanning, participants provided personal event titles (i.e., a family dinner) for 4 different timepoints (5 years, 1 year, and 1 week ago; 1 year in the future). Participants were scanned 2 weeks later and asked to mentally retrieve 10 personal events for each timepoint. Following scanning, participants verbally recalled the personal events outside the scanner while being recorded. The recordings were then transcribed and used for further analysis. Preliminary results using partial least squares (PLS) analysis revealed that the activation of the recollection and attention networks were less differentiated for BCP than healthy control participants for the personal memories from 1 year ago and 1 year in the future, despite providing a similar number of perceptual details on the personal memory verbal recall for each timepoint. Further analyses will examine the relationship between episodic memory performance and activation of the networks identified by PLS. This will help precisely identify targets for cognitive rehabilitation strategies and ultimately improve the quality of life of BCP.

Topic Area: LONG-TERM MEMORY: Episodic

C5 - Neural dedifferentiation and reduced specific memory in aging

Troy M. Houser[1] (thouser@uoregon.edu), Caitlin R. Bowman[2], Dagmar Zeithamova[1]; [1]University of Oregon, [2]University of Wisconsin-Milwaukee

Neural dedifferentiation refers to an age-related phenomenon whereby brain regions with a highly specialized role become less responsive to their preferred stimuli and more responsive to other stimuli. Moreover, dedifferentiation also emerges at the level of functional networks that become less pronounced: functional connectivity among regions within established brain networks becomes weaker and connectivity among regions belonging to different networks becomes stronger in aging. Here, we examined the relationships between age, neural dedifferentiation during rest, and behavioral measures of specific and general memory. Specific memory was most affected in aging and was accompanied by evidence of neural dedifferentiation. The results open new avenues for inquiry about how network level interactions in the brain support different memory functions.

Topic Area: LONG-TERM MEMORY: Episodic

C6 - Pupil dilation during recognition memory is influenced by cue-trace interactions but not by memory strength

Wen Jian[1], Elena K. Festa[1], Mingjian He[2], William C. Heindel[1]; [1]Brown University, [2]Massachusetts Institute of Technology

During recognition memory tests, previously studied items elicit greater pupil dilation than unstudied items, a phenomenon termed the pupillary old/new effect. One popular explanation for this effect is that the magnitude of pupil dilation tracks the strength of the memory trace. However, recent findings suggest that it may reflect instead the interaction between the retrieval cue and the stored trace, as pupils dilate more in response to greater perceptual cue-trace match ("pupillary match effect"). To further examine these mechanisms, we investigated the pupillary effect following two study conditions that increase memory strength relative to single presentation but have differential effects on encoding: Distributed learning (with sporadic repetitions) enhances contextual recollection while massed learning (with immediate repetitions) minimizes contextual recollection but supports familiarity. Behavioral results showed that distributed learning improved recognition accuracy and confidence (both indexing memory strength) to a greater extent than massed learning relative to single-trial learning. However, the pupillary old/new effect remained comparable across the three conditions, showing no effect of memory strength. Moreover, distributed learning resulted in a larger pupillary match effect compared to single learning, while massed learning showed a reversed early pupillary match effect. Our results suggest that during recognition memory, the magnitude of pupil dilation reflects the nature of encoded trace and its interaction with retrieval cue, rather than memory strength per se. The increased pupillary match effect for distributed learning may reflect enhanced contextual recollection, while the reversed match effect for massed learning may reflect reduced retrieval effort associated with increased processing fluency.

Topic Area: LONG-TERM MEMORY: Episodic

C7 - Episodic counterfactual plausibility is negatively associated with ease of simulation: behavioral and neural evidence

Ricardo Morales-Torres[1,2] (ricardo.morales.torres@duke.edu), Kaylee Miceli[1,3], Shenyang Huang[1,2], Felipe De Brigard[1,2,3]; [1]Center for Cognitive Neuroscience, Duke University, [2]Department of Psychology and Neuroscience, Duke University, [3]Department of Philosophy, Duke University

People often engage in episodic counterfactual thinking (ECT), or the act of imagining alternative ways past events could have occurred. These simulations can vary in their perceived plausibility, ranging from highly plausible (having a different breakfast) to highly implausible (winning the lottery). Classical psychological models, such as the simulation heuristic, suggest that the perceived plausibility of a counterfactual is determined by how easily it comes to mind. However, this heuristic has been mostly tested with fictional narratives and only scarcely with autobiographical events. In our research, we conducted two behavioral (1 and 3) and one fMRI (2) experiments to examine the simulation heuristic's predictions in the context of ECT and its potential neural basis. In all experiments, participants recalled various autobiographical memories. After a week, they generated counterfactual scenarios for these memories, then rated their perceived plausibility and ease of simulation. The results of Experiment 1 supported the simulation heuristic, showing that easier simulations are rated as more plausible. Experiment 2 revealed that implausible simulations, compared to plausible ones, elicited greater activation in the left prefrontal cortex, a pattern associated with increased cognitive control demands in memory retrieval. Experiment 3 showed that even when participants were tasked with generating implausible counterfactuals exclusively, they still exhibited the pattern predicted by the simulation heuristic. Collectively, our findings support the simulation heuristic in ECT (Exp. 1), its robustness (Exp. 3), and how this effect might be mediated by the generation of less plausible counterfactuals requiring more cognitive control over mnemonic processes (Exp. 2).

Topic Area: LONG-TERM MEMORY: Episodic

C8 - Changes in hippocampal cerebral blood flow in moderate-severe traumatic brain injury

Annick F. N. Tanguay[1] (annick.tanguay@vumc.org), Sophia Kekes-Szabo[1], Hillary Schwarb[2], Neal J. Cohen[3], Binu P. Thomas[4], Melissa C. Duff[1]; [1]Vanderbilt University Medical Center, [2]University of Nebraska-Lincoln, [3]University of Illinois Urbana-Champaign, [4]University of Texas Southwestern Medical Center

A reduction in cerebral blood flow (CBF) can occur in the chronic stage of traumatic brain injury (TBI) regardless of volumetric differences in brain structures. Thomas et al. (2021) showed that lower hippocampal CBF correlated with higher depression symptoms and greater sleep disturbance, but not cognitive changes in a sample with predominantly mild TBI. Here, we compared hippocampal CBF and hippocampal volume between 25 individuals with chronic moderate-severe TBI and 28 non-injured comparison participants (NC), and tested whether these measures related with symptoms of depression (Beck Depression Inventory-II), sleep quality (Pittsburgh Sleep Quality Index), and episodic memory ability (Auditory Verbal Learning Test). We found lower hippocampal CFB and volume bilaterally in the TBI group relative to the NC group. Higher hippocampal CBF and larger volume correlated with better episodic memory function, but did not correlate with symptoms of depression and sleep quality. Preliminary analyses with a subset of participants who received additional testing (NC: n = 8, TBI: n = 8) revealed that higher hippocampal CBF strongly correlated with better episodic memory on the Picture Sequencing task of the NIH toolbox ($r = 0.68$, $p = .002$), whereas hippocampal volume did not ($r = 0.17$, $p = .504$). Thus, hippocampal perfusion can predict cognitive function in moderate-severe TBI, even in the chronic phase of injury, and may supplement volumetric analyses to predict long-term outcomes. The predictive value of hippocampal CBF and volume may hinge on factors like TBI severity and sensitivity of the outcome measures.

Topic Area: LONG-TERM MEMORY: Episodic

C9 - Visual exploration reveals the precision of semantic and spatial memory

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Memories range in precision from highly detailed to vague, but the neural origin of this spectrum is not yet known. Current theories attribute these differences to the anatomical organization of the human hippocampus, with increasing memory resolution in the anterior to posterior direction. However, it remains unclear whether semantic and spatial components of memory share a common anatomical gradient. To address this question, we created a sequence-memory fMRI task that independently manipulates the semantic and spatial attributes of repeating sequences. Participants (N = 9) learned visuospatial sequences of objects and detected mismatching test sequences that differed along spatial and semantic dimensions. Eye-movement tracking was used to differentiate semantic versus spatial memory influences on behavior with high temporal precision. Linear mixed-effects modeling indicated that after learning, participants made predictive eye movements to the next location in the sequence ($F(1,8.8) = 8.8$, $p < 0.001$), reflecting spatial memory. Fixation durations increased for unexpected objects but not for objects presented in unexpected locations ($F(1,34.6) = 4.8$, $p = 0.04$), reflecting semantic memory. Finally, accuracy on the task varied based on semantic and spatial similarity, with better detection of mismatching sequences that were either spatially or semantically far from targets ($F(1,9.6) = 9.6$, $p = 0.008$). These findings indicate that the precision of spatial and semantic memory can be differentiated in eye-movement behavior and recognition responses. We will describe fMRI results that utilize these behaviors to relate semantic and spatial gradients along the hippocampal long axis to memory precision.

Topic Area: LONG-TERM MEMORY: Episodic

C10 - Memory-selective neurons in human medial temporal lobe and medial frontal cortex can be modulated by the decision criterion during recognition memory

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According to Signal Detection Theory, a recognition memory judgment consists of determining whether the familiarity strength elicited by an item exceeds the decision criterion for classifying it as previously studied (old) or novel (new). While many experiments have investigated the neural mechanisms underlying the memory component of recognition tests, much less work has explored the neural underpinnings of the decision criterion. Recent fMRI findings revealed that widespread frontoparietal activity in old versus new response contrasts is greatly affected by changes in criterion placement regardless of task difficulty (Layher et al., 2023). To expand on these findings, we administered a recognition memory task that included manipulations of criterion placement and task difficulty in seven epilepsy patients with depth-electrode implants. We obtained single-unit recordings from these patients in the amygdala, hippocampus, anterior cingulate cortex, supplementary motor area, ventromedial prefrontal cortex, and fusiform face area. Across all regions, we isolated 688 neurons and identified 80 memory-selective neurons that showed significantly different firing rates between correct old and new responses during the test stimulus presentation period. A support vector machine (SVM) decoding classifier determined if the firing rates of the 80 identified memory-selective neurons were modulated by manipulations of criterion placement and/or task difficulty. The SVM classifier successfully decoded response type (85%, $p < .001$) and criterion condition (68%, $p < .001$), but failed to differentiate the task difficulty level (52%, $p = .30$). These preliminary results suggest that memory-selective neurons in the recorded regions can encode decisional information related to criterion placement.

Topic Area: LONG-TERM MEMORY: Episodic

C11 - False Recognition in Aging is Due To an Emphasis on Semantic Information at Encoding

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According to the semantic categorization account, older adults' overreliance on pre-existing semantic knowledge at encoding causes false recognition by reducing the quality of visual representations. Alternatively, the impaired perceptual encoding hypothesis suggests that older adults demonstrate reduced encoding of visual details that would allow successful discrimination of similar lures, irrespective of the copresence of semantic information. The current fMRI study investigated whether older adults' emphasis on pre-existing semantic knowledge at encoding impaired visual encoding while increasing false recognition, as well as the brain regions engaged. Participants encoded unique fonts associated with words (meaningful condition) and pseudowords (meaningless condition), making a pleasantness decision task. At retrieval, participants

were asked to judge the font as 'old' or 'new' with confidence levels. 1) In the meaningful condition, representational similarity analysis at encoding with a model of vision (AlexNet) revealed an age-related dedifferentiation for visual representations in the early visual cortex. This was associated with an age-related hyperdifferentiation for semantic representations (Word2Vec) in the ventral anterior temporal lobe. Data suggests that older adults with lower specificity of visual representations in combination with higher specificity of semantic representations falsely recognised more fonts. 2) Encoding-retrieval similarity revealed that the reduction of specificity of the encoded fonts in aging in the meaningful condition is reflected as an increased neural pattern similarity in the early visual cortex. The behavioral and fMRI results are consistent with the semantic categorization account and potentially suggest that perceptually-based false recognition can be reduced if older adults do not emphasize semantic information.

Topic Area: LONG-TERM MEMORY: Episodic

C12 - Occipitotemporal alpha and theta dynamics support memory formation in the developing brain

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The medial temporal lobe (MTL) is crucial for episodic memory and receives inputs from the occipital cortex to form memories for visual stimuli. The oscillatory mechanisms underlying the occipital-MTL interaction in the developing brain are largely unknown. We analyzed intracranial EEG data from 131 occipital and 90 MTL electrodes in 31 pediatric patients (5.9-20.5 years) undergoing direct cortical monitoring for seizure management. Subjects studied pictures of scenes by responding indoor/outdoor during scene presentation in preparation for a memory recognition test. First, we characterized oscillations in the occipital cortex and MTL. Oscillation detection revealed that alpha dominates the occipital cortex [median(IQR), 8.48(4.98) Hz], and theta dominates MTL [median(IQR), 6.88(3.46) Hz]. We observed an age-related increase in MTL peak frequency. Second, we analyzed event-related phase-amplitude coupling (PAC) between detected oscillations and high-frequency activity (70-150 Hz), a mechanism posited to support information and mnemonic representation, as a function of recognition performance (subsequent hit vs. miss). We observed increased PAC on subsequent hit compared to miss trials in stimulus-locked and response-locked data in both regions. The occipital stimulus-locked PAC effects positively correlated with recognition accuracy. Third, we analyzed occipital-MTL phase synchrony, a mechanism of inter-regional interaction, with occipital and MTL peak frequencies separately. We observed increased phase synchrony on subsequent hit compared to miss trials in stimulus-locked and response-locked data in occipital and MTL peak frequencies. These results demonstrate the important role of neural oscillations in providing the functional infrastructure of memory in the developing brain by facilitating local processing and inter-regional interaction.

Topic Area: LONG-TERM MEMORY: Episodic

C13 - Flexible updating of hippocampal representations guides multi-step prediction

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Our daily lives are temporally structured, enabling prediction of upcoming events. For predictions to be useful, they should be updated when environments change. How does the brain update its predictions in the face of new information? We asked how and when predictive representations change after individuals learn new information about the structure of an environment, focusing on the hippocampus – a region involved in sequence memory and prediction. Participants (N = 32) learned sequences of environments. They then learned novel transitions that linked two previously separate sequences into a single, integrated sequence. During fMRI, participants anticipated upcoming environments one to four steps into the future in the integrated sequence, requiring them to mentally traverse novel transitions to make correct predictions. Participants were able to anticipate using these novel transitions immediately after integration and continued to improve over time, suggesting both rapid and gradual updating of sequence representations. Multivariate fMRI analyses in the hippocampus revealed that representations of the previously separate sequences became more similar after the sequences were linked by new transitions, compared to a no-integration baseline. Importantly, this difference between conditions was strongest for early task runs, suggesting rapid updating of temporal structure in the hippocampus. Finally, hippocampal sequence integration in early runs was related to anticipation performance, particularly on trials in which participants had to mentally traverse the novel transition to make predictions. Overall, this suggests that the hippocampus rapidly updates memory for temporal structure in the service of guiding flexible and adaptive behavior over multiple timescales.

Topic Area: LONG-TERM MEMORY: Episodic

C14 - Visual fixations to objects reflect configural processing in the perirhinal cortex among younger and older adults

Natalia Ladyka-Wojcik[1], Rosanna K. Olsen[1,2], Jennifer D. Ryan[1,2], Morgan D. Barense[1,2]; [1]University of Toronto, [2]Rotman Research Institute (Baycrest Health Sciences)

Object recognition relies on the ability to bind the configural arrangement between object features into mental representations. Evidence in amnesic patients with medial temporal lobe (MTL) damage points to the perirhinal cortex (PRC) as a key region supporting configural object processing. Recently, modelling of functional connections of the PRC suggests that it interfaces with the brain's oculomotor (i.e., eye movement) control system. However, little work has explored the relationship between visual fixations to configural objects and functional activation of the PRC. In our study, younger and older participants (N = 95) completed a configural object processing task while undergoing functional imaging (fMRI) and while their fixations were tracked. Within each experimental block, participants saw five repetitions of three computer-generated objects comprised of distinct upper and lower halves. On the sixth and seventh repetitions, we showed participants three possible configurations: old objects from prior repetitions in the block; reconfigured objects in which the two halves had been presented as parts of different objects in the block; and novel objects in which both halves were new. Manually segmented masks constrained our functional analyses of the MTL. Both older and younger adults showed novelty preference in their fixations, but only younger adults showed evidence of object familiarity in average fixation durations. The PRC was the only MTL region that showed significantly different activation between age groups for old, reconfigured, and novel objects. Finally, our results provide evidence for the relationship between PRC activation and configural novelty reflected in eye movements, mediated by age.

Topic Area: LONG-TERM MEMORY: Episodic

C15 - Horror-evoked Arousal Predicts Biased Distance Estimations for Continuous Events

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Temporal memory is critical for survival. For example, to identify predictors of upcoming threats or the causal relationships between actions and harm necessitates the ability to understand not only what events came first, but also at what timescales these events occurred. As such, distance as a factor of perception may be influenced and guided by current arousal states which are impacted during encoding. Previous work from our group and others has shown that threat increases temporal order memory, but less research has examined its influence on estimations of temporal distance. Here, we investigated the influence of arousal and valence on a variety of short movie clips depicting threatening and neutral events extracted from horror movies, and tested a retroactive estimation of elapsed time (i.e., distance estimation) between two pairs of image stills drawn from the same clip. Our finding (n=168) that threat altered distance estimations for aversive (M = 1.96) compared to neutral clips (M = 2.01), $t(167) = -2.3707$, $p = 0.0189$, such that perceived elapsed time was compressed for the aversive clips. We also found on a clip-by-clip basis, arousal was a significant predictor of distance estimations, $\chi 2(1) = -2.3707$, $p = 0.01889$, such that greater self-reports of arousal predicted compressed estimations of elapsed time. This research builds upon work that implies threat-related arousal during encoding may highlight the complex interplay between time perception and memory functions.

Topic Area: LONG-TERM MEMORY: Episodic

C16 - Narrative coherence bends the arrow of time when recalling naturalistic events

Angelique Delarazan[1] (a.delarazan@wustl.edu), Jeffrey Zacks[1], Elena Bosak[1], Zachariah Reagh[1]; [1]Washington University in St. Louis

Temporal and contextual associations organize the recall of past experiences, such that elements can be linked based on temporal proximity or semantic relatedness. However, our understanding of these phenomena mostly stems from standard memory paradigms that focus on isolated elements, such as word lists. In contrast, real-life experiences consist of dynamic events with complex, meaningful connections. Ongoing experiences are often remembered as discrete events, but sometimes come together as part of a larger narrative. Recent studies show that temporally distant events can be linked together and are better remembered if the events could be integrated into a broader, coherent narrative. Although prior work demonstrates our ability to link naturalistic events in memory, it is unknown how we structure and organize these memories during free recall. Here, we investigate how temporally-distant events of varying levels of narrative coherence influence the organization of recalled experiences. Participants learned and subsequently recalled events from picture book-style stories that either formed one coherent narrative, or two separate, unrelated narratives embedded in an overarching, causally related story. We found an overall recall benefit associated with recalling events in chronological order. We also found that narratively coherent events were more likely to be recalled, but that this was associated with a deviation from temporally-organized recall. These results extend the importance of temporal organization in recall to complex naturalistic events, and further suggest a natural proclivity for leveraging the meaning of events to construct memories from everyday experiences.

Topic Area: LONG-TERM MEMORY: Episodic

C17 - 7T laminar fMRI responses during encoding and retrieval of naturalistic virtual experiences

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Previous research has consistently identified a set of brain regions, including the hippocampus and medial prefrontal cortex (mPFC), that supports recollection of our past experiences. What happens in the brain during the initial formation of such autobiographical memories is less clear. To address this issue, we had healthy adult participants embark upon an interactive guided tour through a virtual reality town during which they had a range of naturalistic experiences while being scanned using 7T fMRI. They returned later that day and recalled the virtual experiences first silently during fMRI, followed by retrieval aloud outside the scanner. We investigated fMRI responses in the layers (superficial, middle, deep) of the mPFC and other cortical areas, along with the hippocampal subfields, when encoding and recalling these everyday experiences. Analyses included examination of whether the initial formation of autobiographical memories was supported by specific cortical layers, with a particular interest in the deep layer and also the hippocampal subfields CA3 and dentate gyrus. In addition, the encoding data were interrogated with respect to whether experiences were well or poorly remembered during subsequent retrieval. Because recall took place approximately 12 hours after encoding, this dataset also afforded us the opportunity to examine laminar and subfield responses during an early phase of systems-level consolidation of (virtual) autobiographical memory representations, something that has rarely been reported. Overall, this rich 7T fMRI dataset has started to expose how memories more akin to real life might be formed and represented at the level of neural microcircuits.

Topic Area: LONG-TERM MEMORY: Episodic

C18 - Is mental visuospatial imagery essential for episodic autobiographical memory?

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For most of us, recalling detailed, episodic autobiographical memories (AM) conjures up vivid visuospatial scene imagery in front of our mind's eye. However, little is known about whether visuospatial scene imagery is essential for episodic AM retrieval. Furthermore, the hippocampus has been implicated to support both cognitive processes, making it difficult to disentangle its precise contributions to each one. Here, I will present the results of a three projects of my group examining this intricate relationship. First, I will present behavioral and functional magnetic resonance imaging (fMRI) data from individuals with aphantasia suggesting that diminished abilities to construct mental scenes result in less detailed, less confident, and less emotional AM retrieval which is reflected neurally by an altered functional connectivity between the hippocampus and visual-perceptual cortices. Second, I will present high-field 7 Tesla fMRI data from young healthy participants during an AM task. These data illuminate that one specific hippocampal subfield, i.e., the pre- and parasubiculum maybe especially important for scene-based cognition and that this subfield is strongly connected to brain network typically associated with AM retrieval. Third, I will present an additional 7 Tesla fMRI dataset showing that the hippocampus is more involved when one single scene is being imagined whereas the ventromedial prefrontal cortex is more involved when an extended event is being imagined. In sum, I present multiple datasets indicating that the hippocampus is crucial for the construction of vivid visuospatial mental scenes and that these are essential for detail-rich, episodic AM retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

C19 - Scene memory is better for dynamic than static stimuli in immersive virtual reality

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Everyday events are formed in immersive 360-degree 3D settings, but little is known regarding how the dynamic aspect of such experiences influences memories. Dynamism can signal a meaningful change during everyday life that creates more distinctive events from our continuous experiences of the world. Here we explored the prediction that dynamism preferentially affects scene-related aspects of memory. Participants experienced 360-degree 3D immersive video events (e.g., a bathroom setting) in virtual reality while wearing an immersive VR headset. Half of the video events included a dynamic object in the scene (e.g., steaming iron), whereas the other half included a static version of a semantically similar object (e.g., iron turned off). An "Old"/ "New" recognition memory test followed, in which participants were cued by the dynamically manipulated object (e.g., iron). "Old" responses were then followed by additional questions assessing scene (setting name and object location) and object (recall two additional objects from the event) memory. The results indicated better recognition memory in the dynamic than static condition. Moreover, dynamic experiences were also associated with better scene memory compared to static experiences, however, there were no differences in object memory. Together these findings reveal that dynamic experiences contribute to better scene-related aspects of memories. More broadly, our findings exemplify how we can use immersive 360-degree experiences to manipulate the dynamic nature of the real world to investigate how we form and remember events.

Topic Area: LONG-TERM MEMORY: Episodic

C20 - Intracranial neurofeedback of hippocampal theta oscillations enhances human memory formation

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While hippocampal theta oscillations (3–8 Hz) have long been hypothesized to underlie memory formation, causal evidence in humans is limited. Neurofeedback is a technique that allows individuals to volitionally control their brain state by receiving task feedback based on their online neural activity. This approach uniquely enables the causal manipulation of brain states, tightly constrained by task demands. Thus, to test if causally increasing or decreasing hippocampal theta power benefited or diminished

memory formation, we employed neurofeedback in individuals with epilepsy undergoing intracranial electroencephalographic (iEEG) recordings. The task involved object classification during the time of encoding, where subjects made one of two judgments about an object image following a color cue (Green: Size; Blue: In/Out). Neurofeedback was controlled via the brightness of the color cue: increased theta power yielded a brighter hue, whereas decreased theta power yielded a darker hue. Neurofeedback was performed before the presentation of each object image for up to two minutes until theta power reached a threshold, which triggered the presentation of the object image. Theta power used for neurofeedback was estimated after accounting for aperiodic components. Preliminary analysis revealed a significant increase in associative memory hit rate for up-regulated vs. down-regulated trials ($n = 8$, $t(7) = 2.02$, $p < .05$) for patients who received neurofeedback to the posterior hippocampus. To our knowledge, this provides the first evidence of hippocampal theta neurofeedback modulating associative memory formation, providing casual evidence for its role in human memory.

Topic Area: LONG-TERM MEMORY: Episodic

C21 - 7T laminar fMRI reveals the microcircuitry underpinning recall of remote autobiographical memories

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The ability to retrieve remote autobiographical memories from many years ago is important for maintaining the narrative of our lives. Previous neuroimaging research suggests that individual remote autobiographical memories are represented in the medial prefrontal cortex (mPFC) and hippocampal subfield CA3. However, the cortical and subcortical microcircuits involved in autobiographical memory retrieval are largely unexplored. To address this issue, we used 7T laminar functional MRI to test whether representations of individual remote autobiographical memories were present in particular hippocampal subfields and/or in the cortical layers (superficial, middle, deep) of brain areas typically involved in autobiographical memory recall, including parahippocampal, temporal, medial parietal and medial prefrontal cortices. Healthy adult participants retrieved six remote (2-5 year old) autobiographical memories six times each while being scanned. Using representational similarity analysis, we found that individual remote autobiographical memory representations were detectable in one brain area, the deep layer of the mPFC. We then examined whether the trial-by-trial strengths of these remote autobiographical memory representations were correlated with those in any other cortical layer or hippocampal subfield – so-called informational connectivity. We found that mPFC deep layer memory representation strengths were correlated with those in one brain area, namely CA3. This finding suggests that there may be sharing of memory-related information specifically between the mPFC deep layer and CA3 during recall of remote autobiographical memories. Overall, these results highlight the involvement of feedback processing pathways, which typically travel in the deep cortical layers, when recollecting autobiographical memories from the remote past.

Topic Area: LONG-TERM MEMORY: Episodic

C22 - Dissociable neural mechanisms for encoding of memories associated with conceptual and visual-perceptual detail

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Encoding everyday events involves processing an array of details, including those pertaining to the unfolding of the event (central details) and those that describe peripheral elements to enrich the encoded memory. Importantly, these peripheral elements can vary, presenting conceptual or perceptual details that further describe the event. Recent theories suggest that there are functionally specialized hippocampal networks along the longitudinal axis (anterior, posterior) for encoding conceptual versus perceptual details. Whether these networks are also activated during encoding of complex events that emphasize these content elements remains unknown. To address this knowledge gap, we conducted a neuroimaging study in which healthy participants ($N = 37$) listened to three narratives containing different information depending on narrative version. Each narrative began with an introduction detail and contained 14 central details that depicted the unfolding of the presented story and were the same within story type across conditions. Interspersed between the central details were 3 conceptual, visual, or auditory peripheral details (which varied by condition). To test how these peripheral details altered memory encoding while keeping central story details constant, we analyzed neural activity for each narrative condition during the encoding of the 14 central details. Consistent with predictions, we observed enhanced activation in the anterior hippocampus, lateral orbitofrontal cortex, and ventral striatum during encoding of narratives presented with conceptual details. Conversely, we observed enhanced activity in the posterior hippocampus, precuneus, and inferior parietal lobule during encoding of narratives with visual-perceptual details. These results extend theories of hippocampal functional specialization to encoding complex memories.

Topic Area: LONG-TERM MEMORY: Episodic

C23 - Education moderates the effect of hippocampal volume on episodic memory decline

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Episodic memory is the ability to encode, store, and retrieve information about past events. The hippocampus is critical for episodic memory. Volumetric hippocampal declines, and subsequently episodic memory declines, are a hallmark of advanced age and Alzheimer's disease. However, the degree to which age or Alzheimer's disease affects the association between hippocampal volume and episodic memory varies across people. Such individual differences may be explained by cognitive reserve, a property of the brain that allows for cognitive performance that is better than expected given the degree of brain changes due to aging or disease. In the current study, we test the cognitive reserve hypothesis by measuring whether education (a cognitive reserve proxy) protects episodic memory from expected decline due to hippocampal volume. We used an existing database of 62 older adults at risk of Alzheimer's disease, from the Consortium for Early Identification of Alzheimer's Disease-Quebec. Participants reported the years of education completed. They received anatomical 3D-T1-w structural MRIs. Hippocampal volume segmentation was done with FreeSurfer 5.3 standard pipeline steps. Participants completed a Face-Name episodic memory task at baseline, two years later, and four years later. Regression analyses using the R statistical software v.4.3.0 revealed education significantly moderated the effect of hippocampal volume on episodic memory decline, $\beta = -1.97$ ($SE = 0.93$). A Johnson-Neyman analysis found that over 14 years of education was neuroprotective against hippocampal-related memory decline. Analyses did not reveal any sex differences. Findings support the cognitive reserve hypothesis that lifestyle factors can shield cognition from neurodegeneration due to life-course/brain disease-related changes.

Topic Area: LONG-TERM MEMORY: Episodic

C24 - Dimensionality affects memory for events in immersive virtual reality

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Real-world events are three-dimensional (3D) and immersive. Prior research using virtual reality (VR) has suggested that 3D experiences may boost memory performance but are limited because they do not directly compare 3D and 2D experiences in fully immersive settings. Across two studies, we investigated how dimensionality affects memory for real-world events experienced in an immersive virtual reality (VR). Participants experienced 360-degree videos of real-world events (e.g., standing in a train station) while wearing an immersive VR headset, and we manipulated dimensionality through stereoscopic and monoscopic presentation of the videos. Memory for the video events was then tested by presenting a partial screenshot from the video and asking participants to assess the vividness and quality of scene-related aspects during memory recall. The results revealed that 3D events were experienced with a stronger sense of presence, which contributed to greater vividness and scene-related qualities of memory during remembering. Our findings indicate the potential of VR to investigate key properties of real-world memories such as their 3D nature.

Topic Area: LONG-TERM MEMORY: Episodic

C25 - The curse of imagery: Trait object and spatial imagery relate to trauma and stress outcomes

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Imagery is integral to autobiographical memory (AM). Past work has highlighted the benefits of high trait imagery on episodic AM, such as faster, more detailed retrieval and greater feelings of vividness and reliving. However, these advantages may also come with drawbacks: following stressful or traumatic events, strong imagery could promote the intrusive memories and flashbacks characteristic of PTSD. We examined relationships between trait object imagery (e.g., imagery for form, size, shape), trait spatial imagery (e.g., imagery for spatial relations, locations), and PTSD symptoms (e.g., intrusive memories) using self-report measures in online studies in two independent samples: undergraduates (n = 493) and trauma-exposed adults (n = 936). Controlling for gender and depression symptoms, regressions indicated that higher object imagery was associated with more PTSD symptoms in both samples (βs = 0.11–0.21, ps < .002). In contrast, spatial imagery was associated with fewer PTSD symptoms (βs = 0.09–0.15, ps < .03), although in undergraduates this effect interacted with gender such that it was present in men and not women. These findings suggest that different forms of imagery have different (or even opposing) relationships with remembering, which in turn impacts outcomes following exposure to trauma and stress.

Topic Area: LONG-TERM MEMORY: Episodic

C26 - Boundaries of behavioral tagging: arousal alters setting of learning tags produced by weak learning

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Prior research has demonstrated that Pavlovian fear conditioning to an object category selectively enhances 24-hour episodic memory for related items encoded before conditioning (Dunsmoor et al., 2015; Hennings et al., 2021). This finding conforms to the behavioral tagging hypothesis, which posits that weak memories can be strengthened if a more salient event occurs around the time of weak learning (Ballarini et al., 2009). While prior rodent research has examined boundary conditions that govern behavioral tagging, the factors that initiate placement of behavioral tags in the first place remains underexplored. This study investigates whether a non-specific increase in arousal interferes with the placement of learning tags, therefore preventing memory capture by subsequent fear conditioning. In three experiments with 25 participants each, trial-unique items from two object categories (animals/tools) were encoded before, during, and after Pavlovian fear conditioning. Experiment 1 replicated prior findings, demonstrating selectively enhanced 24-hour recognition memory for fear-conditioned (CS+) versus unpaired (CS-) items across all encoding phases. Experiments 2 & 3 introduced non-specific arousal before weak encoding, but were otherwise identical to Experiment 1. Results demonstrated abolishment of the 24-hour selective retroactive memory effect. However, after ~1 month (Experiment 3), a selective retroactive enhancement emerged, suggesting that conceptual information related to threat-specific items (CS+) may be selectively consolidated in the long-term, even when the effect is not observable after a shorter retention interval (24 hours). These results contribute to understanding factors that modulate retroactive enhancements of episodic memory, highlighting the complex interplay between arousal, learning tags, and memory consolidation.

Topic Area: LONG-TERM MEMORY: Episodic

C27 - Age differences in the mechanisms underlying remembering events vividly and confidently

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The way humans remember events changes across the lifespan. Older adults often rate the vividness of their memories as being greater or equal to younger adults, despite poorer performance on episodic memory tasks. This study explored how the content (place, person and object) and specificity (conceptual gist versus perceptual detail) of event memories relate to the subjective experience of memory vividness and memory confidence, and how this relationship is affected by healthy ageing. 100 healthy older adults and 100 young adults were tested online, using an adapted version of a paradigm developed by Cooper and Ritchey (2022). At encoding, participants generated a distinctive story to associate together (1) a theme word, and images of (2) a famous person, (3) a place, and (4) an object, to generate unique events. Memory test consisted of identification of the event components using word labels (indexing conceptual gist), and perceptual lure discrimination (indexing perceptual details). Replicating Cooper and Ritchey (2022), we found that young adults base their memory vividness judgements on their ability to remember the conceptual gist of the events more so than the perceptual details. Older adults followed a similar pattern, despite performing less well on the task. In young adults only, memory vividness was significantly correlated with perceptual detail for place, whereas memory confidence was significantly correlated with perceptual detail for place and object. The results suggest that while episodic memory declines with age, older adults use similar information to young adults to judge how confidently and vividly they remember.

Topic Area: LONG-TERM MEMORY: Episodic

C28 - Overnight memory transformation in the human brain– from perceptual detail to conceptual gist

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How do memories change over time? Recent work suggests that in the process of consolidation, memory representations undergo transformations across a perceptual-to-conceptual gradient. While sleep is strongly implicated in memory consolidation, its impact on this gradient remains poorly understood. Here we used high-density scalp electroencephalography (EEG) to track memories across i) encoding, ii) pre-sleep retrieval, iii) whole-night sleep and iv) post-sleep retrieval. Participants (n=24) learned word-image associations (verb-object and verb-scene) across two separate experimental sessions. We used support vector machine (SVM) classifiers to decode memory representations at two different levels of abstraction: lower-level perceptual (i.e., image-based) and higher-level categorical (i.e., object vs. scene). This was done by using brain activity from an independent one-back task and by testing the classifiers' decoding accuracies during pre- and post-sleep retrieval. Results revealed a dissociation of representational decodability from pre-to post sleep retrieval. Specifically, while lower-level perceptual decoding was greater during pre-sleep compared to post-sleep retrieval, the inverse was true for higher-level categorical decoding. These findings are consistent with the notion that (sleep) consolidation transforms memory representations from high-fidelity reinstantiations into more schema-like, conceptual 'gists'.

Topic Area: LONG-TERM MEMORY: Episodic

C29 - Is implicit memory associated with the hippocampus?

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According to the traditional memory-systems view, the hippocampus is critical during explicit (conscious) long-term memory, whereas other brain regions support implicit (nonconscious) memory. In the last two decades, some fMRI studies have reported hippocampal activity during implicit memory tasks. The aim of the present discussion paper was to identify whether any implicit memory fMRI studies have provided convincing evidence that the hippocampus is associated with nonconscious processes without being confounded by conscious processes. Experimental protocol and analysis parameters included the stimulus type(s), task(s), measures of subjective awareness, explicit memory accuracy, the relevant fMRI contrast(s) or analysis, and confound(s). A systematic review was conducted to systematically identify implicit memory studies that reported fMRI activity in the hippocampus. After applying exclusion criteria, thirteen articles remained for analysis. We found that there were no implicit memory fMRI studies where subjective awareness was absent, explicit memory performance was at chance, and there were no confounds that could have driven the observed hippocampal activity. The confounds included imbalanced stimuli between conditions, imbalanced attentional states between conditions (yielding activation of the default-mode network), differential novelty, and explicit memory (including false memory). As such, not a single fMRI study provided convincing evidence that implicit memory was associated with the hippocampus. Neuropsychological evidence was also considered, and implicit memory deficits were caused by factors known to disrupt brain regions beyond the hippocampus, such that the behavioral effects could not be attributed to this region. The present results indicate that implicit memory is not associated with the hippocampus.

Topic Area: LONG-TERM MEMORY: Episodic

C30 - Functional Network Integration Mediates Arousal Effects on Naturalistic Recall

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A consistent finding in memory research is that arousing stimuli are more likely to be remembered than neutral ones. Yet, the neural mechanisms underlying how arousal supports memory are not fully understood. Here, we examined whether functional network integration is a potential mechanism by which high arousal events are better remembered. We used two publicly available fMRI datasets, where participants watched an hour-long movie clip immediately followed by a free verbal recall session. Using graph theoretical approaches, we tested how the dynamic re-organization of functional networks during encoding was associated with recall performance. Further, we leveraged large language models to estimate the arousal level of movie events and validated the results with human ratings from behavioral experiments. Across both datasets, whole-brain functional network integration was associated with more rich and accurate recall (Dataset1: b=.19, SE=.03, t(809)=5.66, p<.001; Dataset2: b=.16, SE=.03, t(1017)=5.26, p<.001). Events with high arousal were indeed better remembered (Dataset1: b=.20, SE=.04, t(796)=4.57 p<.001; Dataset2: b=.19, SE=.04, t(1004)=4.65, p<.001) and coincided with events with greater functional network integration (Dataset1: b=.22, SE=.04, t(796)=4.91, p<.001; Dataset2: b=.21, SE=.04, t(1004)=5.33, p<.001). A formal mediation analysis revealed that functional network integration mediated the effects of arousal on recall (Dataset1: b=.04, 95%CI=[.02, .06], p<.001; Dataset2: b=.03, 95%CI=[.02, .05], p<.001). Our results suggest that arousal-dependent biases in memory are related to dynamic changes in the integration of functional networks. Combining approaches from systems and affective neuroscience, our work contributes to building an integrative theoretical framework that bridges affective states, ongoing cognition, and functional network topology.

Topic Area: LONG-TERM MEMORY: Episodic

C31 - Encoding and retrieval of virtual naturalistic experiences during OPM-MEG

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Our life experiences are captured in autobiographical memories. To date, neuroimaging research has predominantly focussed on the recall of autobiographical memories, because examining their formation is challenging in head-immobilising brain scanners like MRI and cryogenic magnetoencephalography (MEG). Here we circumvented this issue by utilising whole-head, wearable optically pumped magnetometer (OPM)-MEG combined with interactive virtual reality. Healthy adult human participants moved through a virtual town using a walk-in-place method. During their town tour they had a range of naturalistic experiences that varied in content and duration. We collected neural data throughout the tour using a ~130 channel OPM-MEG system. The next day, and also during OPM-MEG, participants recalled and described their memories of the tour experiences. Our analysis focussed on characterising the neural signatures, across frequency bands, associated with forming memories of these virtual naturalistic experiences, including those that went on to be remembered or degraded (where now the ground truth is known). This rich dataset has yielded several notable findings, which include: (1) During encoding, increased gamma power (35-60 Hz) localised to retrosplenial cortex and hippocampus was especially prominent at the beginning and end of experiences, potentially aligning with ideas about event boundaries. (2) Retrieval of virtual experiences engaged the same set of brain regions previously implicated in recalling actual lived experiences. More generally, our study shows that it is possible to combine virtual reality and OPM-MEG to examine how the brain functions in something much more akin to everyday life which, until now, has eluded detailed scrutiny.

Topic Area: LONG-TERM MEMORY: Episodic

C32 - Intersubject neural similarity and pattern reinstatement during recall are enhanced at meaningful moments during film viewing

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How do we represent and remember complex experiences? Recent work on event cognition suggests that we parse and organize such experiences in a meaningful way. Asking people to communicate their experiences by summarizing a sequence of events can reveal this organization. Here, we introduce a storyboard paradigm to investigate event representations. Participants watched 50 video clips (approximately 1-2 minutes each) from an episode of a television show (BBC's Sherlock, S1E1: A Study in Pink). They were then asked to create a storyboard that conveyed the underlying story by selecting individual frames within each clip. There were no restrictions on the number of frames participants could select. We found remarkably high agreement among participants in selecting individual frames. In a separate analysis of an open fMRI dataset containing both the encoding and recall of the same video clips, we found that within the Posterior Medial Cortex (PMC), the probability of a particular timepoint containing a storyboard frame was positively correlated with the intersubject neural pattern similarity. Further, encoding patterns weighted by their respective storyboard probabilities also significantly correlated with the recall activity patterns even after accounting for the unweighted encoding patterns. Finally, we compared storyboard moments to event boundaries and found that storyboards capture distinct information from event boundaries, both behaviorally and neurally. These results suggest that storyboard moments capture crucial information about how we represent complex experiences. Storyboards allow us to study meaningful moments underlying experiences and can be useful for investigating episodic memory at a finer scale.

Topic Area: LONG-TERM MEMORY: Episodic

C33 - How the Brain Constructs and Maintains Coherent Episodic Memories through Eye Movements

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The process of constructing, maintaining, and reconstructing episodic memories is closely linked to the temporal dynamics of visual exploration through sequences of eye movements (Johansson et al., 2022; Nikolaev et al., 2023). However, the neural mechanisms that mediate relational memory across eye movements are not yet fully understood. This study presented participants with a series of visuospatial events, each consisting of six distinct elements (faces, places, objects) positioned in different screen locations. This setup allowed for the identification and analysis of various types of inter-element associations. During a 10-second encoding phase, participants visually explored each event. Following this, the visual stimuli were removed, leaving participants with a 10-second "looking-at-nothing"-phase, where they had to retain the event and continue forming and recalling the visuospatial relationships among the elements. EEG and eye movement data were collected during the intervals with and without visual information. Finally, an associative memory test assessed memory for event-specific inter-element relationships. The results showed that the vividness of memory during the interval without visual information correlated with the amount of inter-element gaze transitions. These specific gaze transitions predicted subsequent memory for the corresponding inter-element associations and were related to changes in fixation-related neural activity observed in the desynchronization of alpha and synchronization of theta. This study is the first, to our knowledge, to identify at a fixation level the neural signatures subserving the inter-element linking process of dynamically constructing and maintaining coherent episodic memories across eye movements in the absence of visual input.

Topic Area: LONG-TERM MEMORY: Episodic

C34 - Selective memory retrieval does not depend on semantic congruency between retrieval goals and test cues: ERP evidence

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For memory to serve our goals we need to selectively retrieve the relevant past experiences. Research has shown that although selective retrieval is internally driven, it is also facilitated by overlap between external cues and targeted memories, consistent with the encoding specificity principle. Here, we investigated this goal-driven control further in a preregistered electroencephalographic event-related potential (EEG-ERP) study. We asked if semantic congruency between internal goals and external cues would modify retrieval selectivity. Thirty-seven participants studied objects paired with scenes. At test, they saw object names and judged if each was a target, i.e., it was studied with one of two targeted scenes designated per block (the retrieval goal). Non-targets were objects studied with another scene, or new objects. Test objects were either semantically congruent with one targeted scene or incongruent with both. Behaviourally, target-non-target discrimination was poorer when object names were congruent with the

targeted scenes. Participants responded faster to congruent targets but were slower to congruent non-targets suggesting impaired non-target rejection due to congruency. In contrast, congruency did not impact the target-selectivity of the left parietal (LP) ERP effect associated with recollection. Analysis of mean ERP amplitude at three LP electrodes (500-800 ms) showed strong target-selectivity with non-significant LP effect for non-target memories and no significant effect of semantic congruency. Analysis at mid-frontal sites revealed no significant FN400 ERP effect. The data suggest that semantic overlap (congruency) between goals and test cues does not impact pre-retrieval memory selection, but may impede other processes contributing to accurate task performance.

Topic Area: LONG-TERM MEMORY: Episodic

C35 - A day that America will remember: flashbulb memories, collective memories and collective future thoughts of the capitol riots

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From a cognitive perspective, this study explores the impact of social identity on the inter-subjects similarity of memory representations for the Capitol riots, which happened in Washington on January 6th, 2021. Seventy Belgian and 79 American citizens freely recalled the unfolding events and responded to questions about their recollections and future thoughts. Using a schematic narrative template encompassing the event, causes, and consequences, the analysis revealed that Belgians exhibited significantly greater similarity in representations of the event and its causes compared to their American counterparts. Conversely, Americans demonstrated higher similarity in representations of the consequences. Interestingly, the degree of similarity between Americans' representations of the consequences correlated with both the media exposure frequency and the number of interpersonal discussions. This hints at the role of cultural artifacts, such as media, in shaping collective representations of the aftermath of the Capitol riots. Notably, Americans reported more flashbulb memories than Belgians. Participants who formed a flashbulb memory for the Capitol Riots believed that the event would be more remembered in the future, advocating for increased governmental efforts to commemorate it, and expressing higher concerns about potential future attacks on the Capitol, compared to participants who did not form flashbulb memory. Together, the findings suggest that the content of memories for a public event exhibits cross-individual similarity influenced by their social identity through culturally specific artifacts. Moreover, future thinking regarding the community is influenced by personal memories of hearing the news of the event.

Topic Area: LONG-TERM MEMORY: Episodic

C36 - Interference between similar memories increases the dimensionality and dispersion of recalled content

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Although countless memory studies have documented that similarity between memories produces interference and forgetting, relatively less is known about how memories adapt to interference so that they are successfully recalled. In rodents, high-dimensional neural representations have been shown to be critical for flexible behavior and cognition (e.g., Rigotti et al., 2013). Here, we tested whether memories adapt to interference through increases in the dimensionality of memory content. Human subjects (N = 120) extensively learned 6 face-scene associations. For half of the subjects, all of the scenes were from the same visual category and highly similar (e.g., 6 'libraries'; competitive condition); for the other half of subjects, each scene was from a distinct visual category (non-competitive condition). After learning, participants completed a recall task in which they were shown each face and typed a description of the corresponding scene. To quantify memory dimensionality, Natural Language Processing was applied to the scene descriptions, yielding a semantic embedding for each scene (memory). Principal Component Analysis applied to these embeddings revealed that, compared to the non-competitive condition, participants in the competitive condition contributed relatively less to early components (1-5) and relatively more to later components (6-20), suggesting interference resulted in higher-dimensional memory representations. Additionally, K-means clustering (with K=6 categories) applied to the embeddings revealed that the distance to cluster centroids (dispersion) was significantly greater in the competitive condition compared to the non-competitive condition. Collectively, these findings support the idea that similarity between memories induces adaptive increases in the dimensionality of memory content.

Topic Area: LONG-TERM MEMORY: Episodic

C37 - Can one emotional memory inhibit another? Investigating neural recapitulation patterns related to valence-dependent retrieval-induced forgetting

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This work will contribute to an understanding of how positive and negative content is represented in memory, by examining whether retrieval of one valence of emotional information can inhibit retrieval of another. Retrieval induced forgetting (RIF) describes how retrieving a subset of items from a greater list can lead to the forgetting of other items within that list. It remains unclear whether an RIF-like pattern occurs across valences, such that selective retrieval of one valence of information may induce forgetting of differently-valenced content. The current work will utilize an adapted RIF paradigm in which participants study a series of categorized lists and then have retrieval practice for only negative, only positive, or only neutral words from a particular category (or have no retrieval practice, in a control condition). After a delay, participants will then be asked to retrieve all exemplars from the category. The key question is whether retrieval practice with one valence (e.g., negative) will lead to a reduction in later recall of differently-valenced (e.g., positive) content from the same category. Using fMRI, we will further examine the mechanisms leading to this effect, investigating how neural recapitulation during retrieval practice corresponds with recall on the subsequent recall task. By comparing to activity from the study phase, we can distinguish neural recapitulation of trial-unique content, valence-generalized content, and category-generalized content, thereby determining how recapitulation of each type during retrieval practice relates to RIF-type effects. Overall, this study will clarify how emotional memories of different valences are represented.

Topic Area: LONG-TERM MEMORY: Episodic

C38 - Goal-dependent Integration and Differentiation of Hippocampal Representations.

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Evidence from prior neuroimaging studies suggests that hippocampal representations of prior experience are not fixed. Indeed, different studies report different degrees of pattern similarities across stimuli that share the same context: a similarity increase, an orthogonalization, or a similarity decrease. A possible explanation for these different results is that hippocampal representations are expressed in a goal-dependent manner, such that activity profiles appear integrated when retrieving general information and differentiated when retrieving specific experiences. We aimed to test this hypothesis using functional magnetic resonance imaging (fMRI) in young adults. Participants initially watched two episodes of the sitcom Seinfeld during an unscanned encoding stage. They then completed a cued recall task during a subsequent scanning session in which they had to recollect previously encoded information at varying levels of detail: specific scenes (event condition), narratives of one character in one episode (narrative condition), or the main plot of one episode (episode condition). The cues were sentences presented visually and were the same across the different conditions. Thus, we systematically biased retrieval toward either episodic gist or event-specific detail while holding the cues constant. We will use representational similarity analysis to quantify the degree of integration/differentiation within each condition. We expect retrieval-related activity in the hippocampus to be maximally integrated in the episode condition and maximally differentiated in the scene condition. We anticipate an intermediate response profile in the narrative condition. Preliminary analyses of pilot data from two subjects suggest different activation profiles across conditions.

Topic Area: LONG-TERM MEMORY: Episodic

C39 - Examining the Neural Dynamics of Semantic Memory Integration Using Noninvasive Brain Stimulation with Concurrent EEG

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Our experience shapes the structure of our knowledge in short- and long-term contexts (e.g., problem-solving, learning). Despite its importance, how knowledge is organized across individuals and how this structure may change over time is far from understood. Here, we investigated how the brain supports these dynamic processes using EEG concurrently with transcranial direct current stimulation (tDCS) to assess how facilitating or inhibiting activity in the angular gyrus (AG), a region important for integrating semantic information, affects the dynamic restructuring of relationships between concepts in long term memory. Participants first rated relatedness between all pairwise combinations of 20 concepts (N = 190 ratings). During tDCS of 2mA over the left AG, they performed a conceptual combination task requiring them to integrate new information about the same concepts they previously evaluated. Following stimulation, they performed the same relatedness judgments again. Participants received cathodal, anodal, and sham stimulation to AG across 3 counterbalanced sessions. The relatedness judgments before and after stimulation were analyzed using graph theoretical methods to construct semantic memory networks that were compared to test for changes in the structure of conceptual knowledge as a result of the semantic integration task performed under stimulation. The EEG data were analyzed using event-related potential (ERP) methods and showed how these restructuring effects are related to the N400 component, a well-established marker of semantic processing. We discuss the implications of these findings for our understanding of the restructuring of knowledge through the course of experience and its consequences for successful learning and problem solving.

Topic Area: LONG-TERM MEMORY: Semantic

C40 - Evoking Episodic and Semantic Details with Instructional Manipulation in Young and Older Adults

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Older adults tend to describe experiences from their past with fewer episodic details, such as spatiotemporal and contextually specific information, but more non-episodic details, particularly personal semantic knowledge, than younger adults. While the interpretation of the reduced episodic details is transparently interpreted in the context of episodic memory decline typical of aging, the interpretation of the increased production of semantic details is not as straightforward. We modified the widely used Autobiographical Interview (AI) to create a Semantic Autobiographical Interview (SAI) that explicitly targets personal semantic (P-SAI) and general semantic memories (G-SAI) with the aim of better understanding the production of semantic information in aging in relation to instructional manipulation. Older adults produced a higher proportion of off-task utterances (i.e., details not probed by instructions) across all sections of the interview. Specifically, older adults produced more autobiographical facts in the AI, more episodic and general semantic details in the P-SAI, and more self-knowledge in the G-SAI, as compared to young adults. However, older adults also consistently produced more probed autobiographical facts than did young adults on the P-SAI. These findings suggest that the increased production of semantic details in aging reflects a bias in autobiographical recall that goes beyond episodic remembering, as reflected by an age-associated abundance of semantic details across sections of the interview, findings that are not accommodated by accounts of aging and memory emphasizing reduced cognitive control or compensation for episodic memory impairment.

Topic Area: LONG-TERM MEMORY: Semantic

C41 - Using naturalistic celebrity stimuli to probe links between memory, interest and curiosity

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Curiosity is an intrinsic motivational state that shapes information-seeking behaviour. Past work has provided evidence that metacognitive retrieval experiences during unsuccessful memory recall act as a source of state curiosity for the information that could not be recalled. Whether unsuccessful recall is associated with the induction of curiosity for naturalistic stimuli in the domain of knowledge about famous people remains currently unknown. The way in which interindividual differences in interest may influence curiosity for such naturalistic stimuli is an open question as well. We addressed these questions through an experiment that employed Feeling-of-Knowing (FOK) judgements (as a metacognitive marker of experienced closeness to successful recall) for the names of visually presented celebrity faces from different categories of fame, and probed subsequent curiosity through subjective ratings. We show that FOK experiences during unsuccessful recall are positively correlated with subsequently reported curiosity. Moreover, we demonstrate that interindividual differences in interest for the domain in which a celebrity is famous also relates to curiosity. A mixed-effects modelling analysis revealed that FOK experiences during unsuccessful recall and interest are independently associated with the reported curiosity. These results are in line with the notion that curiosity depends on both the identification, and the desire to resolve a salient gap in knowledge. Future work is needed to examine whether the demonstrated links also directly influence the information-seeking behaviour that is characteristic of curiosity in naturalistic settings.

Topic Area: LONG-TERM MEMORY: Semantic

C42 - Can students effectively apply encoding techniques to support learning in person and online?

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Past work has demonstrated that drawing a sketch, compared to other strategies during encoding, improves memory of to-be-remembered information (Wammes, et al., 2016). A large body of evidence has demonstrated that similar brain regions related to motor and perceptual processing are active when observing or performing a representative action, suggesting that mirror neurons in the brain can contribute to learning (Rizzolatti & Craighero, 2004). Here we examined whether an observer's memory for words is improved when watching someone else draw or write to-be-remembered information. Depending on group, participants (n=45 in each) either performed the encoding tasks themselves, observed another person doing the tasks, or watched a video of the tasks being performed in an online learning environment. All participants were shown target words sequentially, along with prompts (intermixed, within-subject) to either silently read, write, or draw a picture of the target. On a later free recall test, participants were given 2-minutes to type all the words they remembered from the encoding phase. For both performers and observers, drawing benefited recall the most. Results suggest that encoding by conceptualizing a drawing is sufficient and beneficial to memory regardless of whether it is performed or observed, in line with past research suggesting that mirror neuron activation can support learning. Importantly, the magnitude of the drawing benefit was greatest when this encoding task was performed rather than observed or watched in a video, suggesting an additional role of personal relevance in enhancing memory. While drawing is always beneficial, performing it maximizes its effectiveness.

Topic Area: LONG-TERM MEMORY: Semantic

C43 - Stimulus Representation in the Interactions Between Multiple Brain Regions

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Cognitive neuroscience research increasingly focuses on how cognitive functions are distributed across multiple brain areas and networks. Yet, studies on how individuals represent stimuli have largely examined neural populations and representation at local levels. The present study considered that stimuli may also be represented in terms of the interactions between multiple regions. For example, consider how age is represented: Analogous to how a voxel may show increased activation when viewing a child as opposed to an adult, a pair of regions may show increased connectivity when viewing a child relative to viewing an adult. To investigate the possibility that some areas of the brain represent stimuli in this distributed fashion, we adapted typical procedures for Representational Similarity Analysis (RSA). Traditional RSA involves isolating regions to examine the links between stimulus features and voxelwise activation patterns. By contrast, we examined groups of regions simultaneously and investigated how stimulus features are linked to the interactions between regions. Applying this strategy within an fMRI study, we demonstrate the existence of distributed stimulus representations and show how examining brain data from this perspective yields particular insights into how the prefrontal cortex represents conceptual features of stimuli. These findings have the potential to open new avenues for understanding how

information is processed and encoded. Accordingly, our study also lays out methodological principles that other researchers can use to investigate this and related phenomena within their own data.

Topic Area: LONG-TERM MEMORY: Semantic

C44 - Past experience changes the trajectory of neural changes following new learning

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The capacity for learning new information is highly contingent upon prior knowledge. Learning about a completely new topic or domain can take considerable time, whereas learning new information that connects with existing knowledge is typically much easier and tends to be more robust. In the brain, these two scenarios may differ in the degree to which cortically-mediated memory structures can be harnessed to support integration of newly-encountered information. Past work suggests that the presence of relevant schemas or abstracted conceptual networks, supported by the neocortex, can speed the process through which new knowledge is acquired. In the present MRI study, we examined this question by comparing microstructural and functional changes following new learning in the domain of visual object identification. A group of expert birdwatchers and matched controls performed an initial bird identification task on unfamiliar species while being scanned. Both groups were then given training on how to differentiate the highly overlapping items for two hours outside the MRI. Post-training task performance showed improvement for trained concepts, with a greater increase in accuracy for experts. In experts, improved learning was also associated with neural changes in visual processing and frontoparietal regions that appeared to support both perceptual and conceptual aspects of rapid learning, including the differentiation of highly similar items and the ability to abstract across variable exemplars of the same concept or category. These findings support theoretical accounts of memory that stress the importance of prior knowledge in determining how new information is integrated into existing knowledge structures.

Topic Area: LONG-TERM MEMORY: Semantic

C45 - The representation and retrieval of general versus specific category knowledge

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Building useful knowledge requires representing both shared and unique features of the elements of our environment (most dogs bark; your friend's dog bites), and we are able to flexibly retrieve the kind of feature most relevant to our current goals (particular caution around your friend's dog). How does the brain accomplish these feats of representation and retrieval? We use high-resolution fMRI to identify how shared and unique features are represented after category learning and during different memory-based decisions. Participants learn categories of flowers, where each flower has some petals shared with same-category exemplars and one petal that is unique to that exemplar. We assess how shared and unique petals are neurally represented immediately post-learning as well as during a retrieval task in which participants are cued with a category or exemplar label and indicate whether a flower presented at a delay matches the label. Data collection is ongoing (N = 23 of 30), with preliminary analyses suggesting that distinct regions are recruited during successful retrieval of category information (anterior hippocampus, medial prefrontal cortex) versus exemplar information (lateral parietal cortex). These findings are consistent with recent work uncovering prototype and exemplar representations in these networks (Bowman et al., 2020, eLife). Additional analyses will characterize the representational similarity of both item and feature-level representations, and how these representations are recruited during retrieval processes at different levels of abstraction. The approach will help us better understand how the brain builds knowledge structures that support flexible memory-based decisions.

Topic Area: LONG-TERM MEMORY: Semantic

C46 - Get a grip: Seeing objects activates grip representations automatically and quickly

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Humans live in a world of meaningful objects, which we categorize in the service of action. Understanding the neural processes involved in object categorization is an important step towards understanding the relationship between the brain and behaviour. Neurocognitive models from the framework of grounded and embodied cognition suggest that reuse of motor information associated with objects use partially constitutes our categorization abilities. To investigate this question, we applied spatiotemporal representational similarity analysis (RSA) to electroencephalographic (EEG) responses from the publicly available THINGS database in which participants passively viewed over 20,000 pictured objects in rapid serial visual presentation. This technique allows us to characterize the representational geometry of neural activity recorded from the scalp across time. Using this technique, we decoded grasp information, captured by ratings of object graspability, for a brief period starting at about 200 ms after the presentation of the object. This provides support for the notion that object categorization is constituted, in part, by the motor information associated with object use, and shows that such activation occurs automatically and quickly in the presence of objects of the world.

Topic Area: LONG-TERM MEMORY: Semantic

C47 - Are objects oriented towards your dominant hand easier to recognize?

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Previous research demonstrated that conceptual knowledge of manipulable objects is partially grounded in the motor system. For instance, explicitly retrieving knowledge about how a manipulable object is interacted with (e.g., pinched or clenched?) is easier for right handed people if the object is oriented so that it more easily affords grasping with the right hand (Chrysikou et al., 2017). We tested if motor experience through handedness also influences participants' abilities to name objects that are commonly grasped with their dominant hand. Participants were asked to name images of graspable objects whose handles were oriented toward either their left or right hand. In a preliminary study, right handers (n=27) were faster to name images of graspable objects oriented toward their dominant hand, whereas the orientation of non-graspable control images (animals) did not influence naming latency. While only two left handers were tested, they showed a (n.s.) complementary pattern. This shows that motor experiences and/or action tendencies influence object identification for manipulable objects, suggesting not only that conceptual knowledge of graspable objects includes activation of motor features, but also that this activation contributes to their recognition. This supports grounded models of semantic memory. Ongoing work will attempt to replicate this relationship between orientation and handedness for right handers while also examining left handers and exploring whether individual differences in motor imagery may modulate the effects.

Topic Area: LONG-TERM MEMORY: Semantic

C48 - Factors that lead to the continued influence effect of misinformation: how can we effectively encode corrections?

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The continued influence effect (CIE) occurs when retracted information exerts an unwanted influence on decision making. The integration account proposes that ineffective integration of corrections during encoding leads to increased susceptibility to misinformation. However, the specific encoding processes underlying effective integration remain unclear. In our study, participants learned about an effect (e.g. fire) and its cause (e.g. arson), and encountered corrections or confirmations of the cause. They were then tested on the veracity of the causes across two days. We hypothesized that response time when retrieving the veracity of misinformation would reflect integration strength. Indeed, behavioral results showed that faster response times during veracity judgement on day 1 were associated with reduced CIE on day 2 ($F(1,50) = 39.99$, $p < .001$). Corrections elicited a larger frontal slow wave than confirmations ($F(1,49) = 4.58$, $p = .037$), suggesting that associative encoding played a larger role in the integration of correction and misinformation. Increased P300 amplitude when learning about the effect was associated with fast response times and reduced CIE ($F(2,92) = 4.29$, $p = .017$), highlighting the importance of detailed encoding of an event on effective misinformation correction. Results from the current study provide evidence

that false tags are effortfully appended to misinformation through associative processing. Focusing on creating associative links between misinformation and its correction can be an effective way to combat the CIE.

Topic Area: LONG-TERM MEMORY: Semantic

C49 - Exploring Knowledge Integration: Insights from Angular Gyrus (AG) and Ventrolateral Prefrontal Cortex (vlPFC) HD-tDCS

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Semantic knowledge refers to one's store of facts and information, which can be acquired through direct experiences or inferred from knowledge encountered across episodes. Self-derivation through integration is a form of semantic knowledge acquisition involving the generation of novel insights by connecting distinct yet relevant pieces of information. The prefrontal and parietal cortices have been shown to contribute to semantic integration, but the causal role of each region remains unknown. This study sought to uncover the specific causal roles of the AG and vlPFC during semantic integration using High-Definition Transcranial Direct Current Stimulation (HD-tDCS). Anodal or sham HD-tDCS was applied to the left AG or the left vlPFC before participants engaged in semantic self-derivation (Varga and Bauer, 2017). Participants read sentences that could be integrated to derive novel facts, and were later tested on their knowledge of these facts. Additionally, participants' IQ was assessed using WASI-II. The preliminary results revealed a distinct relationship between participants' integration ability, IQ, and stimulation condition. Specifically, a significant correlation between participants' IQ and integration abilities was identified. Interestingly, there was an interaction between IQ-integration correlation and stimulation condition, such that a strong correlation was present in both conditions for AG participants but was only present in the sham group and absent in the stimulation group for vlPFC participants. This study revealed an intricate relationship between IQ and the neural substrates of semantic integration, suggesting the extent of contribution of AG and vlPFC to semantic integration may depend on participants' overall reasoning ability.

Topic Area: LONG-TERM MEMORY: Semantic

C50 - Interrogating brain engagement as a function of exception learning performance

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Navigating a dynamic environment requires a balance of efficiency and adaptability. Category learning, the process of generalizing past knowledge to novel experiences, is an integral part of efficient learning. However, what happens when the learner encounters "exceptions" that violate what has already been learned? Here we explore learning-related activation in the brain during rule-plus-exception learning. Participants (N = 41) underwent fMRI scanning during a category learning task. Stimuli were cartoon flower images sorted into two categories according to a rule-plus-exception structure. Notably, exceptions were introduced later in learning, after participants had become familiar with category prototypes and rule-following stimuli. Participants were divided into "high" and "low" performance groups based on the median split of end-of-learning exception categorization performance. When exceptions were introduced, we found higher activation in hippocampus for all stimulus types that was associated with improved exception learning. In medial prefrontal cortex (MPFC), engagement differed for prototype versus exception stimuli, with higher activation in high versus low learners specific to prototype stimuli; the opposite effect occurred for exception stimuli. A stimulus-specific effect was also found in parietal regions: better exception learning performance was associated with increased activation to exceptions but decreased activation to prototypes. These findings are consistent with theoretical accounts of these regions' roles in learning. Hippocampus plays a broad role in integrating rule-violating information, whereas MPFC and parietal regions respectively engage to encode regularities and details. The complementary role of these regions enables the learner to successfully integrate exceptional information while preserving existing knowledge.

Topic Area: LONG-TERM MEMORY: Semantic

C51 - Transient semantic memory retrieval failures: Factors associated with the tip-of-the-tongue phenomenon

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The tip-of-the-tongue (ToT) phenomenon is a transient memory retrieval failure that can affect almost everybody. Since Brown and McNeils (1966) seminal study, ToTs have been examined experimentally through various paradigms and stimuli. However, there is still much that is uncertain regarding what can lead to ToTs. To this end, we sought to examine whether different mnemonic factors (i.e., age of acquisition, frequency of retrieval and recency of last encounter) impact the retrieval of two semantic categories: famous faces and famous places. In total, 80 young adults participated in this study, each of whom completed a self-paced experiment for both the famous faces and famous places. The participants were required to make a judgement on whether they knew the name, were in a ToT state, the image was familiar or if the name was not known. Following the known and ToT judgements, participants completed a recognition stage, as well as questions examining each of the mnemonic factors. For both faces and places, a positive age by known judgement correlation was identified. Furthermore, by computing logistic regressions for each of the mnemonic factors, it was found that later acquired names, a lower frequency of retrieval, and less recently encountered names, all predicted an increase in ToT occurrences. These results demonstrated a similar pattern for both faces and places, with places being stronger predictors for each factor. By examining these factors simultaneously across two different semantic categories, we provide further evidence regarding the factors influencing semantic retrieval failures.

Topic Area: LONG-TERM MEMORY: Semantic

C52 - Recent statistics shift object representations in parahippocampal cortex

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There is a stability vs. plasticity trade-off within our semantic system. Our representations need to be stable enough to support our general knowledge of the world but flexible enough to incorporate new information as our environment changes. How does the human brain manage this trade-off? We analyzed the Natural Scenes Dataset in which eight participants viewed thousands of scenes across 30 fMRI sessions. An encoding model learned voxel-wise responses to each of 80 object categories that appeared in the scenes (e.g., giraffe, umbrella) and estimated multivoxel patterns for these objects within each session. We found that multivoxel pattern similarities matched the semantic similarities of a word embedding model across areas in the medial temporal lobe (MTL) and high order visual areas. Within the MTL areas containing semantic representations, only in parahippocampal cortex (PHC) were these representations sensitive to recent co-occurrence statistics in the scenes: the ways that objects appeared together in the first half of a session influenced neural pattern similarity in the second half of the session. Greater mismatch between recent and long-term statistics predicted more change in PHC. We also saw evidence of representational drift in PHC at a longer timescale, across sessions. These results demonstrate that while some regions of the brain encode stable visual object semantics, PHC exhibits higher plasticity, with semantic representations constantly tweaked by the statistics of the recent environment.

Topic Area: LONG-TERM MEMORY: Semantic

C53 - An edge-centric approach to discerning the neural networks underlying event script processing

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Every day, we rely on our schematic event scripts to interpret and predict the flow of our experiences. Many brain regions have been shown to contribute to event script processing, but the underlying functional networks have not yet been disentangled. Here, we aimed to discern the neural networks that engage in script processing by examining how deviations from real-world scripts alter functional connectivity in the brain. Leveraging an edge-centric functional connectivity approach, we clustered pairs of brain regions into communities associated with video viewing. These communities

encompassed regions from the hippocampus, the default mode network (DMN), and the ventral visual stream (VVS). We then inspected the connectivity of each community using the fMRI data from Baldassano et al. (2018), in which individuals viewed videos that either adhered to naturalistic event scripts (intact condition) or deviated from these scripts (scrambled condition). We found that communities involving the hippocampus, DMN, and VVS showed higher connectivity at video event boundaries in the scrambled condition compared to the intact condition, which suggests that these communities are responsive to the adherence to real-world scripts. Moreover, as individuals' exposure to scrambled videos increased, the difference in functional connectivity between intact and scrambled conditions diminished, particularly in neural communities involving DMN. This finding indicates that the functional connectivity of DMN can adapt to deviations from event scripts through repeated exposure. In conclusion, our results reveal flexible functional networks that not only engage in real-world script processing but also adapt to experiences diverging from script schemas.

Topic Area: LONG-TERM MEMORY: Semantic

C54 - Semantic Memory and Temporal Discounting

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People vary in the extent to which they devalue future rewards as the delay to receiving them increases (this is known as temporal discounting). It has been proposed that episodic memory abilities contribute to reducing discounting by promoting more future-oriented choices. Episodic memory allows individuals to make more patient choices by creating detailed imaginations of future events. However, future imagination also relies on semantic memory (e.g., schemas). Here we investigated whether episodic memory and/or semantic memory are associated with temporal discounting. We hypothesized that semantic memory is more critical than episodic memory for supporting future-oriented decisions. A sample recruited from Prolific (N=205) completed a Qualtrics survey. Participants first completed an encoding task consisting of 54 words derived from six semantic categories. Following this task, participants did a temporal discounting task in which they made choices between smaller, sooner and larger, later monetary rewards. Then they completed semantic and lexical fluency tasks. Finally, they were tested on their recognition for the words from the encoding task. We found that temporal discounting correlated negatively with semantic fluency ($r = -0.215$, $p = 0.002$), such that better semantic fluency was associated with more future-oriented choice. This result remained even after controlling for lexical fluency, age, gender, education, and socioeconomic status. The hit rate for previously seen words was not associated with temporal discounting, however ($r = -0.022$; $p = 0.757$). Together, these results suggest that semantic memory is a more important contributor to patient choice than episodic memory is.

Topic Area: LONG-TERM MEMORY: Semantic

C55 - The Semantic Level of a Testing Question Influences Subsequent Memory Reactivation

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Our knowledge of a concept can be represented at multiple levels of semantic granularity - from item-specific perceptual features to contextual meaning. Each level has meaningful consequences for whether and how we access memories. In this study, we asked if the granularity through which we reactivate a concept impacts its later retrieval. During fMRI scans, participants learned and retrieved pairs of novel words and visual images of everyday items. After initial encoding, participants actively restudied pairings by answering questions drawing on one of three granularities: item, category, or theme. Finally, participants performed a recognition test of encountered images versus similar lures. To test whether each concept was represented in multiple semantic granularities, their neural representational similarity matrices (RSMs) were tested against model RSMs. Six regions-of-interest (ROIs) showed a significant correspondence between recorded and model RSMs for item and category patterns in the ventral temporal cortex (VT), the bilateral anterior temporal lobe (ATL), the perirhinal cortex, and the visual word form area (VWFA). Testing-induced retrieval through different semantic granularities significantly influenced VT and vlPFC pattern reactivation during subsequent recognition. A Gaussian Naïve Bayes (GNB) classifier was able to distinguish recognition patterns based on their testing history (item, category, theme questions) for remembered and non-remembered concepts in VT, and only remembered trials in VWFA. These findings suggest that the semantic level evoked during testing can influence subsequent memory reactivation.

Topic Area: LONG-TERM MEMORY: Semantic

C56 - Parahippocampal cortex integrates semantic and visual features of object images

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Recognizing objects and understanding how they relate to one another depends on distinctive and integrative coding of semantic and perceptual features. Evidence from prior neuroimaging research in which words were used as stimuli suggests that the semantic and visual features of objects are represented in distinct cortical areas, including lateral occipital cortex (LOC), the temporal pole (TP), and parahippocampal cortex (PHC), and that fully-specified object concepts reflect integrative coding of these features in perirhinal cortex (PRC). It is unclear, however, whether a similar representational landscape will emerge when images are used as stimuli. We asked this question using functional magnetic resonance imaging with healthy young adults. During scanning, participants made semantic and visual judgements about object images in separate task contexts. The stimulus set contained objects that were either visually similar or semantically similar, but not both. We used representational similarity analyses to determine whether the activity evoked by objects were predicted by behavior-based models that captured the semantic and visual similarities among the stimuli. Using this approach, we revealed evidence of visual similarity structure in LOC across both task contexts, which is consistent with our previous results obtained using words as stimuli. Activity in PRC expressed semantic similarity structure in the semantic task context only. Thus, this result diverges from the integrative coding we revealed using object concepts presented as words. Interestingly, PHC showed both semantic and visual similarity structure across task contexts, suggesting that it supports the integration of these different kinds of object features.

Topic Area: LONG-TERM MEMORY: Semantic

C57 - Resting-State Memory Consolidation in Attention Deficit Hyperactivity Disorder

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A brief period of eyes-closed waking rest after learning improves memory. Prior research from our lab suggests that this rest-induced memory improvement is associated with low-frequency electroencephalography (EEG) power. Because Attention Deficit Hyperactivity Disorder (ADHD) has been associated with both memory deficits and differences in resting-state brain activity, this exploratory study aimed to examine declarative memory consolidation across a period of post-learning waking rest in individuals diagnosed with ADHD. Our central hypothesis was that individuals with ADHD would show reduced memory improvement after a period of post-learning waking rest, compared to control participants. N=29 ADHD and N=28 control participants listened to a short story followed by either 15min of waking rest or a 15min distractor task (within-subjects). A recall test was administered immediately afterwards and 24hrs later. EEG was recorded during the rest period, along with EOG (electrooculography) and EMG (electromyography). Compared to controls, individuals with ADHD showed reduced relative delta ($t=2.18$, $p = 0.038$) and theta ($t=2.18$, $p = 0.035$) EEG power during rest, as well as reduced trait mindfulness ($t=4.03$, $p < 0.001$). Our preregistered hypothesis tests showed no memory retention differences between ADHD and control participants. However, when controlling for variability in inattention symptoms, rest improved memory in control participants ($p=.016$) but impaired memory in ADHD participants ($p=.025$). Our findings suggest that individuals with ADHD may differ from controls in both brain and mental activity during rest, and that these differences may be relevant to resting-state memory consolidation.

Topic Area: LONG-TERM MEMORY: Semantic

C58 - Insights from Simultaneous EEG-fMRI and Patient Data Illuminate the Role of the Anterior Medial Temporal Lobe in N400 generation

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The N400, a negative event-related potential (ERP) is known to reflect the processing of semantic information. While scalp recordings have contributed to understanding the psychological processes underlying the N400, they have been limited in identifying its neural basis. However, recent intracranial recordings and fMRI studies have shed light on the role of the anterior medial temporal lobe (AMTL) in semantic processing. To investigate the neural underpinnings of the N400 effect, we simultaneously recorded ERPs and event-related fMRI during a semantic relatedness task in a sample of young, healthy subjects. Additionally, we collected ERPs and structural brain data from older healthy adults and patients with amnestic mild cognitive impairment (aMCI), a population characterized by neurodegenerative changes in the AMTL. In our fMRI results, we identified bilateral loci in the AMTL as the global maxima. Employing an EEG-informed fMRI analysis, we explored trial-to-trial fluctuations in semantic processing by linking single-trial N400 amplitudes to the Blood Oxygen Level Dependent (BOLD) signal. This approach provided the first direct evidence linking the N400 recorded at the scalp level to the corresponding BOLD signal in the AMTL. Consistent with these findings, patients with aMCI exhibited a diminished N400 effect compared to healthy older adults. Furthermore, voxel-based morphometry analysis revealed a correlation between the magnitude of the N400 effect and the integrity of the AMTL. By integrating data from simultaneous EEG-fMRI, and patient studies, our research advances our understanding of the neural substrate of the N400 and highlights the critical involvement of the AMTL in semantic processing.

Topic Area: LONG-TERM MEMORY: Semantic

C59 - Are representations in the hippocampus organized by the emotional content of stimuli? A multivariate analysis of intracranial electrode recordings

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Although long understood to be sparse, episodic, and not organized around the similarity of stimuli or events, recent work suggests that representations in the hippocampus may have important structure. Within-category stimulus correlations among patterns of activity measured with fMRI from subfield CA1 can be significantly larger than between-category correlations (Schapiro et al., 2018; Nature Commun.) and some individual variability in rapid category learning can be explained by white matter integrity in the trisynaptic and monosynaptic hippocampal pathways (Schlichting et al., 2021; Hippocampus). We examined spike rates and local field potentials (LFPs) recorded by intracranial electrodes implanted in the hippocampus, amygdala, anterior cingulate cortex, and prefrontal cortex of 14 epileptic patients while they viewed and evaluated faces expressing positive, negative, or neutral affect. Using regularized logistic regression (elastic net), we attempted to discriminate patterns of activity associated with positive and negative faces within the hippocampus and spanning the four regions with electrodes. After exhaustive computational experimentation, modeling trial-level spike rates as well as the time-varying spectral power of the LFPs, it was not possible to discriminate positive from negative faces in this dataset. However, these null results do not provide tacit support for the conventional view. Instead, we situate these important null findings in a hypothesis space that considers the importance of time for how category structure may influence the hippocampus. In doing so, we discuss the limitations of intracranial recordings (our dataset, and the modality in general) for addressing questions of neurocognitive representation in the brain.

Topic Area: LONG-TERM MEMORY: Semantic

C60 - Predicting conceptual understanding through key information encoding during a STEM lecture

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When students are presented with new concepts during a science lecture, successful understanding relies on effective encoding of individual units of information as well as subsequent integration of these encoded pieces into a unified network that captures their underlying relationships. Using the embedding space of a large language model, a prior study revealed that the semantic network structure of a lecture can predict which units of information are most likely to be recalled, and also which units of information are most indicative of subsequent understanding of the central concepts. These results identify the key time points of a lecture where the information presented is critically predictive of subsequent comprehension of the main concepts of the lecture. In this follow-up fMRI study, participants watched the same video lecture – focused on several Newtonian physics concepts – and subsequently were asked to verbally recall what they remembered and learned from the lesson while still inside the scanner. Focusing on the specific time points where information is presented that most strongly predicts subsequent understanding of the central concepts, we use multivariate neural classification and related analysis methods to characterize the neural patterns associated with encoding of information for successful subsequent conceptual understanding. These findings highlight new approaches for understanding how conceptual understanding is built up over time – such as over the course of a lecture – and reveal new insights about the neural processes underlying this type of abstract knowledge acquisition that is critical for STEM education.

Topic Area: LONG-TERM MEMORY: Semantic

C61 - Thematic relations outperform taxonomic relations in memory retrieval

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Prior knowledge has long been known to influence retention of newly learned information. In particular, known semantic associations across items facilitate subsequent retrieval for these items, and this effect scales with measures of semantic relatedness. In the field of concepts and categories, the processing of taxonomic (e.g., dog-bird) versus thematic (e.g., dog-leash) conceptual relations has been a topic of extensive interest. In Experiment 1 (n = 79), we show that word pairs with thematic relations led to shorter reaction time and better memory performance, followed by taxonomic relations (paired permutation test, two-sided: $p < 0.001$) and finally unrelated pairs ($p < 0.001$). We hypothesized that thematically related words are more quickly and more accurately retrieved because they are more accessible in one's semantic memory. To test this, we designed a follow-up Experiment 2 where participants encode thematically related, taxonomically related, and unrelated word pairs. Participants then complete a forced-choice associative memory test in which they are instructed to determine the paired word for a previously seen word, given three response options which are thematically related, taxonomically related, or unrelated to the cued word (3AFC). Analyses of errors in this experiment will help us understand how accessibility in semantic memory may contribute to episodic retrieval. Next steps will focus on applying transcranial magnetic stimulation (TMS) to brain regions that are thought to be responsible for thematic and taxonomic processing, to evaluate a dual hub account of the neuroanatomical organization of semantic memory (Schwartz et al., 2011).

Topic Area: LONG-TERM MEMORY: Semantic

C62 - A bottom-up approach to finding individual differences in mental representation

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Individual differences in mental representation are often studied by first defining different groups, then assessing whether their representations differ in important ways. We consider a more data-driven approach to discovering representational subgroups without grouping participants beforehand. We employ a triadic judgment task to measure the semantic similarity of a set of DallE-generated faces, places, and objects that systematically vary in five binary attributes per domain (N = 118). For each domain, we computed 5-dimensional item embeddings for each individual, and for the group as a whole. The group embedding reliably encoded all five binary attributes in each domain (e.g. for face images, embeddings reliably differentiated race, perceived gender, age, setting, and time-of-day). To find representational subgroups, we first computed, for all pairs of participants, a representational similarity score by taking the Procrustes similarity of the corresponding individual embeddings. We then clustered individuals based on these similarities. For each distinct cluster of respondents we calculated cluster-level embeddings and assessed what properties these encode. We found subgroups that differ significantly in their conceptual representations of faces, mainly varying in the weight given to the different latent attributes (race, gender, age, context, and time). Fewer distinct groups were observed for representations of places and objects, suggesting that we vary more consistently in how we view the social world over the places we visit and things we use.

Topic Area: LONG-TERM MEMORY: Semantic

C63 - From common to unique: connectivity changes in the anterior temporal lobe in semantic memory linked to semantic retrieval ability.

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Retrieval of semantic knowledge about unique entities relies on a network of regions with a key hub proposed in the left anterior temporal lobe (ATL). Individuals with left temporal lobe epilepsy (L-TLE) are impaired at proper name retrieval, but the interaction of this ATL hub with other regions in the semantic network and how differences in connectivity might relate to behavior remain open questions. To address them, we recruited a sample of 25 L-TLE patients and 17 healthy controls. In an MRI scanner, participants performed a semantic decision task where they were presented with a cue (e.g., Albert Einstein) and two target words (e.g., Physics and Biology) and had to select which target was more related to the cue. Some trials involved common nouns as the cue instead. L-TLE patients had more difficulty with unique entities but were like controls on all the connectivity measures. All participants showed increased functional connectivity between the left ATL and the left medial prefrontal cortex (MPFC) during proper noun retrieval. Increased connectivity between these two regions was also associated with slower performance during the proper trials but not the common. We previously showed increased activation of the left ATL and MPFC during retrieval of information about unique entities and here we demonstrate their interactivity is also enhanced. This suggests a different engagement of the semantic network that may reflect personal significance of proper nouns. However, an increased reliance on personally relevant information might also lead to slower performance on the task.

Topic Area: LONG-TERM MEMORY: Semantic

C64 - Investigating the representational modality of dimensional concepts

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Conceptual representation, or the way in which the brain renders any given idea or object, has implications for nearly all aspects of perception and cognition. As a result, there are many theories about how and where concepts are represented, largely based on the usage of categorically defined stimuli (e.g., A vs. B, cats vs. dogs). Dimensional, continuous concepts, which contain no inherent bounds, are often adapted to fit within categorical paradigms (e.g., a concept such as "weight" may be transformed into "light" vs. "heavy"). However, these substitutions may not capture the scalar, relative properties that the original dimensional concept may have contained. The present study seeks to retain the scalar nature of three different dimensional concepts (aspect ratio, weight, and price) and to compare their neural representations to those expected by prior theories of conceptual representation. Five rectangular objects (a lighter, deodorant stick, battery, wallet, and smart TV remote) were organized on scales of each of the three dimensional concepts, such that the scales did not correlate with one another above a threshold of r > .30. Twenty participants will judge the five object images, and object names, during a 1-back comparison task for each dimensional concept, within a 3x2 block design (Aspect Ratio, Weight, Price; Object Images, Object Names) and while undergoing a simultaneous fMRI-EEG scan. We will use whole-brain searchlight representational similarity analysis (RSA) and EEG RSA methods to determine where and when each concept is represented, relative to what a selection of prior theories would predict.

Topic Area: LONG-TERM MEMORY: Semantic

C65 - Different learning processes for response accuracy and precision in implicit perceptual-motor sequence learning

Ziyan Y. Han[1], Paul Reber[1]; [1]Northwestern University

We hypothesize that skilled expertise in sequential motor movements depends on both the basal ganglia for action order and the cerebellum for increasingly precisely timed responses. We used the Serial Interception Sequence Learning task to examine implicit perceptual-motor sequence learning, measuring both response accuracy and timing precision during learning. Participants were asked to make precisely timed responses to cues that followed a covert 12-item sequence with an embedded timing rhythm. Participants completed 4 blocks of practice with the trained sequence during which 20% of trials were interspersed non-repeating foil segments. After training, participants completed a test with 2 blocks of consistently repeating sequences equally balanced between the trained and two novel foil sequences. Sequence learning gradually developed during practice as seen by an increasing difference in accuracy between the trained sequence and occasional foil segments. Increased accuracy was observed for the trained sequence during test as well. However, the fine precision of correct responses exhibited a different pattern. During training, precision was lower for the foil segments almost immediately. But at test, precision declined at the beginning of each repeating sequence block regardless of whether it was practiced. Precision of the correct responses appears to be sensitive to whether the current sequence is a repetition of the prior sequence, implying a very rapid short-term learning effect quite different from the gradual increase in accuracy that occurs over hundreds of repetitions. The difference in learning timescale may reflect separate contributions of the basal ganglia and the cerebellum to sequential motor learning.

Topic Area: LONG-TERM MEMORY: Skill Learning

C66 - Do procedural and declarative category learning form distinct or shared representations? An fMRI-RSA study

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Studies on interactions between procedural and declarative learning have focused on largely on competition during encoding, consolidation, or use (retrieval). Less attention has been paid to interactions between the representations created by each system. In a behavioral study, we demonstrated that information from both declarative and procedural learning can contribute to response selection. Participants were instructed to use a completely diagnostic, verbalizable, shape-based rule to categorize exemplars and received feedback after each trial. However, the categories also differed probabilistically in their color distributions. Participants used both color (learned procedurally) and shape (learned declaratively) to categorize exemplars, making faster responses to stimuli that were congruent with training color distributions compared to incongruent (2.98s vs 3.28s, respectively, t = 3.16**). Debriefing confirmed participants were unaware of the color distributions. This result suggests that both the color (procedural) and shape (declarative) information contributed to response selection. We now ask whether procedural and declarative learning contribute to a shared representation of the stimulus space, or whether there are distinct procedurally-learned and declaratively-learned representations that jointly contribute to response selection. In the current study, participants performed the same categorization task while fMRI data was acquired. Preliminary univariate analysis reveals greater activation in a fronto-parietal network (including inferior frontal gyrus, ventro-medial frontal gyrus, and inferior parietal lobule), as well as striatal areas, to incongruent than congruent stimuli. Ongoing fMRI representational similarity analysis will allow us to determine whether information is shared between systems at the level of stimulus space representation, or only later at response selection.

Topic Area: LONG-TERM MEMORY: Skill Learning

C67 - Hippocampal ripples during offline periods predict motor sequence learning.

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How does the human brain acquire complex motor skills? Recent studies have revealed that offline rest periods are critical for motor skill learning and implicated the hippocampus in this process. In the declarative memory domain, a key mechanism for offline memory consolidation is the repeated reactivation of neural representations associated with an experience, driven by hippocampal sharp-wave ripples. However, no motor memory studies have recorded directly from hippocampus and therefore the roles of ripples on motor memory remains unknown. Here, we tested the prediction that hippocampal ripples during offline periods contribute to human motor skill learning. Eighteen participants (9 male; age: 31.3 ± 10.16 years) undergoing invasive monitoring for epilepsy surgery performed a standard motor sequence learning task. Specifically, participants were asked to tap a keypress sequence (i.e., 41324) as quickly as possible using their non-dominant hand, in 30-sec blocks interleaved with 30-sec rest periods. We detected hippocampal ripples across the recording session on hippocampal bipolar channels. All statistical tests were performed using linear-mixed effects models in R. Participants showed significant improvement in tapping speed across training ($p < .0001$). Ripple rates increased during rest compared to active tapping periods ($p <$

.0001). Furthermore, ripple rates during rest increased across training (p = .0329). Finally, ripple rates during rest predicted tapping speed on the subsequent learning block (p = .0122). In sum, increased hippocampal ripples during offline periods may play a functional role in motor skill learning, suggesting the involvement of hippocampus in memory consolidation beyond the declarative memory domain.

Topic Area: LONG-TERM MEMORY: Skill Learning

C68 - Micro-consolidation occurs during implicit motor sequence learning, but is not influenced by exercise

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Consolidation is a key process of strengthening new memories to reduce interference after learning new skills, and has typically been investigated over a period of hours to days following practice. However, micro-consolidation, a phenomenon recently discovered during the brief rest periods within practice sessions, appears to be a key process in early motor skill learning of explicit sequences. We investigated if micro-consolidation generalises to implicit motor sequence learning, as implicit and explicit sequence learning are known to rely on overlapping, yet distinct neural networks. In a sample of 38, right-handed, healthy, young adults, utilising an undisclosed 12-item repeating sequence serial reaction time task, we demonstrate that micro-consolidation occurs in the absence of explicit sequence awareness. We also investigated the effect of a preceding 20-minute bout of high-intensity exercise on micro-consolidation, as exercise is known to augment the consolidation of new motor skills. At this acute timescale, micro-consolidation was not modified by a proceeding bout of high intensity exercise. Overall, our findings suggest that micro-consolidation is a general feature of early sequence learning that does not necessitate explicit awareness. Additionally, our results indicate that exercise is unlikely to impact consolidation on the micro timescale when there is close temporal proximity to the task.

Topic Area: LONG-TERM MEMORY: Skill Learning

C69 - Smart segmentation supports transfer learning

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We are faster in making sense of and learning new challenges when we have accomplished a similar challenge before. Speeded learning based on previous experience, transfer learning, is thought to depend upon the identification of a stable task structure. However, many common tasks contain a hierarchical or nested stable structure, in which subtasks vary in behavioral relevance, and the extent to which transfer learning mechanisms represent nested stable task structures is currently unknown. We tested the learning and memory behavior of healthy adults and examined learning of a fixed sequence of tasks where some subtasks acted as distractors and other subtasks determined the outcome of successful navigation to a goal. The relationship between subsequent memory of subtasks and reaction time during learning, together with computational modeling of learning and segmentation, revealed that participants who demonstrated transfer learning adopted a smart task segmentation strategy including the separation of distracting subtasks. This research was supported by the National Institute of Health, National Institute of Mental Health, K99MH120048-01 (A.J.), the National Institute of Neurological Disorders and Stroke NS21135 (RTK), and Brain Initiative, 1U19NS107609 (E.A.B.).

Topic Area: LONG-TERM MEMORY: Skill Learning

C70 - Reactivation of motor memory by passive finger movements with robotic hand exoskeleton

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Motor learning evolves beyond the period of training on a skill. Key to this evolution is reactivation, which destabilizes once-consolidated motor memory, thus enabling further refinement of skills through reconsolidation. Here, an important question arises: what triggers this reactivation? While reactivation has traditionally been assumed to occur by re-experiencing the same context as in training, no two experiences are exactly alike in our uncertain world. Consequently, the context involved in reactivation (e.g., motor command, somatosensory feedback, visual input) inevitably differs from that in training. This difference demands the brain to make concessions on the contexts necessary for effective reactivation. However, excessive concessions could admit reactivation under contexts unrelated to the original training, leading to potential overwriting or disruption of the memory. To examine how the brain resolves this plasticity-stability dilemma in reactivation, we conducted finger movement learning experiments that systematically manipulated the context for reactivation. Notably, we introduced a 'passive condition' where participants, using a robotic hand exoskeleton, re-experienced the somatosensory feedback and visual inputs in the absence of motor commands. This passive condition resulted in a performance gain comparable to the condition involving all three components. The performance gain was still observed when participants performed a cognitively demanding task while experiencing the somatosensory feedback, suggesting that somatosensory feedback alone can trigger reactivation. In contrast, visual inputs alone did not yield such gain. These results imply that the brain primarily relies on somatosensory feedback related to motor actions during training to resolve the plasticity-stability dilemma in reactivating motor memory.

Topic Area: LONG-TERM MEMORY: Skill Learning

C71 - Implicit sequence learning does not generalize even after multiple sessions and days

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Expertly skilled performance typically involves generalized knowledge across the domain of expertise, yet laboratory studies of learning through practice have frequently shown highly specific and inflexible learning. Here we considered the hypothesis that training over multiple days with interleaved sleep may foster more flexible representations supporting implicit learning. Participants (N=33) practiced a covertly-embedded, 12-item repeating sequence by making precisely-timed keypresses according to moving visual cues. In addition, the timing between cues followed a consistent pattern, creating a practiced sequential rhythm. Participants completed 72 sequence repetitions within a 1-hour session with tests of both sequence knowledge and transfer to the same cue sequence with the inverted timing rhythm. Two additional sessions were completed on subsequent days (23.9±0.57/48.0±0.70 hours later) that included a pre-test, additional training, and a post-test, resulting in a total of 216 repetitions of the practiced sequence over three days, and five tests of sequence knowledge and transfer. As in our previous studies, participants exhibited robust sequence-specific learning that increased with additional practice, but consistently showed little to no transfer to the same sequence with inverted timing rhythm. Extended, multi-day training with periods of interleaved sleep still did not produce knowledge representations sufficient to generalize to a slightly different training context. We speculate that the hyper-specificity of our laboratory-based learning might limit generalization due to the consistency of the cued responses, which presents a different practice experience than the natural course of self-directed practice, which is more likely to incorporate substantial variability in repeated performance.

Topic Area: LONG-TERM MEMORY: Skill Learning

C72 - In the zone: Enhanced motor sequential performance in a perceptual-motor skill learning task parallels higher flow ratings

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Flow states are a self-reported elevated cognitive state associated with enhanced skill performance. The present study uses an implicit perceptual-motor sequence learning paradigm to determine if flow ratings relate to task performance measures. In two experiments, participants made precisely-timed motor responses to falling targets presented in a covertly-embedded repeating sequence. Task difficulty is controlled adaptively to each participant's performance level by adjusting the overall task speed. We aimed to enhance the likelihood of entering a "flow state" by setting the task speed to a relatively high accuracy rate and offering consistent sequence repetitions without any untrained target segments. In Experiment 1 (n = 27), participants completed 7 blocks of training (1 block = 420 targets) while providing ratings of their flow state and perceived difficulty after each block. Self-ratings of flow over time were correlated within

each participant with accuracy and the average correlation across participants (Fisher transformed) found that these were reliably greater than zero. A similar analysis with difficulty ratings did not observe a reliable relationship. In Experiment 2 (n = 54), participants completed 4 training blocks in which untrained target segments made up 20% of each block and flow ratings were again provided after each block. Flow ratings across blocks were again found to correlate with accuracy but did not reliably correlate with difficulty ratings. We conclude that even in the first hour of practice with a novel, implicitly learned perceptual-motor sequence, participants begin to experience at least the beginning of flow states when task accuracy improves.

Topic Area: LONG-TERM MEMORY: Skill Learning

C73 - Exploring the Role of Interoception and Interoceptive Brain Regions in Episodic Memory Across the Adult Lifespan: An fMRI Study

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Interoception—the sensation and interpretation of inner body status— has been known to play a critical role in various cognitive functions. However, its impact on episodic memory and age-related memory impairment remains unclear. Regarding neural mechanisms, the anterior insula cortex (AIC) and anterior cingulate cortex (ACC) have been known as a neural network integrating interoceptive and cognitive information, yet their role in episodic memory remains unexplored. In this study, to bridge this gap in knowledge, we aim to examine the role of interoception and interoceptive brain regions in episodic memory across adult lifespan by conducting an fMRI experiment. In the fMRI experiment, participants aged 18-79 engaged in an image encoding task under two different conditions: Interoceptive-orienting (IO) and Exteroceptive-orienting (EO) conditions. In IO, they rated images based on heart-sensation intensity, while in EO, they rated based on the size of main subject. A week later, recognition memory was measured. Our findings showed superior subsequent memory in IO condition compared to EO, regardless of age. Preliminary fMRI data reveal greater activation in the AIC and ACC during successful IO encoding then EO. Moreover, we found stronger functional connectivity between these interoceptive regions and the hippocampus during IO than EO, which indicates the interaction between interoceptive network and hippocampus can be a supporting mechanism of role of interoception on episodic memory. These results proposed that interoception may play a crucial role in supporting episodic memory remains across the adult lifespan. This finding shed light on the development of interoception-based interventions to enhance memory.

Topic Area: LONG-TERM MEMORY: Development & aging

C74 - Comparing neural activity of younger and older adults using mobile electroencephalography during mobility in an indoor real-world environment

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Neurocognitive inputs are required for safe mobility and navigation through the environment. Mobile neuroimaging has made it possible to observe brain activity outside of standard laboratory environments while participants are in motion. Yet, few studies have explored the portability of these devices in a true real-world environment without a specific task imposed on participants (e.g., dual task, motor demands). Therefore, our research utilizes mobile electroencephalography to examine and compare neural activity during sitting and walking in laboratory and real-world environments across younger (n=40) and older adults with and without a falls history (n=36). In younger adults, statistical analyses demonstrated significant differences in mean theta, alpha, and beta band power (μV2) across the four conditions. Overall, we observed increased brain activation for walking compared to sitting, and for real-world walking compared to laboratory walking. Preliminary findings suggest that elicited band power may differ across younger and older adults, and older adults with and without mobility impairments. Our findings expand current knowledge on brain function, human mobility, and fall risk using real-world methods and technology. As our findings suggest that mobility and environmental factors may modulate neural activity, we highlight the potential and importance for real-world methods to supplement standard research practices to increase the ecological validity of studies conducted across the scientific community.

Topic Area: METHODS: Neuroimaging

C75 - Brain-behavior associations of cognitive skills and cortical structures in developing populations influenced by musical experience

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The cognitive benefits associated with learning to play an instrument include enhanced skills related to language, executive functioning, and musical processing [2, 1, 3, 4]. Furthermore, cross-sectional studies have also noted structural changes in musicians' brains along the cerebellum, temporal, parietal and frontal regions [5]. However, longitudinal studies can further explore the trajectories of potential associations between structural brain changes and performance of cognitive skills. The current study is a follow-up to a study that examined performance-based differences and structural differences exclusively in groups of child participants. In the current study, behavioral and structural data from the Pediatric Longitudinal Imaging Neurocognition and Genetics study (PLING), (n = 68, ages: 5-12 years) was collected and analyzed. The goal is to analyze the changes in brain-behavior associations of cognitive skills and cortical structures in developing populations during three years. A subgroup of participants learned to play an instrument as part of the study on Studying the Influence Music Practice Has On Neurodevelopment in Youth (SIMPHONY), (n = 23, ages: 5-12 years). Preliminary results demonstrate higher cortical volume levels of the left Cerebellum associated with a higher performance in language measures of phonological awareness, reading accuracy and syntactic processing in participants with a musical background. The pattern then inverses around the third time point. The current conclusion is that participants without a musical background appear to experience a "catching-up" growth during the third time point. Ongoing analyses will test additional associations in the temporal, parietal, and frontal regions.

Topic Area: METHODS: Neuroimaging

C76 - Systematically investigating sustained activity estimates of cognitive control processes in mixed blocked/event-related fMRI designs

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Mixed -block/event-related fMRI designs have unique advantages for studying the neural mechanisms of cognition, in that they enable separation of sustained activation signals (i.e., persisting across trials) from those that are transient (i.e., event-related). Prior work has suggested that sustained activation patterns reflect the presence of cognitive control processes (e.g., task-set / goal maintenance) in fronto-parietal and cingulo-opercular brain networks. Nevertheless, the mixed design has been infrequently deployed in cognitive neuroscience studies, due its additional design and analysis constraints. Consequently, psychometric and reliability assessments of sustained activation estimates (i.e., compared with event-related) are lacking. Here, we conducted a systematic investigation of this type, capitalizing on data from the Dual Mechanisms of Cognitive Control (DMCC) project, a large-sample (N>100) fMRI study, in which mixed designs were utilized to estimate brain activity while each participant performed a battery of 4 different cognitive control tasks (AX-CPT, Cued Task-Switching, Stroop, Sternberg WM) in each of 3 conditions (Baseline, Proactive, Reactive). Extending and confirming claims made in the prior work, effect sizes were found to be small (~0.2) for sustained activation and were significantly less than event-related effects. Nevertheless, sustained activation patterns were consistent across tasks and strongest in cingulo-opercular and prefrontal regions, replicating prior findings. Individual differences in sustained activity were not highly reliable across tasks within these regions, but cross-task correlations were similar in magnitude to those for event-related activity. Additional analyses of sustained activity, focusing on test-retest reliability and twin-similarity are warranted and possible, by capitalizing on other unique DMCC dataset features.

Topic Area: METHODS: Neuroimaging

C77 - The role of sex-steroid hormones and brain volume variation in aging

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Introduction: Aging affects males and females differently, as indicated by differences in lifespan, disease occurrence, and prevalence. Particularly, older females are at a

heightened risk of Alzheimer's disease, possibly associated with hormonal fluctuations during menopause. Our hypothesis suggests that sex hormones (17ß-estradiol (E), progesterone (P), and testosterone (T)) may predict alterations in imaging biomarkers, specifically hippocampal volume (HV), which could be indicative of dementia. Methods: 128 individuals, consisting of 38 in early middle age (41±4.7 years), 48 in late middle age (58±4 years), and 42 older adults (72±6.3 years), were investigated here. They underwent structural magnetic resonance imaging (MRI) along with a battery of cognitive and motor tasks. Approximately 12 months later, 87 participants underwent a second round of MRI and task assessments. Saliva samples were collected during both visits for the quantification of sex hormones. Results: In our preliminary observations, regression models that considered all subjects indicated a connection between baseline T levels and changes in volume in both the left and right cerebellar cortex. Additionally, baseline P levels were linked to volume alterations in the left hippocampus. Notably, we also identified correlations between changes in E levels and variations in cerebellar cortex volume. Additional analyses will include investigations in males and females separately and will also include behavioral metrics. Conclusion: Our ongoing study offers a unique perspective on the predictive role of sex hormones in brain volume changes over time, providing valuable insights into the intricate mechanisms linking hormonal dynamics to structural brain alterations.

Topic Area: METHODS: Neuroimaging

C78 - Dynamical models reveal anatomically reliable attractor landscapes embedded in functional brain networks

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Analysis of resting state brain networks (RSNs) has generated many insights into cognition. However, the mechanistic underpinnings of resting state dynamics and RSNs are still not well-understood. It remains debated whether resting state activity is best characterized as noise-driven fluctuations around a single stable state, or instead, in terms of a nonlinear dynamical system with nontrivial attractors embedded in the RSNs. Here, we provide evidence for the latter by constructing whole-brain dynamical systems models from individual resting-state fMRI recordings in the Human Connectome Project using the Mesoscale Individualized NeuroDynamic (MINDy) platform. The MINDy models consist of hundreds of neural masses representing brain parcels, connected by fully trainable and individualized weights. The models revealed a diversity of nontrivial attractor landscapes including multiple equilibria and limit cycles. However, when projected into anatomical space, these attractors mapped onto a limited set of canonical RSNs, including default mode network and cognitive control network, which were reliable at the individual level. Further, by creating convex combinations of models, several bifurcations were induced that recapitulated the full spectrum of dynamics found via fitting. These findings suggest that the resting brain traverses a quite diverse set of dynamics, which generates several distinct but anatomically overlapping attractor landscapes. Thus, the spatiotemporal structure of the resting brain may be better captured through neural dynamical modeling and analysis. In ongoing research, we extend MINDy to cognitive task states to reveal task-triggered reconfiguration of whole-brain dynamics, providing a new analysis framework for cognitive neuroscience that connects rest and tasks.

Topic Area: METHODS: Neuroimaging

C79 - Precision data-driven modeling of cortical dynamics reveals idiosyncratic mechanisms underlying canonical oscillations

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Task-free brain activity affords unique insight into the functional structure of brain network dynamics and is a strong marker of individual differences, but has proven difficult to model at fast time-scales. Previous approaches have either used normative models, in which only a small number of parameters need to be estimated, or relied upon statistical characterizations rather than true generative (predictive) modeling. By contrast, in this work, we present a novel optimization framework that makes it possible to directly invert brain-wide models from single-subject recordings. This technique provides a powerful neurocomputational tool for interrogating mechanisms underlying individual brain dynamics (``precision brain models") and make quantitative predictions. We extensively validate the models' performance in forecasting future brain activity and predicting individual variability in key M/EEG markers. Lastly, we demonstrate the power of our technique in resolving individual differences in the generation of alpha and beta-frequency oscillations. We reveal a powerful characterization of subjects based upon models' attractor topology and a dynamical-systems mechanism whereby these topologies generate individual variation in the expression of alpha vs. beta waves.

Topic Area: METHODS: Neuroimaging

C80 - Developmental Trajectory of Inhibition-Related Brain Activation during a Stop-Signal Task in Typically Developing Children

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Adolescence is a period of marked developmental changes in brain and cognitive abilities. One such ability that undergoes maturation during this time, inhibitory control, supports impulse regulation and goal-directed behavior and is implicated in adolescent externalizing psychopathology. However, the typical developmental patterns of regional neurofunction underlying inhibitory control during this critical period remain poorly understood. We longitudinally studied developmental trajectories of brain function associated with inhibitory control in healthy children, beginning at age eight, when they were ascertained by clinicians to be prepubertal, as they progressed through the pubertal transition to age 18. Within the "NIMH Intramural Longitudinal Study of the Endocrine and Neurobiological Events Accompanying Puberty," 557 fMRI scans were collected from 131 healthy children (mean age across longitudinal scans=11.9±2.6 years, 56 girls, 75 boys) while they performed a Stop-Signal task. Data were analyzed across development in a voxel-wise manner using AFNI's 3dMSS tool to perform mixed-effects spline-based modeling, controlling for sex and task performance. Age-related changes in neural activation during response inhibition were found in left insula and right DLPFC (pFDR<0.01). Resulting spline models demonstrated that for both regions, irrespective of sex or task performance, the degree of activation was lowest at age eight and increased through age 18. These data contribute to previous evidence suggesting that brain regions underlying cognitive control show age-related functional changes during adolescence. Future investigations, within this same cohort, will integrate effects of pubertal hormones and the roles of pubertal timing and tempo on inhibitory control-related brain development throughout this dynamic developmental period.

Topic Area: METHODS: Neuroimaging

C81 - Functional activation during an associative memory task and its association with self-efficacy in older adults with memory impairments

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The ability to episodically encode and retrieve information between two items is shown to be hindered on tests of associative memory in older adults with mild cognitive impairment (MCI). Biological and physiological changes, including those observed in brain structure and function, are known to cause age-related memory impairments. Psychosocial factors like self-efficacy, which is the confidence in one's ability to execute actions to meet certain situational or domain-specific demands, may also contribute to memory decline. While previous research has shown that enhancing self-efficacy can improve memory performance, the neural correlates that may explain this relationship remain unclear. Therefore, we developed a six-week self-efficacy intervention to examine its effects on memory and corresponding changes in functional activation in older adults with MCI. Participants (n=28) were randomized to either the intervention to improve self-efficacy for memory or a general education control group. Inclusion criteria for participants were based on standardized testing results, indicative of cognitive decline rather than dementia, and maintained the ability to carry out daily activities independently. For baseline and endpoint assessments, memory performance was measured by an associative memory task in fMRI, while subjective memory beliefs were assessed using the Multifactorial Memory Questionnaire. Multiple linear regression

models were used to examine the differences between groups post-intervention for each outcome measure. Preliminary results revealed an association between functional activation and memory performance in the memory self-efficacy intervention group. These findings help to elucidate the role of psychosocial factors in age-related memory deficits.

Topic Area: METHODS: Neuroimaging

C82 - Neural Circuitry and Therapeutic Targeting of Depressive Symptoms in Schizophrenia Spectrum Disorders

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Conceptual similarities between depressive and negative symptoms complicate biomarker and intervention development.This study employed a data-driven approach to delineate the neural circuitry underlying depressive and negative symptoms in SSDs.Data from three studies: two neuroimaging studies and a randomized repetitive transcranial magnetic stimulation(rTMS) trial were analyzed(n=157) to assess brain-behavior relationships.Partial Least Squares Correlation(PLSC) investigated associations between resting-state functional connectivity and depressive and negative symptoms.Secondary analysis of rTMS trial data(active n=37,sham n=33) were used to assess relationships between PLSC-derived symptom profiles and treatment outcomes.PLSC identified three latent variables(LVs) relating functional brain circuitry with symptom profiles. LV1 related a general depressive symptom factor with positive associations between and within Default Mode Network(DMN), Frontoparietal Network(FPN), and Cingulo-Opercular Network(CON).LV2 related negative symptoms(no depressive symptoms) via negative associations, especially between FPN and CON, but also between DMN with FPN and CON.LV3 related a guilt and early wakening depression factor via negative rather than positive associations to the DMN, FPN, and CON.The secondary visual network had a positive association with general depressive symptoms and negative associations with guilt and negative symptoms.Active(but not sham) rTMS to the bilateral dorsolateral prefrontal cortex(DLPFC) reduced general depressive but not guilt-related or negative symptoms.Our findings clearly differentiate the neural circuitry underlying depressive and negative symptoms, and even segregated across the two-factor structure of depression in SSDs.These findings support divergent neurobiological pathways of depressive symptoms and negative symptoms in people with SSDs.As treatment options are currently limited,rTMS to the bilateral DLPFC is worth exploring further for general depressive symptoms in people with SSDs.

Topic Area: METHODS: Neuroimaging

C83 - Longitudinal iron accumulation in caudate related to changes in frontoparietal control network connectivity and planning ability in older adults

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Cognitive functions attributed to the frontoparietal control network (FPCN) are central to goal-directed behaviors, and these abilities are vulnerable to decline with advancing age. Age-related declines in executive function (EF) have been linked to dopaminergic striatal dysfunction. Elevated striatal iron deposition has been associated with lower cognition, and differences in brain function. 132 older adults at familial risk for AD from PREVENT-AD cohort underwent MRI scanning at baseline and follow-up (mean interval, 2.7y). 81 completed the CBS test battery (Planning, Token Search); 127 completed the TMT and Stroop at each timepoint. QSM maps were reconstructed from a 3D single-echo GRE sequence and QSM value in caudate was then calculated. Multi-echo resting state functional connectivity (RSFC) matrices were initialized to the 200-parcel Schaefer atlas for each participant. Correlation between parcels in FPCN was computed for each timepoint, resulting in 2 X RSFC matrices. Here, we examined the impact of longitudinal iron accumulation in caudate, a core subcortical node of the FPCN, on RSFC changes in the FPCN using behavioral Partial Least Squares, and then examined impact of this multivariate association on changes in EF using linear mixed model. We found that increasing iron content in caudate was significantly associated with longitudinal FPCN RSFC ($p<.05$). Caudate iron - FPCN longitudinal effects were associated with decline in planning ability ($r=.67$, $p<.005$) but not other measures of EF. These findings suggest that iron accumulation may be a driving pathological factor in RSFC changes, and predicts changes in planning ability with advancing age.

Topic Area: METHODS: Neuroimaging

C84 - Heterogeneity in Functional Connectivity: Dimensional Predictors of Individual Variability during Rest and Task fMRI in Psychosis

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Individuals with schizophrenia spectrum disorders (SSD) often demonstrate cognitive impairments, associated with poor functional outcomes. While neurobiological heterogeneity has posed challenges when examining social cognition in SSD, it provides a unique opportunity to explore brain-behavior relationships. We examined the relationship between behavioral data and individual variability of functional connectivity at rest and during an emotional-processing task. Neuroimaging and behavioral data were analyzed for 193 individuals with SSD and 155 controls (total n = 348). Individual variability was quantified through mean correlational distance (MCD) of functional connectivity between participants; MCD was defined as a global 'variability score'. Hierarchical regressions were performed on variability scores derived from resting state and Empathic Accuracy (EA) task functional connectivity data to determine potential predictors (e.g., age, sex, neurocognitive and social cognitive scores) of individual variability. SSD showed greater MCD during rest ($p = 0.00013$) and task ($p = 0.022$). In the hierarchical regression, diagnosis remained significant when social cognition was included during rest ($p = 0.008$), but not during task ($p = 0.50$); social cognition was significant during both rest and task (both $p = 0.01$). Diagnostic differences were more prevalent during unconstrained resting scans, whereas the task pushed participants into a more common pattern which better emphasized transdiagnostic differences in cognitive abilities. Focusing on variability may provide new opportunities for interventions targeting specific cognitive impairments to improve functional outcomes.

Topic Area: METHODS: Neuroimaging

C85 - Migraine modulates neural synchrony during emotionally valenced naturalistic fMRI

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Migraine is a neurological disorder characterized by painful headaches (Szabo et al., 2019). Migraineurs experience hypersensitivities to sensory stimuli due to cortical hyperexcitability, which also produces changes in emotional processing. Functional magnetic resonance imaging (fMRI) studies have found that migraineurs have increased neural activity in the cingulate gyrus and amygdala (Szabo et al., 2019) in response to negative emotional stimuli, however, how migraine impacts emotional processing in daily life remains unknown. Naturalistic stimuli mimic conditions in the "real world" and better represent our lived experience (Sonsukare et al., 2019). To examine differences in neural synchrony between migraineurs and controls in response to emotional naturalistic stimuli, we collected fMRI data from 17 participants with migraine and 26 healthy controls while they viewed three short films intended to elicit different emotions (i.e., positive valence, negative valence, and neutral valence). Intersubject correlation analyses (ISC) were performed for all unique pairs of participants within and between groups, and differences in ISC were calculated using linear mixed effects modelling. While watching the positive and negative films, migraineurs had heightened synchrony

in regions associated with auditory and emotional processing, including the superior temporal gyrus and posterior cingulate cortex. Controls had heightened synchrony in regions associated with visual processing and threat detection, including the lateral occipital cortex and amygdala. This suggests that there are differences in how migraineurs process emotionally charged stimuli and provides a starting point for investigating how migraine impacts emotional processing.

Topic Area: METHODS: Neuroimaging

C86 - Naturalistic audiovisual stimulation reveals characteristic patterns of fMRI synchrony in temporal lobe epilepsy

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In individuals with drug-resistant temporal lobe epilepsy (TLE), chronic seizure activity and neural reorganisation may contribute to consistent functional abnormalities in the brain. To explore the potential of movie-driven functional magnetic resonance imaging (fMRI) to identify such abnormalities, we compared neural synchrony (quantified as inter-subject correlation; ISC) as persons with TLE (n = 16) and approximately demographically matched neurotypical controls (n = 21) watched a suspenseful film clip during fMRI. Results from linear mixed effects modelling revealed significantly higher ISCs in neurotypical controls than persons with TLE across various cortical regions, including the right superior parietal lobule and inferior frontal gyrus, bilateral occipital cortices, and bilateral precuneus. Further, the TLE group exhibited significantly greater synchrony than controls in the bilateral superior temporal gyrus (STG). This was corroborated by a pilot analysis of seizure laterality, whereby both left and right TLE patients showed greater neural synchrony in the right STG compared to controls. Together, these results suggest that TLE patients show functional reorganization of the STG that may be related to altered auditory processing. More broadly, these findings provide evidence of consistent changes in functional activation associated with epilepsy and pave the way for developing models for classifying presurgical TLE patients on the basis of their neural responses to naturalistic stimulation.

Topic Area: METHODS: Neuroimaging

C87 - M1-PMd connectivity modulation via fMRI-neurofeedback

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Neurofeedback (NF) used at rest could serve as a mean to explore the connection between resting state connectivity, task-related connectivity, and task performance. Evidence shows greater M1-PMd connectivity is associated with superior performance in action selection. However, the causal relationship has not been thoroughly examined. Therefore, this study aimed to determine if M1-PMd connectivity could be modulated through covert fMRI-NF during rest, subsequently affecting cognitive-motor function. 20 adults took part in this counterbalanced within-subject double-blind study. Participants were trained covertly with fMRI-NF in two separate conditions to increase and decrease M1-PMd connectivity. The NF training was conducted in a 3T MRI scanner and, as a covert training, participants were just instructed that the higher the feedback bar was, the more money they would earn. No main effect of condition nor run and no condition*run interaction effect was found on M1-PMd connectivity modulation during NF. This hence did not lead to the expected behavioural changes in cognitive-motor function. A positive correlation between reward sensitivity and NF performance in the decrease condition was found. We conclude that the lack of effects found here could be due to ceiling effect of M1-PMd connectivity, and that more training could lead to the desired results.

Topic Area: METHODS: Neuroimaging

C88 - Neurocognitive Implications of Infantile Hydrocephalus: Findings from Functional Connectivity and Behavioural Measures

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Infantile hydrocephalus is characterized by an atypical accumulation of cerebrospinal fluid in the brain, especially in the posterior ventricular horns, diagnosed and treated before the age of 2 years. The direction of ventricular dilatation subjects the periventricular white matter and the posterior cortex to sustained compression and cortical thinning. This posterior affectation prompts an exploration into its effects on visuomotor functions. This study focuses on the impact of infantile hydrocephalus on functional connectivity within the posterior cortex, focusing on the visuomotor integration network, including the inferior frontal occipital fasciculus (visual processing for motor planning), superior longitudinal fasciculus (motor planning processes), and frontal aslant tract (execution of motor skills). By examining the feedback and feedforward methods within the visuomotor integration network, we gained a nuanced understanding of how infantile hydrocephalus disrupts these pathways. Fourteen patients, matched for age and sex with fourteen typically-developing controls, underwent resting-state functional MRI at an average age of 9 years. Results revealed reduced functional connectivity in visuomotor pathways among infantile hydrocephalus patients with pronounced implications for the left and right fusiform gyrus and precuneus. Patients also performed below average in tasks involving visuomotor integration, visual processing, motor coordination, and fine motor manipulation. The concurrent exploration of these domains offers a more holistic perspective on the neural and behavioural aspects of visuomotor integration in children with infantile hydrocephalus.

Topic Area: METHODS: Neuroimaging

C89 - Concurrent brain stimulation and fNIRS to probe human cognitive function

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Objective: Intermittent Theta-Burst Stimulation (iTBS; Huang et al., 2005), an excitatory form of Transcranial Magnetic Stimulation (TMS), is a promising technique for enhancing cognitive performance. However, the mechanisms by which iTBS induces neuroplasticity are poorly understood. In this study, iTBS was applied to the DLPFC to investigate the effects on functional brain activity and cognition across young, middle and older ages. Methods: In two sessions, forty-five healthy adults aged 19 to 73 years received iTBS over the DLPFC corresponding to F3 (left) and F4 (right) in the International 10-20 System for EEG configuration. Participants completed four computerised cognitive tasks, assessing attention, inhibition, sequence learning and working memory performance before and after iTBS. The Artinis OxyMon functional near infra-red spectroscopy system (fNIRS) with a 12-channel optode arrangement was used to record functional activity over the DLPFC at 10Hz throughout both sessions, including during stimulation and cognitive tasks. The reaction time and amplitude of task-related eye-movements were recorded using an Eyelink 1000 Eye Tracker. Results: FNIRS data analysis is ongoing and will investigate the short-term changes in oxygenated, deoxygenated and total hemoglobin concentrations following iTBS within each task. Initial analysis of the data revealed task- and age-related changes in oxygenated haemoglobin (HbO2) levels following iTBS. Conclusions: In this study we will reveal how iTBS over the DLPFC alters functional brain activity to support a beneficial effect on cognitive performance.

Topic Area: METHODS: Neuroimaging

C90 - Social Cognition and Individual Variability as Measured by Fractional Amplitude of Low-Frequency Fluctuation in Autism and Schizophrenia

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We aimed to use fractional amplitude of low-frequency fluctuation (fALFF) in autism and schizophrenia spectrum disorder (ASD and SSD) to explore group differences, individual variability and the relationship with social cognition. fALFF from 440 participants (175 controls, 59 ASD, and 206 SSD) was computed using resting-state functional magnetic resonance imaging as signal power within slow-4 (0.027 – 0.073 Hz) and slow-5 (0.01 – 0.027 Hz), normalized by the power in the remaining frequency spectrum. Mentalizing score was derived from a factor score of multiple higher-order social processing tests. Permutation analysis of linear models were employed to investigate the relationship of cortical fALFF with group, mentalizing, and group x mentalizing interaction. Each participant's average distance of fALFF map to all others was defined as a variability score with higher score indicating less typical maps. Lower slow-4 and slow-5 fALFF in visual and motor regions were found in both SSD and ASD compared to controls. SSD showed differences from controls in insula and medial prefrontal cortex. No significant differences were observed between SSD and ASD. There was a widespread association between slow-4 and slow-5 fALFF values with mentalizing scores, but no mentalizing by group interaction. Further, greater individual variability in fALFF maps was significantly negatively associated with mentalizing scores ($p < 0.0001$). Common pattern of fALFF in ASD and SSD suggests shared neurobiological mechanisms between the two groups with social cognitive deficits in ASD and SSD sharing a common pattern with poor performers in the control group.

Topic Area: METHODS: Neuroimaging

C91 - Navigating cognition: A comparison of resting-state and task-based fMRI localization

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A major challenge to understanding human cognition from neuroimaging studies is that regions involved in higher-order cognition vary highly between individuals. Numerous groups have therefore pursued a precision mapping approach, using localizing data to define functional regions at the individual level. However, which type of localizing data yields the highest precision is unclear. In this study, we compared the ability of resting-state and task-based (3T) fMRI data acquired in 19 subjects to localize individual functional regions in the cerebellum. The cerebellum's tightly packed and highly variable functional regions present a challenge for localization, offering an ideal test case. From the task, data, we constructed task batteries either focused on motor function, language, or working memory (task-specific localizer) or several domains (task-general localizer). We used a hierarchical Bayesian model to adapt a cerebellar group atlas according to the localizer data. We then used these individualized regions to predict functional boundaries in held-out data of the same individual using the Distance-Controlled Boundary Coefficient. Performance was evaluated across the whole cerebellum, and separately for cerebellar motor, action, multiple demand and social regions. In cerebellar motor regions, rest performed worse than task-based localization, whereas for cognitive regions rest and task performed similarly. Across the whole cerebellum, task-general localizers outperformed task-specific localizers, whereas a combination of language and working memory tasks was advantageous for mapping cerebellar social-linguistic regions and multiple demand regions. We believe these findings will be useful in guiding the localization of cerebellar functional regions in future studies of cerebellar cognition.

Topic Area: METHODS: Neuroimaging

C92 - Multivariate transdiagnostic neural biomarkers of Schizophrenia and Autism Spectrum Disorders during the empathic accuracy task

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Schizophrenia (SSD) and Autism Spectrum Disorders (autism) are both characterized by social cognitive deficits, which vary substantially within, but overlap across, diagnoses. In this study, we aimed to identify group-specific and shared brain functional network configurations present during a social processing functional magnetic resonance imaging (fMRI) task. Functional connectivity during the empathic accuracy (EA) task from 411 participants (autism: N=67; SSD: N=174; Controls (HC): N=170) was analyzed by DiSTATIS (i.e., multi-table multidimensional scaling). DiSTATIS extracts a combined latent dimension space characterizing prominent network configurations across participants and enabling comparison between groups in the same space. Bootstrap tests were used to examine network configuration and group differences. Two orthogonal dimensions were identified from DiSTATIS. The first dimension's configuration (explaining 14.98% of the signal) was characterized by differentiation between language (LAN) and default mode versus visual (VIS) and dorsal attention networks (DAN). The second dimension's configuration (explaining 11.97% of the signal) was characterized by differentiation between auditory, somatomotor versus frontoparietal networks. On group-wise comparison, HC showed specific differentiation between VIS and DAN ($p < .05$); autism showed specific differentiation between LAN and ventral-multimodal network ($p < .05$); and SSD showed specific non-differentiation between primary and secondary VIS ($p > .05$). The prominent latent dimensions of the overall EA-related network configuration were similar across groups, with specific configuration of autism in LAN and of SSD in VIS. Future examination of their relationships with cognition and clinical outcomes can reveal potential biomarkers for social cognitive deficits in autism and SSD.

Topic Area: METHODS: Neuroimaging

C93 - Hippocampal subfield volumes correlate with subjective, but not objective, memory in older adults with normal neuropsychological test performance

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Subjective cognitive decline (SCD), defined as perception of memory or cognitive impairment with normal test performance, may be a preclinical stage of Alzheimer's disease (AD). Self-perception of frequency of memory slips correlates with neuroimaging markers of AD including cerebral amyloid deposition and functional connectivity of the hippocampus and posterior default mode network. Here we measured hippocampal subfield volumes in cognitively unimpaired older adults and examined their association with frequency of forgetting and verbal memory. Participants were 51 older adults (23M, age 71.0 SD=6.3) with normal neuropsychological test performance who completed the Memory Functioning Questionnaire (MFQ) and a high-resolution T2-weighted scan of the medial temporal lobe at 3T. The Automatic Segmentation of Hippocampal Subfields (ASHS) processing pipeline was used to extract CA1, CA2, CA3, dentate gyrus, and subiculum volumes. Partial correlations, controlling for age, sex, and intracranial volume, were performed to examine the association between subfield volumes, Frequency of Forgetting and California Verbal Learning Test (CVLT) immediate and long delayed recall scores. Frequency of Forgetting was correlated with left CA2 [r = .42, P =.003] and right subicular volume [r = .45, P =.001], while CVLT measures were not correlated with any hippocampal subfield volume. The associations between subicular volume, a region implicated in AD, and subjective, but not objective memory, suggests that self-perception of frequency of memory lapses in daily life may be sensitive to subtle, early AD-related volumetric changes within the hippocampus. The similar dissociation found for CA2, a region linked to social memory in animal models, is noteworthy.

Topic Area: METHODS: Neuroimaging

C94 - Alterations in resting-state functional connectivity in Charles Bonnet Syndrome

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Charles Bonnet Syndrome (CBS) is a debilitating phenomenon where individuals experience complex visual hallucinations secondary to vision loss, e.g., age-related macular degeneration, and glaucoma. Altered resting-state networks may contribute to the visual hallucinatory manifestations of CBS. Additionally, CBS symptoms may arise from increased glutamatergic and decreased γ-aminobutyric acid (GABA) receptor activity in areas surrounding deafferented cells in visual cortex. The current study examined functional connectivity between resting-state networks and visual cortex

GABA+ and glutamate (Glx) concentrations in CBS. A CBS participant was compared to healthy age-matched controls. A multi-band multi-echo resting-state fMRI sequence and seed-to-target analysis of network connectivity was performed. A MEscher-GArwood Point RESolved Spectroscopy (MEGA-PRESS) sequence was performed with a 25 mm3 voxel placed medially in the visual cortex to quantify GABA+ and Glx concentrations. The CBS participant showed changes in connectivity (both increases and decreases) within the salience network (SN), default mode network (DMN) and visual network (VN). For example, there were decreases in connectivity of the VN with the medial pre-frontal cortex in the DMN; decreases in connectivity with the precuneus in the VN; and decreases in connectivity with the superior temporal gyrus and an increase with the fusiform gyrus within the SN. There was no change in GABA+ or Glx concentrations in V1 between the participant with CBS and controls. Our findings of functional cortical changes but no neurometabolite changes in the CBS participant suggest network level alterations in CBS which could account for the experience of their visual hallucinations.

Topic Area: METHODS: Neuroimaging

C95 - GABA Levels are Significantly Lower in Mild Cognitive Impairment Patients

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Gamma-aminobutyric acid (GABA), the brain's major inhibitory neurotransmitter, has been identified as one factor that might contribute to the functional deterioration and cognitive decline observed in Alzheimer's disease (AD). Animal models of AD have established an important role for GABA and human functional neuroimaging studies have observed hyperexcitability in brain regions associated with cognitive and sensory function in both AD patients and in patients with mild cognitive impairment (MCI), consistent with a disruption of inhibitory GABAergic processing. Furthermore, studies utilizing magnetic resonance spectroscopy (MRS) have observed age-related reductions in GABA in several brain regions in healthy older adults. However, there has yet to be an MRS study comparing GABA levels in MCI patients compared to age-matched healthy older adults. In the present study, we utilized MRS to measure GABA levels in bilateral auditory, sensorimotor, and ventrovisual voxels of interest (VOI) in healthy older adults (n=30) and MCI patients (n=17). Additionally, we applied a tissue correction strategy to control for the dependency of GABA measurements on underlying VOI tissue composition. MCI patients exhibited significantly ($p < .001$) lower levels of GABA in all VOIs except for the left auditory VOI (MCI still exhibited lower levels in this region, but the effect was not significant).

Topic Area: METHODS: Neuroimaging

C96 - White matter sufferance and obsessive symptomatology in post-COVID-19 cognitive dysfunction

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Post-COVID-19 neurocognitive dysfunction afflicts an impressive rate of survivors up to one-year after infection, encompassing difficulties in attention and memory, altogether worsening their psychosocial functioning. Literature suggests they stem from viral-induced brain insult via systemic inflammation, with evidence of demyelinating lesions, abnormal metabolism in wide-ranging areas, and altered functional connectivity. However, neurobiological signature of specific cognitive deficits is still undefined. This study explores the association of white matter (WM) integrity with verbal memory (VM) performance in COVID-19 survivors previously admitted to emergency department six-month after infection. We gathered VM measure through Brief Assessment of Cognition in Schizophrenia (BACS), providing equivalent scores, to distinguish good and poor performer (VM < 2). Obsessive-Compulsive Inventory (OCI-R) was implemented to evaluate potential association of obsessive symptoms with VM. Total WM lesion volumes (TLV) were extracted through the SPM12 toolbox LST. We then compared low-performer survivors (N=11) with the good ones (N=61) in VM task on whole-brain Diffusion Tensor Imaging (DTI) using TBSS (FSL), correcting for age, sex, BMI, and OCI symptoms. Verbal memory scores were significantly lower in previously hospitalized patients ($t=-2.30$, $p=0.02$), and negatively predicted by TLV ($r=-0.36$, $p=0.002$). Additionally, verbal memory performance worsens as obsessive symptoms increase ($r=-2.55$, $p=0.031$). DTI analysis revealed that poor-performers exhibit lower Fractional Anisotropy in several projective and inter-hemispheric fibres while enhanced Radial Diffusivity emerged in overlapping tracts compared to their counterpart. Overall, we suggest WM microstructure as a valid biomarker for long-lasting VM difficulties in COVID-19 survivors, thus informing potential treatment options targeting specific brain damages.

Topic Area: METHODS: Neuroimaging

C97 - Exploring the effect of choroid plexus volume on white matter integrity and cognitive deficits in bipolar and unipolar depression

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Major depressive disorder (MDD) and bipolar disorder (BD) are leading causes of life-long disability. Persistent cognitive impairment even in euthymic phases impacts quality of life. Although both inflammation and white matter (WM) disruption were associated with cognitive impairment in mood disorders, a comprehensive picture of the underlying biological mechanisms is still missing. Given recent results highlighting the enlargement of choroid plexus (ChP) in mood disorders being correlated with peripheral inflammatory markers, we investigated ChP effect on WM integrity and cognitive deficits, exploring a mediation effect of WM on the relationship between ChP enlargement and cognitive deficits. ChP volumes were extracted through Freesurfer (37 depressed-BD, 40 depressed-MDD). DTI analyses (TBSS, FSL) were conducted to explore the association of ChP volumes with WM integrity, accounting for lithium treatment (BD), age, and sex. We evaluated the effect of ChP volume on six cognitive domains, gathered through Brief Assessment of Cognition in Schizophrenia (BACS). Lastly, we tested moderated mediation models setting diagnosis as moderator, extracted DTI measures as mediators, ChP volume as predictor and verbal fluency (VF) as outcome. ChP volume negatively associated with fractional anisotropy and positively with mean diffusivity (only in BD) and radial diffusivity (RD) in a widespread pattern of WM fibers. ChP volume significantly predicted VF. The moderated mediation model was significant, with only BD showing the indirect effect of ChP volume on VF mediated by RD. These results depicted disease-specific biological mechanisms underlying cognitive impairment in BD and MDD, proposing to deepen the role of immune-brain interface in BD.

Topic Area: METHODS: Neuroimaging

C98 - Evaluating RETROICOR and aCompCor-based denoising for improving multi-voxel pattern analysis

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fMRI measurements from the brain are characterized by small task-driven fluctuations in the background of large amounts of structured noise from different sources. One major source is physiological noise from non-neural sources such as the cardiac and respiratory cycles. RETROICOR is a retrospective correction approach for improving the signal-to-noise ratio of fMRI data employing estimates of the phase of these cycles from concurrent, peripheral physiological measurements. Conversely, aCompCor is a component-based method that utilizes components of measured signals from non-neural anatomical sources such as cerebrospinal fluid for denoising, without the need for physiological measures. However, it remains unclear whether aCompCor or RETROICOR improves the reliability of multivariate pattern analyses, and how these metrics vary across brain regions (Bhandari et al. 2018). Here we evaluate the effects of these denoising pipelines for improving multivariate pattern analyses. We leveraged deep-sampled fMRI and physiology datasets in which participants (N=20) performed a complex decision-making task across 10 fMRI sessions. We examined how including different combinations of denoising methods influence multi-voxel pattern reliability and Representational Dissimilarity Matrix (RDM) reliability. We show that, across the whole brain, neither pattern reliability nor noise ceiling for RDMs are affected by additional RETROICOR denoising if aCompCor is already employed. However, in some selected brain regions, RETROICOR causes a decrease in pattern correlation and noise ceilings.

These results suggest that including RETROICOR in a preprocessing pipeline that already includes aCompCor could have a negative effect on the signal to noise ratio in task-based fMRI experiments.

Topic Area: METHODS: Neuroimaging

C99 - Uncovering Lifespan-Consistent Representations in Cognitive Function through Metric Learning

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Changes in cognitive function across the lifespan can be captured by four core reference abilities: episodic memory (MEM), fluid reasoning (FLUID), perceptual speed (SPEED), and vocabulary (VOCAB). Stern et al. collected fMRI data across tasks targeting these reference abilities and found no significant age-related differences in Reference Ability Neural Networks (RANNs) across age groups (20 to 80 years). Efforts to distinguish these networks with linear analytical approaches, including principal components analysis (PCA) and linear-indicator regression, resulting in accuracy of 77% (+- 5%, MEM: 76%; FLUID: 82%; SPEED: 79%; VOCAB: 71%). Here, we consider a non-linear approach based on metric learning, which constructs latent spaces from the same high-dimensional fMRI data and is interpretable via sampling. Our metric learning approach yielded a substantial improvement in classification accuracy (87 +- 5%) across all four reference abilities by acquiring the latent embeddings that reduce the intra-class variability while maximizing the inter-class variability. With these embeddings, we were able to extract more robust and interpretable spatial activation patterns. On pairwise classification we achieved an even higher average accuracy of 96% (+-2%) across the six binary comparisons (MEM vs. FLUID: 96%; MEM vs. SPEED: 99%; MEM vs. VOCAB: 97%, FLUID vs. SPEED: 95%; FLUID vs. VOCAB: 97%; SPEED vs. VOCAB: 94%). Age-related changes in networks underlying cognition can provide insights into possible cognitive decline, and alert physicians and caregivers of a need for treatment or intervention. Our findings demonstrate that RANN biomarkers can be made more robust and interpretable using non-linear methods employing metric learning.

Topic Area: METHODS: Neuroimaging

C100 - Modularity of Functional Connectivity Networks in a Cue Separation Grasp Task

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Prehension involves location-dependent reach transport and orientation-dependent grasp components. To understand how the brain integrates object location and orientation for grasp, we studied how the order of transport / grasp cues influences whole brain functional connectivity. We collected BOLD signal data from 12 participants in an Event-related fMRI Experiment. Participants were instructed to reach and grasp a cube illuminated to the left or right of midline (Location Cue: L) and a verbal instruction to orient the hand for vertical or horizontal grasp (Orientation Cue: O). The order of these cues (LO vs. OL) varied randomly. fMRI data were analyzed separately based on three predictors: Delay 1 (between the two cues), Delay 2 (between the 2nd cue and go signal), and an Action Phase. Graph Theory Analysis was performed based on 200 regions of interest (nodes) at each phase. Preliminary analysis based on 3 participants: During Delay 1, nodes coalesced into three modules: 1) a central parietofrontal strip approximating primary somatomotor cortex, 2) two more anterior-posterior premotor / visuomotor parietofrontal regions, and 3) a ring of cortex skirting 1+2 but with no occipital/temporal involvement. Occipital involvement increased in Delay 2. Parietofrontal Modules 1 + 2 joined (reducing to two modules) after Delay 2 for LO and the action phase for OL, i.e., always after the location cue. The Global Clustering Coefficient is always reduced in the action phase. We conclude the order of L-O cues influences modularity, such that location information produces more parietofrontal 'binding', presumably in preparation for transport.

Topic Area: METHODS: Neuroimaging

C101 - EEG-ExPy: Democratizing the Cognitive Neuroscience Experiment

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Cognitive neuroscience experiments using EEG and related techniques have traditionally been restricted to lab settings, with dedicated space, expensive hardware, and professional technical/academic/student staff. Fortunately however, it is now becoming possible to run a wide range of classic experimental paradigms in a highly affordable fashion with minimal specialist equipment and expertise. This shift represents to many a "democratizaton of the cognitive neuroscience experiment". It is in this spirit that we introduce EEG-ExPy (github.com/NeuroTechX/EEG-ExPy) - A Python-based platform for cognitive neuroscience experimentation and education. This new tool allows a variety of visual, auditory, and other tasks to be run using a personal computer and a minimal+affordable, wireless (bluetooth), consumer-grade EEG device (e.g. InteraXon Muse, Neurosity Crown, OpenBCI Cyton, G.tec Unicorn). It can also be used with research-grade systems (including concurrently with mobile devices) in a lab setting. EEG-ExPy offers a fully self-contained solution to running cognitive neuroscience studies, with functionality spanning the entire span of data recording/stimulus presentation/analysis, with setup times of <30 seconds. This ease of use makes it attractive for a wide audience, including research scientists, clinicians, educators, and hobbyists. Use cases to date span a wide range of settings, from high school outreach programs, hackathons, under/graduate-level neuroscience courses, brain stimulation clinical trials in psychiatry, and bedside recordings in neurology patients. Here we describe the motivation, design, and usage of EEG-ExPy, demonstrating data from several featured experiments, including face-selective N170 ERP components, visual and auditory oddball tasks, and frequency tagging with visual and steady-state evoked potentials.

Topic Area: METHODS: Neuroimaging

C102 - Exploring individual differences in neural event boundaries

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Experience is segmented into a nested series of discrete events, separated by sharp neural state transitions that can be identified in fMRI data collected during passive narrative viewing (Baldassano et al., 2017). Current state segmentation techniques manage the noisiness of fMRI data by identifying boundaries within group-averaged data, with the logic that neural state transitions that are related to event boundaries are shared whereas noise is idiosyncratic. However, participants often disagree about the timing of event boundaries, suggesting that the perception of event boundaries is itself idiosyncratic. As such, we validated the Greedy State Boundary Search (GSBS) algorithm (Geerligs et al., 2021) for use at the individual level of analysis. We applied GSBS to individual participant data in two publicly available fMRI datasets (Alexander et al., 2017; Chen et al., 2017), subsequently averaging these individualized neural boundaries across participants to see if key results from previous work held. The resulting timeseries correlated well with normed behavioural boundary timing in key regions such as the posterior parietal cortex ($p<.0001$), demonstrating that GSBS can be used to identify meaningful individualized neural event boundaries. We then leveraged these individualized boundaries to explore individual differences. For example, we found that the number of boundaries increased with age ($p<.0001$), mirroring developmental patterns found in boundary judgements (e.g., Ren et al., 2021). These results highlight the importance of developing and validating fMRI tools for the individual level of analysis; what meaningful insights could we be missing when we average away what makes each of us unique?

Topic Area: METHODS: Neuroimaging

C103 - Dynamic neural representations of auditory selective attention

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Representational similarity analysis (RSA) has been used to characterize where and when different stimulus features or categories are represented in the brain. We extended this approach to investigate executive control processes - namely, auditory selective attention - by analyzing representations within electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) data. Young adults listened for a target syllable among distractor syllables while we recorded EEG (N=30) or fMRI (N=19). The rich (21 conditions) design included spatial attention, nonspatial attention, and passive listening. In EEG, we extracted representational features at each time point during a trial using the topography of either the raw voltage timecourse or cognitively-relevant frequency bands (e.g. alpha). In fMRI, we extracted representational features using a searchlight approach. In both cases, we estimated dissimilarity between each pair of conditions at one timepoint or one region via the validated classification accuracy of a linear support vector machine (trained separately for each subject, with leave-one-trial-out cross-validation) . Within EEG, we observed differences in the dynamics of neural representation between features. For example, when subjects were cued to use spatial versus non-spatial attention, we observed a transient representation of attention type in the raw voltage, but a sustained representation in alpha band power. Within fMRI, we also observed region-specific representations. For example, posterior superior temporal gyrus encoded the difference between active and passive listening, but not attention type, while regions along parietal sulcus robustly encoded the type of attention. Representational analysis allows new investigations of neural processes underlying executive control.

Topic Area: METHODS: Neuroimaging

C104 - Linking time and space in those with epilepsy to investigate seizure spread

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In epilepsy, a neurological disorder marked by recurrent seizures, the brain's spatiotemporal signal patterns are disrupted. Our research seeks to enhance understanding of the mechanisms underlying seizures by examining the spatial patterns of intracranial electrophysiological signals, particularly preceding and during seizures. This study is pivotal in bridging the gap in our knowledge regarding the structure-function connection in the brain, a relationship that remains poorly understood, especially in the context of epilepsy. Our multimodal approach combines brain diffusion tensor imaging (DTI) with stereo EEG (sEEG) to explore the intricate relationship between the brain's structural architecture and neural activity. We utilize connectome harmonics, calculated as the eigen vectors of the brain graph Laplacian. This enables us to break down the time-series of brain activity into a dynamically weighted composition of these harmonics derived from white matter tracts, offering a nuanced view of neural processes. Building on this framework, our research maps the dynamic changes in brain activity during epileptic events. By closely examining how the spectrum of the connectome harmonics shift before, during, and after seizures, we can gain deeper insights into the transient brain states associated with epilepsy. This innovative use of connectome harmonics spectrum analysis in epilepsy research brings a fresh perspective to the field. It holds the potential for improving our understanding of seizure mechanisms and potentially leading to more effective, targeted interventions. The findings from this study are expected to contribute to enhancing diagnostic accuracy and tailoring personalized treatment strategies for individuals living with epilepsy.

Topic Area: METHODS: Neuroimaging

C105 - Socioeconomic status is associated with reward processing, interleukin 1b and striatal connectivity in males with major depressive disorder.

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Major depressive disorder (MDD) is a common disorder with multifactorial risk factors. Socioeconomic status (SES) is one such risk factor, and is linked to MDD treatment outcomes and symptom severity. SES is associated with altered resting state functional connectivity (RSFC) in reward processing circuitry and elevated proinflammatory cytokine levels in non-depressed individuals. However, the role of SES in exacerbating MDD psychopathology is poorly understood. To address this gap, data regarding SES, depression severity, self-reported reward processing using the Behavioral Inhibition/Behavioral Activation Scale (BIS/BAS), serum pro-inflammatory cytokine levels (IL-6, IL-1β), and RSFC was collected for 323 participants (211 MDD, 112 control, 63.2% female) at six sites. General linear models assessing the effects of MDD diagnosis and SES on self-reported reward processing and pro-inflammatory cytokine levels. Whole-brain seed-to-voxel functional connectivity analyses were performed for the dorsal (DS) and ventral striatum (VS). Relative to controls, MDD participants from low SES backgrounds had lower BIS/BAS drive and altered striatal RSFC with temporoparietal regions. We also observed a positive relationship between SES and proinflammatory cytokines in males with MDD. Our results shed light on the role of SES in exacerbating the deficits in reward processing, and in contributing to the alterations in resting state striatal connectivity and pro-inflammatory phenotype observed in individuals with MDD. Better characterizing this relationship may inform future treatment approaches and intervention development.

Topic Area: METHODS: Neuroimaging

C106 - Factors affecting signal quality of functional near-infrared spectroscopy measurements of neural activity

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Functional Near-Infrared Spectroscopy (fNIRS) has emerged as a useful technique in the investigation of the neural mechanisms of cognitive processes. fNIRS is substantially more cost effective and allows for a greater level of mobility during measurement when compared to other commonly utilized neural activity recording techniques, such as functional magnetic resonance imaging. While these attributes of fNIRS enable novel study methodologies, the use of near-infrared light causes fNIRS measurements to suffer from lower spatial resolution and shallower penetration depth into brain tissue. Therefore, it is pertinent that nuisance factors affecting the quality of fNIRS signal be quantified to allow for more effective study designs or implementation of new technology to solve these challenges. This study measured the signal quality of fNIRS measurements in frontal and parietal regions in young adults (N = 76) during a memory task. Overall, signal quality was better in the frontal than parietal cortex. Among the factors assessed, signal quality was significantly higher in non-Hispanic White adults than ethnoracial minorities (African American and Hispanic) in both frontal and parietal. Darker hair was associated with poorer signal quality in the parietal but not in the frontal cortex. Greater hair density was not related to signal quality. Hair color mediated the effects of ethnoracial group on signal quality suggesting that hair rather than skin pigment impacts signal quality. Spending more time making sure hair is completely removed from the optodes might reduce these signal quality impairments.

Topic Area: METHODS: Neuroimaging

C107 - A Comparison of Freesurfer and Automatic Segmentation of Hippocampal Subfields for Estimating Hippocampal Volumes among Preschoolers

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The hippocampus is a complex structure comprised of multiple internal circuits (i.e., subfields), including the Cornu Ammonis (CA) fields 1-4, dentate gyrus (DG), and subiculum that subserves memory across the lifespan (Amaral & Lavenex, 2007). Hippocampal subfields are thought to undergo extended postnatal development (Lavenex & Lavenex, 2013), however studies with human children are limited, partially due to methodological limitations. Our study aims to compare hippocampal subfield volumes derived from two automated software packages, Freesurfer and Automatic Segmentation of Hippocampal Subfields (ASHS), among a sample of 3- to 5-year-old children. A total of 33 children (N = 33, Mage = 4.26 ± 0.61 years, 60.6% female) provided a whole-brain T1-weighted .9mm isotropic scan for Freesurfer 7.1.1 (Fischl, 2012) and a T2-weighted scan (.4mmx.4mmx2mm) of the medial temporal lobe for ASHS processing (Yushkevich et al, 2014). Volumes derived from the two methods were robustly correlated across each bilateral subregion and subfield (subiculum, CA1, and CA2-4/DG), average r(31) = 0.58 (rleft = 0.68, rright = 0.47). Paired sample t-tests showed significantly smaller Freesurfer segmentation volumes in all subfields except bilateral CA1-head (Δ = 151.11mm3, $p < .001$) and right subiculum-body (Δ = -8.28mm3, $p = .18$). Our findings revealed correlations and differences in hippocampal

volumes derived from Freesurfer and ASHS. Our future steps include 1) comparing both methods to manual tracing, 2) examining potential divergences in group comparisons based on children's sex, socioeconomic and nap status, and 3) investigating differences in estimates of developmental changes in subfields between the two methods.

Topic Area: METHODS: Neuroimaging

C108 - Neurophysiological modelling of network stimulation reveals distinct signatures across low- to higher-order networks

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The human brain comprises several distinct 'resting-state' networks, which exhibit structured spontaneous activity patterns and are implicated in a range of cognitive functions. Prior research has revealed a hierarchical neurocognitive organization of these networks, following a continuous 'principal cortical gradient' (PCG; first eigenvector of rsfMRI functional connectivity) progressing from low-order unimodal sensory/motor regions, through to high-order multimodal regions. A key question for cognitive neuroscience is whether this topographical feature of brain organization influences how different brain regions respond to inputs and engage in information processing. This was investigated in the present study using intracranial neurostimulation in surgical patients, together with computational brain network modelling. We analyzed sEEG+hdEEG data from epilepsy patients undergoing intracortical single-pulse electrical stimulation. Using the Whole-Brain Modelling in PyTorch (WhoBPyT) Python library (github.com/griffithslab/whobpyt), we fit individualized neural models to these data. A 'virtual lesion' approach then evaluated which responses to stimulation in multi- vs. unimodal cortical areas are reliant on recurrent feedback connections. In both sEEG/hdEEG datasets, we found strongest global field power when high-order multimodal networks were stimulated than when low-order unimodal networks were, and that virtual lesions suppressed late responses significantly more for high-order than low-order regions. Interestingly, both of these effects followed a spatial trajectory and linear ordering, closely matching that of PCG. Our results suggest that cortical regions differ in their strategy for information processing and activity dynamics, with high-order multimodal cortex being more globally integrated and interdependent, and low-order unimodal cortex being relatively independent of external inputs from other brain regions.

Topic Area: METHODS: Neuroimaging

C109 - Multi-Layer Extreme Learning Machine for Classification of Subjective Cognitive Decline and Neurodegenerative Disease Stages using White Matter Data

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Neurodegenerative disorders, characterized by the accumulation of brain proteins, can lead to cognitive impairment and disability, posing diagnostic and functional challenges. White matter (WM), housing vital neural circuits and glial cells, can sustain damage, resulting in clinical symptoms that affect daily life independence. Recent advances in imaging enhance accessibility to brain MRI and amyloid PET exams. Traditionally focusing on grey matter, this study underscores white matter's significance and potential in neurodegenerative disease diagnosis. This study utilized a Multi-Layer Extreme Learning Machine (MLELM), an advanced machine learning technique, to analyze data from 455 participants in the Biobank Innovations for Chronic Cerebrovascular Disease with Alzheimer's Disease Study (BICWALZS), encompassing individuals with 49 subjective cognitive decline (SCD), 260 mild cognitive impairment (MCI), 103 alzheimer's disease (AD), and 43 vascular dementia (VD). For each participant, we constructed the WM populational connection label Map (pCLM) using the DARTEL toolbox and the international consortium for brain mapping (ICBM) template. This map was generated by overlaying T-2- FLAIR and amyloid PET data, which were co-registered to the T1-weighted MRI image. Subsequently, we created an ensemble dataset for analysis. The results of the pairwise comparisons using the MLELM revealed statistically significant differences between SCD and MCI, SCD and AD, as well as SCD and VD, showcasing the effectiveness of the model in distinguishing these conditions. While no statistically significant differences emerged between MCI and AD, MCI and VD, and AD and VD, the study demonstrated proficiency in accurately classifying individuals with SCD from other cognitive stages.

Topic Area: METHODS: Neuroimaging

C110 - Fluid Cognition and Functional Connectivity Relate to Cortical Iron in a Depth-Specific Manner in Healthy Aging

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Age-related differences in fluid (speed-dependent) cognition, for healthy individuals, have been associated with elevated iron in deep gray matter nuclei, assessed by quantitative susceptibility mapping (QSM), as well as with the merging of functional brain networks, defined from resting-state functional MRI. These age-related differences in iron accumulation and functional connectivity may overlap, particularly in cortical regions, but the few QSM studies assessing cortical iron have used macroscopic approaches that cannot resolve depth-specific differences in iron content. Because cognitive decline in healthy aging is dominated by the slowing of response-related processes, as compared to decision-related processes, the effects of iron content may be more prominent in deeper depths responsible for output functions, as compared to superficial depths responsible for integrating information from other brain regions. Here, using an adult lifespan sample (N = 136; ages 18-80 years), we estimated depth-wise measures of cortical iron, using column-based QSM analyses, and resting-state functional connectivity, using the graph theoretical measure of system segregation. We assessed the relation of cortical iron, at specific depths, to age, functional connectivity, and fluid cognition (tests of memory, executive function, and perceptual-motor speed). Results indicated that higher iron content in deeper, but not superficial, depths was significantly associated with (1) increased age, (2) lower functional connectivity, and (3) worse cognitive performance for adults ages 50+ years. These results suggest that iron content in deeper cortical depths may uniquely contribute to age-related differences in cognition and brain function and may potentially serve as a biomarker of neurodegenerative disease.

Topic Area: METHODS: Neuroimaging

C111 - Comparison of single- and across-trial fMRI estimates of encoding-related activity in young and older adults

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We re-analyzed fMRI associative encoding-related activity acquired from 36 young and 64 older adults, utilizing trial-by-trial estimates of BOLD signal magnitude (beta estimates) to compute participant-wise effect sizes of fMRI 'subsequent memory effects' (SMEs) in a range of brain regions. These estimates were compared with those derived from the original analysis of the same data which employed an across-trial estimation procedure. We examined 'positive' SMEs in bilateral IFG and left hippocampus, and 'negative' SMEs in 9 additional regions. Consistent across estimation methods, IFG SMEs were more left-lateralized in the young compared to the older group and negative SMEs were robust in young participants. However, while the original analyses indicated a positive correlation between right IFG SMEs and memory performance in the older group, SMEs estimated with the single-trial approach demonstrated a negative relationship with memory performance in the same participants. Moreover, hippocampal SMEs were robust across age groups using across-trial estimates, but unreliable in either age group when estimated using the single-trial approach. In the regions where older adults' negative SMEs were reliable in the original analyses, these effects reversed in direction when estimated using the single trial approach. Unsurprisingly, in light of these findings, across-participant correlations between single- and across-trial SME estimates were low (rs = .04 to .45). Clearly, single-trial and the more conventional across-trial approaches to estimating fMRI contrasts do not necessarily converge. Possible reasons for the divergent results will be discussed.

Topic Area: METHODS: Neuroimaging

C112 - Quantifying Resting-State Functional Connectivity in Critically Brain Injured Patients: A Graph-Theoretical Approach with fNIRS

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Up to 20% of unresponsive patients with critical brain injuries in the ICU, believed to be unconscious, exhibit signs of awareness. However, there remains a need for objective and robust tools that are easily accessible to accurately characterize preserved cortical function and aid in predicting patient outcome. Advanced functional neuroimaging techniques are emerging to improve diagnostic and prognostic precision post-injury and assist in clinical decision-making. This study employs graph-theoretical analyses to quantify resting-state functional connectivity in brain injured patients using functional near-infrared spectroscopy (fNIRS). Mathematically calculated network parameters were used to quantify brain connectivity in patients and healthy controls. Resting-state data was collected for 6 minutes using a full head coverage, 129-channel fNIRS system from a group of unresponsive acutely brain injured ICU patients (N=16) and healthy controls (N=23). A localized comparison revealed significant group differences in clustering coefficient, local efficiency, and degree in several channels including those located in the left mid frontal, left postcentral parietal, and left mid temporal regions. These three network parameters were then integrated into machine learning algorithms to classify patients and healthy controls. Accuracy rates for a linear support vector machine classifier reached up to 75% using clustering coefficient. This study will enhance the understanding of brain connectivity in acute brain injury and ultimately hopes to offer a scientific foundation for clinicians and family members to make well-informed decisions regarding patient care.

Topic Area: METHODS: Neuroimaging

C113 - Adolescent Impulsivity is Predicted by Dynamic Functional Connectivity Between the Amygdala and Cognitive Control Network

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Adolescence is a period of development known for physiological and behavioral changes. Impulsivity is noted to increase during adolescence; however, the brain mechanisms behind this are not fully understood. Previous research has found that regions of the cognitive control network (CC) and the amygdala are active during impulsive behavior, especially in adolescents. Studies on resting-state functional magnetic resonance imaging (rs-fMRI) have found that static functional connectivity (sFC) between these areas is associated with impulsivity. In contrast, fewer studies have examined adolescent impulsivity using dFC, which measures changes in FC patterns during rs-fMRI. Thus, this study examined the relationship of FC between the CC network and the amygdala (dFC and sFC, separately) and impulsivity within a developmental sample. Two datasets of typically developing adolescents/young adults were used in this study: the Human Connectome Project Development (HCP-D) (n=512, mean (sd) age=15.09 (3.82) years, 241 males) and a replication dataset (n=149, age=18.59 (3.97) years, 69 males). DFC was conducted using a non-overlapping window approach while sFC was computed using the whole time-series, after which a principal component analysis (PCA) was conducted for the sFC and dFC, separately. In the HCP-D, we found that, above and beyond age, dFC predicted impulsivity, with stronger connectivity between the CC and amygdala indicating higher impulsivity. SFC was not able to predict impulsivity. The replication dataset showed similar results, suggesting robust findings. Our results suggest that stronger dynamic connectivity between the amygdala and areas involved in higher-order cognition reflects a tendency toward impulsive behavior in adolescents.

Topic Area: METHODS: Neuroimaging

C114 - Examining age-related differences in recollection and retrieval monitoring effects using single- and across-trial fMRI approaches

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Most fMRI studies examining age differences in the neural correlates of episodic retrieval have employed across-trial general linear models (GLM) to derive estimates of BOLD activity elicited on 'recollected' versus 'unrecollected' test trials. Here, we re-analyzed a previously published dataset examining fMRI correlates of recollection and retrieval monitoring in 36 young and 64 older adults. Single-trial beta estimates of BOLD signal magnitude from 9 regions of interest (ROIs) were extracted. We estimated recollection effects by computing the differences in the mean beta estimates averaged over 'recollected' vs. 'unrecollected' trials. In addition, we transformed these recollection estimates into estimates of effect size to derive standardized retrieval-related metrics, thereby controlling for across participant differences in the gain of the fMRI hemodynamic response function (HRF). The raw and standardized recollection estimates were highly correlated (all rs > .900). These single-trial recollection estimates were then compared with those derived from the original analysis which employed an across-trial GLM approach. The correlations between the retrieval metrics estimated with the two approaches were mostly negligible (rs = -.03 - .32). Moreover, findings for age differences and the relationships between recollection effects and memory performance differed markedly between the two approaches in multiple brain regions. These findings call for further examination of the relative merits of the two approaches in investigating neural correlates of memory processing. Reasons for the divergent findings and their implications for the interpretation of previously reported age differences in fMRI correlates of episodic memory retrieval will be discussed.

Topic Area: METHODS: Neuroimaging

C115 - BrainEffeX: A Shiny app to explore typical effect sizes in functional neuroimaging research

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Typical functional MRI (fMRI) studies are often statistically underpowered, leading to the inability to replicate many findings. This can arise when power analyses are conducted improperly or skipped altogether. One reason power analyses are so difficult is that it is currently not straightforward to estimate expected effect sizes from existing literature. To address this, we created a Shiny app to facilitate exploration of effect maps derived from "typical" fMRI studies. Using six large (n>500) publicly available fMRI datasets (ABCD, HCP, HBN, SLIM, PNC, UKB), we created a database of 38 effect size maps for frequently used study designs encompassing functional connectivity (FC) and task-based activation, then conducting within-subject, between-group, and correlation analyses for FC and activation. We then created a user-friendly Shiny app to explore these maps. Users can select a map type (FC or activation) and test type (1-sample, 2-sample, correlation), and optional inputs (e.g., specific dataset, task, or behavior of interest). The app then displays Cohen's d values alongside 95% simultaneous confidence intervals across edges or voxels for studies that fit the selected criteria. Effect maps are also visualized as connectivity matrices (FC studies) and mapped onto the brain (activation studies). The database and explorer are intended to be the starting place for an evolving resource to define some guidelines for effect sizes we may expect in the community. Furthermore, these resources will facilitate the ongoing development of an empirical power calculator for fMRI studies needed to facilitate study planning for more robust and reproducible neuroimaging research.

Topic Area: METHODS: Neuroimaging

C116 - Rehabilitative exercise in idiopathic Parkinson disease: microstructural white matter changes by using Diffusion Tensor Imaging

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Background DTI in idiopathic PD patients revealed disruptions in cortico-thalamic connectivity, leading to basal ganglia output inhibition and dysfunction in cortico-subcortical circuits. The aim is to determine if specific rehabilitative exercise induces changes in DTI parameters reflecting myelin-axonal integrity. Material and methods Thirteen (mean age 69.1±6.5 years) patients with idiopathic Parkinson's disease (PD) underwent rehabilitative exercise (RE). Upper-limb RE were conducted over an 8-week period. DTI images were acquired and preprocessed using FSL and MRtrix3. DTI tractography was performed using DSI Studio. Computerized dynamic posturography and UPDRS-III were employed to assess the clinical improvement. Results Whole brain DTI conducted before (t0) and after motor training (t1) showed statistically significant differences for the values of MD(p=0.0092), AD(p=0.017), RD(p=0.0092) of the inferior cerebellar peduncle, for the MD value (p=0.047) of the middle cerebellar peduncle, for the MD(p=0.009),AD(p=0.03), and RD(p=0.01) values of the right anterior corticothalamic radiation , and for the AD value of the left superior corticothalamic radiation (p=0.047). Recovery in postural stability (p=0.017) and enhancement in motor activity (p=0.0074). Discussion There is a gap in studies investigating microstructural changes before and after rehabilitation using DTI. The reduction of pathological findings in the inferior cerebellar peduncle, identified through DTI analysis is crucial for processing proprioceptive and cerebellovestibular stimuli and may influence changes in the anterior and superior corticothalamic tracts. This underscores the potential contribution of the cerebellum to PD compensatory mechanisms. Our research aims to address this gap, potentially advancing our understanding of treatment effects and refining interventions for PD patients.

Topic Area: METHODS: Neuroimaging

C117 - Assessing the impact of subject-specific masks on reliability of subcortical connectivity

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The connection between the periaqueductal gray (PAG) and the amygdala is regarded as a key pathway for regulating fear processing and pain modulation. However, due to the PAG's location within the subcortex surrounded by cerebrospinal fluid, the PAG is highly susceptible to physiological distortions and noise. Moreover, due to the PAG's small size and inter-individual variability, it is unclear how effectively standard group-derived masks can isolate PAG signal, particularly at standard field strengths. To address this gap, we examined how the use of subject-specific PAG masks influence the reliability of 7-Tesla PAG-amygdala functional connectivity across 3 consecutive resting-state runs in humans (N=48) using the intraclass correlation coefficient (ICC). Subject- and run-specific PAG masks were created by identifying the cerebral aqueduct as voxels with high variance at the individual level, dilating this selection by 2mm, and removing the aqueduct. Contrary to our predictions, we found comparable levels of reliability of PAG-amygdala connectivity when using subject-specific (ICC = 0.532) and group (ICC = 0.513) PAG masks. Although this suggests a minimal impact of masking strategy on reliability, given prior research advocating for subject-specific masks in other contexts, future investigations are needed to comprehensively compare the benefits of functionally defining the PAG. Furthermore, the relatively good reliability found here suggests an exception to the low reliability often reported for subcortical connectivity, warranting further investigation. Evaluating which factors influence PAG reliability is critical for delineating the role of the PAG and related structures in ongoing investigations of emotional and physical disorders.

Topic Area: METHODS: Neuroimaging

C118 - Functional Brain Networks Underlying Recalling and Imagining Autobiographical Events

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Functional magnetic resonance imaging (fMRI) studies typically explore the blood-oxygen-level-dependent (BOLD) signal underlying discrete cognitive processes that occur over milliseconds to a few seconds. However, autobiographical cognition is more protracted and requires fMRI tasks with longer trials to capture the temporal dynamics of the underlying brain networks. In the current study, we provide an updated analysis of the fMRI data obtained from a published autobiographical event simulation task, with a slow-event-related design (34-second trials), that involved participants recalling past events, imagining past/future events, and completing a semantic association control task. Our updated analysis using Constrained Principal Component Analysis for MRI (fMRI-CPCA) lengthened the temporal window, kept network-level anatomical depictions constant over time points to extract networks stable over time, and enabled more networks to be extracted. Results replicated two networks evident in the original results, including the Default Mode Network (DMN) which was activated by the autobiographical event tasks but deactivated by the control task, and the Multiple Demand Network (MDN) which peaked early during all conditions but was more sustained for the Recall task. Two novel networks emerged, including the Access to Internally Stored Information network (AISI) which, while active for all conditions, was more strongly engaged during the imagination and semantic association conditions than during recall, suggesting a role in constructing novel associations. These results indicate that the DMN does not support autobiographical simulation alone but co-activates with the MDN and AISI network depending on evolving task demands during the simulation process.

Topic Area: METHODS: Neuroimaging

C119 - Predicting Cognitive Performance in Older Adults from White Matter Hyperintensities with the Lesion Quantification Toolkit

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Cognitive decline can cause substantial functional impairment in older adults, but the rate of cognitive decline varies significantly between individuals. Prior research has associated cognitive decline in older adults with white matter hyperintensities (WMHs) using fluid-attenuated inversion recovery (FLAIR) MRI imaging. The recently released Lesion Quantification Toolkit (LQT) provides a measure of gray matter disruption by WMHs, which quantifies a given gray matter parcel's level of disconnection caused by WMHs intersecting white matter tracts. An open question is whether this measure is useful in the context of normal cognitive aging. The present study sought to predict cognitive performance in cognitively normal older adults using the gray matter disruption measure. We processed FLAIR images from datasets from York University, Cornell University, and the multisite Alzheimer's Disease Neuroimaging Initiative, and then analyzed the combined dataset (n = 303) with partial least squares path modeling. We specified causal paths from 1) gray matter disruption to cognition, 2) education to cognition, 3) age to cognition, and 4) age to gray matter disruption. Only the path from gray matter disruption to cognition was reliable (path coefficient: -0.30; 95% CI: -0.45 to -0.19). The effect was driven most heavily by subcortical regions, including the bilateral putamen, the bilateral pallidum, and cerebellar regions. The results demonstrate the value of parcellated WMH measures for predicting cognitive performance in older adults, with potential implications for early identification of pathological aging. Future analyses will examine a more diverse set of cognitive reserve and cognition variables unique to each dataset.

Topic Area: METHODS: Neuroimaging

C120 - Investigating neural correlates of late life depression using large datasets

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Recent longitudinal population studies have revealed a relationship between late life depression (LLD) and early visual and somatosensory cortices. Although evidence for early visual and somatosensory involvement in LLD can sporadically be found in the literature, the majority of LLD research focuses on association cortices such as frontal, cingulate, and default mode regions. As such, the role of visual and somatosensory cortices in depression is poorly understood. To address this gap in knowledge, we utilized population data from the UK Biobank (https://www.ukbiobank.ac.uk/) to summarize the structural brain correlates of depression across large-scale brain networks. Using data from 20,843 participants ages 40-69, we conducted linear regression analysis between imaging derived phenotypes (IDPs) from T1 structural MRI data and depression score data collected via questionnaire. We then mapped the results

onto a low-dimensional brain parcellation ('Yeo-7') that distinguishes between unimodal cortices (i.e. sensorimotor and visual areas) and association cortices (i.e. default mode and frontal networks). Significant neural correlates were found in visual, somatomotor, ventral attention, limbic, and default networks. Brain regions most associated with state depression were found in the left supramarginal gyrus, left superiortemporal area, and left inferiorparietal area. These results suggest the existence of whole-brain neural correlates of LLD. The sensorimotor-association axis may provide a foundation for understanding the spatial distribution of LLD correlates across unimodal and association cortex.

Topic Area: METHODS: Neuroimaging

C121 - Developing a Deep Learning Segmentation Tool for the Choroid Plexus – FastPlex

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The choroid plexus (ChP) is located within the four ventricles of the brain and forms the blood-cerebrospinal fluid (CSF) barrier. The ChP plays an important role in cognition and neuropsychiatric disorders. Neuroanatomical alterations of the ChP have been identified in autism, schizophrenia and Alzheimer's disease. The delay in ChP research is due to a lack of readily accessible, automated tools that can reliably label the ChP in structural images. Manual segmentation is currently the "gold-standard", but as the field moves toward multi-site consortiums with large samples, it is time consuming and non-sustainable. Here, we introduce an ongoing effort to create a fast, reliable, machine learning-based tool for ChP labeling on T1-weighted MRI images. Sampling 22,000+ brain MRIs from open-source neuroimaging databases such as the Human Connectome Project (HCP), Connectome Studies Related to Human Disease (CRHD), Adolescent Brain Cognitive Development (ABCD), and others we plan to manually segment the ChP from a representative subset (N=700). This subset will be generalizable since it includes a wide variety of image resolutions, scanner manufacturers, subjects' age and sex, as well as clinical status. The representative subset will be used to train, test and validate the deep learning algorithm (FastPlex) and it will be made compatible with the FastSurfer pipeline. The manual labels and the FastPlex will both be publicly available upon completion, with the goal to help speed up investigations of ChP's functional role in aging, development, cognition, and neuropsychiatric conditions.

Topic Area: METHODS: Neuroimaging

C122 - Integrating Spatial Transcriptomics and Proteomics in Traumatic Brain Injuries: A Multimodal Image Analysis Pipeline

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Spatial transcriptomics methods are increasingly utilized to investigate gene expression profiles with sub-cellular resolution in intricate brain cytoarchitecture while avoiding the loss of local and global spatial relationships. While gene expression analysis through RNA sequencing can simultaneously evaluate hundreds to thousands of genes, assessment of protein expression is still required for validation and can aid in characterization of cellular identities and behaviors. We have developed a methodological pipeline to register and analyze data across multiple modalities ensuring high-integrity spatial registration without disruption of biological information, using both spatial transcriptomics and immunofluorescence imaging on tissue sections. We demonstrate the utility of this method in the context of traumatic brain injury (TBI), a complex pathology in a highly complex tissue. TBI is characterized by a series of inflammatory and neurodegenerative events, as well as reactive gliosis. The latter represents activation and hypertrophy of astrocytes and is associated with a significant increase in glial fibrillary acidic protein (GFAP). Studies were conducted using the 10X Genomics Xenium instrumentation and protocol on tissue sections collected from male C57Bl6/J mice (N=6) at 48 hours after controlled cortical impact (CCI) TBI. A total of 349 genes, including GFAP, were evaluated. Subsequent immunolabeling and confocal imaging of GFAP was performed on the same tissue sections. Spatial transcriptomic and proteomic images were processed in a custom MATLAB script. Our study presents a novel and scalable approach for high-throughput multimodal data measurement in TBI pathology and biomarker research, and is further applicable for other neurological disorders.

Topic Area: METHODS: Neuroimaging

C123 - NITRC's Triad of Services: Software, Data, Compute

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The NeuroImaging Tools and Resources Collaboratory (NITRC) is a neuroimaging knowledge environment for MR, PET/SPECT, CT, EEG/MEG, optical imaging, clinical neuroinformatics, computational neuroscience, and imaging genomics tools and resources. NITRC's Resource Registry (NITRC-R) promotes software tools and resources, vocabularies, test data, and databases, thereby extending the impact of previously funded neuroimaging informatics contributions to a broader community. The NITRC Image Repository (NITRC-IR) hosts freely-downloadable data, offering 17 data projects, 11,559 subjects, and 13,282 imaging sessions. The NITRC Computational Environment (NITRC-CE) provides cloud-based configurable computational services via commercial cloud providers such as Amazon Web Services and can also be downloaded to local machines. Funded by the NIH since 2006, NITRC continues to identify existing software tools, resources, and data in order to support research, education, and neuroinformatics efforts.

Topic Area: METHODS: Other

C124 - Gamma oscillations in the frontal cortex and lucid dream induction success

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Lucid dreaming, characterized by the dreamer's awareness of dreaming while asleep, offers promising scientific and clinical applications, including nightmare treatment. Despite its potential, the reliable induction of lucid dreams in controlled settings remains a significant challenge, limiting progress in the development of such applications. Current strategies, including the use of audio-visual cues played during sleep to trigger dream awareness, have shown limited success. This study aims to enhance the understanding and methodology of lucid dream induction by identifying neural predictors of cue efficacy. We re-analyzed EEG data from a previous experiment that employed audio-visual cues to induce lucid dreams, focusing on the comparison of brain activity preceding successful and unsuccessful lucidity cues. Specifically, we investigated the patterns of oscillatory activity within high-frequency (gamma) and low-frequency (delta) bands across frontal and occipital regions. Our findings reveal a pronounced increase in gamma power in the frontal regions preceding successful lucidity cues, suggesting that elevated frontal gamma activity represents an optimal neural state for the induction of lucid dreams via auditory cues. This insight not only advances our understanding of the neural mechanisms underlying lucid dreaming but also holds potential for improving the effectiveness of lucid dream induction techniques, thereby unlocking new possibilities for therapeutic and creative explorations. The specificity of our findings to frontal gamma activity underscores the importance of targeted neural states in enhancing cognitive awareness during sleep.

Topic Area: METHODS: Other

C125 - Event-related BOLD responses distinguish aversive auditory second-order conditioning

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Background: Pavlov described second-order conditioning, where a stimulus that has acquired value (through classical conditioning) can be associated with other neutral stimuli. This paradigm is thought to model our motivations for much of our daily behaviour. Previous research in rodents and humans has suggested that second-order associations can be independently expressed. Our previous EEG research using aversive auditory stimuli has demonstrated that ERP responses can distinguish first-order and second-order stimuli, with activity localised to the prefrontal cortex for first-

order stimuli and activity localized to the temporal cortex for second-order stimuli. Rodent research differs in that it finds that the hippocampus is critical for second order conditioning. Using fMRI, our goal was to explore the neuroanatomical structures involved in human second-order conditioning with greater spatial resolution. Method: In this experiment, we designed an event related fMRI study to explore the neural correlates of second-order aversive auditory conditioning. Young adults (18-35 years, n=27) underwent aversive auditory conditioning on day 1 and second-order conditioning in a 3T MRI scanner. White noise was used as an aversive unconditioned stimulus (US+). Initially neutral tones were used as first-order (CS+/CS-) and higher-order (HO+/HO-) associates. Results: We found that first-order stimuli could be differentiated by significant clusters in the right angular gyrus and cingulate cortex. We also found that second-order stimuli could be differentiated by significant clusters in right temporal areas. Conclusions: Prefrontal cortex and temporal cortex may play an important role in second-order conditioning in humans.

Topic Area: OTHER

C126 - Neurocognitive Correlates of Narrative Processing in Children

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Complex real-world environments like a typical classroom presents children with rich, multisensory stimulation where learning relies on cognitive skills such as attention, memory, and executive functions. For typically developing children this can, at times, be stressful and exhausting. However, children with learning disabilities face these challenges daily. Clinical measures often fail to capture the complexity of these environments and, thus, poorly characterize their inherent challenges. Accordingly, measures of how children engage with complex stimuli are needed. Narratives, such as films and books, require listeners to encode and retain information over long durations, and integrate this information with existing knowledge. By examining which brain regions are active while a child engages with narratives, and to what extent activity is correlated across individuals, we may better understand how children extract meaning from complex stimuli. To this end, we examined neural synchrony (a measure thought to represent shared experience) during movie-watching within a large and cognitively diverse sample of children and measured their comprehension of the stories. Participants also completed a battery of tests including standardized measures of intelligence, social responsiveness, and language skills. These cognitive skills were found to be uniquely predictive of neural synchrony in frontal, default-mode, occipital, and attention networks, suggesting that the development of different cognitive abilities underscores a child's ability to understand complex narratives. The results of this work will inform how children engage with complex streams of information and suggest developmental milestones that predict how well children will succeed in environments like the modern classroom.

Topic Area: OTHER

C127 - Cerebello-Basal Ganglia Functional Connectivity Differences in in Alzheimer's Disease and Mild Cognitive Impairment.

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Extensive research on the cerebral cortex and the hippocampus has improved our understanding of mild cognitive impairment (MCI) and Alzheimer's disease (AD). Historically, however, the cerebellum's role in these stages of cognitive decline has been traditionally neglected due to its associations with motor function. Recent research has demonstrated cerebellar structural and connectivity differences in MCI and AD. Further investigating is however needed. In cognitively normal (CN) older adults cerebello-basal ganglia (CB-BG) functional connectivity is lower compared to younger adults. However, it remains an open question how these networks differ across different stages of cognitive decline and whether they are associated with cognitive and/or task performance. Here, we investigated CB-BG resting state networks associated with motor and cognitive cortical circuits across CN, MCI, and AD populations. The Alzheimer's Disease Neuroimaging Initiative (ADNI-3) was used to obtain the data of 478 participants who completed a motor and cognitive battery. All participants also underwent resting state functional magnetic resonance imaging (fcMRI). Analysis was completed using the CONN toolbox. We found a higher FC between Crus I with globus pallidus pars externa and lower FC between lobule VIIIb and dorsal caudal putamen in AD compared to CN individuals. However, no significant results were found when comparing AD to MCI or MCI to CN, suggesting that this stage of cognitive decline does not affect cerebello-basal ganglia networks. Further understanding of network dysfunction that includes the cerebellum can help inform future clinical work and elucidate the mechanisms of MCI and AD.

Topic Area: OTHER

C128 - Unravelling the neural dynamics of hypnotic susceptibility: Aperiodic neural activity as a central feature of hypnosis

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The ability for hypnotic responding is marked by great inter-individual variation in the population, while the neural underpinning of this variability remains elusive. The current work leveraged multivariate statistics and machine learning to probe the neural dynamics underlying inter-individual differences in hypnotic susceptibility. We assessed the efficacy of linear classifiers in distinguishing between high and low hypnotic susceptible individuals using neural features from resting-state electroencephalography (EEG) both pre- and post-hypnotic induction. Our focus encompassed both aperiodic and periodic components of the power spectrum, and graph theoretical measures derived from functional connectivity patterns. Several neural features related to both the pre-induction period and to the effect of the induction (post- minus pre-induction) significantly differentiated susceptibility levels, which underscores the complex dynamics of hypnotic phenomena. Based on model comparisons and feature ranking, we discerned the pre-induction aperiodic exponent as the primary discriminating neural feature. This novel finding not only resonates with the increasing emphasis on this neural component in broader EEG research but also promotes the idea that the primary neural distinction in hypnotic susceptibility is evident at baseline, even before hypnosis. Based on prevailing interpretation of aperiodicity in the EEG signal, our findings support the idea that hypnotic susceptibility reflects a latent trait observable at the neural level in the balance of cortical excitation and inhibition.

Topic Area: OTHER

C130 - Occupational Attributes relate to Large-Scale Brain Network Organization

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Individuals invest a significant portion of their daily lives in their professions, implicating occupations as influential in cognitive functioning. Diverse jobs require distinct knowledge, skills, and abilities, contributing to a multifaceted, lifelong experience that likely shapes bidirectional influences on brain development. While prior studies have predominantly focused on specific occupational factors causing focal brain changes, this approach may underestimate the impact of large-scale brain network organization. Additionally, characterizing occupations nominally limits hypothesis testing and data analysis. The current study explores how brain network organization correlates with continuous occupation scores across three dimensions: 1) occupational complexity, 2) alignment with science, technology, engineering, and mathematical (STEM) disciplines, and 3) emphasis on computational versus health knowledge. Participants (N = 403, ages 18-85 years) from the Nathan Kline Institute-Rockland Sample were utilized. Occupation scores, derived via a validated method converting free-entry occupations into continuous dimensions, were related to brain network organization, measured by the strength of within-network versus between-network connections (i.e., network segregation). Multivariate analyses revealed associations between network segregation and occupational scores. Specifically, individuals in occupations that required computational (versus health) knowledge, exhibited more network segregation in their salience ventral attention network. Notably, men, but not women, in these computational occupations also displayed increased segregation in their visual and control systems. These findings underscore the intricate relationship between large-scale brain organization and occupations, emphasizing gender-specific variations. These results not only shed light on neural measures warranting further exploration but also emphasize the need to understand and address gender disparities in STEM disciplines.

Topic Area: OTHER

C131 - Aperiodic vs. slow wave activity in rat sleep stages

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Sleep is an important part of any animal's life. Humans spend a significant percentage each day sleeping; other mammals, such as cats, spend more than 50% of each day sleeping. Lack of sleep disrupts cognitive functioning, as well as emotional and physical health. Historically, sleep is divided into stages, differentiated based on electroencephalography (EEG) recordings, muscle activity, motion, and parasympathetic responses, with recent developments showing that the non-oscillatory, aperiodic EEG signal is a strong marker for sleep stage. This is interesting because, while deeper sleep stages are associated with increased EEG "slow-wave" activity, we have recently shown in clinical populations that EEG "slowing" is better explained by shifts in aperiodic activity compared to slow-wave oscillations. Therefore, we hypothesize that aperiodic activity is a better predictor of sleep stages than slow wave activity, and that not all slow "waves" in sleep are true oscillations. Here, we analyze a dataset consisting of rats' intracranial EEG going through sleep-wake cycles (Watson et al., 2016), to investigate whether they show a similar pattern in aperiodic activity over sleep stages as observed in other species (humans and mice). Preliminary results show the same pattern; deeper sleep stages are associated with steeper spectra compared to REM or awake. Aperiodic activity is related to E:I, which could inform future research to investigate this concept in relation to cognitive phenomena that require healthy sleep, and establish a potential causal relationship between aperiodic activity during sleep and cognition.

Topic Area: OTHER

C132 - Self-regulatory, cognitive and personality contributions to an ontology of boredom proneness.

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Boredom proneness shows consistently high correlations with depression despite feeling phenomenologically distinct. In this exploratory study, we explored self-regulatory, cognitive and personality variables that might disambiguate trait boredom proneness from both depression and anxiety. We first ran regressions on a large survey dataset (n~2,300) predicting boredom proneness, depression and anxiety using different sets of variables. By plotting the standardized beta weights on polar plots for each regression, the resulting 'fingerprint' for each domain can be compared. Notable differences emerged for each construct. For example, low levels of self-control were more predictive of boredom proneness than depression and anxiety. Whereas increased neuroticism was most predictive of anxiety followed by depression and least predictive of boredom proneness. As for cognitive variables, low levels of flow were most predictive of anxiety followed by boredom proneness and then depression. This research provides insights into what distinguishes these phenomenologically distinct but highly related cognitive-affective experiences.

Topic Area: OTHER

C133 - Splitting the brain: Complete corpus callosotomy in adulthood profoundly disrupts the functional architecture of interhemispheric brain networks

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Corpus callosotomy is a major intracranial intervention that severs the largest fiber tract in the human brain as a last-resort treatment for medically-intractable epilepsy. A rich history of experimental psychology has revealed striking insights into the 'split-brain' phenomenon, describing two cerebral hemispheres operating independently, without conscious awareness of the other. However, we know comparatively little about the impact of callosotomy on the human brain's functional architecture: extant literature is limited to pediatric patients and/or single case studies. Here we investigate, for the first time, multiple adult callosotomy patients using modern network neuroscience methods. Five patients (2 partial splits, 3 full splits) underwent resting-state fMRI at least one-year post-op; large-scale patterns of intrinsic functional connectivity (FC) were assessed using seed-based and parcellation-based techniques, including edge timeseries and multiresolution modularity. For comparison, healthy adult controls were taken from the HCP 100 Unrelated Subjects sample. We find that full callosotomy dramatically diminishes interhemispheric FC, whereas partial splits retain relatively-normal levels of FC—even when only 1 cm of splenium is spared. Similarly, multivariate patterns of edge co-fluctuations suggest the left and right hemispheres are broadly-decoupled following full callosotomy, and the topological organization of functional modules becomes strongly lateralized. Curiously, the visual network demonstrates nominal interhemispheric FC when resting-state is collected with eyes open—but not with eyes closed, perhaps indicating that synchronized external sensory inputs can yield the appearance of interhemispheric coupling in the absence of anatomical pathways. Together, these results provide a novel perspective on the split-brain and a functional basis for 'disconnected' cognition.

Topic Area: OTHER

C134 - Resting-state precision functional mapping corresponds with behavioral effects of intracranial electrical stimulation

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Intracranial electrical stimulation (iES) can provide causal information regarding the function of a stimulated brain region. Non-invasive mapping procedures, such as those based on functional MRI (fMRI), provide complementary information to iES. However, the accuracy of fMRI has been limited because typical procedures (i) collect insufficient amounts of data for reliable within-individual estimates and (ii) rely on patients performing tasks that typically target a single functional domain or network, and can yield variable results depending on the task design and patient's strategy. In contrast, resting-state functional connectivity (FC) can estimate multiple networks at once and does not rely on an active task. Here, we investigated whether within-individual FC estimates from extensively sampled patients correspond with behavioral effects elicited by clinical iES. Six patients with drug-resistant epilepsy who were scheduled for invasive monitoring completed up to 4 MRI sessions, providing 35-245 minutes of fMRI rest data. Three patients additionally provided 10-35 minutes of language task-based fMRI data. Electrodes were localized using a post-surgery CT image co-registered to MRI data. Stimulation (bipolar, 50 Hz, 1-15 mA, 300 μs pulse width) was applied while patients read passages aloud. Positive (e.g., hand jerks) and negative (e.g., speech arrest) effects were documented by an epileptologist. Across participants, an optimization analysis indicated that the FC-estimated language network displayed 64-82% correspondence with reading deficits, while a task-based language map displayed 45-79% correspondence, suggesting that resting-state FC-based network estimation provides similar information to task-based language mapping. Ongoing work is assessing correspondence of FC-defined networks in additional functional domains.

Topic Area: OTHER

C135 - Hippocampus Subfield Volumes Associated with Spatial Memory Performance in Older Adults At-Risk for Developing Type 2 Diabetes

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Older adults at-risk for developing type 2 diabetes are more likely to experience accelerated cognitive aging and neurodegeneration due to impaired brain metabolism. Type 2 diabetes is associated with smaller hippocampal volumes, lower hippocampal intrinsic excitability – a process important for memory formation and updating, and poorer spatial memory – a task dependent on the hippocampus to store and retrieve information regarding the location of objects and events within the environment. Our study investigates the relationship between spatial memory, hippocampal subfield volumes, and type 2 diabetes risk in late adulthood to better understand the hippocampal regions impacted during early stages of diabetes and whether they influence spatial

working memory performance. Sixty older adults at risk for diabetes participated in this cross-sectional study. Those with untreated depression, neurological impairment, or previous vascular incidents were excluded. Diabetes risk was confirmed through body mass index, hemoglobin A1c levels, fasting glucose levels, and a diabetes questionnaire. Eligible participants completed a touchscreen trial-unique, delayed nonmatching-to-location (TUNL) task to assess spatial working memory, and a 3T MRI scan to acquire T1 weighted images of the hippocampus which were segmented and analyzed using HippUnfold. Results suggest that poorer spatial working memory performance is correlated with smaller hippocampal subfield volumes. Given the strong association between dementia and type 2 diabetes, understanding the early development and cognitive effects of diabetes allows us to uncover opportune moments to begin interventions aimed at preventing or delaying dementia.

Topic Area: OTHER

C136 - Longitudinal basal forebrain atrophy is related to changes in functional connectivity in older adults at risk for Alzheimer's disease

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The basal forebrain (BF) is one of the earliest brain regions affected in Alzheimer's disease (AD). The BF compromises large cholinergic projection neurons that densely innervate the entire cortical mantle and serves as the primary source of acetylcholine. This neurotransmitter plays a vital role in cortical processes, especially cognitive functions involving attention. Recent cross-sectional studies have found that the BF exhibits broad connectivity with key hub regions of functional networks, which is disrupted in mild cognitive impairment and AD. However, longitudinal changes of the BF structure and functional connectivity and their consequence on cognition in presymptomatic AD are not understood. Longitudinal anatomical and resting-state multi-echo functional MRIs were analyzed in a sample of 150 healthy older adults (mean age at baseline = 67.75 years, SD = 4.89) at risk of AD. BF volume significantly atrophied between timepoints (~32 months, $F(1, 163.90) = 16.18$, $p < .001$) after accounting for sex, age, education, intracranial volume, and brain volume. Using multivariate partial least squares analysis, longitudinal atrophy was significantly associated with annualized percent change in BF-cortical resting-state functional connectivity ($p < .05$). Greater BF atrophy was associated with reduced BF connectivity to lateral temporal cortex, motor cortex, and middle cingulum. These results provide novel evidence for longitudinal structure-function changes with advancing age to the cholinergic system.

Topic Area: OTHER

C137 - Facilitating Meditation with Focused Ultrasound Neuromodulation: A First Investigation in Experienced Practitioners

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In recent years, scientific evidence for the benefits of consistent meditation has grown dramatically; however, so too has evidence that many would-be practitioners find great difficulty in maintaining a regular practice. Thus, if it were possible to reliably induce successful states of mindfulness—more quickly, consistently, or with less effort—this significant barrier to the benefits of mindfulness would be effectively lowered. We aim to study the possibility of inducing mindfulness via direct neuromodulation using focused ultrasound (FUS) applied to three candidate regions: the posterior cingulate cortex (PCC), the bilateral head of the caudate, and the bilateral ventral-anterior insular cortex. Here, neuro-navigated FUS is applied for 12 minutes to 36 expert Vipassana meditators midway through a 1-hour Vipassana meditation. During each session, meditative depth and a wide range of physiological measures are probed throughout the meditation, while extensive phenomenological questionnaires are given after each session. Our pilot data in experts so far (n=14) reveals a robust effect of caudate stimulation on self-reported meditative depth during meditation when compared to sham stimulation (perception of sham is at chance). Likewise, changes in the caudate condition on sub-scores of the Meditation Depth Inventory and Profile of Mood States compared to sham stimulation are consistent with deeper meditation and deeper relaxation during/after caudate stimulation. Finally, heart rate decreases while heart rate variability increases following caudate stimulation compared to sham simulation, while these are strongly ($r > 0.8$, r is negative for heart rate) [anti]correlated with reported depth only in the caudate condition.

Topic Area: OTHER

C138 - Statistical learning of temporal-order regularity is easier in the auditory than visual modality

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It is generally found that temporal and spatial information is relatively salient in the auditory and visual modalities, respectively. In the present study, we investigated such relationship in a novel statistical learning test in which temporal and spatial positional regularities were present in the same stimuli concurrently. In the study phase of the visual concurrent positional statistical learning (cPSL) test, 12 simple geometric shapes were individually specified to appear in either the first or second frame of a trial on the left or right side of the screen. Similarly, in the study phase of the auditory cPSL test, 8 non-verbal sounds were individually specified to appear in the first or second order through the left or right speaker. During the subsequent test phase, participants were required to make yes-no judgments for stimuli positioned correctly in both temporal and spatial positions (T+S+), correct in temporal but incorrect in spatial position (T+S-), correct in spatial but incorrect in temporal position (T-S+), and incorrect in both temporal and spatial positions (T-S-). The results revealed that statistical learning was superior in the auditory than visual modality, mainly because it was more difficult to identify the correct targets (T+S+) and to reject incorrect foils of the T-S+ condition in the visual than auditory modality. The present findings support the saliency of temporal information in the auditory modality and extend the link to the context of statistical learning. Further explorations of the neural correlates of such link would be pursued in future research.

Topic Area: OTHER

C139 - Opposing anterior hippocampal correlations with autobiographical memory vividness in recent versus remote life periods

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What determines how immersively we experience our past? When reliving past events, some individuals report doing so with greater vividness, which is thought to reflect the degree to which a memory is re-experienced. Both autobiographical episodic memory and vividness have been linked to the hippocampus; as the posterior hippocampus is hypothesized to play host to greater detail, here we probed for a possible association between self-reported memory vividness and anterior and posterior hippocampus volumes. Sixty participants completed autobiographical memory interviews from childhood, adolescence, early adulthood and the prior year, followed by high-resolution MRI scans on a later date. We found that the volume of the anterior hippocampal region was positively correlated with the vividness ratings of recent memories, but negatively correlated with the vividness ratings of childhood memories. The posterior hippocampal region did not correlate with ratings from any life period. This absence of posterior hippocampus correlation suggests that vividness ratings might follow from generalized mental maps of autobiographical memories rather than detailed re-creations. Opposing correlations of subjectively experienced autobiographical vividness with the anterior hippocampus in recent versus remote periods poses an interesting puzzle: possible explanations are discussed.

Topic Area: OTHER

C140 - Age and Sex Moderate the Effects of Sleep Quality on Resting-State Functional Connectivity in the Salience and Default Mode Network

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Advanced aging often coincides with declining sleep quality, which can contribute to cognitive decline and an increased risk of dementia. Neuroimaging offers valuable insights into how poor sleep may affect brain health before cognitive or behavioral changes appear. Moreover, it is essential to consider potential age- and sex-related

differences in these effects. The goal of this study was to investigate how age and sex moderate the impact of sleep quality on resting-state functional connectivity (rsFC). Based on the extant literature, we predicted that sleep quality would significantly impact connectivity in the default mode network (DMN), salience network, and the amygdala. Adults (N=107), aged 20-74, completed the Pittsburgh Sleep Quality Index (PSQI) and underwent two 5-min sessions of rsFC. Three-way interactions between age, sex, and sleep quality were found between the DMN and the left superior parietal lobule (lSPL). A two-way interaction between age and sleep quality was found between the salience network and right precentral gyrus (PreCG)/post central gyrus (PoCG). No relationships were found using the amygdala as a seed region. Follow-up analyses suggested that sleep latency was the largest contributor to the sleep quality-connectivity effects found. The results suggest that poor sleep affects the salience networks in both males and females, with variations in adaptive patterns depending on age. The DMN appears particularly sensitive to sleep impairments in females, with younger and older adults adapting differently, implicating different compensatory mechanisms. Longer sleep latency may indicate a risk for insomnia and in turn suggests hyperarousal as a possible mechanism.

Topic Area: OTHER

C141 - Investigating the Impact of Transcranial Direct Stimulation on Excitatory Purkinje Cell Firing in Essential Tremor: A Computational Model Approach

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Introduction: This paper investigates the modulation of excitatory Purkinje cell firing using transcranial direct current stimulation (tDCS) in a computational model of essential tremor (ET) based on the cortico-cerebello-thalamo-cortical (CCTC) network. Transcranial electrical stimulation (tES), including transcranial alternating current stimulation (tACS) and tDCS, is increasingly explored for therapeutic purposes in motor movement and cognition. Methods: The study initially employed a computational model of ET with tACS, aiming to mitigate tremor oscillations. Modifications involved replacing the tACS sinusoidal stimulation with a direct current to simulate tDCS. The model, consisting of various neural components, demonstrated the potential of tDCS to decrease pathological spiking activity associated with essential tremor. Results: Control conditions, representing the model without stimulation and with tACS, were compared to modified conditions simulating tDCS. Results showed that the removal of tACS stimulation produced outcomes similar to the control without stimulation, while tDCS simulation yielded results comparable to the control with tACS. This suggests that tDCS, by delivering direct excitability or inhibition, can effectively modulate neural oscillations in the model. Conclusion: The paper concludes by discussing the distinction between tACS and tDCS in terms of current delivery patterns and highlights the potential of tDCS to offer a direct and effective modulation of neural activity. The findings contribute to understanding how different transcranial electrical stimulation techniques impact neurons at a cellular level, holding promise for novel therapeutic interventions in various brain disorders.

Topic Area: OTHER

C142 - Can we experimentally induce a dream of our choosing?

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Memory consolidation has been linked indirectly with dreaming, but causal evidence is needed to comprehensively understand the functions of dreaming. Dream research faces several challenges, including the difficulty of experimentally controlling dream content as well as the fact that dreams reported upon awakening are subject to distortion and forgetting. Memory consolidation can be systematically manipulated using Targeted Memory Reactivation (TMR), whereby sensory stimulation during sleep can trigger processing of associated memories (most consistently during slow-wave sleep). Stimuli presented during sleep can be incorporated into dreams, but the extent to which TMR can provoke dream content has not been thoroughly tested. Here, participants performed two distinct tasks designed to be readily incorporated into dreams, each entailing a unique respiratory signature that could be objectively verified during sleep. The two tasks were associated with two different sounds. When participants entered REM sleep, experimenters presented one of the sounds, attempting to induce a dream with elements of the associated task. Participants also provided a 7-minute verbal report of each task before sleep and in the morning to test whether cue-induced dreams impacted memory. Preliminary analyses showed high rates of task incorporation in dream reports collected after each REM period. Additional analyses will assess the extent to cue-related dream elements were present. We will also determine if respiration during sleep changed as a function of cue presentations; such firm evidence of dream curation would open the door to investigating how dreaming may influence memory storage.

Topic Area: OTHER

C143 - Detection of freely moving thoughts using SVM and EEG signals

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Freely moving thought is a type of thinking that shifts from one topic to another without any overarching direction or aim. The ability to detect when freely moving thought occurs may help us promote its beneficial outcomes, such as creative thinking and positive mood. Despite these benefits, no studies thus far have used machine learning to detect freely moving thought using “objective” (e.g. neural or physiological) measures. Our study fills this gap, using event-related potential (ERP) and spectral features of EEG signals in machine learning to detect freely moving thought. Specifically, our classification models detect freely moving thought based on previously collected EEG signals during a simple attention task. The statistical and entropy features of the P3 ERP and alpha spectral measures were entered as inputs to the support vector machine (SVM) for detecting freely moving thoughts. EEG features were first examined with both inter-subject and intra-subject strategies. The best combination of EEG features achieving higher classification performance in both strategies were then selected to combine with behavioral features to further enhance classification performance. Our best performing model has an MCC and AUC of 0.3105 and 0.6665 for inter-subject models and 0.2815 and 0.6407 for intra-subject models respectively. The above chance level performance in both strategies using EEG and behavioral features shows great promise for machine learning approaches to detect freely moving thought and highlights their potential for real-time prediction of freely moving thought.

Topic Area: OTHER

C144 - Effect of Transcutaneous Vagus Nerve Stimulation on the Perception of Time Deviations

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Time perception is a fundamental aspect of human cognition, and is associated with a range of cognitive processes, including executive functions such as inhibition control and working memory. There is evidence that transcutaneous stimulation of the vagus nerve (tVNS) can improve cognitive functions such as response inhibition and conflict processing. However, it is still unknown whether tVNS affects time perception. We expect that tVNS would affect the processing of time by modulating the neural circuits responsible for time perception, including prefrontal cortex, as it increase the activation of the locus coeruleus-noradrenaline system. To test this hypothesis, we asked 20 participants to perform an anisochrony detection task while they received tVNS or a sham stimulation. In this task, participants were asked to identify whether a sequence of five tones was temporally regular (i.e., isochronous) or irregular. When irregular, the fourth tone in the sequence was delayed. A staircase protocol produced estimates of the anisochrony detection threshold. We found that tVNS improved participants' ability to detect smaller time delays compared to the sham stimulation, showing enhanced sensitivity to detecting deviations from isochrony of tones. These findings suggest a potential link between the neural circuitries stimulated by tVNS and those subserving time perception.

Topic Area: OTHER

C145 - Novel cognitive testing tool for epilepsy patients and the cognitive deficits detected

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People with epilepsy (PwE) often have impaired cognition. However, cognitive testing instruments commonly used for PwE are lengthy and require in-person administration. Moreover, PwE often live far from tertiary care centres. Fully understanding the cognitive abilities of PwE is essential for developing targeted and proactive neuropsychological interventions for this population. Thus, it is imperative to identify an efficient, yet comprehensive, cognitive assessment for PwE that can also be administered remotely. This pilot study assesses the feasibility of using an online cognitive testing battery called Creyos for PwE to explore their cognition. Creyos involves 12 tasks, each evaluating a different area of cognition and taking one to three minutes to complete. Participants are recruited from an in-patient neurology unit in London, Ontario, Canada and complete the tasks on an iPad from their hospital bed. Results are compared to age- and sex-matched norms from the Creyos normative database of over 75,000 healthy individuals. Thus far, 46 PwE (mean age = 38.0 (SD=16.2), 29 females) completed the Creyos battery. Participants performed significantly worse than matched norms on 11 tasks ($p<.05$) and in the three broad cognitive domains that the 12 tasks map onto: short-term memory ($t= -6.235$), reasoning abilities ($t= -4.163$), and verbal processing ($t= -7.094$) ($p<0.05$). This work supports previous research showing deficits among PwE in several cognitive areas, and especially contributes to the limited literature on objective short-term memory deficits among PwE. We also established the feasibility of Creyos for PwE and support the use of online cognitive testing for PwE.

Topic Area: OTHER

C146 - Association between vascular risk factors, as measured by the CAIDE risk score, and resting-state functional connectivity differs by menopause status

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Past work has found that natural menopause at midlife affects the brain's intrinsic functional organization, as measured by resting-state functional connectivity (rsFC). Vascular risk (VR), which has been found to increase during post-menopause, is associated with alterations in rsFC. However, it remains unknown whether VR may account for reported differences in rsFC between middle-aged pre- compared to post-menopause females, and if any observed differences relate to chronological age. To address this, we used behavioural partial least squares (B-PLS) connectivity analysis to examine the effect of menopause, age, and VR in 33 premenopausal (Pre-Meno) and 36 postmenopausal (Post-Meno) middle-aged females on rsFC. To measure VR, we computed subjects' Cardiovascular Risk Factors, Aging and Dementia Risk (CAIDE) scores. The B-PLS analysis identified two significant latent variables (LV2 and LV4, p's<0.001). LV2 identified age effects in Post-Meno females where advanced age was associated with decreased within-network FC in the default mode, hippocampal, salience/ventral attention, and somatomotor networks, and decreased between-network FC involving hippocampal, dorsal attention, salience/ventral attention and somatomotor networks. LV4 identified an age vs. CAIDE effect in Pre-Meno females where increased age and lower CAIDE score was associated with decreased FC between the hippocampal and dorsal attention network, and with generalised increases in between-network FC, with the exception of the hippocampal network. We conclude that the association between CAIDE and Age with rsFC differs among menopause groups and that CAIDE risk may be more related to brain function in Pre- compared to Post-Meno females at midlife.

Topic Area: OTHER

C147 - Cognitive Profiles in Treatment-Resistant Late-Life Depression and the Impact on rTMS Treatment Outcomes

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Late-life depression (LLD) is frequently linked to cognitive impairment, yet substantial heterogeneity exists among individuals. Data on the extent and frequency of cognitive impairments are inconclusive, particularly in treatment-resistant depression (TRD). This study aimed to investigate cognitive profiles of older adults with TRD vs. non-TRD and identify distinct cognitive subgroups among individuals with LLD. Additionally, we examined whether cognitive subgroups differentially responded to treatment with bilateral repetitive transcranial magnetic stimulation (rTMS). A total of 165 patients with LLD were subdivided into treatment-resistant and nonresistant groups and compared to healthy controls (HC) on measures of executive function, information processing speed, verbal learning, and memory. Cluster analysis was conducted to identify subgroups within the LLD group based on cognitive scores. Demographic and clinical variables, as well as outcomes with bilateral rTMS were compared between the cognitive subgroups. We found that patients with LLD exhibited significantly worse performance across most cognitive measures compared to HC, and these impairments were more pronounced in TRD. A three-cluster solution emerged, including "Cognitively Intact" (n = 89), "Cognitively Diminished" (n = 29), and "Impaired Memory" (n = 47) groups. Both the "Cognitively Diminished" and "Impaired Memory" groups had more anxiety symptoms than the "Cognitively Intact" group. No significant differences were observed in other variables, nor in the response to rTMS treatment. Future research is needed to determine the relationship of cognitive subgroups with risk for further cognitive worsening and neurodegeneration.

Topic Area: OTHER

C148 - Promoting Brain Health and Resilience: The Effect of Three Types of Exercise on Blood-Based Neurotrophins

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Physical exercise is positively associated with mechanisms of brain health, one involving blood-based neurotrophins. Neurotrophins are neuroprotective, promoting brain health and resilience via growth and plasticity of neurons. However, the differential influences of exercise type on neurotrophic release into the cardiovascular system have yet to be established. In a repeated measures cross over design, we evaluated the acute impacts of moderate-intensity continuous exercise, high-intensity interval exercise, and resistance exercise on blood-based neurotrophins in 12 subjects (18-45) over a 5-week period. In all exercises, subjects had phlebotomy, cardiac, grip and mood measures taken pre-exercise, post-exercise, 30-minutes, and 60-minutes post-exercise. Brain-derived Neurotrophic Factor (BDNF), an extensively studied protein involved in neuroplasticity served as the primary neurotrophin of interest, while the other measures served as secondary measures associated with brain health and resilience. The primary hypothesis posited an acute increase in blood plasma BDNF immediately following each exercise with sustained elevation for 30-minutes returning to baseline by 60-minutes. Secondary predictions suggested high-intensity interval exercise would yield a higher BDNF response relative to the other exercises. Blood-based analysis of BDNF is currently underway and will be shared during poster presentations. However, cardiac metrics (RMSSD) significantly changed from pre to post as an effect of exercise and time and gradually recovering to baseline, suggesting dynamic changes in parasympathetic tone for all conditions. Grip and mood measures showed no significant changes. This study serves to elucidate the relationship between exercise and brain health and promote further inquiry into the mechanisms of exercise on brain health.

Topic Area: OTHER

C149 - Attempting dream decoding with generalizable visual EEG encoding models

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The realm of dreams remains relatively uncharted, largely due to the reliance of subjective reports to access dream content. This study aims to use electroencephalogram (EEG) to decode visual dream contents. We leveraged an encoding model which generates EEG signals from deep neural network (DNN) feature maps of visual images. The model was trained on a large EEG dataset of waking EEG responses to 18,540 naturalistic images (THINGS2). We first investigated the model's generalizability by testing it on another waking EEG dataset built from the same image database (THINGS1). The encoding model successfully generalised across diverse data collection conditions by training on visual perception from THINGS2 and accurately

decoding visual perception from THINGS1. Distinct neural representations for different visual images were observed at 0.1-0.15 and 0.5 seconds following the presentation of visual stimuli. Second, we tested if the same model trained on waking perception would generalise to a novel database of EEG collected during dreaming (DREAM). Visual DNN feature maps were generated for each dream report by converting dream reports to images using text2image AI (Stable Diffusion XL 1.0). A permutation test and representative similarity analysis (RSA) were conducted on both the waking and dream EEG dataset. The correlation between the dream EEG signals and AI-generated dream images was insignificant, though we observed relatively higher decoding for REM dreams than non-REM dreams. Future improvements to the model might include a larger dream database or more specific tuning of the encoding model to capture the differences between waking and dreaming perception.

Topic Area: OTHER

C150 - Sex Differences in the Association Between Blood Pressure and Cognitive Aging Trajectories Among U.S Hispanic/Latino Adults

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Increased blood pressure is associated with cognitive decline. However, few studies have examined sex differences in the associations between blood pressure and cognitive aging trajectories in U.S. Hispanic/Latino adults. Participants included 1,075 Hispanic/Latino adults without dementia, ages 41-104 years (mean=71.95 years, SD=8.0), from the National Alzheimer's Coordinating Center collected 2015-2022 from 33 sites. Three sets of mixed-effects regression models were built to assess the interactive effect of baseline blood pressure variables [e.g., pulse pressure (PP), systolic (SYS), and diastolic (DIAS) blood pressure] and sex on longitudinal changes in cognition (global, immediate and delayed episodic memory, verbal fluency, processing speed, attention, working memory, and language). All models were adjusted for age at baseline, years of education, cognitive status, language preference, Hispanic/Latino heritage, body max index, apolipoprotein E4 carrier status, and hypercholesteremia. Our results showed two significant 3-way interactions indicating sex differences in the associations between blood pressure variables and cognitive trajectories ($Fs \geq 5.634$, $ps \leq 0.01$). Specifically, compared to women, men with higher PP and SYS experienced a greater decline in global cognition ($\beta = -0.014$, $p = 0.018$) and attention ($\beta = -0.007$, $p = 0.011$) over time, respectively. No significant interactions of DIAS by sex were found. Our results suggest that men may be more susceptible to cognitive decline at higher levels of blood pressure than women. These findings are consistent with recent work that observed greater age-related differences in brain volumes among Hispanic/Latino men compared to women. Future studies should elucidate the mechanisms driving sex differences in the associations between blood pressure and cognitive aging trajectories.

Topic Area: OTHER

C151 - Large-scale cortical networks are organized in structured cycles

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The brain needs to perform a diverse set of cognitive functions essential for survival, but it is unknown how it self-organizes to ensure that each of these functions is fulfilled within a reasonable period. It is a widely shared belief that they arise from dynamic switching in coherent activity within large-scale cortical networks. Here, we developed a new method to study the temporal evolution of these networks based on the long-term asymmetries in state transitions. We show that cortical networks activate in a structured manner in spontaneous brain activity. Reproduced across five independent magnetoencephalography (MEG) studies, we show that the network activations are stochastic on short time scales but self-organize into a distinct cycle that has a 300-1000 ms duration, with each network occupying a preferred location within the cycle. We further show that the cycle groups cortical networks with similar function and spectral content at specific positions within the cycle, and in turn, that the position of an individual's brain activity within the cycle is predictive of cognition, including the spontaneous replay of memories. Moreover, we find that an individual's cycle strength and cycle speed are heritable and predictive of individual traits; with stronger and slower cycling found in older people and males. These results suggest that cortical network activations are inherently cyclical and may provide the organisation the brain needs to spend time focusing on different cognitive functions. This occurs at time scales that have previously been shown to be the most relevant for global brain processing.

Topic Area: OTHER

C152 - Brain network flexibility predicts Openness/Intellect and intelligence

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Growing understanding of the nature of brain function has led to increased interest in interpreting the properties of large-scale brain networks. Methodological advances in network neuroscience provide means to decompose these networks into smaller functional communities and measure how they reconfigure over time as an index of flexibility. Recent evidence has identified associations between flexibility and a variety of traits pertaining to complex cognition including creativity and working memory. The present study used measures of dynamic resting-state functional connectivity in data from the Human Connectome Project (N = 994) to test associations with Openness/Intellect and general intelligence, two traits that describe flexible cognition. Using a machine-learning cross-validation approach, we identified reliable associations of intelligence with cohesive flexibility of parcels in large communities across the cortex, and of Openness/Intellect with overall flexibility among parcels in smaller communities. These findings are reasonably consistent with previous theories of the neural correlates of intelligence and Openness/Intellect, and help to expand on previous associations of behavior and dynamic functional connectivity within the context of broader personality dimensions.

Topic Area: OTHER

C153 - Shared longitudinal neural representations of sleep, depression and cognition

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Relationships between sleep, depression, and cognition are complex with many conflicting observations such as both insomnia and hypersomnia manifesting as symptoms of depression. We have recently shown counterintuitive correlations of shared neural representations between associations of longer sleep and increased frequency of insomnia and depression in resting-state activations. Insomnia and depression were associated with hyperconnectivity in resting-state activations but hypoactivation in task conditions. However, these observations were cross-sectional and therefore unable to inform potential causation. In this study, we begin to address the temporal aspect of these relationships with repeated resting-state fMRI scans paired with measures of sleep, depression, and cognition in UK-Biobank (N=1188). We measured the association between the change in fMRI signals between two scans and the change in phenotype recorded at each scan. This analysis revealed associations of change in sleep duration with top-down attentional modulation from frontoparietal to visual areas (coefficient=0.61; p-value=0.002) and associations of change in depression symptoms with functional connectivity between default mode and motor networks (coefficient=0.4; p-value=0.032). Additionally, brain-wide associations between changes in frequency of insomnia and both sleep duration and depressive symptoms were positively correlated while those between sleep duration and depression were not. This indicates that neural dynamics change similarly with increase in sleep duration and in insomnia frequency. These results further support the notion of insomnia as a hyperarousal state where neural dynamics resemble those of rested wakefulness. They enable us to understand the causal relationships between insomnia and depression which could ultimately inform new and more effective interventions.

Topic Area: OTHER

C154 - Spontaneous fluctuations in task-independent brain network topologies are correlated with core and multidomain cognitive skills in early adolescence

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The role of spontaneous inter-regional coordination in the adolescent brain, via incompletely maturated neural circuits, in developing cognitive skills is elusive. We investigated the cognitive correlates of dynamic topological fluctuations in task-independent brain networks, using resting-state fMRI from 4099 pre/early adolescents (53.1% females, median age = 120.0 months) from the Adolescent Brain Cognitive Development (ABCD) study. Dynamically-varying networks and their topological properties were estimated from custom-processed fMRI signals using a covariance-based approach. Their temporal variability was quantified by the coefficient of dispersion, and was correlated with performance across the ABCD neurocognitive tasks, using multivariate linear regression models (controlling for false discovery). The temporal variability of multiple properties of dorsal attention and frontoparietal control networks was positively correlated with age-corrected crystalized and total composite scores, and performance in the picture vocabulary, oral reading recognition and matrix reasoning tasks ($p<0.05$, $\beta = 0.037 - 0.051$, 95% confidence interval (CI) = [0.011, 0.081]). Topological variability in the prefrontal cortex was positively associated with performance in the list sorting working memory task ($p<0.01$, $\beta = 0.056 - 0.068$, CI = [0.025, 0.099]). Modularity variability in fronto-basal ganglia and left salience networks was negatively associated with total composite and matrix reasoning scores ($p<0.05$, $\beta = -0.043$ to -0.038, CI = [-0.076, -0.007]). These results suggest that spontaneous fluctuations in circuit topology of underdeveloped adolescent brains may play a significant role in overall cognitive function, fluid and crystallized ability, cognitive flexibility, and domain-specific performance.

Topic Area: OTHER

C155 - Virtual reality and dreaming

D. Blaise Elliott[1] (blaiseelliott@u.northwestern.edu), Daniel J. Morris[2], Rachel E. David[3], Justin Wall[4], David Glowacki[5], Ken A. Paller[6]; [1]Northwestern University, [2]CiTIUS Intelligent Technologies Research Centre, [3]Milarepa Center

Virtual Reality (VR) technology has great potential for exploring new dimensions of human cognition. When comparing real-world experiences, VR experiences, and dreamed experiences, in each case there is a sense in which the experience is real as well as a sense in which it is not. Dream research has historically faced many challenges, including the difficulty of experimentally controlling dream content. Waking elements commonly re-appear in dreams, but here we also used sensory stimulation to enhance incorporation. We investigated a VR experience developed by Glowacki and colleagues (2022), who reported that their multi-person experience functioned to blur conventional self-other boundaries. We used a variant, termed Ripple, using Oculus devices. Users interact in the Ripple environment, connecting from different locations. Our study began with an in-lab session lasting 90 minutes in which participants completed Ripple with one to three other participants situated in different rooms. Then they completed online dream journals each morning for a week. Then they returned to the lab to repeat the Ripple VR experience and to sleep overnight with polysomnographic recordings plus auditory reminders of Ripple. A second week of dream reports was obtained, followed by a final interview. Preliminary analyses showed that Ripple elements were incorporated into dreams. We are also examining whether any particularly profound moments of awe or beauty during Ripple influenced subsequent dreaming. This initial investigation underscores the potential for VR to produce ego attenuation and prosociality, while also biasing subsequent dreams, which could then amplify VR effects.

Topic Area: OTHER

C156 - The neural development of Mandarin lexical tone processing in bilingual English-Mandarin children

Andres F. Diaz[1] (diaza1@stjohns.edu), Sharry Guo[2], Autumn Hill[1], Valerie L. Shafer[2], Gavin M. Bidelman[3], Yan Yu[1]; [1]St. John's University, New York, USA, [2]The Graduate Center, City University of New York, [3]Indiana University

Both language experience and stimulus properties (i.e., acoustical salience) influence the development of lexical tone processing. Event-related potentials (e.g., mismatch responses, MMRs) and behavioral measures show that Mandarin lexical tone processing is immature in monolingual toddlers and preschool children. However, the developmental trajectory and how childhood bilingualism affect the MMR with respect to lexical tone processing remain largely undefined. Here, we used EEG and an oddball paradigm in which Mandarin tone 3 (low rising) served as the standard stimulus, and tone 2 (rising) and tone 1 (high level) as deviant stimuli. We measured MMRs in bilingual English-Mandarin children between 5 and 10 years of age and between 13-18 years of age. We found that the youngest children (5- to 7-year-olds) showed more positive MMR to Tone 3 -Tone 2 contrasts compared to older children (8- to 10-year-olds), while these two age groups showed similar MMR to the Tone 3 – Tone 1 contrasts. Bilingual teenagers showed similar Mismatch Negativity (MMN) and late negativity responses to native Mandarin speaking adults [Yu et al. (2018)]. These results suggest that automaticity in lexical tone processing occurs over a more protracted timeframe in bilingual Mandarin-English learning children compared to their monolingual Mandarin-learning counterparts.

Topic Area: PERCEPTION & ACTION: Audition

C157 - The neurophysiology of multi-feature music processing in children with different language backgrounds

Angela Cheng[1] (angela.cheng22@my.stjohns.edu), Maxfield Rodgers[1], Kristal Reyes[1], Faith Chai[1], Blessy Gill[1], Gavin M. Bidelman[2], Valerie L. Shafer[3], Yan H. Yu[1]; [1]St. John's University, New York, USA, [2]Indiana University, [3]The Graduate Center, City University of New York

The association/dissociation between music and language processing has long been a matter of debate. Musicians and tonal language speakers are more sensitive to pitch differences than nonmusicians and nontonal language speakers. Bilingual experience modulates auditory processing of sounds, but it is unclear whether and how bilingual experience affects music processing. We measured music processing in bilingual children (5-10 years old) from Mandarin (a tone language) households and three groups of age-matched children from non-tone language households (Bilingual Spanish-English, monolingual mainstream American English (MAE), and African American English (AAE)). The central question was whether bilingual experience on its own enhances auditory processing in general, or whether the its influence on music is dependent on language-specific properties (e.g., tone language, syllable-timed (English) or stress-timed (Spanish) language)). Event-related brain potentials (ERPs) were recorded in an oddball paradigm with six types of music changes (intensity, pitch, rhythm, timbre, slide and location). Preliminary results suggest that for music location changes, monolingual children from MAE backgrounds show larger negative responses (i.e., change detection) than the other three groups. Bilingual Mandarin-English and Spanish-English children showed larger negative responses to intensity compared to the MAE and AAE children. Children with Spanish-English backgrounds showed weaker responses to the change of rhythm and pitch compared to the other three groups. There were no clear advantages of pitch processing for children with Mandarin-English backgrounds. Our initial findings imply that bilingual experience on its may not influence music processing

Topic Area: PERCEPTION & ACTION: Audition

C158 - Investigating the Neural Underpinnings of Math and Reading Across the Lifespan

Hillary Mastarciyan[1], Ju-Chi Yu[3], Devin Sodums[2], Brian Levine[2,4,5], Moriah Sokolowski[1,2]; [1]Toronto Metropolitan University, Toronto, ON, Canada, [2]Rotman Research Institute, Baycrest Health Sciences, Toronto, ON, Canada, [3]Campbell Family Mental Health Research Institute, Centre for Addiction and Mental Health, Toronto, ON, Canada, [4]Department of Psychology, Univeristy of Toronto, Toronto, ON, Canada, [5]Department of Medicine [Neurology], University of Toronto, Toronto, ON, Canada

Math and reading are important skills typically learned during childhood; a period characterized by well-documented changes in large-scale brain organization. Previous studies exploring the neural basis of academic skills focus on how activation within individual brain regions relate to math or reading ability. While this approach provides significant insights into the neural underpinnings of early academic skills, it may underestimate the influence of whole brain network organization. The current study investigates the association between network level functional organization of the whole brain and individual differences in reading and math across the lifespan. Participants include 403 adults and 85 children (age range; 6-85 years) from the enhanced Nathan Kline Institute-Rockland Data Sample (NKI-RS). Reading and math ability were measured using the Wechsler Individual Achievement Test (WIAT-IIA), a standard assessment used to measure academic achievement. Whole-brain network organization, measured by the strength of within-network versus between-network connections (i.e., network segregation), was calculated using functional connectivity matrices from resting-state functional magnetic resonance imaging (fMRI) scans. Multivariate analyses were used to investigate the association between network segregation, across 7 brain networks, and individual differences in math and reading

ability, controlling for age. Results revealed that reading ability correlates with greater network segregation in visual, default and frontoparietal networks. Furthermore, math ability correlates with greater network segregation of the limbic system from the rest of the brain. Additional analyses unravel age-specific associations between academic achievement and network segregation. These findings highlight that functional brain organization contributes to individual differences in academic learning across the lifespan.

Topic Area: THINKING: Development & aging

Poster Session D

Monday, April 15, 2024, 8:00 – 10:00 am, Sheraton Hall ABC

D1 - Multi-session transcranial alternating current stimulations facilitate working memory in older adults by synchronizing the parietal theta oscillation

Yun Zhong[1] (ceceliazy@163.com), Xiyue Chen[1], Ying Cai[1]; [1]Zhejiang University

Recent studies have reported that multi-session theta transcranial alternative current stimulations (tACS) over the inferior parietal lobule (IPL) enhanced working memory (WM) in older adults. However, without direct examinations of untrained tasks and clarifications of the underlying neural plasticity mechanism, its further application remains unclear. Forty-four elders participated in the current study (50~61 years, 23 females). For 5 consecutive days, half participants received 20-minute 4-Hz tACS over the IPL during a word-learning task and others received 30-second sham stimulations. Electroencephalographs (EEG) were recorded 1-day before and after stimulations in both the resting state and during a change detection task for colors. Additional behavioral tests followed 1-month later. We found improvements in the word-learning recency effect (i.e., verbal WM) and the color WM accuracy only in the tACS group (ps < 0.001, BFs > 30), which were sustained for 1 month (ps < 0.01, BFs > 10). Meanwhile, we compared the neural changes between the two groups. In the resting state, tACS didn't change the theta powers (4-7Hz) but increased the theta synchronizations between the stimulation site and the ipsilateral parietal sites and contralateral frontal sites (after multi-comparison corrections). Moreover, the parietal theta synchronization increases predicted both behavioral improvements in the tACS group (ps < 0.05, BFs > 1.9). Consistently, during the color WM maintenance, tACS increased event-related potentials and theta synchronizations in similar areas. Together, our study demonstrated that the multi-session tACS improved general WM ability by increasing the parietal theta synchronizations, and largely extended the future application of tACS.

Topic Area: EXECUTIVE PROCESSES: Working memory

D2 - EEG-based decoding of stimulus shapes and their categories in working memory

Frida Printzlau[1,2] (frida.printzlau@utoronto.ca), Olya Bulatova[2], Keisuke Fukuda[1,2], Michael Mack[1]; [1]University of Toronto, [2]University of Toronto Mississauga

Working memory (WM) allows us to store information in a highly accessible format for an upcoming task. Traditionally, WM studies require participants to keep a precise copy of a stimulus in mind. But in the real world, we might need to store the same information for different types of tasks, such as recognition or categorisation judgements. For example, when deciding if a bike is the exact model you want, or the same brand. In this study, we asked how categorisation modulates WM representations. Participants first learned to group unfamiliar shapes from the Validated Circular Shape (VCS) space (Li et al., 2020) into two categories. They then completed a shape WM task that either required delayed match-to-sample or delayed match-to-category judgements on different blocks while we collected electroencephalography (EEG) data. We tracked the emergence of stimulus-, category- and task level information with high temporal resolution using multivariate pattern analyses of EEG. The neural activity pattern contained information about the memorised shape for about one second following encoding. Initially, the stimulus code overlapped across the two tasks, but quickly separated according to task. Later in the delay, stimulus coding persisted only for the match-to-category task and was accompanied by a neural category signal, indicating that categorisation may require an active stimulus representation. To our knowledge, this is the first illustration that the VCS space is decodable from EEG, preserving the circular similarity structure. This provides a fruitful avenue for researchers looking to characterise neural representations of unfamiliar stimuli with high temporal resolution.

Topic Area: EXECUTIVE PROCESSES: Working memory

D3 - Characterizing hierarchical organization structures of working memory

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It is well acknowledged that working memory (WM) reorganizes information according to structures such as chunks to overcome its limited capacity. Although previous computational models could characterize WM performance, a model capable of inferring organizational structures of information in WM from behavior is still lacking. Moreover, most models operate on a one-layer dimension and seldom take hierarchical properties into account. Here, we developed an integrative model aiming to capture the WM hierarchical structure. Specifically, we defined 1-D sequence WM as the primitive profile based on the previous sequence WM model, and applied it self-referentially and recursively to all levels from local to global along the hierarchy to characterize overall behaviors. We verified our hierarchy WM model and compared it to the sequence WM model in two experiments. In Experiment 1, human participants were instructed to retain a sequence of 9 syllables belonging to three trisyllable words in WM. Our hierarchical model demonstrates better performance in explaining reaction time (RT) than the sequence WM model and could infer the innate hierarchical structure at both group and individual levels. As a control, in Experiment 2, subjects performed the same task but on 9 random syllables. The sequence WM model performs better than the hierarchy model in accounting for behavior in this case, indicating a lack of structured organization for the random syllables. Taken together, we developed a new computational model to characterize how sequence information is organized in WM, which efficiently captures the hierarchical chunking strategy humans employ to overcome capacity limitations.

Topic Area: EXECUTIVE PROCESSES: Working memory

D4 - Programs that organize task execution are decodable everywhere

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It is well recognized that control during extended tasks requisites some form of hierarchical cognition. For existing accounts this involves higher-level sequence-representations (e.g., schemas, situation models) controlling the identity and sequence of lower-level actions/rules/contexts much like recipes control cooking. Related studies have evidenced the decodablity of these higher-level sequence-representations from the activity-patterns of the control related fronto-parietal multiple demand (MD) regions and/or the default mode (DMN) regions. In comparison, we suggest a more pervasive aspect of hierarchical control whereby all kinds of control processes during extended tasks (e.g., attention, WM) may be brought about through subsuming meta-control programs related to the overarching goal. These programs are instantiated at the beginning of execution but embody the executive commands that will go on to instantiate the various control processes across the entire task duration. This mode of hierarchical control predicts that otherwise identical tasks that only differ in their total length would still be executed via distinct meta-control programs. Our participants executed two otherwise identical extended tasks that only differed in their lengths. The two tasks involved identical rules and contexts, and involved no sequence-representations. We found that these tasks could still be decoded at their beginnings and completions, evidencing the presence of distinct meta-control programs that were assembled and dismantled respectively at these junctures. Interestingly, this decoding was not limited to MD and DMN regions but involved nearly the entire cortex, suggesting that the meta-control programs that ensconce control operations involve the entire cortex.

Topic Area: EXECUTIVE PROCESSES: Working memory

D5 - Working memory interrupted: the role of age and benefits of anticipation

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Task interruptions are an integral part of everyday life. Handling them requires the flexible use of working memory and attentional control mechanisms, which were shown to be affected by cognitive aging. Here, we investigated age effects on dealing with task interruptions, and potential advantages of anticipating an interruption, using EEG and a

retrospective cueing (retro-cue) working memory (WM) paradigm. Young (18-30) and older (55-70) participants performed a visual WM task, in which they had to maintain the orientation of two bars, one of them being probed for report following a retro-cue. Within blocks of 10 trials, they were either always, never, or randomly interrupted with an arithmetic task before the onset of the retro-cue. As expected, interruptions induced lower performance in the primary task, and this decline was stronger in the older participants. However, in contract to younger participants, older participants benefited from anticipation. Further, the EEG revealed a lower oscillatory power in the theta frequency range and a reduced suppression of alpha/beta oscillatory power to the retro-cue following interruptions. These effects were more pronounced for the older participants. In both groups, anticipated interruptions were associated with increased theta and alpha/beta power before and during the interruption phase, and stronger beta suppression to the retro-cue. The results support the notion that interruptions impair the refocusing of attention on the primary task, more specifically so in older people. However, they also show that anticipation enables preparatory mechanisms for the interruption task and facilitates primary task resumption.

Topic Area: EXECUTIVE PROCESSES: Working memory

D6 - When distraction interferes with natural behaviour

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Visual distraction is a ubiquitous aspect of everyday life. Consider following a recipe when baking. We have no trouble finding the necessary utensils and ingredients in the kitchen and combining them into a comforting product. During such natural behaviours, we often encounter many competing visual objects (distractors) while we hold relevant objects in mind (e.g., seeing the flour as we search for the sugar). Despite the distractions, we usually succeed in completing our behavioural goals. Studying the consequences of distraction during such temporally extended tasks, however, is not tractable with traditional methods. To solve this, we developed a virtual reality approach that segments complex behaviour into cognitive subcomponents, including encoding, visual search, working memory usage, and decision-making. Participants copied a model display by selecting objects from a resource pool and placing them into a workspace. By manipulating the distractibility of objects in the resource pool, we discovered dissociable but interacting effects of distraction across the different cognitive subcomponents. Distraction slowed down behaviour and increased costly body movements. Critically, distraction increased encoding demands, interfered with visual search, and decreased reliance on working memory. We could successfully trace the consequences of distraction all the way to the decision-making processes that gate memory usage. Our findings reveal that distraction has focal instead of widespread effects on behaviour but has cascading consequences on core cognitive processes.

Topic Area: EXECUTIVE PROCESSES: Working memory

D7 - Hippocampal ripple and its interaction with neocortex support successful visual short-term memory

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Hippocampal ripple activity, a highly synchronized neural oscillations generated by local neuronal assemblies (70-180 Hz), has been indicated as playing a critical role in human episodic memory. Nonetheless, how the hippocampal ripple and its interaction with neocortex supports visual short-term memory (VSTM) remains far from clear. The current study investigated the intracranial electroencephalogram (iEEG) recordings of both the hippocampus (HPC) and lateral temporal lobe (LTL) from 14 epilepsy patients during a delayed matching to sample task with naturistic objects as stimuli. The results revealed that hippocampal ripple rates dynamically changed across different VSTM stages. Specifically, hippocampal ripple rates increased during early encoding, ramping up during maintenance, and persistently rising until VSTM responses were made. Importantly, greater ramping-up of hippocampal ripple rates during maintenance predicted successful VSTM memory while higher ripple rates during retrieval predicted faster response times. Moreover, these hippocampal ripples were coupled to the LTL ripples with higher probabilities of LTL ripples occurring around hippocampal ripples (i.e., HPC-LTL co-rippling), showing a similar ramping up during maintenance, especially among remembered trials. Similarly, greater HPC-LTL co-rippling during VSTM retrieval predicted faster response time. Further ripple-locked multivariate decoding analysis based on broadband spectral power revealed that both hippocampal ripples and LTL ripples were associated with memory representational reinstatement during all VSTM stages. All the above-mentioned results were corrected for multiple comparisons. Taken together, our preliminary findings suggested that dynamically changed hippocampal ripple activity, coupled with LTL ripples, coordinates the reinstatement of memory representations in supporting successful VSTM.

Topic Area: EXECUTIVE PROCESSES: Working memory

D8 - A Timeline of the Stimulus Memorability Benefit in Visual Working Memory

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Some visual stimuli are more memorable than others. Previously, we found that memorable stimuli enjoy a dual benefit within visual working memory (VWM). They are stored more efficiently in VWM and are also more competitive at attracting VWM resources than forgettable stimuli. In this study, we examined the hypothesis that this competitive advantage of memorable stimuli reflects preferential allocation of spatial attention toward memorable stimuli. To test this, we had participants perform a VWM task where they remembered an array composed of both memorable and forgettable faces. Critically, on 20% of trials, letters were superimposed on the faces at various stimulus onset asynchronies. When this happened, participants had to report all the letters they saw instead of faces. This enabled us to examine where spatial attention was allocated at different times during viewing. Here, participants did not report more letters superimposed on memorable faces than on forgettable faces until 450ms after the face onset, suggesting that spatial attention is not immediately biased toward memorable stimuli. Next, we examined when the efficiency and competitive benefits emerge in relation to the differential allocation of spatial attention. Specifically, we had participants perform the same VWM task while manipulating the stimulus duration. Here, the efficiency benefit emerged before the attention effect, but the competitive benefit emerged after it. We speculate that this may be due to memory-guided attention where memorable stimuli are efficiently encoded into VWM, and because they are in VWM, they attract attention, thus garnering an additional processing boost (the competitive benefit).

Topic Area: EXECUTIVE PROCESSES: Working memory

D9 - Inhibitory Control in Working Memory Gate Opening: Insights from Alpha Desynchronization and Norepinephrine Activity Under atDCS Stimulation

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Our everyday activities require the maintenance and continuous updating of information in working memory (WM). To control this dynamic, WM gating mechanisms have been suggested to be in place, but the neurophysiological mechanisms behind these processes are far from being understood. This is especially the case when it comes to the role of oscillatory neural activity. In the current study, we combined EEG recordings, anodal transcranial direct current stimulation (atDCS), and pupil diameter recordings to triangulate neurophysiology, functional neuroanatomy, and neurobiology. The results revealed that atDCS, compared to sham stimulation, affected the WM gate opening mechanism but not the WM gate closing mechanism. The altered behavioral performance was associated with specific changes in alpha band activities (reflected by alpha desynchronization), indicating a role for inhibitory control during WM gate opening. Functionally, the left superior and inferior parietal cortices were associated with these processes. The findings are the first to show the causal relevance of alpha desynchronization processes in WM gating processes. Notably, pupil diameter recordings as an indirect index of the norepinephrine (NE) system activity revealed that individuals with stronger inhibitory control (as indexed through alpha desynchronization) showed less pupil dilation, suggesting they needed less NE activity to support WM gate opening. However, when atDCS was applied, this connection disappeared. The study suggests a close link between inhibitory-controlled WM gating in parietal cortices, alpha band dynamics, and the NE system.

Topic Area: EXECUTIVE PROCESSES: Working memory

D10 - Investigating the Neural Substrates of Working Memory in Williams Syndrome and Typically Developing Children

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Williams syndrome (WS) is a rare neurodevelopmental disorder caused by hemideletion of ~26 genes at chromosomal locus 7q11.23. While previous behavioral research has reported working memory (WM) problems in people with WS, the neural underpinnings of this finding remain largely unexplored. Using fMRI, we investigated the neural responses to a WM task in children with WS and typically developing children (TDs). 3T-fMRI data were longitudinally collected from 15 individuals with WS (mean age=16±3.9 years, 11 females, 48 visits) and 20 TDs (mean age=15±3.9 years, 16 females, 40 visits). Groups were matched for accuracy on the WM task (WS=75.1%, TD=74.6%), which consisted of viewing pairs of images presented separately and sequentially and then indicating whether the second image matched the first image in terms of either content or height on the screen. Using a voxel-wise, mixed-effects model, we tested for group differences in activation during working memory while controlling for age and sex. Results were thresholded at p<0.05, FDR corrected. We found that individuals with WS had altered recruitment of regions in the working memory network compared to TDs. The results included reduced activation bilaterally in inferior parietal lobules and increased activation in bilateral dorsolateral prefrontal cortex (DLPFC). Our findings of hypoactivation in parietal regions are consistent with prior research showing structural and functional alterations in WS. Additionally, we found that individuals with WS recruited DLPFC more than their TD peers. Together, our findings demonstrate alterations in neural processing in regions associated with working memory in WS.

Topic Area: EXECUTIVE PROCESSES: Working memory

D11 - Nature Ultrasoundscapes for Attention Restoration and Stress Reduction

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Engaging with natural environments has been shown to reduce stress and improve cognitive performance. Exposure to natural stimuli may refresh our ability to focus by providing a respite from constant demands on our attention. Natural stimuli may also improve emotional and physiological well-being, mitigating the negative effects of stress. This effect has been demonstrated by comparing recordings of natural soundscapes to urban soundscapes. Natural soundscapes often include frequencies that are beyond the range of human hearing (ultrasound). Stimuli with ultrasound appear to increase alpha activity in the brain more than stimuli without ultrasound. Alpha wave activity is associated with a state of relaxed alertness, which may assist with tasks that require focused attention. Relaxation is typically linked to decreased stress levels. It is presently unknown whether incorporating the ultrasound range into recordings of natural soundscapes (aka ultrasoundscapes) can enhance their attention-restoring and stress-reducing properties. To investigate this, we conducted a randomized controlled trial comparing the effects of different types of soundscapes (nature or urban) with different levels of bandwidth (audible-only or audible plus ultrasound). We used a backward digit span task and an n-back task to both deplete and assess attention. Participants completed Positive and Negative Affect Schedule (PANAS) questionnaires to assess their stress levels and emotional responses. Both the task blocks and questionnaires were completed before and after the soundscape intervention. The study compared the attentional and emotional outcomes of natural and urban soundscapes, with and without ultrasound frequencies, to quantify their effects on attention restoration and stress reduction.

Topic Area: EXECUTIVE PROCESSES: Working memory

D12 - Analysis of Alpha Band Activity: Spatial Working Memory in Adults with ADHD

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In our previous research, we identified alpha band changes in children (7-14 years old) diagnosed with Attention-Deficit Hyperactivity Disorder (ADHD) during a Sternberg spatial working memory (SWM) task. Compared to typically developing (TD) children, those with ADHD displayed diminished alpha desynchronization during encoding, particularly over the occipital region, consistent with a potential maturational lag in ADHD in visual attentional processes. This study revisited a subset of these individuals, now adults, to investigate whether the observed alpha band differences persist into adulthood. A total of 85 participants (34 TD/51 ADHD) with mean ages of TD = 25 (±6.7) and ADHD = 23.3 (±4.6) engaged in a SWM task with different loads (1, 3, 5, or 7), while EEG was recorded. ERSP was computed to analyze EEG signal-power changes throughout the trial between groups. Results revealed alpha desynchronization during encoding across Frontal, Central, Parietal, and Occipital scalp regions. This pattern was load-sensitive, replicating earlier findings and supporting alpha as a reliable attentional marker in working memory. However, significant differences between ADHD and TD were observed in parietal electrodes, but not over occipital electrodes as seen in childhood, with no group-by-load interactions in any region. The data suggest a tendency for alpha normalization in the occipital region among ADHD adults, possibly reflecting cortical response maturation. However, the disparity in the parietal region suggests a potential reorganization in cortical network processing during encoding in adulthood. These findings contribute to our understanding of neural dynamics in ADHD individuals.

Topic Area: EXECUTIVE PROCESSES: Working memory

D13 - Structural organization of multiple sources of information for efficient encoding in working memory

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Working memory (WM) is a core cognitive function to flexibly inform and guide future behavior, with its capacity constraining various cognitive abilities. Previous empirical and modelling studies have implied that the human brain may compress or organize multiple sources of information based on their relational regularities, or underlying structure. However, empirical evidence is scarce for how the brain represents structural information in WM and for how it spontaneously leverages this information to organize the storage of multiple items in the service of efficient encoding. Recent developments in cognitive neuroscience suggest that cognitive maps may provide a general framework for organizing information in different tasks and across various domains. Here, we developed a novel experimental WM paradigm in combination with MEG recordings to examine the neural mechanisms supporting efficient information storage by leveraging the underlying task structure. Participants were asked to memorize a sequence of gratings varying on two continuous dimensions: orientation and frequency. Each stimulus could therefore be described within a two-dimensional feature space. Crucially, we manipulate the consistency of directional information defined in the two-dimensional feature space between sequential items. We observed that information was more precisely stored in the same direction compared to different direction condition, indicating that direction information is spontaneously leveraged to compress multiple sources of information. Furthermore, we are examining how abstract direction is encoded in the brain and whether grid-like representations are involved to efficiently organize multi-information storage in WM.

Topic Area: EXECUTIVE PROCESSES: Working memory

D14 - Reactivating and Reorganizing Activity-Silent Working Memory: Two Distinct Mechanisms Underlying Pinging the Brain

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Recent studies have suggested that working memory (WM) can be maintained in an activity-silent state, where it cannot be decoded but can be reactivated by a high-contrast visual impulse (i.e., "pinging the brain"). However, the mechanism underlying pinging the brain remains unclear. The current study tested whether the ping worked through its specific context (e.g., overlapped locations between pings and stimuli) or by generally reducing brain network noise. We recorded electroencephalograph signals

from 58 participants during a delayed recall task. For each trial, two orientations were presented simultaneously along the screen's horizontal or vertical midline and a pre-stimuli cue indicated the recall order. Pings were presented during the delay period and can be categorized as context-dependent or context-independent based on whether their locations overlapped with memorized items. The Mahalanobis distance was utilized to index the representation strength at each time point and the cross-temporal decoding was calculated to examine the representational dynamics. All these analyses were based on posterior voltage signals and findings were focused on the prioritized memory items. Our results revealed comparable reactivations of pings when they were context-independent, but only the reactivations after the horizontal ones became significant when pings were context-dependent. Furthermore, for the same horizontal pings, reactivations lasted longer and representations became more generalized when pings were context-dependent. Together, we confirmed two distinct mechanisms underlying pinging the brain, context-independent pings reactivated WM through noise reduction in a transient and location-invariant way, while context-dependent pings reactivated and reorganized WM in a more sustained but location-sensitive way.

Topic Area: EXECUTIVE PROCESSES: Working memory

D15 - Working Memory Capacity Predicts Serial Dependence for Facial Identity

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Serial dependence (SD) occurs when current perceptions are biased towards sensory input from the recent past. The present study investigated whether interindividual differences in working memory (WM) could predict SD in facial identity perception. Electroencephalography (EEG) was used to capture early perceptual face processing (N170) and WM processing (frontal negative slow waves) in a combined WM/SD task. Participants (n = 25) retained one or three cartoon faces (low/high WM load) while viewing a real facial image preceded by the presentation of a task-irrelevant face. After a 6 s response delay, participants judged the real face in a matching task, followed by a WM test for the cartoon faces. Participants were divided into two groups according to their WM capacity. For participants with low WM capacity, SD occurred in both low and high WM load conditions, while participants with high WM capacity showed SD only in the high load condition. The EEG results for the task-irrelevant face showed significant differences between the high and low load conditions at both perceptual and WM processing stages. In addition, time-frequency analysis revealed significant modulations in alpha/beta frequencies during the response delay. Crucially, the EEG differences were only observed for participants with high WM capacity, suggesting that it is possible to actively prevent task-irrelevant sensory input from being integrated with goal-relevant percepts when WM is not depleted. Overall, our results show that WM control processes related to inhibition of task-irrelevant information and to selective encoding and maintenance of task-relevant information can predict SD face effects.

Topic Area: EXECUTIVE PROCESSES: Working memory

D16 - Confident but wrong: Improving metacognitive assessments of working memory representations

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Our ability to recall information from visual working memory (VWM) is not only constrained by overall capacity limits but also subject to our own assessment of our confidence: We may maintain inaccurate VWM representations we feel confident about. Such confident errors can cause severe costs (e.g., traffic accidents), and thus, it is imperative to reduce them. Here, we tested whether confident errors could be reduced through training, wherein participants received performance feedback on the accuracy of metacognitive assessments of their VWM representations. Furthermore, we examined if this training benefit generalized to new stimulus types. Participants (n = 78) remembered a briefly presented array of six colored squares or oriented bars, and then reported each item along with their confidence in the accuracy of their report. Critically, they received 10, 5, or 0 points for an accurate VWM report coupled with high, low, or no confidence, respectively. Conversely, they lost 10, 5, or 0 points for an inaccurate response coupled with high, low, or no confidence. After measuring baseline performance without feedback, participants repeated either the color or orientation VWM task with feedback. Participants then repeated the two VWM tasks without feedback to assess the training benefit and its generalizability. Overall, we found a reduction of confident errors during and after training relative to baseline. This benefit also generalized to the untrained stimulus. Taken together, our results demonstrate rapid and stimulus-general improvement of metacognitive assessment of VWM representations. Underlying neural components for recognition confidence (e.g., FN400, P3) will be discussed.

Topic Area: EXECUTIVE PROCESSES: Working memory

D17 - Chronic cannabis users exhibit altered alpha and beta oscillations serving numerical working memory processing

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Cannabis is one of the most widely used psychoactive substances in the United States and research has shown that cannabis use impacts several cognitive domains, including inhibitory control, attention, and memory. However, despite such widespread use, the mechanisms underlying these effects remain poorly understood. In this study, we investigated the neural dynamics serving working memory processing in chronic cannabis users and nonusers using high-density magnetoencephalography (MEG) and a novel numerical working memory task. Briefly, MEG data were collected from 39 participants while performing a numerical working memory paradigm, whereby participants were asked to either maintain a group of visually presented numbers or to rearrange the numbers in ascending order. Significant oscillatory neural responses were imaged separately for each condition using a beamforming approach and subjected to whole-brain repeated-measures ANOVAs. Across both conditions, we found that cannabis users exhibited significantly weaker alpha oscillations in superior parietal, occipital, and other regions during encoding relative to nonusers. Interestingly, during the maintenance phase, there was a group-by-condition interaction effect in the right inferior frontal gyrus, left prefrontal, parietal, and other regions, such that cannabis users exhibited stronger alpha and beta oscillatory responses during the manipulate relative to maintain condition, while no such differences were found in nonusers. Finally, oscillatory response strength in the prefrontal cortices predicted accuracy in the nonusers, but not in cannabis users. In conclusion, our results provide evidence for altered neural oscillatory activity across a broad network of regions serving numerical working memory processes in chronic cannabis users relative to nonusers.

Topic Area: EXECUTIVE PROCESSES: Working memory

D18 - Cognitive Training Improves Working Memory, Processing Speed, and Neural Efficiency in Multiple Sclerosis

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Multiple Sclerosis (MS) is a demyelinating disease of the central nervous system featuring multifocal white matter lesions. Working memory (WM) and processing speed (PS) deficits are among the most prevalent cognitive disturbances in MS, and cognitive rehabilitation may serve to improve lost function. The present study investigated performance measures obtained before and after training on either a letter n-back WM or Visual Search PS task in MS. Three MS groups were included in the study: an n-back (WM) training group (N = 14), a visual search (PS) training group (N = 14), and a no-contact control group (N = 15). WM and PS were measured through the administration of 2-back and 4x4 letter array Visual Search (VS) tasks, respectively, before and after a 4-5 week at-home adaptive training procedure. Behavioral measures, including accuracy and reaction time (RT), were obtained along with dense electrode array electroencephalographic (EEG) measures during the 2-back and VS tasks. The findings for the behavioral measures indicated that both the WM and VS training groups showed significant improvement on RT and RT variability from pre- to post-test on their specific training tasks. Importantly, indices of PS variability (purported markers of neural efficiency) provided unique information related to training effects and signified improved neural efficiency after training. Some transfer of training was found for both the n-back and VS groups. These results show the potential benefits of cognitive rehabilitation in MS, and highlight PS and surrogate behavioral markers of neural efficiency associated with each training domain.

Topic Area: EXECUTIVE PROCESSES: Working memory

D19 - Brain-Behavior Correlates of Working Memory in Typical Reading and Dyslexia

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Working memory (WM) is essential for reading and often an area of challenge among readers with dyslexia. Prior research with typically developing children (TD) found that verbal and spatial WM were supported by lateralized neural mechanisms (Nagel et al. 2013). In the context of literacy, verbal WM may be more closely associated with reading (Giofre et al., 2018), yet the brain bases of spatial versus verbal WM in dyslexia remain largely unexplored. This study directly compares verbal and visuospatial WM mechanisms in children with and without dyslexia. Method. Participants were children with typical reading skills (n = 30, Mage = 9.5, SD = 1.2) and dyslexia (n = 26, Mage = 10.6, SD = 1.2). During fMRI, children completed a WM task with a verbal condition and a spatial condition. Results. The two groups did not differ significantly in their visuospatial task accuracy, but did differ marginally in verbal WM (TD > DYS). At the whole group level, both the verbal and spatial conditions engaged bilateral inferior/superior parietal cortex and middle/superior frontal gyrus, consistent with prior literature. Comparison of verbal and spatial conditions revealed greater activation for verbal WM in left occipito-temporal regions associated with print processing. Differences emerged in children with and without dyslexia. Children with dyslexia did not exhibit significantly different activation patterns in the verbal and spatial conditions, in contrast to TD readers. These results may have implications for the roles of verbal and visuospatial WM processes in reading (dis)ability.

Topic Area: EXECUTIVE PROCESSES: Working memory

D20 - Effect of Age-Related Hearing Loss on Auditory Working Memory in Age-Related Hearing Loss: An fNIRS Study

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Age-related hearing loss (ARHL) increases listening effort by taxing working memory (WM) resources. We probed neural activation patterns during an auditory N-back task in older individuals with ARHL immediately after being fitted with hearing aids. Twelve participants (mean age = 80.3) with bilateral sensorineural hearing loss performed a continuous auditory N-back task with 0-back, 1-back, and 2-back conditions, each with 32 trials and a three-second response window. Linear mixed-effects models were constructed for the dependent variables of N-back accuracy, response time and fNIRS beta values, using 0-back as a fixed effect to control for sustained attention. The independent variables were conditions (1-back and 2-back), and regions of interest (ROI:left dorsolateral prefrontal cortex-LDLPFC, superior temporal gyrus-STG, and inferior parietal lobule-IPL). Accuracy decreased significantly and response time increased statistically from 1-back to 2-back. fNIRS results revealed significant 2-way interactions between task and ROI. Activation in the IPL decreased from 1-back to 2-back but activation in the STG increased from 1-back to 2-back. We did not find an expected increase of activation in DLPFC during the 2-back tasks. The lack of significant interaction in the DLPFC suggests atypical neural compensatory mechanism in older adults with hearing loss, where cognitive resources are reallocated to the STG. Such reorganization might indicate a potential adaptive response of the brain prioritizing the processing of auditory input resulting in reduced information processing in WM. By analyzing how hearing aids influence brain activity and cognitive processes, we can understand their potential role in cognitive decline linked to ARHL.

Topic Area: EXECUTIVE PROCESSES: Working memory

D21 - Medial orbitofrontal cortex repetitive transcranial magnetic stimulation may best treat addiction & preserve working memory for the nicotine-dependent

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High-frequency repetitive transcranial magnetic stimulation (HF-rTMS) over the dorsal lateral prefrontal cortex (DLPFC) is the generally accepted neurostimulation protocol for smoking cessation treatment, although medial orbitofrontal cortex (mOFC) placement may better aid in preserving working memory. This exploratory study assessed DLPFC versus mOFC rTMS placement in patients with Tobacco Use Disorder (TUD) to reveal possible memory harms, as tested using the N-back working memory task. The Medical University of South Carolina conducted a double-blind, sham-controlled, randomized clinical trial of participants (n=18, 9 female) aged 49.8 [9.7] (mean [SD]) nearby Charleston, South Carolina, who enrolled for rTMS smoking cessation treatment (15 sessions over 3 weeks). rTMS was sham or active MRI-guided to the DLPFC (10 Hz, 3000 pulses each session) for facilitation protocol or to the mOFC (1 Hz, 900 pulses each session) for inhibition. N-back studies occurred prior to rTMS treatment #1, #6, #11, #15, and 1 month after rTMS #15. 16 participants began treatment: 9 received DLPFC rTMS; 7 received mOFC rTMS. 12 participants (7 DLPFC vs. 5 mOFC) were analyzed. Mixed model results showed significantly different correct trials between 0-back (5.29±0.31), 1-back (3.27±0.31), and 2-back (2.21±0.31), ($p < 0.01$). A trend difference existed between DLPFC treatment (3.24±0.24) and mOFC treatment (3.93±0.25), ($p=0.054$), in stimulating working-memory accuracy. Though the DLPFC controls over working memory, the mOFC mediates task retrieval, outcome-specific information, and goal-oriented action. This could account for the trend difference favoring mOFC placement. More research must be done to affirm this is the best placement protocol.

Topic Area: EXECUTIVE PROCESSES: Working memory

D22 - Prediction of working memory and neuropsychiatric symptom variability with oscillatory and non-oscillatory EEG measures

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Working memory (WM) is the capacity-limited process supporting the transient maintenance of goal-relevant information. The aim of the present study was to relate several complementary indicators of neural dynamics underlying WM to across-subject variance in measures of WM task performance, trait-level WM capacity, and psychiatric symptomatology. Electroencephalography (EEG) data were analyzed from a heterogenous sample of 100 adults (a combination of care-seeking and non-care-seeking individuals) as they performed WM tasks, including a spatial capacity task (SCAP) and dot-pattern expectancy task (DPX). Machine learning models were trained to predict: (1) WM task performance (accuracy), (2) trait WM capacity (WAIS and WMS WM subtests), and (3) psychiatric symptomatology (Brief Psychiatric Rating Scale). Features included EEG-based measures of power, oscillation symmetry, non-oscillatory power spectrum properties, and complexity, which were extracted from the encoding, maintenance, probe, and inter-trial stages of each task. We found that measures of non-oscillatory power spectrum properties during SCAP significantly predicted variance in WM capacity, and oscillation symmetry during DPX (a goal-maintenance task) significantly predicted psychiatric symptomatology. These models heavily weighted features derived from frontal and occipital regions-of-interest. We observed variability in prediction and feature importance among tasks, with no single measure dominating prediction at a given stage. However, we generally found better prediction during task than during the inter-trial fixation period, suggesting task-based brain activity is more predictive of behavioral outcomes than task-free activity. Ultimately, this project expands on the utility of integrating both oscillatory and non-oscillatory measures of EEG signal in prediction of trait- and state-like outcome measures.

Topic Area: EXECUTIVE PROCESSES: Working memory

D24 - Examining MEG visual mismatch responses to American Sign Language by hearing signers and non-signers

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Auditory mismatch responses (MMR) are commonly used in spoken language to examine automatic detections of linguistic anomalies/changes at various linguistic levels. Examining the spatial and temporal characteristics of visual MMR (vMMR) in sign languages can provide valuable insights on perceptual learning and its role on language development. Using Magnetoencephalography (MEG), the current study established a vMMR paradigm in American Sign Language (ASL) to examine the role of sign language experience on linguistic visual processing among hearing signers and non-signers. We identified one pair of real lexical signs (BOY, handshape=flat-B and location=forehead; KID, handshape=horn and location=nose) and switched the handshapes to create two non-signs (NS_1, handshape=horn and location=forehead; NS_2, handshape=flat-B and location=nose). We adopted an oddball paradigm where deviants are interspersed

within standards about 15% of the time. In each block, the standards and deviants constitute a lexical vs. non-lexical contrast by changing the handshape but not the location (e.g., standard: BOY, deviant: NS_1). Participants are instructed to detect changes in the central cross while the signs were presented in the periphery to ensure preattentive processing of the signs. So far, we have gathered data from 9 hearing signers and 2 hearing non-signers. All hearing signers are proficient in ASL. Preliminary results suggest increased vMMR between 150-250ms in occipital and temporal regions with both lexical and non-lexical deviants for hearing signers, but not for non-signers. We aim to include 16 participants for each group and conduct ROI-based as well as exploratory whole-brain level analyses once the data collection is complete.

Topic Area: LANGUAGE: Other

D25 - A Cross-Linguistic Analysis of Aphasic Speech

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Wernicke's aphasia (WA) is a neurological disorder caused by damage, often from a stroke, to specific language networks in the human brain. This damage results in speech that is spoken at a normal speed and rhythm, and with proper grammatical structure, but the content is usually incomprehensible. Research on people with WA typically focuses on linguistic errors in relation to a person's native language. Studying these errors has failed to yield clear insights regarding specific neural mechanisms and damage behind particular WA symptoms. For instance, if certain linguistic errors are shared among WA patients who speak languages with different structures and syntax, then this realization may point to specific neural networks that are affected compared to those that may be more language-specific. The analog here is low-level vs. high-level programming languages. To evaluate this set of hypotheses, transcripts from native speakers of English, French, Japanese, and Cantonese (WA and healthy controls) were collected from the AphasiaBank (https://aphasia.talkbank.org/). A state-of-the-art large language model (Anthropic's Claude v2) was used to perform an in-depth comparison of speech components and rules, ranging from grammar to coherence, across different representative languages. The model was able to identify signs of Wernicke's Aphasia, such as neologisms, paraphasias, filler words, and word finding difficulty, as well as many commonalities between the languages. Based on this data, an interlinguistic computational analysis model for aphasic speech has been developed.

Topic Area: LANGUAGE: Other

D26 - Exploring the Neural Mechanisms of Executive Function in Bilinguals Compared to Monolingual Speakers

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Research suggests that the experience of bilingualism may confer some advantage in certain domain-general executive functions (EF). Several behavioural studies have demonstrated that bilingual speakers outperform monolingual speakers on certain EF tasks, showing faster reaction time and higher accuracy during monitoring, inhibition, and switching (Costa et al., 2009). However, a comparable number of studies demonstrate no behavioural advantage on EF tasks for bilingual compared to monolingual speakers (Paap & Greenberg, 2013). Neural measures might be more sensitive to identify experience-driven variation in EF processing that arises from hearing and using more than one language. However, relatively few studies have explored neural mechanisms underlying these tasks in bilingual compared to monolingual speakers (Cespón & Carreiras, 2020), and fewer have explored how variation in the bilingual experience (age of second language (L2) onset, duration of exposure) predict neural processing during EF tasks. The current study presents event-related potential data from adult bilingual (n = 30) and monolingual (n = 30) participants. EEG is recorded while participants complete 3 tasks: a) Flanker task to measure inhibition and monitoring, b) Stop-signal task to measure inhibition and monitoring, c) Task-Switch paradigm to measure switching. Amplitude and latency of two components, the N200 and P300, will be extracted and compared across groups. Larger N200/smaller P300 amplitude and faster P300 latency for bilinguals suggest bilingualism to be associated with more efficient neural processing during EF tasks. Linear regression will test whether age of L2 acquisition and duration of L2 exposure predict N200/P300 amplitude/latency in the bilingual group.

Topic Area: LANGUAGE: Other

D27 - Statistical learning in the hippocampus and neocortical regions: Evidence from intracranial neural entrainment

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Statistical learning (SL) is a powerful mechanism that supports the ability to extract regularities from environmental input. Yet, its neural underpinnings are not well understood. There is strong evidence pointing to the involvement of sensory cortices in SL, but a recent computational model proposes that the hippocampus may support this learning mechanism as well. However, direct neural evidence for the role of the hippocampus in extracting patterns in speech through SL is scarce. In addition, the degree to which engagement of the hippocampus and non-hippocampal cortical regions relates to subsequent behavioral learning effects has not yet been explored. In the current study, six patients with drug-resistant epilepsy who received stereoelectroencephalography listened to a continuous speech stream containing repeating "hidden" trisyllabic words. Neural entrainment at the frequency of syllables provided an index of sensory processing, while entrainment at the frequency of the embedded words provided an index of statistical learning. After listening, SL was further assessed through explicit and implicit behavioral measures. At the behavioral level, we found evidence of statistical learning on our implicit task, with nearly all patients showing facilitated performance for predictable syllables. Moreover, preliminary analyses at the neural level revealed different temporal tuning responses across electrodes. Critically, a subset of electrodes showed entrainment uniquely at the word rate, indicating specific sensitivity to the word structures. These electrodes were mainly located within the hippocampus, frontal cortex, and middle temporal cortex. Further analyses will aim to elucidate how neural entrainment across regions relates to performance on our behavioral tasks.

Topic Area: LANGUAGE: Other

D28 - The moderator for the effects of the disconnection of white matter tract on postoperative cognitive function in patients with brain tumors

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In patients with brain tumors, damage to the eloquent white matter tracts can lead to permanent functional impairment postoperatively. However, there are individual differences in the relationship between the extent of white matter tract damage and cognitive impairment. In this study, we focused on the left frontal aslant tract (FAT), which involved verbal fluency, and investigated whether the extent of the impact of the left FAT damage on postoperative verbal fluency differs by age. Participants were twenty-six patients with brain tumors who underwent brain tumor resection. The mean age was 47.5 (14.5) years. Verbal fluency was measured using a letter fluency test (LFT) and a category fluency test (CFT). We retrospectively collected data at more than three months postoperatively for all except two patients. The probability of disconnection of the left FAT was computed using Tractotron software. The multiple regression analysis showed that age significantly affected LFT scores (β = -0.50, p = 0.007), whereas FAT damage was not significant. The interaction between age and FAT damage was significant (β = -0.55, p = 0.04). For the CFT, age was marginally significant (β = -0.33, p = 0.07), whereas FAT damage was not. The interaction between age and FAT damage was marginally associated with CFT scores (β = -0.48, p = 0.08). We found that the impact of the left FAT damage on postoperative verbal fluency varied by age. The results suggested that damage to the left FAT might lead to chronic impairment of verbal fluency in older patients.

Topic Area: LANGUAGE: Other

D29 - Individual Differences in the Emerging Reading Network: A GIMME Investigation of Functional Connectivity in Beginning Readers

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Rapid specialization of reading-related regions is apparent within the first few months of schooling, particularly within the Visual Word Form Area (VWFA). However, little is known about how this increasingly specialized region connects to existing language systems to form a cohesive network. Furthermore, existing knowledge is largely based on group averages, potentially obscuring important individual differences. This study takes a data-driven approach to understanding functional connectivity of the emerging reading network. N=100 kindergarteners (mean age = 5.6 years) completed a reading task during fMRI as well as standardized cognitive assessments. Using subgroup group iterative multiple model estimation (S-GIMME) with a Walktrap community detection algorithm, we examined person-specific connectivity between a priori regions of interest (ROIs). At the group level, participants consistently demonstrated contralateral connectivity between language regions. GIMME further identified three subgroups of individuals with similar network features. Subgroups differed significantly in their mean network density, centrality of language regions, and centrality of the VWFA node within an individual's network. The three groups also differed significantly in their mean literacy skill. The group with the highest reading performance also demonstrated greater VWFA centrality, more left-lateralized networks, and the strongest connectivity in the phonological loop (IFG-STG). These differences were not attributable to demographic factors or language ability. These findings shed light on a critical developmental stage to suggest that beginning readers largely rely on more distributed, bilateral associations between language and vision hubs, and reading skill is associated with an increasingly efficient, left lateralized circuit.

Topic Area: LANGUAGE: Other

D30 - Neural evidence for voice-specific representations during listening and silent reading

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Previous studies (Alexander & Nygaard, 2008) have shown evidence for voice-specific auditory imagery during silent reading. Neuroimaging studies have also demonstrated activation in temporal voice areas (TVA) during silent reading (Yao et al 2011) but have not been designed to determine whether the imagery is talker-specific or instead represents a generic voice. This study investigates the neural correlates of voice representation and talker-specific auditory imagery using naturalistic materials. Prior to scanning, participants heard two male talkers read text passages from autobiographies of Mark Twain and Benjamin Franklin. Talker and author were counterbalanced across participants. The talkers' voices differed in mean pitch and speaking rate, and participants were able to identify the talkers following initial exposure. During scanning, participants (N = 20) read passages they were told were written by the two talkers, interspersed with additional listening passages from each talker. Separate functional localizer tasks were used to identify areas involved in auditory language processing (Scott et al 2016) and voice processing (Pernet et al 2015). An SVM classifier showed robust above chance discrimination of the two talkers' voices during listening intervals in multiple ROIs across the language network, including bilateral TVA. Several ROIs in the left temporal lobe additionally showed evidence of above-chance discrimination of talker identity during silent reading of passages that were 'authored' by the two talkers but that participants had never heard spoken aloud. These results suggest that voice-specific representations are active during silent reading and constitute a form of auditory imagery during reading.

Topic Area: LANGUAGE: Other

D31 - Beyond the Neocortex: Exploring Cerebellar Involvement in Language Comprehension

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Although traditionally considered a motor structure, the cerebellum plays a key role in higher-order cognitive functions such as language. However, it remains unclear what the cerebellum contributes to language. In this study, we investigated the activity in the cerebellum during sentence comprehension with fMRI. We used a large language model to develop a set of sentences and parametrically manipulated different language features. Stimuli included wordlists, bigram sentences, sentences with low-frequency words, and sentences with semantic and syntactic violations. We acquired ultra-high field (7T) fMRI data from the cerebellum and neocortex of healthy participants while they listened to the spoken sentences via headphones. Preliminary results show activity mainly in the inferior section of the cerebellar language regions identified using a recently developed functional atlas of the cerebellum. Activity profiles in the language region are highly variable across participants for both the cerebellum and the neocortex. Wordlists and bigrams activated working-memory regions in the cerebellum, while sentences with semantic or syntactic violations or those with low frequency words show higher activity in language regions of the cerebellum and neocortex. This suggests that cerebellar language regions are highly selective to sentences with intact meaning. Ongoing data collection and analysis are expected to give more insight into the variability of these activity profiles across participants and reveal consistent language processing patterns across individuals.

Topic Area: LANGUAGE: Other

D32 - Varying sound-symbolic contributions of acoustic parameters in shape- and size-optimized pseudoword sets across multiple domains of meaning

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Sound symbolism defines the non-arbitrary relationship between the sound of a word and its meaning. Previously, we analyzed relationships between the acoustic parameters of a set of 537 consonant-vowel-consonant-vowel (CVCV) auditory pseudowords, optimized for the shape domain, and their ratings on scales reflecting size, shape, weight, texture (hard/soft), brightness, arousal, and valence (Nygaard et al. & Hoffmann et al., CNS 2022). Here, we extended this work to a new set of 638 CVCV auditory pseudowords optimized for size associations, which participants again rated for size, shape, weight, brightness, arousal, valence, and two aspects of texture (hard/soft and smooth/rough). Acoustic analyses compared nine vocal parameters (mean pitch, pitch standard deviation, pulse number, fraction of unvoiced frames [FUF], jitter, shimmer, mean autocorrelation, mean harmonics-to-noise ratio [HNR], and duration) to perceptual ratings using conventional correlation methods, while three spectro-temporal parameters (speech envelope, spectral tilt, and the fast Fourier transform [FFT]) were compared to perceptual ratings using representational similarity analysis [RSA]. For the new, size-optimized set, we observed size associations with mean HNR, mean autocorrelation, duration, FUF, and jitter, that were not found for the original, shape-optimized set. Previous results for the shape and other domains were replicated, reflecting phonetic similarities between pseudoword sets. Additionally, the texture domains closely resembled each other within and across pseudoword sets. Overall, vocal and spectro-temporal parameters contributed differentially to ratings in each domain. These results reinforce our previous findings that sound-symbolic associations are domain-specific and do not simply arise from associations to a domain-general factor such as arousal.

Topic Area: LANGUAGE: Other

D33 - Working memory and proficiency in adult second language neurocognitive processing: An ERP study

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Working memory (WM) has been shown to account for variability in adult second/additional language (L2) learning (Gabriele et al., 2021). However, research findings for the role that WM may play in neurocognitive L2 processing, in conjunction with the role of L2 proficiency, are mixed. Thus, our study employs event-related potentials (ERPs) to examine whether and how WM and proficiency modulate L2 learners' brain signatures in (morpho)syntactic processing. Electroencephalograms were recorded while intermediate L2 learners of Spanish (N = 9) completed a grammaticality judgment task including four experimental conditions: phrase structure (PS), subject-verb agreement (SV), noun-phrase number and gender agreement (NPn, NPg). Participants also completed complex span WM tasks (operation, reading, and

symmetry) and aural and written tasks of Spanish proficiency. Preliminary ERP analyses showed apparent P600 effects for NPn and NPg, whereas no clear effects were elicited for PS or SV, although small positivities suggest individual variation. Correlation analyses, considering effect size, evidenced a medium, negative correlation between WM and the P600 magnitude for NPn (r = -.471) and a large, positive correlation between proficiency and the P600 magnitude for NPn (r = .829). All other rs < .263. These preliminary results suggest that larger P600 effects may be associated with higher proficiency and less reliance on WM for NPn agreement, the structure closest to learners' L1. Ongoing data collection and analyses will reveal whether these associations are maintained, whether similar associations are found across linguistic conditions, and whether WM and proficiency interact to modulate the neurocognition of L2 processing.

Topic Area: LANGUAGE: Other

D34 - Measuring listening effort in adults with hearing loss using fNIRS

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Interpersonal communication frequently requires listening to speech in noisy conditions. These listening challenges are further exacerbated for individuals with hearing loss, who must exert greater effort to understand speech in noise. The current study used functional near-infrared spectroscopy (fNIRS) to assess the neural correlates of listening effort in older adults with a range of hearing ability, from normal hearing to moderate unaided hearing loss. Participants listened to sentences in noise with either a high (easy) or low (hard) signal-to-noise ratio (SNR). The sentences also differed in whether the last word was easily predictable from the preceding context (high/low context). Participants completed the task with two different response modes: In one half of the task, they verbally repeated the last word of the sentence. For the other half, they made a forced-choice keyboard response regarding whether the last word of the sentence was predictable from the preceding context, thereby avoiding motion artifacts from speaking. fNIRS recording was completed at bilateral frontal and temporal regions. Results from 11 adults show increased oxygenation in left dorsolateral prefrontal cortex for low SNR, indicating greater listening effort in more challenging listening conditions. Participants with greater degrees of hearing loss are also expected to show greater functional connectivity between dorsolateral prefrontal cortex and auditory cortex, which would indicate that hearing loss is related to stronger involvement of top-down processing in speech perception during effortful listening.

Topic Area: LANGUAGE: Other

D35 - Far, Car, War, Boar: Mechanisms of Automatic Word Recognition

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Word recognition is integral to fast and fluent reading. This automatic process retrieves orthographic (word form), and phonological (sound) information immediately, but is dependant on previous experience and expectations. Neuroimaging studies have shown differences in expected vs. perceived words elicit EEG responses sensitive to distinct types of word information. To assess how the brain evaluates and responds to orthographic and phonological information individually during reading, this study created sound-spelling conflict through word association. Twenty-nine English speaking adults completed a rhyming task while EEG data was recorded. Participants were instructed to judge if word-pairs rhymed or not via button press as quickly and accurately as possible. Word-pairs were visually presented in four conditions: congruent trials which shared both orthography and phonology (cool/pool) or shared neither (boat/fair), and incongruent trials with conflicting orthography and phonology (cane/rain, or most/cost). Participants had slower reaction time and lower accuracy in their judgement of incongruent trials. Comparison of congruent trials to their incongruent counterparts revealed N400 negativity occurred independently during recognition of orthographic and phonological mismatch. Additionally, a more positive P600 was found in incongruent trials than congruent, suggesting the late component was evoked by sound-spelling conflict itself. Findings indicate that both orthographic and phonological differences between word-pairs are automatically recognized at the N400 window (400-600ms), however the processing of conflict does not fully occur until the P600 interval (600-900ms). The late positivity may reflect additional error monitoring given unexpected sound-spelling mismatch, or moderation of prior expectations following conflict.

Topic Area: LANGUAGE: Other

D36 - The N400 is sensitive to story-level context in naturalistic language comprehension.

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Successful language comprehension is facilitated by congruency between linguistic input and current local context. A lack of congruency is thought to be reflected in the N400 ERP response, with unexpected words eliciting larger N400 amplitudes. One way to probe this relationship is via surprisal, which was typically calculated using restricted context windows of only a few words prior to the target word. However, Large Language models now allow for surprisal calculations based on the entirety of linguistic context. This provides an opportunity to explore the sensitivity of the N400 to contextual richness. Here, 40 participants (27 female, mean age 24.6) listened to 12 short stories while their electroencephalogram was recorded. Word-by-word surprisal values were calculated via GPT-2 using two contextual windows: sentence-level and story-level. This allowed us to examine whether the N400 is sensitive to contextual information accrued across the story and outside the current sentence. We used linear mixed effects models to compare the effect of the two surprisal predictors on N400 amplitudes. Akaike Information Criterion-based model comparisons revealed that the story-level surprisal model explains more variance in N400 amplitudes than the sentence-level model. Story-level surprisal interacted with word position and log word frequency, with the N400-surprisal relationship strongest for low frequency words at the beginning of each story. This finding indicates that the N400 reflects a rich amount of contextual information. We suggest that an approach such as that employed here might be used to shed light on how individuals adapt their internal language models to local context.

Topic Area: LANGUAGE: Other

D37 - Discrete hierarchy of temporal receptive windows from a deep neural network using continuous time cells

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A body of work shows a hierarchy of temporal receptive windows (TRWs) in the human cortex. Different brain regions respond to different kinds of information organized at different timescales. Time cells, observed in the hippocampus and cortex are believed to be important in a neural sense of time. Rather than firing in discrete clusters, time cells fire in smooth continuous sequences. To understand whether discrete temporal receptive windows are consistent with a smooth distribution of time constants, we trained SITHCon (Scale-invariant Temporal History Convolutional Network) to predict language-like sequences, with discrete transitions between symbols at multiple hierarchical levels, analogous to phonemes, words, and sentences. SITHCon is a deep network with layers of time cells tracking 'what' happened 'when'; learnable weights change the meaning of `what' from layer to layer. Each layer has a continuum of log-spaced time constants. We found evidence that the deep network containing of continuous time constants was able to extract information at discrete levels of the hierarchy. We saw different characteristic timescales to the autocorrelation function over layers of the network, despite the time cells in each layer having precisely the same distribution of time constants. As in TRW experiments, we permuted the input sequence at scales corresponding to each hierarchical level. We found that earlier layers are affected at small shuffling scales but not larger ones, while higher layers are impacted severely and especially at larger shuffling timescales. Our results indicate that networks with continuous time constants can exhibit a hierarchy of temporal receptive windows.

Topic Area: LANGUAGE: Other

D38 - A "wordy" endeavor: Functional near-infrared spectroscopy for investigating angular gyrus function and lateralization

Hannah Potts[1], Youstina Tadros[1], Siena DeAngelo[1], Savannah Campbell[1], Carole Scherling[1]; [1]Belmont University

A better understanding of language, and available tools to probe neurological correlates, informs not only neuroscience research and is valuable in clinical interventions. One parietal region associated with reading and comprehension is the angular gyrus (Seghier, 2012). Language is consistently associated with handedness, with right-handers showing left hemispheric lateralization (Knecht, 2000) and more variable hemispheric dominance in left-handers (Bidula, 2017). These patterns of activation have been observed with many imaging tools, such as fMRI and EEG but has not been largely

studied using a novel tool, functional near-infrared spectroscopy (fNIRS). This is a non-invasive imaging technique using infrared light to detect oxygenated and deoxygenated blood, as a measure of brain activation (https://nirx.net/). The angular gyrus is not an area that has been extensively studied using fNIRS. The current study investigated fNIRS' capability to measure angular gyrus activity during a word/non-word forced-choice discrimination task in a sample of 62 undergraduate participants. We predict detection ability of this tool for functioning of this brain region as well as its capacity to reveal expected left-lateralization in a right-hand cohort. Preliminary analysis for right handers revealed bilateral angular gyrus activity during the task (3 of 4 channels active in the right hemisphere and 2 of 4 channels for the left hemisphere), ($p<0.05$). Meanwhile, no lateralization effects were revealed for left handers. This indicates that there are potential differences in hemispheric lateralization of the angular gyrus when making semantic judgements, which may be modulated by handedness.

Topic Area: LANGUAGE: Other

D39 - Representational Similarity Analysis of the Neural Representations of Orthographic, Phonologic, and Semantic Processing

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Contemporary reading models propose two word recognition processes: decoding from orthography to phonology, and whole-word reading from orthography to semantics. Prior neuroimaging studies localized regions involved in reading, while emerging techniques enable the comparison of activation patterns with cognitive models outside the brain. Our study uses Representational Similarity Analysis to investigate patterns of activity in sub-regions of the reading network and evaluates their similarity to orthographic, phonologic, and semantic models during word reading. We also explore how individual differences in the strength of these representations relate to reading skill. Forty neurologically healthy, monolingual English-speaking adults participated in two sessions. The first included standardized reading and intelligence measures, demographics questionnaires, and a word naming task. In the second, participants silently read monosyllabic words while detecting person names in a 3.0T fMRI scanner. Word-by-word theoretical representational dissimilarity matrices (RDM) were constructed, with the orthographic model using Levenshtein Distance, the phonological model using Phonological Edit Distance, and the semantic model using cosine distance of Global Vectors. Empirical RDMs were calculated using Euclidean distance. Spearman Rank Correlations were used to correlate the theoretical and empirical RDMs. One-sample t-tests determined whether the correlations were distinct from 0. Linear regression models were used to examine individuals' orthographic, phonologic, and semantic similarity per sub-region against the standardized measures. Results indicate distributed patterns of activation in the reading network. Of note, in the left inferior temporal gyrus, individuals with higher similarity to orthographic and semantic processing showed stronger sight word reading efficiency.

Topic Area: LANGUAGE: Other

D40 - The Effect of Language Dominance on Bilingual Emotional Processing: A Behavioral and ERP Study

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Bilinguals experience heightened emotions in their first language, L1. Studies demonstrating the emotional asymmetry across languages have examined bilinguals whose L1 is the native and dominant language. The present study asked whether heritage bilinguals who speak a language at home in which they are no longer dominant, will show an effect of emotion in the societal language (SL) in which they have become dominant. Heritage bilinguals with a variety of home languages completed a Face-Word Emotional Stroop task in their SL, English. They judged the emotionality of faces (fear vs happy) while ignoring a congruent or incongruent emotion word. They also completed a questionnaire that provided an index of their language dominance. Stroop performance was measured using behavior and EEG. Behavioral results showed that like studies with L1-dominant bilinguals, English-dominant heritage speakers were slower and less accurate on incongruent than congruent trials, suggesting a strong emotional Stroop effect in the SL. ERP data showed that unlike L1-dominant bilinguals, who show stages of conflict resolution in both early (350-550ms) and late (700-900ms) epochs, heritage bilinguals showed conflict resolution only in the late epoch. They also showed a stronger N2 component. Although the behavioral results appear similar across different types of bilinguals, the pattern of brain activity suggests a different time-course for emotional conflict resolution in heritage bilinguals.

Topic Area: LANGUAGE: Other

D41 - What's so special about language? A comparative study of linguistic vs. musical effects on tactile perception.

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Recent research has demonstrated that verbal cues, when integrated with sensory information, can significantly enhance our perceptual discrimination of subtle differences. One question that remains unanswered is whether this perceptual enhancement can be driven exclusively by spoken words, or if non-verbal cues, like musical tones, can produce a similar effect. The current study explored this by associating hard-to-distinguish vibrating tactile patterns with either spoken words or musical notes, ensuring participants were exposed to both conditions by employing a within-subject design. This approach helped eliminate biases relating to individual, cultural, or linguistic differences. Associative training took place over the course of one week, as participants felt the tactile patterns simultaneous with both verbal and non-verbal cues. By assessing participants' ability to distinguish within sets of tactile patterns both before and after this associative training, we aimed to investigate any changes in perceptual discrimination performance linked to the auditory cues provided during the learning phase. Remarkably, only the tactile patterns connected with spoken words demonstrated notable improvement in recognition after the five-day training period, suggesting a distinct advantage of verbal stimuli in enhancing sensory discrimination. These finding prompt further investigation into the specific characteristics of speech that might facilitate this unique perceptual advantage, such as its acoustic properties, the commonality of its phonemes and syllables, and its sensorimotor aspects. Our discussion considers the potential mechanisms that could explain why spoken language is particularly effective in boosting perceptual discrimination performance, offering valuable insights into the intersections of sensory perception, language, and cognitive neuroscience.

Topic Area: LANGUAGE: Other

D42 - Context effects on working memory maintenance

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Background / Motivation: The goal of this study was to examine working memory engagement during reading comprehension. Specifically, we were interested in the extent to which sentence context is actively maintained during sentence reading. Design & Preliminary Analysis: Participants read sentences in two conditions: connected and disconnected; our planned analyses will focus on the break between sentences. We will examine the NSW, a negative slow wave event-related potential, as a measure of working memory engagement. To date, we have collected data from 42 participants (Mean Age = 19.5, 26 female, 14 male, 2 non-binary). Planned Analyses: We plan to adopt a multi-level mixed modeling approach to analyze the NSW data, which will increase our statistical power and take into account trial-to-trial variation. We will also expand our analyses to include time-frequency approaches, which will allow us to investigate oscillatory activity during the breaks between sentences. We will focus on activity in the theta (4-7 Hz) and alpha (8-12 Hz) frequency bands. We expected to observe an NSW effect in the break following Sentence 1. We also expect to find higher theta power and lower alpha power during the breaks. If the same pattern of effects is found for sentences in both connectedness condition, the results would suggest that we automatically maintain sentence context in working memory over time even when it unlikely to be relevant to the upcoming input.

Topic Area: LANGUAGE: Other

D43 - Pervasive impairments on hippocampus-dependent memory tasks in major depressive disorder: Role of memory, executive function, and subfield integrity

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Previous research suggests that individuals with major depressive disorder (MDD) demonstrate hippocampal (HPC) abnormalities at the level of structure and function, including episodic memory. More recently, there have also been demonstrations of HPC subfield-specific atrophy, generally in CA1, CA3, and dentate gyrus subregions. Typically, abnormalities in subfield-structure and function have been examined in isolation. In the present study, we tested performance on hippocampus-dependent memory tasks alongside subfield-specific integrity of HPC structure in a sample of patients (N = 24) with clinically diagnosed treatment-resistant depression. Assessments included behavioral pattern separation, pattern completion, autobiographical memory, memory for face-name associations, and neuropsychological tests of executive functioning, in combination with surface-based estimation of subfield-specific atrophy derived from high-resolution structural MRI. As compared to matched control participants (N = 20), patients exhibited impaired recall from episodic autobiographical memory, irrespective of the age of memories. Patients also demonstrated impaired recognition performance on tests of pattern separation, face-name associations, and pattern completion. These behavioural deficits in patients were observed alongside significantly reduced volume in the left dentate gyrus, left CA3, and right CA1 regions. MDD often also results in impairments in executive control, which can influence memory performance. In the present sample, neuropsychological markers of executive-function were positively related to discrimination performance for previously learned items and associations across several tasks. Our findings reveal pervasive impairments on tasks tapping into multiple functions that depend on HPC integrity. They also highlight a role for executive function deficits on tasks that are typically considered HPC-dependent.

Topic Area: LONG-TERM MEMORY: Episodic

D44 - Voluntary down-regulation of memory encoding occurs via attentional withdrawal, not active suppression

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Humans sometimes encounter visual stimuli that they desire to not remember. While classic studies of memory control suggest that observers can down-regulate their encoding of undesired stimuli by actively suppressing stimulus processing, recent investigations have asserted that memory control is exclusively up-regulatory in nature. Here, we sought to directly test whether down-regulation of memory encoding is possible, and if so, whether down-regulation depends on active suppression. In two experiments, participants were cued prior to the onset of real-world objects to not remember (down-regulate) or try "extra hard" to remember (up-regulate) a given object. To characterize the directionality of any observed regulation, we also included a baseline condition in which observers were instructed to "remember" (Experiment 1) or "just look at" (Experiment 2) a given object. On half of the encoding blocks, the pre-cue changed in a fixed order across objects (e.g., up-down-baseline-up-down-baseline) to allow for the deployment of any mechanisms that require anticipation of regulation demands. In doing so, we found that down-regulated objects were remembered less often than baseline objects that were "remembered", but not those that were "just looked at", even when the cue was highly-predictable. By contrast, up-regulation was observed across all baseline and predictability manipulations. In the brain, dissociable ERP (Frontal Positivity) and time-frequency (Occipital Alpha Power) signatures of attentional engagement dovetailed regulation patterns in behavior. These findings suggest that observers are capable of down-regulating encoding relative to active learning by withdrawing their attention but are not able to suppress encoding beyond passive stimulus perception.

Topic Area: LONG-TERM MEMORY: Episodic

D45 - Subsecond dynamics of behaviorally-relevant pattern separation in the human hippocampus

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Episodic memory depends on pattern separation, the ability to discriminate between unique experiences. The neural dynamics of pattern separation were studied in the rodent hippocampus, with unclear behavioral relevance. Human imaging studies were consistent with behaviorally-relevant pattern separation, but the temporal resolution precluded testing the dynamical theories postulated by the rodent and theoretical work. We recorded the intracranial electroencephalogram (iEEG) from the human temporal lobe (amygdala, dentate gyrus/Cornu Ammonis3 (CA3), CA1 and parahippocampal cortex), during the performance on a mnemonic discrimination task. The stronger hippocampal representational similarity between the previously encoded and newly presented stimulus interferes with correct discrimination. The hippocampal representational dynamics are consistent with discrete attractors, characterized by abrupt transitions at sub-second time scale. Finally, higher dimensionality increase predicts correct discrimination, suggesting the orthoganization as a mechanism implementing the pattern separation. This is the first demonstration of behaviorally-relevant pattern separation dynamics at subsecond timescale in the human brain.

Topic Area: LONG-TERM MEMORY: Episodic

D46 - Consistency of Autobiographical Memory Retrieval in Older Adults At Risk of Cognitive Decline

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Older adults experiencing cognitive decline show deficits in episodic memory, including recall of autobiographical memories (AMs). To our knowledge, the consistency of repeated retrieval of AMs as a potential marker of cognitive decline has not been investigated. We examined whether AM consistency across a six-month interval is lower in older adults who are "at-risk" of cognitive decline. Thirty-three participants (aged 62-88) enrolled in a larger study (Olsen et al., 2017) were classified as either at-risk of cognitive decline (N=15) or healthy controls (N=18) using a cut-off score of 26 on the Montreal Cognitive Assessment. Across six monthly 'time 1' sessions, participants recalled 12 AMs (2 per session). At 'time 2' sessions that took place 6 months after the 'time 1' sessions, participants were cued to recall the same AMs they had described in the corresponding 'time 1' session. Consistency of recall was measured using Universal Sentence Encoder (USE), a machine-learning tool that captures semantic meaning. USE vectors were used to assess similarity between pairs of AMs (1=100% similarity). Wilcoxon rank sum tests revealed that the similarity of retrieved AMs were significantly greater in the control (M=0.75) than the at-risk group (M=0.69), W=45, $p<.001$. This group difference was also evident when the analysis was computed using only the content from each narrative coded as episodic (as per the Autobiographical Interview scoring protocol). This study informs our knowledge of the consistency of repeated AM retrieval in the context of aging and cognitive decline.

Topic Area: LONG-TERM MEMORY: Episodic

D47 - Temporal Order Memory in Naturalistic Events Is Influenced by Semantic Knowledge and Hierarchical Event Structure

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Previous studies on temporal order memory (TOM) using discrete pictorial stimuli showed that people are sometimes better at remembering the temporal order of items occurring within the same perceptual event than items spanning across a perceptual boundary (Heusser et al., 2018, JEP:LMC), but that the opposite can also occur if supporting contextual cues are present during test (Wen & Egner, 2022, Cognition). However, it is hard to generalize this result to naturalistic events without considering how semantic knowledge and hierarchical event structure may support the encoding and retrieval of temporal order information. To investigate these possibilities, we created hierarchically organized narrative stimuli describing everyday events, with semantic order constraints among events either on the coarse-level or on the fine-level. We found that participants could use semantic order constraints at either level to improve TOM. This led to better across-event TOM when coarse-level semantic constraints were provided, but better within-event TOM when fine-level semantic constraints were provided. In addition, when participants could not leverage semantic order constraints,

they were more confident about temporal order across events than within events, independent of accuracy. Their distance rating of event pairs was inflated when the two events spanned across an event boundary. Finally, in serial recall, participants frequently chunked their recall based on coarse-level event membership. These results suggested that the role event boundaries play in shaping temporal order memory task performance depends on people's ability to use information other than episodic memory.

Topic Area: LONG-TERM MEMORY: Episodic

D48 - Item memory benefits from schema congruency and incongruency

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Previous research suggests that both information congruent and incongruent to pre-existing knowledge (schemas) improve episodic memory compared to information that is neither particularly congruent nor incongruent (U-shaped function). Some models associate benefits for schema congruency with increased familiarity and benefits for schema incongruency with increased recollection. To date, evidence for both hypotheses within the same study is still rare. In two event-related potential experiments, we tested whether (and how) memory for incidentally studied target words (e.g., taxi) is improved by (in-)congruency with schemas activated by preceding word triplets. Triplets could activate congruent schemas (e.g., bus, ferry, airplane), incongruent schemas (e.g., apple, pear, plum), or no schemas (e.g., priest, whiskey, tambourine) with respect to the target word. The test phase included studied targets and related lures (e.g., train, cherry). Schema congruency and incongruency improved memory, but schema congruency did so to a greater extent. Behavioral remember/know estimates (Experiment 2) suggest that both ends of the U-shaped function are associated with increases in familiarity and recollection. However, the advantage for congruent versus incongruent information was mainly associated with more remember responses. Consistently, we found a greater recollection-related LPC effect in the congruent than in the other two conditions. However, differences in the familiarity-related FN400 effect were not observed. Thus, our study provides evidence for the U-shaped relationship between schema (in-)congruency and item memory performance. However, contrary to model predictions, we found strong evidence for a role of recollection in the congruency effect while the contribution of familiarity remained elusive.

Topic Area: LONG-TERM MEMORY: Episodic

D49 - The influence of retrieval practice on real-world event memory

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Actively recalling information from memory (retrieval practice) is widely recognized for its utility in enhancing long-term memory. This practice not only improves later recall for purposefully retrieved information (the testing effect) but also enhances retention of information that is sufficiently related to the explicitly retrieved information (retrieval-induced facilitation). Remarkably, retrieval practice exhibits superiority in bolstering memory when juxtaposed with restudying (i.e., passively reviewing) identical material, underscoring the critical role of active retrieval in these enhancement effects. Despite the acknowledged efficacy of retrieval practice, there has been little research devoted to investigating how this technique might alter memory for real-world events. To address this gap, we explored the comparative mnemonic impact of retrieving versus restudying verifiable details of a staged event—a sensory- and interaction-rich tour of a historic building. Preliminary results (N = 37) demonstrate a testing effect: participants who practiced retrieving event details had a higher likelihood of correctly recalling these details fourteen days after the event (with final recall conditionalized upon correct retrieval during at least one review session). These analyses reveal, for the first time, that testing effects prevail for personally experienced real-world events. Retrieval-induced facilitation effects, however, were not present: participants who practiced retrieving event details did not have a higher likelihood of correctly recalling event details that were related—albeit never retrieved. In the interest of examining the influence of retrieval practice on memory comprehensively, we will also present data on details extracted from free recall narratives, spontaneous temporal recall dynamics, and subjective memory phenomenology.

Topic Area: LONG-TERM MEMORY: Episodic

D50 - The Impact of Moderate-Severe Traumatic Brain Injury on Hippocampal Structure and Function

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Early imaging studies of the impact of traumatic brain injury (TBI) on the structure and function of the hippocampus focused on the volume of the whole structure. Attempts to associate volume and performance on neuropsychological tests of memory yielded inconsistent associations. Considerable new knowledge has since been gained about the architecture and organization of the hippocampus. We compared hippocampal volume along the longitudinal axis, taking measures of the head, body, and tail, in 24 individuals with moderate-severe TBI and 28 non-injured comparison participants. We also examined the relation between volume and performance on a measure of episodic memory, the Auditory Verbal Learning Test (AVLT). Volumetric measures were derived from FreeSurfer 7.2.0 and corrected for intracranial volume. We found significant group differences in volume for each hippocampal segment, with the largest effect for head volume, replicating work on the increased susceptibility of hippocampal head atrophy in TBI. The TBI group performed significantly lower on the AVLT (delayed recall score) than the comparison group. We found significant correlations between the volume of the entire hippocampus and the AVLT, in both hemispheres, in the TBI group, but not in the comparison group possibly due to restricted range. Correlations between all hippocampal segments and the AVLT were significant in the TBI group, but did not survive correction for multiple comparisons. Advances in the sensitivity of behavioral and neural measurement of hippocampal-dependent memory positions future work to generate new hypotheses on the impact of hippocampal pathology on behavioral outcomes in TBI and targeted rehabilitation approaches.

Topic Area: LONG-TERM MEMORY: Episodic

D51 - How Does Context Variability Interact with Encoding-Retrieval Match?

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Two experiments investigate how context variability during encoding, in an episodic long-term memory task, interacts with the match between the encoding and retrieval contexts. Overall, item recognition improved when an item was studied under variable cognitive processing as compared to consistent cognitive processing and encoding-retrieval context match benefitted memory. In terms of the interaction between the factors, we hypothesized that transfer appropriate processing/encoding specificity would be a more important factor in determining memory performance than context variability. If so, matching the context of repeated encoding exposures as closely as possible to the upcoming retrieval context (and therefore reducing variability) should produce the best memory performance. If not, and if variability has benefits beyond transfer appropriate processing, then at least one exposure to the test context (achieving encoding-retrieval match) intermixed with additional variability in context should be more beneficial than repeated practice of the retrieval context. We found the latter pattern. There was no benefit of repeated matching retrieval cues (as long as the encoding cues included at least one instance of a match to the retrieval cues) when compared to a mix of variability and encoding-retrieval match. Additional repetitions with varying contexts produced significantly better performance than did the repetition of the matching context. This refutes a potential strict interpretation of transfer appropriate processing/encoding specificity. We argue that the current study and other recent findings indicate that encoding variability is a beneficial strategy for recognition memory.

Topic Area: LONG-TERM MEMORY: Episodic

D52 - A Theory of Memory for Items and Associations

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We present a retrieved-context theory of memory for items, associations, and their interaction (CMR-IA). Our theory assumes an evolving representation of temporal context that binds to items and associations, allowing the rememberer to make judgments based on the occurrence of a mnemonic target within a particular context. In addition to the assumptions inherited from prior retrieved-context theories, CMR-IA

assumes a conjunctive (Gestalt) representation for paired associates, increased attention to rare items, and variable thresholds for recognition decisions. We apply CMR-IA to classic findings concerning recognition of items and associations, including effects of recency, similarity, receiver-operating characteristic curves, word frequency, differential forgettings of items and associations, and contiguity effects for successive probes. We next extend our model to cued recall phenomena, including serial position effects, distribution of correct responses and errors, contiguity effects, associative symmetry, and similarity effects. Fitting data from two new experiments, we show that CMR-IA can account for data on successive tests of item and associative information, as well as their dependencies. We see the success of CMR-IA as supporting the unification of context-based theories of item memory with Gestalt theories of associative memory.

Topic Area: LONG-TERM MEMORY: Episodic

D53 - Neuronal population representation of human emotional memory

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Understanding how emotional processing modulates learning and memory is crucial for the treatment of neuropsychiatric disorders that lead to memory dysfunction and emotional dysregulation. We investigated how the human medial temporal lobe (MTL) supports emotional memory in both single neurons and neuronal populations during encoding and recognition of an emotional memory task in patients with medically intractable epilepsy. Our findings reveal distinct representations for both remembered compared to forgotten, and emotional compared to neutral scenes in neuronal populations located in the amygdala, hippocampus, and entorhinal cortex. Using principal component analysis (PCA) and its demixed counterpart (dPCA), we demonstrate that a distributed network of human MTL neurons exhibiting mixed selectivity on a single-unit level collectively processes emotion and memory, with a small percentage of individual neurons responding conjointly to emotion and memory despite an interaction in the recorded population. We found that neurons exhibit the highest firing rates during emotional, subsequently remembered trials, a possible mechanism for emotional memory enhancement. Additionally, we found that misses and correct rejections were similarly represented, suggesting that the neuronal populations respond to subjective, rather than veridical, judgments of novelty. Finally, we examined the relationship between neuronal spiking and both scalp EEG and intracranial LFPs. These results expand our understanding of the neural mechanisms underlying emotional memory by focusing on the activity of individual neurons rather than signals measured at more macroscopic levels, like electrical intracranial local field potentials (LFPs) and hemodynamic responses measured with functional magnetic resonance imaging (fMRI).

Topic Area: LONG-TERM MEMORY: Episodic

D54 - The construction of complex narrative time

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The notion of narrative time is essential for understanding and remembering stories. Recent studies have shown that humans are remarkably accurate in judging the time of occurrence of videoclips extracted from a previously encoded movie. Here, we asked whether time-of-occurrence judgments provided through a visual analog scale can shed light on the gradual formation of a temporal representation of previously unseen narratives. To this aim, we asked different groups of subjects to repeat the time-of-occurrence task under different conditions of exposure to the movie content (cueing conditions). In a first "no-cueing" condition, participants were asked to place 80 2-sec videoclips extracted from a previously unseen 40m TV show ("24"). The task was repeated three times using the same video clips, and no increase in temporal precision was observed across repetitions. In a second "random-cueing" condition, task repetitions were interspersed with the passive viewing of 160 additional videoclips (cues) extracted from the movie, presented in temporally scrambled order. Again, performance did not significantly increase across task repetitions. A significant decrease in placement errors across repetitions was instead observed when the same cues were presented in chronological order ("chronological-cueing" condition) with the level of performance almost approaching that of a group of subjects that were previously exposed to the full movie ("movie" condition). In accordance with a general reconstructive account of long-term memory, these results suggest that the temporal information provided by sparse inputs can be exploited to gradually form a temporal scaffolding of the narrative, filling the gaps between encoded information.

Topic Area: LONG-TERM MEMORY: Episodic

D55 - Value-Directed Remembering in Parkinson's Disease

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Value-directed remembering (VDR) paradigms assess the influence of reward on episodic memory, and prior work has demonstrated that source recognition is greater for stimuli associated with high versus low reward. Neuroimaging data (EEG, fMRI, DTI) suggest that the effect of value on memory depends on dopaminergic projections between the midbrain and hippocampus. Our study tests the hypothesis that patients with Parkinson's Disease (PD) have a diminished effect of value on memory and associated responses in the hippocampus and brain reward system. PD patients were recruited for two experimental sessions, one on levodopa and one after a 12-hour withdrawal from levodopa. Functional magnetic resonance imaging (fMRI) data was collected as patients completed a VDR source recognition task. During the study phase of the task, we presented participants with words to memorize (item) with the location on the screen (source) varying randomly. These words were assigned to one of two conditions: high reward versus low reward. During retrieval, we asked participants to recognize both the item and source information for the presented words. Correctly recognizing a word either earned $1.00 (high reward) or $0.01 (low reward). Participants were instructed to earn as much money as possible. As hypothesized, we found that there was no effect of value on memory performance. Differences in dopaminergic hippocampal activity in levodopa-on and levodopa-off states and its association with motivated memory encoding will be presented along with discussions regarding future research.

Topic Area: LONG-TERM MEMORY: Episodic

D56 - Enhancing real-world event memory and well-being in individuals with transient epileptic amnesia using a smartphone-based intervention

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The ability to remember past experiences plays a critical function in our lives, and its loss can have a profound impact on quality of life and well-being. Transient epileptic amnesia (TEA) is a subtype of temporal lobe epilepsy characterized by hippocampal abnormalities and interictal memory complaints, including accelerated long-term forgetting and autobiographical amnesia. We developed HippoCamera, a smartphone-based intervention that guides participants to record and replay high-fidelity memory cues for daily events using principles from memory science. Previous work has demonstrated robust and long-lasting benefits to episodic recollection in healthy older adults following repeated reactivation of real-world memories using HippoCamera, accompanied by increased pattern differentiation in hippocampal activity. Here, we investigated whether these memory benefits extended to individuals with TEA, who experience impairments in autobiographical memory retention. Patients with TEA and matched healthy controls, recruited from The Impairment of Memory in Epilepsy (TIME) database, used HippoCamera for 5.5 weeks. For the first three weeks, participants recorded two events daily—as a within-subject comparison, recorded cues were assigned to either a "replayed" condition, where they were replayed over the entire study, or a "baseline" condition, where they were never replayed. Using a modified Autobiographical Interview task, we found that participants had improved episodic recollection for "replayed" events relative to "baseline" events. Further, following study completion, participants reported positive changes in psychosocial factors, such as self-concept and confidence. The present work reflects the first autobiographical memory intervention in TEA and demonstrates how HippoCamera can benefit memory and well-being for individuals experiencing memory impairments.

Topic Area: LONG-TERM MEMORY: Episodic

D57 - Ripples during associative and non-associative memory retrieval in humans.

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Ripples in the hippocampus are high frequency (80-120 Hz) bursts of synchronous activity which have been linked to memory retrieval in awake humans. However, it is unclear whether ripple events are regionally specific to the hippocampus and how they are related to the type of memory being retrieved. Further, it remains unknown how ripples impact the underlying neural firing in the hippocampus and surrounding cortex. Here, we investigate these questions using intracranial electroencephalography (iEEG) and micro-wire data from the hippocampus and entorhinal cortex (EC) of nine epilepsy patients who performed associative (scene-object cued recall) and non-associative (scene recognition) memory tasks. We first used an unsupervised method to explore the frequencies of gamma bursts (30-200 Hz) around memory retrieval in hippocampus and EC iEEG. In hippocampus (but not EC) the distribution of gamma-bursts had a peak at ~100 Hz, which aligns with the human ripple frequency range. Next, we algorithmically detected hippocampal ripples and found that the ripple rate increased after memory cue onset in both associative and non-associative tasks. Importantly though, this increase was more persistent in associative retrieval trials. Finally, multi-unit activity analysis indicated a peak in neuronal firing rates (FR) around ripples, but with an asymmetry between hippocampal and EC FR. Specifically, local hippocampal FR preceded hippocampal ripples whereas EC FR followed hippocampal ripples. Together, these results suggest ripples are a prominent oscillatory signal around retrieval particularly in hippocampus, and their dynamics are differentially modulated by memory type and underlying neuronal firing across hippocampus and EC.

Topic Area: LONG-TERM MEMORY: Episodic

D58 - Shared multivariate brain patterns during recall associated with greater overlap in recalled information

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During encoding and recall of naturalistic events people instate shared multivariate patterns throughout higher order cortical regions of the brain. These shared patterns are thought to reflect shared mental models of the encoded and recalled events. We explored whether neural patterns are more correlated in participants who recall events more similarly to each other. Participants were scanned using fMRI as they encoded two 15-minute movies and verbally recalled those movies either immediately or after a 2-day delay. Intersubject pattern similarity (ISPS) was calculated from fMRI data for four default mode subnetworks previously shown to be connected to the hippocampus. Verbal recall was transcribed, segmented into events, and fitted to topic models. This produces a vector of "topic activations" that represents the abstract concepts present in recall for each event. We calculated how similar each participant's recall was compared to the group by correlating the vector of topic activations for each subject, for each event to the group. Further, we manually scored each recall transcript for details using published methods. We found that topic similarity is strongly associated with recall ISPS in posterior medial, medial prefrontal and medial temporal networks, particularly at the 2-day delay. This suggests that when participants recall events similarly after a delay, their pattern of brain activation is also more similar. However, ISPS was not related to the number of details recalled suggesting that shared activation patterns between people are not simply reflective of how well something is remembered, but how similarly it is remembered to others.

Topic Area: LONG-TERM MEMORY: Episodic

D59 - Event processing and memory in Mild Cognitive Impairment

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Humans perceive everyday experiences as a sequence of individual events, typically involving people carrying out certain activities in a particular location. A change in the ongoing situation is usually perceived as an "event boundary", which marks the passage of this information into long-term memory and signals the start of a new event. Therefore, the ability to detect event changes is crucial to understand and remember situations. We tested event processing and memory in individuals with Mild Cognitive Impairment (MCI), who typically show a long-term episodic memory impairment. However, it is unclear whether MCI also causes problems in comprehending a situation as it unfolds and in recalling something immediately after it happens. Thirty MCI adults and thirty healthy controls listened to short stories narrating life-like situations. Five stories described separate activities (e.g., baking then reading the newspaper), five equally long stories concerned a single activity (e.g., baking). Participants recalled these stories immediately after their presentation and an hour later. Participants then read the same stories and marked the narrative changes. Individuals with MCI found it difficult to mark story changes and were less likely than healthy controls to detect switches across separate activities. Also, compared to controls, they were impaired at recalling both types of stories, not only after a long delay, but even immediately after their presentation, and this difficulty was more pronounced for stories with more changes. These results suggest that MCI individuals' difficulties in processing story changes disrupt both their comprehension and their memory of a certain situation.

Topic Area: LONG-TERM MEMORY: Episodic

D60 - Do impressions of characters and their actions influence memory of a narrative?

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Our memories are not exact representations of what we experienced. Rather, they are influenced by factors such as context, emotion, and expectations. One such factor that is crucial to the way we represent everyday events is our impressions of the people around us. However, the way attitudes about people influence memory for events is not well understood. We hypothesized that the extent to which a character is liked, how moral they are perceived to be, and how well their actions align with expectations will influence how that character is remembered. In the present study, participants watched a short film broken into 10 clips where two main characters made morally gray choices. Following each clip, participants answered multiple choice and free response questions designed to measure how much they liked the character, how moral they believed the character was, and what subsequent course(s) of action the character should and would take in the next clip. After watching all of the clips, participants were asked to describe everything they remembered from the movie in detail, and provide final descriptions of the main characters. Our preliminary results show considerable individual variability across character impressions and recall performance, which we will leverage to correlate with impressions and expectations. Ongoing analyses use clip number as a proxy of the narrative unfolding to measure how opinions about the characters changed over time. Other analyses will use natural language processing models to determine whether participants who rate the characters similarly use similar language to describe the characters.

Topic Area: LONG-TERM MEMORY: Episodic

D61 - Generalization Ability in Memory and the DRM Paradigm

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In day-to-day life, individuals are able to extrapolate learned information and generalize it for application to new events. The Deese, Roediger and McDermott (DRM) paradigm has been designed to induce false memory, thought to result from the extraction of a "gist", or generalization, across related information. Participants are presented with semantically related word lists and asked to recall them later. False memory manifests by recall of critical lures: items that are semantically related to the list items but never presented. In the existing literature, false alarms in the DRM are sometimes considered a form of generalization. However, endorsement of semantically related lures may also be caused by a lack of specificity in the memory trace. The current study sought to understand how false alarm rates in the DRM relate to generalization ability versus the ability to remember differentiating details . A sample of 95 healthy young adults were assessed on their relational generalization and similarity-based generalization abilities using an acquired equivalence task and a prototype learning task, respectively. Results showed that individual differences in false alarm rates were unrelated to either type of generalization. Instead, participants with higher rates of false alarm in the DRM also performed worse on measures of memory specificity , such as confusing in memory two similar animals or confusing repeated and recombined association. The findings suggest that a lack of specificity in memory is responsible for the manifestation of high false alarm rates in the DRM as is not related to other forms of generalization.

Topic Area: LONG-TERM MEMORY: Episodic

D62 - Predicting image memorability from evoked feelings

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While viewing a visual stimulus, we often cannot tell whether it is inherently memorable or forgettable. However, the memorability of a stimulus can be quantified and partially predicted by a collection of features. Higher-level properties that represent the 'meaningfulness' of a visual stimulus to viewers best predict whether it will be remembered or forgotten across a population. We tested how the feelings evoked by an image, operationalized by valence and arousal, contribute to the memorability of scene images. We ran two complementary experiments to investigate the influence of affect on scene memorability, in the process creating a new image set (VAMOS) of hundreds of natural scene images for which we obtained affective ratings and memorability scores. From our first experiment, we found memorability to be highly reliable for scene images that span a wide range of evoked arousal and valence. From our second experiment, we found that both valence and arousal are significant but weak predictors of image memorability. Scene images were most memorable if they were slightly negatively valenced and highly arousing and least memorable if they were extremely positive or unarousing. However, valence and arousal together accounted for less than 10% of the variance in image memorability. These findings suggest that evoked affect contributes to the overall memorability of a scene image but, like other singular predictors, does not fully explain it.

Topic Area: LONG-TERM MEMORY: Episodic

D63 - The neural signature of retrograde memory enhancement by contrastive focus accent

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It is well established that motivationally significant events are preferentially stored in memory even when the relevance of an event becomes evident only sometime after encoding. Here, we used the ERP subsequent memory effect (SME) to explore the mechanisms underlying such a retrograde memory enhancement (RME) during prosodic focus marking. Prosody is a way to make a phrase more salient. Contrastive focus accent is often interpreted exclusively, such that an utterance is only true for the focused element, not for any others. Participants listened to short stories containing two context sentences which included sets of three elements (e.g., pearls, rubies, sapphires) and a critical sentence. The critical sentence repeated one of the three elements with or without a contrastive focus accent (e.g. PEARLs vs pearls). Memory performance tested in a subsequent recall test was not affected by the focus manipulation. In the ERP we explored whether there is a retrograde SME on the focused element, i.e. a more pronounced SME the more elements from the preceding context sentence are remembered. Consistent with this view, the ERP elicited by the focused element was more positive going between 300 and 700 ms if two elements were remembered than if only one element was remembered. This retrograde SME was most pronounced at parietal electrodes and only present in the contrastive focus marking condition. These data suggest that contrastive focus marking initiated a reinstatement of the preceding sentence context by which these elements are prioritized in memory and therefore more likely remembered.

Topic Area: LONG-TERM MEMORY: Episodic

D64 - Thalamocortical interactions in episodic relational memory across the lifespan

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Episodic memory relies on binding individual elements to create contexts, attending to associative, spatial and temporal dimensions of events. These relational aspects of memory have rarely been examined together within the same study and their neural substrates remain to be ascertained. While memory research has focused on the involvement of the medial temporal lobe (MTL) in binding processes and the prefrontal cortex (PFC) in supporting mnemonic control operations, higher-order thalamic nuclei may be critical in modulating the interplay between MTL and PFC during memory retrieval. Furthermore, episodic memory abilities improve rapidly during middle childhood, concomitant with PFC development, while age-related episodic memory decline is generally attributed to interference of non-relevant information along with gradual structural changes. To better understand interactions between these brain regions in relational memory over the lifespan, as well as interactions between semantic and episodic memories, twenty-three children (aged 9 to 14), twenty-two young adults (aged 18 to 35) and twenty-four elderly adults (over 60 years) underwent MRI scanning with a high-resolution functional protocol during a memory retrieval task comprising item memory as well as associative, spatial and temporal relational memory for both semantic and non-semantic materials. Results revealed a strong impact of semantic memory on episodic memory, especially for adults, which was more pronounced with age. Anterior thalamic involvement was found across retrieval conditions, differing across age groups, with functional coupling of anterior thalamus with PFC and MTL regions. These results will be discussed in line with current models on human memory development across the lifespan.

Topic Area: LONG-TERM MEMORY: Episodic

D65 - The effects of divided attention on long-term memory retrieval

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Previous studies observed an asymmetry between the effects of attention on long-term memory (LTM) encoding vs. retrieval. While divided attention has resulted in decrements in encoding to LTM, it has minimal or no effect on retrieval performance. Several theories have been proposed to explain this asymmetry, suggesting that retrieval is automatic or differences between tasks are used for retrieval. This study examined another possibility that tasks requiring more precise representations may be more susceptible to detrimental effects of divided attention by using the continuous report paradigm. Participants (N=19) learned 180 object-orientation associations and retrieved those orientations in either divided attention or full attention conditions. Mixture modeling fit on error distribution has shown that under DA condition, guess rate was higher while the standard deviation remain the same. These results suggest that dividing attention during retrieval reduces the accessibility of memoranda while the precision remains intact.

Topic Area: LONG-TERM MEMORY: Episodic

D66 - Narrative linking during encoding drives associative inference

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We often make inferences about novel associations based on prior experiences. This ability, associative inference, is thought to be a key process by which memory guides future behavior. Prior studies of associative inference have typically instructed participants to use narratives or mental imagery to aid in memory of associations between objects. However, these studies have not explicitly tested the function of narratives in this process, leading to an important unanswered question: how crucial are narratives in associative inference, and what role might they be playing? We used a modified associative inference paradigm to answer these questions. Importantly, our design factorially combined two factors during associative encoding: use of a narrative, and explicitly linking the two objects. Participants separately learned AB and BC object pairs within ABC triads using four sets of instructions: (1) generate stories to link objects (Story Together), (2) generate stories for objects independently (Story Separate), (3) compare physical properties of two objects (Compare Together), and (4) describe physical properties of objects individually (Describe Separate). We tested participants' ability to make inferences about AC associations as a function of encoding strategy. We found that active linking conditions have higher AC accuracy. This suggests that both narratives and explicit linking matter for associative inference. Ongoing analyses are using Large Language Models (BERT) to examine the prediction that narratives shape semantic representations to align associative links and promote successful inference.

Topic Area: LONG-TERM MEMORY: Episodic

D67 - Using ERPs to investigate the effects of culture and language on memory in Mandarin-English bilinguals.

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Bicultural bilinguals offer a unique lens through which to investigate the influence of culture and language on cognition. Previous work demonstrates that bilinguals experience joint activation of both languages, but the co-activation is influenced by cultural context in that it privileges words that refer to culturally salient concepts; a culturally-specific context will bias activation of the corresponding language. What is not known is whether these biases from cultural associations also impact later retrieval of words. The present study reports two experiments investigating the influence of culture and language on recognition and source memory while event-related potentials (ERP) are recorded. Participants in both experiments were young adult Mandarin-English bicultural bilinguals and the task was based on an old/new recognition paradigm. During encoding blocks, participants observed a stream of Mandarin and English items that were either culturally neutral or relevant to Chinese culture. In Experiment 1, the recognition block required participants to determine whether items were previously seen (Old) or entirely new (New), and in Experiment 2, participants determined whether items were presented in the same language (Old) or as translated equivalents of previously seen items (Translate). For Old items, culturally salient concepts presented in Mandarin elicited the highest recognition accuracy and smallest N400 amplitude. For New and Translate items, culturally salient concepts presented in English elicited the highest false alarm rates and largest N400 amplitudes. This suggests that cultural context biases activation of the congruent language label facilitating better memory for old items but introducing biases for new items.

Topic Area: LONG-TERM MEMORY: Episodic

D68 - Brain-Wide Responses to Item Repetition

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Repetition plays a vital role in learning and memory processes across species. Although repetition produces learning, it generates muted neural responses in both perceptual and memory regions. Here, we investigated the neural correlates of repetition across widespread brain regions as subjects perform an episodic memory task. Recording intracranial electroencephalographic (EEG) signals in neurosurgical patients (n=55) revealed repetition-related reductions in high frequency activity (HFA) and increases in low frequency (LFA) activity, consistent with previous studies of repetition suppression. This pattern indicates suppression of oscillatory power that typically accompany successful memory encoding and retrieval. We observed these effects in recordings taken from widespread neocortical regions, as well as in the hippocampus proper. Contrary to predictions of several theories, the degree to which repetition suppressed spectral correlates of successful memory encoding did not reliably predict subsequent memory for the repeated items.

Topic Area: LONG-TERM MEMORY: Episodic

D69 - The effects of targeted reactivation on memories cued once or multiple times during a nap

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During sleep, memory traces are reactivated and consolidated into long term memory. Targeted memory reactivation is a technique used to selectively bias reactivation for certain memories by presenting non-invasive sensory cues. We tested whether the number of times a cue was presented during sleep would impact the incurred benefit. Participants (N=31) completed a computerized object-location task, in which 60 images were presented along with related sounds. Participants first learned to associate the sound and image, and then memorized their location on a grid. During non-REM sleep, 40 of these sounds were presented either once (20 sounds) or five times (20 sounds) in an interleaved fashion. The remaining 20 sounds were not presented during sleep. Participants then completed another spatial task, which was designed to interfere with the previously encoded spatial memories, before finally being tested again on the initial object positions. The results showed no significant performance benefits for cued objects regardless of the number of sound presentations. This may be due to the interference task, which substantially increased post-sleep error rates. Nevertheless, we did find differences between the electrophysiological profiles linked with multiple vs. single sound presentation during sleep. Spindle spectral power predicted improvements in performance for the objects cued five times, but not for those cued once. For sounds presented once, post-cue power corresponding to slow wave activity was higher for those linked with objects that benefited more over sleep. Our results inform future research using targeted memory reactivation to selectively bias memory during sleep.

Topic Area: LONG-TERM MEMORY: Episodic

D70 - Self-Report Anterograde and Retrograde Memory Outcomes Following Electroconvulsive Therapy in Adults with Major Depressive Disorder

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Electroconvulsive therapy (ECT) is an effective treatment for major depressive disorder (MDD). Research suggests that ECT may disproportionately affect memories formed in close temporal proximity to ECT, while older memories remain unaffected. Here, we tested this hypothesis with a novel self-report scale of retrograde memory, and contrasted performance against a validated scale of anterograde memory. Eighteen individuals with treatment-refractory MDD (mean age=41.5 years; 55.6% female) were tested before and after a course of ECT. Nine non-depressed controls (mean age=43.7 years; 30.3% female) were tested at a single time point. To assess retrograde memory, participants completed the Subjective Appraisal of Retrospective Memory (SARM). The SARM assesses the ability to recall detailed events across 5 distinct life periods: the past month, 1-6 months, 6-12 months, 1-5 years, and 5-10 years. To assess anterograde memory, participants completed the Multifactorial Memory Questionnaire (MMQ: Memory Mistakes). At baseline, compared to controls, patients reported greater difficulty remembering past events across all time periods on the SARM (p-value range: 0.007-0.1) and endorsed greater anterograde memory difficulties on the MMQ ($F(1, 21)=6.14$, $p=0.02$). Following ECT, on the SARM, patients reported greater difficulty remembering events from the month immediately preceding ECT ($t(13)=2.2$, $p=0.048$), with no significant changes for other time periods. ECT did not impact anterograde memory on the MMQ ($t(13)=1.67$, $p=0.12$). Our findings suggest that ECT may negatively impact the recall of episodic memories formed within the month prior to treatment, while more remote memories are unchanged. Self-perceived anterograde memory does not seem to be affected by ECT.

Topic Area: LONG-TERM MEMORY: Episodic

D71 - Associative inference is influenced by schema congruency

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The presence of overlapping elements in distinct events promotes the formation of associative inferences across event boundaries, thereby shaping how new information is integrated with pre-existing knowledge. This study investigates the influence of schema congruency on mnemonic processes involved in such associative inferences. The present study employed EEG recordings of brain activity to assess encoding and retrieval-based processes in an associative inference task. Participants (N=38) encoded AB events set against unique congruent/incongruent background contexts, creating different schema representations across different learning trials (e.g., multiple forest scenes for a 'forest' schema). Subsequently, they encoded novel but overlapping CB events against neutral backgrounds. During retrieval, participants were tested on the indirect AC inferences and recalled the schema and context of the AB events. Behavioral results indicated similar AC inference performance for both congruent and incongruent events. While schema memory remained unaffected by congruency, context memory was better for congruent events. EEG data revealed differences between correct and incorrect inferences during CB encoding for congruent events and during AC retrieval for incongruent events. Further, hierarchical multivariate pattern classifiers, designed to identify schema and context-specific neural activity, showed that while congruent events

were associated with schema reactivation, incongruent events elicited context reactivation. In summary, our findings suggest that associative inferences across event boundaries are supported by different mnemonic mechanisms, depending on whether the events align or deviate from existing schemas. Specifically, inference for schema-congruent information is likely accomplished via integrative encoding, whereas inference across schema-incongruent information seems to depend on flexible retrieval processes.

Topic Area: LONG-TERM MEMORY: Episodic

D72 - The long-term impact of chemotherapy on episodic memory and mental health in breast cancer survivors

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Breast cancer is the most prevalent cancer diagnosis worldwide. Cancer treatments, particularly chemotherapy, have pervasive effects on cognitive functioning and emotional well-being that can adversely impact quality of life. Chemotherapy has neurotoxic effects on the hippocampus, a critical structure involved in declarative memory and mental health. This study aims to understand how chemotherapy impacts episodic memory in women aged 30 to 65 with breast cancer who are at least 6 months post-chemotherapy and healthy controls, and how affective symptoms may mediate cognitive impairment. Participants completed questionnaires to assess anxiety, depression, stress, fatigue, and sleep quality. In a subsequent session, participants encoded two short verbal stories using the Taler Stories Task, then completed an immediate and 20-minute delayed recall task and rated their level of cognitive effort exerted to complete this task. Preliminary findings suggest that breast cancer survivors (BCS) significantly recalled fewer episodically rich details during the immediate and delayed recall tasks relative to controls, with no significant effect of time. Although BCS reported increased symptoms of stress, anxiety, depression, fatigue, and sleep disturbances compared to controls, they were not significantly correlated with their episodic memory or their cognitive effort. BCS also required significantly more cognitive effort than controls which was significantly correlated with a reduction in accuracy during immediate and delayed recall. This same relationship was not observed in controls. Understanding the long-term effects of chemotherapy on episodic memory, mental health, and their relation, in BCS is crucial to determining therapeutic approaches to improve their quality of life.

Topic Area: LONG-TERM MEMORY: Episodic

D73 - A retrieved context account of episodic recall and event segmentation

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There is a rich history from cognitive psychology and cognitive neuroscience that humans segment their continuous experience into meaningful events or episodes (Radvanksy & Zacks, 2014; Clewett et al., 2019). Recently, computational cognitive modeling has sought to bridge findings from event segmentation with episodic memory and temporal perception (e.g., Franklin et al., 2020; Horner et al., 2016; Pu et al., 2022). However, work remains to bridge findings across different episodic memory paradigms. The present research generalizes the retrieved context model framework (Howard & Kahana, 2002; Lohnas et al., 2015; Polyn et al., 2009) to behavioral and neural findings from event segmentation, free recall, temporal perception and serial recall. I demonstrate how this model can account for the influence of event segmentation on episodic recall using consistent principles and minimal changes across paradigms. In brief, each studied or retrieved item within an event updates a slowly changing temporal context representation, and boundaries between events lead to a larger shift in temporal context. Temporal context also serves as the retrieval cue, underscoring the importance of temporal information to representations of episodic events. These results provide an important bridge between serial recall and free recall. Both tasks require participants to study lists of items, but the instruction to recall items in any order (free recall) or in their studied order (serial recall) has led to divergent theories between paradigms. Further implications for theories of episodic memory and event segmentation will be discussed.

Topic Area: LONG-TERM MEMORY: Episodic

D74 - Learning exceptions to category rules is supported by distinct white matter networks

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Flexible concept learning involves a host of core mechanisms including working memory, decision making and attention. Such complexity is reflected in a wide range of brain regions spanning occipital, temporal, and frontal lobes that have been implicated in concept learning. Although a rich literature exists on the functional properties of cortical and subcortical regions in flexible concept formation, the involvement of white matter structures between these regions remains an open question. Participants (N=37) completed a complex visual category learning task in the MRI scanner. Category memberships were based on a multidimensional rule with exceptions to rules, as a measure of flexible learning. We quantified the integrity of white matter tracts in the whole human brain with diffusion weighted imaging. Correlational tractography was then used to identify the white matter structures that were related to different behavioural indices of learning. We observed distinct white matter tracts involved in learning exceptions to categories: forceps minor, bilateral fornix, bilateral superior/anterior thalamic radiation, and left cingulum frontal parietal. The integrity, as indexed with fractional anisotropy, of these tracts predicted participant-specific exception learning ability. In contrast, learning rule following items was supported by a separate white matter network involving middle and inferior longitudinal fasciculus. These findings suggest that learning category regularities and exceptions relies distinctly and primarily on a white matter network that spans thalamus, prefrontal cortex, and hippocampus, and highlight the importance of understanding the role of white matter structures in flexible concept learning.

Topic Area: LONG-TERM MEMORY: Episodic

D75 - Insights on the Neurocognitive Mechanisms Underlying Cognitive Impairment in COVID-19: Evidence from a Large-Scale Online Study

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COVID-19 has been associated with acute and long-term cognitive impairments, including memory and concentration deficits, as well as neuropsychiatric symptoms such as anxiety and depression. However, the neuropathophysiological mechanisms underlying these cognitive and affective changes remain poorly understood. Accumulating evidence points towards neuroinflammation as a potential driver of most acute and post-acute neurofunctional symptoms. We aimed to comprehensively characterize cognitive impairment associated with COVID-19 within a large-scale online study including more than 1400 participants, both individuals who had been infected in the past and individuals who had never been tested positive. Our cognitive test battery covered alertness, executive functions, and episodic long-term memory. Our results demonstrate a pronounced and selective impairment of individuals previously infected in a mnemonic discrimination task known to engage hippocampus-dependent pattern separation. This impairment remained statistically significant after controlling for potential confounding factors such as age, gender, level of education, depressiveness, anxiety, and stress. As hippocampal pattern separation has been linked to hippocampal neurogenesis, is it is conceivable that compromised hippocampal neurogenesis following infection may contribute to the memory deficits observed in COVID-19. Our study has important implications for understanding how COVID-19 affects neurofunctional processes and highlights the potential significance of neuroinflammation in the manifestation of cognitive impairments. Furthermore, these findings could contribute to the development of therapeutic strategies for managing long-term COVID-19 symptoms.

Topic Area: LONG-TERM MEMORY: Episodic

D76 - Position of the uncal apex as a predictor of memory function across the adult lifespan

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Structural decline of the hippocampus is a main determinant of episodic memory dysfunction in both healthy and pathological aging. As age-related gray matter atrophy heterogeneously manifests across the hippocampus longitudinal extent, it is crucial to investigate atrophy of its anterior and posterior subregions separately. However, evidence indicate that the anatomical landmark uncal apex, used to demarcate anterior and posterior subregions, changes position as the hippocampus atrophies. This

emphasizes a risk of misclassifying gray matter into the incorrect subregion when using standard demarcation methods, and likely explains several inconsistencies evident among current findings. Yet, it remains unexplored whether inter-individual differences in uncal apex position may predict memory decline in aging. Here, we manually identified the uncal apex in anatomical MRI data from a healthy adult-lifespan sample (n=180; 20-79 years; mean age=49.8±17.4; 90 women); assessed age effects on its position and on anterior and posterior volume comparing manual landmark-based segmentation to coordinate-based segmentation in MNI space (y=-21); and assessed the link between uncal apex position and episodic memory performance. Aging was associated with a more anteriorly located uncal apex (~0.034mm/year) and standard coordinate-based segmentation overestimated age-related anterior gray matter decline. Whereas hippocampal volume did not predict episodic memory, regardless of segmentation method, a more anterior uncal apex was linked to lower episodic memory performance. These results confirm that our understanding of anterior and posterior hippocampal decline in aging is highly dependent on segmentation approach, but indicate that uncal apex position may provide a sensitive alternative for predicting individual differences in behavior.

Topic Area: LONG-TERM MEMORY: Episodic

D77 - The Role of the Fornix in Episodic Memory

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The fornix may play an important role in working and recognition memory. Data collected during a larger study of hippocampal subfield volumes was analyzed to determine the relationship between the fornix and performance on episodic memory tests. The subjects included 26 healthy adults, aged 18-44, recruited from the City College of New York and surrounding community. Photos of natural scenes and everyday objects were used as stimuli. Subjects were scanned with MRI diffusion tensor imaging using a Siemens 3 Tesla Prisma MRI Scanner. Image analysis determined the total number of white matter fiber tracts in the left and right fornix, average length and diameter of the tracts, fractional anisotropy, mean diffusivity, average diffusivity, and radial diffusivity, using the left and right fornix as regions of interest (ROIs). Memory performance was evaluated by the percentage of correct responses. Reaction times were also recorded. A negative correlation ($p < 0.05$) was found between reaction time for new images presented during the recognition task and fractional anisotropy of the combined left and right fornix, with the model being significantly enhanced by adding age as a co-variate. There was also a moderate negative correlation ($p < 0.05$) between reaction time and accuracy for new images in the recognition task. Because the fornix is connected to the anterior cingulate cortex in addition to the hippocampus, it's possible that the fornix plays a key role in the "cognitive control network" that involves the coordination between reactivity and memory retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

D78 - Do theta rhythms in memory formation modulate proactive interference?

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Computational models (Hasselmo et al., 2002; Ketz et al., 2013) posit hippocampal theta oscillations (3-12Hz) resolve interference between old and new associations by promoting pattern separation or completion at distinct theta phases. Yet it remains untested if our ability to resolve memory interference varies several times per second. Here, we test this prediction using our mnemonic dense sampling approach (Biba et al., 2024), which leverages the finding that attention-grabbing cues can make neural phase predictable across trials. By varying the encoding cue-object delay across milliseconds, we can detect sub-second rhythms in memory formation. During learning, participants classified objects based on the preceding cue color (blue: Indoor/Outdoor; orange: Size), while we varied the cue-object stimulus onset asynchrony (SOA: 300-1200ms in 33ms steps). At retrieval, participants attempted to recall the most recent task associated with each object. We manipulated interference by testing objects after they had been associated with only one task (B: Baseline) or two different tasks (PI: Proactive Interference). For both conditions, we used subsequent memory performance to construct encoding success time-courses across SOAs. Preliminary analyses (n=56 of planned N=100) confirmed worse memory in the PI condition ($t=9.02$, $p<2.3x10-12$) and revealed trends toward forming memory rhythmically for both B and PI (6Hz, ps < .05 uncorrected). Spectral analysis also revealed a trend towards individuals oscillating in their susceptibility to proactive interference (B-PI) across SOAs (9 Hz, $z=2.42$, $p=.007$, FDR-corrected $p=.076$). Our present findings suggest proactive interference may vary at the theta frequency, with distinct milliseconds optimized for resolving memory interference.

Topic Area: LONG-TERM MEMORY: Episodic

D79 - Age-related differences in EEG Oscillatory Subsequent Memory Effects

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The present study investigated age differences in the oscillatory correlates of successful memory encoding. Young and older adults viewed images of scenes and objects while undergoing EEG recording for a subsequent memory test. Behaviorally, recognition accuracy was lower in older adults compared to younger adults for scene stimuli. There were no age differences in recognition memory for object stimuli. A time-frequency analysis identified age-variant and age-invariant subsequent memory effects in the theta and beta frequency bands (regardless of image type). The age-invariant subsequent memory effects included theta desynchronization (4-7 Hz) and synchronization for subsequent hits relative to misses, and beta desynchronization (13-17 Hz) over near global channels. Age-variant subsequent memory effects were observed in theta over occipital channels. These findings corroborate some previous studies of neural oscillations and memory performance and help identify the neural correlates of age-related memory decline. Future research is needed to identify the role of theta desynchronization in memory encoding in older adults.

Topic Area: LONG-TERM MEMORY: Episodic

D80 - Evidence for hippocampal involvement in mnemonic discrimination of semantically similar verbal memory traces

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Converging evidence from computational models, as well as animal and human data suggest that hippocampal pattern separation (PS) – i.e., a neural process orthogonalizing similar neural inputs – contributes to the encoding and retrieval of highly specific memory traces. Yet, it is an open question whether PS also contributes to creating specific episodic memory traces of semantically overlapping concepts. Recently, using the semantic mnemonic similarity task (sMST), we found that mnemonic discrimination – a behavioral proxy for PS – decreased as a function of semantic similarity. In the sMST, participants first incidentally encode adjective-noun phrases, then make old-new judgements about identical and semantically highly similar phrases, where similarity is manipulated continuously using a word2vec word-embedding. Here, we extend our extant behavioral findings by directly testing the hypothesis that hippocampal PS contributes to mnemonic discrimination of memory representations with high semantic overlap. Thirty healthy young adults (Mage = 21.1 years, 15 female) completed the sMST during high-resolution functional magnetic resonance imaging that allowed us to map HC activity at the subfield level. Beyond replicating the behavioral effect that semantic similarity decreased discrimination, we observed that semantic similarity scaled encoding-related activity in the inferior parietal lobule – a key region in the neural network supporting semantic processing –, and scaled recognition-related activity in the HC. We will present currently ongoing HC subfield-level analyses testing our main hypothesis – that PS is indeed involved in mnemonic discrimination of highly similar semantic memories.

Topic Area: LONG-TERM MEMORY: Episodic

D81 - HippoMaps: multiscale cartography of human hippocampal organization

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Intro The hippocampus has a unique microarchitecture, is situated at the nexus of multiple macroscale functional networks, contributes to numerous cognitive and affective processes, and is highly susceptible to brain pathology across common disorders. However, despite its widespread interest, large brain mapping projects tend to grossly oversimplify hippocampal structure. Here, we introduce HippoMaps, an open access toolbox and data warehouse for the precise mapping and contextualization of hippocampal data in the human brain. Methods HippoMaps capitalizes on a novel hippocampal unfolding approach as well as shape intrinsic cross-subject and cross-modal registration capabilities. We initialize this repository with data spanning 3D histology, structural MRI and resting-state functional MRI (rsfMRI) obtained at 3 and 7 Tesla, as well as intracranial encephalography (iEEG) recordings in epilepsy patients. Results We show how hippocampal maps can be related using a tailored approach for spatial map association that corrects for autocorrelation. We show how this can be applied in, for example, in comparison of task-fMRI to subfield-related histological mapping. Code and tools are compliant with community standards, and are provided as comprehensive online tutorials that reproduce the figures shown here. Conclusions Applications of hippocampal mapping span methodologies and modalities, spatial scales, as well as clinical and basic research contexts. We encourage community feedback and contributions in the spirit of open and iterative scientific resource development.

Topic Area: LONG-TERM MEMORY: Episodic

D82 - Threat-Related Long-Term Memory Reinstatement in Hippocampus

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Hippocampus, a brain region that is crucial for memory consolidation, is influenced by threat and arousal in complex ways, and thus is implicated in psychiatric conditions like PTSD. Yet, our understanding of how threat-related representations are reinstated in hippocampus over time remains limited. In a recently collected dataset (N = 47), we test how threat-related information is reinstated in hippocampus 1-week after encoding. On Day-1 (encoding), participants watched six (3 aversive, 3 neutral) short (2-min) movie clips in the scanner and provided arousal ratings after each clip. Twenty-four hours later (Day-2), participants came back to the lab to complete a temporal order memory test. Finally, 1-week after encoding (Day-8), they came back to the scanner and watched a disrupted version of each clip. During the disrupted clips, the screen alternated between the original video (On period: 10 second) and a black screen (Off period: 20 second), while audio remained on for the entire clip. Our planned analyses for this poster will focus on hippocampal memory reinstatement during the disrupted movie watching on Day-8. To test this, we will calculate pattern similarity between the on- and off-periods on Day-8 with the corresponding time frames on Day-1. We hypothesize that there will be higher hippocampal similarity during the off- than on- periods (Off>On), reflecting memory reinstatement. We further expect that this Off>On difference will be higher for the aversive than neutral clips, reflecting threat-related bias in memory reinstatement. Furthermore, we expect that arousal ratings for the clips will amplify these effects.

Topic Area: LONG-TERM MEMORY: Episodic

D83 - The effects of naturallistic sonification of space on reaching tasks

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The use of concurrent auditory feedback in coaching and rehabilitative settings shows promise due to their ability to provide rapid responses to an individual's movements. However, few studies have systematically addressed this topic in traditional motor tasks in a laboratory setting, such as reaching tasks. Furthermore, despite clear trends in the literature on how to encode spatial information in sounds, no study has directly examined the behavioral effects of designing auditory cues that intuitively map to naturalistic sound-space relationships. To this end, participants with arms mounted on a robot exoskeleton will perform reaching movements towards visual cues presented in a horizontally placed monitor above their arm. Auditory cues will precede the visual onset of the target, and sound dynamics will be systematically manipulated to either informatively encode spatial information of target position, or to be wholly uninformative. We expect that participants will demonstrate faster and more precise reaching movements towards visual targets preceded by informative auditory cues. We will further compare performance when the sonification of target position matches pre-existing priors in pitch-verticality relationships (up = increasing pitch, down = decreasing pitch) versus when these relationships are inverted. We expect that the effect of informative cues will be stronger when the auditory mapping of target position conforms to priors in pitch-verticality relationships. These results would demonstrate both the potential of auditory cues to efficiently convey movement information, as well as the importance of carefully designed sonification approaches that conform to an individual's lived experiences and prior expectations.

Topic Area: PERCEPTION & ACTION: Motor control

D84 - Amplitude-modulated kilohertz transcranial magnetic perturbation (kTMP) has frequency-specific effects on motor performance

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We tested the efficacy of a novel non-invasive brain stimulation method, kilohertz transcranial magnetic perturbation (kTMP) in modulating motor performance. kTMP is a magnetic induction method capable of applying strong subthreshold E-fields in the kilohertz frequency range to superficial cortical structures without eliciting tactile sensations. Amplitude modulation (AM) of the kilohertz carrier waveform can be used to target physiologically relevant frequencies. In the current study, we asked if kTMP over the primary motor cortex impacted performance on a force-tracking task. We targeted two prominent motor rhythms: 1) Beta (15-30 Hz), a rhythm associated with movement idling and shown in previous work with invasive alternating current stimulation to impede motor learning; 2) Low-frequency oscillations (3-6 Hz), a range useful for decoding movement kinematics that has been shown to be disrupted following stroke. kTMP was applied with a carrier frequency of 3.5 kHz with the intensity set to induce a cortical E-field of 4 V/m. In three separate sessions, we employed two AM-kTMP conditions, individualized beta (17-29 Hz) or 3 Hz (fixed for all participants), or sham stimulation in a double-blind repeated-measures design. Within each session, motor performance was measured before, during, and after the application of kTMP. We found that AM-kTMP modulated motor performance in a frequency-dependent manner: Performance improvement during and following beta stimulation was reduced compared to the 3 Hz and sham conditions. These results indicate that kTMP has the potential to expand our non-invasive toolset to investigate brain function and provide new therapies for brain disorders.

Topic Area: PERCEPTION & ACTION: Motor control

D85 - Neural Dynamics of Expert Sensorimotor Integration: Unveiling Athlete Mastery Beyond Their Specialized Domain

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Expert athletes in fast-paced sports, such as racket sports, exhibit sensorimotor performances at the biological limit. Previous research linked this to a more efficient neuronal implementation of sensorimotor integration processes during the specialized sport. This study investigates the neural processes underlying continuous monitoring of movement consequences with differing degrees of feedback in expert athletes in a non-domain specific task. The research is grounded in the ideomotor theory, emphasizing the brain's encoding of actions based on observable consequences. In the current study, we employed a pursuit-tracking task, where athletes and controls track a moving target using a joystick. Tracking conditions include visible or invisible target and cursor. These conditions allow to manipulate the availability of feedback about tracking success. The current research confirms athletes' superior sensorimotor performance as reflected by the pursuit-tracking task performance. Additionally, we found that when visual feedback about indicator location is withdrawn, participants struggle with keeping the indicator on the goal but improve in moving the indicator in the same direction as the goal. Source reconstruction of EEG data revealed different task-related modulations in theta frequency band activity in brain regions associated with continuous sensorimotor integration between athletes and controls. This study provides insights into expertise-

related changes in neural sensorimotor integration processes, contributing to a neuroscientific foundation for training effects. Methodologically, the study expands the pursuit-tracking task paradigm by introducing an invisible target condition and novel tracking data analysis methods, enhancing the continuous pursuit-tracking paradigm and paving the way for future research in continuous sensorimotor integration.

Topic Area: PERCEPTION & ACTION: Motor control

D86 - Action-specific representations of visual task features: Computation on demand

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It has been previously found that computations of goal-directed behaviour are facilitated by conjunctive neural representations of task features. However, these conclusions are drawn from paradigms that often use arbitrary combinations of task affordances and features that necessitate working memory. Therefore, in the present study, we used a task that requires minimal working memory representations to investigate the temporal dynamics of feature representations and their potential integration in the brain. Specifically, we recorded electroencephalography data from human participants while they first viewed, and then grasped objects or touched them with a knuckle. Objects had different shapes and were made of intuitively light or heavy materials. Importantly, shape and weight were features relevant for grasping but not for knuckling. Using multivariate analysis, we found that representations of object shape were similar for grasping and knuckling. However, only for grasping did early shape representations reactivate at later phases of grasp planning, suggesting that sensorimotor control signals feed back to early visual cortex. Grasp-specific representations of weight/material only emerged during grasp execution after object contact, during the load phase. A trend for grasp-specific integrated representations of shape and material arose, but only briefly during movement onset. These results argue against the view that goal-directed actions automatically integrate all features of a task into a sustained and unified neural representation. Instead, our results suggest that the brain creates action-specific representations of relevant features as required for the separate subcomponents of its action computations.

Topic Area: PERCEPTION & ACTION: Motor control

D87 - Large-Scale Network underpinnings of sustained gripping in Parkinson's Disease

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Parkinson's Disease (PD) is a neurodegenerative disorder affecting movement control. Previous magnetoencephalography (MEG) studies have demonstrated movement-related modulations of motor cortical activity to be attenuated in PD. While most research investigating oscillatory power during movements focused on motor cortical activations, their network context has been widely neglected. We hypothesise that investigating motor cortical oscillatory activation from a network perspective offers a more precise description of oscillatory processes underpinning movement, and may provide more sensitive markers of changes related to PD. We analysed MEG recordings of healthy controls (HC) and PD volunteers obtained during performance of a sustained-gripping task with two grip-force conditions. Following source reconstruction and parcellating of the data, we applied a Hidden Markov Model to obtain a dynamic, large-scale network description of the data, based on distinctive patterns of oscillatory activity. Spectral features and trial-averaged occurrence probabilities of the extracted networks were compared between the two groups. Two networks with increased motor cortical activation were identified, each characterised by unique spatial-temporal characteristics. The occurrence probabilities of these networks were associated with task-related beta power modulations and gripping strength. The dynamics of both networks did not differ between HCs and PD volunteers, but motor cortical beta power was decreased during occurrences of one of the two networks, characterised by high activations in motor cortical and posterior areas, in PD volunteers. Our results open new avenues for investigating oscillatory processes underlying movements and markers of PD by highlighting the importance of studying motor cortical oscillatory activation within its network context.

Topic Area: PERCEPTION & ACTION: Motor control

D88 - Measuring Conscious Monitoring and Metacognition at the Start, Middle and End of a Reaching Movement

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Monitoring our arm position during goal-directed behaviour allows us to bring our limb to a target as accurately as possible. Despite our success in executing accurate movements, some work suggests that individuals have limited access to information about their limb position (Fourneret & Jeannerod, 1998). Contradictory evidence from metacognition research shows that when individuals are asked to rate their confidence after making judgements about their movements, they tend to give higher confidence ratings when they are correct, showing some capacity for self-monitoring (Arbuzova et al., 2021). Participants made reaching movements toward targets on a screen. They were then presented with two movement paths: their actual trajectory and a visually deviated version. We manipulated the location that the deviation was implemented (i.e., start, middle, or end of the path). Participants were asked to determine which trajectory was their own, followed by rating their confidence in their response. Overall, accuracy was lower than expected. Nevertheless, accuracy and confidence were higher when deviations occurred in the middle and end of the movement as opposed to the start, suggesting that participants were more aware of their true limb position at these locations. In addition, metacognitive sensitivity was greater during the middle and end implying that at these locations, individuals' confidence ratings better discriminated between correct and incorrect responses. We conclude that people have a remarkable blindness to the properties of their own movements. As well, monitoring of a limb is significantly reduced at the start of a movement, possibly due to movement programming demands.

Topic Area: PERCEPTION & ACTION: Motor control

D89 - Intracranial EEG Processing of Auditory Feedback in Perisylvian Cortex

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Speaker-induced suppression, a feedback control mechanism, demonstrates that perceptual systems process auditory information differently during speaking and listening. During passive speech listening, the auditory cortex exhibits spatially separated "onset" responses at the start of a sentence and "sustained" responses throughout, but it is unclear how these might be modulated during speech production. Here we used stereotactic electroencephalography in sixteen patients with intractable epilepsy who read sentences aloud, then passively listened to playback to investigate the nature of these response profiles during speaking and playback. Unsupervised clustering of neural responses identified onset and sustained responses to speech in bilateral auditory cortex, with a selective suppression of onset responses during speech production. Other cortical areas were generally selective to speaking or listening but did not specifically suppress onset versus sustained responses. In ventral motor cortex, we observed electrodes involved in prearticulatory motor control. Finally, a "dual onset" cluster localized to posterior insula exhibited onset responses to both speaking and listening with similar latency to the "onset suppression" cluster identified in temporal cortex. "Onset suppression" and "dual onset" regions exhibited phonological feature tuning during temporal receptive field analysis, unlike other generally production/perception-selective areas. This study expands on previous identification of onset and sustained responses in temporal cortex to show that auditory onset responses are generally suppressed during speech production. We interpret this as a component of suppressive mechanisms during speech motor control. The insula exhibiting onset responses during speaking and listening suggests a role in multisensory integration during feedback control.

Topic Area: PERCEPTION & ACTION: Motor control

D90 - Stability and flexibility of visually guided pointing movements with increasing Time-on-Task

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Cognitive functions regulated by prefrontal activity, constrained in capacity seem to be vulnerable to fatigue induced by increasing Time-on-Task (ToT). Movement planning is costly in terms of cognitive capacity and in line, a previous study showed that movement initiation became slower with ToT. However, it is unclear whether the slowing of movement initiation is due to fatigue vulnerability of higher functions involved in movement planning or decreased vigilance. Therefore, in two experiments (N1=26, N2=27), we investigated the effects of ToT on movement stability and flexibility as higher cognitive functions underlying movement performance. In Experiment 1, we examined the stability of movement with a mouse-tracking version of the Eriksen flanker task. Arrowhead centered on the screen and flanked by distractors indicated the direction of the target participants needed to point with the cursor. Stability of movement was assessed based on participants' ability to inhibit incongruent distractor information with ToT. In Experiment 2, we examined the flexibility of movement with conditions where the spatial position of the target changed unexpectedly after its appearance (change-trials). The performance difference between change- and non-change trials were examined. Variables of movement preparation, execution, and subjective fatigue were recorded. Gaze position was recorded to control fixation. In both experiments, the results indicated detrimental effect of ToT induced fatigue on movement variables particularly on movement initiation. Nevertheless, both stability and flexibility of movements remained unchanged suggesting that compromised movement was due to decreasing vigilance and not to fatigue vulnerability of higher cognitive functions. Support: NKFIH-K142321

Topic Area: PERCEPTION & ACTION: Motor control

D91 - Quenching the Groove: Inhibition of left SMA with cTBS Disrupts the Urge to Move to Music

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The pleasurable urge to move to music (termed "groove" by music psychologists) has been shown to be greatest for music with moderately complex rhythms. This is thought to occur because temporal predictions from the motor system reinforce our perception of the beat when there is a balance between expectation and surprise. The supplementary motor area (SMA) has been identified as the potential origin of these temporal predictions based on both neuroimaging and computational modeling studies. Thus, to causally test the role of the SMA in the experience of groove, we used transcranial magnetic stimulation to disrupt activity in this region while non-musicians listened to and rated clips of commercially recorded music that varied in rhythmic complexity and perceived groove. Continuous theta burst stimulation was delivered over left SMA and a control location in primary visual cortex (V1) at 80% of participants' active motor or phosphene threshold. Following stimulation over left SMA, but not V1, participants preferred to move to music with low rather than to moderate rhythmic complexity while pleasure ratings were unaffected. These preliminary results suggest that the left SMA maintains temporal predictions, perhaps by weighting the precisions of prediction errors. Therefore, when left SMA function is inhibited, participants can no longer covertly update their model of the beat in simpler rhythms and thus feel compelled to use movement to reinforce the model instead. In summary, these findings provide causal evidence that the SMA plays a critical role in generating temporal predictions for embodied rhythm processing.

Topic Area: PERCEPTION & ACTION: Motor control

D92 - Don't Look! It's Object-Based: Identifying a Distractor Produces Inhibition in an Allocentric Reference Frame for Saccades

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Studies of object-based inhibition show inhibition in additive spatial and object-based frames of reference (e.g. Jordan & Tipper, 1994). Recent studies have shown that during the active perceptual decision-making process, saccade trajectories to a target are shifted towards the distractor. Once the process is completed, and the distractor inhibited, trajectories shift away from the distractor (Kehoe, et al, 2018, 2021; Giuricich, et al, 2023). The magnitudes of the saccade deviations provide a sensitive measure of target-distractor competition, where both objects are encoded in an egocentric reference frame, i.e. object location is represented relative to fixation. Given prior findings showing object-based inhibition mediated by an allocentric reference frame i.e. objects are represented relative to each other in the scene and independent of fixation, we investigated whether the distractor is inhibited relative to the target or fixation in our perceptual decision-making task which uses a purely eye movement response. Using a saccadic response delayed match-to-sample task where the target and distractor varied in both allocentric and egocentric distances, only egocentric reference frames contributed to shifts in saccade trajectories towards the distractor during active decision-making. In contrast, when the perceptual decision-making process was complete and the distractor was inhibited, both ego- and allocentric reference frames independently contributed to trajectory shifts away from the distractor. This is consistent with additive spatial and object-based inhibitory mechanisms. Therefore, we suggest that distractor inhibition is maintained in cortical visual rather than oculomotor areas.

Topic Area: PERCEPTION & ACTION: Motor control

D93 - Comparing the effect of low- vs. high-pitched metronomes on gait in rhythmic auditory stimulation

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Rhythmic auditory stimulation (RAS) is a promising intervention for gait-disordered populations that involves synchronizing footsteps to regular auditory cues. Previous research has shown that emphasizing beat onsets by adding a metronome to low-groove music improves stride speed and variability, possibly because increasing beat salience provides a clearer external cue to synchronize with. Here, we compared the effect of embedding low-pitched versus high-pitched metronomes in music to determine whether the privileged role of bass sounds in synchronization in other domains would also improve gait synchronization. We expected that adding a bass drum metronome to low- and high-groove music would improve stride speed and variability relative to a higher-pitched kick drum. Preliminary analyses in a sample of 70 healthy adults indicate no difference between high- and low-pitched metronomes. This suggests that the pitch of the metronome may not matter for improvement, and that any stimulus with strong beat salience will be effective. Moreover, adding the metronomes reduced gait differences between high- and low-groove music, in contrast to previous findings of robust gait differences between high and low groove. Therefore, beat salience may drive the effect of groove on gait. Ongoing studies will compare these responses to music without metronome, as well as characterize them in clinical populations.

Topic Area: PERCEPTION & ACTION: Motor control

D94 - Influence of a visual landmark shift on memory-guided reaching in the monkey

Jennifer Iin[1], Veronica Nacher[1], Hongying Wang[1], Saihong Sun[1], Xiaogang Yang[1], J. Douglas Crawford[1]; [1]York University

The brain uses various sources of visual information, including both egocentric (e.g., object location relative to the eye) and allocentric cues (e.g., object location relative to visual landmarks) to aim movements. The main purpose of this study is to determine the influence of allocentric cue shifts on reaching responses in non-human primates. To do this, reach and gaze data were collected from one female Macaca mulatta monkey (ML) trained to perform a memory-guided reaching task. A landmark was presented at 1 of 15 locations on a touch screen. A visual target then appeared transiently at a variable location within or outside this virtual square, followed by a visual mask. After the mask, the landmark either reappeared at the same location (stable landmark condition) or shifted by 8 degrees in one of 8 directions (landmark shift condition). The fixation light then extinguished, signaling a reach to the target. 'No-landmark' controls were the same, but without the landmark. Compared to gaze responses, reach had lower variance and decreased reaching error. The presence of a stable landmark increased the accuracy of both gaze and touch responses and the precision of gaze. It also decreased the reaction time for both gaze and touch. In the landmark shift condition, reaches shifted partially (mean = 29%) with the landmark. We found the gaze responses to shift (mean = 38%) with the landmark too. Overall, this data suggests that the monkey is influenced by visual landmarks when reaching to remembered targets in a similar way as humans.

Topic Area: PERCEPTION & ACTION: Motor control

D95 - Examining predictors of motor imagery timing in Parkinson's Disease

Kathryn Lambert[1], Anthony Singhal[1], Ada Leung[1]; [1]University of Alberta

People with Parkinson's Disease (PD) often exhibit greater motor impairments on one side of the body. It is unclear if these differences in impairment also occur during motor imagery. The present study examined if individuals with PD imagine movements differently according to the side of the body involved in the imagery task. 36 participants with PD (12 F) completed a battery of tests that measured different domains of motor imagery ability. To measure motor imagery timing, participants were timed as they physically moved several blocks across a wooden box using either their more or less affected hand. Participants were then timed as they imagined completing the same task. Cognitive function was screened using the Montreal Cognitive Assessment. Linear mixed effects modelling was employed to determine predictors of performance on the timing task. Participants were more likely to overestimate the physical speed of their movements when the task involved their more affected side ($p = 0.001$). This overestimation regardless of whether the involved hand was their dominant or non-dominant hand. Higher motor imagery vividness ($p = 0.010$) predicted greater overestimation of the more affected hand's physical speed. In contrast, higher cognitive function ($p = 0.001$) predicted a decrease in overestimation. Taken together, these results indicate that the process of motor imagery differs in people with PD depending on whether the imagined movements involve their more versus less affected side.

Topic Area: PERCEPTION & ACTION: Motor control

D96 - From Sound to Action: The Premotor Cortex's Dual Role in Learning Direct and Indirect Melodies

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The production of music necessitates the brain's capacity to connect musical sounds with the corresponding physical movements. This process involves the premotor cortex (PMC), comprising the ventral (vPMC) and dorsal (dPMC) regions, within the auditory dorsal stream of the brain, a critical area for the learning and the expression of auditory-motor associations. While the vPMC is associated with direct, one-to-one associations between objects and actions within the visual domain, the dPMC engages in complex, abstract, and flexible associations. However, the specific roles of the vPMC and dPMC in auditory-motor learning in the context of direct versus indirect associations are unclear. In this study, we applied repetitive 1 Hz inhibitory transcranial magnetic stimulation (TMS) to 126 participants, 21 participants per each of the dpmc, vpmc and V1 (control group), prior to training 45 five-note melodies with either a direct, orderly key-tone mapping, or an indirect, random key-tone mapping on a piano keyboard. We measured the change in the recall of these key-tone associations pre and post training via a pitch-matching task, wherein subjects had to identify and respond to pitches by pressing the corresponding keys without auditory feedback. Results show differences in both learning and pitch matching between V1, dpmc, and vpmc for direct or indirect auditory-motor associations. This suggests that the vPMC and dPMC are crucial in learning auditory-motor associations, with the recall of direct associations being more reliant on the premotor cortex. Additional results from the unconventional condition will be presented in the poster.

Topic Area: PERCEPTION & ACTION: Motor control

D97 - Sense of agency of the voluntary movement in patients with Psychogenic Nonepileptic Seizures

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Psychogenic Nonepileptic Seizures (PNES) are paroxysmal motor nonepileptic events that belong to the category of Functional Movement Disorders (FMD). They exhibit a variable phenomenology of movements perceived as involuntary. While previously referred to as pseudoseizures or psychogenic seizures, recent neurobiological research challenges this traditional perspective, questioning the role of psychogenic factors in their etiology. This study investigates the cognitive construct of the Sense of Agency (SoA) as a critical component of voluntary movement perception, assessing it through an implicit measure in patients with PNES. The study involved 10 female patients suspected of having PNES, with their diagnosis confirmed through Video Electroencephalography (VEEG) to rule out epilepsy. SoA assessment was conducted using an intentional binding paradigm, which measures the temporal association between actions and outcomes, employing categorical synchrony judgments. The results were then compared with those of 10 healthy control subjects. The average age of the participants was 29 years, and PNES patients exhibited limitations in daily activities, social and occupational dysfunction, along with comorbid psychiatric conditions. The study unveiled a significant change in intentional binding among PNES patients when contrasted with the healthy control group. In conclusion, this study enhances our understanding of the cognitive underpinnings of PNES, highlighting the pivotal role of SoA in the pathophysiology of these complex disorders. This research provides invaluable insights into the neurobiological basis of PNES, challenging the previously held belief of exclusively psychogenic origins in FMD.

Topic Area: PERCEPTION & ACTION: Motor control

D98 - Tempo representation in the basal ganglia and its role in sensorimotor synchronization

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Activation of segregated cortico-nigro-striatal-thalamic-cortical (CSNTC) loops is thought to encode the initiation of specific actions or to be involved in controlling action "vigour." We propose that the loops could also be encoding the tempo with which rhythmic actions (ex. finger tapping) are performed. In this way, switching which CSNTC loops are activated would act as a mechanism for tempo correction in sensorimotor synchronization tasks (classically, tapping along to a metronome). As a proof of concept, we represent parallel CSNTC loops as a bump attractor where the activity of units represents the activity of CSNTC loops. This architecture captures the excitation/inhibition patterns of CSNTC loops as well as observations of overlapping striatal representations of similar movements. We use this model to demonstrate how a continuous mapping of actions on the striatum, the proposed role of dopamine in reward prediction error and action switching, and a representation of action frequency in CSNTC loops can explain results of various tapping studies. Specifically, our model explains the observed differences in corrections to large and small tempo changes in synchronization tasks, as well as the increased variation in tapping intervals seen in patients with Parkinson's disorder. Alterations to the basal ganglia and dopamine are experimentally seen to effect movement, synchronization, and temporal and rhythm perception. This research attempts to further our understanding said relationship and may have implications regarding RAS therapy for Parkinson's or perception of rhythm and music.

Topic Area: PERCEPTION & ACTION: Motor control

D99 - DIFFERNTIAL DOPAMINE RESPONSES DURING AUDITORY-MOTOR SYNCHRONIZATION IN YOUNG AND OLDER HEALTHY ADULTS

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We demonstrated that external rhythmic auditory cueing using metronome clicks and rhythmic beats in music improved finger tapping performance and modulated dopamine (DA) responses in the left ventral striatum (VS) in young healthy adults.1 The current study is extended to investigate if the dopamine responses in basal ganglia (BA) are different between young and older healthy adults. Twelve right-handed participants aged between 18 and 35 were included in this study. Each participant underwent two [11C]-(+)-PHNO-PET scans: during one scan, finger tapping with rhythmic auditory stimulation (RAS; RAS condition) and the other scan, the same finger tapping task without RAS (No-RAS condition). Binding potential relative to the non-displaceable compartment (BPND) values were used as outcome measures for DA responses. BPND changes between conditions in the BG were compared between the two groups. In both groups, RAS reduced the absolute tapping period error and significantly reduced tapping variability (both groups combined: $p=.01$ and $p=.001$, respectively). The BPND changes in the right putamen showed a significant group difference ($p=0.028$). Older participants exhibited 13% increase in DA response while young participants exhibited a 4% decrease in DA response in the ROI during the finger tapping with RAS. Our preliminary data have shown that rhythmic auditory cueing may have differential effects on DA responses in young and older adults: reduced DA responses in young adults vs

increased DA responses in older adults. Further investigation will need to confirm the preliminary findings. 1.Koshimori et al (2016). Front. Neurosci

Topic Area: PERCEPTION & ACTION: Motor control

D100 - Iconic gestures form "conceptual pegs": Behavioral and ERP evidence

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Concrete words evoke more vivid mental imagery than abstract words, leading to enhanced memory for both the words themselves and paired associates (e.g., by serving as "conceptual pegs"; Paivio, 1965). We hypothesized that the addition of iconic gestures to spoken action words would mimic effects of concreteness. ERPs were recorded while participants heard unrelated verb-noun pairs (e.g., '…driving apple'). On some trials, the verb was accompanied by a matching iconic gesture (i.e., a steering motion for 'driving'). Free recall was used to test item memory (memory for gestured verbs) and associative memory (memory for verb-noun pairs). In Exp. 1, both types of memory were greater for word pairs accompanied by iconic gestures relative to no gestures or simple beat gestures. However, when the beat gestures were replaced with ambiguous "nonsense" gestures (Exp. 2), memory benefits were limited to the verbs. ERPs elicited by the nouns suggested that the ambiguous gestures may have caused a global shift in attention toward the gestures and away from the paired nouns. Indeed, when the same set of iconic- and non-gestured word pairs were studied without the nonsense-gestured pairs (Exp. 3), the associative memory benefit was restored. Moreover, under these circumstances, nouns preceded by iconic-gestured verbs elicited larger N700 amplitudes relative to those preceded by non-gestured verbs, suggesting enhanced associative imagery. Overall, these results suggest that iconic gestures can provide imagery and memory benefits that resemble those of concreteness. However, these benefits are reduced when listeners expect the gestures to be difficult to interpret.

Topic Area: PERCEPTION & ACTION: Multisensory

D101 - Disconnection Effects in Split-Brain Patients: A Systematic Evaluation of the Impact of Callosotomy on Cognition and Behavior

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How does severing the cerebral hemispheres impact cognition and behavior in 'split-brain' patients,who undergo callosal sectioning for intractable epilepsy? A sharp contrast exists between clinical neurology and experimental psychology in their perspectives on callosotomy's impact.Initial clinical assessments indicated minimal cognitive changes, while subsequent experiments using lateralized testing revealed significant 'disconnection effects'-indicating independent information processing by each hemisphere without the other's awareness or involvement.The ongoing debate about the exact nature of these effects persists due to variations in stimuli, task complexity, post-surgery timing, and callosotomy extent. Addressing this knowledge gap would advance our understanding of information propagation and integration across long-range brain networks, illuminating their role in cognition. In our project, we employed an array of lateralized tests across different cognitive domains/modalities (sensory-motor, sensory-tactile, spatial, visual). Participants performed in both crossed-uncrossed trials (e.g.,left visual field stimuli requiring either a crossed right-hand response or an uncrossed left-hand response) and cross-matching trials involving simultaneous stimuli presentation to both hemispheres for same/different judgments. Preliminary results from 5 callosotomy (2 partial, 3 full) patients show that, full-callosotomy led to significant performance disruptions in crossed but not in uncrossed trials. Hemispheric dominances for speech(left hemisphere) and visuospatial processing(right hemisphere) were supported. Performance in non-dominant hemisphere in speech production and visuospatial tasks broke down following callosotomy. No disconnection effects were observed in partial split-brain patients, even though one of them only had ~1 cm splenium intact, suggesting a threshold-like effect. Our study provides insights into the interhemispheric information integration in cognition and in human agency and consciousness.

Topic Area: PERCEPTION & ACTION: Multisensory

D102 - Neural dynamics of event processing under reduced uncertainty.

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Processing everyday experience may involve monitoring errors in predictions made by working memory representations of the current situation (event models) at points of uncertainty (e.g. when the situation changes, event boundaries). How does event processing change when uncertainty at event boundaries is reduced? To answer this question, we used EEG to examine changes in neural activity during the viewing of two ~7-minute long movie clips. We manipulated uncertainty along two dimensions: familiarity with the movie clips (which were viewed twice and then segmented into events), and by allowing participants to sample visual information in a restricted (by asking participants to maintain central fixation; n = 20) or unrestricted (by allowing participants to freely move their eyes; n = 20) manner. Restricted and unrestricted viewing groups identified boundaries at similar times. However, theta (4-8 Hz), alpha (8-12 Hz), and gamma (30 - 100 Hz) band power was modulated around event boundaries encountered during the first movie viewing, particularly when eye movements were unrestricted. In contrast, during the second viewing, power in these frequency bands was reduced around event boundaries in the unrestricted condition and temporally shifted in the restricted condition. These observations are consistent with uncertainty contributing to event processing, both through knowledge about what is happening when and by the ability to develop that knowledge through active sampling of visual information.

Topic Area: PERCEPTION & ACTION: Multisensory

D103 - Long-term multimodal sensory circuit adaptation to acquired threat is impaired in anxiety

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The need for efficient identification of environmental threat promotes multimodal sensory integration. The sensory cortex exhibits immediate plasticity to acquired threat cues, which evolves and consolidates over time and potentially underlies long-term threat memory. However, evidence to date is limited to cue-specific sensory cortex, leaving it unexplored whether such plasticity also entails heightened integration across multimodal sensory cortices. Threat learning and memory is exaggerated in anxious individuals, constituting a primary mechanism underlying anxiety disorders (especially, posttraumatic stress disorder/PTSD). Intriguingly, while vivid in PTSD, threat memories are often fragmented, suggesting that anxiety facilitates cue-specific (unimodal) sensory processing but impedes multisensory integration. To elucidate these possibilities, we examined interactions across multimodal sensory cortices in an fMRI study of olfactory threat conditioning with immediate and delayed (8 days) recall (N=31). Using generalized psychophysiological interaction (gPPI) analysis of fMRI timeseries, we observed that anxiety positively correlated with functional connectivity increase (from the baseline) between the primary olfactory (piriform) cortex and dorsal anterior cingulate cortex in response to the conditioned (vs. non-conditioned) odor, especially at the delayed recall, confirming heightened defensive response in anxiety. Nonetheless, for the conditioned (vs. non-conditioned) odor, anxiety negatively correlated with functional connectivity increase between the olfactory cortex and primary visual and somatosensory cortices, particularly at delayed recall. These findings reveal time- and anxiety-dependent circuit adaption following threat conditioning: adaptive neural responses to learned threat elicit multisensory integration in non-anxious individuals, whereas anxiety exaggerates cue-specific processing at the expense of multimodal integration, potentially underpinning hallmark symptoms of intrusive memory in PTSD.

Topic Area: PERCEPTION & ACTION: Multisensory

D104 - Predicting Response to McGurk Effect Based on Periodic and Aperiodic Prestimulus EEG Activity

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Previous studies have reported that prestimulus brain oscillations guide perceptual experiences during audio-visual speech perception. However, 'what' features of these prestimulus power drives multisensory speech perception remains unknown. We explored this question in the context of multisensory integration using EEG recordings

of 18 participants previously collected from our group (Kumar et al., 2020) using incongruent McGurk stimuli. We asked whether the subjective differences at the inter-individual and inter-trial levels of variability in prestimulus oscillatory power emerge from the ongoing background (1/f) component of brain activity (or aperiodic activity) or occur due to changes in only the periodic oscillations. Furthermore, we used logistic mixed-effect models to determine the topology of spectral markers that could predict the response to the upcoming illusory perception. We found that perception of the McGurk illusion was predicted by lower occipital alpha (8–12 Hz; Bayes Factor (BF) = 0.51) and lower parietal (BF = 0.48), central (BF = 0.77), and occipital (BF = 0.62) beta (15–30 Hz) oscillations. We also found lower aperiodic offset values over parietal (BF = 0.08) and temporal (BF = 0.16) sensors and a lower 'global' effect of exponent over the scalp, which predicted the response to McGurk illusion, suggesting that prestimulus aperiodic exponent contributes globally to the upcoming McGurk percept. In conclusion, our findings suggest that the predominant source of the prestimulus oscillatory state is aperiodic background activity and that variations in these arrhythmic components account for inter-trial and inter-individual variability in perception of the McGurk illusion.

Topic Area: PERCEPTION & ACTION: Multisensory

D105 - Distinct Temporal Neural Dynamics between Audiovisual Perception and Cross-modal Mental Imagery

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Mental imagery describes the process in which we internally create sensory experience without external input. Given most events in our daily life are multisensory, when we hear a sound we may find we are spontaneously imagining the associated visual in our mind. This type of mental imagery is triggered by the associated information from another sensory modality but remains less investigated. Previous studies found that the brain regions involved during perception and imagery are shared, but how the temporal dynamics would differ between the two distinct processes is still unknown. To address this, we conducted Electroencephalography (EEG) experiments on human participants (N=20) to compare the temporal dynamics between the perception of naturalistic audiovisual events in videos and the cross-modal imagery in which participants recalled the visual contents when hearing only the sounds as well as imagined the sounds when watching silent videos. With multivariate pattern analysis and temporal generalization method, we found that in contrast to the sequential processing of audiovisual perception, cross-modal mental imagery engages more sustained activity. We also observed that visual imagery involves a more delayed time course compared to auditory imagery, suggesting temporal disparities across different modalities of mental imagery. Overall, our study elucidates the temporal dynamics and distinctions in neural processing during audiovisual perception and cross-modal mental imagery.

Topic Area: PERCEPTION & ACTION: Multisensory

D106 - Exploring how perceived stress modulates neural synchrony using naturalistic fMRI

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Previous research shows the widespread impact of stress across the brain, affecting the amygdala, hippocampus, prefrontal cortex, inferior frontal gyrus, insula, parahippocampal gyrus, and cingulate gyrus (Golkar et al., 2014; McEwen et al., 2010; Berretz et al., 2020). However, traditional investigations into the neural correlates of stress have typically centered on stress induction or use stimuli that are not reflective of real-world task demands. In this study, we sought to explore how perceived stress modulates neural synchrony in response to naturalistic, audiovisual movie stimuli that better emulate the task demands of everyday life within an MRI scanner. To do so, we used data from 80 participants from the Naturalistic Neuroimaging Database (Aliko et al., 2020) who each watched one of ten feature-length films during functional magnetic resonance imaging. We separated participants into low- and high-perceived stress groups using a median split on their perceived stress scale (Cohen et al.,1994) score, and then calculated differences in intersubject correlations between the low- and high-stress groups using linear mixed-effects modeling. Results revealed that, even across 10 different films, there was increased neural synchrony for the low-stress vs. the high-stress group in the bilateral superior temporal gyrus, lateral occipital cortex, occipital pole, superior parietal lobule, and right orbitofrontal cortex. Together, our results suggest that individuals with lower stress levels process naturalistic stimuli more similarly in the brain than high-stress individuals. Furthermore, this study offers valuable insights into how perceived stress influences neural processing in a more 'real-world' context.

Topic Area: PERCEPTION & ACTION: Multisensory

D107 - Modulation of neural activity in response to dance training in Parkinson's: A case study

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Introduction. Recent evidence suggests that long-term participation in dance could delay the progression of symptoms in people with mild Parkinson's, but little is known about the neurobiological mechanisms of dance in Parkinson's. The present case study used functional magnetic resonance imaging (fMRI) to investigate potential neuroplastic effects of dance in a 69-year-old male with mild Parkinson's attending weekly dance for Parkinson's classes over a period of 29 weeks. Methods. Neural activations were measured with fMRI at four timepoints (pre-training, 11 weeks, 18 weeks, and 29 weeks), while the participant listened to music from the dance classes and imagined dancing. Blood-oxygen-level-dependent (BOLD) signal modulation associated with the dance imagery was examined using region-of-interest analysis across the four timepoints. Results. Significant changes over time were found in the supplementary motor area, right and left superior temporal gyri, and the right insula. Conclusion. The findings indicate that regular dance participation modulated neural activity in regions associated with motor planning and learning, auditory processing, rhythm, emotion, and multisensory integration. This suggests the potential for dance to have neuroplastic effects across multiple domains in people with Parkinson's. Analysis of neuroimaging data from a larger number of participants is needed to further understand and interpret these findings.

Topic Area: PERCEPTION & ACTION: Multisensory

D108 - Multisensory temporal processing in schizophrenia and bipolar disorder: Implications for positive symptoms.

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Structuring sensory events in time is essential for interacting with the environment and producing adaptive behaviors. Over the past years, the microstructure of temporality received increasing attention, recognized as a fundamental element of consciousness itself, whose alteration can underlie the etiopathogeneses of some clinical symptoms in psychiatric disorders. The present research investigated multisensory temporal processing in patients with schizophrenia (N=21), bipolar disorder (N=20) and healthy controls (N=21) in order to explore a plausible link between alterations in temporal binding of events and psychopathological dimensions. We asked participants to temporally order audio-tactile, visual-tactile, and audio-visual stimuli, and we administered different psychopathological scales to explore depressive, manic and psychotic symptoms underlying the diseases. Results demonstrated that both patients with schizophrenia and bipolar disorder are less precise in temporal processing independently of the sensory modalities involved, suggesting higher tolerance towards multisensory temporal asynchronies. Interestingly, reduced precision in temporal processing of patients is positively associated with the presence and severity of positive symptoms. Our findings support the hypothesis that low-level sensory alterations in temporal processing may be essential for the construction of holistic higher-level representations. Abnormal binding of temporal events could result in fragmented perceptions, subsequently contributing to the emergence of clinical symptoms such as delusions, hallucinations, and disorganized behaviors.

Topic Area: PERCEPTION & ACTION: Multisensory

D109 - Hierarchical or independent: Perception of durations, sequences, and beats across modalities

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In musical rhythms, humans spontaneously perceive the beat: a salient pulse that marks equally spaced points in time. Although humans perceive, produce, and synchronize with musical beats, individuals vary in beat perception ability. This study investigates possible reasons for poor beat perception ability, in the context of a temporal processing hierarchy—beat perception may rely on intact processing of other temporal features or may be independent. The first level of the hierarchy is single duration timing, which we propose is essential to more complex timing tasks including, but not limited to, the perception of beat. The second level is non-beat-based temporal sequence processing, which is presumed to rely on single duration timing. Finally, beat-based sequence processing is presumed to rely on accurate single duration and sequence processing (as beat extraction relies on the perception of predictable intervals within sequences). To determine whether performance conforms to this proposed perceptual hierarchy, we tested 141 participants on three-alternative forced choice discrimination tasks for single duration timing, non-beat-based sequence timing, and beat-based sequence timing. Additionally, we examined performance across auditory, visual, and tactile modalities. We applied k-means clustering to partition participants based on their patterns of performance across the three tasks within each modality. Stronger evidence of a 3-level perceptual hierarchy was found for auditory than visual or tactile stimuli. This suggests that beat perception in the visual and tactile domain may rely on different mechanisms than in the auditory domain.

Topic Area: PERCEPTION & ACTION: Multisensory

D110 - Exploring the predictive role of GABA and Glutamate on temporal binding window in audiovisual perception

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Introduction: This study explores age-related differences in audiovisual integration (AV) by examining the temporal binding window width (TBW) and differences in brain neurotransmitters in young and older adults. Behavioral studies have suggested a broader TBW in older adults, possibly tied to variations in brain excitation and chemistry (Bedard & Barnett-Cowan, 2016; Setti et al., 2011; Basharat et al., 2018). This research correlates AV integration tasks with gamma amino-butyric acid (GABA) and glutamate (GLU) concentrations in the visual cortex. Methods: Participants, comprising 14 young and 11 older adults, underwent behavioral simultaneity (SJ) and temporal order judgement (TOJ) tasks to measure AV integration and magnetic resonance spectroscopy (MRS) with a voxel of interest centered in the occipital lobe to measure neurotransmitter concentrations. Results: Preliminary results suggest MRS_GABA (df=1, f=55.48) and MRS_GLU (df=1, f=4.56) significantly different between younger and older adults, ($p<0.05$). Linear regression analysis revealed yO significant for MRS_GABA and TBW_SJ (yO =256, t=3.27, p=0.004) and TBW_TOJ (yO =128, t=3.67, p=0.002). Additionally, yO was also significant for MRS_ GLU and TBW_SJ (yO =139.6, t=32.1, p=0.04) and TBW_TOJ (yO =175.7, t=3.3, p=0.004) Conclusion: The study evaluates the potential of neurotransmitter concentrations in predicting AV integration. However, expanding the sample size is imperative for a more comprehensive understanding, particularly in elucidating mechanisms behind age-related declines in multisensory processing.

Topic Area: PERCEPTION & ACTION: Multisensory

D111 - The neural processing of continuous audiovisual speech in noise in autism: a TRF approach

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Individuals with autism spectrum disorder (ASD) present with core deficits in social interaction and communication. The goal of our current study is to decipher the neural mechanisms underlying impaired audiovisual speech and language processing in autism. Using the temporal response function (TRF) we analyzed the neural encoding of continuous speech at different levels of the speech processing hierarchy, ranging from acoustic to phonetic, to understand the stages at which information processing breaks down in individuals with ASD. We recorded high-density electrophysiology from high-functioning children (8–12 years) with ASD and an IQ-, sex-, and age-matched group of typically developing (TD) children. Videos of an actor reciting a children's book were generated, and randomly interspersed auditory, visual, and audiovisual versions with different levels of noise were presented in blocks of ~30 seconds while recording EEG and eye tracking data, and participants responded to target words. Preliminary results suggest that neural encoding of the speech stimulus is reduced in ASD at both acoustic and phonemic levels. Furthermore, the TRF from the acoustic envelope of TD and ASD children is higher for the audiovisual condition, suggesting that both groups benefit from the addition of visual speech cues. However, this gain seems to be reduced for ASD children, suggesting impaired neural mechanisms of multisensory integration of speech processing in autism. Additional analyses will focus on the role of top-down processes in impaired neural encoding of multisensory speech, and the relative contribution of altered processing stages in autism.

Topic Area: PERCEPTION & ACTION: Multisensory

D112 - Auditory Dorsal Stream Connectivity Supports the Older Musicians' Preserved Audiovisual SIN Perception and Visual Benefit

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Musical training, an intensive process involving auditory, visual, and motor systems, is proposed to counteract age-related decline in Speech-in-Noise (SIN) perception. While it's clear that visual lip movements aid SIN perception, no study has yet explored whether musical training enhances audiovisual SIN perception in older adults, or the neural mechanisms underlying this process. In this fMRI study, 24 young non-musicians (YNM), 25 older non-musicians (ONM) and 25 older musicians (OM) discriminated syllables-in-noise under lip still and lip congruent movements conditions. OM outperformed ONM but worse than YNM under both conditions. Interestingly, OM showed greater visual benefit than ONM and matched YNM. Through psychophysiological interactions analysis, we found that OM exhibited a similar functional connectivity (FC) level in auditory dorsal stream (bilateral posterior superior temporal gyrus (pSTG) and supramarginal gyrus (SMG) to motor areas including bilateral precentral gyrus (PrCG), supplementary motor areas (SMA), and speech motor areas) as YNM and less FC than ONM. With intersubject spatial correlation, we found OM showed a more similar functional correction spatial pattern in right superior PrCG seeded from right SMG to YNM than ONM. For visual enhancement, OM showed greater visual enhancement of FC from right pSTG to right motor areas than ONM, which also predicted a greater visual enhancement for ONM. Additionally, OM also showed greater structural connectivity along the right auditory dorsal stream, as indicated by greater neural density and lower orientation dispersion. Our findings suggest that auditory dorsal stream connectivity supports preserved audiovisual SIN perception and visual benefit observed in OM.

Topic Area: PERCEPTION & ACTION: Multisensory

D113 - Effect of Autism Spectrum Disorder on Behavioural and EEG Measures of Multisensory Integration

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Sensory differences are common in autistic individuals, reported in up to 94% of individuals. One aspect of sensory processing thought to be impacted is the ability to combine sensory information across sensory modalities, or multisensory integration. While there is an abundance of evidence that integration is impacted, behavioural findings are not entirely consistent. However, previous imaging studies have shown that even when little to no behavioural differences in multisensory integration are observed, differences in the neural mechanisms underlying integration are still seen. In this study, we examined whether there is an effect of autism spectrum disorder diagnosis on

multisensory integration using a speeded response task paired with electroencephalography (EEG) measures. Autistic children (n= 9; 11.4 years, data collection ongoing) and typically developing (TD) children (n= 15; 11.9 years) were presented with auditory pure tones, visual Gabor patches, or a combination of both, all embedded in audiovisual white noise and were instructed to respond as quickly as possible when they detected a stimulus. Stimuli were presented at the participants' unisensory 50% detection threshold, determined via a psychophysical staircase procedure. Only a small effect of diagnosis on accuracy gain and on the magnitude of violations of Miller's race model was found. However, preliminary analysis suggests there are neural differences in parietal and occipital regions between the two groups. Taken together, these results suggest that neural differences for multisensory integration may exist in autistic compared to TD children, even when behavioural performance is well matched.

Topic Area: PERCEPTION & ACTION: Multisensory

D114 - Cross-Modal MVPA Reveals Common Brain Representations of Action and Perception of Newly Learned Melodies

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Playing a musical instrument requires not only the control of finger movements but also coordination with auditory feedback. Studies indicate that with training, a seemingly inseparable relationship can be established between action and perception. This is known as action-perception coupling. Supporting evidence shows that when musicians observe a piano-playing hand silently, there are nonetheless activations in the auditory cortex. Moreover, our own previous work illustrated that when non-musicians listened to melodies they had learned to play, the corresponding patterns of activity in the superior temporal gyrus and dorsal premotor cortex could be used to distinguish between them. To extend on these previous results, we here used fMRI to investigate whether brain representations are similar when non-musicians (a) play two learned melodies on the piano while imagining the sound and (b) listen to the same melodies while imagining the finger movements. In total, 22 participants with no previous musical training participated in the experiment. Conjunction analysis revealed that both auditory and motor-related regions were active in both conditions. Multivariate pattern analysis (MVPA) showed that a classifier could differentiate between the brain patterns associated with the melodies in both the superior temporal gyrus and premotor cortex during the listening condition. However, only activity patterns in the premotor cortex distinguished the two melodies when the participants were playing. Additionally, cross-modal classification showed that representations generalized across conditions in the right premotor cortex. Notably, there were substantial individual differences in classification accuracies across regions and tasks.

Topic Area: PERCEPTION & ACTION: Multisensory

D115 - Brain dynamics associated with perisaccadic time perception: an EEG / graph theory approach

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Numerous studies have shown that saccades influence time perception, but the associated neural mechanisms remain elusive. We explored the cortical dynamics of perisaccadic time perception through a combination psychophysics, EEG, sLORETA source localization, and graph theory analysis. 21 participants viewed a sequence of reference stimuli followed by a test stimulus, either just before saccades or sustained fixation. Following this, participants were asked to judge the duration of the test stimulus compared to the reference. In previous studies we found that stimulus repetition and saccades events interacted at the level of sensorimotor brain dynamics (Ghaderi et al. Cerebral Cortex 2023) and perceived stimulus duration (Ghaderi et al. Heliyon 2022). Here, we combined these two approaches to investigate brain dynamics related to perceived stimulus duration (underestimation vs. correct). Source localization revealed the temporal dynamics in cortical activation, predominantly starting from early visual and concluding in higher-level 'cognitive' areas (middle frontal and anterior cingulate cortices). The graph theory analysis highlighted the pivotal roles of three groups of brain regions: 1) visual, 2) temporal and parahippocampal, and 3) frontal and anterior cingulate cortices. Furthermore, the whole network analysis revealed significant differences in the topological and dynamical features of brain networks between underestimated trials and those with correct judgments. These findings suggest the involvement of multiple cortical regions, potentially linked to various cognitive functions such as sensory processing, memory, and higher-order cognition. Moreover, the results imply that time distortion might be associated with higher-level neural processing within functional brain networks. Supported by NSERC funding.

Topic Area: PERCEPTION & ACTION: Multisensory

D116 - I see, therefore I perceive: functional mapping of internal body representation using a 3D avatar

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Somatomap 3D is a digital avatar tool used to quantify body image disturbance (BID) through measuring body size estimation (BSE) accuracy. However, its use during fMRI to probe body processing regions and networks involved in accurate body image has yet to be tested. We hypothesized that established body processing regions including the extrastriate body area (EBA), fusiform body area (FBA), insular cortex, and temporoparietal junction (TPJ) would be activated while completing the Somatomap task for individuals with and without BID. Twenty unmedicated adults were included in this preliminary analysis. During fMRI, participants used Somatomap 3D to adjust 23 body parts to create an avatar that represented their current body. Using mouse click timestamps, BSE was defined in the time-series as periods when participants were rotating/adjusting the avatar body. The baseline contrast included intervening periods between adjustments. Single group average fMRI analysis was carried out using FSL FEAT. Cluster threshold was determined by Z>3.1 and corrected cluster significance threshold of p=0.05. Peak MNI coordinates were identified using the Harvard-Oxford atlas, and Neurosynth was used to identify activation patterns overlapping with body processing regions. Significant clusters were evident in the whole-brain, voxelwise analysis corresponding to the body part adjustment/rotation periods versus baseline. Cluster activations overlapped with the EBA, FBA, and insular cortex but not the TPJ. This proof-of-concept study suggests that BSE using Somatomap 3D is associated with brain activation patterns in known body processing regions. Somatomap 3D is a task that may be used to examine neural mechanisms underlying BSE accuracy.

Topic Area: PERCEPTION & ACTION: Multisensory

D117 - The Importance of Noise in Audiovisual Learning: An Artificial Neural Network Simulation of the McGurk Effect

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Artificial Neural Networks (ANNs) are now approaching human-like performance on many tasks, and this allows novel methods of probing human learning and perception (Kanwisher et al. 2023). Training ANNs to replicate human perception enables researchers to investigate why our perceptual mechanisms might behave in particular ways, and also to shed light on the sometimes mysterious workings of these networks. This study explores the McGurk effect: an auditory-visual illusion wherein incongruent inputs lead to a fused, but incorrect, auditory percept. We recorded an audiovisual dataset of nine different word pairs previously demonstrated to elicit this effect and tested it on both humans and several recent state-of-the-art ANNs that were trained on audiovisual speech. Human participants selected the perceived word from a dropdown menu, while a K-nearest neighbours classifier was used on ANN output embeddings to decode forced-choice word classifications. We show that some ANNs do indeed exhibit the McGurk effect under certain circumstances. We further considered whether the McGurk effect in ANNs depends on training data, network architecture, or both. We discovered that training on audiovisual speech with noisy audio is crucial for replicating the illusion in ANNs, regardless of their network architecture or training objectives. Additionally, the network that most closely achieved a human-like McGurk effect was trained using a biologically plausible self-supervised task. These findings suggest that visual cues incorporated during speech learning in noisy environments are key to the audiovisual fusion observed in the McGurk illusion.

Topic Area: PERCEPTION & ACTION: Multisensory

D118 - Semantic novelty modulates neural responses to sensory stimuli across the human brain

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Our continuous sensory experience in daily life is dominated by change. Previous research has focused on change due to stimulus motion, eye movements, unfolding events, or auditory edges in speech. However, in naturalistic environments, these stimuli interact with each other and with semantic novelty. We investigate the neural responses to these distinct sources of visual change during film viewing. In addition, we investigate the multimodal interactions between visual change across saccadic eye movements with sensory and semantic features of speech. We analyzed intracranial recordings in humans across 6328 electrodes from 23 individuals. Responses associated with saccades and film cuts were dominant across the entire brain. Film cuts at semantic event boundaries were particularly effective in the temporal and medial temporal lobes. Saccades to visual targets with high visual novelty were also associated with strong neural responses. Specific locations in higher-order association areas showed selectivity to either high or low-novelty saccades. We conclude that neural activity associated with film cuts and eye movements is widespread across the brain and is modulated by semantic novelty.

Topic Area: PERCEPTION & ACTION: Multisensory

D119 - Sensory Sensitivity and Multisensory Integration in adults with ADHD: An EEG Investigation

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Increasing evidence suggests that sensory processing may be impacted in attention-deficit/hyperactivity disorder (ADHD), specifically hyper- and hypo-sensitivities to sensory information in multiple sensory modalities, as well the ability to integrate sensory integration across modalities. Previous studies on sensory processing in ADHD have shown mixed results in behavioural studies, however, multiple imaging studies suggest that even when little to no behavioural differences in multisensory integration are observed, differences in the neural mechanisms underlying integration are still seen. First, we examined whether sensory sensitivity in auditory and visual domains differ in adults with ADHD (n=31) compared to Neurotypical (n=29) adults using a discrimination task with an adaptive staircasing procedure. Second, we examined whether audiovisual multisensory integration is affected in the same adults using a speeded response tasks paired with electroencephalography (EEG) measures. Participants were presented with auditory pure tones, visual Gabor patches, or a combination thereof, all embedded in audiovisual white noise. Participants responded as quickly as possible when they detected any stimulus. No group differences in sensory sensitivity were found for either the visual or auditory domain. The ADHD group exhibited increased multisensory gain in response times compared to the Neurotypical group using Miller's race model, but no difference in accuracy gain. EEG analysis shows differences in neuronal processing in frontal and occipital electrodes. Taken together, these results suggest that behavioural and neural differences for multisensory integration may exist in individuals with ADHD compared to Neurotypical adults, despite a lack of differences in sensory sensitivity.

Topic Area: PERCEPTION & ACTION: Multisensory

D120 - Sensorimotor beta enhancement, not mu suppression, differentiates emotional vs. affectively-neutral content

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According to the influential action simulation theory of embodied cognition, we recognize others' emotions by internally simulating their actions with our own sensorimotor systems. Support for this idea comes from studies using electroencephalography (EEG), which have reported reductions in the power of the mu (8-14 Hz) and beta (16-20 Hz) rhythms over sensorimotor cortex, both when executing one's own movements and observing the actions of others. Specifically, we have previously found that observation of emotional vs. affectively-neutral whole-body movements is associated with greater mu suppression, driven by reduced responses to emotional actions, as well as increased beta enhancement while viewing neutral actions. However, recent evidence suggests that measurements of these periodic oscillations may be conflated with underlying aperiodic ("1/f-like") neural activity, which can influence the shape of the EEG power spectrum. Here we examined the relative contributions of mu and beta rhythms using high-density 128-channel EEG (N = 117) during the observation of emotional and neutral point-light displays (PLDs). To control for low-level motion, all PLDs were compared to scrambled versions of the same actions. After removing the aperiodic component from the data, we found significant mu suppression for coherent vs. scrambled PLDs, but not emotional content. However, consistent with our previous findings, there was a significant difference between emotional and neutral PLDs in the beta band (14-19 Hz), reflecting enhanced activity over frontocentral sensors for neutral movements. Together, these data suggest that neural oscillations in the mu and beta bands contribute differentially to distinct aspects of action observation.

Topic Area: PERCEPTION & ACTION: Other

D121 - Dietary cognitive regulation depends on strategy-specific modulation of choice attributes

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While many aspire to make better food choices, it remains unclear what strategy we should employ for greater regulatory success. For example, to make lasting, healthier food choices, should we try to suppress our appetitive responses or reformulate our thoughts? In the present study, hungry participants (N = 63) first rated the liking of 208 food images (1-6). Then, foods were sorted into 3 separate conditions of 60 foods with roughly equal liking: Respond Naturally, Focus on Health, or Decrease Desire. In this regulated choice phase, participants made decisions to eat (1-4) under one of these 3 conditions in interleaved blocks. Afterwards, participants made post-regulation liking ratings, as well as taste and health ratings of each food (1-6). After regulating their choices, participants disliked foods more post-regulation in the Desire condition ($p = .01$), but liked foods more in the Health condition ($p = 0.005$). Moreover, regulation strategies differed in how food attributes were considered during food liking evaluations. While both regulation conditions decreased the influence of Taste on post-regulatory Liking change (pDesire < .001, pHealth = .002), the Health condition substantially increased the Liking of healthy foods more after regulation ($p < .001$). We identified neural predictors of liking changes across regulation strategies, as well as changes in neural signatures of how food attributes are considered during these evaluations which predict regulatory success. These results suggest that regulation strategies may be implemented by different neural mechanisms and result in different behavioral consequences.

Topic Area: THINKING: Decision making

D122 - Incentivized random exploration associated with dorsal-ventral reinforcement learning circuit connectivity

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When exploring different alternatives, humans and other animals randomize choice as a function of increased noise in the state space. This type of 'random exploration' is typically studied using probabilistic reinforcement learning (RL) tasks. It's assumed there is an association between 'external' and 'internal' drivers of decision noise on such tasks i.e., greater uncertainty about outcomes is thought to lead to increased 'neural variability' in decision-making circuits, driving stochastic choice. Meanwhile, the neural bases of RL are thought to involve a balance between a ventral circuit that computes the value of prospective goals, and a dorsal circuit that computes the value of relevant goal-directed actions. We determined whether resting-state functional connectivity (rsFC) in ventral and/or dorsal RL circuits predicts the degree of random exploration in a well-validated two-stage decision-making task. We were interested in whether low versus high incentives modulated random exploration at each choice stage, and whether this was predicted by individual differences in goal value computations (ventral rsFC) and/or goal-directed action valuation (dorsal rsFC). We found an increased weighting of model-based relative to model-free control under high vs. low incentives, and rsFC of ventral

and dorsal RL circuits modestly predicted this change in decision-making strategies. Random exploration also decreased under high vs. low incentives, and the magnitude of this decrease was predicted by increased connectivity between dorsal and ventral circuits. These data suggest that incentivized random exploration is associated with individual differences in ventral-dorsal RL circuit connectivity.

Topic Area: THINKING: Decision making

D124 - Identifying the neural networks that support categorization using brain-informed drift diffusion modelling

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Categorizing elements of our experience is a cognitive shortcut to transform the overload of sensory information into something conceptually meaningful. Although many categories are defined by regularities (e.g., most birds fly), not all items conform to these simple rules (e.g., bats fly but are mammals not birds). Recent studies have focused on the roles of basal ganglia and hippocampus in category learning, but there remain key open questions about broader cortical networks that support category decision making. Here, we combined functional neuroimaging and drift diffusion modelling (DDM) to characterize the neural dynamics underlying category decisions. We leveraged a rule-plus-exception visual category learning task, in which most items are correctly categorized by a simple feature rule, but rare category exceptions violate the rule and are visually more similar to the other category. Given the opposing demands for learning rule-following items (i.e., generalizing across regularities) and exceptions (i.e., distinct encoding), we predicted that category evidence for item types may be represented by distinct neural networks. We linked trial-by-trial neural activation from atlas-defined ROIs across the whole brain to drift rate in the DDM and evaluated the degree that neural signal predicted category decision making. Results showed that default mode network regions tracked category regularities such that higher activation led to faster and more accurate responses to category prototypes. In contrast, regions within control and salience networks tracked decisions for category exceptions. These findings suggest that distinct cortical networks may represent key latent decision variables during category learning.

Topic Area: THINKING: Decision making

D125 - Risk-taking predicts socioeconomic status-related differences in learning among adolescents

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Adolescents are notorious for engaging in reward-driven risky decision-making behaviors, which are believed to be highly adaptive for learning. Yet, adolescents differ in their tendency to pursue rewards and learn. Indeed, adolescents from lower socioeconomic status (SES) backgrounds often display diminished reward sensitivity and reduced learning outcomes, raising the possibility that diminished reward-driven risk-taking may underlie SES-related learning gaps. Here, we examined whether risk-taking enhances learning in adolescents, and whether individual differences in risk-taking mediates SES-related disparities in learning outcomes. Adolescents (n=125; aged 13-15) from diverse SES backgrounds completed the Balloon Emotional Learning Task, in which they inflated a balloon on each trial to earn points. Notably, over-inflation caused balloon explosions and a loss of points. There were 3 colors of balloons, each with a distinct explosion threshold. Thus, participants had to incrementally learn via explosion-related feedback the optimal pumping frequency of each colored balloon. We found that within adolescents, trial number positively correlated with points earned, indicating that adolescents incrementally learned the balloons' explosion thresholds. Across adolescents, a higher risk-taking propensity (i.e., more pumps and explosions) correlated with better final learning outcomes (points earned). Further implicating risk-taking in the learning process, more risk-taking early in the task predicted better learning outcomes later. We also observed that lower-SES correlated with reduced risk-taking, and poorer learning outcomes (points), and reduced risk-taking fully mediated SES-related gaps in learning. These findings highlight the adaptive nature of adolescent risk-taking, and demonstrate that disparities in risky decision-making may underlie SES-related disparities in learning.

Topic Area: THINKING: Decision making

D126 - Perceptual decision-making at fixation is biased by task-irrelevant contralesional stimuli following unilateral stroke

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Stroke-induced cerebral lesions can cause pathological biases in selective attention, resulting in unilateral spatial neglect for contralesional stimuli in severe cases, particularly for lesions involving the right hemisphere. It remains unclear, however, whether such attentional biases impact evidence accumulation processes involved in perceptual decision-making. Here we characterised the influence of task-irrelevant ipsi- and contra-lesional stimuli on perceptual decisions about centrally presented visual stimuli. Left- and right-hemisphere stroke patients (N=28) judged the direction of coherent motion signals embedded within a central random-dot kinematogram (RDK) while ignoring motion signals presented in two peripheral semi-circular RDKs in the left and right hemifields. Their brain activity was recorded using electroencephalography (EEG). Contrary to expectations, motion signals presented in the contralesional hemifield had a greater effect on central judgements than those in the ipsilesional hemifield. Multivariate EEG analyses revealed robust motion-evoked responses to both task-relevant, central signals and task-irrelevant, peripheral signals. Critically, the neural representations of peripheral stimuli were stronger for contralesional stimuli than for concurrently presented ipsilesional stimuli, consistent with the observed behavioural biases. Our results suggest that unilateral lesions reduce inhibitory control over irrelevant stimuli in the contralesional hemifield, thereby allowing them to interfere with task-relevant processing in central vision.

Topic Area: THINKING: Decision making

D127 - Option similarity modulates subjective strategy use and the value of unchosen options

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Studies have shown that the outcome of a choice updates the value of the chosen option. Less studied is how this outcome affects the value of the unchosen option, for which two predictions exist: first, the outcome associated with the chosen option may generalize to the unchosen option and, second, the outcome of the chosen option may inversely update the value of the unchosen option. We tested these predictions under two choice conditions using a behavioral experiment. Participants made choices between conceptually similar (similar condition: brownie, cupcake) and conceptually dissimilar options (dissimilar condition: cookie, salad), providing written justifications for their choices that were analyzed for objective and subjective strategy use. Next, participants learned whether the outcome of their choice was rewarded or unrewarded. Finally, they made novel choices between two previously unchosen options from either the similar or dissimilar condition, in which one member of the pair was associated with a rewarded choice and the other with an unrewarded choice. Results show that participants used more subjective and less objective strategies in the similar than dissimilar condition. Participants learned the outcome of their choices equally across conditions, but in the similar condition were significantly less likely than chance (41%) to select unchosen options that were associated with a rewarded outcome. Interestingly, regardless of condition, we found that participants who provided more objective justifications for their decisions showed a larger inverse decision bias. These findings add to a growing body of work investigating the effects of option similarity on value-based decision-making.

Topic Area: THINKING: Decision making

D128 - Misperceptions of impact predict intentions to take action against climate change

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To mitigate climate change, we must encourage individuals to take action in ways that are impactful. In two studies, we investigated the cognitive and social factors that predict climate-related behavioral intentions. In Study 1, 60 participants identified actions to address climate change that they believed to be impactful, feasible, or socially-desirable.

Participants tended to generate relatively ineffective actions (e.g., recycling), rarely generating ideas that experts have identified as more effective (e.g., voting, driving less, flying less). Expanding on these qualitative findings, in Study 2, we recruited 300 participants across the adult lifespan to rate 25 actions on several dimensions (e.g., intentions, ease, capability, impact, social approval) informed by the Theory of Planned Behavior. We compared perceived impact (in terms of climate change mitigation) of each action with objective impact (estimated reduction of greenhouse gas emissions). Perceived impact was positively correlated with objective impact, but participants substantially overestimated the impact of reduce-reuse-recycle actions and underestimated the impact of actions related to transportation and green energy. Importantly, perceived impact was a stronger predictor of behavioral intentions than ratings of ease, capability, or social desirability, highlighting the critical role of correcting these misperceptions. Our results reveal that perceived impact is miscalibrated, yet predicts behavioral intentions. In ongoing work, we are testing cognitive interventions to correct misperceptions of impact (e.g., by engaging neural systems for learning from prediction error and episodic simulation). Our findings suggest that generally motivating climate action is insufficient; interventions must also correct misperceptions to direct individuals toward impactful actions.

Topic Area: THINKING: Decision making

D129 - Representations of cognitive maps underlying model-based planning

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When faced with a decision, we sometimes rely on habit, which serves us well in predictable situations. However, in more complex scenarios, we often need to plan towards a goal. Over the last decade, goal-directed planning has been studied using sequential decision-making tasks coupled with model-based reinforcement learning algorithms. However, model-based systems can only successfully plan if they have access to an accurate model of the environment. There is a surprising lack of knowledge on how these internal representations of task structure, or cognitive maps, are constructed. This is partly because many prior studies ensured that participants had full knowledge of the structure of the task before having to make decisions. How do humans construct cognitive maps, and how is this instantiated in the brain? How do their cognitive maps relate to their ability to use model-based planning? To address these questions, we modified an established two-step decision-making task and conducted behavioral and neural representational similarity analyses (RSA) over planning relevant versus irrelevant associations between choice options in the task. In a sample of participants undergoing fMRI scanning, behavioral RSA reveals that participants come to represent abstract, planning-related relationships among items in the task. Alongside this, neural patterns in parahippocampal cortex, and orbitofrontal cortex come to represent these relationships. Further, a whole brain searchlight reveals a broader set of brain regions involved in representing task structure, including mediodorsal thalamus. Our results suggest that cognitive maps represent multiple facets of task structure, which are in turn encoded by distinct neural regions.

Topic Area: THINKING: Decision making

D130 - Decoding Decision Dynamics: Unraveling Neural Correlates of Criterion Shifting

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The ability to flexibly shift decision criterion thresholds (to criterion shift) has been found to be a uniquely stable individualistic cognitive trait, yet there is limited knowledge as to why this stability is observed. Under ambiguous circumstances, the ability to be more conservative or liberal has the potential to improve decision outcomes. We previously examined connectivity in association with 2 ROIs, the inferior parietal lobule (IPL) and anterior insula, and have found that resting-state functional connectivity can help to identify brain regions associated with individual differences in strategic decision-making under ambiguous circumstances even when these regions are not directly activated by the task. However, a fuller characterization of the patterns of activation predictive of criterion-shifting behavior may help link this specific decision behavior with wider cognitive and computational processes. In prior investigations, extensive frontoparietal engagement has been identified in connection with the maintenance of conservative as opposed to liberal criteria in tasks related to recognition memory. Building on these insights, our current investigation aims to clarify the predictive capacity of resting-state functional connectivity in determining the extent of individual criterion shifts. Functional Magnetic Resonance Imaging (fMRI) data from thirty participants were collected during a criterion-shifting recognition memory task and at rest. Our hypothesis posits that frontoparietal connectivity during rest correlates with the degree of criterion shifting. This research not only sheds light on the neural basis of criterion-shifting behavior but also contributes to a broader understanding of cognitive and computational processes associated with decision-making.

Topic Area: THINKING: Decision making

D131 - Unraveling the neural representations of preference with a naturalistic neuroimaging approach

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Our brains innately compare and contrast diverse stimuli in daily life, even when making preferences among similar stimuli presented concurrently. In contrast, when each stimulus is evaluated independently, the difficulty level of making preferences escalates. Therefore, this study aims to investigate the neural mechanism of preference and how preferences are represented in the brain. We examined 70 participants using functional magnetic resonance imaging (fMRI) as they viewed 18 varied videos. Without receiving prior notice, participants were then asked to rank their preferences for each video pair, totaling 153 pairs, and also to rate their liking for each video individually outside of the scanner. Using representational similarity analysis (RSA) across 100 brain regions of interest (ROIs), we examined the correlations between preferences and neural representations of those videos. Even after adjusting for the effect of subjective liking, our RSA results still revealed a number of significant associations between preferences and various brain regions, including regions involved in selective attention (e.g., dlPFC), memory formation (e.g., hippocampus), evaluation processing (e.g., NAcc), and regions engaged in the computation of psychological distances across dimensions, such as the inferior frontal gyrus (IFG), superior temporal sulcus (STS) and supplementary motor area (SMA). Our results indicate that preference formation in the brain is a natural and complex process, involving memory, evaluation, selective attention as well as the calculation of psychological distances between stimuli. In conclusion, our study adds to a deeper understanding of preference mechanisms, emphasizing the complexity of human evaluative processes.

Topic Area: THINKING: Decision making

D132 - Reducing Biases in Decision-Making in the COVID-19 Pandemic

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Delay discounting refers to a decision-making bias in which smaller, immediate rewards are favored over larger, delayed rewards. Delay discounting can serve as a behavioral index of willingness to engage in public health measures, including vaccination, in response to the COVID-19 pandemic. Orienting individuals towards specific future events has been shown to reduce delay discounting. The present study examined the efficacy of a future-imagining induction on delay discounting in a multinational sample (N = 7,667; 14 countries) during the COVID-19 pandemic. Participants were randomly assigned to future-imagining induction or control groups. Based on pilot testing, the control condition involved copying meaningless text, whereas the induction involved typing a description of an imagined event in response to a general future time and event cue (i.e., imagine celebrating a friend's birthday after the pandemic is over). Participants then rated their degree of future thinking on a 10-point scale before completing a measure of delay discounting that involved deciding between varying smaller, immediate monetary rewards and a larger, delayed monetary reward (e.g., $1000 now vs. $2000 at one of 7 delays: 1 week/1 month/3 months/6 months/1 year/3 years/10 years). Results indicated that the induction group reported thinking about the future significantly more and discounted future rewards significantly less than the control group. During the COVID-19 pandemic, having participants imagine a future event significantly reduced biased decision-making. Future research should explore the efficacy of this induction in increasing uptake of public health measures that could inform government responses to current and future health crises.

Topic Area: THINKING: Decision making

D133 - The Neurocognitive Process of Group Decision in a Naturalistic Context

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Group decision-making is crucial in human life, but the underlying cognitive process and neural bases are unclear. Here, we addressed this issue by inventing a large-group naturalistic decision task. In experiment (Exp) 1, groups of 16-20 individuals were asked to freely discuss a difficult problem which required them to choose 5 out of 10 options and report their personal selections every 4 minutes. The results indicated a significant increase of selection convergence over time. Employing the Hidden Markov models (HMM), we found that a two-state model best fit their behaviors. One state was more associated with personal preference and the other one with social influence. Moreover, the latter predicted final selection better than the former at early phases. In Exp 2, we tested which architecture of the group organization was optimal for group decision. The results showed that groups with one leader performed better than other organizations (e.g., no leader, four equal leaders, four leaders with different status). In Exp 3, the hemodynamic concentration changes of each individual were simultaneously collected using functional Near-Infrared Spectroscopy (fNIRS) hyperscanning and subject-to-group neural synchronization (GNS) were calculated. Through representational similarity analysis, we observed a close association between GNS in the temporoparietal junction (TPJ) and the social influence state. No GNS was found for personal preference. Together, these results suggested that the TPJ-associated social influence played a pivotal role in group decision, and groups with a single leader outperformed other types of group organization during decision.

Topic Area: THINKING: Decision making

D134 - Creativity involves the subjective valuation of ideas via the Brain Valuation System

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Creativity is thought to rely on a generation phase associated with the default-mode network (DMN) and an evaluation phase supported by the executive control network (ECN). In the current study, we aimed to show the involvement of subjective valuation (or preferences) in creativity, as suggested by Lopez-Persem et al. (2023). At the neural level, we wanted to find which regions support these processes during creativity. We conducted creativity tasks, decision-making tasks and fMRI imaging on forty healthy participants. We performed behavioral model fitting and whole-brain parametric modulation analyses. Results show that: (i) the subjective value of an idea depends on its originality and adequacy: value = (α x originality^δ + (1- α) x adequacy^δ)^(1/δ) (ii) preferences vary between subjects: some value originality more than adequacy (α>0.5) and vice-versa (iii) during the creative process, valuation is supported by the brain valuation system (BVS), a network classically involved in decision-making (iv) surprisingly, originality and adequacy evaluation are respectively supported by the DMN and the ECN and (v) preferences parameters (α and δ) correlate with real-life creative abilities, as measured by a battery of tests. Overall, we replicate the behavioral results of Lopez-Persem et al. (2023), showing the involvement of subjective valuation in creativity. At the neural level, we demonstrate which regions encode the originality, adequacy and the subjective value of ideas. Overall, this study completes the current understanding of the neurocognitive bases of creativity and demonstrates the involvement of the BVS in creativity.

Topic Area: THINKING: Decision making

D135 - Deciphering Amotivation in Schizophrenia: A Bayesian Computational Analysis of Exploratory Behavior

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Amotivation significantly influences functional outcomes in schizophrenia (SZ), yet its etiological pathways and effective treatments remain elusive. This study builds upon the virtual exploration work in SZ from Siddiqui et al., by applying a Bayesian computational framework to dissect the components associated with amotivation in SZ. We examined 24 outpatients with SZ and 26 controls who completed the Virtual Novelty Exploratory Task, which involves first-person perspective exploration of a simulated city environment. Our behavioral analysis of task performance investigated group differences and relationships with clinical rating measures of amotivation. Then, we employed a 3-level Hierarchical Gaussian Filter model to the behavioral data and evaluated model parameters based on group differences and relationships with clinical amotivation. Our behavioral analysis found that amotivation was correlated with "Exploratory-Walking" behavior (p=0.004, r=-0.56). "Scanning-Environment" behavior was also reduced in the SZ group (p=0.025). From a computational perspective, the SZ group exhibited an increase in the phasic component of the learning rate (kappa; p=0.005). Further, SZ patients' amotivation was correlated with model parameters that represented uncertainty reduction response (β_2; p=0.006, r=0.54) and prior-about-novelty (μ_2^(k=0); p=0.009, r=-0.52). Our findings offer empirical support for the aberrant salience hypothesis and highlight underlying cognitive processes associated with amotivation in SZ. Specifically, patients with SZ appear to experience increased uncertainty in their world perception as they assimilate more information (kappa). Additionally, patients with more severe motivation deficits appear to demonstrate a reduced inclination to minimize uncertainty through exploration (β_2) and perceive their environment as being less novel (μ_2^(k=0)).

Topic Area: THINKING: Decision making

D136 - Hand and eye movements during object categorization discriminate between younger and older adults

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The ability to flexibly categorize objects is an essential aspect of adaptive behavior. In complex environments with rapidly changing task demands, accurate categorization requires the resolution of feature-based interference. Recent neuroimaging and neuropsychological evidence suggest that perirhinal cortex allows us to group objects based on either their semantic or visual features when faced with cross-modal interference. We build on these findings by asking whether hand and eye movements made in the context of categorization tasks with cross-modal interference discriminate between younger and older adults. We additionally examined whether these behavioral indices track overall cognitive status in older adults. Three objects were presented on each trial: a referent, a target, and a distractor. Targets in the visual categorization task were visually similar to the referent, whereas distractors were semantically similar to the referent. Targets in the semantic categorization task were semantically similar to the referent, whereas distractors were visually similar to the referent. Categorization decisions were made by touching targets in our motion-tracking experiment and with a button press in our eye-tracking experiment. We found that reach trajectory and gaze, which are continuous measures of decision making, reliably discriminated between younger and older adults. In both cases, older adults were influenced by the distractors to a greater degree than were younger adults. Most interestingly, reach and gaze were significant predictors of overall cognitive function in the older adult group. These findings suggest that hand and eye movements may reveal subtle age-related changes in cognitive functions supported by perirhinal cortex.

Topic Area: THINKING: Decision making

D137 - Neurocomputational Mechanisms Underlying the Subjective Cost of Exerting Self-Control

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Failures of self-control are a major challenge to humans and can impose a range of costs on daily functioning. Emerging cognitive neuroscience work has demonstrated that exerting control is registered as cognitively costly. Here, we sought to characterize the neurocomputational mechanisms underlying how the perceived cost of exerting self-control is estimated in humans. Healthy dieters completed a self-control decision task

outside (Study 1: N=60) or inside (Study 2: N=25) the fMRI scanner. On each trial, participants viewed a food image that varied on temptation intensity and reported their willingness-to-pay (WTP) to avoid the food depicted on each trial. We used computational modeling and neuroimaging to reveal how temptation changes the cost of self-control and identify the neural circuits that encode these costs. In Study 1, computational modeling revealed that multiplicative scaling best accounted for the observed increase in self-control costs with higher temptation ($p<.001$). In Study 2, brain activity was modeled with a parametric modulator of WTP value during the decision period. Higher bids yielded increased activation in medial orbitofrontal cortex and dorsal anterior cingulate cortex ($p<.01$), pointing to a central role in these brain regions in estimating the perceived cost of self-control. Our findings reveal a computational mechanism through which temptation intensity increases the cognitive cost of using self-control and further suggests that exercising self-control engage a distinct neural circuit than those traditionally involved in implementing control. Understanding the neurocomptational basis of these cost estimates may provide neural targets to help improve the success of self-control strategies.

Topic Area: THINKING: Decision making

D138 - Promoting Healthy and Eco-Friendly Food Choices: Mechanisms Underlying the Impact of Color-Coded Food Labels and Attentional Instructions

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Nutritional food labels can help make better choices. Color-coded food labels (traffic lights) that classify foods as green, yellow, or red according to their overall healthiness have been shown to encourage purchases of healthier foods. Likewise, color-coded labels on foods' environmental impact (e.g., carbon footprint) have been proposed to increase eco-friendly consumption. In two laboratory studies, we examined how color-coded labels signaling food's health or ecological impact alter food choices. Moreover, we tested the added benefit of directing attention to color-coded information on dietary choices. Participants (N=160) completed two versions of an established computerized food task, requiring 300 food choices under different conditions: with/without color-coded labels and with/without additional instructions to deliberate food healthiness/eco-impact. In color-coded conditions, visual cues (green, yellow, orange, red) signaled foods' healthiness (health frame) or ecological impact (eco frame). Color-coded cues promoted healthy (health frame) and ecologically friendly (eco frame) food choices. Directing attention to color labels was significantly more effective in promoting healthy/eco-friendly choices than color label cues alone. Motion-tracking data (computer mouse trajectories during computerized food choices) suggest that changes in choice conflict (as captured in AUC, Area Under the Curve) might mediate color-label-induced changes in 'good' behavior. Results of a computational model of choice (drift-diffusion model) allowed examining changes in starting bias and evidence accumulation underlying altered choice behaviors. Our results shed light on how color-coded labels can change dietary patterns that impact personal health and the environment. These findings might help develop new interventions to address the obesity crisis and climate change.

Topic Area: THINKING: Decision making

D139 - Post Cingulate Cortex Mediates Emotional Approval of Victimization in the Moral Decision

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People often feel the decision to be more difficult when it causes harm to others. Hence, we hypothesize that in trolley-problem-like dilemmas, a 2-stage process is required where options are first compared for both emotional and utilitarian values, then the emotional value of the tentative victim will determine if the consequence is acceptable. Although previous studies have proven that emotional and utilitarian value differences determine the decision, it remains unclear that how the mind overcomes emotional response to violating moral standards. In this study, we identified brain regions responding to the 2 stages of moral decision-making, and those responding to emotional and utilitarian value differences, respectively. We collected functional MRI data of 40 participants making moral decisions in trolley-problem-like dilemmas constructed with fictional characters. Participants must choose to save only 1 character and to leave the other one as victim, in cases of emergency. Fictional characters are depicted with realistic photos and stories. Participants were asked to familiarize those characters and evaluate them for their values in advance. Analysis revealed that activation in dorsal lateral prefrontal cortex and anterior cingulate cortex negatively correlates utilitarian value differences between options, indicating their role in the reasoning system that deal with utilitarian values of the options. More interestingly, posterior cingulate cortex was identified to be positively corelates to the emotional value of the victim (i.e., unchosen). These results demonstrates that while cognitive network mediates utilitarian appraisals and makes tentative decision based on the value comparison, PCC specifically mediates emotional acceptance of victimization.

Topic Area: THINKING: Decision making

D140 - Loss is the new win: The reversal of feedback-related negativity (FRN) differences in response to goals

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Asymmetrical effects of feedback valence during decision-making suggest that behavioural responses are more impulsive, inflexible, and predictable following a loss compared to a win. Feedback-related negativity (FRN) is a neural signature reflecting early feedback valence evaluation, generating larger (more negative) amplitude in response to losses compared to wins. However, these traditional results overlook the default goal of win maximization, where wins are goal-congruent and losses are goal-incongruent. We asked participants to play a binary response game across two separate goal conditions, where they tried to win (win maximization) or lose (lose maximization) as much as possible. Our manipulation of goal was successful in that behavioural responses following goal-congruent feedback (ie, win in win maximization and loss in loss maximization) were more consistent than goal-incongruent feedback. We observed an interaction between FRN amplitude and goal, whereby FRN was more negative for losses relative to wins during win maximization but more negative for wins relative to losses during loss maximization. These results suggest that both behavioural and neurophysiological responses to feedback can be flexibly redefined as a function of congruence or incongruence with the current goal state.

Topic Area: THINKING: Decision making

D141 - Exploring how Generalized Anxiety Disorder impacts the latent processes and neural correlates underlying approach-avoidance conflict decision-making

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The ability to arbitrate approach-avoidance (AA) conflict, a cognitive state elicited by simultaneous reward and punishment, is critical for adaptive decision-making. Across rodent and human models, AA conflict has been associated with anxiety and is supported by a network of brain regions including the medial temporal lobe (MTL), striatum, and prefrontal cortex (PFC). This work, however, is limited in two respects. (1) Human models employing functional Magnetic Resonance Imaging (fMRI) have historically relied on analyses that fail to disentangle how neural activity relates to latent decision-making characteristics underlying AA conflict. (2) There has been limited work stressing the mechanisms underlying AA conflict by testing it in samples with anxiety psychopathology, despite anxiety's integral role in AA conflict in healthy and clinical populations. To address these limitations, individuals with GAD and healthy controls completed an AA conflict task while undergoing fMRI. Application of the Hierarchical Drift Diffusion Model, a computational modelling approach, indicated that the GAD group engaged in faster evidence generation to avoiding conflict. The GAD group showed divergent patterns of neural recruitment compared to controls in the MTL, striatum, and PFC during evidence generation, response caution, inhibition, and optimization of cognitive processing. Our findings spotlight the differing contributions of the PFC and MTL to AA conflict evidence generation and regulation, and provide novel evidence that excessive anxiety impairs engagement with the decision-making process at a computational and neural level.

Topic Area: THINKING: Decision making

D142 - The common root of creativity-related preferences across domains

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Decision-making is a daily practice for human beings, and creative decision-making is one of them. Studies on value-based decision-making have revealed that the brain valuation system exhibits consistency of value representation across various contexts. Previous research on creativity has proposed a breakdown of creative ideation into two main processes: a generative phase for spontaneous idea associations and an evaluative phase for monitoring these ideas. During the evaluation, ideas are judged based on their adequacy and originality, two defining dimensions of creativity. Recent findings integrate a valuation stage to the evaluation of ideas to monitor their assigned subjective value , computed based on their adequacy and originality. The aim of the current study is to ascertain the consistency of preferences across diverse creative domains. To achieve this, seventy-three participants engaged in free-generation tasks across three creativity domains: semantic associations, alternative uses, and drawings. Subsequently, they rated their responses based on likability (subjective value measurement) and perceived adequacy and originality. Participants tended to provide ideas more rapidly when they liked them more across all three domains. This emphasizes the motivational role of valuation in the creative process. Furthermore, across these domains, the likability of ideas seemed to stem from a combination of their adequacy and originality. Through computational modelling, we established that a similar non-linear value function, with consistent weighting and convexity parameters across domains, governed ideas' judgments. These findings reflect both the inherent nature of the valuation process observed in value-based decisions and contribute to consolidating our understanding of creative ideation.

Topic Area: THINKING: Decision making

D143 - No Evidence for a Generalized Construct of Cognitive Effort Aversion

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People tend to avoid engaging in cognitively demanding tasks unless the benefits outweigh the costs of effortful action. Yet, while evidence from more than a decade of work in cognitive neuroscience seems to suggest that effort is aversive and that the decision to exert effortful control follows a trade-off, the constituent elements of this trade-off are far from perfectly understood. For instance, it remains unclear if the supposedly unitary nature of cognitive effort costs generalizes broadly across mental tasks: Are people equally averse to cognitive effort exertion across task domains? Here, we examine this question using a large-scale repeated-measures design. Participants (N = 240) each completed four different well-established experimental tasks designed to quantify their aversion to exerting cognitive effort: the Demand-Selection Task, an Effort-Discounting Task, an effort foraging task, and an incentivized Simon task where the opportunity costs of time was manipulated. Using a multilevel and multivariate Bayesian computational model, we found that while participants avoided effortful action within each task (replicating past work), there was no systematic relationship between participants' performance or effort-preferences across tasks. In other words, participants who exhibit strong effort aversion in one task did not exhibit strong effort aversion in other tasks. Taken together, our results call into question the notion of a generalized, trait-like construct of cognitive effort aversion. Moreover, our results indicate that assessing effort processing within a single paradigm might not be sufficient to generate conclusions about the general motivational status of an individual.

Topic Area: THINKING: Decision making

D144 - Neural Correlates of Learning of Priors in Perceptual Decision-Making

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In a Bayesian framework of perceptual decision-making, sensory evidence and prior expectations integrate during the decision-making process. Here, we examine the neural correlates of acquiring base-rate priors in a perceptual decision-making task. Behavioral and neural data were collected from 22 adult participants in a two-alternative forced-choice motion discrimination task. Participants were exposed to colored dot stimuli with varying levels of motion coherence (0%, 13%, 35%, or 100%). For each participant, one motion direction (left or right) was more frequent than the other. The majority of participants became sensitive to the prior across learning, reflected in a bias to choose the more frequently occurring direction on 0% coherence trials in which no diagnostic sensory information was present. Analysis of the 3T fMRI data revealed a robust time by motion coherence interaction in the left caudate nucleus. In the 100% coherence condition, this region's activation decreased across runs, suggesting neural adaptation as the task became more predictable. In the 0% coherence condition, we observed the opposite effect, indicating that left caudate is more activated during these uncertain trials as the participant gains experience with the base-rate prior. This pattern may reflect implementation of the prior to judge 0% coherent trials. This approach is novel in its application of fMRI to study learning of base-rate priors through experience. Future directions include employing drift-diffusion model parameters to correlate behavioral data with neural activity, offering a more comprehensive understanding of the interplay between learned priors and evidence in decision-making.

Topic Area: THINKING: Decision making

D146 - Individual differences in functional brain network organization associated with a decision-making exploitation bias in older adults

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The exploration-exploitation (EE) trade-off involves the decision between exploring new sources of reward or exploiting options that have been rewarding in the past. In recent work, we identified a set of brain networks implicated in EE decision-making and hypothesized that age-related changes in the functional connectivity of these networks contributes to an exploitation bias in older adults. To test this hypothesis, we took a multivariate network-level approach to examine the relationship between resting-state functional connectivity (RSFC) fMRI and performance on a foraging-based EE decision-making task in a cohort of older adults (N = 118, mean age = 69.7 years). As predicted, greater exploitation was associated with dedifferentiated and less modular brain networks. Specifically, exploitation was associated with greater RSFC of the visual, somatomotor and dorsal attention networks with the rest of the brain, as well as between-network connectivity of the somatomotor and default networks. These findings align with previous research implicating the functional connections between the visual and dorsal attention networks in the encoding of relevant visuospatial information and optimization of the task strategy. Further, lower modularity of the SMM and default networks, which is typically seen with advancing age, may be indicative of an over-reliance on prior knowledge to guide future behaviours, thereby biasing decision-making towards exploitation. These findings, relating RSFC to performance on a foraging-based EE decision-making task, provides novel evidence linking differences in the functional network architecture of the brain to putative exploitative decision-making biases in older adulthood.

Topic Area: THINKING: Decision making

D147 - Investigating the interplay between tonic and phasic pupillary activity and cognitive flexibility and stability

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The impact of locus coeruleus (LC) activity on task performance, as well as the concordance between LC firing modes and pupil diameter changes are well established. However, the direct influence of tonic-phasic pupillary activity, on cognitive control has not been systematically investigated. We examined these associations, specifically focusing on cognitive flexibility and cognitive stability. Participants completed a stability-flexibility task, with pupil recording. We measured flexibility based on response times on task-switch trials, and preference to switch tasks on ambiguous trials. Stability was measured by performance on repeat and distractor inhibition trials. These measures were modeled using pupillary phasic-tonic dilation, using bayesian multilevel analyses. We find a lower preference to voluntarily switch (lower flexibility preference) in individuals with higher switch costs (lower ability/effort exerted to be flexible), and individuals with shorter response times on distractor inhibition trials (higher stability). The latter finding indicates a possible tradeoff between the ability to be stable and preference to be flexible. A higher phasic pupil response in task switch trials was associated with lower switch costs, i.e., higher flexibility. We observed a lower preference to voluntarily switch (i.e., a lower flexibility preference) in individuals with

higher average tonic activity, contrary to existing findings in the literature. Additionally, higher average tonic pupil predicted quicker errors on trials measuring cognitive stability. Overall, these findings provide evidence that pupillary phasic and tonic activity is associated with, and can index, cognitively stable and flexible performance.

Topic Area: THINKING: Decision making

D148 - Neural Evidence of How Shipping Fees Impact Purchasing Decisions

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The surge in online shopping has heightened consumers' frustrations regarding shipping fees. Understanding the influence of shipping fees on purchasing decisions is crucial, given that most consumers are reluctant to pay additional charges. However, research on how neural correlates represent cognitive and emotional processes in this context is limited. To address this gap, we conducted an fMRI experiment to explore the association between various combinations of shipping fees and purchasing decisions. In total, 40 healthy participants (22 males and 18 females, mean age = 23.4, SD = 2.8) performed a shopping task. During scanning, participants indicated their intent to purchase a pair of shoes with various price combinations, maintaining constant total prices ($37) while varying shipping fees (zero, $1.5, $3, $4.5, and $6). Group analysis revealed significant positive activation in the medial prefrontal cortex (mPFC), inferior parietal lobe (IPL), and ventrolateral prefrontal cortex (vlPFC) under shipping-free conditions compared to conditions with lower shipping fees ($1.5 and $3). Additionally, the motor cortex and dorsolateral prefrontal cortex (dlPFC) showed positive activation under shipping-free conditions compared to those with higher shipping fees ($4.5 and $6). Behavioral results showed an overall decrease in purchasing intentions as shipping fees increased. These findings indicate a general preference for free shipping, even when total prices are equivalent. Specifically, participants appear to perceive shipping-free options as more rewarding than those with low shipping fees; however, they seem to readily purchase the free shipping options without engaging in extensive evaluation compared to those with high fees.

Topic Area: THINKING: Decision making

D149 - Discounting of Cognitive Effort and Ambiguity: Piloting A Novel Task Approach

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Prior research has found evidence of ambiguity aversion in tasks involving probabilistic and delay discounting. Specifically, people are more likely to prefer monetary options with exact risks and delays respectively, compared to ambiguous equivalent options. However, it is unknown if this is also observed in cognitive effort discounting. In this study, 24 young adult participants completed a non-verbal "word"-search task, followed by a two-choice effort discounting task for hypothetical monetary outcomes. In the cognitive experiential phase, participants completed a set of puzzles of various difficulty levels. They subsequently completed a decision-making phase with 108 experimental trials, choosing between a smaller reward-smaller effort (SSE) and a larger reward-larger effort (LLE) option. The trials differed by the magnitude of reward difference between the two options, the magnitude of the puzzles' difficulty level differences between the two options, and the inclusion of ambiguity on the LLE option. Multilevel logistic regression models were used to examine the participants' likelihood of accepting the LLE option. As predicted, participants were more likely to accept a larger effort option when the reward magnitude difference was higher. In contrast, they were less likely to accept a larger effort option when the difficulty level of the LLE option was much higher than the SSE option. In line with prior research, participants demonstrated ambiguity aversion in our cognitive effort discounting task, but only at higher difficulty level differences. This study also demonstrates the ability of our novel task to examine the influence of ambiguity on effort discounting.

Topic Area: THINKING: Decision making

D150 - Joint longitudinal and survival modeling predicts avoidance decisions

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Decision making requires approaching and avoiding stimuli representing rewarding and aversive outcomes. Approach-avoidance is dependent on the temporal dynamics of the decision. Both when an actor chooses to approach/avoid and what environmental changes occur are crucial to adaptive decisions. Modeling temporal dynamics of continuous predictors (e.g., increasing threat or diminishing reward) leading to a single choice (switching from approach to avoidance), is difficult. We apply models that jointly account for dependencies between survival outcomes (when) and longitudinal measurements (what), to an approach-avoidance conflict task (Pacman). Decisions to move along a corridor involved potential gains (dots, resulting in points) and losses (ghost attack, resulting in death). Our joint models build on a linear mixed effects model, capturing how a predictor (e.g., threat, reward) changes over time, combined with a time-to-event model, capturing event occurrence. These sub-models are linked via shared random effects structures using Bayesian model fitting. These models are effective at predicting trial-level subject behavior in an online sample (n=191), and in presurgical epilepsy patients (n=15). These models predict temporal avoidance decisions in held-out trials (average online AUC: 0.76 [95% CI:0.75-0.78]; average patient AUC: 0.80 [95% CI:0.76-0.85]). They outperform permuted models where predictors were shuffled (mean online AUC difference: 0.19 [95% CI:0.16-0.22]; mean patient AUC difference: 0.24 [95% CI: 0.15-0.32]). Additionally, we find preliminary evidence that these models can incorporate neural measures, such as hippocampal theta or prefrontal high-frequency activity, to predict avoidance decisions.

Topic Area: THINKING: Decision making

D151 - Frontal structural integrity and increased frontoparietal rs-connectivity are associated with financial ability in middle-aged and older adults

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Appropriately managing finances is an important part of daily living. Financial ability deficits increase one's susceptibility to financial scams and exploitation and rapid declines in these abilities have been proposed as an early sign of dementia. Most of the research on financial ability has focused on the default mode network and Alzheimer's disease. The present study investigated the neural basis of financial ability in cognitively normal middle-aged and older adults by focusing on the role of structural integrity and resting-state functional connectivity in brain regions responsible for numeric processing and the extent to which these relationships predicted one's risk for dementia—a sum score of well-validated risks. Adults aged 50-74 (N=67) completed a financial ability task (e.g., counting money, making change) outside the scanner. Partial least squares regression was used to test the relationship between financial ability and brain metrics. The mediating role of language, reasoning, memory, speed, and executive functions also was explored. Better financial ability was associated with structural integrity of the bilateral inferior frontal gyrus (IFG), with increased connectivity between the bilateral IFG and the left parietal cortex, and with decreased connectivity between the right middle frontal gyrus and the left parietal cortex. Reasoning, executive function, and language composites mediated multiple relationships between brain metrics and financial ability. None of the brain measures were related to dementia risk. The findings provide a new perspective on the role of numeric processing brain regions in explaining financial ability among middle-aged and older adults free of dementia.

Topic Area: THINKING: Development & aging

D152 - Age Differences in Decision-making Strategies to Process Featural vs. Structural Perturbations in Environmental Choice-Outcome Mappings

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Recognizing crucial survival features and grasping genuine structures amid environmental noise is vital for navigating life. Previous studies suggest that cognitive

aging impacts older adults' capacity to manage tasks involving uncertainty, maintain task representations, and preserve task structures. Yet, the specific influences of different sources of uncertainty on older adults' cognitive processing of environmental information remain unclear. To address this, 27 younger adults and 22 older adults participated in a probabilistic fMRI experiment, which required them to choose keys with varied color and shape combinations in interconnected rooms to unlock doors and optimize rewards at different levels of uncertainty. Behavioral results demonstrated that older adults exhibited lower success rates than their younger counterparts, as featural noise increased, regardless of structural noise. Reinforcement learning-based computational models were employed to investigate the roles of selective attention and successor representation in accounting for age group behavioral differences. Younger adults favored a more model-free algorithm, while older adults tended toward a more model-based approach, despite both age groups being able to identify relevant dimensions. Finally, brain imaging results revealed that increased structural noise induced higher responses in default mode areas, with heightened medial frontal activation in older adults but increased precuneus activation in younger adults. Conversely, elevated featural noise prompted higher responses in non-default mode areas, with increased cerebellar and frontal responses in older adults and heightened parahippocampal and middle temporal responses in younger adults. The above findings reflect age-related differences in neurocomputational strategies that yield distinct behaviors in response to environmental uncertainty.

Topic Area: THINKING: Development & aging

D153 - Effects of age and curiosity on decision-making and memory

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Curiosity is a form of intrinsic motivation, which, if harnessed, has the capacity to enhance learning and memory. Curiosity has been linked to catecholamine systems, which change across the lifespan. We developed a task to examine the nature of age-related changes in curiosity and its impact on memory and decision-making: the Photographic Art Storytelling Task (PAST). PAST uses photographic art with secret "stories" about each photograph's origin. Participants first rated their level of curiosity about knowing the story behind each photograph. Next, participants were shown the stories behind a subset of photographs which they endorsed as "high curiosity" and "low curiosity." Critically, we designed half of the stories to be interesting (rich history or remarkable detail) and half to be boring (simple description of the physical scene). Preliminary data include 11 older and 15 young adults with concurrent pupillometry measurement. Pupil dilations positively correlated with curiosity ratings, suggesting a role of the locus coeruleus-catecholamine system in tracking intrinsic motivation. We found no age-group difference in initial curiosity ratings. However, there were age-group effects in the extent to which initial curiosity shaped the perception of story outcomes and impacted future information seeking. Specifically, after reading part of the stories, older adults maintained their curiosity regardless of the story outcomes (interesting/boring), whereas young adults' curiosity levels changed. Preliminary data suggest memory benefits for "high curiosity" photographs for both groups. Together, these findings suggest curiosity has a beneficial impact on memory, but that curiosity may be harder to modify in older adults.

Topic Area: THINKING: Development & aging

D154 - The Impact of Socioeconomic Status on White Matter Network Organization and General Cognitive Ability in Adolescents

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Socioeconomic status (SES) is associated with the development of general cognitive ability; however, the biological underpinnings of this relationship are still not understood. To test whether white matter network organization mediates the relationship between SES and general cognitive ability in adolescents we constructed white matter connectomes and extracted multiple measures of SES for 219 cases from the Adolescent Brain Cognitive Development study. Graph-theory based metrics of whole brain white matter network organization were produced and general cognitive ability was estimated using NIH toolbox measures. No significant mediation effect of white matter network organization metrics on the relationship between SES and general cognitive ability was observed. Network clustering was associated with general cognitive ability and financial stability and trauma history were associated with network efficiency. Only males showed an association between food and housing security and network clustering and modularity. Males also exclusively showed an association between network clustering and general cognitive ability. These findings suggest that different aspects of SES have unique impacts on white matter network development and cognition that do not impact all children equally. To test the stability of these findings, further processing and analysis will be conducted on the rest of the approximately 11,000 participants available through the Adolescent Brain Cognitive Development study.

Topic Area: THINKING: Development & aging

D155 - Mapping the neural signatures of abstract reasoning across the lifespan

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Fluid intelligence (Gf) is broadly defined as the ability to problem-solve in novel situations, learn new skills, and adapt to changing environments. Abstract reasoning is a critical component of Gf and is known to undergo extensive development and refinement across the lifespan, yet the neural bases of such maturation remains poorly understood. Herein, we sought to address this gap by mapping the normative lifespan trajectory of the neural oscillatory dynamics underlying abstract reasoning. To accomplish this, we recruited a sample of 142 cognitively-normal participants (ages 9-67 years) who completed an abstract reasoning task during magnetoencephalography (MEG). MEG data were analyzed in the time-frequency domain and significant oscillatory responses relative to baseline were imaged using a beamforming approach. Whole-brain correlations with age were then conducted per oscillatory map to identify the lifespan trajectory of the neural dynamics serving abstract reasoning. These analyses revealed that oscillatory theta activity strengthened as a function of age in the primary visual cortices ($r=.39$, $p<.005$), and weakened with age in the bilateral supramarginal gyri (left: $r=-.42$, $p<.005$; right: $r=-.34$, $p<.005$). Further, alpha/beta oscillations in the right superior temporal gyrus ($r=-.62$, $p<.005$) and gamma oscillations in the right medial prefrontal cortex (mPFC; $r=.30$, $p<.005$) strengthened across the lifespan. In conclusion, these findings indicate spectrally-specific changes in the lifespan trajectories of neural oscillatory activity serving abstract reasoning, reflecting developmental fine-tuning and aging-related alterations across higher-order cognitive networks.

Topic Area: THINKING: Development & aging

D156 - Visuospatial processing, memory, and reasoning in poor readers

Zahra Kheradmandsaadi[1], Hee Yeon Im[1], Deborah Giaschi[1]; [1]The University of British Columbia

In addition to reading difficulty, developmental dyslexia is associated with impairments in phonological processing, perception, attention, executive function, reasoning, and memory. To compensate for verbal and language problems, a reliance on visuospatial abilities has been suggested but not sufficiently explored. However, dysfunction in brain regions mediating visuospatial processing has been reported in dyslexia. Therefore, we hypothesize that both visuospatial and verbal cognitive abilities are impaired in dyslexia. These deficits may also be evident in the strategies used to complete cognitive tasks. We tested 14 typical readers and 9 poor readers (age 14-17 years) with good vision. The Cambridge Brain Sciences Cognitive Platform was used to assess six cognitive functions: visuospatial processing, reasoning, short-term and working memory; verbal reasoning and short-term memory. Participants also reported their strategies used to complete each task (categorized as verbal or visual). Raw test scores were converted to z-scores based on age-adjusted norms. Poor readers performed significantly worse than typical readers across all tasks, particularly visuospatial memory. In controls, better performance on verbal and visuospatial reasoning was associated with better visuospatial processing and working memory, respectively. The inverse relationship was found for poor readers. No group differences were evident in the strategies used. Our results confirm the impairment of both verbal and visuospatial cognitive abilities in adolescent poor readers. Contrary to previous reports, no evidence was found for reliance on visuospatial strategies in poor readers. Poorer reasoning ability with better

visuospatial processing and memory in poor readers may suggest a maladaptive compensatory reliance on visuospatial mechanisms.

Topic Area: THINKING: Development & aging

D157 - The influence of a single bout of aerobic exercise on creativity

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Acute bouts of aerobic exercise have been reported to lead to improvements in various aspects of cognition (i.e., attention, memory, and executive function). One area of cognitive research that has not received as much focus is the relationship between exercise and creativity. Creative thinking allows individuals to view things originally and plays a crucial role in problem solving. Recent reviews have highlighted the positive influence of acute and chronic exercise on improving creativity. However, studies examining the influence of acute bouts of exercise on creativity in young adults are sparse, and limited by variations in methodology. The present study sought to examine whether engaging in acute exercise prior to or during assessments of creativity boosts creativity in young adults. The Alternate Uses Task (AUT) examines divergent thinking and measures four aspects of creativity: fluency, originality, flexibility and elaboration. The time-constrained task required individuals to name as many alternative uses for an object that they can think of. Participants (n=60) were randomized into one of three conditions: (1) a 30-minute bout of aerobic exercise prior to the AUT, (2) a 30-minute bout of exercise during the AUT, and (3) watching a 30-min exercise video prior to the AUT. We report differences in AUT performance as a function of the timing of task administration and condition. To conclude, the timepoint of task administration has an influence on creativity in young adults. Interventions (i.e. exercise) that boost creativity have important applications, as creativity plays significant roles in problem solving, adaptation and innovation.

Topic Area: THINKING: Other

D158 - Hidden brain states as neural correlates of verbal creativity during metaphor generation

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Various neural oscillations have been implicated in the brain mechanism towards creative cognition. Prior research mostly relied on trial-averaged approaches to identify neural correlates of behavioral outcomes, and they could be ambiguated by the spontaneous and compound nature of creative thinking. In this study, we applied a hidden Markov Model to identify neural oscillatory patterns, represented by brain states, that correlate with verbal creativity. Participants (N=49) engaged in a metaphor generation task while their EEG data was recorded. Hidden brain states were extracted from EEG spectral powers in a range of frequencies based on relevant literature. They were then correlated with metaphor aptness and novelty ratings, obtained from both independent judges (crowd) and participants themselves (self). An “alpha-state”, characterized by widespread alpha band synchronization, was associated with high novelty ratings both by crowd and self-evaluations. The alpha-novelty effect extends prior findings on the positive link between alpha oscillation and creative thinking. Additionally, a “desynchronization” state, characterized by below-average spectral power across frequencies but led by the alpha band frequencies in posterior regions, was associated with high self-ratings of metaphors for both novelty and aptness. The desynchronization state may be interpreted as an arousal state because alpha band desynchronization putatively indexes cortical excitation. Thus, the time profile of the desynchronization state, along with its correlation with self-ratings, revealed in the current study contributed new evidence to the neural correlates of the creative process.

Topic Area: THINKING: Other

D159 - Factors contributing to the believability of memory narratives

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Sharing memories are a fundamental way humans communicate with, and relate to, each other. Factors influencing whether these retold memories are credible or not are poorly understood. While forensic testimony appears to be influenced by factors such as age, race, or the confidence with which one reports the memory, the evaluation of everyday memories has been minimally studied. We investigated whether the details provided in memory narratives influence credibility ratings. Details were studied by using definitions first suggested by Levine et al. (2002), who identified two types of narrative details: internal and external. Internal details are those directly connected to the episodic aspects of the memory, while external details refer to tangentially-related semantic facts or depictions not directly related to the main event. We created a series of narratives that varied the number and type of internal and external details, and across several studies our 825 participants rated these narratives for perceived credibility or saliency. We show that internal details are more effective than external details in enhancing credibility ratings and that internal details related to people had the greatest impact on credibility judgements. Our results provide a new lens through which to understand credibility judgements both in forensic and everyday contexts.

Topic Area: OTHER

Poster Session E

Monday, April 15, 2024, 2:30 – 4:30 pm, Sheraton Hall ABC

E1 - Investigating the Cognitive Correlates of Semantic and Perceptual False Memory in Older and Younger Adults: A Multi-Group Latent Variable Approach

John T. West[1] (johnwest@psu.edu), Rebecca L. Wagner[1], Ashley Steinkrauss[2], Nancy A. Dennis[1]; [1]The Pennsylvania State University, [2]Boston College

Falsely remembering information can have negative consequences for day-to-day functioning, and can be especially problematic for older adults who experience higher rates of false memory. Because there is considerable variability between older adults in memory and cognition, it is essential that we understand the factors that place older individuals at risk for developing false memories. Whereas lower frontal functioning has previously been related to false memory in general, prior research suggests that there may also be domain-specificity in the factors associated with false memory. To test this possibility, 211 young adults and 152 older adults completed tasks measuring semantic false memory, perceptual false memory, semantic discrimination, perceptual discrimination, and frontal functioning. Structural equation modeling revealed that – contrary to predictions – individual differences in semantic and perceptual false memory were best captured by a single, domain-general false memory factor. Although cognitive abilities were not uniquely related to false memory when assessed together, semantic ability, perceptual ability, and frontal functioning were all negatively associated with false memory in isolation. Importantly, the extent to which these cognitive abilities protected against false memory did not differ between older and younger adults. Results suggest that for both older and younger adults, individual differences in the tendency to falsely remember information are reflected by a domain-general construct that has negative (yet redundant) associations with various cognitive abilities.

Topic Area: LONG-TERM MEMORY: Development & aging

E2 - Dopaminergic and reward-related enhancement of memory in aging

Claire J. Ciampa[1] (claireciampa@brandeis.edu), Thomas M. Morin[1,2], Jourdan H. Parent[1], Jordyn L. Cowan[1], Alex Adornato[1,2], Katherine O'Malley[1], Arielle Tambini[3], Cristina Cusin[2], Jacob Hooker[2], Anne S. Berry[1]; [1]Brandeis University, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, [3]Nathan Kline Institute for Psychiatric Research

Age-related dopamine reductions are linked to declines in episodic memory and reward processing, making the dopamine system a key target for memory enhancement in aging. We investigate the independent and interactive effects of dopamine and reward on memory in a sample of 44 healthy older adults (mean age=69, range=60-82) who have undergone two fMRI scans (first on a placebo and second on 20mg oral methylphenidate to enhance dopamine availability). During each scan, participants completed an encoding task with alternating “high reward” blocks ($5/remembered item) and “low reward” blocks ($0.01/remembered item). A memory test 24 hours later assessed 1) item recognition, and 2) reward context of the items. We found that both reward and methylphenidate improved item memory, demonstrated by main effects of reward (p=.003) and drug (p=.02) on hit rate. While reward and methylphenidate did not enhance context memory, there was a trend toward better memory for high reward contexts (p=.09). Hippocampal fMRI activation was higher during high reward blocks

compared with low reward blocks (p=.03), suggesting that the hippocampus may be more active while encoding high rewards. There was no effect of drug on hippocampal activation (p=.16), and no Reward*Drug interactions predicting hippocampal activation or memory. Finally, higher hippocampal activation related to better context memory (p=.02) but not item memory (p=.31), consistent with work showing that the hippocampus supports context encoding. These results demonstrate that enhanced dopamine and reward improve item memory in older adults, and that high reward relates to greater hippocampal activation, which supports better context memory.

Topic Area: LONG-TERM MEMORY: Development & aging

E3 - Maintenance of Gray Matter Diffusion in Older Adults Relates to Better Episodic Memory

Danielle L Greenman[1], Ilana Bennett[1]; [1]University of California Riverside

The brain maintenance theory suggests that the more "young-like" a person's brain is, the better they perform on cognitive tasks. Using diffusion-weighted magnetic resonance imaging, studies have found that older adults whose diffusivity in white matter is more similar to younger adults, indicating preservation of tissue microstructure, have better memory performance. Prior work has also supported the brain maintenance model using diffusivity in gray matter, but not using biophysical diffusion models that may better capture its less coherent underlying tissue properties. To test this, we used neurite orientation dispersion and density imaging (NODDI) to estimate diffusion in the hippocampus and dorsal and ventral striatum in 75 younger and 64 older adults who also completed the Rey Auditory Verbal Learning Task (RAVLT). For each participant, each NODDI metric in each region was subtracted from the younger adult group average, thus smaller difference scores indicated more young-like diffusion. Results revealed that, independent of age group, smaller diffusion difference scores in the hippocampus and dorsal striatum, but not the ventral striatum, related to better RAVLT total recall. This finding supports the brain maintenance theory. Moreover, whereas the negative diffusion-memory relationships were seen for all NODDI metrics in the hippocampus, they were only significant for intracellular and free diffusion in the caudate and putamen, providing clues about which tissue properties need to be preserved for better episodic memory in aging.

Topic Area: LONG-TERM MEMORY: Development & aging

E4 - Effects of Age, Sex, and Associative Load on Memory and its Relation to White Matter Microstructure

Abbey Page[1], Shruti Prabhakar, Jamilah Zubair, Ilana Bennett; [1]University of California at Riverside

Associative memory is worse with age, in males, and when there are more items to be remembered together (higher associative load). Independent of the age and sex effects, memory for associations between pairs of items has been linked to microstructure of white matter tracts that connect the hippocampus to the frontal cortex (e.g., fornix). However, less is known about relationships between white matter microstructure and memory for higher associative loads. The current study investigated these effects in 17 younger and eight older adults who completed a novel associative memory task where they studied and were subsequently tested on word sets of varying sizes (pairs, triplets, and quadruplets). A high-resolution diffusion-weighted MRI scan was also obtained from which single-tensor measures of tissue microstructure were extracted from standard fronto- and medial-temporal tracts of interest. Behavioral data revealed better associative memory in younger than older adults, males than females, and for pairs than triplets or quadruplets. Diffusion data revealed better integrity (higher fractional anisotropy, lower mean diffusivity) in the fornix and bilateral sagittal stratum in younger than older adults. When controlling for age group and sex, partial correlations further revealed that the extent to which associative memory was modulated by set size (i.e., larger difference in performance to pairs than quadruplets) significantly related to sagittal stratum integrity. These findings highlight a possible role of the sagittal stratum, which connects the brainstem and thalamus to temporo-occipital-parietal white matter, in associative memory, particularly at higher associative loads.

Topic Area: LONG-TERM MEMORY: Development & aging

E5 - Measuring relative differences in socioeconomic status on hippocampal subfield volume and relational memory performance in a developmental sample

Meghan K. Ramirez[1], Abi Heller-Wight[1], Connor Phipps[1], Jennifer Sexton[1,2], Anna Wilhelm[1], Carolyn E. Nagengast[1], Emma A. Armbruster[1], Arthur Maerlender[3], Vaishali Phatak[1], Daniel L. Murman[1], David E. Warren[1]; [1]University of Nebraska Medical Center, [2]University of Nebraska - Omaha, [3]University of Nebraska - Lincoln

Socioeconomic status (SES) is associated with differences in structural and functional brain development. Specifically, SES has been linked to individual variability in memory abilities as well as structural development of the hippocampus, a brain structure necessary for memory. Here we investigate the relationship between SES, hippocampal-dependent relational memory, and hippocampal subfield volume (HcSubV) by utilizing preliminary data from the Polygenic Risk of Alzheimer's disease in Nebraska Kids (PRANK) study. Periadolescent children (N=114) completed an MRI and a relational subsequent memory (RSM) task where they studied pairs of common objects followed by a memory test for the studied pairs. Here, we tested associations between HcSubV, RSM, and SES. SES was operationalized using the income to needs ratio (INR). We found HcSubV of the left dentate gyrus (p=.048) and left hippocampal tail (p=.014), but not INR, were associated with RSM performance. Then, we performed a median split of our sample based on INR. There were no significant relationships of interest identified in the high INR group (N=52). However, several statistically significant correlations were observed in the low INR group (N=62). RSM performance was associated with low INR (p=.038) and total HcSubV (p=.040). Further investigation into this RSM-HcSubV relationship identified several left-lateralized HcSubV associations including left dentate gyrus (p=.021), total left hippocampus (p=.029), left hippocampal tail (p=.029), and left cornu ammonis 1 (CA1) (p=.043) volumes. These preliminary novel findings extend prior work on SES, memory, and hippocampal volumetrics by demonstrating that low relative SES may be selectively associated with memory and hippocampal volume.

Topic Area: LONG-TERM MEMORY: Development & aging

E6 - Understanding the role of visual processing in older adults' memory retrieval

Jaclyn Ford[1] (jahennessey@gmail.com), Elizabeth Kensinger[1], Samantha Williams[1], R. Gerald Monkman[1], Brianna Lenza[1], Sandry Garcia[1]; [1]Boston College

A prevailing view in the cognitive aging literature is that memory impairments in older adults are related to ineffective recruitment of sensory regions during memory search, driven by a global sensory deficit. However, such patterns may be reversed in paradigms that include a subsequent memory "elaboration" phase. This age-by-time interaction suggests that older adults can engage posterior visual processing regions during memory tasks, but that this recruitment may be dependent on specific task design. The current research was designed to better understand when and how visual processing contributes to memory retrieval in older adults, specifically comparing two hypotheses: a) that visual processing regions can be recruited by older adults whenever they are provided additional retrieval time, and b) that visual processing regions are recruited by older adults following explicit prompts to "elaborate" on the retrieved image. 101 participants from across the adult lifespan (18-93) incidentally encoded a series of word-image pairs, then completed a three-part retrieval task after a thirty minute delay. Replicating prior research, age-by-time interactions were identified in posterior regions when participants were given additional time and the explicit instruction to elaborate on their memory. Notably, this pattern was not present when participants were given additional time, only, suggesting that time, alone, is insufficient to allow older adults to access visual processing mechanisms. Instead, retrieval support, in the form of the explicit "elaboration" instruction, may alter how older adults approach the memory task.

Topic Area: LONG-TERM MEMORY: Development & aging

E7 - Age differences in the neural representation of naturalistic events

Karen Campbell[1] (karen.campbell@brocku.ca), Selma Lugtmeijer[2], Djamari Oetringer[3], Geerligs Linda[3]; [1]Brock University, [2]University of Birmingham, [3]Donders Institute for Brain, Cognition and Behaviour

Event segmentation is a fundamental process that improves understanding of current events and recall of past events (Zacks et al., 2001). Naturalistic stimuli (e.g., movies) can be used to study the neural underpinnings of event segmentation, with recent work suggesting that perceived event boundaries relate to changes in neural states that coincide in several regions across the cortex (Geerligs et al., 2022). An open question is whether these neural state changes are stable across the lifespan. Participants (N = 577, age 18–88) from the CamCAN cohort were scanned with fMRI while viewing an 8-

min movie. To identify neural state boundaries, we applied the greedy state boundary search (GSBS; Geerligs et al., 2021), which identifies the optimal number of state boundaries based on correlations of brain activity over time. Participants were sorted into 34 age groups of 17 participants. Perceived event boundaries were based on another group of participants who segmented the movie outside the scanner. There was a significant effect of age on neural state duration, with longer states with increasing age. This effect was strongest in the visual cortex and medial and lateral frontal cortex. Perceived event boundaries overlapped with state changes in the ACC, dmPFC, left superior and middle frontal gyrus, and anterior insula, but there was no effect of age on this relationship. This suggests decreased differentiation between successive neural states in some regions with age. But critically, the relationship between neural states and perceived event boundaries remains similar with age, suggesting preserved coarse event segmentation.

Topic Area: LONG-TERM MEMORY: Development & aging

E8 - Sketchnoting as a drawing-based memory encoding strategy in older adults

Marya Nurgitz[1], Adina Levi[1,2], Myra Fernandes[3], Morgan Barense[4], Asaf Gilboa[1,4], Gary R. Turner[2]; [1]Rotman Research Institute, [2]York University, [3]University of Waterloo, [4]University of Toronto

Memory consolidation is a hippocampally mediated process influenced by information encoding methods, and therefore can be strategically enhanced. Drawing is one such example, and engages non-hippocampally mediated processes via the amalgamation of motor, visual and verbal information. This multimodal memory trace facilitates enhanced encoding and can strengthen recall and recognition memory for patients with hippocampal damage when compared to writing encoding methods. Given these findings, we hypothesized that older adults experiencing age-related memory decline due to changes in hippocampal structure and function could benefit from drawing as a mnemonic aid. We trained healthy older adults to use sketchnoting (a drawing technique) to improve daily memory performance through a 6-week training program in which they learned sketchnoting techniques and encoded naturalistic auditory information (i.e., autobiographical podcasts). Participants were randomly assigned to a sketchnoting or written control encoding modality to record podcast content, and completed immediate and delayed memory tests. Preliminary results revealed that sketchnoting improved delayed memory performance, but gains did not surpass those observed with written note-taking. Furthermore, participants demonstrated greater retention of information over time only when sketchnoting, with about one third of participants experiencing delayed memory gains. This may suggest a skill acquisition phase that precedes an improved consolidation phase for multimodal information. Such delayed improvement and retention findings may be explained by the elaborative and multimodal nature of drawing, and its ability to utilize non-hippocampally meditated processes in older adults with normal decreases in hippocampal volume.

Topic Area: LONG-TERM MEMORY: Development & aging

E9 - Age-related changes in anatomical connectivity of the human hippocampus revealed using quantitative fibre tracking

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Change in memory capacity is a common complaint as people get older. The hippocampus plays a central role in memory and its healthy function is dependent on the integrity of white matter fibres that connect the hippocampus with other brain regions. We still know surprisingly little about age-related changes in structural connectivity of the hippocampus. To address this gap, we combined high-quality structural and DWI data from the Human Connectome Project with cutting-edge fibre-tracking methods to quantitatively characterise structural connectivity between the hippocampus and cortical mantle in two groups of healthy participants; young (26-35 yo; n=10) and older (56-65 yo; n=10). We generated 70 million tracks across the entire brain using dynamic seeding and applied a tailored DWI pipeline that allowed us to identify and isolate tracks (and their density weights) with an endpoint in the hippocampus. Our approach allowed us to quantitatively assess the density of connections between the hippocampus and 180 cortical regions for each participant. Between-group differences in track-density were then assessed using independent samples t-tests. Our preliminary results reveal significantly reduced white matter pathway density between the hippocampus and medial parietal cortex (specifically, area POS1: $p<0.05$; ~44% reduction) and parahippocampal gyrus (specifically area PHA1: $p<0.05$; ~39% reduction) in the older participant group. Our novel method provides a powerful new approach to assess age-related changes in white matter pathway density in the human brain in vivo. Our results provide key contributions to ongoing efforts to understand age-related changes to hippocampal dependent memory systems in the human brain.

Topic Area: LONG-TERM MEMORY: Development & aging

E10 - Does prediction error play a differential role in updating recent versus remote episodic memories?

Catalina Mengyao Yang[1], Katherine Duncan[1], Morgan Barense[1]; [1]University of Toronto

Mnemonic prediction errors (PE), or the mismatch between retrieved memories and reality, are thought to trigger memory updating. Yet, it remains unclear whether PE is required to update memories of all ages, and whether PE has distinct effects depending on the remoteness of a memory. There is also debate regarding whether recent or remote memories are more readily updated upon reactivation. We address these questions by investigating how reactivation procedures (with or without PE) and memory age (delay between acquisition and reactivation) interact to determine the updating of naturalistic episodic memories. In Session-1, we showed participants a series of videos featuring salient action-outcome events. In Session-2, participants saw the videos again when they returned after one of three delays (1-hour, 24-hours, or 2-weeks). Here, we elicited PE in half of the videos by abruptly interrupting the action-outcome contingency. Immediately following this, we introduced new interfering videos. In Session-3, we conducted a structured memory interview for Session-1 videos. We operationalize memory updating as the number of details from the new interfering videos incorporated into the original video memories. Preliminary data (n=34) demonstrate that our design is positioned to answer our question: 1) memory intrusions rates within each condition are sufficient for meaningful comparisons and are similar to previous reports, and 2) despite some forgetting, participants were able to remember most videos with high confidence during reactivation. Our study integrates theories of memory storage dynamics and prediction errors, and we expect our final results to elucidate interacting factors that influence memory updating.

Topic Area: LONG-TERM MEMORY: Episodic

E11 - Initial encoding strength determines the effectiveness of targeted memory reactivation with odor cues

Gautam Narayan[1] (narayag1@uci.edu), George Babineaux III[2], Matthew Cho[1], Sandhya Murugavel[1], Tiange Lu[1], Nicholas J. Lew[1], Sarvia Aquino[1], Eitan Schechtman[1]; [1]Department of Neurobiology and Behavior and Center for the Neurobiology of Learning and Memory, University of California Irvine, Irvine, California, USA, [2]College of Science and Technology, North Carolina Agricultural and Technical State University, Greensboro, North Carolina, USA

Sleep plays an active role in the consolidation of memories that were encoded during the day. Targeted memory reactivation is a technique that uses non-invasive sensory cues, such as odors, to preferentially reactivate associated memories during sleep. In a pioneering study, Rasch et al. (2007) showed that odor reactivation during sleep improved memory for all learned items in a spatial task. Since the design included only one odor and a single learning block, it remains unclear whether the odor cues benefited consolidation of the learning context as a whole or selectively targeted the learned associations. We used a within-subjects design to test whether the presentation of odor cues during sleep would selectively prioritize consolidation for one category of objects over another. Participants (N=32) were trained on a 2D object location task, where each category was paired with a distinct odor, before taking a pre-nap test. During non-REM sleep, participants were re-exposed to one of the odors. After their nap, participants completed a test of the object locations. Our results showed a benefit of cueing, but only when accounting for pre-sleep memory performance. Cueing benefited memory uniformly, but this benefit was stronger for weakly encoded memories. These results provide a conceptual replication of Rasch et al. (2007), suggesting that odor-cueing can be used to selectively reactivate sets of memories with a task rather than the learning context as a whole. Moreover, our results provide more evidence that initial encoding strength dictates the extent of reactivation effectiveness.

Topic Area: LONG-TERM MEMORY: Episodic

E12 - The effects of reactivation during sleep on the neural representations of episodic memories.

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Sleep involves the reactivation of recently acquired memories, thereby shaping the neural representations supporting them. An essential feature of episodic memory is the link between a specific memory item (e.g., a chocolate cake) and the context in which it is embedded (e.g., your tenth birthday party). However, the possible role of sleep in binding memories to their contexts remains poorly understood. To investigate how reactivation during sleep impacts this binding process, we instructed participants to form stories, each linking together four objects (e.g., a gong) in unique contexts (e.g., a hike in the woods). As a measure of object-context binding, we used functional MRI to measure the overlap between neural representations for objects linked together by a story. Then, during non-REM sleep, we unobtrusively presented object-congruent sounds to selectively reactivate a subset of the object memories, a technique termed targeted memory reactivation. Sleep was followed by an additional functional MRI scan, identical to the previous one. We hypothesized that reactivating memories during sleep would either selectively strengthen object-context binding for the targeted objects, or, alternatively, keep the items segregated, prioritizing specificity. We found that targeted reactivation during sleep promoted specificity in items' neural representation in the left ventromedial prefrontal cortex, as reflected by a decrease in neural overlap for reactivated vs. non-reactivated memories. The effect of selective reactivation counteracted a general increase in within-context similarity that we observed across pre- and post-nap functional MRI sessions. These results suggest that reactivation during sleep decontextualizes memories rather than strengthening item-context binding.

Topic Area: LONG-TERM MEMORY: Episodic

E13 - A high-resolution investigation into the influence of interference on memory: Examining the role of the visual cortex and subregions of the hippocampus

Rebecca Wagner[1], Luke Dubec[1], John West[1], Jordan Chamberlain[1], Nancy Dennis[1]; [1]The Pennsylvania State University

Episodic memory accuracy is supported by pattern completion and pattern separation processes mediated by neural activity in the occipital cortex and subregions of the hippocampus, including CA1, dentate gyrus (DG), and CA3. These processes can be affected by interference, both from time and increased similarity between the features present in old and new information. The present study utilized high-resolution fMRI during a continuous recognition mnemonic similarity task to explore how increasing interference influences both processes in younger adults. We manipulated interference by systematically increasing the number of trials between when an image was first presented and when it was either re-presented (i.e., targets) or when a perceptually similar lure was presented. Behaviorally, we found that both accurate recognition for targets as well as lure discriminability significantly decreased with increasing interference. Group-level univariate analyses in visual cortices showed that activation differences between targets and lures diminished with increasing interference, such that there were greater differences in the low interference condition compared to the high interference condition. Pattern similarity analyses within subject-specific CA1 and DG/CA3 regions showed a different pattern. Specifically, neural similarity between targets and correctly rejected lures diminished with increasing interference, such that greater pattern overlap was found for the low interference condition. Taken together, results suggest that increasing interference negatively affects the fidelity of young adults' neural activation, as well as their ability to accurately discriminate previously experienced information from novel, yet similar information.

Topic Area: LONG-TERM MEMORY: Episodic

E14 - Won't get fooled again: The benefit of spatial proximity to the rejection of lures in an associative memory task

Alexa Becker[1], Nancy Dennis[1]; [1]The Pennsylvania State University

The current study examined the associative memory benefit of spatial proximity relative to spatial distality for pairings of unrelated objects. Retrieval consisted of intact pairs (targets) as well as rearranged pairs (lures) within each condition. Past research has demonstrated a discriminability benefit for spatially proximal stimuli (e.g., Gestalt groupings) relative to spatially distal stimuli, with some work suggesting that this benefit is driven by a heightened ability to reject lures in the spatially proximal condition. Additionally, univariate fMRI work in Gestalt perception has found that Gestalt groupings are associated with reduced BOLD response in the intraparietal sulcus (IPS) relative to spatially distal objects, argued to be indicative of greater ease of processing of the grouped stimuli. We extended this work to examine the neural signature of lures in each condition by investigating differences in neural distinctiveness that may contribute to these discriminability benefits. Behaviorally, we found that the false alarm rate was significantly lower for proximal stimuli relative to distal stimuli, consistent with past research. We also found a difference in neural distinctiveness within the IPS between proximal lures and distal lures. Specifically, proximal lures were less confusable with proximal targets than distal lures were with distal targets in this region, as indicated by within-category similarity amongst lures. In tandem with behavioral results, this indicates that the reduced neural confusability of proximal lures was supportive in their correct rejection.

Topic Area: LONG-TERM MEMORY: Episodic

E15 - Theta phase synchrony underlies successful memory retrieval

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Previous studies have found that theta synchrony throughout the brain underlies improved encoding of list items. However, the details, especially the topography, of the theta synchrony effect underlying memory retrieval is poorly understood. Here, we analyzed free recall data from 375 patients implanted with intracranial electrodes for epilepsy monitoring. Each session consisted of sequentially presented word lists that the subject subsequently attempted to recall. For each macroelectrode pair, we compute the difference between theta (3–8 Hz) phase locking during the period preceding correct recall of an item, and phase locking before a matched period of silence, to generate a theta synchrony network map specific to memory retrieval function. Likewise, we examine the periods after successful versus unsuccessful word encoding and before fast versus slow recall of arithmetic facts for a comprehensive picture of memory function. We report a significant whole-brain theta synchrony effect in verbal encoding, verbal recall, and math recall. We find 44 regions in the verbal recall contrast and 20 regions in the math recall contrast that serve as significant network hubs, while no region was a significant desynchronizing hub. Among the most significant hubs were regions functionally implicated in memory function, such as the LTC, EC, and HPC, but overall, the hubs were distributed throughout the brain, especially in the case of math recall. In retrieval, we also find a positive correlation between node strength and theta power effect of memory. Future work will probe further the relationship between the functional networks of memory encoding and retrieval.

Topic Area: LONG-TERM MEMORY: Episodic

E16 - Neuroelectric Correlates of Autobiographically Salient Music Listening

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Autobiographically salient (ABS) music, associated to one's past, (i.e., people, locations, and events), is posited to engage memory processes more efficiently than familiar (FAM) music. We tested this hypothesis by having older adults (n = 37, 70.4 ± 5.8 yrs, 18 F) listen to ABS, FAM, unfamiliar (UFAM) music in two separate experiments, accounting for associated changes in neural activity. In Experiment 1, we aimed to determine the time older adults needed to correctly identify ABS, FAM, and UFAM clips that were 10-s long. Participants were quickest in identifying ABS music (2.07 ± 0.08 s), intermediate for FAM (2.91 ± 1.32 s), and slowest for UFAM music (3.89 ± 1.71 s), indicating faster recollection for ABS music than FAM and UFAM music. This experiment shows that 5-s segments are more than sufficient to study musical memory in older adults. In Experiment 2, we measured scalp recordings of event-related potentials while participants listened to 5-s clips. All music conditions generated transient evoked responses at the onset. The contrast between FAM and UFAM and ABS and FAM music revealed greater positivity over the left parietal scalp region between 598 ms-1523 ms and 883 ms-1172 ms, respectively. These results suggest that recognizing ABS music associated with the past may engage recollection of episodic details in addition to

familiarity. Together, the experimental findings indicate that ABS music is associated with faster identification and stronger memory-related activity that encompasses familiarity in a dynamic continuum.

Topic Area: LONG-TERM MEMORY: Episodic

E17 - Exploring the effect of sleep structure on internalizing symptoms and emotional memory: preliminary evidence

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Altered sleep characteristics, including increased Rapid Eye Movement (REM) sleep and decreased Slow-wave sleep (SWS), are putative risk factors for high internalizing symptoms. Prior research has shown associations between REM sleep and emotional memory consolidation, and between SWS and neutral memory consolidation, although the evidence is mixed. This study examines REM and SWS as predictors for internalizing symptoms of general distress, anhedonia, anxious arousal, and anxious apprehension, as well as negative and neutral episodic memories. Healthy adults encoded scenes featuring either negative objects (e.g., a snake) or neutral objects (e.g., a chipmunk) placed on neutral backgrounds (e.g., an outdoor scene). After a 12-hour of wakefulness or sleep, participants indicated whether an object or a background was old or new compared to what they encountered during encoding. All participants completed one night of laboratory-monitored polysomnography, and reported internalizing symptoms using the Mood and Anxiety Symptom Questionnaire and the Penn State Worry Questionnaire. The percentage of SWS significantly predicted lower anhedonia and anxious apprehension, and better memory for neutral objects. In contrast, REM sleep was associated with higher general distress and anxious apprehension, and predicted better memory for negative objects, although not significantly. Descriptively, REM was related to better memory for negative objects than neutral ones, while SWS was linked to similar memory performance across negative and neutral objects. Interventions targeting sleep characteristics, such as increasing SWS and decreasing REM sleep, could potentially alleviate internalizing symptoms and mitigate negative memory bias.

Topic Area: LONG-TERM MEMORY: Episodic

E18 - Examining the impact of fornix and cingulum microstructure in memory for naturalistic events

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Previous work has shown that the functional connectivity (FC) between the hippocampus (HC) and the posterior medial network (PMN) during event offset is associated with subsequent recall success and retention of details. This study focused on the white matter pathways between HC and PMN (the posterior fornix and cingulum) and sought to investigate the relationship between white matter microstructure and memory performance. We hypothesized that microstructure properties within the posterior fornix and cingulum would relate to functional connectivity (FC) between HC and PMN and predict recall performance. Participants were scanned using fMRI as they encoded two 15-minute movies and verbally recalled them immediately or after a 2-day delay. We additionally collected diffusion-weighted MRI for each participant. The verbal recall was transcribed and scored using published scoring methods. We extracted white matter microstructure metrics (fractional anisotropy, axial and radial diffusivity) for the fornix and cingulum from individually delineated probabilistic tractography. We performed a principal component analysis to obtain microstructural scores for each participant. The whole-movie HC-PMN FC was calculated using Pearson's correlation. Using linear models, we modelled the relationship between microstructure versus FC and microstructure versus memory. We found a positive relationship between cingulum microstructure and memory, in which retention of central details was associated with high cingulum fractional anisotropy and low axial and radial diffusivity. The fornix-recall relationship was similar but lacked significance. The results suggest that the cingulum may play an important role in supporting the long-term maintenance of episodic memory.

Topic Area: LONG-TERM MEMORY: Episodic

E19 - The effect of threat intensity on episodic conditioned fear memory

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According to associative learning models and animal research, unconditioned stimulus intensity governs facets of Pavlovian fear conditioning (Helfman 1989); including rates of acquisition (Annau & Kamin, 1961), extinction (Storms et al., 1962) and fear memory retention (Codero, Merino & Sandi, 1998). Here, we examined whether US intensity affects episodic memory of fear conditioned stimuli (CS). Fear conditioning can enhance episodic memory selectively for semantic exemplars used as CSs, including for CSs seen before fear conditioning (retroactive enhancement). During conditioning, images from only one category were paired with shock (CS+), while the other category was unpaired with shock (CS-). Notably, as the ceiling on intensity is ethically constrained, we incorporated a highly aversive multimodal US, composed of a high intensity shock and a loud burst of white-noise, and compared episodic memory results to a group receiving a low intensity US. Subjects returned ~24 hours later for a surprise recognition memory task. While low intensity group showed selective retroactive enhancement for neutral items that replicated prior findings (Dunsmoor et al., 2015; Hennings et al., 2021), a high intensity US impaired memory recognition for stimuli in all three experimental phases. This result suggests while higher intensity expedites fear learning in animal models, it may impair episodic memory performance. This has implications for translational research, as the shock intensity commonly used in human research studies may not approximate the deleterious effect on separate implicit and explicit memory systems involved in processing highly aversive events.

Topic Area: LONG-TERM MEMORY: Episodic

E20 - Prior Knowledge and Memory Encoding: Investigating the Influence of Congruency and Incongruency on Learning

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Several studies show that prior knowledge, such as schemas, strengthens encoding and accelerates recall of new memories that are in agreement with it (congruent), while others show the opposite pattern where prediction violation facilitates learning. To reconcile the contradictory findings in these two lines of research, a recent framework, the schema-linked interaction between the medial temporal and medial prefrontal regions (SLIMM), postulates that both highly congruent and highly incongruent information with a schema benefit the process of consolidation during learning. However, the SLIMM model remains under scrutiny since empirical evidence is scarce to support its hypotheses. Furthermore, the neural underpinnings of such learning processes remain unknown. While some models suggest a trade-off between the medial prefrontal cortex (mPFC) and the medial temporal lobe (MTL) for congruent and incongruent effects respectively, other models predict an essential role of MTL structures in encoding information congruent to existing knowledge structures. We use behavioural methods and fMRI to understand whether and how the representation of prior knowledge enhance encoding and retrieval of new events. We developed a novel spatial schema paradigm, which compares three conditions of varying degrees of congruency to previous knowledge. Our results demonstrate a mnemonic advantage for congruent events, while incongruent events and those lacking a strong prior schema exhibit a disadvantage, suggesting that reaffirming expectations facilitates learning. In the concurrent fMRI study, we compare learning systems in the brain that support learning under certain and uncertain conditions and investigate the formation and update of schema representations with newly acquired information.

Topic Area: LONG-TERM MEMORY: Episodic

E21 - On a roll: Successful retrieval primes the brain to retrieve other memories via dopaminergic responses

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Which brain states prepare us to successfully retrieve memories? Animal models suggest that slowly changing concentrations of modulatory neurotransmitters, including

acetylcholine, dopamine, and norepinephrine, may shape retrieval. In line with this possibility, our group previously found that novelty–a form of stimulus salience associated with neuromodulator release–decreased associative retrieval ability for multiple seconds (Patil & Duncan, 2018). Acetylcholine is the only novelty-evoked neuromodulator theorized to suppress retrieval by inhibiting pattern completion; therefore, we hypothesized that acetylcholine drove this finding. Here, we test this mechanism. Specifically, we used functional magnetic resonance imaging (fMRI, n=29) to test whether activation of cholinergic nuclei mediates novelty's suppression of pattern completion, indexed with encoding-retrieval similarity (ERS). Inline with previous research, participants recalled fewer places and faces associated with words when novel objects preceded these words ($t=-2.31$, $p<0.05$). Preceding novel objects also reduced ERS across the ventral stream, consistent with suppressed pattern completion (all $t>2.16$, $p<0.05$). However, contrary to our hypothesis, neuromodulatory centers did not signal novelty in this task. Surprisingly, we found that both dopaminergic and cholinergic nuclei responded more to familiar objects, and the response in dopaminergic regions uniquely mediated subsequent ERS in the medial temporal lobe (MTL) cortex (indirect effect (ab)=0.0004, $p<0.05$). Our findings point to dopamine's lingering influence over memory retrieval, expanding the landscape of mechanisms that prepare us to remember.

Topic Area: LONG-TERM MEMORY: Episodic

E22 - Investigating the correlation between sharp wave-ripples and eye movements during memory consolidation and retrieval in the human hippocampus

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Introduction: Sharp Wave Ripples (SWRs) are transient electrophysiological events originating from the human hippocampus, believed to be crucial for memory encoding, consolidation, and retrieval. The emergence of SWRs has been intensively debated. We explore the relationship between SWRs in the human hippocampus (HPC) and eye movements during an associative memory task within a 3D virtual environment. Hypothesis: We hypothesize that SWRs are linked to saccadic and smooth pursuit eye movements (SPEMs). Method: We employed stereoencephalography (SEEG) signals from epilepsy patients with HPC electrodes and recorded eye positions while participants performed the task. We utilized a robust SWR detection algorithm based on existing research to identify SWRs and applied our lab's algorithm to align SWRs with saccades and SPEMs. Our memory task involves navigating a circular maze with two arms, striking objects whose colour correlates with maze wall textures. A state-space model was used to estimate each participant's dynamic learning curve. Results: Our preliminary results involved three participants with nine electrodes implanted in their hippocampus and 15 channels in the CA1. The study involved 2355 seconds of gameplay, during which 7620 sharp-wave ripple (SWR) events were detected. The SWR rates were found to be significantly higher than the baseline recordings. Additionally, the study implied a temporal correlation between SWRs and eye movements during the task, with 15188 saccades and 2662 SPEMs observed. Conclusion: Our results indicate a link between hippocampal SWRs and eye movements during associative learning, suggesting a role of eye movements in associative memory formation in humans.

Topic Area: LONG-TERM MEMORY: Episodic

E23 - Individual differences in gist and detail recall of slideshows are predicted by anterior and posterior hippocampus volumes

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How can individual differences in witness' brains affect their testimony? 66 participants viewed twelve slideshows with neutral or negative valence, then completed free recall for their contents. We rated participants' responses for production of correct gist and detail information, and evaluated the onset timing of the information. This information was submitted to analysis with non-rotated PLS, alongside information about brain volumes. One significant LV was obtained, revealing that earlier and better retrieval of gist was associated with larger hippocampal head, hippocampal body and amygdala volumes; whereas earlier retrieval of detail was associated with greater hippocampal tail volumes. These findings align with the predictions of models of hippocampal function that emphasize a scale gradient on the structure's long axis, and provide a naturalistic, non-spatial example of how large and detailed spatial scale on this axis may translate to 'gist' and 'detail' representations in the hippocampus. Further, the findings raise the possibility that brain morphology could influence the type of information witnesses best remember.

Topic Area: LONG-TERM MEMORY: Episodic

E24 - Granularity of hippocampal long-axis representations with repeated encoding

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Repeated exposure to an experience can either strengthen the neural representation of that unique experience or integrate it with overlapping memories to the detriment of memory specificity. The hippocampus is thought to play a critical role in maintaining unique mnemonic representations that can be differentiated from similar experiences. However, it is unclear how repeated encoding affects representation of overlapping experiences along the long-axis, which differs in representational granularity. We investigated how the hippocampus represents granular content along its long-axis with repeated encoding. We scanned healthy young adults with 7 Tesla fMRI as they repeatedly encoded unique objects paired with one of four scenes: two visually similar beaches, and two visually similar kitchens. At retrieval, they were presented with each object and asked to retrieve which specific scene it had been paired with. We examined pattern similarity across the long-axis of the hippocampus as a function of repeated encoding and degree of content overlap between object-scene pairs. We found that patterns in the posterior hippocampus changed more than in the anterior hippocampus with repeated encoding, becoming less similar to other memories with each exposure regardless of how much scene content overlapped. Across the long axis, while individual trials maintained representational specificity with repetition (e.g. apple-beach1 vs apple-beach1), they became differentiated from overlapping trials (e.g. apple-beach1 vs pylon-beach1). Thus, we found evidence of both content-agnostic and content-specific changes in pattern similarity with repetition, suggesting multiple scales of representational change within the hippocampus with experience that serves to preserve unique, granular memory traces.

Topic Area: LONG-TERM MEMORY: Episodic

E25 - Where did I leave my keys? The effects of enactment on the precision of object-location memory.

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Research on the enactment effect suggests that performing an action during learning leads to better memory than solely listening to corresponding words. This well-established effect has yet to be examined in the context of object-location memory. We used Tompary et al.'s (2020) experimental paradigm in which participants learn the association between object images and their locations along the perimeter of a ring. At test, they are asked to place each item in its learned location. This paradigm provides a measure of the angular distance between the learned and recalled locations, affording a continuous precise measure of recall accuracy. Here, participants were assigned to one of two encoding conditions. The active condition required using a mouse to drag an object to its target location; the passive condition involved watching the object move to its target location (in a yoked design). Immediately after learning, participants in both conditions placed the objects in the locations they recalled. Preliminary results (N = 27 per condition) revealed a trend towards an enactment effect, in that participants exhibited more precise recall in the active than the passive condition. This pattern was most noticeable on trials in which the recalled position was within the correct quadrant (i.e., 90˚). We suggest that the motor component of enactment during learning benefits the fine-tuning of recall; movement may help us calibrate once we have an approximate idea of an object's studied location. Mouse tracking data were collected and will be used to characterize this effect dynamically.

Topic Area: LONG-TERM MEMORY: Episodic

E26 - Down the Rabbit Hole: The Self-Perpetuating Properties of Curiosity and Its Influence on Memory

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Curiosity exerts a key influence on information-seeking and memory. Yet information-seeking can vary across situations; while some curiosities are satisfied with a quick answer, others might trigger extensive search. Experimental studies of curiosity have primarily focused on the closing of an "information gap" as the resolution of curiosity (e.g., by revealing trivia answers). These studies do not examine how curiosity can be further perpetuated by additional information. The current study aimed to investigate whether curiosity could in fact "open" rather than simply "close" knowledge gaps after receiving resolving information. Participants completed an online trivia task during which they predicted the answers to trivia questions, viewed the answers, and received related follow-up information. Critically, our trivia paradigm allowed participants to request additional information after the answer was revealed. We measured subjective curiosity at multiple stages of each trial, including before and after answer reveal, allowing us to examine how curiosity changed with knowledge acquisition. Approximately one week later, participants underwent a memory test. Rather than an instantaneous satiation, we showed that curiosity can increase after receiving the answer at initial resolution. This increase in curiosity predicted the likelihood of requesting additional information even after accounting for initial curiosity, providing initial evidence for the proposed self-perpetuating nature of curiosity. Our ongoing analyses investigate how these self-perpetuating properties of curiosity contribute to memory updating and the recall of information. This research demonstrates that curiosity evolves dynamically with information states, and is suggestive of distinct potential routes to influencing memory formation.

Topic Area: LONG-TERM MEMORY: Episodic

E27 - Do perceptual or conceptual organizations more strongly bias the formation of new episodic memories?

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New episodic memories often comprise schematic content derived from semantic knowledge (e.g., remembering books in an office even if absent; Brewer & Treyens, 1981). This suggests that semantic content reigns supreme when guiding memory formation, which is surprising given that semantic guidance is considered weaker during faster cognitive processes like attentional selection when compared to low-level features (e.g., color). As attention is often considered the gateway to memory access, we set out to evaluate whether semantic content is the largest factor in biasing episodic memories, or if lower-level perceptual similarities induce bias of equal magnitude? We modified a spatial mapping task (Tompary & Thompson-Schill, 2021) and organized to-be-remembered images into 6 clusters with either conceptual ("birds", "sports equipment", "vehicles") or perceptual ("blue", "green", "brown") overlap. Critical items possessed a conceptual and perceptual cluster feature ("blue bird") and were displaced from their two clusters to evaluate how strongly their remembered location was biased towards each. In a small pilot sample (N = 11) we observed learning benefits from conceptual and perceptual clusters and nearly equivalent bias of critical items toward both cluster types. Though speculative, the current results suggest that conceptual organization is not the preferred method of memory organization, but rather one of multiple experience-based memory organization strategies that might be enabled by recruitment of discrete, modality-specific neural pathways. Future experiments plan to independently evaluate conceptual and perceptual biases in long-term memory formation, particularly in experimental settings where perceptual features are thought to be preferentially utilized (i.e., visual search).

Topic Area: LONG-TERM MEMORY: Episodic

E28 - The role of context in segmentation and continuity

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Human experience intertwines an ongoing sense of continuity with spontaneous segmentation into discrete events in memory. Nevertheless, what governs the fundamental interplay between continuity and segmentation is currently unknown. To answer this question, we leverage two well-established yet separately studied phenomena that showcase these ends: On the continuity end, serial dependence: the observed bias of current perceptual decisions towards preceding ones. On the segmentation end: the emergence of event boundaries following contextual change which are found to shape memory. From a Bayesian standpoint, serial dependence is associated with predictions, and segmentation with prediction failure, thus a shared account may underlie them both, and govern the continuity-segmentation balance. Here, we optimized a paradigm that tests serial dependence and event-boundary effects on memory in a single setup. Participants viewed tilted everyday objects, each surrounded by a colored circle frame which served as the objects' context, and performed an object-orientation task, which classically exhibits serial dependence. This was followed by two memory tasks- associative memory for the color of the frame that surrounded each object, and temporal-order memory for object pairs. The results show that context change triggered event boundaries, leading to better associative memory at boundaries, as well as improved temporal order memory for pairs of items within events compared with across events. Complementarily, serial dependence decreased at event boundaries. These results provide evidence for a potentially shared context-based account for perception and memory, by which context stability promotes continuity, and context change triggers segmentation.

Topic Area: LONG-TERM MEMORY: Episodic

E29 - Can patients with disorders of consciousness form autobiographical memories?

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Assessing preserved cognitive functioning in patients with disorders of consciousness (DOC) is a challenging clinical problem. Traditionally, patients who survive their initial brain injury but remain behaviourally unresponsive are assumed to have no cognitive functioning. However, previous research has shown that a subset of these patients produce neural responses on a variety of tasks ranging from simple auditory perception to command following, suggesting evidence of a rich inner life. That said, little is known about other essential cognitive functions, such as whether they can form novel autobiographical memories. This study included 12 healthy controls and one DOC patient. These participants were each seated in a wheelchair and equipped with a wearable camera during a guided mall tour. One week later, all participants underwent fMRI scans while they watched recordings from their own visit, others' visits, and a control condition (a bookstore setting that no participant visited). A linear support vector classifier (SVC) was trained on trial-averaged BOLD activity from controls using an ROI of regions implicated in autobiographical memory (via the NeuroQuery meta-analysis database). This model was then tested on the patient's data. The patient's classification accuracy was within the range of healthy controls (Balanced Accuracy = .438, Z = -1.213, p = .113) and significantly greater than chance levels defined via permutation testing (p = .008), suggesting that the patient could differentiate between autobiographical and non-autobiographical memories. In conclusion, this novel paradigm shows potential in enabling the investigation of autobiographical memory in behaviourally unresponsive patients following a brain injury.

Topic Area: LONG-TERM MEMORY: Episodic

E30 - Memory decisions are predicted by temporally-asymmetric global similarity in parietal cortex

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The ability to recognize a previously-encountered stimulus (recognition memory) is one of the most well-studied forms of memory. According to an influential class of computational models, recognition memory decisions are based on the global similarity (sum of all similarities) between a current stimulus (a memory 'probe') and previously-encountered stimuli. These global matching models can explain a number of behavioral phenomena, including why stimuli are sometimes falsely recognized. Several fMRI studies have linked neural measures of global pattern similarity (nGPS) to recognition memory decisions. However, these studies share an important limitation: nGPS could either reflect the influence of previous episodic experiences or generic properties of a given memory probe (e.g., its typicality). Here, we leveraged a massive dataset (Allen et al., 2022), in which participants completed up to 40 fMRI sessions (30,000 trials) of a continuous recognition memory test. By computing nGPS between a given memory probe and events not only from the past, but also events in the future, we tested for temporally asymmetric relationships between nGPS and recognition memory decisions. For novel probes (new stimuli), we found that greater nGPS to past events vs. future events was associated with a higher probability of 'old' responses (false recognition). For old probes (repeated stimuli), the influence of nGPS on memory decisions critically depended on when the probe was previously encountered: if the prior encounter occurred recently, the influence of nGPS was markedly suppressed. Together, these

results provide important evidence linking temporally-specific neural measures of global similarity to recognition memory decisions.

Topic Area: LONG-TERM MEMORY: Episodic

E31 - Quantifying schemas in future narratives

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Schemas are mental representations of common structures of experience, and their importance in human memory has been recognized since the time of Bartlett. Recently, it has been proposed that schemas also play a role in structuring our imagination of the future. However, tools for automatically measuring the schematic content of written and spoken event narratives are underdeveloped. We report a preliminary investigation on the development of quantitative methods for measuring schematicity in people's narratives about the future. We analyzed narratives of imagined future events in an experimental paradigm designed to induce differences in schematic content (Roberts et al., 2017). Specifically, healthy young adults (N = 30) each imagined 8 novel events involving a person, place and object from either the same autobiographical schema (e.g., "working at company A"; congruent condition) or from three distinct schemas (incongruent condition). We found that metrics including dispersion in semantic embedding space (computed using the Universal Sentence Encoder; Cer et al, 2018) and average distances in word association networks (created using the Small World of Words dataset; De Deyne et al., 2019) differentiated between narratives from these two conditions. Our finding suggests that schemas manifest in narratives that are relatively compact in both semantic and associative spaces. These results highlight how quantitative tools can help us understand schema scaffolding in the construction of imagined events, which carries the potential for applications to other cognitive paradigms and patient populations.

Topic Area: LONG-TERM MEMORY: Episodic

E32 - Hippocampal connectivity predicting recognition and categorization performance

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The hippocampus is a key contributor to our ability to remember both specific experiences (memory specificity) and extract common information from these experiences to generate new knowledge (memory generalization), through interactions with distinct cortical regions. While there is support for distinct hippocampal connections supporting each of these memory processes, they have not been tested together using the same task. The present study investigates whether distinct hippocampal connections can predict individual differences in memory specificity and memory generalization scores on the same task. To test this, participants underwent two fMRI scans while passively viewing face stimuli. Between the two scans, they learned to sort faces into one of three categories, and after the MRI session, they were tested both on their recognition of the training faces as well as their ability to generalize the previously learned categories onto new faces. Background hippocampal connectivity during passive face viewing was related to recognition and categorization success. Hippocampal connectivity with the frontal pole predicted recognition ability, connectivity with the precuneus predicted categorization ability, and connectivity with lateral occipital cortex predicted both abilities. Overall, this suggests that the hippocampus has distinct yet overlapping connections to support both memory processes.

Topic Area: LONG-TERM MEMORY: Episodic

E33 - Gamma and Alpha Band Power Capture Multiple Mechanisms of Variability in Memory Encoding

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Variability in attention can influence memory encoding over short time scales (e.g., orienting to sudden changes in the environment), or across more extended periods (e.g., sustaining attention to a task, dividing attention across multiple tasks). However, the neural mechanisms underlying the interaction between episodic encoding and temporal changes in attention remain poorly understood. We investigated changes in scalp EEG spectral power as attention varied across multiple time scales. Participants memorized lists of words presented with colored squares and then performed free recall after a brief delay. Some participants memorized the words as a single task, and others pressed a button for a pre-specified square color (target detection task). We observed greater gamma band power (30-100 Hz) early relative to later in lists and prior to the appearance of words that were successfully encoded during single-task and target trials, but not distractor trials. Furthermore, alpha band power (8-13 Hz) increased as more list items were presented and decreased following the presentation of target trials in the dual-task condition, particularly when the coinciding word was later successfully recalled. Spectral power in the gamma and alpha frequency bands may capture discrete neural mechanisms by which variability in attention over time impacts memory encoding.

Topic Area: LONG-TERM MEMORY: Episodic

E34 - Neural Representations of Schemas and Episodic memory using Visual Narratives

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Memories are flexible and dynamic, allowing us to recall past experiences and make predictions about the future based on previously experienced schemas or our episodic memories. Using high-spatial resolution intracranial electroencephalographic (iEEG) recordings in the human brain, we explore the neural representations of internally generated schemas during visual narratives (in the form of comic strips). Utilizing decoding analyses, we examine the temporal evolution of schema processing through lower-level (e.g., occipital cortex) and higher-level (e.g., prefrontal (PFC)) regions of the brain. In addition, we show how violations of schematic knowledge are processed throughout the hierarchy, how episodic memory of schema violations change these representations over time, and how the hippocampus supports reinstatement of mnemonic neural representations over time.

Topic Area: LONG-TERM MEMORY: Episodic

E35 - Temporal dynamics of memory encoding and retrieval in the human medial temporal lobe and prefrontal cortex

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The medial temporal lobe and prefrontal cortex coordinate their activity in the service of memory. We used intracranial recordings from 36 neurosurgical patients (22 male, 19 ± 4.7 years old) to investigate the relative timing of activity in these regions during encoding and recognition testing of natural scene images. From an initial set of 605 channels, we selected only those with task-related high frequency broadband (HFB; 70-150 Hz) responses--which index neuronal population activity--yielding 181 dorsolateral prefrontal cortex channels, 30 anterior cingulate cortex channels, 30 polar prefrontal cortex channels, 67 parahippocampal and rhinal cortex (PHRC) channels, and 29 hippocampal (HC) channels. Linear mixed-effects modeling revealed a three-way interaction between hit/miss, region, and encoding/retrieval in predicting the latency of peak HFB activity. During successful encoding, PHRC was active first, followed by HC and then frontal regions. By contrast, during unsuccessful encoding, there was no difference in the timing of PHRC and HC activity. The HC's HFB power also

differentiated successful over unsuccessful encoding at the time of its peak activity. During successful retrieval, HC was active first, followed by PHRC and frontal regions in tight succession. By contrast, during unsuccessful retrieval, there was no difference in the timing of PHRC and HC activity, and frontal regions were more spread out in time. These results suggest that during encoding, HC receives information from PHRC, functioning as an extension of perception. During retrieval, HC functions as part of a top-down circuit involving the prefrontal cortex.

Topic Area: LONG-TERM MEMORY: Episodic

E36 - Focal Human Left Temporal Pole Damage Produces Emotional Amnesia

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The temporal pole has traditionally been considered a hub for the semantic memory network, but is also involved in social and emotional processes. One challenge in studying the functional role of this structure is that conditions producing temporal pole lesions (e.g. semantic dementia) typically also affects other brain structures. In this study we included rare patients with focal temporal pole lesions and pharmaco-resistant epilepsy, while measuring the function of the amygdala with intracranial recordings. The patients studied lists of 14 words of which one was an emotionally negative oddball and one was a perceptual oddball (presented in a different font) and subsequently performed a free recall test. A control group of 15 pharmaco-resistant epilepsy patients without temporal pole lesions showed the expected increase in memory for both emotional and perceptual oddballs compared to control words. Interestingly, patients with lesions in the left temporal pole showed a selective decrease in memory for emotional oddballs relative to control words. This reduction was present in all 5 patients with left temporal pole lesions, but not in two patients with right temporal pole lesion. Analysis of intracranial EEG showed that a gamma salience response to both emotional and perceptual oddballs in the left amygdala was normal in these patients suggesting that the emotional memory deficit cannot simply be explained by disruption of the amygdala as a consequence of the left temporal pole lesion. Taken together the results suggest that the left temporal pole is involved in episodic emotional memory in the verbal domain.

Topic Area: LONG-TERM MEMORY: Episodic

E37 - Cognitive electrophysiology and big data: advancing science through open-source, standardized data

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In human cognitive electrophysiology, many studies contain low numbers of subjects, largely due to the financial and logistical difficulties involved in collecting EEG. Intracranial recordings of the brain are particularly uncommon, given the small subset of the population requiring invasive neural implants for medical treatment. Nonetheless, there exists an increasing recognition that large sample sizes are critical for obtaining reliable experimental results. Over the past decade, in collaboration with multiple institutions, the Computational Memory Lab at the University of Pennsylvania has compiled the largest intracranial and scalp EEG datasets in the world, yielding well over 50 peer-reviewed publications. Currently, we are working to standardize these data to comply with the Brain Imaging Data Structure (BIDS) specifications, for upload to the open-source neuroscience data sharing platform OpenNeuro. To date, we have published more than 500 hours of intracranial EEG data, from over 250 unique participants and over 750 experimental sessions. We have further released over 9500 hours of scalp EEG data, from 398 unique participants and 6781 experimental sessions. We recorded these data and the corresponding behavioral events while participants completed a variety of memory experiments. These were often variants of the canonical free recall task, with modulations that included semantically categorized word lists, a time delay of days between encoding and retrieval, and a spatial navigation component. In publicizing the release of these rich datasets, we hope to empower researchers to make novel discoveries that will advance the field of cognitive neuroscience.

Topic Area: LONG-TERM MEMORY: Episodic

E38 - Emotional dissociations in temporal associations: opposing effects of arousal on memory for details surrounding unpleasant events

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Research targeting emotion's impact on relational episodic memory has largely focused on spatial aspects, but less is known about emotion's impact on memory for an event's temporal associations. The present research investigated this topic. Participants viewed a series of interspersed negative and neutral images with instructions to create stories linking successive images. Later, participants performed a surprise memory test, which measured temporal associations between pairs of consecutive pictures where one picture was negative, and one was neutral. Analyses focused on how the order of negative and neutral images during encoding influenced retrieval accuracy. Converging results from a discovery study (N = 72) and a pre-registered replication study (N = 150) revealed a "forward-favoring" effect of emotion in temporal memory encoding: participants encoded associations between negative stimuli and subsequent neutral stimuli more strongly than associations between negative stimuli and preceding neutral stimuli. Finally, preliminary analyses of data (N =29) from an ERP study using the same design have shown centroparietal positivity patterns linked to the identified emotional memory effects, which suggests that the "forward-favoring" effect of emotion may be linked to attentional mechanisms. Overall, these findings may reflect a novel trade-off regarding emotion's effects on memory and are relevant for understanding affective disorders, as key clinical symptoms can be conceptualized as maladaptive memory retrieval of temporal details.

Topic Area: LONG-TERM MEMORY: Episodic

E39 - Distinct brain pathways for recalling the conceptual and perceptual details of naturalistic emotional memories

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Emerging evidence suggests a dissociation among default mode network (DMN) subsystems during retrieval of conceptual and perceptual event details. An open question is whether these subsystems are differentially involved in remembering emotionally negative and positive events, which vary in their mnemonic content. For instance, compared to positive memories, negative memories tend to be associated with greater perceptual detail and sensory recapitulation. Here we examined how default subsystems support conceptual versus perceptual remembering, and how these processes are modulated by emotional valence. In a naturalistic design, participants viewed positive, negative, and neutral news clips, then brain activity was recorded while participants covertly recalled the videos in response to word cues. One day later, participants wrote memory descriptions for each video, and content was categorized into conceptual and perceptual details. Linear mixed effects models were used to examine the effects of valence and number of remembered conceptual and perceptual details on retrieval-related activity in the hippocampus, amygdala, and DMN regions. We found that activity in the hippocampus and amygdala was related to perceptual detail memory, and that in the amygdala, this relationship was stronger for negative memories. We additionally observed dissociations in default network contributions to emotional memory retrieval: whereas ventral DMN activity was related to memory for perceptual details, especially for neutral memories, dorsal DMN regions were sensitive to valence and correlated with memory for conceptual details for emotional memories. These results suggest differential contributions of default subsystems to recalling conceptual and perceptual details of emotional memories.

Topic Area: LONG-TERM MEMORY: Episodic

E40 - Organizational Dynamics of Memory Across Days

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How does the organization of memory change over several repeated experiences? Previous studies of multi-trial free recall investigated changes in patterns of retrieval for the same list within a single learning session. In the present study, we examine changes in memory organization when learning occurs over multiple days. Past work typically finds that subjects recall items in increasingly stereotyped orders, with less reliance on the temporal characteristics of the most recent experience. Here we investigate how

semantic, temporal and subjective clustering evolve across a multi-session experiment. We analyze data from a free recall experiment previously reported by Katerman et al. (2022). In each of five sessions, subjects studied a list of 576 words, with the words appearing in a new random order in each session. Prior to encoding, subjects performed a 10-minute recall task in which they attempted to recall as many words as they could from the previous session, which occurred at least one and often several days earlier. We found preserved contiguity effects reflecting previous recall order instead of encoding order. This effect increased across subsequent sessions, attesting to the important role that retrieval plays in shaping memory for items. Next, we asked how intrusions may interact with study-test delays. We found that long study-test delays favor the generation of intrusions which are additionally likely to be carried across subsequent sessions. These new findings provide support for subjects' tendency to strongly encode associations made during free recall.

Topic Area: LONG-TERM MEMORY: Episodic

E41 - Quantifying the Composition of Memories with Scrambled Narratives

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Our memories of the past are not faithful recordings, but stylized reconstructions of our previous experiences. These reconstructions are shaped by a variety of factors, including the individual rememberer and the passage of time. For example, some individuals better recall the particularities of a given moment (i.e., episodic details) while others emphasize generalities (i.e., schematic details). We propose a new, efficient experimental paradigm for quantifying episodic-schematic composition of memory. Participants read and subsequently recalled a story with the order of events randomly scrambled. Participants recalled the story by reordering brief descriptions of each story event according to two different task instructions. The Episodic group was asked to "rearrange the events into the order in which you remember them occurring", and the Schematic group was asked to "rearrange the events into the order that you believe the story would have originally been told". Episodic and schematic composition in recall was quantified as the Spearman correlation between the order of participants' recalled events and both the presented order of events (episodic) and original order of events before scrambling (schematic). Paired-sample t-tests indicate that episodic composition was greater in the Episodic group (M=0.51) than Schematic group (M=-0.16), $t(20)=4.39$, $p<.001$, and schematic composition was greater in the Schematic group (M=0.43) than Episodic group (M=-0.11), $t(20)=4.49$, $p<.001$. This study highlights a novel way to efficiently quantify the qualitative composition of a memory.

Topic Area: LONG-TERM MEMORY: Episodic

E42 - Associative memory formation but not consolidation is affected by distracting information during repeated study

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A common technique used to intentionally create strong associative memory representations is to repeatedly study with self-testing to practice retrieval of the associated items. This kind of learning is essentially a trial-and-error (T&E) strategy that likely benefits from accelerated consolidation through repeated memory re-activation and retrieval. However, there is also a risk that erroneous practice responses create interfering distracting memories. Here, we compared T&E learning of novel country-name/flag pairs over multiple repetitions where each trial required selecting the correct answer from among two or six alternatives. The additional T&E foils might slow learning or could possibly enhance learning by requiring greater effort. In Experiment 1, participants (n=48) attempted to learn 60 flags across five T&E study repetitions with either two or six alternatives. Participants improved flag memory reliably but T&E with six alternatives learned less well (31.7% versus 44.6% post-test) indicating that more distracting foils produced less effective learning. In Experiment 2 (n=50), we tested whether more foils might interfere specifically with the initial creation of flag-name associations. Before T&E training, participants saw the correct name for each of the 60 flags twice followed by fourteen study trials across two days. Participants improved reliably and similarly with fewer and more foils during training (71.9% and 67.9% post-test). We conclude that more foils during study interferes with memory formation but once created, additional memory strengthening occurs regardless of the number of foils. Establishing a new memory trace appears to be sensitive to distracting information, but subsequent consolidation through re-activation is not.

Topic Area: LONG-TERM MEMORY: Episodic

E43 - Optogenetic inhibition of the rodent dorsal hippocampus impairs temporal duration sequence memory retrieval

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Convergent animal and human research have demonstrated that the hippocampus represents timing information embedded within a sequence of events. However, the specific roles of hippocampal subdivisions remain unclear. We developed a novel cross-species behavioural task to examine the temporal acquisition process using a novel computation modelling and then investigated the role of rodent dorsal hippocampus (dHPC) in temporal duration memory after acquisition. Across a number of training days, Long Evans rats learned to identify, via a left/right lever press, two distinct auditory sequences, each comprised of a pure tone and white noise of differing durations. We then developed a computational model to characterize the temporal learning dynamics of each participant and to identify the source of inter-participant variability. This model comprised of two components: (1) Bias, a cubic spline function captured the extent to which a subject's responding is biased towards one lever in the early phases of learning; and (2) Learning, a sigmoid function was implemented to provide insight into each subject's learning process. We found that although rats were able to successfully learn the different sequences, they demonstrated different strategies: some rats acquired both sequences equally throughout learning while others were biased towards learning one sequence over the other early on. After successful sequence acquisition, we inhibited the dorsal hippocampus (dHPC) using optogenetics. dHPC inhibition during sequence presentation impaired performance while inhibition during choice phase had no impact. Our data suggest a critical role for the rodent dHPC in representing temporal duration information in the context of sequences.

Topic Area: LONG-TERM MEMORY: Episodic

E44 - Real-time reorienting of preparatory sustained attention lapsing during episodic retrieval using closed-loop pupillometry

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Successful goal-directed knowledge expression is modulated, in part, by moment-to-moment lapses in preparatory sustained attention (assayed by pupillometry/scalp EEG alpha-power) in pre-goal periods immediately preceding memory retrieval attempts. While theoretically informative, correlations between attention and retrieval success yield limited evidence regarding the causal role of attention lapsing on memory retrieval and constrain implications for whether moment-to-moment attention can be intervened upon to optimize performance. Here, we leveraged real-time readouts of trial-to-trial pupil diameter to trigger attention-reorienting probes just prior to retrieval attempts. After completing a goal-directed associative memory encoding task, 75 young adults (18-25 yrs) indicated whether they remembered test probes as having been encountered in one of two task goals during encoding. Memory was assayed at the trial-level (hits/misses) and individual-level (memory d'). At the beginning of each block, we built participant-specific distributions of baseline-pupil during tonic fixation periods for trigger-thresholding. Critically, then, moment-to-moment pupillary dilations/constrictions which exceeded the empirical threshold triggered deployment of salient, real-time attention-reorienting probes just prior to retrieval probe delivery. As predicted, we found a correlation between hit/miss item memory and pre-stimulus tonic pupil diameter. Attention-reorienting triggers on attention lapsing trials rescued performance (item-memory d'), returning close to that of control trials (those with no detected attention lapses/triggers), although there was marked variability in reorienting efficacy across participants. These initial findings set the stage for better understanding the causal mechanisms underlying arousal-based attention lapsing and its effects on episodic retrieval, as well as considerations for designing more personalized attention-reorienting interventions.

Topic Area: LONG-TERM MEMORY: Episodic

E45 - Curious Hippocampal Subfields: An Ultra High-Field FMRI Study on Curiosity-Enhanced Memory

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Curiosity is a powerful motivator for learning and memory. While states of curiosity affect hippocampus-dependent memory formation via the dopaminergic circuit, it is unknown how different hippocampal subfields contribute to curiosity-related memory enhancements. Consistent with theories and studies in rodents on the role of how the dopaminergic circuit interacts with specific hippocampal subfields in support of memory formation, we addressed the question of how the ventral tegmental area (VTA) and hippocampal subfields support curiosity-related memory enhancements. In combination with 7T fMRI, healthy participants (N=19) encoded trivia questions and answers associated with high or low curiosity. Further, participants also took part in a pre- and post-encoding resting-state fMRI phase. Replicating previous behavioural findings, participants recalled answers and recognized incidental face images more from high- than from low-curiosity conditions. When participants were in a state of high curiosity, Bayesian region-based analysis of univariate BOLD activity revealed moderate evidence for curiosity-related activation (i.e., high vs. low curiosity) in the VTA and subiculum. In addition, we found strong evidence that VTA BOLD activity during the presentation of trivia questions (i.e., during curiosity elicitation) predicted curiosity-related memory enhancements. Comparing pre- and post-encoding resting-state periods, we observed moderate evidence for increased resting-state functional connectivity between the VTA and subiculum during the post- compared to pre-encoding rest periods. These findings suggest the involvement of the VTA and subiculum in curiosity-related memory processes. Furthermore, research on the influence of the dopaminergic circuit on hippocampal subfields in humans may illuminate cross-species commonalities that are pivotal for memory formation.

Topic Area: LONG-TERM MEMORY: Episodic

E46 - Alterations in Hairstyle impact the Other-Race Effect in Face Memory

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The Other-Race Effect is the phenomena wherein people can recognize individuals of their own-race significantly better than of a different race. Alterations in hairstyle, an external facial feature, have never been studied in conjunction with the other-race effect, even though hair is used as a cue for facial recognition. This study investigated the other-race effect with hair alterations to determine the role of hair in recognition memory, and specifically to identify how it differs between races. In an old-new recognition test, Black and White participants were asked to recognize Black and White faces, half of which had altered hairstyles in the test phase. Behavioral data and the parietal old/new effect, measured through ERPs, were recorded for all participants, making this one of the first studies to report ERPs on the other-race effect for Black participants. Behavioral data confirmed the other-race effect for White participants whereas Black participants did equally well. Memory performance suffered from hair alterations, especially for Black faces. Hair modifications significantly impacted the neural correlates of the other-race effect. White participants did not show a parietal old/new effect for altered other-race faces, whereas Black participants did. Black participant also showed a significant parietal old/new effect for altered own-race faces. The findings suggest that hair is relied on by individuals as a cue for facial identification. In addition, Black individuals pay better attention to hair and thus are more aware of changes that occur to it.

Topic Area: LONG-TERM MEMORY: Episodic

E47 - Differential Time-Frequency Dynamics Underlie Memory Encoding and Memory Selectivity

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The ability to preferentially encode valuable information amidst a plethora of miscellaneous information is an essential aspect of human memory. In laboratory tasks, a common finding is that higher-valued information during encoding leads to greater associative and recollective memories at retrieval. However, it is unclear if the same encoding processes that underlie memory selectivity also underlie encoding of recollective memories more generally. The current study analyzed electroencephalogram data for oscillatory activity during a value-directed remembering paradigm (VDR). During the task, participants encoded words assigned different point values with the instruction to maximize their score during test. Subjective states of recollection (i.e., "remember") and familiarity (i.e., "know") were assessed at retrieval. The behavioral results revealed that the value-driven gain in memory performance was selective to "remember" responses. However, analysis of oscillatory subsequent memory effects during encoding revealed a dissociation between subjective states of recollection and memory selectivity. During encoding, alpha oscillatory power in the occipital/temporal cortex displayed significantly more desynchronization for high-value compared to low-value words early during encoding. Words successfully retrieved and subsequently classified "remember" compared with words subsequently classified "know" resulted in a qualitatively different activity, including beta and theta desynchronization in later epochs. The findings suggest that, while value-directed encoding leads to increased rates of recollection, differential processes at encoding contribute to subsequent memory selectivity and the qualia of subsequent memories.

Topic Area: LONG-TERM MEMORY: Episodic

E48 - Fos expression does not reflect specific coding of experience

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The relationship between neural activity and the expression of immediate early genes has been a crucial question in understanding how experience drives plastic changes in the brain. Although there have been many years of research, it remains unclear what kind of neuronal activity can induce the Fos protein. Previous studies indicate that cells with heightened activation by external stimulus are more likely to express Fos. However, this conclusion was primarily based on the analysis of averaged results from all neurons in the mouse. To test this model at the single-cell level in vivo, we employed transgenic mice crossbred between Trap2 and Ai9 strains, so that Fos drives the expression of red fluorescent protein tdTomato. With this setup, we compared calcium activities between neurons with high Fos expression and those showed low expression. We found that while the group trend remained consistent as previously reported, the conclusion does not hold at individual cell level, which leads to different interpretation of the results. These results indicate that while Fos-high neurons exhibit heightened calcium activity on a group level, but these features only weakly predict Fos expression on individual cell level, thus unlikely to be the singular factor determining Fos expression. Rather than selective response to external stimulus, intrinsic properties such as overall excitability and connectivity of the cells offer more accurate prediction of Fos expression at individual cell level. Our data suggest more complex interaction between neuron activity and Fos expression under physiological conditions.

Topic Area: LONG-TERM MEMORY: Episodic

E49 - Acute stress modulates hippocampal memory and extraction of regularities across experiences

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Acute stress strongly influences the hippocampus. Most prior research has focused on the encoding of individual events (episodic memory), which is supported by the trisynaptic pathway (TSP; EC-DG-CA3-CA1). Recent studies show that an additional, monosynaptic pathway (MSP; EC-CA1) supports the process of extracting regularities across events (statistical learning). Rodent studies suggest that these pathways are differentially impacted by stress. We investigated this possibility in humans for the first time. Participants were first assigned to a stress group (socially evaluated cold pressor) or a control group (matched warm water) before learning. They then underwent fMRI while encoding sequences of trial-unique scenes containing temporal regularities. Namely, scene categories were arranged into pairs such that some categories (A, predictive) reliably preceded other categories (B, predictable). Participants returned the next day to complete behavioral tests of episodic memory for scene exemplars and statistical learning for category pairs. Initial results suggest that acute stress may enhance statistical learning and bias the hippocampus toward processing predictable information. In the stress group only, the prediction of upcoming B categories could be decoded from BOLD activity patterns in CA2/3/DG during presentation of A items. Behavioral evidence of statistical learning was higher and positively correlated with MSP background connectivity under stress. Stress additionally shifted patterns of episodic encoding during statistical learning, with the stress group showing stronger hippocampal

subsequent memory effects for B items. These results reveal a complex impact of stress on human hippocampal processes, enhancing rapid learning of regularities while encouraging active comparison between expectations and inputs.

Topic Area: LONG-TERM MEMORY: Episodic

E50 - Representation of decision uncertainty in the brain during hypothesis testing

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Understanding how humans seek and process information under uncertainty is fundamental to our decision-making processes and adaptive behaviors. Behaviorally, we have found that individuals will seek information to reduce uncertainty via hypothesis testing to resolve goal-oriented behavior However, little is known about the neural mechanisms underlying these hypothesis-testing processes. Therefore, we designed a fMRI study to investigate the neural mechanisms behind hypothesis testing. In the task, 20 participants were presented with three stimuli, each consisting of one feature on three different dimensions. Participants were instructed to figure out the target feature to open a treasure chest. The Target feature changed after four consecutive choices of the stimulus with the target feature. Analysis using a reinforcement learning model revealed decreasing decision uncertainty before a feature switch, indicating effective hypothesis testing during the task. Neuroimaging analyses indicated that activation in the ventromedial prefrontal cortex (VMPFC) decreased as a function of increasing decision uncertainty (ROI analysis, $p < 0.01$), while frontoparietal network activation positively correlated with decision uncertainty (whole-brain corrected). We speculate that as participants systematically tested features, VMPFC activation increased corresponding to successful goal achievement as decision uncertainty decreased, while frontoparietal networks were engaged to help resolve uncertainty. In summary, our findings highlight the significance of VMPFC and the frontoparietal network in representing decision uncertainty during hypothesis testing.

Topic Area: LONG-TERM MEMORY: Episodic

E51 - Exploring memory consolidation interference: The impact of different wakeful post-encoding activities on visual detail memory.

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Post-encoding wakeful rest is beneficial for the retention of new memories, relative to task engagement. This can be explained by a consolidation account: rest is thought to provide optimal conditions for stabilising fragile new memories by reducing interference associated with task engagement, for example, encoding and sustained attention. However, the contribution of these factors to consolidation remains poorly understood. To examine this, a mnemonic discrimination paradigm, which is sensitive to rest effects in visual detail memory, was combined with an event segmentation paradigm that has been used to examine the effects of different mental activities on memory. Four hundred young adults (18-36 years old) were recruited for this online experiment. The procedure comprised the incidental encoding of photos of everyday items, a 7-minute delay condition, and a mnemonic discrimination test to probe detail memory for the encoded photos. Crucially, participants were allocated randomly to one of four groups (each n = 100), which determined their delay condition activity: (a) wakeful rest or watching a video of an everyday experience while completing (b) encoding, (c) attention, or (d) event segmentation (encoding + attention) tasks. Contrary to expected outcomes: (i) no benefit of rest was observed in detail memory, relative to task engagement, and (ii) detail memory was superior following event segmentation than rest and attention conditions. These outcomes tentatively suggest a state of attention and encoding may benefit consolidation, possibly due to the novelty of this condition encouraging consolidation, and demonstrate a need for further work exploring the determinants of consolidation.

Topic Area: LONG-TERM MEMORY: Episodic

E52 - The relationship between cortical reinstatement of scene information and memory accuracy

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Previous fMRI research contrasting retrieval-related scene reinstatement in adults with developmental amnesia and healthy controls identified reinstatement effects of equal strength in the two groups, despite dramatic behavioral differences in scene memory (Elward et al., 2021). Motivated by this striking finding, here we employed fMRI to examine scene reinstatement in healthy young adults when reinstatement effects were elicited by test items associated with accurate scene retrieval as opposed to when effects were estimated regardless of retrieval accuracy. 24 young adults (aged 18-29 years) first studied words overlaid on a scene, an object or a scrambled image. The word-image pairs were presented on either the left or right side of the display. In a subsequent scanned test phase, participants were presented with previously studied words along with new words. In the retrieval task of interest here, for those words identified as previously studied, participants judged whether the image associated with the word at study was a scene, an object or a scrambled image. Scene reinstatement effects were operationalized as greater retrieval-related activity for words that had been paired with a scene rather than a scrambled image. Relative to reinstatement effects for test items attracting correct source judgments, there was no evidence of a dilution of the effects when test items were unsegregated by accuracy, despite performance that was well below ceiling. This finding adds to the results previously obtained in developmental amnesic participants and suggests that retrieval-related scene reinstatement can occur independently of behavioral evidence that a scene was retrieved.

Topic Area: LONG-TERM MEMORY: Episodic

E53 - Flexible Object-Label Associations Following Rapid Perceptual Learning in Patients with Hippocampal Damage

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Hippocampal damage is traditionally thought to impair conscious, flexible memory (declarative), while leaving intact non-conscious, inflexible memory (nondeclarative) such as perceptual learning following extensive repetition. Recently, Squire et al. (PNAS, 2021) trained patients with hippocampal damage on a one-shot perceptual learning of black and white, ambiguous images (Mooney figures), and showed that correct naming of disambiguated images was retained even months after learning. The declarative memory output (naming previously ambiguous images) and the rapid rate of acquisition led us to speculate that these new representations could also be flexible. We adapted the encoding phase of Squire et al.'s study by presenting 3 Mooney exemplars of each category (e.g., if the target item was a giraffe image, our participants were asked to name 3 different ambiguous images of giraffes). Patients with hippocampal damage and healthy matched controls named the Mooney figures and were then shown either an intact version of the image (disambiguated condition), or a new, unrelated image. Images from the same category belonged to the same condition. During testing (1 and 7 days post-encoding), participants named new Mooney figures from the previously presented categories, including the ones from Squire et al.'s study. Accurate naming would require the generalization of perceptual learning, extending the labels to new items. We found that both controls and patients showed evidence of generalization, with improved naming accuracy for related, but never seen before items. The ability to abstract and generalize what they learned suggests that perceptual learning may be accomplished by rapid cortical integration.

Topic Area: LONG-TERM MEMORY: Other

E54 - Object, tactile, and spatial oddity judgements are impaired in DG-compromised rats but enhanced in CA1-compromised rats

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The hippocampus (HPC) is necessary for supporting episodic memory, although HPC subregions might differentially contribute to various underlying component processes. For example, the dentate gyrus (DG) is involved in the orthogonal representation of similar information (i.e., pattern separation) to facilitate precise encoding. Given that this computational process occurs as information enters the DG, the DG might additionally be involved in non-mnemonic, perceptual discrimination. Moreover, although prominent theories of HPC function predict a domain-specific role of the DG in processing space/scenes, it is possible that the DG plays a domain-general role in discriminating other stimulus types that form rich, episodic memories. In contrast, perirhinal cortex (PRh) has been involved in successful domain-specific perceptual discrimination

involving objects. Therefore, we assessed performance on visual, spatial, and tactile oddity tasks in rats with compromised DG, PRh, or CA1 functioning, the latter included as a negative control. Our results demonstrate that DG-compromised rats exhibited impairments on all three tasks at an intermediate level of difficulty, but spared performance on the easier level. Conversely, PRh-compromise produced only visual oddity deficits (easy version). Unexpectedly, CA1-compromise enhanced discrimination in all modalities. These results support the domain-general involvement of the DG in difficult perceptual discriminations compared to the domain-specific (object identity) involvement of PRh in this process. Furthermore, our results demonstrate that perceptual discrimination can be enhanced by blocking CA1 activity, possibly due to reduced interference from retrieval processes. Current studies are investigating perceptual discrimination in human cases with damage to the DG or CA1 using analogous oddity tasks.

Topic Area: LONG-TERM MEMORY: Other

E55 - Understanding the Roles of Phasic and Tonic REM Sleep in Memory Consolidation

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During sleep, newly formed memories are strengthened and integrated with existing memories. According to several leading proposals, this consolidation process occurs sequentially. First, repeated re-activation of newly encoded memories occurs during non-rapid-eye movement (NREM) sleep. Next, these memories are integrated into established memory networks during REM sleep. The heterogeneity of non-REM periods of sleep is well-characterized and considered in physiological analyses, whereas REM sleep is most often treated as one homogenous single state. However, previous studies have shown that REM sleep consists of two microstates, the phasic and tonic microstates. The phasic microstate resembles a stable sleep period associated with the restorative functions of sleep, while the tonic microstate consists of quiescent segments associated with environmental awareness. Despite these distinctions, there has been limited research analyzing the specific REM microstates in relation to sleep-dependent memory consolidation. We aim to bridge this gap in knowledge by examining the differential contributions of phasic and tonic REM activity in memory consolidation during sleep. Using previously collected datasets, we will analyze the microarchitecture of REM sleep and measure the relationship between phasic and tonic REM activity and behavioural indices of memory changes from the pre-sleep to post-sleep period. We hypothesize that phasic activity will positively correlate with increased post-nap memory performance, along with other physiological sleep indicators of memory consolidation, specifically spindle power during slow-wave sleep. These findings will provide further insight into the role of REM sleep and the sequential interactions between NREM and REM sleep in memory consolidation.

Topic Area: LONG-TERM MEMORY: Other

E56 - On the Relation Between Polydrug Use and Prospective Memory

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Prospective Memory (PM) involves forming intentions for future execution. Illicit drug use disrupts neural systems essential for cognitive functions that support PM like long-term memory retrieval and attentional control. However, the impact of recreational and polydrug use on PM remains underexplored in nonclinical populations. In this study we performed latent class analysis to identify patterns of polydrug use in a large undergraduate sample (n = 598). We examined the effect of self-reported drug use on PM using a comprehensive substance use questionnaire and an experimental PM task with a behavioral intervention known to improve PM in individuals with neurological impairments (i.e., implementation intention encoding). This intervention involves verbally repeating an intention during its formation and visualizing its completion. The results of our latent class analysis shows patterns of drug use where class membership consisted generally of 'Alcohol Only', 'Alcohol & Cannabis (with some psychedelic use)', and a "Illicit Polydrug' users. We hypothesized that participants assigned to latent classes with more reported drug use would be associated with impoverished PM ability. Furthermore, we hypothesized that implementation intentions would mitigate the negative effect of drug use history on PM. Results show support for both hypotheses, where greater self-reported drug users showing deficits on the behavioral task relative to other groups that received standard encoding. Illicit Polydrug users that received implementation intention encoding did not differ in performance relative to other latent classes. The tested hypotheses will be presented with a discussion of the impact of neuromodulation via drug use on prospective memory.

Topic Area: LONG-TERM MEMORY: Other

E57 - Examining the representational stabilization of lifetime period narratives in real time

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Lifetime periods represent prolonged periods of stable experience, both at the level of the individual and the collective. Retrospective studies are commonly used to study autobiographical and collective narratives for lifetime periods but cannot detect the development of narratives as that period is lived. To this end, we prospectively tracked the formation of lifetime period narratives of the COVID-19 pandemic. Participants wrote brief "chapters" about the pandemic for their autobiography and a history book, repeatedly in at least five of nine surveys conducted during 2020 and 2021. Universal Sentence Encoder, a machine-learning algorithm, quantified the similarity between pairs of narratives, enabling assessment of changes in the consistency of semantic meaning over time. First, similarity with the first narrative (May 2020) decreased over time likely reflecting the synthesis of diverse experiences; importantly, it was not simply an effect of increasing temporal distance as the reduction plateaued by early 2021. Second, the similarity of narratives generated at adjacent time-points increased over time, likely reflecting a stabilization as experiences became routine. Although for both analyses, similarities were higher for one's collective versus autobiographical narratives, there were no time x type interactions suggesting these changes reflect a more fundamental stabilization process of lifetime period memories irrespective of whether the content is autobiographical or collective. More generally, this study offers a new application of natural language processing to life story research that could be used to advance our understanding of other aspects of memory and cognition.

Topic Area: LONG-TERM MEMORY: Other

E58 - The power of attention: how to boost long-term memory representations in working memory

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While theoretical models suggest that there is an information exchange between working memory (WM) and long-term memory (LTM), it is not clear whether existing LTM representations can be strengthened by attentional manipulations in WM. The current study attempts to address this question using electroencephalography. We designed a novel task in which subjects first learned associations between objects and their presentation position. In a subsequent WM task (retro-cue paradigm), the same object-location associations re-occurred. One third of the objects appeared consistently in the cued condition of the retro-cue task, another third in the non-cued condition, while the rest were never repeated in the WM task (control condition). During the final retrieval phase, subjects were presented with the same objects and had to retrieve the associated locations. Data from the retrieval phase were analyzed. Behavioral results indicated that subjects were fastest and most accurate in retrieving the locations associated with cued objects that had undergone attentional selection during the WM task. Similarly, we obtained a significantly higher left parietal old-new amplitude when comparing the cued condition with the other two conditions. Finally, we trained a classifier to discriminate between retrieval trials with objects that had undergone different WM manipulations. The classifier was able to discriminate trials with cued objects from trials with non-cued and control objects. However, when the control and non-cued conditions were contrasted, the decoding accuracy did not exceed chance level. Overall, this shows that attentional selection in WM can strengthen an existing LTM representation and benefit subsequent retrieval.

Topic Area: LONG-TERM MEMORY: Other

E59 - Orienting attention to selective contents of long-term versus short-term memories: an ERP study

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The neural correlates of internal attention have been studied extensively by exploiting retrospective cues (retro-cues) during the delay interval in short-term memory (STM) tasks. In comparison, the neural correlates of internal attention acting within long-term memory (LTM) have received little investigation. Here, we recorded electrophysiological responses during selective orienting of internal attention within LTM vs. STM contextual memories to compare the pattern and timing of neural processes engaged. In a learning task performed over two days, participants (N = 29) studied a series of unique associations between scenes and two everyday embedded objects. On the third day, they performed delayed-response tasks based on the retrieval of object identities associated with previously studied scenes (LTM task) or new scene-objects associations encoded into STM (STM task). Spatial retro-cues directed selective internal attention or neutral retro-cues provided no information about the location of the object to be probed. Behavioral data confirmed a significant retro-cueing effect for both tasks. Our ERP results revealed cue-related ERPs, namely Early Directing Attention Negativity (EDAN) and Late Directing Attention Positivity (LDAP), for both tasks, with a stronger LDAP for the LTM task than the STM task. Multivariate decoding of the time-series data of internal attention showed similar patterns over time between LTM and STM representations. In conclusion, our results demonstrate that internal attention can be oriented not just to STM information, but also to information reactivated from LTM.

Topic Area: LONG-TERM MEMORY: Other

E60 - Sigma power and encoding strength in sleep-based and retrieval-mediated memory consolidation

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Emerging evidence suggests that memory consolidation can be achieved during wake, using repeated retrieval training, rather than only during sleep. However, the neural mechanisms of sleep-based and retrieval-mediated consolidation have never been directly compared. Sigma activity, which is important for sleep-based consolidation's enhancement of initially weakly encoded memories, may be involved in this selective enhancement in both consolidation states. To test this, we compared the interaction of sigma band (~12-15 Hz) power and encoding strength across different memory interventions. Participants (N=22, 18-31 years) learnt different object-word pairs in each of 3 sessions, completed an immediate recognition test, then experienced 1 of 3 120-minute interventions: (i) retrieval training (repeated cued-recall); (ii) restudy (repeated viewing, eliciting no consolidation); or (iii) a nap opportunity. After 45 minutes, participants were given a delayed recognition test. It was hypothesised that sleep and retrieval training, but not restudy, would enhance weakly encoded memories, when sigma power was high. We instead found that across all conditions, high sigma power stabilised the initial encoding strength, and low sigma power lead to the deterioration of initially strongly encoded memories, $\chi2(1)=5.11$, $p=.024$, $\beta=1.06$. This suggests that sigma activity may represent a unifying mechanism of stabilising initial memory strength, across different brain states and learning paradigms. Our research is the first to investigate sigma activity's influence on memories during wake. Further research is required to determine sigma activity's specific influence on memories, involving their qualitative, inter-item, and longitudinal changes, to uncover if it is involved in state-independent consolidation, or paradigm-independent learning.

Topic Area: LONG-TERM MEMORY: Other

E61 - The relation between medial temporal lobe structures and spatial navigation following moderate-severe TBI

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Individuals with moderate-severe traumatic brain injury (TBI) have difficulty navigating life. Survivors struggle to integrate back into their communities, participate independently in daily activities, and act flexibly while navigating their social and physical environments. The virtual Morris water maze (vMWM; Astur et al., 1998) assesses spatial navigational behavior in a virtual environment where participants must repeatedly navigate to a hidden platform using environmental cues. Previous findings in non-injured participants reveal associations between medial temporal lobe structures and fractal dimensionality, an index of search path complexity in the vMWM environment (Daugherty et al., 2015). We investigated the impact of chronic moderate-severe TBI on spatial navigation and examined associations with volumetric measures of the medial temporal lobe. vMWM and magnetic resonance imaging data were collected and analyzed for 24 participants with chronic moderate-severe TBI and 29 non-injured comparison participants (NC). We found a significant group difference with greater distance travelled and longer path complexity on trial 15 (the final trial) for the TBI group. Increased path complexity correlated with lower parahippocampal volume, but not hippocampal volume. Future work investigating the relation between spatial navigation and hippocampal subfields or subregions may prove more sensitive in detecting the predicted associations in this population. Furthermore, extending this work to examine hippocampal contributions to the navigation of social environments could offer a test of our proposal that hippocampal dysfunction underlies a range of behavioral impairments in TBI including memory, navigation, and social functioning.

Topic Area: LONG-TERM MEMORY: Other

E62 - Effect of real-world experience on lab-based scene memory

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Boundary extension (BE) is as an error in scene memory, such that participants retrieve details beyond the given boundaries of a scene image. Boundary contraction (BC) is the opposite effect, whereby participants retrieve less context within the boundaries of a given scene image. In the BE literature, there is variability in the types of stimuli that are used, how BE is tested, and the proposed mechanisms underlying the phenomenon. Some research supports the view that BE reflects (re)construction of the scene from an internal representation that was formed, whereas other research supports the view that BE (and BC) emerge from image-based properties, including the number of central objects and whether an object is pictured in close range or from a wider angle. Assessing the effects of prior knowledge and experience of a scene on this bias can help disentangle the role of visual perception and scene construction. The current study tested the influence of familiarity on scene recognition through the comparison of lab-based encoding of images of pre-experimentally familiar (real-world) places with images of unfamiliar places. Participants used a continuous rating scale to indicate how they perceived the boundaries of a test image relative to a previously studied image. There was a tendency for BC across both image conditions, with evidence of maintained, and an instance of greater, BC for familiar than unfamiliar scene images. Importantly, the lack of evidence for increased BE with greater familiarity favours an image-based theoretical account of BE and BC.

Topic Area: LONG-TERM MEMORY: Other

E63 - The Neural Correlates of Metamemory for Prospective Memory

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Prospective memory (PM) is the ability to plan and execute future intended goals. It is a critical cognitive process for various real-world tasks, including completing and submitting assignments, attending class and meetings, and balancing a social life. PM can be broken down to two components, which can be measured using electroencephalogram and event related potentials (EEG/ERPs): cue detection, assessed by the N300, and intention retrieval, assessed by the prospective positivity. Metacognition, specifically metamemory, also plays an important role in PM, as it reflects how an individual observes, directs, and regulates their own cognition and memory skills. Metamemory judgements may predict how somebody chooses to implement reminders or strategies to complete their future oriented goals. Previous behavioral research indicates that individuals tend to underestimate their PM capacity, and their judgements of how their memory abilities positively relate to their PM performance. Also, intention retrieval may be more sensitive to metamemory predictions than cue detection. The purpose of the current novel study is to examine the neural correlates of metamemory for PM in college students using EEG/ERPs. This methodology will determine if metamemory has a particular relationship with either component of PM. We hypothesized that metamemory scores would positively predict the prospective positivity amplitude and PM performance. With this information, researchers can characterize the role of metamemory in PM performance and advise college students on how to think

about their own memory abilities, implement memory strategies, and carry out their intended goals.

Topic Area: LONG-TERM MEMORY: Other

E64 - Manipulation Type Interacts with Scene-Object Recognition Performance and Memory-Based Eye-Movement Behavior

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Previous work suggests that eye movements are sensitive to changes in encoded scenes (e.g., addition of an object) that go undetected in explicit reports. However, other studies indicate that these memory-based viewing effects are only evident when participants report the change. These results have important implications for memory systems theories that propose hippocampus-dependent memory is exclusively declarative (i.e., accessible to awareness). In our experiment, we examined whether manipulation type (object additions versus deletions) interacts with awareness and viewing patterns (e.g., greater viewing and recognition of the change when a new object is present in a scene, decreased viewing and recognition when an object is removed from a scene). We addressed this question by comparing viewing effects across scene types (manipulated, repeated) subdivided by whether the critical scene region was empty or filled. We also investigated the influence of test type (indirect, direct) on memory-based viewing effects. As predicted, more time was spent looking at objects than empty space, and object additions were more often reported than object deletions. Memory-based viewing effects (manipulated > repeated AOI viewing) were also larger when the critical region was filled, especially when memory was tested directly. Preliminary results suggest that these effects may depend on awareness (i.e., knowledge of the change), though analyses are still underway. Our results indicate that manipulation type should be considered in studies that address questions about memory, awareness, and eye-movement behavior. Future studies should examine object identity and/or position changes (e.g., left-right shifts), which was not done here.

Topic Area: LONG-TERM MEMORY: Other

E65 - Is the late positive potential (LPP) a marker of emotional memory encoding and consolidation?

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This study investigates the role of the late positive potential (LPP) in the encoding and consolidation of emotional memory. The LPP is the component of the event-related potential (ERP) that is most consistently modulated by emotion, but the cognitive function represented by the LPP is currently unclear. It is well known that emotion affects how well information is remembered, and some studies suggest that LPP amplitude predicts later memory. The present study tests the hypothesis that the LPP is related to processes that enhance memory for emotional stimuli; more specifically, we hypothesize that the LPP may represent the process by which emotional memories are "tagged" for enhanced consolidation. In a pre-registered study, we recorded EEG as participants read negative and neutral words. Memory for these words was then tested at both a short delay (~15 minutes) and a long delay (~24 hours and after a period of sleep). We hypothesize that trials with larger LPPs will be more likely to be remembered, and that the LPP will mediate the relationship between emotion and memory. If the hypothesis about tagging for consolidation is correct, we expect these effects to be more pronounced after the long delay, during which memory consolidation occurs.

Topic Area: LONG-TERM MEMORY: Other

E66 - Effects of Spatial Predictability on Attentional Orienting and Memory Retrieval

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During visual search, ignoring distractors can be just as important as learning where to find targets. Research has shown that predictable target and distractor locations can facilitate visual search. Here, we tested how learned regularities about target and distractor locations impact subsequent memory retrieval and attentional orienting. In two online Experiments, participants learned to identify unique targets in real-world scenes, while simultaneously ignoring distractors. A factorial design manipulated the categories that defined targets and distractors objects (toys vs clothes) and their spatial predictability (fixed vs variable). Participants were faster and more accurate at finding predictable (fixed) than non-predictable (variable) targets. The consequences of this learning were then tested in attentional-orienting (Experiment 1) and memory-retrieval (Experiment 2) tasks. In Experiment 1, attentional orienting performance was linked to both relevance and predictability. Namely, participants were better at detecting targets than distractors. Also, benefits were demonstrated for fixed compared to variable targets, but not for fixed versus variable distractors. In Experiment 2, participants' performance on object and scene memory were linked to relevance, with better performance for learned targets than distractors. However, there were no significant differences in performance based on predictability. Therefore, predictability was an important factor for facilitating orienting, but in the case of memory retrieval, predictability did not automatically confer advantage. Together, the effects of relevance and predictability during learning had different patterns of consequences on subsequent performance depending on task demands – whereas strong interactions between the factors determined attention-orienting functions, future memory quality was mainly driven by relevance.

Topic Area: LONG-TERM MEMORY: Other

E67 - When natural behaviour flexibly engages memories of different timescales

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Memories of different types and timescales – for instance, working memory (WM) and long-term memory (LTM) – have been shown to support discrete cognitive operations like attentional allocation and attentional sampling. During free-flowing natural behaviour, however, memory traces of different kinds provide the scaffolding for these discrete operations in a continuous and interconnected way. In three virtual reality (VR) experiments, we embraced the multifaceted nature of memory guided behaviour. Participants copied a Model display by selecting realistic objects from a Resource pool and placing them into a Workspace. We tracked head, hand, and eye movements as well as free-flowing interactions with the environment. On this basis, we segmented continuous temporally extended behaviour into tractable sub-units: encoding, visual search, and memory usage. Through the repetition of specific arrangements within the environment and using non-repeated/novel arrangements as a baseline, we demonstrate how different types of memories guide the interconnected processes of encoding, search, and memory utilisation. Overall, we uncover multiple ways in which LTM supports naturally unfolding behaviour. First, we demonstrate that reliance on information in memory – compared to gathering information from the external environment – increased when Model arrangements were repeated. Further, search times improved for repeated Resource arrangements. We also found high performance in a subsequent recognition memory task for repeated arrangements, suggesting that the incidentally formed representations during the task were durable and accessible. Our work provides an innovative framework for investigating naturally unfolding memory-guided behaviour, offering new insight into the interplay among vision, memory, and action.

Topic Area: LONG-TERM MEMORY: Other

E68 - Conditioned place preferences to nicotine in a human virtual reality task

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The escalating prevalence of electronic cigarette (e-cigarette) use among young adults has emerged as a pressing public health concern, encompassing adverse consequences like nicotine addiction and related health risks. This study aims to investigate whether undergraduate students, characterized by differing levels of nicotine use, demonstrate a Conditioned Place Preference (CPP) for a virtual room linked to nicotine lozenge administration, contrasting it with a neutral room associated with a placebo lozenge. The underlying hypothesis suggests that participants engaging in nicotine use would spend more time in, report greater subjective enjoyment in, and explicitly prefer the VR room previously paired with nicotine administration compared to a neutral room. Over the course of a week, each participant underwent three sessions: initial sessions involved the administration of nicotine or placebo lozenges in designated

VR rooms, while the third session allowed participants to explore both VR rooms without lozenge administration. Our results indicate that nicotine users demonstrate a preference for the virtual reality environment paired to nicotine lozenge administration. This finding contributes to quantifying the strength of CPP in relation to e-cigarettes, potentially establishing a predictive relationship between CPP strength and real-life nicotine abuse. This study establishes a crucial foundation for subsequent research, regulatory initiatives, and public health interventions aimed at addressing the escalating prevalence of e-cigarette use among young adults.

Topic Area: LONG-TERM MEMORY: Other

E69 - The relation between connectivity gradients and spatial representations in human entorhinal cortex

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The entorhinal cortex (EC) is the key interface between neocortex and hippocampus in which spatial and non-spatial relations between experiences are organized in cognitive maps. Computational work suggests that the hippocampal-entorhinal system may support generalization by factorizing the representation of experiences into their structure in medial EC (MEC) and specifics in lateral EC (LEC), allowing their flexible recombination. Interestingly, a functional distinction between MEC and LEC is congruent with the abundance of spatially-tuned cells in MEC as well as with their distinct whole-brain connectivity profiles. Here we investigate the anatomical relation between spatial representations and cortical connectivity along EC to gain insights into the involvement of entorhinal representations in brain-wide cognitive processes. To this end, we assess the regional specificity of spatial representations in EC during task-based fMRI and identify a human equivalent of rodent MEC and LEC based on their distinct whole-brain functional connectivity profiles. We determine individual connectopic maps reflecting the dominant change in connectivity patterns along EC based on task- and resting-state fMRI. This analysis reveals an anterior-posterior gradient that separates EC into two distinct subregions. Based on this, we probe how individual connectopic maps relate to the distribution of spatial task representations observed in EC, and further examine implications of interindividual differences in entorhinal information processing for behavioral performance. A better understanding of the relationship between representational mechanisms in EC and its brain-wide connectivity can inform investigations on its wider role in cognition and further contribute to bridging the gap between rodent and human research.

Topic Area: LONG-TERM MEMORY: Other

E70 - The Effect of Post-Learning Rest on False Memory in the Deese-Roediger-McDermott Paradigm

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While sleep has long been known to benefit memory consolidation, recent studies demonstrate that even a brief period of eyes-closed waking rest following encoding can similarly benefit memory. Eyes-closed rest has been shown to benefit a wide variety of memory types, including for declarative, procedural and spatial learning. But sleep is argued to not only quantitatively strengthen memory traces, but also qualitatively transform them over time. For example, sleep may influence false memory formation. The present study tested whether post-encoding waking rest similarly affects the formation of false memories, using the Deese-Roediger-McDermott (DRM) false memory paradigm. We hypothesized that rest would increase false memory as measured by recall, but decrease false memory as measured by recognition. In a within-subjects design, N=51 participants either sat quietly with their eyes closed for 15 minutes or spent an equivalent period of time completing a distractor task, following auditory encoding of 8 DRM word lists. Afterwards, participants were tested on their memory, via both recall and recognition. There was no significant effect of rest on false memory using either recall ($t(50) = 0.26$, $p = .796$) or recognition ($t(50) = 1.20$, $p = .237$) tests. There was also no significant effect of rest on memory for studied words (recall: $t(50) = 1.32$, $p = .194$; recognition: $t(50) = 0.51$, $p = .612$). This may indicate that waking rest does not affect certain types of qualitative memory transformation thought to occur during sleep, including the gist-extraction type processes underlying false memory in the DRM.

Topic Area: LONG-TERM MEMORY: Other

E71 - Phylogeny of the anatomical projections from the neocortex to the hippocampal region: evolutionary insights into the nature of declarative memory

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Unlike the mammalian neocortex, the hippocampal region largely preserved its cytoarchitectural organization and its role in mnemonic functions throughout more than 200 million years of mammalian evolution. Following recent advances in imaging of the human hippocampal region (Reznik et al., 2023), in the current study we sought to leverage this contrast and to examine changes in anatomical connectivity between the hippocampal region and the broader cortex across species. Specifically, we examined differences in unimodal and transmodal cortical input to the perirhinal cortex, entorhinal cortex, and the parahippocampal cortex (postrhinal cortex in the rodent) in the rat, marmoset, macaque, and human. Our results demonstrate that mammalian evolution, culminating in humans, has been associated with a decrease in unimodal input and a corresponding increase in transmodal input to the hippocampal region. Importantly, these changes in connectivity cannot be explained merely by changes in the relative size of transmodal areas across species. Furthermore, we found that in the primate lineage, cortical input from the broader cortex to the entorhinal cortex was dominated by transmodal areas compared with the cortical input to the perirhinal/parahippocampal cortices. Our observations provide a comparative anatomical framework supporting the fundamentally constructive nature of declarative memory and indicate that memory-related processes in different species operate on different types of sensory information.

Topic Area: LONG-TERM MEMORY: Other

E72 - Looking at numbers: Evidence for a neural representation of state transitions in the entorhinal and prefrontal cortices

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Previous work has demonstrated that the hippocampal-entorhinal region is sensitive to the relational structure of experience, in both spatial and non-spatial domains. Within this, the medial entorhinal cortex (MEC) may play a role in generalising task structure across different sensory stimuli and environments. However, it remains unclear how we use our relational memory to guide behaviour: even if we know the states involved in making coffee, to exploit this knowledge we need to know which actions to take. To support this, the entorhinal cortex may map out learned 'actions', or transitions, between nodes in a graph structure (like velocity signals in navigation). To test this idea, we carried out an fMRI experiment (n=57) in which participants learned to navigate around a numberline using a set of mathematical operations. This strong linear prior allowed us to test for the similarity of possible actions from each state. Using representational similarity analysis, we find a representation of possible transitions per state in the entorhinal cortex ('non-spatial affordances'). Concurrently, the medial prefrontal cortex, a region previously associated with action choice, represented the magnitude of possible actions from each state. Importantly, this action code is independent of any other features of the state space, and we believe this to be the first evidence that the entorhinal cortex is involved in the representation of actions in an abstract space. These findings reinforce suggestions from systems and computational neuroscience that

medial temporal representations do not just describe our surroundings, but actively guide our behaviour.

Topic Area: LONG-TERM MEMORY: Other

E73 - Lexico-Semantic Processing in Older Adults with Subjective Cognitive Decline: An Eye-Tracking Study

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In the continuum of Alzheimer's disease (AD), the clinical phase follows Mild Cognitive Impairment (MCI) and Subjective Cognitive Decline (SCD). Jessen et al. (2014, 2020) demonstrated that individuals with SCD have an increased risk of developing AD dementia over time, supporting a three-stage model of AD. Despite overall normal cognitive performance, specific disruptions in lexical-semantic functioning, such as challenges in naming pictures, are observed in SCD, hinting at a potential early cognitive marker of AD. Recent eye-tracking studies have unveiled distinctive visual patterns in individuals with MCI and AD compared to cognitively healthy participants (CS) during various cognitive tasks. Therefore, eye-tracking could be an effective tool to compare differences in visual analysis patterns during lexical-semantic processing in SCD relative to a cognitively healthy control group of participants. Sixty participants (30 SCD, 30 CS) took part in a task regarding the identification of known faces versus unknown faces. A significant interaction effect between groups and the 'missed identification' face category was observed ($F[1,753] = 5.662$, $p < 0.05$, $\eta 2 = 0.01$). Controls exhibited more saccades and fixations when viewing a known face, even when unable to identify it behaviorally. These results affirm the efficacy of eye-tracking in discerning visual pattern disparities in SCD participants relative to controls. Eye-tracking could present a non-invasive and cost-effective alternative to current invasive and expensive methods for identifying AD biomarkers, and underscores its potential as a precise diagnostic aid in the early stages of Alzheimer's disease.

Topic Area: METHODS: Other

E74 - Introducing the Mini-Intraoperative Language Test (MILT): a new language battery for awake brain surgeries

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Intraoperative awake language mapping is currently the state-of-the-art method to assess language organization and prevent postoperative deficits. Besides its clinical applications, this technique can significantly contribute to our understanding of cortical language organization within and across individuals. However, there is currently no standard protocol used across centers. Here we present a new language battery created in Brazil, the Mini-Intraoperative Language Test (MILT), which contains 10 language subtests that can be applied in 3- to 5-minute time windows and repeated (in different versions) across 10-15 pre-mapped cortical sites. We apply the Tanigushi method, which uses monopolar electrodes to induce stimulation for longer periods of time (3-5 minutes vs. 4 seconds, as in the Penfield method), and can reduce the incidence of epileptic seizures. Here we present the subtests, the normative studies conducted in Brazilian Portuguese to create them, and data from two pilot cases. In the future, our aim is to adapt MILT to different languages and develop an automated platform that makes MILT application and analysis in the surgical environment more efficient.

Topic Area: METHODS: Other

E75 - Can Prefrontal tDCS Improve Memory in Younger or Older Adults? A Rigorous Clinical Trial with Null Results

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Previous work has found that a single session of anodal tDCS to the left dorsolateral prefrontal cortex (dlPFC) can temporarily improve memory in younger or older adults, but this effect has not always been replicated and may be moderated by time of day (see Wong et al., 2018). Here, we report the results from a randomized, controlled trial designed to replicate these time-of-day findings in episodic memory in younger adults, and also to determine the extent these tDCS on working memory and among older adults. We conducted the largest double-blind, between-subjects, multi-session tDCS study on memory to date. One-hundred and fifty younger adults and 91 older adults received anodal tDCS or sham stimulation to the left dlPFC or left parietal cortex prior to episodic memory retrieval and working memory tasks at different times of day (i.e., morning and afternoon). We found expected effects of task difficulty manipulations on each of our memory measures. However, contrary to our primary pre-registered hypotheses, we did not find any effect of tDCS or time of day on younger or older adults' episodic or working memory performance. Based on these and prior results, we conclude that a single session of tDCS using the typical (and often recommended) parameters does not improve episodic memory retrieval or working memory in either age group.

Topic Area: METHODS: Other

E76 - A novel continuous measure for subjective experiences: Implications for neuroimaging.

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Functional neuroimaging studies are often concerned with correlating subjective experiences with neural data. The most common method for doing so involves periodic probes that interrupt task performance, rely on discrete responses, may suffer from range limitations, and thereby limit the granularity of participants' subjective experiences. To address this limitation, we developed a novel mechanism to collect continuous feedback of subjective experiences during a mood induction. Participants were induced to feel either boredom or interest and used a rotating dial to express in real-time their subjective experiences (rightward movements indicated increased levels of affect). Traditional Likert-scale measures were also taken before and after mood induction. The rate of change of responses on the dial (i.e., slope) significantly correlated with the change in pre and post Likert responses ($r = 0.44$) indicating that this method minimally captures what is measured in Likert scales. The dial provided more information based on individual differences in boredom proneness such that the slope describing state boredom changes was steeper for the highly boredom prone. This dynamic was not captured in the Likert scales. This method of collecting continuous subjective reports may provide important insights when paired with neural data that would be missed with more traditional approaches

Topic Area: METHODS: Other

E77 - Network-targeted rTMS for treatment of Alzheimer's disease (AD) using a personalized 3D-printed frame

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We explore the efficacy of a 20-Hz hippocampal network-targeted repetitive transcranial magnetic stimulation (rTMS) protocol for treating early AD patients. We conducted an evaluator-blinded, randomized, and sham-controlled clinical trial involving 44 early-stage AD patients, who were confirmed by amyloid deposition on PET scans or cerebrospinal fluid tests. The patients were randomly assigned to the rTMS treatment group or sham control group. The intervention consisted of twenty rTMS sessions over four weeks, targeting the left parietal area connected to the hippocampus, guided by individual fMRI maps. A personalized 3D-printed frame was utilized for precise coil placement. The primary outcome was measured by the Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog) score at four and eight weeks post-baseline. Secondary measures included the Clinical Dementia Rating-Sum of Boxes (CDR-SB), the Seoul-Instrumental Activity Daily Living (S-IADL) scales, and resting-state fMRI connectivity between the hippocampus and cortical areas. Among 30 patients who completed the entire 4-week sessions, those in the rTMS group demonstrated significant improvement (i.e., reduction) in primary and secondary outcomes compared to the sham group. Furthermore, the improvement of the ADAS-Cog immediately after the 4-week sessions was associated with increased functional connectivity between the hippocampus and precuneus. These findings support using rTMS as a non-pharmacological approach to treating AD, highlighting its potential to induce beneficial

neural plasticity within the hippocampal-cortical network. Finally, using personalized 3-D printed frames represents a promising innovation that could improve the precision and efficacy of rTMS treatments, making it a viable option in clinical settings without depending on neuronavigation technology.

Topic Area: METHODS: Other

E78 - Apparent Gray Matter Loss in Early Adolescence Cannot Be Explained by White Matter Growth

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A fundamental puzzle about brain development is why the volume of gray matter (GM) apparently declines as white matter (WM) grows when children enter adolescence. The prevailing theory posits that an expanded distribution of myelin causes the inner edge of the GM to "whiten" while total brain volume remains steady, shifting the MRI-measured WM:GM boundary closer to the brain's outer surface. This theory inherently predicts that GM volume loss is concurrent with WM volume growth across regions, within sexes and over time, although these predictions have yet to be explicitly tested. In this study, we test these predictions by mapping regional GM and WM volumetric changes in 2,333 participants of the Adolescent Behavioral Cognitive Development (ABCD) study aged 9-14 years who each received three MRI scans two years apart. We show that average GM and WM volume changes follow distinct spatial, temporal, and sex-specific patterns, indicating that GM volume loss is not balanced by WM volume growth, although cortical GM thinning is weakly correlated with WM growth in some regions. We conclude that myelin is not the main source of measured GM volume loss, and we propose alternative candidates.

Topic Area: NEUROANATOMY

E79 - Cytoarchitectonic mapping and probabilistic atlas of the human claustrum

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INTRODUCTION. The claustrum is often described as the brain's most mysterious nucleus. In large part, the mystery endures because the claustrum's complex anatomy and proximity to adjacent structures make it difficult to resolve at resolutions typical of in vivo MRI. Here, we create a high-resolution, three-dimensional, probabilistic, cytoarchitectonic reference atlas of the claustrum, to advance investigation in living humans. METHODS. We mapped the claustrum according to apparent anatomy in 10 postmortem brains (5 female, ages 37-85), on Merker-stained coronal sections at 1 micron in-plane resolution (distance between sections = <1.2mm). Then, we reconstructed the claustrum in three-dimensions, and computed probabilistic maps in interoperable MRI reference spaces, at 1mm isotropic resolution. RESULTS. The high-resolution delineation, in both hemispheres, and across multiple brains, allowed a thorough characterization of the claustrum's structure, whilst underscoring the inherent difficulty of claustral investigation in vivo. We observed extraordinary heterogeneity in cytoarchitecture across the claustrum's extent, and found that the claustrum directly abuts the olfactory tubercles, amygdaloidal complex, and the piriform cortex: surpassing what is denoted by other high-resolution atlases. Our probabilistic maps revealed a high degree of intersubject variability, especially in the claustrum's ventral extension into the temporal lobe. CONCLUSIONS. Ours is the first three-dimensional cytoarchitectonic reference of the human claustrum, based on the analysis of multiple brains. Alongside advances in MRI resolution, this reference holds significant potential to illuminate claustral structure-function relationships, by reducing misattribution of function to adjacent structures. The probabilistic maps will be integrated into the Julich Brain Atlas.

Topic Area: NEUROANATOMY

E80 - Investigating the neural bases of episodic memory and navigation in children and young adults

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Cognitive maps and episodic memory are often linked, but there is no agreement regarding the nature of the overlap, if any, and whether relations wax or wane over development. We used a real-world encoding task and structural MRI to investigate how these cognitive functions are related. Participants (n = 130) were led along a staged tour where they interacted with and learned facts about 16 objects. Episodic memory was evaluated with an autobiographical free recall and a cued recognition test. Spatial memory was evaluated by testing route efficiency, judgement of relative direction (JRD), and map building. T1- and T2-weighted images were acquired from 116 participants in a 3.0T Siemens scanner. Bilateral CA1-2, DG-CA3, and Sub volumes were automatically segmented using the Bender et al. (2018) atlas, manually corrected, and adjusted for intercranial volume. Behavioral results indicate the measures of spatial and episodic memory contribute to two components, accounting for 85.6% of the total variance. Navigation measures of route efficiency and map building and memory measures of spatiotemporal details and free recall contribute strongly to the first factor. The second factor includes perceptual and event details and JRD. Although the two factors are strongly correlated ($r = .81$, $p < .001$), factor congruence analysis shows that across age, the two factors are distinct. These behavioral findings suggest that navigation and episodic memory are neither cleanly delineated nor the same construct but overlap due to shared task demands and neural substrates. Ongoing analysis explores correlations with HPC and subfields volumes.

Topic Area: NEUROANATOMY

E81 - A Novel Assessment of Musical Creativity: Behavioral and EEG Studies

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What makes a creative musician? Studies on musical creativity have traditionally focused on comparing musicians with different levels of improvisation training (e.g. western classical and jazz musicians), mainly due to ease of access in lab-based, experimentally controlled environments. Although there is much to be learned from these studies, many open questions remain about the nature of musical creativity. Here we introduce BP sequencer: an experimental interface for generating and evaluating music in the Bohlen-Pierce (BP) scale. BP sequencer yields empirical, computationally tractable data, while requiring relatively low levels of domain-specific knowledge for the user, thus lowering the barrier-to-entry for understanding creativity by making it accessible to those with minimal training. We report three experiments – two behavioral and one EEG – in which we quantify the number of sequences generated by each individual and isolate the musical-informatic features that were rated as creative. Participants showed a wide range of fluency in generating novel sequences. Sequences rated as more creative were generally longer, had more unique pitches, and had higher interval entropy. Furthermore, using electrophysiology (EEG) we quantified three distinct candidate biomarkers: frequency-tagged activity (power spectral density), intrinsic frequency-based activity (alpha), and early and late phases of time-based (ERP) activity, that together contribute to prediction and positive prediction error, both of which are central to the perception of creativity. This sequencer can provide a useful tool for assessing creative perception and cognition, and open up the theoretical link between positive prediction errors and the perception of creativity.

Topic Area: PERCEPTION & ACTION: Audition

E82 - Neurophysiological Adaptation to Hearing Amplification: Rapid Reduction of Listening Effort in Older Adults

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Understanding speech-in-noise poses a significant challenge for older adults with hearing loss, leading to increased listening effort. This increased effort can impact higher cognitive functions due to limited cognitive resources. Traditional interventions such as hearing aids face barriers such as cost, which has led to the development of accessible alternatives such as Personal Sound Amplification Products (PSAPs). The adoption of these solutions is crucial, especially considering that sustained listening effort can lead to mental fatigue and reduced cognitive performance. This study examined changes in listening effort associated with hearing amplification, focusing specifically on self-reported measures and alpha power (8-12 Hz). Twenty-seven participants, aged 60-87 years, underwent a hearing assessment, including pure-tone audiometry and the QuickSIN test. Participants engaged in a syllable discrimination task, indicating whether pairs of syllables were the same or different under three signal-to-noise ratios. Self-

reported listening effort was measured during the task, which was performed twice in two counterbalanced sessions (with and without PSAPs), while brain activity was recorded by electroencephalography (EEG). Results indicated significantly reduced self-reported effort during speech-in-noise with PSAPs. Parieto-temporal alpha power increased with signal-to-noise ratios but was mitigated (i.e., reduced) by hearing amplification. The reduction in alpha power coincided with a decrease in self-reported effort. Source localization indicated diminished activity in left auditory regions with amplification, particularly in the auditory cortex and thalamus. These findings suggest that, following a brief period of PSAP use, the brain rapidly adapts to amplification, highlighting the potential of over-the-counter devices to alleviate listening effort in older adults.

Topic Area: PERCEPTION & ACTION: Audition

E83 - A neural mechanistic model of auditory tri-stability

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The human brain effortlessly deciphers ambiguous auditory signals, resulting in multi-stable perceptions. This phenomenon is traditionally investigated via the auditory streaming paradigm, employing ABA_ triplet sequences. The prevailing body of research has focused on perceptual bi-stability. It interprets the perceptions either as a single integrated stream or as two simultaneous distinct streams. Our study extends this inquiry to include tri-stable perceptions. We collected empirical data from participants engaged in a tri-stable auditory task, utilizing this dataset to refine a neural mechanistic model that had successfully reproduced multiple features of auditory bi-stability. Remarkably, the model successfully emulated basic statistical characteristics of tri-stability without substantial modification. This model also allows us to demonstrate a parsimonious approach to account for individual variability by adjusting the parameter of either the noise level or the neural adaptation strength.

Topic Area: PERCEPTION & ACTION: Audition

E84 - GABA and Glutamate/Glutamine Concentration in Auditory Cortex Correlate with Hearing Loss in Older Participants

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Age-related hearing loss is characterized by reduced speech intelligibility in complex acoustic environments. Previous studies have reported that individual differences in levels of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) in the auditory cortex are associated with individual differences in auditory function. However, the impact of the excitatory neurotransmitter glutamate, as well as the ratio of glutamate to GABA (E/I balance), on auditory function is still unclear. In the present work, we analyzed MEGA-PRESS magnetic resonance spectroscopy (MRS) data collected as part of the Michigan Neural Distinctiveness (MiND) Study to estimate GABA and Glutamate/Glutamine (Glx) concentration in both the left and right auditory cortices of 60 young and 144 older adults. GABA and Glx were estimated in the MEGA-PRESS difference spectrum using the Gannet toolbox in MATLAB, correcting for tissue composition. Additionally, auditory performance was measured during Speech-in-Noise, Words-in-Noise, Digits-in-Noise, and Pure-Tone Threshold tasks. Linear regression analysis was applied to examine the association between GABA/Glx levels and auditory performance. We replicated previous findings that lower GABA in the right auditory cortex was associated with worse speech-in-noise performance in older adults. Further, we found that lower Glx levels in the right auditory cortex were also associated with poorer performance in all three hearing in noise measures in the older cohort, while EI balance was not correlated with auditory performance.

Topic Area: PERCEPTION & ACTION: Audition

E85 - Reduced mismatch negativity in college students with a history of mTBI

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Mild traumatic brain injury (mTBI), or concussion, is a public health concern, as ~ 2,000,000 individuals seek treatment per year in the United States alone. Cognitive symptoms of mTBI (e.g., attentional deficits, slower processing speed, and memory impairments) usually resolve within three months of injury. However, a subset of individuals experience lasting cognitive deficits, suggesting consequences persist. For example, on average, our undergraduates with a history of mTBI (>4 years post-injury) exhibited worse visual working memory performance than those without a history of mTBI. Here, to track the earliest identifiable effect of mTBI, we tested if a persistent deficit occurs in early sensory responses. Mismatch Negativity (MMN) is an event-related potential (ERP) that occurs in a pre-attentive response to deviant stimuli. Past literature reports a reduced MMN in patients with traumatic brain injury and retired athletes with repetitive mTBI history, suggesting functional abnormalities in involuntary attention. We assessed whether mTBI (average injury = 3 years ago) is associated with an attenuated auditory MMN amplitude. We collected EEG (32-channel, Biosemi) data from individuals with a history of mTBI (n=10) and individuals without a history of mTBI (n=10). During EEG recording, participants listened to standard tones (80%) and infrequent pitch-deviant tones (20%). Relative to controls, there was a significant decrease in the mTBI MMN amplitude with a large effect size (t=2.05, p=.05, d=0.92). These findings suggest sensory processing is also affected, adding to our understanding of the scope of persistent consequences after mTBI.

Topic Area: PERCEPTION & ACTION: Audition

E86 - ERP correlates of auditory peak shifts in stimulus generalization

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The peak shift effect is a widely observed phenomenon in which discrimination learning causes generalization gradients for learned responses to peak at a novel stimulus rather than a trained one. Associative theories posit that the peak shift arises from reweighting connections between stimulus representations and decision/response outputs. Non-associative representational plasticity perspectives explain the peak shift as resulting from changes in stimulus representations themselves. We investigated behavioral and event-related potential (ERP) expressions of the peak shift, the latter being used to characterize the processing stage(s) in which peak shifts arise. Stimuli consisted of 7 different frequency modulation (FM) rates ranging from “slow” (4.14, 6.9,7.2 octaves/s) to “fast” (9.52, 9.94, 16.56 octaves/s). Subjects were trained with feedback to respond “Target” for a 8.28 octaves/s FM rate and “Non-Target” to 6.9 octaves/s. Test trials using FM rates from the entire stimulus continuum were interspersed among these training trials. Analyses of "Target" responses on test trials revealed a gradual increase in peak shift as discrimination learning progressed. This was evident in more "Target" responses to a shifted 9.52 and 9.94 octaves/s FM rate than the trained target rate. Interestingly, two components of the ERP response to test stimuli appeared to parallel these changes seen in behavior: the P2 and a Late Posterior Positivity (LPP). Data is discussed in regard to what these components may mean for the processes involved in perceptual discrimination learning, and potential contributions from multiple learning processes in generating peak shifts.

Topic Area: PERCEPTION & ACTION: Audition

E87 - Event-Related Potential Differences in the Auditory Imagery of Speech and Nonspeech

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Auditory imagery, the internal experience of a sound in the absence of an external sound source, is a complex cognitive process that we use each day to relive a past event or imagine a novel sound not yet experienced. Previous research has shown that auditory imagery encodes physical properties of a stimulus, including pitch, timbre, loudness, and melody. It is also known that perceived human speech sounds are processed differently than non-speech sounds. However, it is unknown whether imagined human speech sounds are processed differently from non-speech sounds as in perception, which would have broad implications for the noninvasive detection of covert speech. To answer this question, participants were trained to associate shapes with two different types of sounds: human speech and non-speech (animal vocalizations and artificial sounds). Then, they were asked to imagine these sounds when presented with the

associated shape. Electroencephalography (EEG) data were recorded while the participants both imagined and heard the sounds. The amplitude of the late positive Event-Related Potential (ERP) complex (LPC, 350-500 ms) associated with imagery was significantly smaller for speech sounds than non-speech sounds over a right-posterior region of interest. In addition, participants' self-reported ability to control auditory imagery of speech sounds as quantified by the Bucknell Auditory Imagery Scale was significantly negatively correlated with the amplitude of the LPC for speech sounds, but this relationship did not hold for non-speech sounds. This suggests that, similarly to perception, the way in which the brain simulates speech is unique compared with other sounds.

Topic Area: PERCEPTION & ACTION: Audition

E88 - Neural underpinnings of musicians' enhanced continuity illusion for both speech and music

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The continuity illusion is an auditory phenomenon in which a sound stimulus is perceived as continuous through noise-filled interruptions. Enhanced continuity perception has been shown to be indexed neurophysiologically by reduced auditory theta (4-8 Hz) power and phase-locking as well as enhanced beta (14-30 Hz) power following interruption onsets/offsets. Using segments of classical music and trisyllabic words, we examined the behavioral and EEG responses to the continuity illusion in musicians (n =14) and non-musicians (n =16). Individuals identified whether the auditory stimuli sounded continuous or interrupted. We hypothesized that musicians' enhanced ability to detect acoustic gaps would diminish their ability to experience the continuity illusion, and in turn exhibit less aforementioned theta and beta changes than non-musicians. Contrary to our predictions, behaviorally, musicians perceived continuity significantly more than the non-musicians for music and speech equally. EEG oscillatory results indicated that musicians exhibited more suppressed theta phase-locking and spectral power to interruption boundaries than non-musicians for both music and speech. Moreover, musicians exhibited greater motor alpha power for music and speech, and stronger motor beta power for speech only, suggesting a gating mechanism of motor activation in musicians to aid the integration of noise and speech—thereby, enhancing the continuity illusion. Our findings indicate that musical training transfers to spoken language perception via neuroplastic adaptations to auditory-motor networks.

Topic Area: PERCEPTION & ACTION: Audition

E89 - Exploring encoding of Timbre Perception in EEG using Machine Learning

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Timbre is the perceptual quality of sound that is neither loudness, nor pitch. It is a critical feature that can be used to help organize the auditory environment into perceptual streams. In music, timbre can be used to perceptually segregate instruments that are playing concurrently. Perception of timbre is related to multiple acoustic cues, some of which include harmonic structure, amplitude envelope, onsets and offsets. This poses challenges in understanding how the brain processes timbre. Machine Learning offers promise by potentially classifying neurophysiological signals based on the timbre of the sound presented to the individual. To test this possibility, participants were presented with a series of brief tones that varied in timbre (trombone, clarinet, cello, piano and pure tone) while their EEG was recorded. A gradient boosting classifier was used. Different types of features were explored, ranging from raw EEG inputs to specific features such as harmonics-based spectral information, regularity-based features and ERP-based features. Using raw EEG yielded the best performance with accuracies exceeding chance by 10-20% for most participants in distinguishing between instrument responses for 5-way classification. More advanced classification algorithms or different features may be able to better distinguish between tones with a musical timbre. This research offers better understanding of how timbre processing is encoded in EEG signals and insights for the development of intelligent, BCI-based hearing aids.

Topic Area: PERCEPTION & ACTION: Audition

E90 - Anodal transcranial direct stimulation reveals causal links between the supplementary motor area and groove perception

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Why we experience 'groove', or the pleasurable feeling of 'wanting to move' to music, remains to be understood. One reason may be that groove is related to increases in motor brain activity. For example, transcranial magnetic stimulation over the primary motor cortex shows that high-groove music elicits higher corticospinal excitability than low-groove music. However, there is a lack of causal evidence that motor areas contribute to groove perception. Here we used transcranial direct current stimulation (tDCS), a causal method that modulates brain excitability in two opposite directions: anodal stimulation, which increases cortical excitability, and cathodal stimulation, which inhibits cortical excitability. We targeted the supplementary motor area (SMA), an area that fMRI studies indicate has higher activity for high-groove rhythms. Sixty subjects (anodal N = 31; cathodal N = 29) participated in two sessions, receiving active tDCS or sham while rating experienced groove and pleasure to 40 drum sequences from the Lucerne Groove Research Library. We predicted that anodal tDCS would increase groove ratings, while cathodal tDCS would decrease them relative to sham stimulation. As expected, anodal stimulation increased groove ratings when compared to sham, but no effect of cathodal stimulation was found. Thus, the results support that the SMA plays a role in groove perception—greater SMA excitability leads to greater experience of groove. Further research could examine whether SMA stimulation selectively alters groove, or concomitantly alters the perception of other musical features.

Topic Area: PERCEPTION & ACTION: Audition

E91 - The interactions of spatial and pitch cues in auditory scene analysis

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The human auditory system can decompose complex sound mixtures into distinct perceptual auditory objects through a process known as Auditory Scene Analysis (ASA). Pitch and spatial cues are among sound properties known to influence sequential grouping (Plack, 2018). The impact of pitch in ASA has been well characterized using Van Noorden's (1975) ABA paradigm, in which two streams of tones, 'A' and 'B' are interleaved, and the factors contributing to perceptual segregation of the two streams (including pitch) are explored. Here, we manipulate pitch and spatially displace the A and B sequence sources to understand how spatial and pitch cues trade off in perceptual organization. We used a 91-channel geodesic dome (radius 1.65m) loudspeaker array with 9th-order ambisonic rendering (Sonible, Austria) in a sound-attenuating room. Participants sat in complete darkness with heads at the center, ears at 0 elevation, and eyes fixated on an LED at 0 azimuth. Trials featured 32 repetitions of ABA triplets (A: 125ms, 400 Hz; B:125ms, >= 400 Hz; 125ms inter-triplet interval; 16-sec overall). A and B streams were presented symmetrically on the horizontal plane, and listeners reported segregation/integration via keypresses (Cusack et al., 2004). We first used adaptive testing to create, for each listener, a two-dimensional (space and pitch), 49-coordinate psychophysical space. Then, each coordinate was tested 10 times, measuring the proportion of time streams were segregated. Our results suggest that small spatial separations promote segregation but apparent weightings of the two dimensions in determining segregation vary substantially between individuals.

Topic Area: PERCEPTION & ACTION: Audition

E92 - Influence of social and semantic context in processing speech in noise.

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Social interactions occupy a substantial part of our life. Not only interacting in first person, but also listening to others' interactions is critical in understanding our social world. Although the role of semantics in speech comprehension has been studied, the role of social context, and its interaction with semantics, remain unknown. We conducted a series of four perceptual experiments to better understand the processing of multiple-speaker conversations from a third-person viewpoint, manipulating the social and semantic context of a conversation. We used a stimulus set consisting of two-speaker dialogues or one-speaker monologues (factor: social context) arranged in intact or sentence-scrambled order (factor: semantic context). Each stimuli comprised five sentences, with the fifth sentence embedded in multi-talker babbling noise. This fifth sentence was subsequently repeated without noise, with a single word altered or

unchanged. Stimuli were presented over headphones to healthy young adult listeners, who were asked whether the repeated sentence was same as or different from the previous in-noise sentence. Overall, we found significant effects for both social and semantic contexts when processing a conversation. We also found a negative correlation between a measure of autistic traits and individual performances only when processing a dialogue. Our findings highlight that both semantic and social aspects of a conversation can modulate the processing of conversations. They also suggest that processing dialogues, but not monologues, is linked to individual social abilities. These results raise new questions regarding predictive or other mechanisms that may be at play when perceiving speech in social contexts.

Topic Area: PERCEPTION & ACTION: Audition

E93 - An fMRI Study of Music Listening for Mild Cognitive Impairment: Effects of Liking, Familiarity, and Self-Selection

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Music-based interventions for healthy aging rely on the idea that listening to pleasurable music engages auditory and reward systems; however, this result has not yet been observed in cognitively impaired older adults. Here we tested older adults with mild cognitive impairment (MCI) in a music listening fMRI task. Twelve older adults (aged 54-87), who scored 0.5 or above on the Clinical Dementia Rating scale, listened to self-selected and researcher-selected musical excerpts and rated them on a four-point liking and familiarity scale during fMRI. Main effects of listening showed activation in auditory network including Heschl's Gyrus (HG) and superior temporal gyrus (STG). Self-selected music and music rated as "loved" and "very familiar" additionally activated hippocampus and parahippocampal gyrus, and medial prefrontal cortex. A self>other-selected music contrast showed significant effects in HG, STG, planum temporale, and right planum polare, as well as posterior cingulate, amygdala, and right temporal pole. Contrasting loved>hated music showed significant effects in the aforementioned auditory regions, motor regions (bilateral precentral gyri), and default mode network (paracingulate gyrus, precuneus). Linear contrast of familiarity ratings showed significant effects in the auditory network including bilateral STG, right middle temporal gyrus, and left planum polare, and regions important for memory including left parahippocampal gyrus, left temporal pole, and right orbitofrontal cortex. Results suggest that preferred and familiar music engages memory and emotion processing systems, and extend previously-observed effects of music listening towards MCI, thus serving as a baseline for music-based interventions in this population.

Topic Area: PERCEPTION & ACTION: Audition

E94 - Hey, I thought I was right!: Neural correlates of unexpected feedback on a simple perceptual task

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How do people process feedback that violates their expectations? Many electroencephalography (EEG) studies have examined error processing with performance feedback, but no studies to our knowledge have examined how feedback that is incongruent with one's expectations is processed. To this end, our study used an auditory delayed match-to-sample task during EEG recording. On each trial, two different pure tones (selected from frequencies of 400, 450, and 570 Hz) were presented in sequential pairs, and young adult subjects (n = 15) indicated whether the latter tone in each pair was higher or lower-pitched than the first tone. Visual response feedback consisted of on-screen text utilizing a novel half-congruent (true feedback), half-incongruent (deceptive feedback; i.e., "incorrect" when the response was actually correct) design. We hypothesized that feedback-related surprise on incongruent feedback trials would affect event-related potential (ERP) amplitude, relative to trials with congruent feedback. Event-related potentials (ERPs) were time-locked to feedback onset and contrasted between congruent and incongruent feedback trials using cluster-based permutation tests. We observed a significantly stronger fronto-central negativity occurring around 300-400 ms for the incongruent, relative to congruent, feedback trials. This ERP modulation is consistent with the feedback-related negativity (FRN), an ERP associated with reward prediction error processing. Despite the feedback's visual nature, the scalp topography suggests an auditory source. We conclude that this auditory FRN reflects participants' mental replay of the auditory stimuli, in order to retroactively "repair" auditory representations according to the feedback.

Topic Area: PERCEPTION & ACTION: Audition

E95 - An intracranial EEG study on auditory deviance detection.

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The neural network underlying human auditory deviance detection is not fully understood. To address this, we recorded SEEG from 31 adult patients with drug-resistant epilepsy who had depth electrodes implanted in all brain lobes. The local Research Ethics Committee approved the study, and patients gave informed written consent to participate. Patients passively heard a stream of bilaterally presented tones while reading. We used the Optimum-1 paradigm [1], which consisted of 300 standard tones interleaved with 300 randomly presented deviant tones per block (3 to 10 blocks per patient). Deviant tones differed from standards in: 1) intensity (louder or softer), 2) frequency (higher or lower), 3) sound source location (right or left), 4) shorter duration, or 5) silent gap in the middle. Electrode coordinates were obtained from MRI and CT images using the iElectrodes toolbox. Non-epileptic channels were bipolar referenced (n=2041), and ERPs (0.1-30 Hz) and high-frequency band activity (HFA, 75-145 Hz) were extracted. Significant ERP responses to tones compared to the baseline period were observed primarily in temporal and insular areas, and also included the hippocampus, amygdala, and frontal, parietal, and cingulate cortices (1238 channels, FDR corrected). Deviance detection channels (409 channels, cluster-based permutation statistics) primarily showed in temporal, insular, pericentral, and prefrontal cortices, among other regions. HFA responses showed a similar profile but in a reduced proportion of channels. Our results show the spatiotemporal dynamics of a distributed brain network supporting auditory processing and deviance detection. [1] Näätänen et al., 2004, DOI:10.1016/j.clinph.2003.04.001.

Topic Area: PERCEPTION & ACTION: Audition

E96 - Development of Excitation-Inhibition Balance Predicts Speech Processing Abilities

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Sensory processing relies on the interaction of excitatory and inhibitory neuronal circuits. In healthy brains, excitation and inhibition are in check, a state termed E/I-balance. As a result, cortical excitation in response to stimuli is followed by proportional inhibition. Here, we test the relevance of the development of E/I-balance for speech processing, reanalyzing a large openly accessible electroencephalography data set. To include a maximal range of E/I-balance, we include data from both typical children and autistic children, for which prior work has observed E/I-imbalance. We examined the relationship between E/I-balance and auditory processing of naturalistic speech for a final sample of 64 non-autistic children matched by age, sex, and nonverbal-IQ to 58 autistic children between 6 and 17 years of age. We employed a recently introduced functional measure of E/I-balance based on alpha oscillations and long-range temporal correlations in resting-state EEG. Auditory speech processing was quantified through EEG encoding models using the speech spectrogram as predictor. We observed significant prediction accuracies to the spectral TRF model for both non-autistic and autistic groups ($p<.001$). We also found a significant relationship between the developmental trajectory of E/I-balance and speech processing abilities ($p=.048$). Specifically, better neural processing of speech was related to balanced E/I across childhood. In contrast, lower speech processing was linked to increased excitation and thus E/I-imbalance in older children. Our results provide evidence for a relationship between E/I-balance and auditory–sensory speech processing, highlighting the potential vulnerability of speech processing in autistic children to an E/I-imbalance compared to their non-autistic counterparts.

Topic Area: PERCEPTION & ACTION: Audition

E97 - Spatiotemporal dynamics of spontaneous tau-rhythms in human temporal cortex

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Human electrophysiological activity displays intricate oscillations, with the most prominent rhythmic activity manifesting in the alpha-band (8–13 Hz). While the organization of alpha-band rhythms in occipital and sensorimotor cortex has been extensively studied, this is not the case for tau-rhythms, the rhythms in the alpha-band in the temporal cortex. On the hypothesis that these rhythms are basic building blocks for processing functions that are reused across separate sensory domains, tau-rhythms are important to understand for auditory and speech processing. However, this requires a careful differentiation of tau-rhythms from rhythmic or evoked activity in the theta- and delta-bands and an in-depth description of its spatiotemporal dynamics. Here we investigate dynamics and generators of tau-rhythms using high-resolution invasive electrophysiological data. A large dataset, encompassing both subdural grid as well as stereotactically placed depth electrodes, was analyzed to delineate alpha-rhythm generators. We identified rhythms with independent amplitude in the alpha-band, and mapped them to cortical and subcortical regions. Focusing on tau-rhythms in the temporal cortex, we found several independent oscillatory sources for selected individual participants, with differential spatial spread across the temporal cortex and event-related desynchronization to sound. Next, we explored generative models of these rhythms using leadfield simulations, considering the possibility of traveling waves or separate oscillatory sources. We characterized the human tau-rhythm, identifying several oscillatory sources within temporal cortex. The findings contribute to the understanding of the family of different alpha-band rhythms and provide a necessary foundation for future investigation into the functional significance of tau-rhythms in perceptual processing.

Topic Area: PERCEPTION & ACTION: Audition

E98 - Eyes tap to beats: Proactive sensing in music listening

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Listening to music is an active, anticipatory process involving the brain and body's synchronization with rhythms to facilitate the processing of musical stimuli. Although the motor system's role in this process has been acknowledged, its specific contribution remains to be fully elucidated. Through a series of experiments, which included behavioral analysis, eye tracking, and electroencephalogram (EEG) assessments, we identified a novel phenomenon termed 'eye tapping.' This reflexive synchronization of involuntary eye blinks with musical beats mirrors the well-known action of finger tapping. Remarkably, such synchronization persists even without melody, and correlates with the detection accuracy of on-beat overtones, indicating that 'eye tapping' may play a part in attentional sampling and processing at crucial moments within the music. Our study also revealed a significant mutual information between the timing of eye blinks and the power of neural oscillations at the beat's frequency. Additionally, we observed a predictive increase in the weight of the EEG's temporal response function preceding an eye blink. These findings align with both the Dynamic Attending Theory and Active Sensing Theory, suggesting that eye blinks not only coincide with neural entrainment but also conform to temporal structures shaped by musical rhythms, thereby assisting in the temporal prediction and processing of musical events. This research significantly advances our understanding of proactive, cross-modal sensing during music listening, highlighting the intricate interplay between auditory perception and motor responses.

Topic Area: PERCEPTION & ACTION: Audition

E99 - From Lab to Concert Hall: Live Performance Effects on Acoustic-EEG Phase Locking

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Experiencing a live musical performance is an immersive activity that can be enhanced in many ways relative to listening to recorded music, but little is known about how the experience of liveness itself affects neural entrainment. This project provides unique insight into EEG-audio stimulus tracking in a live performance setting. We tested whether the liveness of a performance, as measured by the difference between live and recorded performance conditions, affects acoustic-EEG phase-locking. 21 participants from the New England Conservatory (NEC) community listened to recorded and live performances of four solo violin excerpts performed by renowned violinist Joshua Brown at NEC's Pierce Hall, including 2 live and 2 recorded performance trials presented in counterbalanced order. After each trial, participants gave ratings of engagement, spontaneity, pleasure, and distraction. Significantly higher ratings of engagement, spontaneity, and pleasure were observed for the live vs. recorded trials. Acoustic-EEG phase locking was significantly higher during live than recorded conditions at low-frequency, delta-band frequency ranges: 0.6-2 Hz and 2.6-4 Hz. Since the lower frequency-range corresponds to the beat rate whereas the higher range corresponds to the note rate, results suggest stronger neural entrainment to beat and note-event levels during live performance. Ongoing analyses will link phase-locking values to trial-by-trial ratings, thus relating specific frequencies of EEG-audio stimulus tracking to fluctuations in pleasure, engagement, and the perception of spontaneity in live performances. Results point to a neural entrainment-based account of what makes the experience of live music rewarding.

Topic Area: PERCEPTION & ACTION: Audition

E100 - Effects of Learning on Neural Representations of Rhythm and Beat

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Listening to rhythmic sounds elicits activity in the basal ganglia, cerebellum, and motor cortices, including supplementary motor area and premotor cortex. Rhythms with musical structure that give rise to a steady underlying pulse, or 'beat', elicit increased activity in the SMA and basal ganglia, suggesting these areas are involved in beat perception. However, because people hear music regularly, rhythms eliciting a strong beat are necessarily more predictable than amusical, irregularly-timed rhythms that are often used as control stimuli. Thus, neural correlates of beat perception may be confounded by the relative experience-driven predictability of strong-beat rhythms. To address this confound, we will equalize the predictability of a subset of rhythms that vary in beat strength, and measure BOLD activity associated with the rhythms before and after predictability is equalized. Across 4 sessions, participants train on 12 unique rhythms (4 strong-beat, 4 weak-beat, and 4 non-beat) in finger-tapping tasks. In pre- and post-training fMRI sessions, we measure BOLD responses while participants listen to the rhythms during a rhythm discrimination task. Brain regions that are truly sensitive to the beat will maintain activity differences between beat strength conditions in both pre- and post-training scans. However, predictability-sensitive regions will show no difference between beat strength conditions in the post-training scan only, as all rhythms will be equally predictable. Data collection is currently ongoing (~15% of sample collected), preliminary results will be presented.

Topic Area: PERCEPTION & ACTION: Audition

E101 - Testing Effects of Theta-Band Amplitude Modulation on Attention and Working Memory

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Musical sounds contain modulations in amplitude and frequency. The human brain's ability to interpret music depends on neuronal oscillations in multiple frequency ranges including the theta-band (4-8 Hz), which underlies cognition and behavior. We tested whether modulating theta-band amplitude of music could affect brain activity in fMRI during a working memory task and a sustained attention task. Amplitude modulation was applied to each of 32 familiar song stimuli by varying the amplitude of the song's volume at a frequency within the theta-band that is an integer multiple of the song's tempo in Hertz. Participants completed the SART attention task and the n-back working memory task while listening to modulated and unmodulated music (counterbalanced), either online or in-person looking at brain activity with fMRI. In a second-level analysis of the first 12 fMRI subjects, increased brain activity is observed for the modulated>unmodulated contrast in bilateral superior temporal gyri and left insula for the SART, and in the supplementary motor area and dorsal and ventral striatum for the n-back task. These areas correspond to the auditory network, the reward system, and systems involved in rhythm perception. As music stimulates multiple areas of the brain, and theta-band activity in the brain is associated with cognitive functions including attention and working memory, applying these amplitude modulations to music may be

useful as subtle forms of brain stimulation that may in turn impact how music can change cognition and behavior.

Topic Area: PERCEPTION & ACTION: Audition

E102 - Stimulus interference and oscillatory EEG feature relationships with auditory working memory fidelity

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Auditory working memory studies have begun to employ method of adjustment paradigms where participants reproduce sounds in real-time to match their memory of presented items. This has given researchers a better picture of auditory working memory fidelity than one-shot paradigms (e.g., same-different). In two studies (behavioral, EEG), we assessed the impacts of stimulus interference during retention on the fidelity of pitch memories. In experiment 1, participants heard a target tone having a randomly selected fundamental frequency (f0) followed by interference signals (4 s), and then an opportunity to match the target f0. Interference could be in the form of target similar tones, white noise, or silence. Interference type significantly impacting auditory working memory fidelity, with tone interference causing the greatest impairments to matching accuracy and precision. In Experiment 2, we recorded high-density EEG (128 channels) during performance of the same task with tone interference only. Preliminary analyses suggest that auditory working memory fidelity is related to the phase of prestimulus tau rhythm oscillations and the power of frontal theta oscillations during retention. Results are discussed in the context of "slot" and "resource" models of auditory working memory, and the role that oscillations may play in ongoing working memory processes

Topic Area: PERCEPTION & ACTION: Audition

E103 - Cortical envelope-tracking of speech and music using electroencephalography

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Speech and music are two of the most uniquely human cognitive functions, featuring complex temporal dynamics that are reflected in brain electrical activity. Phase-tracking of the acoustic envelope of speech in the 5-Hz theta band of the electroencephalography (EEG) (and magnetoencephalography (MEG)) is believed to correspond to the 5-Hz syllable rate of speech (Luo and Poeppel, 2007). Less is known about envelope tracking in music, which might be very different from speech because of differences in the number and complexity of component envelopes (Doelling and Poeppel, 2015; Harding et al., 2019). Whereas a single talker presents a single envelope to the listener, polyphonic music (i.e., with melody and harmony) is intentionally a coherent mixture of several envelopes. We investigated the cortical tracking of speech and music by recording brain electrical activity using EEG while participants listened to speech, monophonic music, or polyphonic music. Envelope tracking was measured by cross-correlating the absolute value of the Hilbert transform of the audio envelope with the low-pass filtered EEG signal for each stimulus presentation. Results indicate that music shows a stronger tracking than speech, consistent with the findings of Harding et al. (2019). However, the pronounced tracking of music was driven by the monophonic stimuli. We hypothesize that monophonic music presents a single envelope, similar to speech, but at a more consistent rate and with more stationarity than speech, resulting in stronger tracking.

Topic Area: PERCEPTION & ACTION: Audition

E104 - The effect of voice identity training on speech understanding in noise

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Noisy environments make it difficult to understand speech, but familiar voices such as those of a spouse are more intelligible than novel voices in noise. Listeners can even be trained to become familiar with voices in the lab. However, it is unclear what sort of training is necessary to achieve this familiar voice benefit. We hypothesized that the more listeners were trained to associate the talkers' voices with unique personhood, the more intelligible these voices would become in noise. To test this hypothesis, we recruited 240 participants online via Prolific and assigned them to three groups. In the Control group, participants listened to one hour of sentences spoken by two unfamiliar talkers and completed a semantic judgement task. In the Identity group, participants instead judged which of two possible talkers had spoken each sentence. Finally, in the Bio group, they completed the same task as the Identity group but were also given photos and biographies for the talkers. After training, participants in all groups completed a speech intelligibility task with sentences spoken by trained and novel voices, presented against two levels of background noise. We found that trained voices were more intelligible than novel voices overall. The benefit from training was greater at the more favourable background noise level. However, this benefit did not vary between groups. This suggests, despite our hypothesis, that the familiar voice benefit is not supported by talker personhood. More general mechanisms, arising from simple exposure to or engagement with the voices, must instead be considered.

Topic Area: PERCEPTION & ACTION: Audition

E105 - Auditory hyper-reactivity and gating across development in autism

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Background: Autism has been historically defined by difficulties in social communication, restricted and repeated behaviors and interests, and motor stereotypies. Autistic people also exhibit sensory processing disruptions that have been shown to contribute to these core symptoms. Sensory issues, such as hyper-reactivity and sensory gating, are characterized clinically by parent questionnaires. However, behavioural measures of them are available in laboratory settings. One promising method to study sensory issues in autism is the acoustic startle response. The acoustic startle response is a reflexive muscular contraction to a sudden loud sound. It is a measure of acoustic reactivity. In addition, the modulation of the startle response by a quieter pre-pulse that precedes the louder pulse is referred to as pre-pulse inhibition which is a measure of sensory gating. Objective: The objective of this study is to use an acoustic startle paradigm to examine sensory reactivity and sensory gating differences in autism across development. Methods: Autistic (n=26) and non-autistic (n=43) children and adults completed an auditory startle task to assess the acoustic startle response and pre-pulse inhibition. Results: There was a main effect of reactivity $F(1, 61)= 5.37$ $p=0.024$ and no interaction with age. There was no group difference in pre-pulse inhibition. Conclusion: Autistic participants presented with hyper-reactivity as assessed by the startle response. However, they did not have any difficulties in sensory gating as measured by pre-pulse inhibition. The neural pathways involved in both theses processes are well-established. Therefore, this study narrows down the possible pathways involved with sensory disruptions in autism.

Topic Area: PERCEPTION & ACTION: Audition

E106 - Neural and behavioral dynamics of timing processing in subcortical lesion patients

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The capacities to encode the precise timing of sensory events, and to time our own (re-)actions are pivotal to act and adapt to a dynamically changing environment. The basal ganglia (BG) and the cerebellum (CE) are part of a cortico-subcortical network engaged in timing and rhythm processing. While the CE encodes the precise timing of sensory stimuli, the BG generates temporal predictions. What happens when either of these two brain regions are lesioned? In this study, we recruited healthy controls (HC) and stroke patients with lesions in either the BG or CE. After delineating patient's lesion locations upon their anatomical MRIs, we individually quantified the lesion extension and the group-level overlap. Next, we combined evidence from an EEG and behavioral experiment to investigate the causal role of BG and CE in the sensory and sensorimotor mechanisms of temporal processing. In a tapping synchronization task, participants were asked to tap along with temporally regular auditory sequences presented at three increasing speeds. In the EEG experiment, participants passively listened to isochronous auditory sequences. Comprehensive within- and between-group analyses assessed individual and trial-level neural and tapping dynamics while processing and synchronizing with the temporal regularity in auditory streams. For both data we

characterized instantaneous frequency, acceleration, stability, phase coherence and entropy. Combined results from the EEG and the behavioral experiments demonstrated that BG and CE lesions causally impacted the precise neurophysiological encoding of the rhythm and further affected the abilities to produce and synchronize behavior to temporally regular stimuli.

Topic Area: PERCEPTION & ACTION: Audition

E107 - Multi-level reorganization in the temporal dynamics of sound processing in early blind people

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Early blindness triggers reorganization in brain networks that code for sound processing. How visual deprivation impacts the temporal dynamics of different stages of auditory discrimination (acoustic to categorical coding) remains unexplored. We used electroencephalography (EEG) to characterize the time course of brain representation elicited by sounds belonging to eight categories in congenitally blind (CB) and sighted individuals (SC). Multivariate decoding analyses revealed enhanced sound decoding in CB from ~160 to 1000ms after sound onset. Classifier weights transformed and projected on the sensors were enhanced in CB with the topography evolving along a fronto-posterior axis as the sound unfolded in time. To investigate which formats of sound processing were enhanced in CB, we used representational similarity analysis (RSA) with different sound models: (I) Modulation Transfer Function (MTF) simulating early stage of acoustic processing, (ii) layers of a deep neural network (DNN-YAMNET), (iii) models based on categorical membership of sounds and participant specific similarity ratings of each sound pairs. MTF model peaked at ~200ms in the EEG of each group, with no differences between the two populations. Correlations between brain activity and specific DNN layers were enhanced in CB at ~200ms and sound offset likely representing modulations in intermediate acoustic processing. Categorical representation of sounds emerged at ~250ms in both groups, with CB showing an enhanced representation peaking at ~550ms. These results suggest that early blindness triggers a multi-level reorganization in brain networks coding for sounds, with enhanced intermediate-level acoustic discrimination earlier in time, followed by an increased categorical coding of sounds.

Topic Area: PERCEPTION & ACTION: Audition

E108 - Exploring the effect of coloured background noise on auditory discomfort in people with post-traumatic stress disorder

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People with post-traumatic stress disorder (PTSD) often experience auditory sensitivity such as hyperacusis, misphonia, and an enhanced auditory startle reflex. Sound masking with coloured noise has been studied for its therapeutic potential in several settings and populations, but to date has not been explored in people with PTSD. This study seeks to understand whether background exposure to coloured noise can i) improve auditory discomfort; and ii) reduce auditory startle reflex in people with PTSD. Using a mixed design, auditory oddball paradigm, this study will compare people with PTSD who have auditory symptoms with healthy controls recruited from a community sample. The first part of this experiment will compare comfort across white, brown, and pink noise conditions. In the second experiment, while holding visual fixation constant, participants will be exposed to each coloured noise condition while listening to a series of pure tones. For each experiment, changes in baseline heart rate response, skin conductance, and subjective measures will be compared to assess auditory discomfort and startle reflex . It is predicted that compared to healthy controls, those with PTSD will experience greater improvements in auditory comfort and reductions in auditory startle reflex. The results of this study have potential to improve our understanding of how people with PTSD differ in their perception of sounds across frequency spectra. This work can set the stage for further investigation into potential auditory therapies for PTSD.

Topic Area: PERCEPTION & ACTION: Audition

E109 - Migraine, Lifestyle, Cognition, and Psychological Health Factors: A Population-Based Cross-Sectional Study Examining Findings from the CLSA

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Migraine is a neurological disorder, affecting 8.3% of the Canadian population. Our study investigated differences between aging Canadian migraineurs and non-migraineurs with respect to their lifestyle choices, cognitive abilities, psychological well-being, and general health factors. While previous migraine research focused on ages 18-40, our population-based cross-sectional study concentrated on participants over the age of 45. We utilized secondary data collected by the Canadian Longitudinal Study on Aging (CLSA), which encompassed two cohorts: Comprehensive cohort (n-migraine=3,736, n-non-migraine=22,974 with 14.0% migraineurs) and Tracking cohort (n-migraine=2,270, n-non-migraine=14,759 with 13.3% migraineurs). Our results indicated that migraineurs had a significantly lower level of physical activity (regarding frequency, duration, and intensity), higher nutritional risk, worse sleep (concerning quality, duration, and latency), higher psychological distress, and lower satisfaction with life as compared to controls. Migraineurs perceived their memory as declining and worried about that decline, yet results displayed no significant difference in migraineurs and non-migraineurs memory. Our results confirmed migraineurs rated their physical, mental, and oral health lower than non-migraineurs, and reported a higher intensity of pain and discomfort resulting in a higher frequency of missed activities with significantly higher functional impairment scores. Aligning with migraine comorbidities, the migraineurs demonstrated an increased prevalence of anxiety disorders, mood disorders, depression, and epilepsy. Understanding the inherent differences between aging migraineurs and non-migraineurs is essential for a complete depiction of this disorder throughout the lifespan. These findings will allow researchers and clinicians to target their exploration and treatments on improving the quality of migraineurs lives and promotion of healthy aging.

Topic Area: PERCEPTION & ACTION: Development & aging

E110 - Plasticity of visuoconstructional skills: Children with late vision onset learn to reproduce spatial patterns but show some persistent impairments.

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Visuospatial construction refers to the ability to spatially organize individual components into a whole. This skill relies on the integration of multiple cognitive systems, including visuospatial processing, motor planning, and executive functioning. While many assessments characterize the nature of these skills and observed impairments, little is known about the fundamental contribution of early visual experience in acquiring visuoconstructional skills. Here, we describe our work with children born with treatable blindness and left untreated for several years until they are identified and provided with sight-correcting cataract-removal treatment by our team at Project Prakash. To investigate the role of early- versus late-onset visual experience for acquiring visuoconstructional skill, we designed a set of tasks involving matching and reconstructing 2D patterns of colored M&M candies. By assessing children's performance before sight-onset and at multiple timepoints thereafter, we were able to perform within subject longitudinal analysis of this skill acquisition as a function of increased visual experience. Performance changes were quantified using Procrustes-based performance scores and characterization of strategy. Our data reveal that some aspects of visuoconstructional skill develop immediately after treatment, requiring only the onset of vision but no visual experience. However, other aspects of this skill, such as capturing overall form and proportions, emerge only months or years after treatment, thus requiring both vision and extensive visual experience. Overall, late vision onset seems to lead to an over-reliance on local or piecemeal relations while delaying or even omitting the ability to capture and reproduce the global form of a pattern.

Topic Area: PERCEPTION & ACTION: Development & aging

E111 - Music training mitigates age-related changes in mismatch negativity and precision in auditory memory

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Musical training is associated with enhanced auditory perception and domain-general cognitive abilities. Research has demonstrated cognitive advantages from musical engagement, (e.g., inhibitory control) present throughout the lifespan, but whether this applies to perception in older age is unclear. We investigated if and how music training enhances precision in perception in 26 older amateur and professional musicians (62–85 years, 13 females) and 25 older non-musicians (61–82 years, 16 females). Participants were administered a novel paradigm of auditory mnemonic discrimination while electroencephalography was recorded. The mismatch negativity (MMN), an event-related potential of change detection, was measured using a passive auditory oddball paradigm with standard and deviant pure-tone sequences differing in pitch contour. After exposure, all participants completed an incidental memory test for targets amongst similar lure sequences (matched for frequency but differing in contour) and dissimilar foil sequences (differing in frequency and contour). Compared to non-musicians, musicians showed enhanced MMN amplitudes and better memory discriminability for targets compared to lures and foils. Findings suggest better precision in perception and auditory memory performance in older adult musicians as compared to non-musicians. Given age-related declines in both perception and memory, findings suggest contributions of musical engagement to cognitive reserve in support of healthy neurocognitive aging. Future research is necessary to examine the causal mechanisms of perceptual and cognitive benefits associated with music training.

Topic Area: PERCEPTION & ACTION: Development & aging

E112 - Age-related changes in auditory cortical responses: interactions between pitch, background noise, pure-tone thresholds, and lifetime noise exposure

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Decline of hearing abilities in older adults is nearly universal and is due to changes in both the peripheral encoding and central processing of acoustic information. It is well known that noise exposure can negatively impact peripheral encoding of acoustic information, but the impact of noise exposure on central processing of acoustic information is less well understood. To explore this putative connection, older and younger adults were given a comprehensive lifetime noise exposure questionnaire, and an assessment of pure-tone audiometry. We found that pure tone audiometry correlated with noise exposure, but more so with age. We also used EEG to measure cortical responses to a pure tone (1, 4, or 8 kHz) in varying amount of white noise (No Noise, Quiet Noise [35 dB SNR], Loud Noise [10 dB SNR]). As expected, N1 and P2 were larger in older adults compared to younger adults for 1 kHz tones; however, N1 was similar in both groups for 4 kHz and 8 kHz tones. Interestingly, the N1 for 1 kHz tones was predicted by age, while N1 for 4 and 8 kHz tones was predicted by pure tone thresholds. P2 amplitude was similar between groups for all tones in noise. Pure-tone thresholds for 8 kHz tones were predictive of the P2 amplitude for 8 kHz tones, while age predicted P2 for 1 kHz tones. Although noise exposure correlated with pure tone audiometry, it did not explain cortical responses as well as hearing thresholds or age.

Topic Area: PERCEPTION & ACTION: Development & aging

E113 - Age-related Changes in Neural Synchronization with Naturalistic Music

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Hearing abilities tend to decline as people age. While a substantial body of prior research has focused on how older adults process and comprehend speech, less attention has been devoted to how older adults encode and perceive naturalistic music. This research gap can be attributed, in part, to the inherent intricacies of the music encountered in everyday life, making it a challenging stimulus to effectively control in laboratory studies. In this study, we investigated whether neural synchronization to different musical features in naturalistic music differs between younger and older adults. Participants from both age groups (37 younger and 38 older adults) were asked to attentively listen to the music stimuli, while Electroencephalography (EEG) signals were recorded. Neural synchronization was characterized by the temporal response function (TRF) - a modeling technique that establishes the relationship between the brain response and acoustic features of auditory stimuli. Our results showed that the musical feature 'spectral flux' - a measure of the dynamics of a signal's power spectrum - drove the strongest neural synchronization in both age groups. Interestingly, older participants exhibited overall larger neural synchronization, yet the sensitivity of the synchronization is notably weaker to changes in musical tempo. Our findings align with previous research on the hyperactivity phenomenon, suggesting that older participants may exhibit enhanced sensitivity to variations in amplitude. Despite this age-related hyperactivity, sensitivity to musical tempo was reduced, suggesting that encoding of music is changed in various ways in older adulthood.

Topic Area: PERCEPTION & ACTION: Development & aging

E114 - Associations of oddity discrimination task accuracy with perirhinal cortex volume in a multi-ethnic cohort of older adults

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Alzheimer's disease (AD) neuropathologies (i.e., beta-amyloid, tau) begin to accumulate decades before cognitive symptoms appear. The perirhinal cortex (PRC) is among the earliest brain regions to develop tau. Cognitive tests sensitive to this region could identify individuals at high risk of AD dementia. Tests that minimize language demands and cultural biases are important given North America's increasing diversity. We investigated whether lower accuracy on an oddity discrimination task predicts reduced PRC volume in ethnically-diverse older adults. This task was chosen given minimal language demands and findings of impaired object discrimination in patients with PRC damage. N=69 adults without dementia (mean age=67.1 years; 66.7% female; 46.4% South Asian; 26.1% East Asian; 23.2% White; 4.3% other ethnicity) from the Canadian Multi-Ethnic Research on Aging (CAMERA) study completed an oddity discrimination task with 3 conditions: familiar objects, unfamiliar objects, and size control. Participants underwent brain MRI, including a high-resolution T2-weighted scan of the medial temporal lobes (MTL). We used the Automatic Segmentation of Hippocampal Subfields pipeline to segment the MTL. Linear models demonstrated a significant association between smaller PRC volume and lower accuracy on the unfamiliar condition (β=0.46, p=.03), but not familiar (β=0.30, p=.22) or size conditions (β= 0.05, p=.83), controlling for age, sex, education, total intracranial volume, and Montreal Cognitive Assessment score. These findings suggest that difficulties discriminating among unfamiliar objects might indicate reduced PRC integrity in a diverse cohort. Future work will examine associations between oddity discrimination and plasma p-tau to confirm whether this task is sensitive to elevated AD risk.

Topic Area: PERCEPTION & ACTION: Development & aging

E115 - Exploring the Dynamics of Eye Movement: How Fixations Affec Facial Recognition in Younger and Older Adults

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Information about different facial features is distributed across various regions of the face. The eye region is especially informative for identity perception, but preferences vary among individuals, with some focusing on the eyes and others on the nose. Notably, fixation patterns differ between age groups: older adults tend to focus more on the lower half of the face, while younger adults show enhanced identity perception when their fixation is restricted to the eyes. This study investigates where younger and older adults look on faces and whether focusing on specific facial regions improves face recognition performance. The study aims to compare the fixation locations of younger and older observers and examine how restricted fixation location interacts with age. In each trial, participants were first shown a fixation square, followed by a target face and a face selection task. The off-face condition started with a fixation square outside the anticipated face display area, while the on-face condition began with a square on the forehead, eye, nose, or mouth. The preliminary analysis included 20 younger and 20 older adults, revealing age-related differences in both conditions. Restricting fixation location appears to mitigate these age-related differences, with older adults showing improved performance, especially at the eye and nose locations. Interestingly, an age-related difference emerged at the nose location, where older adults benefited more from nose fixation than younger adults. Overall, both age groups exhibited better face perception performance when initial fixation was directed to the eye and nose regions.

Topic Area: PERCEPTION & ACTION: Development & aging

E116 - Directionality distinguishes pictures from their referents in 7-9 months old infants

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Seven-month-old infants discriminate between pictures of objects and their referents as has been shown with habituation-dishabituation experiments and also manifests as preferential looking at real objects. Gerhard et al. (2016) presented infants with both a toy and a picture of that same toy. Both during first presentation and after habituation, infants preferred to look at the real objects. What are the visual cues infants use for that discrimination? Motivated by research on adult observers that demonstrate the significance of motion parallax over other depth cues to achieve a sense of presence and place (Wang & Troje, 2023), we tested the hypothesis that motion parallax alone is sufficient to cause preferential looking in infants. Using the same toys as employed by Gerhard et al. we tested three groups of 20 seven-to-eight-months-old infants. Stimulus pairs represented the three possible combinations of the following three displays types: (a) the real 3D toy; (b) a realistic picture of the same toy presented on a 13" iPad screen; (c) the same rendering displayed using MPDepth, a technique that adds depth-from-motion-parallax to a picture (Troje, 2023). Infants who had the choice between (a) and (b) looked longer at (a) (57% vs. 43%, $p<0.01$). Infants who compared (b) and (c) preferred (c) (52% vs 48%, $p<0.05$). Those who compared (a) and (c) did not show a significant preference (51% vs 49%, n.s.). As hypothesized, the introduction of motion parallax alone is sufficient to generate a preference that is comparable to the real-object advantage.

Topic Area: PERCEPTION & ACTION: Development & aging

E117 - Visual gamma oscillations in 1- to -5-year-old children using OPM-MEG

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Gamma oscillations play an important role in cortical information processing and cognition, including visual perception and attention. Little is known, however, about the early development of gamma due to limitations with recording high frequency gamma signals in electroencephalography or testing young children in conventional magnetoencephalography (MEG) systems. Optically pumped magnetometers (OPMs) are a novel, wearable MEG system that can be adapted to fit smaller head sizes suitable for paediatric participants and provide the means to measure MEG signals in young children, including high fidelity gamma band activity. The present study is the first to investigate visual gamma-band responses in 1-5-year-old children using a whole-head OPM-MEG system and includes data collected and analyzed after December 2023. OPM data were recorded in 51 children (23 males, Mage=3.23 years) while they viewed oscillating concentric circles known to induce gamma-band oscillations, which reflect cortical excitation and inhibition (E-I). Data were epoched and filtered to broad gamma-band (25-80Hz) and beamformed to reconstruct source activity. Our analyses showed a significant positive association between low and high gamma-band amplitude with age in the visual cortex. Averaged time frequency spectrograms for each, one-year age-range also showed an increase in gamma relative to baseline, most prominently in the 5-year-olds. These findings are the first to use the OPM-MEG system in young children to investigate gamma-band responses. These preliminary results suggest that gamma could be a useful metric of E-I imbalance, which will be foundational to our understanding of typical and atypical developmental trajectories of brain function during early childhood.

Topic Area: PERCEPTION & ACTION: Development & aging

E118 - Unveiling EEG Rhythmic Processing in Autism Using TRF Linear Models

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Autism Spectrum Disorder (ASD) is characterized by rigidity and atypical communication. We and others showed that neuro-oscillatory entrainment to, and anticipation of rhythmic stimuli are impaired in ASD. To test the barebone of entrainment to regularities, we created a paradigm that uses sequences of visual stimuli with different degrees of periodicity. This includes periodic (Isochronous), semi-periodic (Small and Large Jitter), and non-periodic (Random) conditions. EEG results from 20 high-functioning ASD young adults and 19 age- and IQ matched controls show reduced entrainment at the central frequency of stimulation to the Jitter condition. Temporal Response Function (TRF) models are linear models that quantify the relationship between features of a stimulus and the resulting neuronal response. By modelling the outputs (EEG recordings) as a linear combination of the inputs (sensory stimuli), such models capture how variations in stimuli are linearly reflected in the recorded brain activity. An advantage of this approach in clinical populations is implementing individual models, thus accounting for the high variability in sensory processing that often characterizes them. We implemented forward TRF models using EEG traces. For each participant, models were calculated through nested cross-validation, to find the optimal regularization value, and the average model performance. Then, performance was evaluated as the correlation between predicted EEG and the actual EEG and compared between the groups. TRF results replicated the EEG results: group differences were seen in the modeled EEG of the Jitter, but not in the Isochronous condition. This supports the inflexibility of entrainment in ASD to jittered/uncertain environments.

Topic Area: PERCEPTION & ACTION: Development & aging

E119 - Neurophysiological Evidence for the Other-race Effect on Configuration Encoding of Conscious Face Perception

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Human faces can be processed rapidly and automatically. Among salient facial features, however, whether race can be processed unconsciously remains an open question. In our previous behavioral study, the other-race effect (i.e., ORE, better recognition for own-race than other-race faces) was only observed when participants were aware of the facial stimuli. In the present event-related potential (ERP) studies, we focused on the P1 and N170 components at posterior and occipitotemporal sites, which are sensitive to perceived low-level visual properties and encoding of face configuration, respectively, to further examine whether the encoding of face configuration, which may give rise to the ORE, is unconsciously affected by face race in early visual perception. Photographs of East-Asian and Caucasian female and male faces were presented in upright and inverted orientations between a forward and a backward mask when Taiwanese participants were asked to judge the orientation of faces. The presentation durations of faces ranged from subliminal (16.67ms), early-supraliminal (33.34ms), to supraliminal (100ms) conditions. As an index of encoding of face configuration, the inversion effect (i.e., greater responses to inverted than upright faces) was observed in both the P1 and N170 components only in the supraliminal but not in the other two conditions. Critically, the ORE was only observed as the inversion effect was larger for East-Asian than Caucasian faces in the N170 component. Given that no effect was found in the subliminal condition, our ERP findings suggest that encoding of face configuration is modulated by face race only when faces are consciously perceived.

Topic Area: PERCEPTION & ACTION: Vision

E120 - Deficits in concurrent sensory orienting and decision making in children with attention deficit hyperactivity disorder during visual search

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Background: Attention deficit hyperactivity disorder (ADHD) is a common neurodevelopmental disorder in school-age children. However, underlying pathophysiological substrates of cognitive deficits (e.g. inattention and poor executive function) in childhood ADHD remain unclear. Therefore, exploring neural markers of cognitive impairment in children with ADHD is vital for the early assisted diagnosis of ADHD and the selection of intervention targets. Methods: We collected electroencephalography (EEG) signals from 70 children with ADHD and 65 matched typically developing (TD) children while performing a visual search task. Oscillation-based multivariate pattern decoding was used to investigate visuomotor coordination during spatial attention. Results: Compared with TD children, children with ADHD

showed an impairment in accuracy, response time, and response time variability. Multivariate machine learning revealed that the ADHD group showed deficits in alpha (visual-related) and beta (motor-related) power-based decoding accuracy, indicating impaired sensory orienting and decision making in children with ADHD. Importantly, the ADHD group exhibited a delay between alpha and beta decoding, suggesting a deficit of concurrent visuomotor coordination in children with ADHD. However, this visuomotor asynchrony was absent in TD children. Furthermore, visuomotor asynchrony between alpha and beta decoding could predict behavioral impairments and the severity of symptoms in children with ADHD. Conclusion: These observations reveal that impaired concurrent visuomotor coordination might be a potential neural marker of attentional selection impairment in children with ADHD, further advance the understanding of cognitive deficits, and provide potential research directions for the early diagnosis and optimization of intervention in neurodevelopmental disorders.

Topic Area: PERCEPTION & ACTION: Vision

E121 - Uncertainty-driven updating enables segmentation and categorization of naturalistic activity

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Humans form sequences of event models—representations of the immediate situation—to predict how activity will unfold. Multiple mechanisms have been proposed for how the cognitive system determines when to segment the stream of behavior and switch from one active event model to another. Here, we use a large-scale naturalistic dataset to compare two gating mechanisms for model updating: prediction uncertainty and prediction error. We constructed a computational model combining a recurrent neural network for short-term dynamics with Bayesian inference over event types for event-to-event transitions. This architecture learns event schemas representing knowledge about event types and uses them, along with observed perceptual information, to construct a series of event models. This architecture was trained on one pass through an 18-hour corpus of naturalistic human activity. Another 3.5 hours of activities were used to test each variant for agreement with human segmentation and categorization. The architecture was able to learn to predict human activity, and it developed human-like segmentation and categorization. We then compared two variants of this architecture designed to better emulate human event segmentation: one transitioned when the active event schema produced high uncertainty in its prediction; the other transitioned when the active event schema produced a large prediction error. The variant that transitioned from one active event schema to another based on prediction uncertainty provided the closest match to human segmentation and forming human-like event categories—despite being given no feedback about segmentation or categorization. These results establish that event model transitioning based on prediction uncertainty can naturally reproduce two important features of human event comprehension.

Topic Area: PERCEPTION & ACTION: Vision

E122 - Tracking the neural signatures of visual and motor prioritisation in working memory through space and time

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Visual representations and action plans within working memory can be flexibly and dynamically prioritised to guide adaptive behaviour. Such prioritisation is accompanied by modulations in electroencephalography (EEG) activity. Namely, lateralised posterior alpha-band attenuation tracks changes in internal attention to item locations, whereas lateralised central beta-band attenuation tracks changes in response-plan selection. Due to the limited spatial resolution of EEG, the subcortical-cortical networks controlling alpha and beta modulations during internal attention remain elusive. Here, we asked participants to perform an internal selective-attention task that independently modulated prioritisation of visual and motor representations while recording EEG in a magnetic resonance imaging (MRI) scanner. Participants held two items (encoded on the left and right side of the screen) each linked to an action (left or right button press) in working memory. In half of the trials, an informative retrocue prompted participants to prioritise one visual item and its associated action plan in working memory. In the other half, retrocues were uninformative, so neither visual-spatial nor action selection was possible. The EEG analysis replicated patterns of contralateral alpha attenuation for spatial item selection and contralateral beta attenuation for motor selection. Analysis of concurrent fMRI data revealed the engagement of frontal and parietal areas (including the posterior inferior frontal cortex and right inferior parietal cortex) during internal spatial attention and of the corresponding sensorimotor hand representation during internal action selection. Together, these results reveal preliminary clues about the sources underlying the modulations of frequency-specific activity that accompany flexible sensory and motor prioritisation in working memory.

Topic Area: PERCEPTION & ACTION: Vision

E123 - Development of the hippocampus and the ability to perceptually integrate images drive the emergence of visual illusion susceptibility in childhood

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Young children are less susceptible to the Ebbinghaus visual illusion—in which misleading contextual information distorts an object's apparent size—than older children and adults (Doherty at al., 2010). We investigated the possibility that this is due to changes in the ability to perform perceptual integration across development (Kovacs, 2000) due to ongoing development of the hippocampus (Barense et al., 2010). We hypothesized that young children do not integrate the misleading image context, preventing it from affecting their size perceptions. If so, physically integrating the image components for viewers should allow children to "see" the illusion. Children aged 4-10 (n=93) and adults (n=30) viewed the Ebbinghaus, Sander, and Vertical-Horizontal illusions. These illusions differ in whether target items and surrounding context are visually integrated: the Ebbinghaus illusion is unintegrated (target and context do not touch) and the Sander and Vertical-Horizontal illusions are integrated. Consistent with prior work, younger children experienced the (unintegrated) Ebbinghaus illusion less than older children. In contrast, children of all ages were equally susceptible to the (integrated) Sander and Vertical-Horizontal illusions. These findings indicate that the ability to integrate visual context drives the developmental emergence of illusion susceptibility. We further explored the role of hippocampal development by investigating categorical perception, a hallmark of hippocampally-mediated processes in which continuous perceptual differences are binarized (experienced as a sudden shift). We examined the degree to which participants' responses varied sigmoidally (as expected in categorical perception) versus linearly. Young participants were less categorical, suggesting developmental change in the role of the hippocampus.

Topic Area: PERCEPTION & ACTION: Vision

E124 - Examining the Temporal Dynamics of the Impact of Mental Rotation on Bistable Motion Perception

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Introduction: Mental rotation is the process of transposing an imagined item into a different mental position. Here, we examined the temporal dynamics of the effect of mental rotation on perception of visual motion by using a bistable rotating stimulus that can be interpreted as moving in either of two directions (clockwise, counterclockwise). Method: Participants (n=55) were instructed to mentally rotate an item in either a clockwise or counterclockwise direction (T1), and then to indicate the perceived direction of motion (clockwise or counterclockwise) of a bistable rotating circle (T2). We varied the time interval between T1 and T2 by inserting a blank screen lasting between 0 to 8 seconds. Data Analysis: We conducted a 2 (T1 instruction: ahead, behind) x 6 (Delay: 0, 0.5, 1, 2, 4, 8) ANOVA, on the proportion of clockwise T2 responses, and subsetted for when T1 is performed correctly. Results: We replicated our previous results indicating the reduction of the proportion of clockwise T2 responses for T1 counterclockwise rotations ($p<0.05$). Current analysis is examining the effect of delay on the effect of T1 on T2. Discussion: We predict a decay of the effect of mental rotation on perceived rotation as time delay increases, indexed by the effect of T1 on T2 decreasing as delay time increases. Alternatively, a lack of such decay would suggest effect-specific temporal dynamics of the effect of mental rotation on bistable motion perception, warranting further investigations.

Topic Area: PERCEPTION & ACTION: Vision

E125 - Inverted visual coding across category-selective visual areas

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Models of brain function propose a shift from retinotopic to amodal coding progressing from visual cortex towards memory structures. However, recently we suggested that memory-related areas implement a retinotopic code characterized by spatially-selective negative population receptive fields (-pRFs), and this code structures interactions among category-selective brain areas involved in scene perception and memory (Steel*, Silson*, 2023, Nat. Neuro.). Here, we investigated whether -pRFs are present within or anterior to other visual-category preferring areas (beyond scenes), or whether -pRFs uniquely appear in regions specialized for scene memory. We computed pRFs for subjects in the Natural Scenes Dataset (Allen, 2022) and compared -/+ pRF concentrations in regions of ventral temporal cortex that prefer scenes (anterior/posterior PPA), faces (iOG-, pFus-, mFus-faces), bodies (FBA-1 & 2), and words (OWFA, VWFA-1 & 2). For scenes, we replicated our previous observation: a higher prevalence of -pRFs in aPPA compared to pPPA and in lateral place memory area (localized using rsFC) compared to OPA (ps<0.005). In contrast, face- and body-selective areas exhibited no differences in -pRF concentration between posterior and anterior functional regions (all ps > 0.09). Interestingly, for word-selective areas, the concentration of -pRFs increased up the processing hierarchy from OWFA to VWFA-1 and 2 (ps < 0.05). Crucially, -/+ pRFs in word-preferring areas had well-matched visual field preferences, supporting the notion of functional linkage. We propose that the -pRFs associated with visual areas may serve functions that demand perceptual-mnemonic interaction across the visual field such as navigation and reading.

Topic Area: PERCEPTION & ACTION: Vision

E126 - Transcranial magnetic stimulation to early visual cortex modulates binocular rivalry

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Non-invasive neuromodulation techniques, especially repetitive transcranial magnetic stimulation (rTMS), are pivotal in mapping neural networks. Among these, continuous theta burst stimulation (cTBS), a form of rTMS, is thought to induce inhibitory effects in the primary motor cortex. Our study explores cTBS in the visual domain, investigating its impact on binocular rivalry (BR) in the primary visual cortex (V1) after administering 600 pulses at 80% phosphene threshold. Binocular rivalry is characterised by alternating periods of visual dominance when two different images are presented simultaneously to each eye. BR is orchestrated by a complex interplay across the visual pathway, from retinal input to lower and higher cortical processing (including attention). Notably, cortical columns in V1 exhibit monocular responses that underpin the perceptual alternations witnessed in BR, however, the exact mechanism is not well understood. In our sham-controlled study, 19 individuals underwent a BR task, observing orthogonal grey-scale gratings with fixed orientation (+/-45°) through a mirror stereoscope and reporting shifts in visual dominance. Following cTBS application to the left V1 using stereotaxic neuronavigation, participants reported the frequency of BR alternations. Our preliminary findings reveal an increased alternation rate in BR after active cTBS (and not sham), suggesting that cTBS can modulate perceptual dominance in visual processing. These insights enhance our comprehension of cTBS's neuromodulatory potential and underscore its promise as a tool for research and potential treatment for neuro-ophthalmological disorders. Our research contributes to the expanding dialogue on the intersection of neuromodulation, visual perception, and cortical plasticity.

Topic Area: PERCEPTION & ACTION: Vision

E127 - Neuronal mechanisms of saccade-coordinated visuospatial memory in the human brain

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Eye movements and visuospatial memory constantly interact to shape an efficient representation of the world. The behavioral and neurophysiological effects of eye movements on holistic scene memory have been extensively demonstrated, yet it remains elusive how visual identity representations dynamically unfold in active vision. It is known that some neurons in the human medial temporal lobe exhibit highly selective tuning to abstract concepts. We thus leveraged the unique opportunity to record single-unit activity from epilepsy patients and probed the response of identity neurons during visual exploration in different memory stages. We designed a novel gaze-contingent visuospatial memory task, where patients encoded images in a spatial layout with the presentation of images triggered by saccades to cued locations. They subsequently re-explored the layout in the same gaze-contingent manner and were then tasked with judging visuospatial match/mismatch, constituting the retrieval condition. We hypothesized that, during retrieval, identity neurons would fire before the onset of their preferred image and saccade initiation. This anticipatory firing would reflect the learned association between image identity and planned saccade landing location. We found preliminary evidence that identity neurons increased their firing rate before image onset, selectively during retrieval but not encoding. Given the gaze-contingent design, the observed phenomenon cannot be explained by peripheral visual afference and/or receptive field remapping. Our data suggests that visual identity representations are reactivated prior to foveal processing. The findings hint at a novel mechanism for memory-guided eye movements which may underlie the functional enhancement of memory retrieval brought by gaze reinstatement.

Topic Area: PERCEPTION & ACTION: Vision

E128 - Ventral Stream has the Final Say in the (Mis)Localization of the Flash Jump Effect.

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A flashed colored bar is misperceived further along the trajectory of motion than its actual location (Flash Jump Effect: FJE), reflecting misintegration of color and extrapolated motion. Manual responses to the perceived location of the color flash are modulated by the strength of ventral stream feature representations (Saini et al, 2021; Sundberg et al, 2005). Can FJE be observed using a saccade response that relies on metrically-accurate dorsal stream representations? We measured FJE when participants made a saccade or manually moved a cursor to the remembered location of the colored flash at the end of each trial. Similar FJEs were observed for both Manual (1.26 dva) and Saccadic (1.53 dva; both p<.001) responses. FJE is observed even when programming the response to a flash in eye-centered coordinates. Given sufficient time, perceived location from the ventral stream may update dorsal-stream representations of the actual flash location. In a second experiment, participants immediately made a saccade to the colored flash, rather than delaying until the end of the trial. We expected to observe the FJE for ventral stream manual response but lose it for the dorsal-stream saccadic response. We observed significant FJE for Manual (1.58 dva) but also Saccadic (2.61 dva) responses (both p<.001). In addition, the saccadic FJE was significantly larger for immediate compared to delayed responses (p = .003) but not the manual (p = .105) effect. Therefore, the dorsal stream is more vulnerable to temporal-spatial mislocalizations, but with time is updated by the ventral stream to reduce the FJE.

Topic Area: PERCEPTION & ACTION: Vision

E129 - The visual word form area is specialized for orthographic-semantic processing of written words

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The visual word form area (VWFA) is a region within the left occipitotemporal sulcus of literate humans, specialized for visual word recognition. However, its functional specificity is debated. Three competing hypotheses are that the VWFA is 1) a general visual processor, specialized for discriminating complex high-spatial-frequency stimuli – i.e., useful for reading but not specialized for words; 2) specialized at a sublexical level – i.e., sensitive to orthographic properties of words; 3) specialized for semantic processing of any meaningful visual stimuli, but not specialized for words. Conversely, we previously demonstrated that 1) the VWFA is specialized for lexical processing of written words, as it discriminates real words from pseudowords (non-word letter-strings

orthographically matched to real words) and 2) the strength of intrinsic functional connectivity between VWFA and Wernicke's area predicts reading skill. Thus, we hypothesize that the VWFA is specialized for orthographic-semantic processing – i.e., understanding the meaning of written words selectively. Adult participants (n=27) underwent 2 fMRI sessions: 1) A block-design multi-category functional localizer, to localize the VWFA and multiple category-selective control regions in each participant; 2) An event-related semantic classification task with words and images from multiple categories, to quantify category-discrimination in these regions. Representational similarity analysis demonstrated category-discrimination for words in VWFA, significantly more than images and all control regions. Multidimensional scaling and hierarchical clustering demonstrated superordinate-category-discrimination (living vs. non-living) for words in VWFA, significantly more than images and all control regions. Our results demonstrate that the VWFA is specialized for orthographic-semantic processing of written words selectively.

Topic Area: PERCEPTION & ACTION: Vision

E130 - Increased brain signal complexity associated with mind-wandering inhibits performance gains following perceptual task training

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Mind-wandering, or attentional shifts from the current task to unrelated thoughts, consumes up to 50% of our waking hours and impacts neural and behavioural function. Mind-wandering is typically associated with decreased performance on perceptual and cognitive tasks but may facilitate performance on tasks that require creative problem-solving. Until now, research has focused on the impact of mind-wandering on immediate task performance, but the impact on learning-related gains over time remains unclear. Previous research examining brain signal complexity during task performance showed that periods of mind-wandering are associated with higher signal complexity compared with focused states, reflecting increased global neural flexibility. In this study, we investigated how the amount of mind-wandering during task performance influences learning and whether higher signal complexity during mind-wandering may represent a flexible neural state conducive to learning. Nineteen healthy adults underwent electroencephalography (EEG) recording while performing a visual texture discrimination task before and after a training period, with their attention state probed throughout the experiment. Task performance significantly improved ($p < .001$) and the amount of mind-wandering during task performance significantly increased ($p = .011$) following training. Greater pre-training mind-wandering was associated with increased signal complexity across all timescales, but this corresponded with lower performance gains following training ($p = .001$). Further, there were no significant associations between post-training mind-wandering, signal complexity, and changes in task proficiency. These results suggest that a high-flexibility brain state associated with mind-wandering may hinder learning in low-level perceptual tasks that demand narrow attention to basic visual stimuli for optimal performance.

Topic Area: PERCEPTION & ACTION: Vision

E131 - Expectation modifies the representational fidelity of complex visual objects

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Prediction has been shown to play a fundamental role in facilitating efficient perception of simple visual features such as orientation and motion, but it remains unclear whether expectations modulate neural representations of more complex stimuli. Here, we addressed this issue by characterising patterns of brain activity evoked by two-dimensional images of familiar, real-world objects which were either expected or unexpected based on a preceding cue. Participants (n=30) viewed stimuli in rapid serial visual presentation (RSVP) streams which contained both high-fidelity and degraded (diffeomorphically warped) object images. Multivariate pattern analyses of electroencephalography (EEG) data were used to quantify and compare the degree of information represented in neural activity when stimuli were random (unpredictable), expected, or unexpected. Degraded images elicited reduced representational fidelity relative to high-fidelity images. However, degraded images were represented with improved fidelity when they were presented in expected relative to random sequence positions; and stimuli in unexpected sequence positions yielded reduced representational fidelity relative to random presentations. Most notably, neural responses to unexpected stimuli contained information pertaining to the expected (but not presented) stimulus. Debriefing at the conclusion of the experiment revealed that participants were not aware of the relationship between cue and target stimuli within the RSVP streams, suggesting that the differences in stimulus decoding between conditions arose in the absence of explicit predictive knowledge. Our findings extend fundamental understanding of how the brain detects and employs predictive relationships to modulate high-level visual perception.

Topic Area: PERCEPTION & ACTION: Vision

E132 - A new technique to measure implicit line orientation discrimination using fast periodic visual stimulation (FPVS).

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FPVS is an electroencephalography marker of discrimination between two classes of frequency tagged stimuli (standards and oddballs). The technique can detect neurodegeneration-related impairment in recognition memory without active response or task comprehension. Here, we develop FPVS as a probe of low-level visual function, with a view to its future use as a sensitive diagnostic marker of visuospatial cognitive impairment. Thirty subjects (21 (±5) years, 7 males) completed five FPVS conditions that implicitly measured their ability to discriminate an oddball line orientation (1°,5°,10°,30°,80°), from a standard vertical line, as well as an equiprobable control condition. Twenty-four subjects (24 (±5) years, 5 males) completed a retest session one month later. Following 100s of recording, activity at the oddball presentation frequency, a neural signal of discrimination between standard and oddball stimuli was observed in response to lines of 5° and above. The magnitude of this oddball response increased as oddball lines deviated more from vertical. Demonstrating consistency in individual subjects, oddball responses were present in 30/30 subjects in response to a deviation of 30° and 29/30 in response to a deviation of 80°. At larger deviations, oddball responses showed high test-retest reliability, measured using intraclass correlations. Overall, these findings demonstrate that FPVS can consistently and reliably measure line orientation discrimination. The stability of these implicit tasks in the cognitively healthy, demonstrates that they hold great potential as a functional biomarker, that could be capable of capturing low-level visual processing impairments in dementia-causing diseases, e.g., Dementia with Lewy bodies.

Topic Area: PERCEPTION & ACTION: Vision

E133 - Testing generalization from static to dynamic faces using magnetoencephalography (MEG)

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Studies of visual perception frequently make use of rapidly presented static images, despite the fact that our natural visual input is dynamic. The onset of these stimuli provokes reliable responses across the visual cortex. Here, we seek to investigate the extent to which the representations evoked during the presentation of static stimuli generalize to dynamic movies that involve those same stimuli. To probe this question, the current study uses magnetoencephalography (MEG) to compare the time course of signals while participants view static frames and dynamic movies of human faces and objects. The static faces vary in terms of head orientations while the dynamic movies show these faces moving naturally from one orientation to another, such that the static orientations always occur sometime during the movie. Time-resolved MEG decoding methods allow us to compare brain MEG signal patterns between the different face orientations. Preliminary results indicate that head orientation can be reliably decoded during static viewing after 100ms. We are now investigating whether models trained on the patterns during static viewing will generalize to the dynamic movies, such that we can predict the time-course of the movies based on these models. The results of this study will help elucidate the connection between static and dynamic representations in the brain.

Topic Area: PERCEPTION & ACTION: Vision

E134 - Stability in Ongoing Conscious Thought Relates to Macroscale Patterns of Brain Organization

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Ongoing thought differs across person and context. However, it remains unclear as to how situations impact the stability of different types of thought. We had 190 healthy participants score their most recent thoughts on 16 dimensions across 14 cognitive tasks. We then used Principal Components Analysis (PCA) to decompose individuals' probe scores on the 16 dimensions into 'thought patterns' representing characteristics of thought that tended to covary across the tasks measured. To quantify how stability in thought varied across the tasks, we computed the intraclass correlation coefficient (ICC) for each task on each thought pattern, with a greater ICC indicating greater within-subject stability in reported thought on a given task. To examine how stability in self-reported thought relates to fMRI-based representations of brain activity, we used existing fMRI data for each of the tasks to map them according to their whole-brain similarity. We then mapped the association between stability in reported thought and these macroscale patterns of brain organization. Two thought patterns whose stability related to whole-brain organization during task processes were "Deliberate Task-Focus" and "Intrusive Distraction". Tasks associated with greater activation of transmodal regions tended to also have more stable thought-content with regards to "Intrusive Distraction", and greater activation of frontoparietal regions associated with higher stability in "Deliberate Task-Focus". The analysis thus indicated that a person's stability in their thinking relates to patterns of whole-brain activation engendered by their situation.

Topic Area: THINKING: Other

E135 - The Relationship between Brain Activity and Ongoing Thought Patterns during Movie Watching

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The relationship between brain activity and ongoing thought patterns during everyday states like movie-watching is poorly understood. One challenge comes from the difficulty of measuring cognition during movies without disrupting how experience and brain activity naturally unfold. Here, we establish a novel method to identify neural correlates of different experiential states during movie-watching while minimally interrupting viewers or disrupting ongoing brain dynamics. Using two samples, we utilized existing fMRI data from 44 participants (Sample 1) who watched three full-length movies and collected experience using multi-dimensional experience sampling (mDES) from 120 participants (Sample 2) who watched 11-minute clips of the same films and responded to comprehension questions. In the lab, mDES was probed five times in each film using a pseudo-randomized probe schedule to create a time course of experience across the clips at a rate of 15 seconds. We identified four patterns of thoughts labelled Episodic Knowledge, Intrusive Distraction, Verbal Detail and Sensory Engagement. The time course of each thought pattern generated by Sample 2 was included as a regressor of interest in a time series analysis of brain activity from Sample 1. This revealed primary visual and auditory cortex were active during periods when experience was characterized by Sensory Engagement — which significantly predicts better scores on the movie comprehension test. Our study highlights an unanticipated role of primary systems in features of experiences and our memories of what we watched in films while introducing a novel method of collecting experience in naturalistic states.

Topic Area: THINKING: Other

E136 - Individual Differences in Neural Correlates of Spontaneous Thought: A Personalized Brain Network Approach

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Neuroimaging studies have demonstrated a positive correlation between self-reported mind-wandering and activation of the default mode network (DMN), while relationships with other brain networks have been inconsistent across studies. To date, these studies have relied on use of population-averaged templates which carry the assumption that spatial arrangements of networks are similar between all individuals. Recent advances in "precision functional mapping" reveal that the topography of networks, including the DMN, varies substantially between people. In this study, we sought to examine the relationship between mind wandering and activation within personalized functional networks. Three subjects' mind wandering experiences were densely sampled (> 300 thought probes per subject) whilst undergoing multiple sessions of fMRI (6 sessions per subject). For each subject, we mapped 17 personalized functional networks using multi-session hierarchical Bayesian modeling. Activation of a specific DMN subnetwork ("DN-A") was significantly positively correlated with trial-wise mind wandering ratings within each subject, though the timing of peak correlation relative to thought probe onset varied across subjects. Outside of DMN, personalized brain networks showed complex patterns of distinct positive and negative correlations with mind-wandering reports across individuals. For instance, while DN-A and dorsal attention network were, respectively, most positively and negatively associated with mind-wandering in Subject 1, such associations were found for a language-related and visual networks in other subjects. Our findings highlight the importance of accounting for individual-level functional anatomy and suggest that distinct neural signatures may be connected to the variability of the contents and dynamics of mind-wandering across individuals.

Topic Area: THINKING: Other

E138 - Higher general intelligence is linked to stable, efficient, and typical brain connectivity patterns

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General intelligence, the general capacity to excel across situations, can be quantified by the positive correlations observed between nearly all cognitive tests. General intelligence is closely linked to academic and professional achievement, and its genetic component suggests potential intergenerational impacts. The shared performance across cognitive domains may arise from shared mechanisms. A recent hypothesis suggests that general intelligence emerges from the task-general capacity to dynamically and adaptively reorganize brain connectivity. Temporal reconfiguration can be assessed using dynamic functional connectivity (dFC), which captures the propensity of whole-brain connectivity to transition between a recurring repertoire of distinct states. Conventional dFC metrics focus on categorical state switching frequencies which do not fully assess individual variation in continuous connectivity reconfiguration. Here, we supplement frequency measures by quantifying within-state connectivity consistency, dissimilarity between connectivity across states, and conformity of individual connectivity to group-average state connectivity. We utilized resting-state fMRI data from the large-scale Human Connectome Project (n=950) and applied data-driven multivariate Partial Least Squares Correlation to explore associations between cognitive ability and temporal reconfiguration. Our findings reveal a positive association between general intelligence and stable maintenance of states characterized by distinct connectivity between networks involved in higher-order cognition, efficient reconfiguration (i.e., minimal connectivity changes during transitions between similar states, large connectivity changes between dissimilar states), and ability to sustain connectivity close to group-average state connectivity. This hints at fundamental properties of brain-behavior organization, suggesting that general cognitive processing capacity is supported by the ability to efficiently reconfigure between stable and population-typical connectivity patterns.

Topic Area: THINKING: Other

E139 - Relationships Between Alpha Waves, Creative Thinking, and Stress

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The current study used electroencephalography (EEG) to examine relationships between alpha waves and creative thinking. Alpha is indicative of a more relaxed mental state and has been associated with creativity. Previous literature on this subject has been contradictory. While most studies have found a relationship between creativity and alpha activity (Ermakov & Saakyan, 2013; Rominger et al., 2019), other studies have not found this relationship (Benedek et al., 2011). These inconsistencies may be related to task differences (Dietrich & Kanso, 2010) and stress levels (Wang et al., 2019). The current study was conducted to address these inconsistencies and determine if creative task difference and stress played a role in modulating creativity-related alpha activity. A

within-subjects experimental design was developed. Thirty-nine participants were given a divergent thinking creativity task, an artistic creativity task, and a non-creative task. EEG data was collected during the thinking phase of all three tasks. Additionally, current stress levels were measured before the tasks were given. A repeated-measures ANOVA revealed significant differences in alpha power between the three tasks at posterior and frontal electrode sites (Pz, FP1, F7, F8). Alpha power was higher for both creative tasks than the noncreative task. Correlational analyses, however, did not reveal any significant relationships between stress levels and alpha power during the three tasks. These results support prior research showing that alpha power is sensitive to creativity, but everyday stress levels may not influence creativity as measured by alpha activity.

Topic Area: THINKING: Other

E140 - Electrophysiological Correlates of Naturally Occurring Thought Patterns

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Humans engage in a continuous flow of thoughts throughout the day. These thoughts change depending on the context in which they occur and correspond with unique patterns of connectivity within and between neural networks. Notably, less is known about the electrophysiological signatures of these thought patterns. To address this question, this study examined the interplay between thought patterns and electrophysiological activity in internally and externally oriented contexts. Forty-one participants were asked to attend internally to their own thoughts (thought focus condition) and externally to a set of videos (video focus condition), during which they were asked to report various dimensions of their ongoing thoughts. We implemented principal component analysis on the ratings of these multiple thought dimensions and identified three thought patterns (representing co-occurring thought dimensions): present external thought, goal-oriented future thoughts, and freely moving external positive thoughts. We found that these three thought patterns differentially associated with the experimental conditions and EEG measures. Present external thought was more closely associated with the video focus condition and showed increased frontal alpha and posterior alpha. Goal-oriented future thoughts increased during the thought versus video focus condition but was not significantly linked to any EEG measures. Freely moving external positive thoughts were more strongly associated with the video focus condition and showed decreased frontal alpha activity. Taken together, our results highlight the complex relationship between thought patterns and electrophysiological activity in different contexts.

Topic Area: THINKING: Other

E141 - Electrophysiological Signatures of Ongoing Thoughts during Naturalistic Tasks

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As humans, we constantly engage in a stream of consciousness representing our ongoing mental experience. While recent work has begun to examine the neural correlates of the dimensions of our ongoing thoughts, they have primarily focused on revealing brain activation and connectivity patterns of thoughts during constrained experimental tasks. The electrophysiological basis of various dimensions of ongoing thoughts outside of the experimental setting remains unexplored. To address this, we examined the electrophysiological signatures of ongoing thoughts in seven participants assessed in a naturalistic task setting across seven recording sessions. Based on a total of 49 datasets, our results revealed distinct oscillatory markers of multiple dimensions of ongoing thoughts as participants completed any computer-based activities they wish to perform. In addition to electrophysiological markers consistent with those observed in experimental settings, we found novel patterns that were not previously reported. Together, these results establish the electrophysiological signatures of numerous dimensions of ongoing thought, assembling a comprehensive set of brain-to-experience mapping of phenomenological features of thoughts. Our findings provide an important step towards predicting thought patterns in the real world with additional clinical implications for establishing biomarkers of typical and atypical thought patterns.

Topic Area: THINKING: Other

E142 - The Neural Basis for Number Processing and Its Relation to Individual Differences in Adults' Math Competence

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Number processing is a fundamental skill for math competence. In this study, we will explore whether variations in brain activations associated with number processing are predictive of adults' math achievements. To this end, we used functional magnetic resonance imaging (fMRI) to 1) characterize brain regions involved in number processing and 2) investigate the relations between the brain activation in various brain regions and adults' math abilities. We collected fMRI data from 104 adults while they completed a number comparison and a phonological comparison task with two types of number stimuli: Arabic digits and hand images. Participants' math competence was measured using the math subtests of the Woodcock-Johnson Tests of Achievement in a separate behavioral session. Univariate analyses of the task contrast within two types of stimuli revealed a set of brain regions (e.g., early visual cortex, precentral gyrus, medial frontal gyrus, etc.) supporting number processing. Correlations between brain activation in various brain regions such as the early visual cortex and participants' math abilities will be further discussed.

Topic Area: THINKING: Problem solving

E143 - Investigating Default and Executive network contributions to novel metaphor production in Spanish/English bilinguals

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A recent convergence of behavioral research from the creativity and bilingualism fields suggests a possible influence of language history on creative thinking ability. Yet, the neurocognitive mechanisms underlying the relationship between bilingualism and creativity have not been investigated to date. One possible mechanism for enhanced creative thinking abilities in bilingual speakers may be their relative strengths in executive control, which are developed via language switching, translation, and interpretive behaviors bilinguals engage with in their daily language use. Executive control has consistently been implicated as a crucial neural and cognitive mechanism in creative thinking across the literature, with top-down control over a broad base of knowledge being essential to the selection of creative ideas of high quality. In an ongoing fMRI study of highly proficient Spanish/English bilinguals (anticipated N = 40; current N = 21), we examine the contributions of the executive and default mode networks to bilingual verbal creativity on a novel metaphor production task. We expect functional connectivity between the default and executive control networks to positively, linearly predict metaphor creativity in participants' second language. We also expect that this effect will be mediated by participants' frequency of use and proficiency in their second language. The present work is a critical next step in unifying the fields of bilingualism and creativity research, and is the first to bring these fields together using a neuroimaging approach.

Topic Area: THINKING: Problem solving

E144 - Brain Network Functional Connectivity During Scientific Creative Thinking in Adolescents

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Similar to general creative thinking, scientific creative thinking has been linked to functional connectivity among the brain's default mode network (DMN) and executive control network (ECN), reflecting a cooperation of spontaneous and goal-directed cognitive processes. However, it remains uncertain to what extent this pattern of functional connectivity exists in adolescents. Given the importance of creativity in academic and career success, it is crucial to better understand creativity during adolescence. In the present functional near-infrared spectroscopy (fNIRS) study, high school students (n = 26) currently enrolled in science courses completed a scientific hypothesis generation task (thinking of novel/plausible explanations for scenarios) and a control task (thinking of synonyms to replace a word in a scenario). For the analysis in this poster, we will conduct functional connectivity analyses between regions of the DMN (e.g. angular gyrus) and ECN (e.g. inferior frontal gyrus) to characterize the

connectivity of brain networks associated with hypothesis generation. We expect an increase in between-network functional connectivity during hypothesis generation compared to the control task. This study is part of a larger experiment investigating the effectiveness of "flex-based learning", a new method of science education focused on promoting cognitive flexibility by teaching strategies for generating, evaluating, and selecting solutions. Although not presented in this poster, future analyses will determine how the flex-based methods impact creative thinking and associated functional connectivity compared to standard curricula. This research has implications for real-world educational interventions that have the potential to foster creativity in STEM education.

Topic Area: THINKING: Problem solving

E145 - The influence of insight on risky decision making and nucleus accumbens activation

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During insightful problem solving, the solution appears unexpectedly and is accompanied by the feeling of an AHA!. Research suggests that this affective component of insight can have consequences beyond the solution itself by motivating future behavior, such as risky (high reward and high uncertainty) decision making. Here, we investigate the behavioral and neural support for the motivational role of AHA in decision making involving monetary choices. The positive affect of the AHA! experience has been linked to internal reward. Reward in turn has been linked to dopaminergic signal transmission in the Nucleus Accumbens (NAcc) and risky decision making. Therefore, we hypothesized that insight activates reward-related brain areas, modulating risky decision making. We tested this hypothesis in two studies. First, in a pre-registered online study (Study 1), we demonstrated the behavioral effect of insight-related increase in risky decision making using a visual Mooney identification paradigm. Participants were more likely to choose the riskier monetary payout when they had previously solved the Mooney image with high compared to low accompanied AHA!. Second, in an fMRI study (Study 2), we measured the effects of insight on NAcc activity using a similar Mooney identification paradigm to the one of Study 1. Greater NAcc activity was found when participants solved the Mooney image with high vs low AHA!. Taken together, our results link insight to enhanced NAcc activity and a preference for high but uncertain rewards, suggesting that insight enhances reward-related brain areas possibly via dopaminergic signal transmission, promoting risky decision making.

Topic Area: THINKING: Problem solving

E146 - A Neurofeedback Study of Default-Executive Network Coupling and Creativity

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Increased functional connectivity between the default mode and executive control networks has been linked to creativity. Yet, whether default and executive network interaction may causally improve creative abilities remains unclear. In an ongoing neurofeedback study using functional near-infrared spectroscopy (fNIRS), participants are assigned to either a default-executive coupling or default-motor coupling condition, then complete a verbal creative thinking task, a go/no-go task, and a neurofeedback task. In the default-executive coupling condition, neurofeedback is directed towards increasing functional coupling between the default and executive networks. In the default-motor condition, functional coupling is entrained between two control regions. Both groups complete two sessions that take place on consecutive days. On day 1, participants provide a baseline of their task performance, then take part in a neurofeedback task. On day 2 the participants then complete another iteration of the creative thinking and go/no-go tasks. In this way, we can examine within- and between-person differences. In a preliminary sample, we observe neural coupling differences between participants in the default-executive (n = 7) and default-motor (n = 7) conditions trending towards significance in the hypothesized direction (p = .16 one-tailed). Additionally, we observe preliminary evidence suggesting that individuals in the default-executive condition demonstrate an improvement to their creative abilities on day 2 (M = 0.08), compared to the default-motor condition (M = -0.09; p = .1 one-tailed), aligning with initial hypotheses. These initial findings trend as expected and provide early signals that will be further examined with the full sample (n = 40).

Topic Area: THINKING: Problem solving

E147 - Neural Correlates of Learning Differences and Experience as Determinants of Design Fixation

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Past research has shown that the inclusion of pictures as examples in design problem solving fosters designers' propensity to adhere to those examples, a phenomenon known as design fixation. In this exploratory study, we examined whether individual differences in learning tendencies during concept building might underlie one's susceptibility to design fixation. We hypothesized that an exemplar-based learning approach, as reflected in brain activity patterns, would amplify the impact of the examples in design problems by heightening the prominence of specific design features over the abstract relationships that bind them. Conversely, an abstraction-based learning approach might prioritize the abstract design rules governing example designs, providing protection from adhering to specific design features of the example and thus, design fixation. To test these hypotheses, mechanical engineering students participated in two experimental sessions. The first session involved completing a learning task and multiple behavioral assessments; in the second session, they underwent a functional magnetic resonance imaging scan (fMRI), while completing learning and two design tasks using a sketching tablet compatible with the imaging environment. Participants' thought processes during task completion were captured through simultaneous verbal protocols during the scans. A classification of design events via verbal protocol analysis using the Function, Behavior, Structure (FBS) ontology for design, in conjunction with the coding of the designs produced revealed an extensive frontoparietal network of regions associated with the propensity for design fixation. We discuss the importance of adopting a real-world, multimethod approach to quantify design fixation, learning tendencies, and individual differences through diverse neurocognitive assessments.

Topic Area: THINKING: Problem solving

E148 - Using Transcranial Alternating Current Stimulation with Concurrent EEG to Examine the Role of Alpha- and Gamma-band Oscillations in Creative Thinking

Necla Ece Yilmaz[1], Evangelia G. Chrysikou[1]; [1]Drexel University

Creative cognition involves the orchestration of various cognitive processes that support the generation of previously non-existent ideas or solutions. Creative problem-solving is often characterized by an interplay between two main processes: creative ideation and idea evaluation. These processes have been shown to represent different states executive control and are generally supported by different large-scale neural networks. With respect to neural dynamics, alpha- and gamma-band oscillations have been reliably associated with the neural mechanisms underlying creative thinking: Alpha-band synchronization has been consistently observed during tasks requiring creative ideation, whereas gamma-band synchronization has been reported predominantly during tasks requiring creative idea evaluation. Previous research has shown that non-invasive brain stimulation techniques offer a way to modulate these specific neuronal dynamics underpinning creative cognition. Despite this, very few studies have manipulated neural synchronization through non-invasive brain stimulation as a tool to enhance creative cognition. In this study, we aimed to address this gap by using transcranial alternating current stimulation (tACS) together with electroencephalography (EEG) over executive control regions to induce targeted neural oscillations during creative thinking. Healthy adult native English speakers participated in a within-subjects study, where they performed a creative ideation task under tACS in (a) the alpha-band range (10Hz), (b) the gamma-band range (40 Hz), or (c) sham stimulation. EEG measures were used to examine the impact of tACS on task-based oscillatory activity. Our analyses revealed results consistent with the facilitatory role of alpha oscillations in creative ideation, thus supporting a potentially causal link between synchronized brain activity and creative cognition.

Topic Area: THINKING: Problem solving

E149 - Sorting based on partial information: behavior, computational modeling, and neural evidence

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Our daily lives are full of sorting activities, from assigning ranks to job candidates to filtering information by relevance. Meanwhile, information is always limited and partial, and how human subjects infer full-scope ranks from fragmented inputs remains unknown. Here we developed a new behavioral paradigm combined with magnetoencephalography (MEG) recordings to examine the underlying computational and neural mechanisms. Participants were instructed to learn the artificial "popularity" ranking of eight films (denoted by eight images) from brief exposure to eight pairwise comparisons (e.g., Film A is two units more popular than Film B). Crucially, the eight pairs are mostly non-adjacent along the rank score and thus only offer partial information (8 out of 28 pairs). Subjects were asked to infer the full-scale popularity of eight films after partial training. First, items close to the lowest or highest popularity score showed higher ranking accuracy (U-curve). Second, pairs with larger rank distances had higher sorting accuracy than those with closer ranks. Both the U-curve properties and distance effect could be well characterized using the Rescorla-Wagner model, in which participants incrementally learn the value of each film from observed pairs. Finally, MEG recordings show that, after training partial image pairs, evoked responses occurring in the right parietal region with approximately 980 ms latency carry the learned rank information. Overall, our behavioral and MEG studies consistently support that sorting with incomplete information can be achieved by a simple reinforcement learning model incorporating implicit value representations and value-updating rules to achieve rapid inference on ranks.

Topic Area: THINKING: Problem solving

E150 - Changes in neural response variability in response to cognitive training and its relation to restricted repetitive behavior in children with autism

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Abnormal neural variability has been recognized as a significant feature of atypical neural processing in autism. However, it remains unknown whether and how neural variability could change in response to cognitive training in children with autism spectrum disorder (ASD), compared to their typically developing (TD) peers. In this study, we investigate cognitive-training-induced changes in neural response variability in children with autism and examine their links to different aspects of restricted repetitive behaviors (RRBs) — insistence on sameness, circumscribed interest, and repetitive motor behavior. We employed an intensive one-on-one five-day training protocol designed to enhance math problem-solving abilities and acquired fMRI data from 19 children with ASD (4 females, age: 9.94 years, FSIQ: 119.43) and 25 TD children (7 females, age: 9.70 years, FSIQ: 118.64) before and after training. In the fMRI scanner, children solved math problems, where they verified whether the presented solution is the correct answer to the problem. Our analysis of trial-by-trial variability in neural responses revealed that children with ASD exhibited greater neural response variability across math problems following training than TD children in inferior parietal and visual and auditory areas. In addition, greater changes in neural response variability were associated with more severe symptoms of insistence on sameness, a sub-category of RRBs associated with cognition, in inferior parietal and superior frontal regions in children with ASD. These findings offer new insights into the interplay between training-induced changes in neural variability and restricted repetitive behaviors, providing evidence for atypical brain mechanisms underlying learning in children with ASD.

Topic Area: THINKING: Problem solving

E151 - How complex is creativity? The functional dissimilarity of brain regions tracks differences in cognitive complexity

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Creative thinking is a complex, higher-order form of cognition which relies on the integration of various component processes, such as memory and attention. A recent study found that the brain achieves such cognitive integration via the communication of functionally dissimilar regions—regions serving very different purposes (e.g., a visual region and a memory region)—thereby supporting creativity. This previous study also identified progressive levels of functional dissimilarity, in which only the highest levels were related to creativity; yet it remains unclear whether these levels track cognitive complexity, and how the complexity of creativity compares to similar forms of cognition. Therefore, in the present study (N=28), we used task-based fMRI to compare creative cognition (producing metaphors and generating novel object uses) to similar forms of cognition thought to primarily vary in complexity (generating common word associations, uncommon word associations, and bi-associations). We examined relationships between the functional dissimilarity levels and brain activity during each cognitive task. We found that the functional dissimilarity levels robustly track the complexity of cognition (Spearman's rho = .93): the highest levels were related to metaphor production and bi-association (both tasks involve integrating two concepts), followed by uncommon association and novel use generation (both involve expanding one concept), with common association at the lowest level. These findings support the validity of the functional dissimilarity levels as a neural feature that scales with cognitive complexity, and provide novel evidence on the complexity of creative thinking, including that metaphor production is a more complex process than novel use generation.

Topic Area: THINKING: Problem solving

E152 - Age-Related Differences in Mathematical Problem-Solving Among Children and Adolescents

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Word problem-solving is a vital skill for connecting mathematical knowledge to real-world applications, yet its developmental trajectory of behavioral and neural mechanisms remains elusive. To address this gap, this study investigates how problem descriptions alter word problem solutions, elucidating age-related differences between adolescents and children using fMRI. Brain imaging data from 48 participants, comprising 21 children (9F/12M, mean age = 10.51 years, SD = 1.09, age range: 8.85-12.67) and 27 adolescents (15F/12M, mean age = 15.36 years, SD = 1.81, age range: 12.33-18.44), were acquired while participants solved word problems containing a relational term. We manipulated the arithmetic operation (addition/subtraction) and lexical consistency (consistent, where the relational term aligns with the operation required to solve the word problems, e.g. more-addition, less-subtraction; inconsistent, where the reverse holds, e.g. more-subtraction, less-addition). Voxel-wise whole-brain analysis revealed significant three-way interactions between age, lexical consistency, and operation, primarily in the fronto-insular-parietal network, including the bilateral intraparietal sulci and left middle frontal gyrus. Specifically, adolescents exhibited a consistency-by-operation effect, with stronger activations for subtraction than addition when the problem description was lexically consistent, whereas a reverse operation effect was profound for lexically inconsistent problems. In contrast, for children, operation effects remained the same regardless of the lexical consistency. These findings suggest that across the learning and proficiency spectrum, problem lexical description does not affect word problem solution until the transition into adolescence. These findings highlight the maturation of cognitive mechanisms in mathematical problem-solving and emphasize the importance of targeted educational interventions in this formative period.

Topic Area: THINKING: Problem solving

E153 - Is this news credible? Neurocognitive mechanisms of news credibility evaluation measured by fMRI

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Searching online to acquire knowledge is of enormous importance: large parts of society are receiving news from online media and further the use of this news source is rising. However, specifically online media are highly infiltered with news intentionally created to deceive or manipulate the recipient (fake news). Thus, particularly when searching for news, the distinction between reliable and less reliable news is essential. In a series of laboratory and functional magnetic resonance imaging (fMRI) studies, we investigate processes of news evaluation and further aim at developing strategies to foster critical media literacy. In this study, we focus on investigating the neurocognitive processes of fake news evaluation using fMRI in typically-developing human adults (N = 36). In a three factorial within-subject design, we examined the effect of features of the stimuli such as the topic (targeting the emotions of fear, disgust and surprise) writing style

(emotional and neutral) and source (newspaper, local newspaper, and tabloid) on the perceived credibility of the news. Results of general linear modelling, suggest that particularly brain areas in lateral frontal, medial frontal, and lateral parietal cortices, (many of them part of the Default Mode Network), were activated when evaluating news' credibility. Further, while differences in brain activity for distinct topics and sources were less pronounced, emotionally written news affected news credibility strongly. Our findings thus indicate that affective and social neurocognitive processes like reflecting the own self, mentalizing, taking perspective or feeling empathy and reward are important for deciding if news are credible or not.

Topic Area: THINKING: Reasoning

E154 - The impact of sleep and retrieval instructions on the implicit learning of relational stimuli

Alissa Gomez[1], Mark Beeman[1]; [1]Northwestern University

Enhanced memory and learning are reportedly benefits of a good night's sleep. Of particular interest, prior research on implicit learning has shown the importance of sleep for one's development of relational knowledge, i.e. how learned stimuli relate to each other (Ellenbogen et al., 2007). Here we utilized an implicit learning paradigm to examine how knowledge is structured in memory during sleep and how retrieval of this knowledge is optimally executed to enable us to make decisions in novel situations. Participants (N = 80) first trained on a set of 8 novel 'virus' stimuli, presented in pairs, and judged which was more dangerous. Unbeknownst to participants, there was an embedded hierarchy amongst the images, such that A>B>C>D>E>F>G>H (participants did not see any labels). These "premise" pairs depicted stimuli adjacent in the hierarchy (e.g., B vs. C; G vs. F). Participants were randomly assigned to return to the lab after a 12-hour interval that either included sleep or not. Upon returning they were re-evaluated on their memory of the premise pairs and asked to make judgments on 9 novel "inference pairs" of the stimuli (e.g., B vs. D; G vs. C). In the first experiment, half the participants were instructed to make these judgments intuitively and showed better memory performance than participants instructed to make analytic judgments. The second experiment examines how this knowledge is structured in memory: whether sleep fosters stepwise, propositional structuring in memory or rather provides a broad overview of the hierarchical information that was implicitly obtained.

Topic Area: THINKING: Reasoning

E155 - A dual process framework of motivated reasoning: Neural and behavioral evidence for the influence of belief endorsement

Brianna Aubrey[1], Katherine L. Alfred[1,2], Jason Liu[1], David J. M. Kraemer[1]; [1]Dartmouth College, [2]University of California, Berkeley

Motivated reasoning causes individuals to prefer conclusions that align with their prior beliefs, rather than conclusions best supported by the available evidence. This process leads people to believe misleading statements about topics like vaccine safety, climate change, or election fraud while discrediting factual information. Comparing patterns of brain activity during different conditions of a logical reasoning task (verbal syllogisms) can help characterize the cognitive and neural processes that lead to motivated reasoning. Correctly evaluating a syllogism requires participants to distinguish between their prior beliefs about a statement and its internal validity in the context of the syllogism. Our findings indicate that motivated reasoning differs on the basis of belief endorsement. When an endorsed belief is challenged, participants display decreased accuracy compared to trials in which evidence supports a statement they do not endorse (and compared to trials in which evidence aligns with their prior beliefs). One explanation for this decrease in performance is that participants ignore conflicting evidence and select the response that aligns with their prior belief without reasoning. However, our results show that participants perceive more conflict and exert more cognitive effort to arrive at a response during these trials, despite reaching the correct conclusion less than fifty percent of the time. This effect is demonstrated by longer response times and differential neural activity in a network of regions that processes response conflict. These distinct response patterns reveal two separate processes of motivated reasoning differentiated by the interaction of belief endorsement and agreement with available evidence.

Topic Area: THINKING: Reasoning

E156 - Neuromodulatory effects of parietal high-definition transcranial direct-current stimulation on network-level activity serving fluid intelligence

Tara D. Erker[1] (tara.erker@boystown.org), Yasra Arif[1], Jason A. John[1], Christine M. Embury[1], Kennedy A. Kress[1], Seth D. Springer[1,2], Hannah J. Okelberry[1], Alex I. Wiesman[4], Tony W. Wilson[1,3]; [1]Boys Town National Research Hospital, [2]University of Nebraska Medical Center (UNMC), [3]Creighton University, [4]McGill University

Fluid intelligence (Gf) involves rational thinking skills and requires the integration of information from different cortical regions to resolve novel complex problems. The effects of noninvasive brain stimulation on Gf have been studied in attempts to improve Gf, however, such studies are rare and the few existing have reached conflicting conclusions. The parieto-frontal integration theory of intelligence (P-FIT) postulates that the parietal and frontal lobes play a critical role in Gf. To investigate the suggested role of parietal cortices, we applied high-definition transcranial direct current stimulation (HD-tDCS) to the left and right parietal cortices of thirty-nine healthy adults (age 19-33) for 20 minutes in three separate sessions (left active, right active, and sham). After completing the stimulation session, the participants completed a logical reasoning task based on Raven's Progressive Matrices during magnetoencephalography (MEG). Significant neural responses at the sensor-level across all stimulation conditions were imaged using a beamformer. Whole-brain, spectrally-constrained functional connectivity was then computed to examine the network-level activity. Behaviorally, we found that participants were significantly more accurate following left compared to right parietal stimulation. Regarding neural findings, we found significant HD-tDCS montage-related effects in brain networks thought to be critical for P-FIT, including parieto-occipital, fronto-occipital, fronto-parietal, and occipito-cerebellar connectivity during task performance. In conclusion, our findings showed that left parietal stimulation improved abstract reasoning abilities relative to right parietal stimulation and support both P-FIT and the neural efficiency hypothesis.

Topic Area: THINKING: Reasoning

E157 - Continuous Effect of Processing Difficulty in Facilitating Analytical Thinking

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While certain studies suggest that experiencing processing difficulties may facilitate analytical thinking, the wider literature displays inconsistent findings. In line with the cognitive load theory, cognitive load created by processing difficulty counteracts the anticipated benefits of the processing difficulty on reasoning which is the potential cause of inconsistencies in the findings. Therefore, it is crucial to investigate the effect of processing difficulties on reasoning while eliminating the concurrent cognitive load from the test material. In contrast to the common methodology of inducing processing difficulty by altering font readability in reasoning task questions, we isolated processing difficulty from the test material to eliminate concurrent cognitive load. We achieved this by creating processing difficulty (via font readability) before presenting the test material. Participants (n=90) first read either easy-to-process or difficult-to-process text about the planet Eris before solving Cognitive Reflection Test (CRT) questions. Subsequently, both groups completed a 5-question CRT written in the easy-to-process font. Participants also reported their confidence in text memory. The group exposed to difficult-to-process text before CRT questions significantly outperformed the easy-to-process text group on the CRT. Although both groups performed equally well in the memory task, the difficult-to-process text condition reported lower confidence in text memory compared to the easy-to-process text condition, confirming trends in the literature. Our methodology for measuring the effects of processing difficulty on reasoning revealed that its impact persists even after removing processing difficulty from the context. Implications of this continuous effect on educational psychology and research methodology will be discussed.

Topic Area: THINKING: Reasoning

E158 - Cognitive components of semantic memory search and implications for creative ideation

Lucie Vigreux[1], Victor Altmayer[1], Marcela Ovando-Tellez[1], Emmnuelle Volle[1]; [1]Sorbonne University, FrontLab at Paris Brain Institute (ICM), INSERM, CNRS, Paris, France

Creative ideas likely result from searching and combining semantic memory knowledge, yet the mechanisms underlying memory search remain unclear. Using an associative fluency task based on polysemous words (PolyFT), Ovando-Tellez et al. (2023) distinguished two search components related to Clustering (exploiting a given meaning) and Switching (changing for another meaning) that correlated with creative abilities. To extend and replicate these findings, 92 French-native participants underwent a computerised version of the PolyFT, using the original three cue-words, and 46 additional polysemous cue-words. Responses were classified according to the different possible meanings of each cue-word and inter-response time was recorded. In addition, participants completed a set of established creativity tasks, executive tests, and a relatedness judgement task to build individual semantic networks. Using a Principal Component Analysis, we were able to distinguish two search components related to Clustering and Switching, replicating the initial study. Similar components were found on both the original and extended set of words. As in the original study, we found significant correlations of these two search components with creativity and executive tests and revealed novel relationships between Clustering and Switching and the properties of semantic networks. Overall, our results replicate and extend prior findings, identifying cognitive components of memory search related to creativity. Additionally, these findings reinforce the validity of PolyFT in investigating semantic memory search processes and demonstrate the task's feasibility in diverse settings.

Topic Area: THINKING: Reasoning

E159 - Localization of acquired deficits in oral word reading versus silent word reading in post-stroke alexia

Elizabeth H.T. Chang[1] (ec1312@georgetown.edu), Sara M. Dyslin[1], Andrew T. DeMarco[1], J. Vivian Dickens[1,2], Peter E. Turkeltaub[1,3]; [1]Georgetown University Medical Center, [2]University of Pennsylvania, [3]MedStar National Rehabilitation Hospital

Patterns of acquired reading impairment (alexia) reflect deficits in orthographic, phonological, or semantic processing. Even though most reading in daily life is silent, prior research of post-stroke alexia primarily relies on oral word reading tasks. This study aims to dissociate the contributions of left-hemispheric brain regions to accurate oral reading versus silent visual word reading. We hypothesized that oral word reading would depend more on the dorsal phonological system, whereas silent word reading in a lexical decision task would rely more upon the ventral semantic system. Support Vector Regression Lesion-Symptom Mapping (SVR-LSM) was employed on a cohort of 68 left-hemisphere stroke survivors (age=61.5 (11.3); gender=39 M, 29 F; months since stroke: 49.4 (57.7)). Inaccurate word reading correlated with lesions in the left supramarginal gyrus and left superior temporal regions, after covarying for lexical decision performance, age, education, and lesion volume (voxelwise p<.005, cluster p<.05, 1000 permutations). Inaccurate lexical decision correlated with lesions in the left angular gyrus and left middle temporal regions after covarying for oral word reading, age, education, and lesion volume. Lesions in the left ventral occipitotemporal cortex correlated with inaccurate performance on both tasks. In line with our predictions, these findings suggest differential reliance on phonological versus semantic processing in oral versus silent reading. Specifically, inaccurate oral reading is more reflective of phonological deficits, whereas inaccurate silent word reading is more reflective of semantic deficits. Elucidating pathways for different types of reading may lead to individualized treatment tailored to specific reading deficits after stroke.

Topic Area: LANGUAGE: Other

Poster Session F

Tuesday, April 16, 2024, 8:00 – 10:00 am, Sheraton Hall ABC

F1 - Brain-body interaction during auditory narratives drives autonomic function

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When people listen to auditory narratives both neural and physiological signals can synchronize between people, but the relationship between these signals, and the underlying mechanism is unclear. We hypothesized a top-down effect of cognition on arousal, and predicted that auditory narratives will drive not only brain signals but also peripheral physiological signals. Despite the lack of visual stimuli, we find that auditory narratives entrain eye movements, saccade initiation, blink onset, pupil size, and heart rate. This is consistent with a top-down effect of cognition on autonomic function. We elaborate on the underlying mechanism by investigating the brain-body interaction when people listen to auditory narratives and at rest. We found an anterior-central EEG scalp potential that correlates with heart rate, pupil size and gaze variation. In addition, we hypothesized a bottom-up effect, whereby autonomic physiology affects arousal. To investigate this bottom-up effect we conducted controlled experiments asking people to breathe in a rhythmic fashion, saccade rhythmically to a dot pattern and vary luminance modulating the pupil size. We found that controlled breathing not only affected heart rate but also pupil size. During controlled saccades we found the heart rate entrained to specific rhythms whereas controlled luminance did not have a widespread effect on other physiological signals. Together this suggests bidirectional causal effects between peripheral autonomic function and central brain circuits involved in the control of arousal.

Topic Area: ATTENTION: Multisensory

F2 - Neural indices of multisensory processing disturbances in people with multiple sclerosis

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People with multiple sclerosis (PwMS) commonly experience cognitive disturbances that negatively impact daily functioning. However, while cognitive dysfunction is often recognized in MS, multisensory processing has been largely understudied. Multisensory processing warrants further investigation in MS, as day-to-day experiences often necessitate attentional control over simultaneous auditory and visual information. To address this gap in knowledge, PwMS and healthy control participants completed a multisensory (audio-visual) processing paradigm in which target and non-target stimuli consisted of visual stimuli (blue/red circles) and/or auditory stimuli (high or low tones). On some trials, auditory and visual stimuli were presented in isolation (unimodal), whereas on other trials, both auditory and visual stimuli were presented simultaneously, eliciting multisensory processing. Ongoing electroencephalographic (EEG) data were obtained during task performance, and the event-related potential (ERP) was derived for different trial categories. On average, PwMS tended to have delayed response speed across all trial types in comparison to the control group, and these differences tended to be most pronounced during unimodal trials (auditory or visual stimulus only). During multisensory target trials (auditory and visual targets presented simultaneously) PwMS demonstrated attenuation of ERP amplitude compared to the control group at 100 msec after stimulus onset for anterior midline electrodes, and at 300-500 msec post-stimulus for posterior midline electrodes, suggesting disturbances in selective attention and stimulus categorization, respectively, during multisensory processing. The findings demonstrate that MS neuropathology can impact multisensory integration, and that this aspect of cognition warrants further investigation to address the full spectrum of disturbances experienced by PwMS.

Topic Area: ATTENTION: Multisensory

F3 - Tracking the Neural Signatures of Predictive Cross-Modal Sensory Processing

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Attention is a fundamental cognitive process that extends its influence across various sensory modalities, playing a pivotal role in the integration and processing of multisensory information. Recent studies have proposed that alpha oscillations within 8-12 Hz range may contribute to cross-modal attention, but this remains a topic of debate. Our study investigates the neural basis of cross-modal attention and its relationship to changes in alpha-mediated focal cortical excitability. We recorded EEG from 32 participants engaged in a cued cross-modal attention task. Participants were cued aurally or visually on a trial-by-trial basis to direct attention either to auditory or visual modalities, where they assessed targets (visual gratings/auditory tones). Decoding alpha power using SVM uncovered distinctive patterns in early and late latencies during the cue-to-target period. Alpha oscillations exhibited unique cortical patterns based on the to-be-attended target modality. We found robust decoding accuracies for the to-be-attended modality within respective sensory areas, i.e., central electrodes for the auditory and parieto-occipital electrodes for the visual modality. Temporal generalization further illustrated the evolving nature of alpha patterns over time. For both modalities, our findings indicated the sustained representation of sensory information in a serial

manner across the hierarchy, emphasizing the maintenance of predictive processing. Furthermore, an alignment between cortical alpha patterns during stimulus processing and the response window suggested a connection between prediction signals and decision-making processes. Our findings contribute to understanding the role of alpha oscillations in cross-modal attentional control. This work extends the current framework for decoding the neural mechanisms of cross-modal attention.

Topic Area: ATTENTION: Multisensory

F4 - Suppression of audiovisual integration to facilitate covert attention: implications for cochlear implant users

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Flexibly processing and attending to sensory information is crucial for navigating complex environments. Multisensory integration aids in these processes by combining complementary signals into highly salient multisensory percepts. Stimuli can also be selectively ignored or attended, further facilitating efficient processing. Spoken language is an example of a multisensory signal, consisting of auditory information and complementary visual cues produced by articulators. Here, we present two experiments that examined the impact of multisensory integration on speech processing in cochlear implant (CI) users, for whom the spatial and frequency content of speech is significantly degraded. In experiment one, sentences were presented at various audiovisual offsets and intelligibility was assessed. Across both CI users and typically hearing listeners, intelligibility was greatest for near-synchronous audiovisual stimuli. However, at large asynchronies (i.e., beyond the bounds of what is physiologically possible), only typically-hearing listeners appeared to ignore misaligned visual cues and focus on auditory information. To further examine how the relative salience of auditory and visual cues affect a listener's ability to attend to or ignore multisensory speech, participants in experiment two listened to simultaneous but spatially distinct streams of audiovisual and audio-only speech while listening monaurally (i.e., in the absence of robust spatial cues). Initial results suggest that during monaural listening, visual cues are more salient and less easily ignored than in the binaural condition. Combined, these results suggest the reduction in spatial cues provided to CI users may render them less likely to disengage from visual speech cues, even when they no longer support intelligibility.

Topic Area: ATTENTION: Multisensory

F5 - Attentional Control Of Multimodal Distractor Processing In Adults: Neurophysiological Evidence.

Edwin Roberto Ramírez Benítez[1,2] (10081996edwin@gmail.com), Rodolfo Solís Vivanco[1,2]; [1]"Manuel Velasco Suárez" National Institute of Neurology and Neurosurgery, [2]Faculty of Psychology, National Autonomous University of Mexico, UNAM

The attentional control's ability to inhibit distractor processing has been extensively documented in unimodal attention tasks, where the distractor and relevant stimulus belong to the same sensory modality. However, little is known about the neurophysiological processing of distractors in relation to their congruence with the relevant stimulus under multimodal conditions. Consequently, the aim of this study was to analyze the temporal and topographic changes in event-related potentials (ERPs) associated with the congruence effect between targets and distractors during a crossmodal attention task involving alternating attention between sensory modalities (visual and auditory). The congruence effect was derived by subtracting ERPs of incongruent conditions from congruent conditions for each sensory modalities. Non-parametric permutation analyses using the Monte Carlo method (500 permutations) were conducted for each modality on parieto-occipital and fronto-central electrodes between -0.2 and 1.1 seconds relative to the presentation of stimuli and distractors. Results revealed a significantly greater congruence effect on visual attention ERPs compared to auditive attention ERPs. In the congruency effect, a more early and negative amplitude over fronto-central regions at 130-200 ms post-stimuli was observed in the visual attention condition compared to auditory attention. Moreover, a heightened congruence effect between the 170 to 200 ms range with a fronto-central distribution correlated with increased congruence effects in reaction times. In conclusion, the processing of congruent distractors in crossmodal attention tasks is modulated by the attentional locus, exhibiting distinct patterns for each sensory modality. These findings contribute to the understanding of the neurophysiological mechanisms underlying multimodal attention.

Topic Area: ATTENTION: Multisensory

F6 - Age-Related Effects on Crossmodal Switching: An Event-Related Potential Study

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The human experience is inherently multisensory, with the integration of sensory information playing a crucial role in perception and behavioral performance. As individuals age, there is a decline in basic auditory and visual processing abilities, prompting questions about the impact on crossmodal switching with age. This study recruited a total of 72 participants, including 36 younger adults (18-26 yrs.) and 36 older adults (63-80 yrs.), using a cued crossmodal attention switching paradigm. Visual and auditory targets were simultaneously presented on congruent or incongruent sides, requiring participants to judge the relevant modality target's location based on cues. EEG recordings were collected during task performance. Results, based on the formal analysis of 28 older adults and 34 younger adults, indicated that older adults exhibited longer reaction times and more errors. Mixing costs (single task vs. mixed-task block) and switch costs (repeated vs. switch trial in mixed-task block) were more prominent in older adults. Event-related potential components, including N1, N2, P3, and LRP, reflected age-related effects on mixing costs, particularly on N2 and LRP onset latency. This suggests that older adults faced challenges in resisting interference from other modalities, leading to delayed response selection, especially during auditory trials. These findings suggested that older adults struggle more with visual distractors, influencing the processing of auditory trials. These findings align with previous research highlighting the difficulty older adults face in filtering out visual distractions.

Topic Area: ATTENTION: Multisensory

F7 - Seeing Speech in a New Light: Augmenting Speech Performance using Lip Movement with Imperceptible Light

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In challenging listening conditions, speech comprehension can be improved through the utilization of visual cues, particularly those related to lip movement. However, can speech comprehension be further enhanced by adopting a proactive approach, such as employing non-invasive rhythmic stimulations over the sensory areas and inducing their intermodulation effects? This study aimed to investigate the causal and modulatory effect of audiovisual speech integration in challenging listening conditions by employing the rapid (yet imperceptible) frequency tagging (RIFT) technique with low-frequency amplitude modulation, measured through magnetoencephalography (MEG). The current study employed a naturalistic audiovisual speech paradigm in conjunction with a dichotic listening task, where participants directed their attention towards one of two speakers while ignoring the other. The lip movements of the speaker were tagged at 55 Hz while the auditory speech was tagged at 40 Hz. Additionally, to examine the impact of rhythmic modulation on speech comprehension performance, the visual tagging frequency was modulated by the low-frequency amplitude derived from either the attended or unattended speech while brain activities were captured using MEG. The results revealed significant effects of both auditory and visual tagging in their respective sensory cortices across all experimental conditions. Moreover, higher-order brain regions exhibited representations of intermodulation frequencies in the right temporo-parietal junction and superior/middle temporal gyrus, specifically in the condition where the visual tagging was amplitude-modulated by the attended speech. These findings highlight the potential of non-invasive sensory stimulation through RIFT as a promising tool for enhancing speech intelligibility, particularly in environments where multiple speakers are present.

Topic Area: ATTENTION: Multisensory

F8 - Cross modal attention through the three sensory modalities in human adults: an EEG study

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Some studies showed that cross-modal stimuli in an oddball task can be influenced by the context (sense of standard stimuli). However, only a pair of sensory stimuli was usually investigated, while all the modalities have never been systematically compared. Here, for the first time, we tested whether a difference exists between the sensory modalities in capturing attention in a cross-modal context. Therefore, we implemented an audio-tactile, audio-visual, and visuo-tactile oddball paradigm. Each bi-sensory task consisted of 70% standard, 10% same-sense oddball, 10% cross-modal oddball, and 10% multisensory oddball stimuli in 15 participants. Each task had at least one standard stimulus before every oddball stimulus. EEG data were recorded with 64 active scalp electrodes. Our results showed a significant effect of the cross-modal oddball when we compared it with the same-sense oddball on P300 event-related potentials (ERP) for each task considered. Moreover, changes also in the earlier attentive ERP components were found when we considered the same cross-modal audio or tactile oddball with a different sensory standard, tactile or visual in the first, and audio or visual in the second. Specifically, standard visual stimuli seem to higher modulate the cross-modal oddball response. In conclusion, cross-modal stimulation evoked a greater attentional activation compared with the same modality. Furthermore, audio and tactile cross-modal stimuli can be influenced by context, particularly the standard visual stimuli. This suggests that vision is the predominant sense and can modulate attention towards other sensory modalities. This work is funded by EU H2020, ERC StG' MySpace, Grant Agreement No.948349.

Topic Area: ATTENTION: Multisensory

F9 - Connectome-based predictive modeling of mind wandering within densely-sampled individuals

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Neuroimaging studies have evidenced that mind wandering can be predicted from whole-brain patterns of functional connectivity at a group-level. Given the large amount of variability present in individual mind wandering experiences, whether group-level models are effective in predicting mind wandering at the individual level remains to be seen. Using data collected in a dense-sampling fMRI study, we sought to answer this question. Participants (n=3) performed a "resting state" visual fixation task with interspersed thought probes across multiple sessions, resulting in 10 hours of scanning and 350 probe trials each. We applied connectome-based predictive modeling (CPM) within individuals, based on functional connectivity within 30-second windows prior to thought probes, using five-fold and leave-one-trial-out cross-validation. These personalized models, which revealed significant prediction of mind wandering within each subject, were each explained by idiosyncratic whole-brain features. The default mode network, the network most widely associated with mind wandering, could be used to significantly predict mind wandering in all subjects, but functional connections important for prediction were variable across subjects. We then tested model generalizability across subjects using both cross-subject training of the personalized models generated by our analyses as well as two published group-level CPMs (stimulus-independent and task unrelated thought and sustained attention CPM). Neither the personalized models, nor the group-level models, significantly predicted mind wandering in all three subjects. These results suggest that the neural basis of self-reported mind wandering is variable across individuals and more broadly demonstrate the importance of applying individualized models in neuroimaging studies and clinical contexts.

Topic Area: ATTENTION: Other

F10 - EEG Neural Oscillatory Correlates of Focal Attention during Speech Auditory Feedback Error Detection and Motor Control

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Objective: The present study used a novel altered auditory feedback (AAF) paradigm to investigate how attentional mechanisms affect speech auditory feedback error detection and motor control, as well as the role of neural oscillations and their associated mechanisms in this context. Method: Electroencephalography (EEG) and speech data were recorded from 21 neurologically intact participants in an AAF paradigm. Participants were directed to focus on the auditory feedback and respond by pressing a button to indicate the detection of a pitch-shift stimulus. Data from this group was contrasted with 22 subjects who completed the same AAF task without attentional instructions. Behavioral data were extracted by measuring speech AAF compensation and percentage of correct button press responses, and event-related spectral power of EEG neural oscillations was extracted using time-frequency analysis within distinct frequency bands encompassing theta (4–8 Hz), alpha (8–13 Hz), low beta (13–20 Hz), high beta (20-30 Hz), and gamma (30–80 Hz). Results: Our data revealed a significantly enhanced high-beta band desynchronization and smaller magnitudes of speech compensation for the attention group. In addition, the time-frequency analysis showed a positive linear association between speech compensation magnitude and the gamma band power, as well as positive relationships between button press accuracy and alpha and low-beta band power. Conclusion: These findings suggest attention results in more stable speech output (i.e. smaller compensation) in response to pitch perturbations in auditory feedback. In addition, the findings also highlight the effect of focal attention on the neural mechanisms of speech error detection and sensorimotor control.

Topic Area: ATTENTION: Other

F12 - Engagement Fluctuations during Collaborative Learning: A Real-World EEG Study

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Collaborative learning is known to be effective, but not all students engage and benefit from it. Here, we conducted electroencephalography (EEG) recordings in a real-world classroom to examine how students engage in a collaborative learning task. A total of 36 high school students participated in the study in groups of four. Students were equipped with portable, 32-channel EEG devices and were instructed to collaboratively make a model of a cell. Student learning was assessed at the end of the EEG session using a test. The sessions were video recorded, and the behavior of each student was coded in 5-second segments, and classified as "on-task," "off-task," or "idle." Analysis of the video data indicated that students alternated between on- and off-task states every 10 to 20 seconds. The amount of time students were continuously on-task was positively correlated with their test performance. Additionally, students were idle for about 13% of the time, meaning that they were not explicitly engaged with the task. However, based on behavior alone, it is challenging to assess how engaged students are cognitively. EEG analyses revealed that students exhibited higher alpha (8-12 Hz) activity when they were off-task compared to on-task, especially in posterior EEG electrodes. During idle periods, students' alpha brain activity was indistinguishable from their brain activity during off-task periods. These findings provide key new evidence for the value of brain data collected in real-world learning settings.

Topic Area: ATTENTION: Other

F13 - Attentional tracking drives contralateral delay activity in a dual working memory and object tracking task

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Recent work suggests visual working memory (VWM) capacity may be limited by the assignment of spatiotemporal pointers to individuated objects, not stimulus information exactly (Thyer et al., 2022). We examined the contralateral delay activity (CDA), an event-related potential thought to track VWM load. The CDA amplitude has been shown to reflect the number of attended targets during multiple-object tracking (Drew and Vogel, 2008), but also the number of to-be-remembered items (i.e. colors; Vogel and Machizawa, 2004). We developed a novel dual-task paradigm to directly contrast the effects of attentional tracking load and stimulus content load on the CDA. Participants tracked either one or two moving discs (attentional tracking load), with either two or four total colors displayed within the discs (working memory load). Participants completed two conditions: a 'tracking only' condition (similar to multiple-object tracking), where participants ignore the colors and maintain attention on the moving discs, and a 'tracking plus memory' condition (similar to multiple-identity tracking), where participants tracked the discs as well as encoded the shown colors. The critical question was whether CDA amplitude would be determined by the number of individuated items tracked, or by the number of distinct colors associated with the currently tracked items. CDA amplitude was largely determined by the number of items tracked (attentional tracking load), with no discernible effect of the number of colors per tracked item. These findings suggest

the CDA reflects the number of spatiotemporal pointers for moving objects, not the identity of those objects.

Topic Area: ATTENTION: Other

F14 - Electrophysiological Analysis of Attention Deficit Hyperactivity Disorder (ADHD) Subtypes: A Subnetwork Modularity Approach

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The neurobiological basis of Attention Deficit Hyperactivity Disorder (ADHD) and its subtypes is not well understood, with some studies suggesting that ADHD-I and ADHD-C may have different neural foundations. This study uses a subnetwork modularity approach based on graph theoretical analysis of EEG data to investigate the neural basis of ADHD and its subtypes. The LORETA algorithm was used to estimate current densities in 84 regions of interest (ROIs) in the cortex and calculate functional connectivity between these ROIs in different EEG frequency bands. The modularity of five functional brain networks (default mode, central control, salience, visual, and sensorimotor) was evaluated using the Newman modularity algorithm. Edge betweenness centrality was also used to assess communication between these functional brain networks. The study found that different brain networks have modularity in certain frequency bands, and ADHD groups showed reduced modularity of the visual network compared to normal groups in the alpha1 band (8-10 Hz). The communication between the visual network and other brain networks, except the salience network, was also reduced in ADHD groups (in the alpha1 band). However, there were no significant differences in the modularity of brain networks and communication among them between two ADHD subtypes. The results suggest a novel mechanism for ADHD involving lower intrinsic modularity in the visual network, disturbed communication between the visual network and other networks, and potential impact on the function of control and sensorimotor networks.

Topic Area: ATTENTION: Other

F15 - Examining individual differences in inward versus outward attentional control: the attentional preference questionnaire

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Attention is a multifaceted phenomenon, with individuals varying in how they allocate and manage their attentional resources. Moreover, individuals may express similarly unique attentional preferences when trying to maintain concentration (i.e., attentional control). Here, we investigate whether some individuals find it easier to stay focused in the face of inward (self-generated) distractions while others find it easier to shut out environmental distractions. By specifically surveying internal and external facets of attentional control, the present study explores the different ways individuals can modulate and direct their attention and how this interacts with other cognitive traits or behaviors. We've developed the Attentional Preference Questionnaire (APQ) to survey an individual's preference for either external or internal attentional control. Participants (N = 541) were given 30 minutes to complete three questionnaires: Need for Cognition, Mind-Wandering, and the APQ. After running analyses to ensure strong reliability and internal consistency, we investigated the structure of the APQ via principal component analysis (PCA), which resulted in one question being excluded from the final questionnaire. We then uncovered a three-factor structure via exploratory factor analysis (EFA), which suggests that the APQ measures three facets of attention, which are mapped onto questions surveying internal, external, and general attentional control. The Attentional Preference Questionnaire can serve as a crucial tool for investigating attentional control preferences. In addition to enhancing our understanding of attentional control, this study lays the foundation to explore how these preferences influence a variety of cognitive processes, including creative problem-solving.

Topic Area: ATTENTION: Other

F16 - EEG Signatures of Orienting Attention to Long-Term vs. Working Memory Contents

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Internal attention selects and prioritizes contents within memory representations to guide future behavior. Most studies have considered internal attention within working memory (WM), but selection and prioritization can also occur within long-term memory (LTM). The neural processes engaged by internal attention in LTM are poorly understood. To compare directly internal attention in LTM and WM, we recorded EEG signals from participants engaged in a task where they were presented with a four-placeholder array, featuring two locations for immediate working memory encoding and two associated with pre-learned long-term memory items. A brief delay after a color-based retrocue, participants reproduced the shape of the cued item. Multivariate pattern analysis was able to able to decode the memory domain of the cued item (WM vs. LTM) during the delay, suggesting that internal attention in LTM and WM is at least partially dissociable. Additional EEG and ERP markers also highlighted differences in selecting and prioritizing LTM and WM contents. Even though spatial attention was not strictly required by the task, orienting attention to WM items showed signs of spatial modulation (lateralized event-related potentials and 8-12 Hz alpha-power lateralization). In contrast, spatial modulations were not conspicuous for internal attention in LTM. Instead, non-lateralized theta power (3-7 Hz) was higher when selecting an LTM item. Our findings suggest that orienting attention to LTM contents involves different neural mechanisms compared to WM. Selecting an item in LTM, therefore, may not be contingent on reinstating a WM representation but instead rely on a different memory format.

Topic Area: ATTENTION: Other

F17 - Tracking task-specific activity in dual-task condition with ultrafast fMRI resolves the neural locus of a central bottleneck of information processing

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Pashler (1984) showed that our ability to perform two attention-demanding tasks at the same time is limited by a central amodal stage of information processing, resulting in the postponement of the second task until central processing of the first one is completed. The neural locus of this central bottleneck has remained elusive because of the intractability of distinguishing task-specific information under dual-task conditions as each task processes through the brain. Here we show the feasibility of using ultra-fast (199ms TR), high-field fMRI (7T) with MVPA to distinguish the brain activity of two arbitrary sensorimotor response selection tasks – each involving 8-alternative discriminations resulting in single-task RTs of over 1 second – as participants (n=26) performed the tasks when they were overlapping (300ms SOA) or not (1500ms SOA). The behavioral results revealed a psychological refractory period (PRP) exceeding 500ms at the short vs long SOA. Using univariate and multivariate fMRI analyses, we traced the flow of information processing of each task through sensory, central amodal, and motor areas. We observed postponement of Task 2 activity of the duration of the PRP at short but not long SOA in a subset of amodal fronto-parietal areas while earlier sensory stages were unhindered. These results provide direct neural evidence for serial queuing of central information processing under overlapping dual-task conditions and identify the neural substrates of the central bottleneck. The findings also demonstrate the feasibility of using ultra-fast fMRI and multivariate analyses to track the flow of information processing in the human brain.

Topic Area: ATTENTION: Other

F18 - How Internal Attention Impacts Learning from Online Lectures

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Maintaining attention for long periods of time (for example, during an online lecture) is challenging because attention, by its nature, is dynamic and often fluctuates between perceptually guided and self-generated thoughts (external and internal attention, respectively). This in-progress study examined the hypothesis that providing learners with opportunities to shift their attention internally during a lecture can improve their learning. To test this hypothesis, we collected EEG data from 98 undergraduate students while students watched a 30-minute pre-recorded science lecture, divided into six 5-minute segments. In the experimental condition, internal attention ("thinking") periods were inserted between lecture segments. During these periods, participants were instructed to quietly think about a lecture-related prompt for 60 seconds before

typing their answer. In the comparison condition, participants were simply asked to press a button to advance from one lecture segment to the next. Preliminary results indicate that participants learned better from lectures interspersed with thinking periods compared to uninterrupted lectures. Analysis of the EEG data demonstrates that EEG power in the alpha band (8-12Hz) was higher during uninterrupted lectures compared to lectures interspersed with internal attention periods. These findings suggest that providing structured opportunities for students to shift their attention internally can improve their overall attentiveness and learning.

Topic Area: ATTENTION: Other

F19 - Gaze cues of human avatars trigger joint attention in macaque monkeys

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Joint attention is a fundamental ability of humans and other social primates. Gaze direction could be informative of the behavioral relevance of environmental objects. Paradigms to explore joint attention usually involve measurements of gaze in at least two subjects making it difficult to conduct with non-human primates. Here we show a novel paradigm using avatars in a virtual environment while monitoring gaze behavior and joystick responses of monkeys. We trained two rhesus monkeys to respond to a human avatar's attention by moving a joystick towards the gazed-at object. We designed social cues by applying natural eye and head movements on a highly realistic avatar. Trials began with the avatar gazing at the animal. After 500 ms, the avatar's gaze shifted towards one of four virtual objects, cuing the animal to move its joystick accordingly for a juice reward. In 10% of trials, the avatar gaze moved in a random direction between two objects. The animals successfully responded to the avatar's gaze (90% task performance). A classifier, trained on eye positions during the 350 ms cue period, achieved 80% accuracy in predicting animal's choice. In catch trials, accuracy decreased to 53%, because the animals directed gaze to one of the two objects closest to the avatar's gaze position, indicating the animals still follow joint attention gaze cues. Our results demonstrate the use of human avatars in experimental setups to explore joint attention in macaque monkeys. It also demonstrates a degree of cognitive flexibility and extrapolation of human gaze cues in macaques.

Topic Area: ATTENTION: Other

F20 - Interoceptive attention and heartbeat detection: Highly aware but confused?

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Previous brain imaging work in our lab has shown that boredom down-regulates the insular cortex, a key region related to interoceptive processing. These physiological sensations provide information on the changing body states such as the feeling of butterflies in one's stomach. To probe for a link between boredom and interoception, we collected a large adult sample (N=350, Mage=38, SD=11) of self-reported interoceptive abilities. We found two novel and particularly intriguing strong positive correlations between boredom proneness (i.e., trait boredom) and i) self-awareness, and ii) interoceptive confusion. These findings suggested that boredom prone individuals attend inordinately to their internal states but struggle to make sense of what they perceive. The present work collected experimental data on interoceptive accuracy and boredom using a heartbeat detection task. Preliminary analysis of our sample (n=103) replicated both boredom proneness relationships with self-awareness and interoceptive confusion. Moreover, preliminary analysis of the heart rate counting task revealed a positive correlation between interoceptive confusion and higher error rates on the heartbeat detection task. This preliminary finding suggests that participants who report being confused by their bodily signals do fail to perceive a high number of heartbeats. We anticipate that this failure of interoceptive attention for the highly boredom prone will arise despite self-reported higher awareness of bodily signals.

Topic Area: ATTENTION: Other

F21 - My Brain Matters: How Multimodal Intra-Individual Classifiers Reliably Predict Attention, While Inter-Individual Classifiers Do Not

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Introduction. While the nature and impacts of attention have been hotly debated in the neuroscience community since the field's origins, the nature of classroom attention, and how students deploy it dynamically over time to learn effectively, is still a nascent field by comparison. Method. We measured brain activity via mobile EEG headsets, facial action amplitudes, posture, and trained observer ratings in real-time in a real classroom during lecture activities to compare the predictability of objectively defined attention via in-class quiz performance and subjectively defined attention via in-class self-reports. Results. Our findings suggest that objectively defined attention is better predicted by the combination of these data than subjectively defined attention, and further, that predicting attention intra-individually (i.e., using subject A's brain, face, body, and observer-rated data at time t to predict subject A's attention at time t + 1 (or time t + 100) is highly reliable, while predicting attention inter-individually (i.e., using subject A's data to predict subject B's attention) is highly unreliable. Discussion. Our findings suggest that in-classroom models and systems designed to predict or provide feedback to teachers or students on the level of students' attention in the classroom requires, with current technology, training classifiers on every student in the classroom, rather than a subset of them. Further, they suggest that the combination of brain, face, body, and observer data better explain variation in objective performance than subjective reports, and this carries implication for studies that exclude one or the other form of data in operationalizing classroom attention.

Topic Area: ATTENTION: Other

F22 - Decoding EEG Correlates of Willed Overt Attention During Visual Search

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Cognitive neuroscience studies of attention have predominantly investigated top-down attention using attention-directing cues. Recent work has begun to investigate self-generated (uncued) shifts of covert spatial attention (willed covert attention). Here we consider the neural correlates of willed overt attention. Studies of willed overt attention share some properties with research on self-generated motor actions (willed action). In willed action, a well-established finding is that neural correlates of an action can be identified seconds prior to the onset of action. In an overt attention visual search paradigm that required a motor action (saccadic eye movements) upon the onset of a search array, we investigated whether the direction of a first saccade from central fixation can be predicted by the pattern of brain electrical activity in the period prior to the onset of the search array and the subsequent first saccade. Applying support vector machine decoding to EEG voltage data, we found that the direction of the first saccade can be decoded throughout the 2 sec period before the onset of the search array. This finding suggests that (1) in willed overt attention, the predictive EEG patterns were not limited to alpha-band power as hypothesized from prior work on willed covert attention, but were found in the broadband EEG voltage data, and (2) motor actions that are not purely self-initiated can also be decoded seconds prior to the onset of the action, extending the previous studies of willed action in which the action is fully self-determined.

Topic Area: ATTENTION: Spatial

F23 - Test for Inhibition hypothesis and EEG alpha rhythm in visual detection: preliminary findings

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The cortical areas related to a given task show attenuated alpha power (8-13 Hz), and those unrelated to the task show strong alpha. Some suggested alpha represents the electrophysiologic mechanism that activates/suppresses cortical activities. In this preliminary study, we tested the causality claim (i.e., inhibition hypothesis), hypothesizing that if it held, alpha power would be higher in the high noise condition (difficult) than in the low or no noise (easy) conditions. Ten adults (4 males) participated: they viewed a movie consisting of a baseline blank screen (2s), followed by static random noise (1.6, 1.8, 2.2s). Then, with the noise on the screen, a static Gabor target (4 angles) gradually increased in intensity (3.2s), to a maximum (1.6s), then gradually decreased (3.2s), and the noise only (2s). Participants pressed keys to indicate the

appearance and disappearance of the target. Noise level was manipulated through luminance modulation and target luminance was constant across conditions. Trials were randomly intermixed into three blocks. A VIEWPixx/EEG monitor generated movie frame-based event markers, and EEG signals were recorded using a 64-channel EEG system (R-net with actiChamp Plus, Brain Products). All channel analyses showed that alpha power attenuated at the onset of the noise on average, with no power difference across conditions. The difference in alpha power attenuation was observable between conditions only when the target was seen, with the largest power reduction in the difficult condition. These tentative results are not in line with the causality claim for alpha.

Topic Area: ATTENTION: Spatial

F24 - Cueing Spatial Attention Within Visual Mental Imagery and Perception

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Introduction: Can auditory cues be used to direct spatial attention toward a feature of an imagined target stimulus? We tested this possibility against well-known effects in visuospatial cueing studies, by presenting either visual or auditory 7-letter words (750ms), containing a target feature in the form of a letter that protrudes above or below an imagined number line (e.g., the letter "g" in manager). Methods: Participants (n = 53) indicated whether the target letter was surpassing above or below using a button press. Visual targets were preceded by visuospatial cues. (asterisks presented on the screen for 500ms), while imagined targets were preceded by auditory cues (1000 Hz or 1500 Hz beep tones in their right or left ear). Valid cues (64 trials) oriented toward the visual or imagined hemifield where the protruding letter was presented, while invalid cues oriented attention towards the other hemifield (24 trials). Results: The 3-way ANOVA with factors Task (Visual, Imagined) x Validity (Valid, Invalid) x Cue Side (left, right) conducted on Reaction Time (RT) showed that the Validity by Cue Side, Validity by Task, and Cue Side by Task interactions were significant. In summary, we observed a facilitation effect for visual targets (valid RT: 608 ± 130ms; invalid RT: 716 ± 151 ms) and an inhibition of return (valid RT + SD: 1421 ± 280 ms; invalid RT + SD: 1361 ± 269 ms) for imagined targets. Discussion: These results suggest there are different underlying attentional mechanisms supporting visual perception and VMI, warranting future investigations.

Topic Area: ATTENTION: Spatial

F25 - High-Gamma oscillations in the SLF I network predict conscious perception of attended visual targets

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Introduction. "Look over there" is a common phrase we have all heard in our life. But how does brain responses to a cue help conscious perception of an impending target? Here, we studied how brain oscillations observed following the presentation of predictive peripheral cues benefit conscious perception. Method. Fourteen participants completed a task with spatially predictive supra-threshold peripheral cues (50 ms) preceding by 250 ms the presentation of near-threshold Gabor targets (16 ms). Performance differences in consciously perceived targets between validly cued (same side) and invalidly cued (opposite side) trials were analyzed via a Conscious Reports (Seen, Unseen) x Validity (Valid, Invalid) ANOVA. MEG recordings during the cue-target period underwent time-frequency decomposition analyses to explore the Validity by Conscious Reports interaction. Oscillatory patterns within regions of interest in the Superior Longitudinal Fasciculi (SLF) were submitted to nonparametric testing. Results. The greater discrimination accuracy for seen compared unseen targets ($p<.0001$) was associated with increased gamma oscillations (~60 Hz) during the cue-target period (~158 ms post-cue) in the right superior frontal gyrus, a node of the SLF I network. Further, high-gamma oscillations in both the superior frontal and superior parietal nodes of the right SLF I, as well as their coherence, were greater for seen compared to unseen trials for valid but not for invalid trials. Discussion. Our results indicate that the high-gamma oscillatory activity within the right SLF I plays a crucial role in guiding attention during the cue-target period.

Topic Area: ATTENTION: Spatial

F26 - Explicit Cueing Effects on Attention are Stable Across Days; Experience-Based Effects Are Not

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In a previous experiment, we found that explicit cueing of a target location yields both internally-consistent (reliable) behavioral effects and test-retest reliability across days. These results suggest that attention driven by explicit cueing yields stable, trait-like, effects that are relatively immune to state changes across days (e.g. sleep quality) or selection history (e.g. priming). Here we tested whether experience-based attention also yields internally-reliable and consistent individual differences measures across days. Participants completed a statistical learning experiment where they learned the likely (frequent) location of the target shape-singleton in a four-item array; distractor color-singletons were sometimes present. Participants returned three to eight days later to complete a second session of the same experiment. We found that individual differences measures (reaction time and accuracy) of target frequency (infrequent - frequent target location) yielded internally-reliable individual differences measures in both sessions one and two, suggesting that participants had stable and consistent behavior within each experimental session. In contrast to our explicit-cueing results, however, we found that measures of the target frequency effect did not correlate across sessions, suggesting that participants' experience-based behavior is reliable within days, but not across days. We additionally found that the effect of distractor presence (distractor present – absent) on reaction time and accuracy yielded both internally-reliable individual differences measures and test-retest reliability. Together, these results suggest that, whereas attention driven by explicit cueing and task rules is trait-like and less affected by changes in states, experience-based attention effects may be more sensitive to states that change across days.

Topic Area: ATTENTION: Spatial

F27 - Investigating the role of beta oscillations in top-down control

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Neuronal oscillations play a key role in the attentional modulation of visual processes. A growing number of evidence indicates that beta activity is influential in the top-down control of visual areas. Here, we wanted to further investigate the role of this oscillatory activity by using a multimodal approach involving EEG and TMS. Participants covertly shifted their attention to one of two locations in a block design. Coherently moving dots then appeared in either cued or uncued locations and participants discriminated motion direction. In the first experiment, EEG was recorded, and performance sampled at different time points from the appearance of a flash, indicating the beginning of the trial. Results show significant pre-flash and pre-stimulus anti-phase activity, between shift right vs. left task conditions ($p = .001$) in the beta band, over occipital electrodes. This could be indicative of attention-like mechanisms sampling alternatively from the two visual fields. We then used perceptual sensitivity (d') and decision criterion (c) measures as determinants of perceptual performance and found that c also fluctuates over time following a beta wave. In a follow-up experiment, we are now looking to establish causality using rhythmic TMS with the same task, stimulating at region V5. TMS will be used at different frequencies (α, β, arrhythmic) to reveal whether boosting beta activity causally modulates visuospatial attention.

Topic Area: ATTENTION: Spatial

F28 - The disengagement deficit in spatial attention: evidence from lesion-symptom mapping after focal brain injury

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Posner's spotlight analogy proposes three attention-orienting mechanisms: disengagement, moving, and engagement. Early research linked disengagement deficits to superior parietal damage, regardless of hemisphere and presence of spatial

neglect. Subsequent studies suggested the involvement of more ventral parietal regions, especially in the right hemisphere (RH), and linked spatial neglect to disengagement issues from ipsilateral cues. However, prior lesion-symptom mapping (LSM) studies faced limitations, including small sample sizes and absence of control groups. Additionally, some studies employed central cues or used long cue-target intervals, which may fail to reveal impaired disengagement. We used a machine-learning approach to conduct LSM on 89 patients with focal cerebral lesions to the left hemisphere (LH) or RH. A group of 54 healthy participants served as controls. Participants were tested with a cueing task that employed peripheral cues and short cue-target intervals, targeting exogenous attention. The main factors of interest were group (healthy participants, LH, RH), target position (left, right hemifield) and cue validity (valid, invalid). While LH patients showed a general contralesional slowing of RTs, only RH patients additionally exhibited a disengagement deficit, as evidenced by a significant interaction between group, target position and cue validity. LSM associated these behavioral outcomes with a cluster in the right superior temporal gyrus, which additionally affected subcortical white matter of the right arcuate fasciculus, corticothalamic pathway, and superior longitudinal fasciculus. Contrary to previous small-scale lesion studies, our results emphasize the role of superior temporal regions, as well as fronto-temporal and fronto-parietal disconnection in the emergence of the disengagement deficit.

Topic Area: ATTENTION: Spatial

F29 - Does Driving while Dual-Tasking Affect Landmark Memory in Young Adults?

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The acquisition of spatial knowledge while navigating a route can be influenced by encoding conditions. For example, a driver who is distracted by a conversation with a passenger may have poorer memory for landmarks relative to a driver navigating without distraction. There are limited ecologically valid studies examining the influence of distractions on memory for landmarks within a driving environment. In the current study, 24 young adults were asked to complete a driving task alone (no distraction), and then under two different divided-attention conditions in which they had to repeat back presented sentences; these were either Easier (4 dB signal-noise-ratio; SNR) or Harder (0 dB SNR) to hear, with the latter requiring a greater amount of cognitive effort. Within a simulated driving environment, implemented using DriverLab, participants followed a lead car along city and rural roads. Afterwards, incidental memory for critical landmarks from each of the three driving conditions (no-distraction, divided-attention high SNR, divided-attention low SNR) was assessed using a landmark recognition task. Memory for landmarks in the no-distraction condition was better than in the easier (high SNR) divided-attention condition, though surprisingly we found no difference in landmark memory following the 'no distraction' and the 'harder' (low SNR) condition. Our results suggest a U-shape curve whereby low-level distraction might seem manageable, but indeed negatively affects landmark encoding. However, in the harder attentional condition, cognitive capacity has likely exceeded to allow processing of the distractor-task, thus enabling selective processing of the primary task to enhance performance on the landmark test.

Topic Area: ATTENTION: Spatial

F30 - Set up a searchlight on multiple object tracking: functional determinants of training intervention

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Previous research described two distinct behavioral patterns in Multiple Object Tracking, linked to object-based and location-based mechanisms (Merkel et al., 2015). A linear relation between performance and level of probe-target-congruency signifies a location-based representation of the individual targets. Error rates and reaction times decreased significantly when a probe encompassed all targets, indicating an object-based representation. This study focuses on representation-specific learning processes during tracking. 36 subjects underwent two imaging sessions in a 3T scanner, to track four out of eight items covertly. In-between they received three training sessions. Participants had to indicate whether a probe showed full congruence or not. Functional data were analyzed using Multiple Voxel Pattern Analysis with a 5mm searchlight and SVM classifier, trained to binary discriminate between increasing congruencies to the m0 and the m4 condition. For areas encoding the objecthood of the entire target-set, the discriminability between any match-condition and m4 should be equally high, whereas a location-based encoding would exhibit an increase in discriminability between conditions the more they differ in their match. Error rates and reaction times showed congruence-dependent increases, with exception for full matches. A repeated-measures ANOVA revealed a significant main effect of session, indicating overall improvement after training, confirmed by Bonferroni-adjusted paired t-tests for all conditions. The classification maps were subjected to a regression with the linear and the deviant function as covariates. The t-values for every covariate at each time point were examined. Tracking-related patterns for both representations within the visual cortex exhibited shifts towards higher-order cortical areas after training.

Topic Area: ATTENTION: Spatial

F31 - Linking subcortical structures to behaviour, micro-saccades and neocortical oscillatory activity supporting cognitive functions

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Growing evidence suggests that subcortical structures play an essential role for key cognitive functions such as attention. However, it is not clear how these structures affect behaviour in relation to oscillatory dynamics associated with attention. We are developing a new research line investigating how the hemispheric asymmetries of subcortical structures relate to lateralisation in neural oscillations, lateralised behavioural biases, and micro-saccades. Across four experiments, we investigated whether the volumetric hemispheric lateralisation of basal ganglia and thalamus could predict the hemispheric asymmetry of oscillations and behavioural bias towards left versus right visual hemifields. The subcortical structures were identified using the FIRST/FSL algorithm applied to MR images. In terms of paradigms, we employed resting state, landmark, covert spatial attention, and visual detection tasks. We did this while measuring behavioural performance, eye-tracking and brain oscillations using MEG (306 sensors). In the spatial attention task, our experiments revealed significant correlations between the hemispheric lateralisation of power of alpha-band oscillations and volumetric lateralisation of the thalamus, caudate nucleus, and globus pallidus. During rest, we observed a significant correlation between the lateralised oscillatory activity and the caudate nucleus as well as the hippocampus. Preliminary findings using the landmark task suggested correlations between hemifield behavioural biases and volumetric lateralisation in the thalamus and caudate nucleus. Our research suggests that subcortical structures impact cognitive control functions. Both outcomes and methodology pave the way for a fresh avenue for exploring the contribution of subcortical structures to cognitive and neural functions.

Topic Area: ATTENTION: Spatial

F33 - Enhanced Attention Near the Hands: Investigating Neural Activity in Area V2

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Behavioral studies have shown that visual processing is enhanced in space near the hand. These alterations might be a result of deploying attention to peri-hand space, like how the oculomotor system enhances visual processing at the endpoint of saccades. The underlying neural mechanisms that would drive altered visual processing near the hand are not well understood and it is not clear whether peri-hand attention might be solely due to vision of one own's hand, proprioceptive feedback to visual cortex, or a combination of both signals. Parietal neurons integrate sources of visual and proprioceptive information for visually guided reach movements. Hence, we hypothesize that enhanced visual processing in peri-hand space is a result of feedback from parietal cortex to early visual areas. To test our hypothesis, we recorded from individual neurons in area V2 of rhesus monkeys, engaged in a passive fixation task in which an oriented bar was presented in the receptive field of neurons in the presence or absence of a nearby hand. When the hand was placed near, yet outside the receptive field, responses to the preferred orientation were significantly enhanced no matter if the hand was visible

or occluded. These enhancements were diminished when the hand was far from the visual stimulus. Our findings suggest that there exist parallel effector-based mechanisms for deploying spatial attention which might ease decoupling of eye and hand movements, and the feedback signals responsible for deploying these attentional signals are proprioceptive in nature. These results have implications for attentional disorders and blindsight.

Topic Area: ATTENTION: Spatial

F34 - Does rhythmic temporal coordination help to avoid conflicts between selective attention and working memory?

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Daily tasks often employ both selective attention (i.e. external sampling) and working memory (i.e. internal sampling), and previous research indicates that these cognitive processes share neural resources. Here, we recorded EEG while participants (n = 23) completed an experimental task that required either external sampling, internal sampling, or concurrent external and internal sampling. We (and others) have shown that both external sampling during selective attention and internal sampling during working memory are linked to theta-rhythmic neural activity (~4—6Hz). In the context of selective attention, for example, theta-rhythmic neural activity seems to temporally coordinate attention-related sampling (i.e., sensory functions) and shifting (i.e., motor functions). That is, theta-rhythmic neural activity is associated with alternating windows of either enhanced sensory processing or an increased likelihood of shifting to another location. Here, we tested whether theta-rhythmic external sampling during selective attention and theta-rhythmic internal sampling during working memory are associated with the same neural resources. We further tested whether putting these cognitive processes in conflict would lead to theta-rhythmic coordination of external and internal sampling (i.e., these processes occurring at different theta phases). Our results indicate that the specific theta phase associated with better behavioral performance is the same during trials that require external and internal sampling. Rather than theta-rhythmic coordination during dual-task trials, we observed interactions between these processes when an externally sampled stimulus matched the already presented, to-be-remembered stimulus. Our findings are consistent with a shared rhythmic sampling process that can perhaps be directed toward either external information or internally stored information.

Topic Area: ATTENTION: Spatial

F35 - Perceptual and neural modulations by regularity of different information value

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The brain is sensitive to regularities in the environment and can use them to make perceptual predictions. Previous work on how these predictions modulate sensory neural processes reported mixed findings. While some studies showed that predicted/expected stimuli are associated with attenuated sensory response compared to the unexpected, others observed enhanced sensory response to the expected. Here, we aimed to reconcile these conflicting results by testing a novel hypothesis that regularities modulate perception differently depending on their information value. Participant's task was to compare two consecutively presented targets (S1 and S2) in either their orientation or location, depending on the task cue presented at trial start. In half of the trials, S1 location is 100% predictable by a preceding cue. For orientation judgements, the cue-S1 regularity is of high information value, as it allowed participants to direct their attention to enhance S1 discrimination. For location judgements, however, the regularity is of low information value, because interpreting the cue alone is sufficient. In Experiment 1, we tested participants online and validated that valid cue-S1 regularity led to better accuracy in both tasks. In Experiment 2, we titrated S1's contrast to match both tasks in their difficulty, and had participants performed the same task while recording their brain activity using MEG. By comparing the evoked activity of S1 when it was predicted vs. not predicted by the cue, and by examining whether such an effect differs between tasks, our results provide new understandings of predictive perception.

Topic Area: ATTENTION: Spatial

F36 - Reduced distractor filtering with age: Evidence from the distractor positivity ERP

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In everyday life, the intricate process of attentional control plays a crucial role in filtering distracting information. Although finding a target in a visual search can be facilitated by providing positive cues (indicating what to attend to), negative cues (indicating what to ignore) may initially bias attention towards distractors (Zhang et al., 2020). This may be particularly true in individuals with less efficient inhibitory control, such as anxious individuals (Salahub & Emrich, 2021) and older adults (Torres et al., 2023; Weeks et al., 2020). To test the efficacy of positive and negative cues in a sample with lower inhibitory abilities, older adults' filtering performance was compared to younger adults' in a visual search task while EEG was recorded. Participants were provided with either positive or negative pre-cues indicating the feature of the target or distractor, and a neutral control condition. Results indicate that older adults benefit most from positive cues, showing a higher N2pc, as well as shorter reaction times, in response to lateral targets. In contrast to young adults, when presented with negative cues, older adults show no Pd component to lateral distractors in any condition, suggesting that they did not inhibit distracting information. Older adults also took longer to respond when presented with negative cues (comparable reaction time to neutral cue trials). These results suggest older adults (with impaired inhibitory abilities) have particular difficulty suppressing distractors when a negative cue is provided, presumably because they have difficult disengaging attention from negatively cued items once it is directed there.

Topic Area: ATTENTION: Spatial

F37 - Does Luminance Produce Attentional Weighting?

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Models of attention assume a relationship between attentional selection and luminance. Brighter objects are thought to have a greater attentional weight relative to dimmer objects. We investigated this assumption using a saccadic delayed match-to-sample task in which the trajectories of saccades provided a sensitive measure of attentional weights of target and distractor. Previous studies have shown that actively competing distractors have an attractive effect on saccade trajectories, but once competition is resolved the distractors repel the saccade. To examine the hypothesis that luminance is functionally equivalent to attentional weighting, we varied the relative luminance of the target and distractor, ensuring it was irrelevant to the task. Salience-based models of attention would predict saccade trajectory deviations towards the distractor that scale with the relative luminance of the distractor during active competition. Once the competition is resolved, distractors with lower relative luminance should elicit reduced trajectory deviations away from the distractor. Fast reflexive saccades tended to be executed to the brighter object, independent of their target/distractor identity. Once the target was discriminated from the distractor, saccades to the target deviated away from the distractor as predicted. Contrary to the hypothesis, we found no evidence that the magnitude of this deviation varied by relative luminance. Taken together, salience drives the execution of reflexive saccades, but does not affect saccade trajectories after visual discrimination has completed. Therefore, luminance is not synonymous with attentional weighting in saccade target selection. This runs counter to attentional models that suggest attention works via increasing perceived contrast.

Topic Area: ATTENTION: Spatial

F38 - Online vs. In-Person: Environment Familiarity Affects Experience-Based and Rule-Related Selective Attention Differently

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In the post-pandemic, Zoom-dominant world, online testing has become ubiquitous within psychological research, raising an important question: does online testing replicate in-person results? We analyzed previously collected data from a single-session online study (n = 66) and a separate in-person test-retest study with two sessions separated by 3-8 days (n = 69) that assessed individual differences in target enhancement and distractor suppression. The visual search task included a briefly

presented array with a shape-singleton target. An additional color-singleton distractor appeared on some trials. Separate target and distractor learning blocks implicitly manipulated the frequent location of target or distractor, respectively. We found that individual differences in accuracy for the frequency effect (infrequent–frequent trials) were marginally correlated between the target and distractor learning blocks in Session 1 in-person but not correlated online or Session 2 in-person. Conversely, distractor presence effects (distractor present–absent trials) in reaction time were only marginally correlated between target and distractor blocks in Session 1 in-person while they were strongly correlated online and in Session 2 in-person. Together, these results suggest that 1) testing context can substantially influence attention effects and 2) environmental distinctions differentially affect experience-based versus rule-related selective attention. One such distinction is that the online and Session 2 in-person experiments could be considered having familiar environments, whereas the environment for Session 1 in-person may be more novel. These results emphasize the need to consider effects of online versus in-person testing environments—as well as participants' familiarity with in-person environments—when interpreting individual differences in cognitive performance.

Topic Area: ATTENTION: Spatial

F39 - Decoding ongoing thought patterns during incidental face recognition based on eye gaze behaviour

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Patterns of ongoing thought have well documented associations with tasks and activities in daily life, as well as a growing list of associations with neural processing. However, their associations with eye gaze is less well understood. The current study aimed to explore the association between different thought patterns and eye gaze behaviour by examining their associations to the locus of fixation during task processing. Using an incidental face recognition paradigm in conjunction with eye-tracking, we examined the relationship between different thought patterns and gaze fixations at predefined areas of interest (AOI), and compared the results under different task loading (low-load versus high-load) and face emotion (happy versus angry) conditions using linear mixed modelling. Results suggested that task loading significantly predicted gaze fixation at task stimuli [F(1, 683.926) = 8.717, P = 0.000], target cue [F(1, 683.556) = 308.245, P = 0.000] and off AOI/screen areas [F(1, 683.646) = 113.919, P = 0.000]. Gaze fixations at task stimuli, in turn, significantly predicted distractive thoughts [F(1, 725.905) = 10.505, P = 0.001]. Finally, face emotion significantly predicted fixation at the mouth area [F(1, 684.095) = 7.343, P = 0.007], which in turn, predicted thoughts focused on social imagery [F(1, 705.881) = 8.717, P = 0.003]. In sum, our results provide preliminary evidence that, in conjunction with environmental conditions, patterns of thought can be predicted by gaze fixation patterns.

Topic Area: ATTENTION: Spatial

F40 - Genetic Influence of Telomere Reverse Transcriptase on Cognition and Cortical Thickness in Aging

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Telomeres are the protective endings on chromosomes that degrade with age. Telomere length (TL) is associated with length of lifespan and Alzheimer's disease risk, with both longer and shorter telomere linked to poorer outcomes. Here we investigate whether differences in a single-nucleotide polymorphism (SNP), telomere reverse transcriptase (TERT), a proxy for TL, influences cognitive aging and cortical thinning in healthy adults. Cognitive assessments and MRI were collected for N=183 adults ages 20-89. We predicted that genetic predisposition to longer (G/G carriers) and shorter (T/T carriers) TL may differentially impact cognition and associated brain regions with aging. Analysis of overall cognition, comprised of executive function (EF), working memory (WM), processing speed, and episodic memory using a general linear model (GLM) revealed a significant TERT by Age interaction ($p<.05$) on cognition. EF and WM were independently significant ($p<.05$) and showed TERT by Age interactions, where older adult T/G carriers had better performance. Nine frontal and parietal regions, integral to EF and WM processes, were examined in participants with MRI (n=161). GLM analyses revealed a significant TERT by Posterior Cingulate (PCG) thickness interaction on EF ($p < .05$), suggesting that PCG's association with EF depends on TERT genotype. Specifically, G/G homozygotes experience less of a benefit of thicker PCG on cognition than T/G or T/T carriers. In sum, moderate telomere disposition may be beneficial to older adults' cognition, whereas across the lifespan longer telomere carriers show weaker association between brain and cognition. Future research will examine TERT influence on longitudinal change.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F41 - Neurocomputational maturation of explore-exploit decision-making in adolescence and emerging adulthood.

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To discover our favorites, we start by trying something new. Typically, such exploration of novel choice alternatives comes at the cost of foregoing options that have benefited us in the past. This highlights the canonical tradeoff between exploration (i.e., sampling novel options with an uncertain value) and exploitation (i.e., sticking with familiar favorites with a known value) in human reinforcement learning. During adolescence—ever-increasing motivations to explore novel options are adaptive and help promote self-discovery, but may also elevate risk-taking and psychiatric vulnerability. We merged behavior, computational modeling, and task fMRI to probe the neurocomputational maturation of explore-exploit decision-making across adolescence (N=135 13-21 year-old participants). We also examined explore-exploit phenotypes across 'reward' and 'loss' environments, to determine whether distinct neurocomputational mechanisms underpin exploration to maximize gains, versus exploration to avoid losses. Our data reveal a clear age-related shift in exploration based on valence: younger participants demonstrate a marked shift in choice computations causing them to engage in hyper-exploratory behavior in loss relative to win contexts. In contrast, young adults demonstrate consistent goal-directed exploration across win and loss. Analysis of fMRI data is ongoing, but will determine how responses to feedback in cortico-subcortical circuits anchored in the dorsal and ventral striatum, amygdala, and the bed nucleus of the stria terminalis shape the probability of exploration versus exploitation in win versus loss contexts as a function of age. These data represent an initial cross-sectional preview of a 5-year longitudinal protocol designed to chart the definitive neurodevelopmental trajectory of explore-exploit decision-making across adolescence.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F42 - Relations between multiple dimensions of poverty and infant and toddler resting state brain networks using fNIRS

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In rural Côte d'Ivoire, poverty rates are nearly 60% (World Bank, 2019). Previous research shows the developing brain is most sensitive to environmental effects between birth and 5 years. Poverty, and its co-occurring risks (e.g. food insecurity, parental stress and poor mental health) adversely affect childhood outcomes during this period of peak brain plasticity (termed sensitive periods; Johnson et al., 2016). We test the effects of multiple dimensions of poverty on infants' and toddlers' brain networks in rural Côte d'Ivoire. Infants and toddlers (n=36; ages 6-26 months; M=13.1, SD=5.15) completed a 4-minute resting-state scan (Inscapes; Vanderwal et al., 2015) while undergoing functional Near Infrared Spectroscopy (fNIRS) neuroimaging. Using graph theoretical analyses, we investigate how brain network metrics (i.e., degree centrality, clustering coefficients, global efficiency, and small-worldness) are related to multidimensional poverty (i.e., MPI; Alkire and Santos, 2014), parental stress and mental health, and early developmental skills (i.e., CREDI; McCoy et al., 2018). Results show that brain network measures are positively related to early developmental milestones, but exposure to poverty and food insecurity is negatively associated with multiple network metrics. Results are discussed in the context of economic interventions to reduce poverty.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F43 - Structural Brain Correlates in Offspring of Parents with and without Exceptional Longevity

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Individuals with exceptional longevity maintain their independence for an extended period and delay the onset of age-related diseases. Their offspring also exhibit extended lifespan and health span – and can be used as a model for studying exceptional longevity. Emerging evidence suggests that offspring of those with exceptional longevity have larger temporal and sensorimotor cortices – but the relationship between parental longevity and overall brain health is not well-understood. We employed multivariate covariance-based statistics to identify a gray matter volume covariance pattern (or network) associated with parental longevity. We also examined if this brain network was associated with cognitive performance. One hundred and thirty-nine older LonGenity study participants with structural MRI scans were included in this analysis (M Age 79.35±6.46 years; 56.11% women). All participants were of Ashkenazi Jewish descent. Eighty-four (60.43%) were offspring of parents with exceptional longevity (OPEL: at least one parent lived 95 years or more) and 55 (39.57%) were offspring of parents with usual survival (OPUS: both parents lived less than 95 years). Multivariate analyses were adjusted for age, sex, years of education, estimated total intracranial volume, and white matter lesion burden. The derived gray matter covariance pattern associated with OPEL was primarily composed of larger volume in frontal, insular and hippocampal brain regions. The extent to which older adults displayed this pattern was associated with executive function and episodic memory. These findings suggest that larger volume in a widespread pattern of brain regions – including regions particularly affected by aging and Alzheimer's disease – are associated with parental longevity.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F44 - Visual evoked potential (VEP) mediates associations between early life stress and cognitive development

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Exposure to early life stress has been associated with increased developmental risk, in part from early alterations to developing neural circuitry. Visual Evoked Potential (VEP) amplitude and latency, thought to index integrity of cortical pathways and global neural maturation, might predict later risk (Calloway et al., 1973; Jensen et al., 2019; Torres-Espinola et al., 2018). However, associations between stress and infant VEP development are not well understood. Pattern-reversal VEPs were recorded from scalp electrodes in 6-, 9-, and 12-month-old infants experiencing low- to mid-SES (n=68). Developmental assessments (Mullen Scales of Early Learning; MSEL) were administered at 24-months. Caregiver stress and demographic variables were collected at 2-months. Hierarchical linear regression tested whether 2-month demographic or stress variables predicted VEP (P1) amplitude or latency at any timepoint. At 6- and 9-months, models did not predict either P1 amplitude or latency. By 12 months, caregiver reports of perceived stress (PSS) significantly and positively predicted P1 amplitude (B = .316, p = .007), adjusting for objective stress and demographic variables. Because P1 amplitude decreases across the first year, higher amplitude may index a less mature pattern. 12-month P1 amplitude also negatively predicted MSEL scores at 24-months, adjusting for PSS (B = -1.893, p = .014), and 12-month P1 amplitude mediated associations between caregiver stress at 2-months and MSEL scores at 24-months (bias corrected 95% = -2.02 to -.31). Results suggest one pathway by which exposure to early life stress might contribute to variation in downstream cognitive abilities in late infancy and early childhood.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F45 - Cognitive development reflects children's multidimensional environments and individual-specific patterns of functional brain network organization

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Cognitive neurodevelopment does not take place in a vacuum, but enmeshed in a complex web of environmental exposures and experiences (exposome). However, it remains challenging to comprehensively characterize the many interconnected features of individual environments in large samples. Moreover, most neuroimaging studies use group atlases to define functional brain networks, masking inter-individual variation in spatial organization (functional topography). Here, we leverage cutting-edge computational approaches to investigate how individual differences in cognition emerge during childhood by characterizing both multidimensional environments and individual-specific patterns of functional brain network organization. We conduct pre-registered analyses in discovery (n=5,139) and replication (n=5,137) samples of youth from the longitudinal Adolescent Brain Cognitive Development Study. We quantify the exposome using multilevel exploratory factor analysis with bifactor rotation across 354 child-report, parent-report and geocoded features. We identified seventeen personalized functional networks (PFNs) using non-negative matrix factorization. Linear mixed effects models and cross-validated ridge regressions related the exposome to PFN functional topography and cognition, accounting for age, biological sex, family (siblings), site, and head motion. Exposome scores were associated with current cognition (discovery: βs=0.12-0.50, ps-bonf<.001; replication: βs=0.15-0.48, ps-bonf<.001) and cognition measured two years later (discovery: βs=0.08-0.24, ps-bonf<.001; replication: βs=0.11-0.22, ps-bonf<.001). The exposome was reflected in PFN topography (actual vs. predicted exposome: discovery: r=0.440, p<0.001; replication: r=0.462, p<0.001). Models trained on the exposome more accurately and parsimoniously predicted current and future cognition (rs=0.42-0.46, ps<.001, AICs -454.28-248.82) than models trained on rich personalized neuroimaging data (rs=0.41-0.45, ps<.001, AICs = 2.02x106). These results highlight the importance of childhood environments in cognitive neurodevelopment.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F46 - Associations between socioeconomic status and EEG alpha power in monolingual and bilingual infants

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Research suggests that the bilingual experience might facilitate the development of some executive function (EF) skills, whereas experiencing low socioeconomic status (SES) has been associated with challenges to EF. Little research, however, has explored how SES contributes to variation in neural processes underlying EF during infancy, nor how SES and bilingualism interact to predict neural processes underlying EF. This study recorded 5 minutes of baseline electroencephalography (EEG) from bilingual and monolingual exposed infants from low- to mid-SES backgrounds (n = 116) when they were 2, 6, 9, and 12 months of age to explore variation in an early neural predictor of EF - baseline frontal alpha power. Results demonstrated that SES variables predicted alpha power at both 9 and 12 months. Maternal education was positively associated with absolute frontal alpha power at 9 months (B = 0.048, p = 0.028) and rates of neighbourhood poverty were negatively associated with relative frontal alpha power at both 9 (B = -0.073, p = 0.015) and 12 months (B = -0.087, p = 0.014). Minimal differences in alpha power were observed between bilingual and monolingual-exposed infants. However, language group did moderate associations between SES and alpha power at 9 months (p = .0026), such that negative associations between SES and frontal alpha were observed for the monolingual, but not bilingual group. Results suggest that SES contributes to variation in neural processes underlying EF from infancy, and that bilingualism might act as a protective factor for early development of EF.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F47 - Associations between Music Sophistication and Memory: A Pilot Study in Healthy Older Adults

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PURPOSE: Memory loss is a leading indicator of cognitive decline in aging adults. Emerging research suggests a relationship between music and memory preservation. This pilot study aimed to understand the associations between music sophistication, such as music perceptual abilities, emotional response to music, and memory recognition in cognitively sound, physically active older adults. METHOD: Thirty-nine (complete data n=30) cognitively sound (based on Mini-Mental State Examination), physically active older adults (60+ yr) volunteered to participate. Participants completed the Beck Depression Inventory (BDI), the State-Trait Anxiety Inventory (STAI-Y), and the Goldsmiths Musical Sophistication Index (Gold-MSI) before completing an object

recognition memory task. Separate linear regression models, with sex as a covariate, were conducted to determine if music perceptual abilities (PA), musical training (MT), singing abilities (SA), emotional response to music (EM), and general music sophistication (GM) were associated with object recognition memory performance. RESULTS: There were no relationships between MT, SA, GM, and object recognition memory performance. Positive relationships were observed between both PA (p=0.055) and EM (p=0.074), and recognition memory performance, however these were not statistically significant. CONCLUSION: The hypothesis that music plays a protective role for cognitive function highlights the need to understand if music sophistication is associated with memory performance in healthy older adults. Previous studies have reported associations between music sophistication sub-factors (PA, MT, EM) and verbal fluency and executive function in cognitively impaired older adults. Future studies need to be conducted to understand the impact of music sophistication on memory preservation in cognitively sound older adults.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F48 - Examining the efficacy of combined tDCS and cognitive training on memory consolidation.

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Transcranial direct current stimulation (tDCS) serves as a non-invasive brain stimulation method, which has shown promise for enhancing learning and memory by applying tDCS to the left prefrontal cortex during working memory and word learning exercises. We recruited 62 healthy older adults (Mage = 72.67; SDage = 4.79; 65% Female) for a 5-session word learning intervention, using a between-subjects, sham-controlled pretest-posttest design with a 3-month follow-up. Participants memorized different word lists each session while receiving active or sham tDCS over the left prefrontal cortex, and were later tested on recall 25 minutes post-stimulation. In subsequent sessions, post-test, and follow-up, cumulative recall of all learned words was assessed, alongside a recognition task. The results demonstrated improved word recognition in the group receiving tDCS at post-test and at 3 month follow-up. Moreover, the results replicated previous work in demonstrating improved word recall after training; however, the degree of improvement was less pronounced as compared to previous work. In the post-test fMRI scans, bold activation was significantly higher in the left dorsolateral prefrontal cortex for participants who received active tDCS treatment compared to the sham group, which may indicate better consolidated memories; however, this increased activity did not persist at 3-month follow-up. The results from this study will inform the design of interventions to mitigate age-related memory decline and also further our understanding of the mechanisms underlying electrical stimulation and brain plasticity.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F49 - Tertiary Sulci and Brain Aging: A Novel Approach to Understanding Cognitive Aging

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Tertiary Sulci (TS) are small, shallow, cortical features thought to form in late gestation. The number of TS in the middle frontal gyrus (MFG) relates to better executive function (EF) in younger adults, and the presence of the paracingulate TS is associated with reduced dementia risk in older adults. It is unclear however how TS influence cognition as the brain undergoes normal aging decline. We used a task-switch paradigm sensitive to cognitive aging to determine whether the presence of posterior middle frontal sulci explained variance in EF task performance among cognitively normal older adults. We measured mixing and switching costs, which broadly measure working memory and switching respectively. TS were manually traced with the aid of anatomical boundaries derived from a data-driven approach. Participants (n = 40) were first grouped based on number of MFG TS, those with less than two or two or more. Controlling for demographic covariates, we found individuals with more TS in the left hemisphere, compared to less TS, had better performance indicated by lower mixing cost (std.Beta =-0.79, p = .016). Additionally, the number of TS as an ordinal measure was also related to lower mixing cost with benefit for 2 (std.Beta =-0.99, p =.025) and 3 TS (std.Beta =-0.98, p = .045) relative to none. Our results indicate the presence of left, not right, MFG TS relates to better EF in older adults. These results support the potential for TS to improve our ability to account for individual differences in cognitive aging.

Topic Area: EXECUTIVE PROCESSES: Development &aging

F50 - Functional connectivity between cortical memory networks and the hippocampus across development

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Decades of research has focused on the role of the hippocampus in the development of memory. However, recent work in adults uncovered a set of cortical memory networks functionally connected to the hippocampus including a Medial Temporal Network (MTN), and a Default Mode Network (DMN) — comprised of the Medial Prefrontal (MP), Posterior Medial (PM), and Anterior Temporal (AT) sub-networks (Barnett et al., 2021). We sought to test the existence of these networks in the developing brain using a publicly available fMRI movie-watching dataset collected in 3-12 year-olds and adults (Richardson et al., 2017). We generated two dueling hypotheses: a) given the general posterior to anterior developmental gradient, it could be that posterior-reliant subnetworks like the MTN and PM develop earlier than the AT and MP networks; b) conversely, in a memory-centric hypothesis, the PM sub-network might develop later than the AT sub-network, given its proposed role in slower-developing episodic memory. We find significant evidence of the existence of these cortical networks in all age groups except the 3-4 year-olds. We find significant age-related changes in the PM and MP sub-networks and the MTN, but no changes with age in the AT sub-network. While 8-12 year-olds show adult-like connectivity from all of the cortical networks to the hippocampus, children aged 3-4 and 5-7 show significantly lower connectivity to the hippocampus than the older age groups. These results coincide with our memory centric hypothesis and will be evaluated further using inter-subject correlation approaches within and across age groups.

Topic Area: LONG-TERM MEMORY: Development & aging

F51 - Developing a method to improve memory in the home, overnight, suitable for helping people with age-related memory impairments

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Sleep supports memory consolidation, thereby preventing some memories from being forgotten, and it can be harnessed for various goals. Using Targeted Memory Reactivation (TMR), reminder sounds played softly during sleep can induce replay of specific memories, thus enhancing subsequent remembering for that information. We adapted this procedure for use in improving memory in the home, with the future goal of partially offsetting memory problems in seniors, including those with early-stage Alzheimer's Disease. Here, in healthy young adults, we tested whether we could improve recall for names and associated biographical information. On Day 1, participants learned biographical information about 20 simulated family members (e.g., "Your oldest son is Henry; Henry is an engineer"). They were then tested about relationships and facts (e.g., "Your oldest son is___? Henry's occupation is___?"). On Day 2, participants learned interfering biographical information about 10 simulated neighbors, followed by memory testing. While participants slept over the next three nights, they received auditory stimulation using wearable sleep technology and algorithms we developed for this purpose. Participants received sounds corresponding to the simulated family (n=20) or frequency-matched control sounds (n=20). On Day 5, memory was tested to determine whether TMR produced a memory benefit. Free recall of names and biographical information for the simulated family improved in the TMR group, whereas it declined in the control group (Day-5 vs. Day-1 recall). Testing older individuals is now warranted, as this procedure appears to hold promise for helping individuals experiencing occasional difficulty recalling loved-ones' names or other high-value information.

Topic Area: LONG-TERM MEMORY: Development & aging

F52 - Age-related differences in theta oscillations across development: insights from intracranial EEG and brain structure-function relationships

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Neural oscillations change across the human lifespan, concurrent with changes in cognition and brain structure, emphasizing their importance in understanding brain development. Scalp-EEG is the primary tool in developmental neuroscience research. However, it cannot access memory-related brain regions, such as hippocampus. Here, we isolated slow (~1.5 – 4.5 Hz) and fast theta (~4.5 – 8 Hz) frequencies in a developmental intracranial EEG (iEEG) cohort (n = 83, n channels = 4618; Mage = 16.40 years, range = 5.93 – 54 years, 51 males). Using task-based (i.e., attending to to-be-remembered visual stimuli) and task-free recordings, we quantified age-related differences in slow and fast theta frequencies in primary sensory, limbic, and association cortices. Mixed-effects regressions revealed that in precentral gyrus, slow theta slowed with increasing age during task-free but not task-based states (p =.002), while the inverse was observed for fast theta (p =.03). In MTL, slow theta slowed with age irrespective of task state (p =.001). In dorsolateral prefrontal cortex, fast theta slowed with age irrespective of task state (p =.005). In relating structure-to-function, for both slow and fast theta in MTL, we observed significant interactions between gray matter volume and task state. Yet, despite the importance of MTL and prefrontal theta oscillations to memory, we found no significant relationship in these regions between age and theta frequencies on recognition accuracy, suggesting age-related variability in theta frequencies reflects a natural feature of development. These findings indicate that theta varies across development, differs by task state, and relates to brain structure.

Topic Area: LONG-TERM MEMORY: Development & aging

F53 - Unveiling Early-Stage Memory Deficits: Pattern Separation Impairments and Neural Dysfunction in Subjective Cognitive Decline

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Pattern separation, the process that establishes distinguishable memory representations of similar episodes, is typically examined through the Mnemonic Discrimination Task (MST). Previous literature has unveiled correlations between deficits in pattern separation and alterations in neural mechanisms attributed to cognitive impairment. However, the alterations in pattern separation performance and whole-brain activation remain unclear in individuals experiencing Subjective Cognitive Decline (SCD), a pre-clinical stage of cognitive impairment. In the present study, 51 older adults aged over 60 years were recruited and divided into two groups based on SCD-Q9 (25 NC, 26 SCD). Participants underwent functional magnetic resonance imaging (fMRI) scanning while engaging in MST. In this task, they were required to make judgments of "new," "similar," or "old" in response to novel items, similar but not identical items (i.e., lure), or repetition items. The analyses revealed that the SCD group exhibited lower Lure Discrimination Indexes (LDI) than NC group. The fMRI analyses demonstrated that individuals with SCD exhibited lower activation in the hippocampus and dysfunction in the frontal lobes compared to those without SCD when they successfully responded to lure stimuli. These findings suggest that individuals with SCD may display detectable pattern separation deficits compared to healthy older adults. These deficits are associated with functional hypoactivation in the hippocampus and dysfunction in the control network, indicating an impaired memory mechanism in a very early stage of cognitive impairment.

Topic Area: LONG-TERM MEMORY: Development & aging

F54 - Behavioral and neural correlates of visual statistical learning during n-back working memory in cognitively healthy young and older adults

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Visual statistical learning involves the implicit association of temporally linked visual stimuli, which was often studied in the context of long term memory. Using fMRI, we examined behavioral and neural correlates of visual statistical learning during working memory and their age-related differences. Twenty-eight young (mean age=20.1(SD=3.0)) and nineteen cognitively normal older adults (mean age=67.1(SD=8.0)) performed 2-back working memory tasks with grey-scaled face and scene images. Each visual category was presented in block where face or scene images were either repeatedly followed by a predetermined face or scene image (STRONG-PAIR) or by different images in rotation (WEAK-PAIR). Additionally, other images were randomly selected with no pre-specified temporal association (RANDOM). Across the age groups, response time (RT) was faster for faces than scenes ($p<0.001$), with significant differences across pairs ($p<0.001$), having faster RT for WEAK-PAIR items than STRONG-PAIR and RANDOM items. Accuracy was higher for face than scene 2-back task performance ($p<0.01$), with higher accuracy with WEAK-PAIR than STRONG-PAIR or RANDOM ($p<0.05$). Overall, young subjects responded faster with higher accuracy than older adults ($p<0.01$). Across the age groups, greater hippocampal activations were associated with STRONG-PAIR compared with WEAK-PAIR items for both face and scene conditions, with greater activations in the left middle frontal cortex and left parietal cortex found in the face 2-back task. The present results suggest that visual statistical learning may interfere with working memory performance in both young and older adults by hampering the control of items in working memory with the learned associations between the items.

Topic Area: LONG-TERM MEMORY: Development & aging

F55 - Sex and menopause status alter age associations with spatial context memory and white matter microstructure at midlife

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Age-related decline in spatial context memory emerges in midlife, the time at which most females with ovaries transition from pre- to post-menopause. Recent evidence suggests that, in post-but not pre-menopausal females, advanced age is associated with lower occipito-temporal/parahippocampal activity and lower spatial context memory. However, it is currently unknown whether similar menopause effects are evident for brain structural connectivity and, in addition, whether such effects on the brain and cognition contribute to sex differences at midlife. To address this, we conducted a study on 96 cognitively unimpaired middle-aged adults (30 males, 32 pre-menopausal females, 34 post-menopausal females). Spatial context memory was assessed using an associative (face-location) memory paradigm, which included easy and hard variants, while white matter microstructure (fractional anisotropy [FA], mean diffusivity [MD]) was assessed using diffusion tensor imaging. Behaviorally, we found that females showed lower levels of spatial context memory with advanced age, independent of task difficulty. The detrimental effect of age was subsequently shown to be specific to post-menopausal females. At the neural level, multivariate partial least squares analyses revealed that advanced age was associated with lower FA and higher MD in predominantly frontal white matter tracts (e.g., anterior corona radiata, genu of corpus callosum), independent of sex and menopause status. However, the expression of this pattern was subsequently shown to be related to spatial context memory in females and post-menopausal females in particular. Overall, our results are consistent with the notion that the transition from pre- to post-menopause is a critical period in female brain aging.

Topic Area: LONG-TERM MEMORY: Development & aging

F56 - An online, updated battery for executive control and episodic memory composites in young and older adults

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Neuropsychological perspectives on cognitive aging suggest that episodic memory and executive function are particularly vulnerable. Previous studies have created composite neuropsychological indexes representing participants' relative episodic memory and executive function performance. However, the measures that make up the composites are often common clinical ones (e.g., Wechsler Memory Scale Logical Memory) and may therefore show ceiling and/or practice effects. In the present study, we replaced our previous episodic memory measures with a new set that are novel, reliable, valid, and easy to administer online (i.e., Taler Story recall, modified Verbal Paired Associates, 4 Mountains Test, Face-Name associative recall, and Brown Location Task). Our goals were to 1) learn how these memory tasks are related to one another in n = 100 young adults (age 18-30) and n = 100 older adults (age 65+) and 2) better understand the

individual-level factors that might influence participants' performance on our new battery, including biological sex and aspects of health, mood, sleep, and medication. Preliminary analyses revealed that participants' scores on the individual memory tasks were off the floor and ceiling and positively intercorrelated in both age groups. The young adults outperformed the older adults on several of the memory tasks.

Topic Area: LONG-TERM MEMORY: Development & aging

F57 - Individual Differences in Resting-State Salience Connectivity and Emotional Memory in the Cam-CAN Dataset

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Aging research reveals that older adults show declining cognitive functions in various domains, including memory. These changes in cognition are reflected in changes within large-scale brain networks, such as the salience, default mode, and executive control networks. Recent research has revealed an association between resting-state functional connectivity of the salience network and recognition memory in younger adults, as well as preserved structural and functional connectivity for the salience network in 'Superagers'- older adults resilient to cognitive decline. Based on this prior work, the present study takes an adult lifespan approach and examines how individual differences in salience network connectivity may be associated with memory performance. We used existing data from the Cambridge Centre for Ageing and Neuroscience (Cam-CAN) dataset. This dataset includes 330 participants (between 18 and 88 years of age), who completed an emotional memory task, as well as underwent structural and functional MRI scans. The emotional memory task consisted of 120 encoding trials where participants saw a neutral object superimposed on a positive, negative, or neutral background. For recognition trials, participants were tested on 160 objects to assess object recognition and background valence. Functional MRI data were pre-processed using SP8 and functional connectivity toolbox (CONN) pipelines. Statistical analysis within CONN revealed that individual differences in salience network connectivity as a factor of age might be able to predict emotional memory performance. These findings underscore the relationship between salience network connectivity and emotional memory, and highlight the importance of examining salience network contributions to memory across the lifespan.

Topic Area: LONG-TERM MEMORY: Development & aging

F58 - Aging and the Role of Prior Knowledge in Item-Level Neural Discrimination of Scene Images

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Using neural pattern information as a window into the contents of memory has become increasingly common in memory research. Aging studies have tended to show age-related dedifferentiation of neural patterns, which may make it difficult to use neural pattern analyses to detect the content of older adults' memories. Behaviorally, allowing older adults to rely on prior knowledge can help older adults successfully encode new information, but it can also lead to false recognition. How reliance on prior knowledge affects age differences in the discriminability of neural patterns remains unknown. The present study investigated whether prior knowledge of scenes affects neural discrimination of individual scene images during perception and during memory. While undergoing fMRI, both young (18-30 years old) and older (60-80 years old) adults viewed a set of scene images (famous and non-famous manmade and natural landmarks) and then were asked to recall them. To assess neural discriminability, representational similarity analysis (RSA) was performed to assess the strength of item-specific representations compared to same category representations. We performed this analysis separately for famous versus non-famous scenes, as well as in perception versus memory. Preliminary results reveal that the strength of RSA-based item representations were correlated with recognition scores. This effect was present in both young and older adults for both famous and non-famous scenes. Thus, early evidence suggests an age invariant and positive relationship between distinctive neural representations of individual items and behavioral memory discrimination that is present regardless of whether participants have prior knowledge of the memoranda.

Topic Area: LONG-TERM MEMORY: Development & aging

F59 - The effects of repetition on young children's memory

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After decades of developmental research characterizing children as ever-curious explorers of their environments, researchers are slowly shifting focus to a converse aspect of development—the tendency to engage in things repeatedly. Interestingly, during a free-play paradigm younger children explored less than their older counterparts; instead they preferred engaging with the same things over and over (Pelz & Kidd, 2020), potentially pointing to underlying benefits of early repetition. In adults, repetition has been found to degrade memory specificity (Wing et al., 2020; Yassa & Reagh, 2014), but the role it plays in children's memory remains unclear. Notably, factors such as the protracted development of the hippocampus, increased forgetting rates, and less overall experience could counterintuitively diminish this effect in young children. The current study developed a child-friendly version of Yassa & Reagh's (2014) memory paradigm to investigate this effect at different developmental stages, and whether young children's memory may protect them from experiencing degradation via repetition. Adults and children 5-10 years old were shown repeating and non-repeating items during exposure before being asked to make old/new judgements about items that were identical, similar-looking, or completely novel. Preliminary results (n= 10) found that adults are marginally worse at identifying items if they resembled a repeating item from exposure. This demonstrates that our novel paradigm is able to replicate the degradation with repetition effect in adults. Determining whether children also demonstrate this effect is ongoing, but we predict a less deleterious impact (or even a benefit!) of repetition, indicating its role in early learning.

Topic Area: LONG-TERM MEMORY: Development & aging

F60 - Children's darting (not diffuse) attentional spotlight shapes the content of their memories

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Children are remarkable learners, often surpassing adults in domains like language learning. These learning strengths are surprising given children's underdeveloped episodic memory abilities. One explanation is that children possess a "broader attentional spotlight" than adults, enabling them to form episodic memories for both goal-relevant and irrelevant information, which could prove useful when goals shift. However, an alternative explanation is that children's focus simply darts more frequently across time between relevant and irrelevant information. To understand the dynamics of children's selective attention and their influence on the content of children's memories, we asked children (6-8 years old) and young adults to perform an n-back task on trial-unique, goal-relevant target images, while ignoring simultaneously presented, trial-unique distractor images. We then assessed long-term memories for both image types. We found that children's memories were less selective for goal-relevant information than adults'. While adults remembered goal-relevant information better than children, children had marginally better memory for goal-irrelevant information. These developmental differences were mediated by children's reduced selective attention. We also discovered that children's attentional spotlight was not "broader" in scope, but instead, darted frequently between goal-relevant and irrelevant content across learning events. Indeed, children were more likely to remember distractors on trials in which they forgot targets, suggesting children oscillated focus between targets and distractors, rather than attended to both simultaneously. These findings offer mechanistic insight into children's unique learning abilities, highlighting how their rapidly shifting selective attention holds the key to explaining why they often remember different information than adults.

Topic Area: LONG-TERM MEMORY: Development & aging

F61 - Effects of Area Deprivation Index and individual-level socioeconomic status on cognitive and brain health among middle-aged and older adults

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Area Deprivation Index (ADI) ranks neighborhoods based on census-block socioeconomic disadvantage. Research assessing the relationship between neighborhood indices and cognitive/brain health among middle-aged and older adults is still in its infancy. Further, it is not known how individual-level socioeconomic status (SES) factors relate to neighborhood-level factors. Participants (N=123) living in Alabama, USA, underwent neuroimaging and neuropsychological testing. Using state-level ADI scores, regression was used to examine associations between ADI and cognition/brain structure to replicate findings in hippocampal and frontal regions. After

controlling for age and sex, ADI was negatively related to most cognitive domains. When individual-level factors were added, these relationships were no longer significant, suggesting shared variance on cognitive outcomes. In particular, racial category was the most significant variable sharing variance with ADI on cognitive outcomes. Also, hippocampal volume, but not frontal volume or thickness, was negatively related to ADI. Entering individual-level factors strengthened this relationship. The failure to replicate the effects of ADI on frontal volume may stem from interactions between ADI and income level; a negative correlation was found only for those with lower income, suggesting a protective effect on the frontal lobe for those with high incomes. Consistent with other studies, temporal volumes but not frontal volumes are consistently associated with ADI. Adding to the literature, ADI also was significantly related to multiple domains of cognition, including speed, episodic memory, and executive function. Further, the findings suggest later life racial cognitive disparities might be mitigated through neighborhood improvements to socioeconomic conditions.

Topic Area: LONG-TERM MEMORY: Development & aging

F62 - Aging and the Role of Prior Knowledge in Category-Level Neural Discrimination of Scene Images

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It is well known that the detail and specificity of episodic memory declines with older age. Prior work has shown that using semantic knowledge can help older adults successfully encode new information but can also lead to false recognition. Using neural pattern information as a window into the contents of memory has become increasingly common, and these analyses allow researchers to assess the neural patterns that are consistently evoked by items in the same category. Whether having prior knowledge of to-be-learned stimuli increases processing of category-level information in older adults remains unknown. In the present study, both young (18-30 years old) and older adults (60-80 years old) viewed a set of scene images (mix of famous and non-famous manmade and natural landmarks) and then were asked to recall them all while undergoing fMRI. To assess neural representations of category-level information, we trained and tested a multivariate classifier to distinguish manmade from natural scenes separately based only on the famous locations or only the non-famous locations. We also did this separately for perception and memory recall. Preliminary results revealed an age deficit in remembering non-famous scenes with comparable performance for famous scenes. We observed better decoding of scene category for young adults in perception, while older adults had an advantage in memory recall. These effects emerged for both famous and non-famous scenes. Thus, age differences in category representations may be driven more strongly by task than by prior familiarity with memoranda.

Topic Area: LONG-TERM MEMORY: Development & aging

F63 - Hippocampal subfield volumes in periadolescent children: association with hippocampal dependent relational memory performance.

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The hippocampus, a structure necessary for normal memory function, shows developmental changes in volume that correspond with hippocampal dependent relational memory ability. However, hippocampal development is protracted and regionally heterogenous, making investigation of hippocampal subfield volume changes important for understanding the development of the hippocampus and related memory abilities. Therefore, the current study aimed to investigate the relationship between hippocampal subfield volume, age, and relational memory task performance in a group of healthy periadolescent children aged 8 - 13 years (N=120). Data was collected as part of the NIA-funded Polygenic Risk for Alzheimer's disease in Nebraska Kids (PRANK) Study (R01 AG064247). Participants underwent an MRI study to assess brain structure and completed the All Manner of Relations task. This published task assesses memory for novel visual stimuli as well as their spatial, sequential, and associative relations with other stimuli. Meanwhile, Automatic Segmentation of Hippocampal Subfields software was utilized to segment the hippocampus into the CA1, CA2-3, dentate gyrus, and subiculum. A statistically significant correlation was observed between CA1 volume and performance on the associative relations condition of the task, $r(117) = .20$, $p = .03$, such that greater volume was associated with more accurate memory. The item, spatial, sequential, and associative relations task performance were significantly associated with age, such that older children consistently performed better on the task relative to younger children. Characterizing the relationship between hippocampal subfield differences and memory may lead to insights on healthy brain development and memory function across the lifespan in health and disease.

Topic Area: LONG-TERM MEMORY: Development & aging

F64 - High-frequency Broadband Activity Increases during Memory Encoding and Retrieval in the Posterior Cingulate Cortex of Children and Adolescents

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Posterior cingulate cortex (PCC) is a central node in the posterior medial network supporting episodic memory. Intracranial EEG (iEEG) studies of PCC show that high-frequency broadband activity (HFA, 70-150 Hz), a robust signature of local population spiking, increases during memory encoding and retrieval. It is unknown whether these same HFA dynamics support memory in the PCC of children and adolescents, and whether age-related variability in these functional dynamics corresponds with age-related variability in memory performance and PCC structure. Here, we analyze iEEG data recorded from 25 neurosurgical epilepsy patients aged 5-30 years (11 females) performing an old/new scene recognition task. Trial-by-trial iEEG data from the study (encoding) and test (retrieval) phases of the task were analyzed as a function of retrieval success (remembered "hit" trials vs. forgotten "miss" trials). Initial results show that HFA increases for hits vs. misses at both encoding and retrieval, but at different times. Successful encoding was associated with an HFA increase from 300ms pre-stimulus to stimulus onset, while successful retrieval was associated with an HFA increase from stimulus onset to 300ms post-stimulus. These findings suggest that the same HFA increases observed at encoding and retrieval in adults also support memory in children and adolescents, while also adding temporal specificity to the effect. Data collection is ongoing. Further analysis will formally test these effects using mixed-effects linear models with cluster-based correction for multiple comparisons in the time domain. We will also test whether these effects increase with age and correspond with age-related reductions in PCC thickness.

Topic Area: LONG-TERM MEMORY: Development & aging

F65 - EEG Subsequent Memory Effects Capture Age-Related Cognitive Changes

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Prior studies of episodic memory have identified patterns of neural activity observed at encoding that predict later recall (subsequent memory effects). However, these studies have primarily recruited young adult participants, and it is unclear whether these patterns 1) similarly predict encoding success in older populations, or 2) reflect differences in memory performance across individuals. The present study investigated whether neural subsequent memory effects can capture age-related cognitive changes in free recall. We recorded scalp EEG in 156 young adults (aged 18-30) and 37 older adults (aged 60-85) as they memorized lists of words. During encoding, participants studied each word either freely (without encoding instructions) or while performing a secondary encoding task (judging the size or animacy of each item). Older adults exhibited distinct neural subsequent memory effects, characterized by reduced negativity in the theta, alpha, and gamma frequency bands, especially when encoding was coupled with a secondary task. Surprisingly, age-related differences in neural activity were most pronounced toward the end of the word list, where recall probability was similar between the two groups. The results suggest that neural differences between the age groups may capture compensatory changes in cognitive processing that mitigate age-related memory decline and allow older adults to successfully encode the final items in a list.

Topic Area: LONG-TERM MEMORY: Development & aging

F66 - Cognitive Intra-Individual Variability is Differentially Associated with Long-term Memory across APOE Allele Status Groups

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APOE allele status is implicated in cognitive decline in Alzheimer's disease (AD), with the E4 allele conferring the most risk, followed by E3, then E2. To further investigate the role of APOE genotypes, the current study examines how individual performance variability, measured by cognitive intra-individual variability (IIV), correlates to long-term memory (LTM) in each allele group. Using AD and non-clinical participants from the National Alzheimer's Coordinating Center Uniform Data Set, we examined this relationship across 6 APOE allele status groups: 1 (E3, E3), 2 (E3, E4), 3 (E3, E2), 4 (E4, E4), 5 (E4, E2), and 6 (E2, E2). IIV obtained using the coefficient of variation calculation on performance across different neuropsychological measures was correlated to LTM for each allele group. Comparisons of group correlations were made using Fisher's R-to-Z calculation. Significant associations were seen between IIV and LTM for all APOE allele status groups: 1 (r =-.149, p <.001), 2 (r =-.267, p =.001), 3 (r =-.427, p <.001), 4 (r =-.468, p <.001), 5 (r =-.625, p <.001), 6 (r =-.563, p <.001). Significant group differences included: 1 vs 2 (z=12.66, p <.001), 1 vs. 3 (z=22.71, p <.001), 4 vs. 2 (z=-13.73, p <.001), 4 vs 5 (z=8.23, p <.001), and 6 vs. 3 (z=-3.25, p=.001). However, 5 vs. 6 was not significant (z=-1.63, p=.10). These results suggest a genotypic effect on this relationship in AD and non-clinical populations.

Topic Area: LONG-TERM MEMORY: Development & aging

F67 - Age-related differences in the semantic N400 effect are unrelated to semantic benefits in episodic memory

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Older age is characterized by attenuated episodic memory, but intact semantic memory. At the same time, online semantic processing, particularly the prediction of lexical information, is attenuated, as reflected by a smaller event-related potential (ERP) N400 effect for predictable versus unpredictable items. Using pictorial materials, we investigated whether age-related differences in online semantic processing, as manifested in the N400 attenuation effect, are reflected in a behavioral measure of semantic processing (i.e., perceived semantic congruency) and, in addition, transfer to episodic memory for semantically related object pairs. Younger (YA) and older adults (OA) studied sequentially presented object pairs with and without semantic relationships (e.g., a bathtub followed by a rubber duck or a pillow followed by a punch, respectively). Their task was to judge the object pairs' semantic congruency. Thereafter, an associative memory test was conducted, in which participants had to discriminate between intact, recombined and new object pairs with and without semantic relationships. In the study phase, YA showed the expected N400 attenuation effect for semantically related pairs. For OA, this effect was reduced, even though there was no difference between both age groups in the semantic congruency judgements and both age groups showed highly similar benefits for semantically related versus unrelated pairs in the ensuing associative memory test. Thus, the results are in line with the idea that OA' associative memory benefit by semantic relationships is decoupled from their online semantic processing, as reflected by the N400 attenuation effect during encoding.

Topic Area: LONG-TERM MEMORY: Development & aging

F68 - Curiosity effects sparked by unsuccessful memory recall in cognitive aging

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A well-established finding in cognitive aging is that familiarity of items tends to be preserved in the context of unsuccessful recall of related associations. The present study addressed whether experiences of face familiarity, in combination with failed recall of corresponding names, induce states of curiosity that shape subsequent information seeking behavior and carry benefits for re-learning. Experiment 1 investigated whether older adults exhibit the same familiarity-based preference in information-seeking behaviour for unrecalled names that was previously reported in younger adults. Experiment 2 examined whether an opportunity to act on this curiosity would provide comparable benefits for re-learning of names in younger and older adults. Experiment 3 aimed to replicate and extend Experiment 2 by determining whether such benefits for re-learning can be directly tied to corresponding curiosity ratings. Across experiments, the older adults displayed a similar, if not more pronounced, positive relationship between face familiarity (under conditions of unsuccessful name recall) and choices in subsequent information seeking as was observed in younger adults. Giving participants an opportunity to leverage their own curiosity for re-learning of initially unrecalled names of familiar faces led to higher subsequent recall accuracy rates than exposure to those names under conditions in which curiosity could not be acted upon, with a comparable pattern for older and younger adults. The present findings add new evidence to the extant literature on preserved curiosity effects in old age. Critically, they also reveal behavioural benefits of this preserved curiosity that may help overcome age-related memory impairment.

Topic Area: LONG-TERM MEMORY: Development & aging

F69 - Effects of BDNF and COMT genetic polymorphism on rule-plus-exception category learning at two stages of the menstrual cycle

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Recent decades have seen an increased focus on the influence of brain-derived neurotrophic factor (BDNF) and catechol-O-methyltransferase (COMT) genetic polymorphisms on human cognition. As BDNF supports neuronal growth and plasticity and COMT regulates dopaminergic function, genetically determined variations in their baseline availability may regulate learning and memory. Because variations in both genes interact with the ovarian hormone estradiol to affect cognition, and category learning performance has been shown to vary across the menstrual cycle, we asked participants to complete a rule-plus-exception category learning task at the low- and high-estradiol points of their cycle. We found effects of BDNF polymorphism on categorization of exceptional and rule-following category item, with Met allele carriers outperforming Val homozygotes. Furthermore, COMT Val homozygotes showed slower response times for category prototype items relative to Met carriers. These results provide first evidence of BDNF and COMT effects on rule-plus-exception category learning, and deepen our understanding of menstrual cycle-dependent changes in category learning performance.

Topic Area: LONG-TERM MEMORY: Episodic

F70 - BOLD repetition suppression effects are accompanied by EEG power differences during repeat object naming

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Repeatedly processing the same stimulus results in faster and more accurate behavioral responses (a phenomenon term repetition priming) that are accompanied by reductions in neural activity in brain regions relevant to processing that stimulus (repetition suppression). Prior studies using fMRI or EEG have attempted to understand how reductions in neural activity may produce behavioral improvements, but a mechanistic understanding may require both the whole-brain spatial precision offered by fMRI and the temporal precision of EEG. Here, we utilized a simultaneous EEG-fMRI approach to maximize both factors while participants viewed and named common object images. Prior to scanning, 40 participants named 100 objects, and these same 100 images ("repeat stimuli") were once again named during scanning along with 100 newly presented object images ("novel stimuli"). In-scanner verbal responses were recorded using an MR compatible microphone. Participants named repeat stimuli approximately 100 ms faster than novel stimuli. Analysis of fMRI data identified significant repetition suppression effects in task-responsive regions including left inferior frontal and fusiform cortex. Analysis of scalp EEG data identified prominent repetition-related reductions in ERP voltages over posterior electrodes. Source-estimated EEG data were coregistered with the surface mesh used for the fMRI data, and EEG power was compared for novel and repeat items in fMRI-defined clusters. Both increases and decreases in power were associated with BOLD repetition suppression within these regions, with the former generally preceding the latter. These data highlight the utility of simultaneous EEG-fMRI

acquisitions in the study of how repeated experiences modify brain-behavior relationships.

Topic Area: LONG-TERM MEMORY: Priming

F71 - Theta oscillations and memory performance effects of transcranial alternating current stimulation

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Introduction: Neural activity in the theta frequency (4-7 Hz) is involved in memory. Several studies showed memory performance improvements after theta-frequency transcranial alternating current stimulation (tACS). However, effects of tACS on the targeted oscillatory brain activity show mixed results. Moreover, transcranial stimulation is typically applied during memory encoding while effects on memory consolidation are less understood. Therefore, we investigated effects of tACS interleaved with brain activity recordings during a memory consolidation phase. Methods: In two cross-over studies, healthy volunteers (Study I: n=39; Study II: n=32) underwent sham and active tACS in separate sessions (5 Hz, 2 mA peak-to-peak, F3/F4 montage). Twenty minutes of total stimulation time was divided into short periods (1 or 4 minutes) interleaved by resting-state EEG recordings (30 or 60 seconds). Memory encoding was performed pre-stimulation, and memory retrieval was tested post-stimulation. Memory performance was assessed by a face-scene associative memory task (Study I) and a free word recall task (Study II). Additionally, Study II assessed working memory during stimulation using a change detection task. Results: Preliminary analyses of grand average oscillatory power in frontocentral EEG electrodes at the stimulation frequency (5 Hz) or in the broader theta band (4-7 Hz) show no significant differences between active vs. sham tACS. Further analyses are ongoing. Results will be presented on the poster. Conclusion: Preliminary evidence shows no entrainment of frontocentral theta activity during the interleaved tACS-EEG protocol. Effects of theta-tACS on memory consolidation, and dependence on individual differences in theta activity are topics of further investigations.

Topic Area: METHODS: Electrophysiology

F72 - Waveform shape better explains the relationship between respiration and neural oscillations than cross-frequency coupling

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The breath cycle is a periodic rhythm consisting of asymmetric inhalation and exhalation phases. There is emerging evidence that respiratory rhythms entrain neural oscillations in various brain regions. More specifically, it is hypothesized that respiration influences neural processing via synchronization of coherent rhythms, as well as phase-amplitude coupling (PAC). These mechanisms of action do not account for a fundamental attribute of these physiological rhythms: waveform shape. Respiratory and neural rhythms are both nonsinusoidal in nature: they wax and wane for various durations, and have sharper or smoother peaks and troughs. Here, we test the hypothesis that the classically reported PAC measures in respiration-mediated neural oscillations may conflate the effects of nonsinusoidal waveform shape with multiple oscillations. To do this, we analyzed a dataset of iEEG patients at rest with simultaneously recorded respiration and electrodes in medial temporal lobe (MTL; hippocampus and amygdala). To extract the true waveform shape of the respiration-entrained neural oscillations, we used spatio-spectral decomposition (SSD) to isolate MTL oscillations at the respiration frequency. From this signal, we used bycycle to extract cycle-by-cycle waveform shape features of the SSD sources. To assess the relationship between these rhythms, we examined their cross correlation and Granger causality. Additionally, we computed classically measured metrics of PAC to test if there were spuriously generated coupling with these nonsinusoidal rhythms. We found that even in the respiration rhythm itself, there is significant PAC indicating either people breathe with nested oscillations (which is unlikely) or PAC of these nonsinusoidal waveforms is being misinterpreted.

Topic Area: METHODS: Electrophysiology

F73 - Thalamo-centric causal connectivity mapping in human brain with intracranial electrical stimulation

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In this study we explore the whole-brain causal connectivity with a central focus on the thalamus' role in shaping whole-brain connectivity motifs, investigated through multi-site stimulation and recording using deep intracranial electrodes. The study involved 27 participants with focal epilepsy and implanted electrodes. Whole-brain causal connectivity was examined by stimulating each bipolar channel while recording from others. The Uniform Manifold Approximation and Projection (UMAP) algorithm was employed to encode neural signals, utilizing time-variant power and inter-trial phase coherence spectrograms of stimulation evoked potentials (SEPs). Activation labeling was derived through semi-supervised learning, and group-level supervised UMAP was used to map activated spectrograms to anatomical identities. Neural features 1&2, characterized by gamma/beta and high theta respectively, were distinguished in cortical stimulations. A unique third cluster (Feature3) emerged in thalamus stimulations, revealing delayed and persistent theta oscillations. Whole-brain causal connectivity matrices unveiled modularity in adjacent areas within hemispheres (Feature-1), widespread representations across hemispheres (Feature-2), and widespread delayed thalamocortical feedback (Feature-3). Comparing thalamic subdivisions, anterior thalamus exhibited recurrent connectivity with the frontal areas, while the posterior thalamus showed stronger connections with parietal and occipital areas. In conclusion, the study encoded whole-brain stimulation-evoked potentials into three neural features, representing direct cortical connectivity, indirect connectivity via cortex, and thalamocortical feedback. Thalamus was found to receive direct connectivity from the whole brain, while its direct cortical projection was hemisphere-limited. Indirect thalamocortical feedback, persisting in cortical signals for approximately 200 ms with a late onset (>165ms upon stimulation), acts as a propagator of theta oscillations throughout the brain.

Topic Area: METHODS: Electrophysiology

F74 - Using Electroencephalography (EEG) to Assess the Long-Term Effects of ACEs on Frontal Lobe-Mediated Cognition

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Given the rise in mental health conditions worldwide, it is imperative to investigate factors that may contribute to increased prevalence to understand the etiology of mental illness. One factor that has received copious amounts of attention is Adverse Childhood Experiences (ACEs). ACEs are traumatic events occurring before the age of 18, including various forms of abuse, neglect, and household dysfunction; all of which can have life-long effects on mental health and behavior. Most studies investigating ACEs focus on attention. For example, children reporting ACEs are more likely to be diagnosed with ADHD compared to those without ACEs. While behavioral correlates of ACEs have been identified, research is limited on the effects of ACEs on brain activity. This study investigates ACEs and cortical responsiveness to cognitive tasks. 72 participants completed an ACEs survey and three tasks assessing selective attention, linguistic processing, and working memory presented randomly while electroencephalography (EEG) was recorded simultaneously. Results reveal that individuals with at least one ACE had longer reaction times on the selective attention task compared to those with no ACEs. Those with no ACEs had greater cortical responsiveness to the working memory task compared to those with at least one ACE. Further, as ACEs increased, responses to selection attention and working memory tasks weakened. Findings suggest that cortical processing differs by experience with ACEs as greater numbers of ACEs are associated with diminished brain activity. The use of EEG may provide a good technological advancement to understand the relationship between ACEs and mental health.

Topic Area: METHODS: Electrophysiology

F75 - Oscillatory mechanisms of intrinsic brain networks

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Non-invasive neuroimaging has revealed specific network-based resting-state networks in the human brain, yet underlying neurophysiology remains unclear. In the current study, we recorded and analyzed intracranial electroencephalography (iEEG) data from 42 participants to characterize local field potentials (LFPs) within three major intrinsic connectivity networks—the default mode network (DMN), frontoparietal network (FPN), and salience network (SN). The result showed significantly stronger within-network phase coherence in low frequencies (4-13 Hz) within the DMN and high frequencies (30-100 Hz) within the FPN. Further analysis using Hidden Markov Modeling (HMM) indicated a preferential pattern of low-frequency phase coupling within the DMN. Phase-amplitude coupling analysis further revealed that the low-frequency phase in the DMN modulated the high-frequency amplitude envelopes within the FPN, providing support for interactions between intrinsic networks. These novel intracranial electrophysiological findings corroborate the network model of intrinsic brain architecture, observing distinct oscillatory profiles between networks, with the DMN preferentially engaging slower frequencies. This research sheds new light on how various networks coordinate resting-state activity through the integration and segregation of neural signals across frequencies— advancing theoretical understanding of network communication mechanisms underlying the brain's intrinsic functional architecture.

Topic Area: METHODS: Electrophysiology

F76 - Beyond Behavior: Using ERPs to Map Parenting Styles' Influence on Selective Attention

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Parenting styles are critical in children's attachment styles, emotional socialization, psychological development, and decision-making. Previous research suggests that unsupportive parenting like authoritarian and uninvolved styles, causes children to struggle cognitively, while authoritative parenting leads to heightened cognitive abilities. Research is limited regarding the connection between parenting styles and cortical processing. One study using fMRI determined that children with unsupportive parents have less adaptive neural connections, which may translate to deficits in cognitive performance over time. No studies to our knowledge have explored temporal differences in cortical activation. Different parenting styles may lead to variations in cortical activation, revealing weakened or delayed processing. The goal of this study was to establish a relationship between parenting style and brain activity to determine the effects that parenting styles have on cognition in adulthood. 67 participants completed a parenting styles questionnaire and the Stroop Task while electroencephalography (EEG) was recorded. Electrical activity was averaged to create event-related potentials (ERPs) in response to the Stroop task. Results reveal that those with authoritative parenting styles had reduced cortical responsiveness in frontal lobes compared to other parenting styles (Congruent P300 Amplitude, $t(42) = -2.773$, $p=0.008$, Incongruent P300 Amplitude, $t(43) = -2.164$, $p=0.036$), suggesting more efficient cognitive functioning when it comes to tasks requiring selective attention. Individuals with less supportive parenting styles may require more cognitive input as reflected by greater cortical responses to the Stroop Task. Future studies on decision-making and/or attention should consider parenting styles as an explanatory factor leading to variability in performance.

Topic Area: METHODS: Electrophysiology

F77 - Are Your International Classmates Really Smarter than You? The Relationship Between Bilingualism and Cognitive Performance

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Bilingualism is one of many phenomena that have received substantial attention in relation to human cognition; yet the findings have been diverse. The purpose of the present study was to examine the relationship between bilingualism and domain-general cognitive functions, looking at both behavioral and cortical differences in 70 college-aged participants. In particular, we investigated executive functioning, language processing abilities, and working memory, using the Stroop Task, the Lexical Decision Task, and the Sternberg Working Memory Task respectively, while brain activity was measured simultaneously using electroencephalography (EEG). Cognitive performance by linguistic status revealed no behavioral differences between monolinguals and bilinguals on the cognitive tasks. However, bilinguals did demonstrate significantly enhanced cortical reactivity in frontal regions (i.e., greater response amplitudes) on the decision-making task, but not the attention or working memory tasks, compared to monolinguals.

Topic Area: METHODS: Electrophysiology

F78 - Characterizing Spontaneous Thought and Conscious Experience at Rest with EEG Microstate k-mers

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Characterizing the intrinsic dynamic activity of brain networks has proven to be an important goal of contemporary neuroscience research. One methodological approach involves probing the correspondence between spontaneous thought and ongoing brain dynamics while individuals are at rest. Large-scale electrophysiological events known as electroencephalographic (EEG) microstates provide an important window into whole-brain neuronal network activity at the millisecond time scale. The sequential nature of these microstates is thought to reflect aspects of phenomenologically tractable cognitive and perceptual states corresponding with individuals' dynamic neurocognitive functioning. In the present EEG study, we examined the occurrence of microstate k-mers, substrings of microstate sequences of k length, to investigate their utility in predicting participants' self-reported spontaneous thought during rest. Participants (N=64) were instructed to report on the content and quality of their spontaneous thought by answering questions adapted from the Amsterdam Resting-State Questionnaire (ARSQ) after 8 separate periods of 2-2.5 minutes of quiet eyes-closed rest. The frequency of k-mers were used as predictors of individuals' ARSQ ratings using multivariate distance matrix regression, separately for each k length [2-10]. We found that microstate k-mers were significant predictors of spontaneous thought and felt experience for several k lengths. Recurrent loops of pairs of microstates were constitutive of the most prevalent k-mers across all lengths of k, suggesting a role for microstate bimers (k-mer length=2) in supporting ongoing phenomenology of conscious experience. These findings support the notion that EEG microstates reflect functionally relevant features of ongoing brain activity. Subsequences of microstates may encode individuals' ongoing spontaneous thought.

Topic Area: METHODS: Electrophysiology

F79 - Effects of Contextual Affect and Face Gaze Direction in Social Cognitive Tasks: A Rigorous Mass Univariate Re-Analysis of ERP Data

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Recent research on how affective context and perceived gaze direction influence the neural time-course of social cognition revealed different effects of contexts on face related ERPs depending on task demands. In an empathy task, gaze modulated ERPs only in positive contexts (McCrackin & Itier, 2021a); in a theory of mind task, gaze influenced processing of both positive and negative stimuli (McCrackin & Itier, 2021b). However, these studies had average sized samples and used the FMUT toolbox to focus on known ERP components of interest. As the studies used different tasks but identical stimuli and procedures, we re-analyzed them using the robust LIMO-EEG mass univariate statistics toolbox to perform a mixed-model ANOVA (N = 86) in a data-driven way (all time points and all electrodes analyzed). We evaluated ERP responses to faces with direct or averted gaze that had been primed with positively, negatively, or neutrally valenced context sentences when participants rated either their level of empathy for, or the affect of, the neutral face targets (theory of mind). No significant effects of gaze direction or context valence was found. A significant interaction between valence and task group was found at left posterior electrodes during the LPP component, a well as a valence by gaze interaction at left posterior sites during the P1. However, none of the Bonferroni-adjusted follow-up contrasts were significant. We did not replicate the original valence and gaze effects when using data-driven rigorous statistics. Results will be discussed in the context of the replication crisis in ERP research.

Topic Area: METHODS: Electrophysiology

F80 - Cue reactivity of non-dopamine neurons in the midbrain

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An influential model of addiction proposes that repeated exposure to addictive drugs results in overvaluation of drug cues and long-lasting cue-drug associations, which results in heightened motivation to seek drugs upon exposure to these cues. This model focuses on the role of midbrain dopamine neurons in forming these associations, known as cue reactivity. However, the neurophysiological responses of non-dopamine neurons to cues predicting opioids vs. natural rewards have not been examined previously. Multi-unit electrophysiological recordings were collected from the midbrain of adult Long-Evans rats during Pavlovian presentation of cues associated with the opioid remifentanil vs. oral sucrose. Non-dopamine neurons were identified using an automated hierarchical clustering algorithm. Our data identify a subpopulation of non-dopamine neurons that shows significant cue reactivity in response to opioid or sucrose cues. These neurons fire almost exclusively in dense bursts and are inhibited by sucrose or remifentanil reward. However, they show an immediate initial phasic activation response being much faster than the phasic response observed in putative dopamine neurons. Additionally, this subpopulation shows enhanced response to opioid vs. sucrose cue within the same neurons, and to sucrose cues in drug-exposed vs. drug naïve animals. Another subpopulation was identified which exhibit immediate inhibition to sucrose cues, however it was only identified in drug naïve animals. One more subpopulation with persistent activation throughout the cue period was observed. Our results demonstrate cue reactivity in non-dopamine neurons in the midbrain. Next steps involve establishing the identity of these neurons and their role in drug seeking behavior.

Topic Area: METHODS: Electrophysiology

F81 - Machine learning based prediction of mental fatigue based on eye-tracking and psychological data

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Prolonged performance of cognitively demanding tasks often leads to a psychobiological state labelled as mental fatigue. Fatigue has been associated with altered biological processes, for example, changes in cardiac activity or pupil size. Using eye-tracking and psychological data, we trained classification and regression algorithms to differentiate between fatigued and non-fatigued states and to predict the level of post-task fatigue, respectively. In two experiments, fatigue was induced by prolonged cognitive tasks. The difference between the two experiments was that cognitive load was higher in Experiment 1 (n = 30) than in Experiment 2 (n = 29). For classification, eye-tracking and psychophysical variables were calculated for the first (i.e. “non-fatigued” label) and the last 5-min of the task (i.e. “fatigued” label). For regression, demographic, eye-tracking, psychophysical and psychological variables were used to predict post-task fatigue. The best performing classification algorithm was the k-nearest neighbour algorithm (AUC = 0.612 [CI95% = 0.588–0.635]). Elastic net regression showed the best predictive performance among the regression algorithms (R2 = 0.608 [CI95% = 0.578–0.639]). Based on permutation importance, the best predictors of post-task fatigue were pupil size, fixation instability and sleep duration. To conclude, the regression-based prediction of post-task fatigue was successful and suggested that eye-tracking metrics explain individual differences in fatigue caused by prolonged cognitive performance. Classification algorithms, however, performed just slightly above chance level, which is a poorer performance compared to models trained on other biomarkers (e.g. heart rate). Support: AM was supported by the National Research, Development and Innovation Office, NKFIH grant (PD147001)

Topic Area: METHODS: Electrophysiology

F82 - A cell type database for intrinsic electrophysiological features of NHP neurons collected from the lateral prefrontal and primary visual cortex.

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Higher-order mental representations underlying working memory function, are believed to arise in primates, with the development and expansion of the granular prefrontal cortex (PFC). For example, in vivo extracellular recordings from behaving non-human primates (NHPs) have shown that persistent firing representing the contents of working memory can be found in lateral PFC but is absent in early sensory areas such as the primary visual (V1) cortex. However, the mechanistic basis of potentially unique primate PFC circuitry remains speculative, partly due to the lack of data on the biophysical and morphological features of diverse cell types directly obtained from different brain areas of NHPs. Furthermore, potential differences in PFC single-neuron properties among different NHP species (e.g. new-world monkey Marmoset and old-world monkey Macaque) remain unknown. The latter is an important question, as marmosets are increasingly being used as models for human cognition, yet their cortical microcircuitry is poorly documented. In our international consortium (NeuroNex), we aim to characterize the biophysical and microanatomical properties of cortical neurons from the dorsolateral (DL)PFC and V1 of multiple NHP species (with focus on Callithrix jacchus) using patch clamp electrophysiology in acute brain slices. We systematically collected membrane voltage responses to different characterization protocols and analyzed intrinsic neural properties. To date, we accumulated over 350 intracellular electrophysiological recordings from marmosets. In addition, we examine anatomical features including dendritic type and laminar location of reconstructed neurons. Some of these data can be browsed on the website ‘PrimateDatabase.com’, a collection of publicly available NHP intracellular recordings.

Topic Area: METHODS: Electrophysiology

F83 - RESTING-STATE EEG COMPLEXITY ACROSS ADULT LIFESPAN SUGGESTS A SHIFT IN BRAIN NETWORK ARCHITECTURE IN MIDDLE-AGE

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Introduction: There is mounting evidence from cross-sectional studies suggesting that ageing is associated with the loss of complexity in brain signals (Ma et al., 2021). However, the complexity trajectory across lifespan and its cognitive association — the focus of the present study — remain unknown. Methods: Three analyses were conducted on 102 participants (age 19.1 - 81.2): (1) to examine age-related trajectory of Lempel–Ziv complexity (LZC) via linear mixed effect models; (2) to reveal cognitive associations pre and post middle-age upon identifying the inverted U-shaped trajectory of LZC via correlation analysis; (3) to investigate if the age-related changes in both LZC and spectral exponent contribute to brain network architecture via minimum spanning tree (MST) analysis. The MST was extracted from brain network computed from corrected imaginary phase locking value (ciPLV) between 64 channels. Results: Firstly, LZC showed an inverted U-shaped trajectory peaking around 50y. Second, antagonistic brain–behaviour associations were observed before and beyond middle-age such that higher complexity was beneficial to cognitive abilities (e.g. Stroop) in older adults, while the opposite was true for younger adults. Third, both the LZC and spectral exponent significantly predicted the MST network characteristics at different life stages. Specifically, a higher LZC indicated more centralized topology before middle-age, while a higher spectral exponent (steeper slope) indicated less centralized topology after middle-age. Conclusion: Our results (1) reveal the quadratic trend of brain complexity; (2) highlight the antagonistic brain–behaviour associations before and beyond middle-age; and (3) suggest that LZC might indicate the shift in brain network architecture.

Topic Area: METHODS: Electrophysiology

F84 - Ketamine and psilocybin differentially modulate the aperiodic component of the power spectral density

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Ketamine and psilocybin are being explored for their potential in studying and treating psychiatric disorders like major depression and schizophrenia. Ketamine, a dissociative hallucinogen, blocks glutamatergic N-methyl-D-aspartate receptors (NMDARs) in the brain, while psilocybin modulates serotonergic 5-HT2A receptors. Similar to schizophrenia's EEG profiles, a single ketamine infusion induces changes in the EEG

signal, affecting event-related potential amplitude and activity within the gamma, beta, and alpha frequency bands. In addition to the information encoded in the periodic components, the aperiodic components of the spectrum, notably the 1/f slope, may reflect underlying neuronal dynamics, including excitatory-inhibitory balance. In our analysis of EEG recordings from 19 subjects during an auditory roving mismatch negativity (MMN) paradigm, we assessed changes under ketamine and placebo conditions. We aimed to detect shifts in the excitatory-inhibitory balance through aperiodic components and compare spectral differences between conditions. We used "fitting oscillations and one-over-f (FOOOF)" to model spectral parameters and partial least squares to statistically analyze their distributions. Our results indicate that ketamine significantly affects alpha and beta bands and alters the EEG spectrum's slope in certain brain regions, indicating altered excitatory-inhibitory balance. This effect is unique to ketamine, as psilocybin only decreases alpha power without affecting aperiodic components. In conclusion, our results emphasize a link between the excitatory-inhibitory balance and the spectrum's slope, reinforcing ketamine's utility as a model for psychosis. Our findings suggest that these large-scale biomarkers of the excitatory-inhibitory balance may be used for early schizophrenia diagnosis.

Topic Area: METHODS: Electrophysiology

F85 - EEG-based classification algorithms reveal differential neural processing of words and images

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Machine learning methods employing neuroimaging data are useful for monitoring the activation and reactivation of neural representations in the brain. Specifically, they can be used for observing brain networks that are recruited for processing specific categories of items. This approach has been used predominantly with functional magnetic resonance imaging data, and more rarely with electroencephalography (EEG) data. Here, we developed a task, analytic pipeline, and stimulus dataset to optimize category classification with EEG. Participants (N=30) viewed a series of images and words belonging to five categories (Animals, Tools, Food, Scenes, and Vehicles) and responded when items from the same category were presented consecutively. We trained support vector machines on their EEG activity and found that both images and words yielded significant category classification accuracy levels, with the former showing higher accuracy than the latter. When comparing category pairs, some were more distinguishable than others (e.g., Animals vs. Scenes were more distinguishable than Vehicles vs. Food). Electrodes over the occipital lobe contributed more to image classification, whereas electrodes over the temporal lobes contributed more to word classification. Our data and analytic pipeline yielded high classification accuracies, at least for image stimuli, providing support for the utility of EEG data for neural decoding. We believe these methods can be instrumental for exploring the activation and reactivation of neural representations on the category level in both wakefulness and, potentially, in sleep as well.

Topic Area: METHODS: Electrophysiology

F86 - Dynamic network analysis of electrophysiological task data

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A popular approach for studying cognition is to use functional neuroimaging combined with a task. In electrophysiological data, we often study the oscillatory task response by averaging the time-frequency response epoched around the cognitive event of interest over trials. Whilst effective, the researcher must decide a trade-off between the time and frequency resolution, and sensors/brain regions of interest. Here, we show how the oscillatory task responses from conventional time-frequency approaches can be represented more parsimoniously at the network level using two state-of-the-art methods: the HMM (Hidden Markov Model) and DyNeMo (Dynamic Network Modes). In a face perception task recorded with MEG (N=19), where participants were shown an image of a famous, unfamiliar, and scrambled face. Comparing DyNeMo, HMM and traditional oscillatory response analysis, we show only DyNeMo is able to detect subtle transient differences in the oscillatory network response for famous vs unfamiliar faces. We observe a sequence of network activations at millisecond speeds that relate to bottom-up and top-down processes. Our results suggest the recognition of famous faces relies on the engagement of a prefrontal network and a suppression of the visual network. We argue DyNeMo offers a more sensitive and interpretable network perspective on the cognitive processes that are revealed in functional neuroimaging studies compared to conventional methods.

Topic Area: METHODS: Electrophysiology

F87 - Complexity Modulation with Naturalistic Narrative Stimuli for Prognosis of Acute Brain-Injured Patients

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The clinical utility of electroencephalography (EEG) to aid in the diagnosis and prognosis of brain-injured patients in the intensive-care unit (ICU) is promising. Specifically, advances have been made in machine learning and complexity EEG methods for classifying different cognitive states. This study aimed to evaluate the usefulness of EEG in predicting good neurologic recovery in unresponsive patients with severe brain injury in the ICU. The study recruited 33 ICU patients and divided them into good (n = 16) and poor outcome (n = 17) groups based on their Glasgow Outcome Scale-Extended scores at 3,6, and 12-month follow-ups after injury. Additionally, 18 healthy control participants were recruited. Various complexity and entropy measures were extracted from the signals as features. The features were analyzed statistically, and the success of features in classifying between intact and scrambled conditions was measured by various classifiers using a stratified 5-fold cross-validation technique. Healthy controls were used to find the measures and algorithms that can best discriminate between intact and scrambled. The top-performing measures and algorithms were determined using a Two-way repeated measures ANOVA. Results from healthy controls showed that Support Vector Classification and Linear Discriminant Analysis were the top-performing algorithms. Furthermore, Fractal Line Length index and Conditional Weighted Permutation Entropy were the top-performing complexity measures for discriminating between intact and scrambled. However, none of these models were able to predict patient prognosis, as the resulting accuracy scores were not correlated with patient outcomes. Further research is necessary to develop these techniques to accurately predict patient outcomes.

Topic Area: METHODS: Electrophysiology

F88 - Validation of a low-cost EEG headband for language ERP research

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Introduction: Motivated by the growing interest in using consumer-grade EEG devices for cognitive research, this study investigated the Muse 2 by InteraXon. While primarily designed to provide mindfulness feedback, the Muse 2 is a low-cost dry EEG headband, thus making it a notable contender in the field. The focus of this study was on its potential for language event-related potential (ERP) studies, specifically the N400 effect, which often serves as an indicator of cognitive effort needed to integrate unexpected words into the ongoing context. Methods: EEG was recorded in 35 participants while completing a semantic relatedness judgment task on visually presented word pairs. Words were sequentially displayed at the center of a computer screen. The second word of each pair was either related (N=56) or unrelated (N=56). The lab streaming layer protocol, along with several other open-source Python-based tools, was used to ensure precise time synchronization between EEG and stimulus streams. Results: Data preprocessing and statistical analysis were performed with the open-source EEGLAB software. Robust t-test showed a significant increased negativity for unrelated compared to related word pairs between 300 and 500 ms. Conclusion: The successful measurement of the N400 semantic relatedness effect underscores the potential of the Muse 2 for language ERP research. Its affordability and portability position it as a promising alternative to traditional EEGs, potentially democratizing ERP research in certain contexts. Furthermore, it paves the way for large-scale data collection and broadens access to a diverse population who may otherwise face challenges in participating in lab-based research.

Topic Area: METHODS: Electrophysiology

F89 - Finding tau rhythms in EEG: an independent component analysis (ICA) approach

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Tau rhythms are largely defined by sound-responsive alpha band oscillations generated within superior temporal gyri. We demonstrate that independent component analysis (ICA) decomposition can effectively identify tau sources and can be used to study tau source activities in EEG recordings. Subjects (N = 18) were passively exposed to 3-sec duration complex acoustic stimuli while their EEG was recorded (64 channels). Each subjects' data was split into 60 parallel processing pipelines entailing use of five levels of high-pass filtering (passbands of 0.1 Hz, 0.5 Hz, 1 Hz, 2 Hz, and 4 Hz), three levels of low-pass filtering (25 Hz, 50 Hz, and 100 Hz), and four different ICA decomposition algorithms (fastICA, infomax, adaptive mixture ICA [AMICA], and multi-model AMICA [mAMICA]). Tau-related independent component (IC) effective source processes were identified from this data as being localized near the superior temporal gyri with a spectral peak in the alpha band. These "tau IC" sources showed alpha suppression during sound presentation that was not seen in other commonly observed alpha-producing IC clusters. The best performing combination of filters and ICA model choice identified at least one tau IC in the data of ~94% of the sample. Altogether, the data reveal close similarities between EEG tau IC source dynamics and tau dynamics reported in MEG and intracranial data. These results suggest that using relatively aggressive high-pass filters and mAMICA decomposition should allow researchers to identify and characterize tau rhythms in nearly all subjects.

Topic Area: METHODS: Electrophysiology

F90 - Measures of hippocampus connectivity as predictors of Theta Burst Stimulation response

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Theta Burst Stimulation (TBS) has been proposed as a therapeutic tool aimed to modulate different maladaptive aspects of behavior. However, the predominant focus of TBS research is on behavioral effects, without sufficient understanding of the underlying mechanisms. This study investigates effective brain connectivity through Corticocortical Evoked Potentials (CCEPs) in response to two stimulation paradigms, Single Pulse Stimulation (SPS) and Theta Burst Stimulation (TBS). CCEPs are characterized by early and late components, reflecting direct and indirect connectivity between the stimulation and target sites. Notably, the root-mean-squared (RMS) voltage of the early component is a marker routinely utilized to assess direct connectivity, previously revealing robust connections between the hippocampus and various cortical regions. We hypothesized that hippocampal connectivity to the limbic system can predict increased theta power persisting post-stimulation, postulated to mediate enhanced plasticity. Through the measurement of RMS voltage of evoked responses following SPS and TBS in stereo-electroencephalography (sEEG) recordings from epilepsy patients, we aim to identify key predictors of the response to electrical stimulation. Preliminary results indicate a significant difference in RMS voltage of evoked responses between the two stimulation modalities –SPS and TBS–, with this difference amplifying with increasing stimulation amplitude. Identification of biomarkers predictive of stimulation response could help pinpointing regions where TBS induces potentially long-lasting plasticity changes.

Topic Area: METHODS: Electrophysiology

F91 - Structure-function coupling of the video-watching EEG on the underlying anatomy

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Brain Structure-Function relationship (i.e. between activity and structural connectivity) is well characterized for fMRI[1,2], and has been studied with EEG during epileptic seizures and event-related potentials[3,4], but has been seldom investigated using continuous EEG. Here, we investigate the structure-function coupling during movie-watching using EEG and MRI data from Healthy Brain Network (n=43)[5] with the resting-state as baseline reference and exploiting the graph signal processing(GSP) framework[6]. EEG cortical sources were estimated using Boundary Element Method and eLORETA, followed by parcellation on the HCP-MMP atlas, Hilbert transform and bandpass filtering in specific frequency bands. Cortical envelopes were projected to the subject-specific structural connectome[7] and the structure-function relationship was quantified using a GSP metric (Structural-decoupling Index: SDI)[8]. During movie-watching, RetroInsular Cortex, Visual V3, and Primary Auditory cortex are closely aligned with anatomy, while the Parahippocampal and inferior frontal sulcus areas are decoupled. The reliability of this pattern was ensured with a different video (Intraclass coefficients: 0.78; 95%CI: 0.72, 0.83). Comparing video and rest SDI, we observed weaker coupling during movie-watching in many regions such as the Premotor and Fusiform Face complex, while the Retrosplenial complex in the PCC and Premotor cortex exhibited stronger coupling. In line with previous work on fMRI[9,8], EEG in sensory areas is more strongly coupled to the underlying structure, while transmodal regions such as PCC exhibit strong coupling. Overall, this study provides novel insights on how the dynamics of continuous EEG relate to the individual brain structure during a complex, naturalistic task as compared to resting state.

Topic Area: METHODS: Electrophysiology

F92 - Preliminary comparative spectral analysis of EEG for two participants during a free recall working memory task

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We present exploratory analysis of EEG collected during a working memory task where (N=2) participants were presented with geometric shapes and words for free recall later on. We investigate the brain wave activities of different electrode regions associated with the default mode network (DMN) and task positive network (TPN) by comparing the complexity of channels with high coherence. The method of analysis is a multistep process: (1) compare the intra-subject wavelet coherence of all channels for each participant, (2) compute the multiscale entropy and fractal dimensions for groups of channels with high coherence, (3) use those complexity measures to predict the recall performance of participants as well as VVIQ scores that were measured separately. Measuring coherence in the wavelet domain allows for time-frequency analysis, separating the different brain wave bandwidths of interest during different (shapes and words) stimuli. A multiscale entropy method is used in order to measure the regularity of cohering signals across different resolutions and therefore bandwidths. Both Katz's and Higuchi's fractal dimensions are computed in order to measure the predictability and estimate the temporal dimensionality of signals. Although the indices do not show strong predictive value for recall and VVIQ scores, there is evidence of region-specific stimuli-specific brain wave activity during the memory encoding phase of the task.

Topic Area: METHODS: Electrophysiology

F93 - Not all-or-nothing: intracellular action potential waveform varies systematically with extracellular gamma oscillatory state

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Individual neurons' action potentials (APs) have a dynamic waveform, the shape of which differs by neuron subtype and species. In analyses of single-unit data, however, this waveform is reduced to a binary "all-or-nothing" event, with systems and cognitive neuroscience focusing on the number and timing of spike events. This analytical convenience has, in turn, resulted in computational theories of neural coding that assume binarity. Despite this assumption, a considerable body of evidence shows that AP waveforms exhibit systematic, within-neuron variation that may contribute additional information beyond the rate or timing of discharge that is ignored in the interpretation of classical results in systems, cognitive, and computational neuroscience. To address this concern, we have developed an AP waveform parameterization approach that quantifies the fine-scale features of extracellular and intracellular spike waveforms. Using this parameterization on patch-clamp recordings of APs, we find within-neuron correlations between features such that, for example, individual APs that decay faster result in

subsequent spikes occurring more quickly. Leveraging this parameterization, we analyzed a dataset of simultaneously recorded patch-clamp APs and local-field potentials (LFPs) in rats. This allows us to examine, for the first time, the temporally causal influence of the LFP on individual AP waveforms. We observed within-neuron differences in spike waveform features in relation to LFP gamma oscillatory states that have been overlooked using traditional spike analyses. Our results provide preliminary evidence for the importance of studying within-neuron variance in AP waveform alongside traditional spiking metrics to enhance our understanding of neural coding and cognition.

Topic Area: METHODS: Electrophysiology

F94 - Crossroads in the learning brain: neural overlap between arithmetic and phonological processing

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Despite the robust evidence about the associations between reading and math performance, the neural correlates of these abilities have been mostly studied in isolation. Previous studies suggest a neural mechanism for this link: brain areas that are involved in phonological decoding may also participate in arithmetic fact retrieval. However, only a few studies have explored both domains within the same participants. In the current study, we used both univariate and multivariate methods to explore the relationship between arithmetic (addition) and phonological processing in children and adults. Using a univariate conjunction analysis, we found clusters of significant overlap between both skills along the inferior frontal gyrus, the middle temporal gyrus and the cerebellum in adults; as well as multiple clusters along the frontal gyrus in children. Moreover, we hypothesized that the multivariate patterns of brain activity corresponding to small addition problems (typically solved using retrieval) should display a larger similarity to phonological decoding processes than large problems (typically solved using computations). But contrary to our expectations, we observed higher similarity between phonological processing and large problems than small problems. These results suggest that large problems may involve phonological processes to a higher extent. Alternatively, the observed overlap may result from a common reliance on general domain processes. In conclusion, our results confirm the existence of shared neural correlates between math and reading, especially along frontal and temporal circuits and grant the need for further research about the role of arithmetic strategies in this relationship.

Topic Area: OTHER

F95 - Distinct distributed networks support visual and linguistic mental imagery

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Mental imagery is the process of experiencing sensory information in the absence of a direct external stimulus. Individual-level precision fMRI studies have provided evidence that a distinct network ("DN-A") can be defined within the canonical default network which shows increased activity when mentalizing scenes, especially when these are reported to be visually vivid. Here, we examined the involvement of brain networks in the phenomenological experience of imagination across other domains. Eight healthy adult participants performed a mental imagery task, imagining various scenarios and rating each on multiple attributes, including visual and auditory vividness, language content, spatial cognition, difficulty, etc. Participants also completed a passive fixation task, used to estimate brain networks in each individual based on functional connectivity. Extensive (7.6 hrs) of fMRI data was collected from each participant. A principal component analysis of behavioral ratings from each trial revealed a principal component (PC1) that represented the main effect of imagining across all trials. Trial-wise regression of PC1 loadings against evoked responses revealed that this component corresponded to activity within DN-A. A second component (PC2) differentiated highly visual/scene-related versus highly auditory/linguistic trials. This component was associated with anticorrelated activity between DN-A and the language network. Our results indicate that, while DN-A appears to play a prominent role in imagining, its involvement is greater for imagining scenes, while other distributed networks (e.g., the language network) are engaged when imagining other types of content. These results also demonstrate the utility of collecting significant amounts of neuroimaging and behavioral data for examining imagination.

Topic Area: OTHER

F96 - Thalamic modulation of competition between large-scale brain networks revealed by intracranial EEG

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This project examines the effect of changes in thalamic activation on the activity within canonical, cortical resting-state networks (RSNs), emphasizing the three networks commonly found to be antagonistic to each other: the default network (DN), salience network (SN) and dorsal attention network (DAN). Three subjects were examined with intracranial-EEG (iEEG) while watching two distinct, animated movies. Electrode placement varied across subjects but in all cases included thalamic regions as well as channels corresponding to each of the seven canonical resting-state networks (Yeo 2011). Data was preprocessed and analyzed using the MNE-Python toolbox. Channels were filtered for power line noise and a high-pass filter of 0.1 Hz was applied. Channels were broken up into 1 second epochs. Events were recorded in which channels associated with the DN and SN were anticorrelated over the course of 1 second intervals. Each epoch corresponding to such an anticorrelation event was analyzed using directed phase-locking interval (dPLI) to determine which channels showed a significant leading and lagging relationship in temporal phase within the alpha (8-12 Hz) broadband range. Results demonstrated during epochs where the default and salience networks were anticorrelated, thalamic activation significantly lagged the SN, and the DN lagged the thalamus and SN. The DAN showed no significant leading or lagging relationships with the thalamus, DN, or SN within these events. This work offers insight into the way the thalamus may play a role in modulating the relationships between RSNs.

Topic Area: OTHER

F97 - Mind spinning? How visual imagery affects visuospatial ability

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Manipulation of objects in space involves mental representations of environmental cues, with varying levels of ability to imagine objects. Previous work reveals involvement of posterior neural networks, while atypical cohorts primarily involve frontal activity (Kong, 2018). The current study examined sixty-eight undergraduates, to conceptualize a concrete visuospatial assessment. Participants completed novel forced-choice judgments of dyad image orientations (same/mirrored), measuring both reaction time (RT) and accuracy, and ERPs in a subset. Mental rotation abilities were probed through 3 blocks of stimuli (BAL: Blocks, Animals, Letters) and 4 Thatcher dyads (normal, manipulated images). The VVIQ extracted a visualization ability score. Task validation outcomes mirror literature findings. Behavioral outcomes showed slower RT in mirror image trials vs. same, $p<0.01$. For the BAL, blocks (4375ms) required longer RT versus letters (2407ms) and animals (2176ms). Accuracy was similar across all conditions ($p>0.05$), indicating speed-for-accuracy compensations. For the Thatcher task, longer RT and decreased accuracy were revealed when both images were manipulated vs. the other dyads ($p<0.01$). Spearman correlations showed no associations between imagery vividness and task performance ($p>0.05$). Preliminary analyses of ERP outcomes (N=49) indicate prolonged frontal and parietal N200 latencies. This may explain the longer RT and decreased accuracy, due to decreased access to visual properties of a stimulus. Meanwhile, higher frontal P300 amplitudes may lead to increased accuracy due to higher engagement of cortical networks associated with task arousal and decision making. Findings suggest that differences in imagery vividness stem from increased frontal involvement, indicating perceptual challenges when manipulating mental images.

Topic Area: OTHER

F98 - Intracranial recordings reveal high-frequency activity in the human temporal-parietal cortex supporting non-literal language processing

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Non-literal expressions such as sarcasm, metaphor, and simile refer to words and sentences that convey meanings or intentions that are different and more abstract than literal expressions. Neuroimaging studies have shown activations in a variety of frontal, parietal, and temporal brain regions implicated in non-literal language processing. However, neurophysiological correlates of these brain areas underlying non-literal processing remain underexplored. To address this, we investigated patterns of intracranial EEG activity during non-literal processing by leveraging a unique patient population. Seven neurosurgical patients with invasive electrophysiological monitoring of superficial brain activity were recruited. Intracranial responses were recorded over the temporal-parietal junction (TPJ) and its surrounding areas while patients performed a language task. Participants listened to vignettes that ended with non-literal or literal statements and then responded verbally to some related questions. We found differential neurophysiological activity during the processing of non-literal statements than to literal statements, especially in low-Gamma (30-70 Hz) and delta (1-4 Hz) bands. In addition, we found that neural responses related to non-literal processing in the high-gamma band (>70 Hz) were significantly more prominent at TPJ electrodes as compared to non-TPJ (i.e., control) electrodes in most subjects. Moreover, in half of the patients, high-gamma activity related to non-literal processing was accompanied by delta-band modulation. These results suggest that both low- and high-frequency activities in the human temporal-parietal junction play a crucial role during non-literal language processing. This investigation provides an opportunity to gain insights into the localized brain dynamics of the TPJ during the processing of non-literal language expressions.

Topic Area: OTHER

F99 - Recurrent processing in Aphantasia

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Though mental imagery is thought to play an essential role in human cognition, there are people who are unable to form voluntary images and yet have no obvious cognitive deficits—a condition that has been called aphantasia. We hypothesize that aphantasia may involve a tendency to operate on perceptual representations at higher levels of abstraction, coupled with a lack of high-to-low level feedback processes, which are thought to be important for vivid visual imagery. In this work we attempt to isolate such recurrent processing using a perceptual pattern completion task with a backward masking manipulation. Perceptual pattern completion is thought to be supported by recurrent processing whereby activation from a partial cue spreads to missing features. This recurrent processing can be inhibited through backward masking. But since individuals with aphantasia may avoid—or have a deficit with respect to—such recurrent processing, is their performance differentially impacted by visual backward masking? We recruited thirty-four individuals with aphantasia to complete a backward-masking task in which we briefly presented participants with partially occluded images and asked them to categorize the shown object into one of four categories. Crucially, these partial images were followed by a visual noise mask, aimed at disrupting recurrent processing that is thought to support pattern separation. We initially expected to find that individuals with aphantasia would be undisrupted by backwards masking, instead finding that they were more impacted by backwards masking relative to controls. This suggests they have intact, but poor, recurrent processing and are thus more susceptible to visual interference.

Topic Area: OTHER

F100 - Factors that Promote Resiliency to Cognitive Decline in People with Multiple Sclerosis

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Multiple Sclerosis (MS) is a neurodegenerative disorder that negatively impacts cognitive function. An individual's resiliency to cognitive decline despite neuropathology is considered to reflect their level of cognitive reserve. Engaging in cognitively stimulating experiences is thought to contribute to the accumulation of this reserve. Educational attainment and premorbid intellectual functioning have previously been used as proxies for cognitive reserve in the MS literature. However, these proxies do not account for the full variety of cognitively stimulating activities that an individual could engage in, and therefore they are insufficient to fully capture an individual's potential cognitive reserve. We aimed to identify a broader range of potential activities that could contribute to cognitive reserve in MS by including factors related to occupation, interpersonal relationships, and game-playing hobbies. Information in each of these areas was obtained alongside conventional measures of cognitive reserve (premorbid IQ, years of education) in people with MS. Participants also completed a comprehensive neuropsychological testing battery that included measures of memory, motor functioning, fluid reasoning, executive functioning, and processing speed. Linear regression analyses revealed current employment status significantly predicted motor performance, processing speed, and fluid reasoning ability; marital status significantly predicted fluid reasoning performance; and video game playing significantly predicted visual-spatial learning and executive functioning. In contrast a conventional cognitive reserve factor did not significantly predict performance in any domain. The findings suggest that employment, interpersonal relationships, and gaming hobbies are neuroprotective factors that can build cognitive reserve over the lifetime in people with MS at risk of cognitive decline.

Topic Area: OTHER

F101 - Firing properties of V1 and lateral of prefrontal cortex neurons in the common marmoset during naturalistic vision

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Decades of single unit recordings across cortical visual areas have revealed a systematic gradient of stimulus selectivity, receptive field size, and task dependency which increases from V1 to PFC, and this pattern is thought to reflect a cortical hierarchy of visual processing. In addition, anatomical and histological studies have shown there is a systematic change in cortical layer thickness, neuron morphology, cell density and cell type across the cortical hierarchy. These anatomical differences have strong implications for types of spiking behavior that should be observed across the visual hierarchy, yet few studies have directly compared the patterns and features of spiking activity across cortical areas. Furthermore, even fewer studies have related the pattern and characteristics of spiking activity across the visual areas to the kinds of cognitive operations each area may subserve. In this study we investigated the firing characteristics of simultaneously recorded neurons in V1 and PFC with neuropixels probes in the awake behaving marmoset. We found systematic differences in the firing characteristics of neurons between V1 and PFC. For instance, V1 neurons tended to have higher firing rates than neurons in PFC, and the activity of V1 neurons tended to be more modulated by eye movements and low-level stimulus features compared to PFC neurons. These results are consistent with the proposition that the activity of neurons in V1 is primarily dictated by processing the features of stimuli that are immediately visible to the animal, whereas the activity of PFC reflects the task, goals and intentions of the animal.

Topic Area: OTHER

F102 - SEEG-based Localization of the Epileptogenic Zone from Complexity Measures Using Machine Learning

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Introduction: In this research, we sought to delineate the epileptogenic zone using a dataset from the Cleveland Clinic, encompassing 28 patients who successfully underwent resective surgery and had prior SEEG recordings from both ictal and interictal

periods. Methods: From time-windowed segments of these recordings, we derived complexity features and characterized them using their mean and standard deviation. Our analysis incorporated features such as Lempel-Ziv complexity, various entropies, fractal dimensions, and the 1/f slope of the brain activity spectrum, among others. We trained three distinct Logistic Regression Models: one using only ictal data, another using only interictal data, and a hybrid model leveraging both periods. Results: Our findings underscored that while the interictal period might be less informative in isolation, it enhances the insights drawn from the ictal phase when combined. A pivotal aspect of our research was discerning a distinctive epileptogenic zone fingerprint. Feature importance analysis pinpointed the Mean Lempel-Ziv Complexity, the standard deviation of the 1/f Slope, and the standard deviation of specific fractal dimensions as the most significant characteristics differentiating resected locations. Conclusion: These results not only contribute to understanding the epileptogenic zone but also foster discussions about complexity in the brain, particularly in the context of the brain criticality hypothesis.

Topic Area: OTHER

F103 - The African Brain and Cognitive Development (AfriBCD) Network: A step towards better representation of neurocognition research in Africa

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Our understanding of neurocognition is incomplete, as most research has been conducted in minority world settings where only 15% of the world's population live (Draper et al., 2022). As such, cognitive neuroscience needs stronger representation from more diverse populations around the world. AfriBCD is a network (currently 131 members) aimed at bringing together researchers and partners who are interested in neurocognition in Africa across the lifespan. Drawing on the views of network members - who represent Africa (17 countries) and other international countries working with African partners (10 countries), a survey was conducted to understand the challenges and potential solutions for catalyzing neurocognition work in Africa. The highest rated challenges include (i) translation and contextualization of measures and tools, (ii) networking to build career path, and (iii) capacity building, infrastructure, and sustainability for more diverse work contexts. Recommendations for addressing these challenges include (i) investing in building respectful partnerships through allocating adequate time/funds, developing project ideas before the start of the project and maintaining long term relationships, (ii) increasing knowledge of networking opportunities that cross borders and create partnerships (i.e. through online networks like AfriBCD) and (iii) funding for early career researchers 1 -2 years post PhD or following a career break. A further twelve solutions were also proposed and will be discussed in this presentation. The key to the AfriBCD Network is co-creation and collaboration. We invite researchers and partners from Africa and around the world to partner with us in this endeavor.

Topic Area: OTHER

F104 - Exploring Minimum Effective Usage Time for a Digital Neurotherapeutic

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Digital therapeutics (DTx) are software-based treatments that deliver evidence-based interventions via devices like mobile phones and XR headsets. The technology underlying Akili's AKL-T01 treatment for ADHD has been evaluated in a pediatric randomized controlled trial and open-label trials across pediatric and adult populations. The treatment protocol for these trials was 25 minutes of engagement per day, 5 days per week. While common for cognitive DTx, and informed by animal studies, this "dosage" level has yet to be examined for efficacy in real-world settings. We analyzed de-identified data from 145 adults in a clinical trial of AKL-T01 and from 2330 adult commercial users of EndeavorOTC® (AKL-T01). We sought to determine whether using the 25-minute regimen with AKL-T01 is necessary to generate the cognitive and clinical improvements reported from the adult trial. The trial data showed that the equivalent of 10-15 minutes daily AKL-T01 engagement for six weeks was sufficient to produce meaningful clinical outcomes. These were a median 4.8 point improvement on the Attention Composite Score (ACS) on the Test of Variables of Attention (TOVA®) and a median 22.3 point gain in Akili's Focus ScoreTM measurement, a clinically-validated proprietary composite measure of key attentional functions. Importantly, the same level of AKL-T01 engagement that was effective for trial participants (10-15 minutes daily) was sufficient to generate comparable Focus Score improvements in commercial users. Our findings suggest that clinical benefit can be generated with a reduced treatment time burden, which may also enhance user retention.

Topic Area: OTHER

F105 - Effect of planning dream content in a lucid dream induction study

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Lucid dreaming, characterized by awareness and sense of control within dreams, holds promise as an intervention in both therapeutic and scientific settings. However, inducing lucid dreams remains challenging, necessitating the development of innovative cognitive induction techniques. One promising approach involves setting prospective intentions to become lucid before sleep. This is coupled with a 60-minute sleep interruption 6 hours post-sleep onset, with previous studies reporting a success rate of about 50%. The present study aimed to evaluate the efficacy of complementing this approach with an additional prospective goal of setting an action plan to execute during the dream. We hypothesized that this modification would improve awareness and control in the dream state. In Study 1, conducted in a home setting, n=6 participants (planning group) who set action plans during the induction procedure reported heightened levels of awareness during dreams, compared to n=6 participants (control group) who did not specify action plans for lucid dreaming. In Study 2, we attempted to replicate this effect in a laboratory setting using full polysomnography in N=20 participants. Sleep architecture, such as REM sleep percentage or sleep onset latency, was assessed using validated automatic sleep staging algorithms. This second study revealed no difference between planning and control groups in levels of awareness during dreams. Neural sleep architecture, either for the night or the morning sleep period, also did not differ between groups. Future research is needed to explore the nuances of lucid dream induction and identify factors influencing their effectiveness.

Topic Area: OTHER

F106 - Dissociable cognitive deficits associated with substantia nigra and locus coeruleus degeneration in Parkinson's disease

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The dopaminergic substantia nigra (SN) and noradrenergic locus coeruleus (LC) play a critical role in modulating a wide range of cognitive processes. Though they have largely been studied in isolation, there is evidence that the dopaminergic and noradrenergic systems modulate overlapping cognitive functions. The question of if and how these two systems independently contribute to cognition is especially relevant to Parkinson's disease (PD) where significant degeneration to the SN and LC occurs early in the disease. However, the shared and distinct contributions of SN and LC degeneration to the cognitive deficits of PD is unknown. To address this gap, we used neuromelanin-sensitive MRI to measure degeneration in the SN and LC in 70 Parkinson's patients and 28 older adults. A reinforcement learning task was used to measure reward learning and standard neuropsychological tasks were used to measure attention/working memory, executive function, and memory. Visuospatial and language performance, not thought to be related to either dopamine or noradrenaline systems, were used as controls. We found that reduced SN neuromelanin signal was associated with worse reward learning in PD patients, but that LC was not. In contrast, reduced LC signal was associated with worse attention/working memory and executive function. We did not find similar relationships in controls, and SN and LC signals were not associated with memory, language, nor visuospatial function in either group. These results suggest that individual differences in the degree of degeneration in the SN and LC could explain differences in the cognitive profiles of PD patients.

Topic Area: OTHER

F107 - The relationship between EEG functional connectivity during sleep and cognitive function in Parkinson's disease

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Changes to sleep are common in Parkinson's disease (PD) and have been associated with worse cognitive performance. Much of this work has focused on either global measures of sleep architecture or on specific oscillations (e.g., sleep spindles). More recently, EEG-derived functional connectivity has also emerged as a possible predictor of cognitive function but little is known about the degree to which patterns of EEG connectivity during sleep can be associated to cognitive function in PD. PD patients (n=47) and healthy older adults (n=23) underwent a neuropsychological evaluation of five cognitive domains (attention, executive function, learning and memory, visuospatial abilities and language) and overnight polysomnography. EEG functional connectivity was measured using imaginary coherence in NREM2 and NREM3 across the delta, theta, alpha, low sigma and high sigma frequency bands. We used partial least squares correlational analysis to investigate the patterns of associations between sleep EEG functional connectivity and cognitive performance. In NREM2 we identified a significant latent variable that explained 38% of the covariance between EEG connectivity and cognition across PD patients and controls. This latent variable was associated with worse performance in all cognitive domains and with higher connectivity in delta and theta bands. In NREM3 the significant latent variable explained 57% of the covariance and was associated with worse memory and with increased connectivity across all frequency bands. Both NREM2 and NREM3 latent variables were similarly expressed across both PD patients and controls. These preliminary results suggest that NREM2 and NREM3 differentially contribute to cognitive performance in PD.

Topic Area: OTHER

F108 - Hebbian Learning: A Kernel-Based Perspective

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Hebb's rule, governing adjustments in synaptic strength and firing thresholds, can be described in terms of the covariance of presynaptic and postsynaptic rates. The Hebbian process is moreover believed to minimize the risks associated with future outcomes. We take a new perspective here in which Hebbian learning is viewed through a reproducing-kernel-Hilbert-space framework. Based on conditional mean embedding, we show theoretically that the collective change in synaptic conductances during learning can be expressed in terms of a conditional expectation, modulated by a covariance operator, on the feature space of past stimuli given present stimuli. To test our hypothesis, we simulate a network of 500 neurons using a Hodgkin-Huxley model and inputs from actual biological data. The change in conductances calculated in the simulation support our theoretical findings. This conditional expectation establishes a crucial link between past and present stimuli, suggesting a memory-recollection mechanism during the learning process. In essence, learning involves direct inference of past stimuli based on present stimuli.

Topic Area: OTHER

F109 - Irritability and Neural Basis of Reward-Processing in ADHD

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Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder in children and adolescents characterized by elevated hyperactivity and impulsivity, and deficits in attentiveness. While irritability is not a diagnostic symptom of ADHD, temper outbursts and irritable moods are common in individuals with ADHD. Irritability is defined by proneness to anger and has been linked to reward processing. Reward processing abnormalities are also strongly implicated in ADHD. Our previous work revealed atypical connectivity within brain networks linked to reward processing in individuals with ADHD who exhibit irritability. Nevertheless, it is not known if reward processing drives irritability in ADHD. In this study, we harness Machine Learning (ML) to probe the link between irritability and co-activation patterns across different brain regions in response to a reward processing paradigm. Our dataset includes brain imaging data and clinical measures from 128 participants (ADHD N=64; Neurotypical N=64), ages 12-30. We will train an ensemble-based ML model utilizing average beta values from Regions of Interest (ROIs) selected based on a suitable meta-analysis to perform classification of ADHD/non-ADHD with/without co-occurrence of irritability. Additionally, we will investigate changes in ADHD symptom severity. We will address collinearity using hierarchical clustering. Model evaluation will be done with k-fold cross-validation, and accuracy measures will be reported. We will inspect the interpretability of the model using the importance of features. Our results will elucidate how brain activity patterns can predict ADHD diagnosis and irritability status and exemplify the application of ML techniques to answer impactful clinical questions using complex multimodal data.

Topic Area: OTHER

F110 - Exploring the neural basis of symbolic and non-symbolic magnitude processing in rural school children from Cote d'Ivoire

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Research conducted in the Global North has found that both symbolic (e.g., Arabic numerals) and non-symbolic (e.g., dot arrays) magnitude processing predict mathematics achievement1. However, in studies that account for both symbolic and non-symbolic magnitude processing, the relations between non-symbolic processing and mathematics achievement are reduced or eliminated1 suggesting a critical role of symbolic number processing in developing mathematical skills. Recent research from Ghana and Côte d'Ivoire found that non-symbolic processing was a significant and unique predictor of mathematics achievement, even when children were more accurate on the symbolic task2. These diverging patterns between Global North and Global South countries suggest the precursors of mathematics are not universal. We used functional near-infrared spectroscopy (fNIRS) to understand the neural mechanisms that underlie context-based differences in precursors to mathematics. We assessed symbolic and non-symbolic magnitude processing in school-aged children in rural Côte d'Ivoire (N=188, Mage=8.89, SDage= 1.43) using a magnitude comparison task. Participants were instructed to select the larger magnitude within pairs of dot arrays (non-symbolic) and Arabic numerals (symbolic). Our preliminary analyses revealed activation in prefrontal and left temporal regions for non-symbolic processing and right inferior frontal gyrus activation for symbolic processing. Activation of left temporal regions, not typically seen in Global North samples3, suggests a potential neural basis for behavioral differences between Global North and Global South context. Brain-behaviour correlations and their relations to mathematics achievement will be discussed. Results from this study will inform how context influences the neurocognitive development of numerical skills.

Topic Area: OTHER

F111 - Task learning is subserved by a domain-general brain network

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Humans have a remarkable ability to learn and perform entirely new tasks after a few trials. Learning novel tasks is one of the most important human faculties, but little is known about its brain mechanisms. Specifically, it is still unclear to what extent domain-general and/or domain-specific brain mechanisms underlie the learning of new tasks. We collected functional MRI while the subjects (N=45) performed six novel tasks inside the scanner. The tasks required the engagement of perceptual, motor, and four different cognitive processes (i.e., attention, expectation, speed-accuracy tradeoff, and metacognition). We found that in the initial stage of task learning, a bilateral frontoparietal network was more active compared to the later stages. Moreover, this effect was stronger for initial task variants that required more learning compared to later task variants. Critically, the same bilateral frontoparietal network was activated in all six tasks, which demonstrates the domain generality of the brain circuits engaged in learning novel tasks. Finally, while overall activity in the bilateral frontoparietal network decreased in the later stages of task learning, the connectivity between the different nodes became stronger. The study shows that the activity and connectivity of the brain network reflect the learning of new tasks, which indicates the existence of a domain-

general brain network for learning a variety of new tasks and that the network may underlie the human capacity for acquiring new abilities.

Topic Area: PERCEPTION & ACTION: Other

F112 - Probing embodied cognition and cognitive-motor interference during walking while listening to words

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The framework of embodied cognition suggests that language processing interacts with actual body movement. Previously, behavioural and neuroimaging evidence demonstrated that motor execution, primarily of hand movements, is facilitated when participants' movements match the meaning of linguistic stimuli. We report here on a proof-of-concept study to probe the idea that language-movement interactions extend to whole-body movements that are highly automized, such as gait. We developed a walking-while-listening-to-language paradigm (WLL), featuring motion capture with concurrent optical imaging (fNIRS). In the first part of the study, using the WLL with motion capture only, sixteen French-speaking young adults were walking while listening to either city names or action verbs. The results showed a semantic effect on gait compatible with the embodied cognition approach, with higher cadence and step length when listening to action verbs vs. city names. In the second part of the study (data collection ongoing), we aimed to test whether WLL constitutes a dual task leading to cognitive-motor interference. Using the full WLL setup (including fNIRS), another 16 adults walked with and without verbal and non-verbal auditory stimuli (verbs, city names, a click track), and under classical dual-task conditions. We hypothesized that exposure to verbs while walking would result in higher cognitive load, measured via prefrontal neural activity, than when walking with city-names or non-verbal stimuli but lower than in a classic dual task. The results of this study will lay the grounds for further research and contribute to better understand the intricate links between language, brain and gross motor functioning.

Topic Area: PERCEPTION & ACTION: Other

F113 - Mapping Invisible Barriers in the Human Entorhinal Cortex: Context Dependence and Previous Experience in Spatial Navigation

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For years, the behavior of grid cells in rodents has been observed during spatial navigation. Recently, BOLD signals with grid-like behavior were shown in humans via fMRI. Our lab had previously shown that BOLD activity in the right Entorhinal Cortex (rEC) exhibits a grid-like representation with 6-fold symmetry relative to the angle traversed while navigating a virtual space with no barriers ("Open Field") and a representation with 4-fold symmetry when walls were added – creating a series of corridors ("Barrier"), showing that the same neural region can represent different spaces with different strategies. We then tested whether the 4-fold signal is due to the visual perception of the walls or the conceptual knowledge that a wall cannot be traversed. To that end, we collected pilot fMRI whole-brain data using a similar experimental paradigm but with the Barrier condition replaced with one where the barriers were invisible. With both experimental conditions looking identical, the 6-fold symmetry was greatly reduced while the 4-fold symmetry increased in the Open Field condition. In addition to anatomical rEC masks like those used in the previous study, we located a functional ROI posterior to the rEC which showed a double dissociation of Open Field activity between subjects that were given the Open Field trials first compared to those that were given the Open Field trials last. It is clear from these extant results that mechanisms in these neural systems may be more context-dependent than previously hypothesized – here modulated by stimuli presentation order and neuroanatomical subdivision.

Topic Area: PERCEPTION & ACTION: Other

F114 - Pet the Pain Away: Can Therapy Dogs Mitigate Pain Perception

Madison Lindsey[1], Alexandra Roach[1]; [1]University of South Carolina Aiken

Alternative, nonpharmacological pain management therapies are currently being used in lieu of opioids and other analgesics and may provide meaningful improvement of pain perception for acute pain. However, to date there is little research being conducted on the effectiveness of such interventions on subjective and physiological measures. We investigated the efficacy of therapy dogs to reduce the severity of subjective pain ratings using the cold pressor task. In collaboration with the American Therapy Dog Alliance, we were able to use trained and licensed German Shorthair pointer therapy dogs in our experimental condition, accompanied by their handlers. Pilot data from a within-subjects design (n=7) indicated that subjective pain ratings were lower when participants pet a therapy dog while submerging their hand in 50° F water compared to when they did not have a therapy dog (p = .033). To expand upon our findings, we have conducted a follow-up study which includes physiological recordings collected using the BioNomadix wearable wireless physiology system. Participants submerged their hand in water and were outfitted with transducers for EDA to measure skin conductance, EMG to measure muscle tension, ECG for heart rate, as well as transducers for pulse and respiration data, using BioNomadix Transmitters and Data Logger. Data will be analyzed using BIOPAC AcqKnowledge 5.0 software to test for clinically meaningful differences in subjective and physiological measures of pain and allostatic load with and without the use of a therapy dog.

Topic Area: PERCEPTION & ACTION: Other

F115 - Estimate Maintenance is Somewhat but not Fully Explained by Motor Cost of Updating

Julia Schirmeister[1] (jul.schirmeister@gmail.com), Britt Anderson[1]; [1]Waterloo University

Previous research has found that when people are asked to keep consistent updates of their estimates of probabilities, they update only intermittently between runs of several trials. This has been used to argue that people fix one working model estimate of probabilities and only update their mental models if they detect change-points. However, this update-withholding behavior could alternatively be explained by a motor-cost confound. Participants have been given their previous response as default; this makes updating more effortful than letting the default remain untouched. In the current study, participants in the "manual" condition were given no default response; they were asked to respond anew every trial. Participants drew red or blue dots out of an urn in a computerized task. For each dot, they were asked to estimate the hidden proportion of dots in the urn. Manual participants did change their responses more often than did the participants in the "automatic" group who were given their old response as default. Some of those new adjustments did appear to reflect true new minor updating events. This supports the hypothesis that a motor threshold was indeed removed for manual participants. Nonetheless, update-withholding behavior was not entirely suppressed. Manual participants making the fewest adjustments showed undeniably intentional spontaneous response maintenance. This study demonstrates that motor cost is not sufficient to explain step-hold behavior found in previous studies. Long runs of maintaining the same estimate can be unprompted and meticulous.

Topic Area: PERCEPTION & ACTION: Other

F116 - Sensory Dysregulation in ASD: A high density electrophysiological study on the processing of tactile stimuli in ASD Children and Neurotypical Controls

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To avoid being overwhelmed by the multitude of sensations in our natural environment, the brain pre-attentively and adaptively modulates the extent to which sensory inputs are processed. Individuals with Autism Spectrum Disorder (ASD) experience hyper- and hypo-sensitivity to tactile stimuli, implying a potential dysregulation in mechanisms underlying sensory processing and adaptation. In this study, we examined neurophysiological responses to vibrotactile stimuli in typically developing (TD) children (N = 52; 23 females) and children with ASD (N = 40; 3 females) aged 5 to 17 (M = 11.05) using electroencephalography (EEG). A custom vibrotactile stimulator delivered stimuli to the median nerve over the right wrist while participants were presented with streams of vibrotactile stimuli of 50ms (standard; 90%) and 20ms (deviant, 10%) in five blocked interstimulus intervals (ISIs): 150ms, 250ms, 350ms, 550ms, and 1050ms. Sensory adaptation was examined by comparing the amplitude of the somatosensory evoked potential (SEP) to the standard for the different ISI conditions, and sensitivity to duration deviants at different memory loads was examined by comparing the mismatch negativity (MMN) response for the different ISIs. Preliminary analyses suggest that both groups

present similar adaptation effects and MMNs across the different ISI conditions, while the base SEP is somewhat altered in ASD. Additional analyses will be focused on establishing the relationship between these electrophysiological responses and measures of sensory sensitivity from the Sensory Profile Caregiver Questionnaire (SPCQ), potentially revealing a neurophysiological biomarker of somatosensory reactivity in ASD.

Topic Area: PERCEPTION & ACTION: Other

F117 - Sex differences in spatial abilities extend beyond vision: Insights from the auditory Corsi test

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Spatial abilities allow humans to comprehend and remember spatial relationships among objects positioned in space. These abilities, for example, play a crucial role in navigating one's environment, assembling furniture, and finding a vehicle in a crowded parking lot. Numerous studies have shown that males outperform female participants in visual-spatial tasks, particularly in the Mental Rotation Test (MRT; Shepard & Metzler, 1971). However, these sex differences have been primarily studied in the visual modality, leaving a gap in the exploration of sex differences in spatial abilities in other sensory modalities. This study investigates spatial abilities using both, visual and auditory stimuli. Fifty young adult participants (n=25 females) took part in the study. The well-established MRT was used to examine visual-spatial abilities. The Audio-Corsi (Setti et al., 2021) was used to examine audio-spatial skills. For the latter test, blindfolded participants were asked to localize the auditory stimuli (i.e., sounds), which were spatially arranged around the listener's head and delivered through headphones. The sounds appeared to come from different locations and were presented in a sequence; the sequences increased in length from two to up to nine sounds. Results showed that males outperformed female participants in the MRT. Interestingly, significant positive relationships between the visual and auditory tasks were found for males but not for females. These findings suggest that females employ distinct mechanisms when addressing auditory spatial tasks, while males leveraged their mental rotation strength to solve the auditory spatial task. This research advances our understanding of sex differences in spatial function.

Topic Area: PERCEPTION & ACTION: Other

F118 - Deaf Gain: Evidence for enhanced beat perception to vibrotactile rhythms in Deaf individuals

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The term "Deaf Gain" is often used to connote a shift in the conceptualization of deafness from a focus on loss to a focus on cognitive and cultural gains. Most neuroscience research examining Deaf Gain has investigated enhancement in processing of visual stimuli. The enhancement appears to be associated with activity in primary auditory cortices, with compensatory plasticity as the proposed mechanism. There is also a smaller body of research which has found evidence indicating that auditory regions may also respond to vibrotactile stimuli. With mixed results from research examining enhancements in vibrotactile perception, we sought to examine vibrotactile rhythm perception in a Deaf population. The current study aimed to examine the capacity for vibrotactile beat perception in a sample of deaf and hearing individuals. In each condition, participants felt a series of vibrotactile rhythms that varied in rhythmic complexity. To compare beat perception ability, we examined sensorimotor synchronization (SMS) and neuroelectric activity at the frequency of the beat. Data were modeled using mix-effect linear models with rhythm complexity, hearing ability and an interaction as predictors. We hypothesized that, compared to hearing individuals, deaf individuals would show enhanced beat perception to vibrotactile rhythms, specifically the more complex rhythms. EEG results indicate heightened oscillatory activity to vibrotactile rhythms in individuals who are deaf compared to those who are hearing. SMS results revealed a significant interaction, with SMS ability specifically heightened in complex rhythms, but only for deaf individuals. Together, these results provide evidence for Deaf Gain in vibrotactile rhythm perception.

Topic Area: PERCEPTION & ACTION: Other

F119 - Neural underpinnings of sensory phenotypes in Autism

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Autistic individuals report sensory differences across modalities. While symptoms vary across individuals, we recently identified five distinct sensory phenotypes that differed in behavioral and clinical profiles. The neural mechanisms underlying sensory phenotypes in autism are unknown. We used resting-state functional connectivity to examine neural differences between sensory phenotypes in Autism. Data were extracted from the Province of Ontario Neurodevelopmental Disorders Network. 638 Autistic participants' (Mage=9.8) parents completed the Short Sensory Profile (SSP). K-means clustering analyses grouped participants patterns of SSP subdomains. Five phenotypes were identified, 1) sensory adaptive, 2) generalized sensory differences, 3) taste/smell sensitivity, 4) under-responsive/sensory seeking, and 5) movement difficulties. We analyzed resting-state fMRI data in a subgroup of participants (N=147, Mage=11.8). We parcellated the brain based on the Schaefer Atlas and calculated functional-connectivity matrices for each participant. We calculated strength of connectivity across 7 functional networks from the Yeo parcellation. Pairwise comparisons for strength of within- and between-network connectivity were conducted across each phenotype ($p<0.05$, FRD corrected). Machine-learning algorithms were used to identify brain regions with the greatest ability to differentiate sensory phenotypes. Numerous differences in network connectivity were observed across phenotypes, including differences in limbic, default-mode, visual, and sensorimotor networks, including selective hyper- and hypo-connectivity. These results suggest that these distinct sensory phenotypes are associated with broad differences in the brain's functional architecture, not only in low-level sensory networks, but also networks associated with higher-level cognitive processes. This reflects findings over the past decade that have shown that sensory differences cascade to influence higher-level cognitive development.

Topic Area: PERCEPTION & ACTION: Other

F120 - Visual mental imagery: an English-language assessment battery for different perceptual and imagery domains with clustered results

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Introduction: Do visual mental imagery (VMI) and visual perception share common cognitive mechanisms when processing domain-specific information? Moreover, do domains cluster in imagery similar to perception? To address these questions, we used an English Imagery and Perception battery (eBIP), adapted from its French version. Methods: The battery assesses participants' performance in identifying objects' physical properties through either imagery (audio cues) or perception (audiovisual cues). This assessment compares five domains for imagery and perception: color, shape, map, face, and letter. We present preliminary results from healthy participants (n=64). Data Analysis: To replicate our previous results, we first analyzed the correlations between imagery and perception and then conducted a 2 (Imagery, Perception) x 5 (domains) ANOVA on accuracy and response time (RT). Results were consistent with those from the French battery. To examine whether the domains cluster similarly between imagery and perception, we first applied K-means clustering to categorize each person's domain performances using accuracy and normalized RT. We identified four distinct clusters characterized by high/low accuracy x high/low RT. Further analysis using log-linear models on these clusters' contingency tables revealed their primary compositions: (1) face imagery, (2) color and shape, (3) map perception, and (4) mixed components. Discussion: Our results indicate participants' quick and accurate responses in color and shape tasks, quick but less accurate responses in face imagery, and slow yet precise responses to map perception. These variances in domain-specific performance between imagery and perception hint at potential differences in their underlying cognitive mechanisms.

Topic Area: PERCEPTION & ACTION: Other

F121 - Thalamocortical circuits naturally perform computationally efficient hierarchical clustering.

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INTRODUCTION. Current artificial neural networks are based on a tiny number of salient neural characteristics (parallel operation of simple computing nodes), thus assuming that other characteristics (e.g., asymmetry of excitatory and inhibitory cells; different cell types (e.g., pyramidal, stellate, tonically active, modulatory); distinct circuit wiring patterns in different brain regions; etc.) may be computationally irrelevant. We investigate whether such additional neural characteristics may confer novel powerful algorithmic abilities. METHODS. We first simulated (as networks of neurons), and then abstracted into algorithm form, a thalamocorical circuit incorporating key features of reciprocal feedforward and feedback connectivity. Features include differential time courses of excitatory vs. inhibitory postsynaptic potentials, differential axon reach of pyramidal cells vs. interneurons, and different laminar afferent and projection patterns. RESULTS. The simulation was shown to organize stored memories into similarity-based categories (clusters), but also, topographically organized feedback then subtracted (inhibited) cluster information from inputs, such that subsequent feedforward operation produced successive subclusters. Analysis showed the relationship of these operations with well-studied algorithms for hierarchical clustering. Moreover, we demonstrated that the derived novel algorithms exhibited desirable computational space and time complexity, and corresponding scaling and efficiency characteristics. CONCLUSIONS. A novel algorithm for hierarchical clustering emerged from a relatively straightforward model of feedforward and feedback activity in a simulated thalamocortical circuit. The resulting algorithm compared well against the large literature of extant hierarchical clustering methods. Implications are discussed for further extraction and analysis of unexpected algorithms directly from brain circuit layout and operation.

Topic Area: PERCEPTION & ACTION: Other

F122 - The Cortico-Basal Ganglia-Cerebellar Pathways of Forming Beat- and Interval-based Temporal Predictions

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We examine the neural correlates and behaviour phenotype underlying the cognitive ability in humans to form temporal predictions during periodic and aperiodic stream of events. Neuropsychological and imaging studies have provided causal evidence for the existence of two distinct neurocognitive mechanisms involved in the mediation of beat- and single-based predictions with direct contributions from the basal ganglia and the cerebellum, respectively. Yet, little is still known about the pathways of implicit and explicit timing in these two contexts, and to what extent sensory inputs from the cortex can alter them. To this end, we developed six tasks probing beat- and interval-based sequences of events, varying in the type of timing output and sensory domains. Behavioural results on 39 participants show a likely benefit in performance for the beat conditions when compared to the interval conditions, particularly for auditory tasks, thus suggesting a putative selective contribution from basal ganglia during beat-based sequences. Neuroimaging results from functional Magnetic Resonance Imaging data acquired on 31 participants, show bilateral representations of the putamen and the cerebellum during the encoding of temporal sequences. Importantly, these representations remain present in the putamen when contrasting the encoding of beat versus interval, and in the cerebellum when contrasting the reverse. According to our main hypothesis, imaging contrast maps indicate the recruitment of the basal ganglia during beat-based sequences, and the involvement of the cerebellum during interval-based sequences. Upcoming data analyses are intended to provide more insights about the functional specificity and connectivity of these two mechanisms.

Topic Area: PERCEPTION & ACTION: Other

F123 - Rhythmic Timing in Continuous-time Recurrent Neural Networks

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Humans' ability to anticipate rhythmic sequences across different tempos plays a crucial role in synchronization and music-making. Various animal species can learn to distinguish between isochronous and irregular rhythms, suggesting that the capacity for tempo-flexible rhythmic timing can be learned without the specialized mechanisms found in the human brains. To study the mechanisms underlying learnable rhythm perception, we studied solutions produced by continuous-time recurrent neural networks (ctRNNs), trained using full-FORCE or backpropagation. The ctRNNs were presented with an isochronous train of pulses across several tempos and were tasked with generating its own predictive pulses anticipating the input pulses. The full-FORCE-trained network exhibited a generalized mechanism for rhythmic prediction, accurately anticipating subsequent pulses and demonstrating increased precision with additional input pulses. This network reproduced key aspects of human timing tasks, displaying enhanced accuracy and reduced bias towards the mean tempo with longer trains of input pulses. It mirrored human-like adherence to "Weber's Law," with increases in pulse width and standard deviation of inter-pulse intervals proportional to increasing input period. The full-FORCE-trained network displayed circular oscillatory dynamics in neural phase space, resembling the neuronal data observed in monkey medial frontal cortices during synchronization tasks. These results could not be replicated in the backpropagation-trained network. The consistency of the full-FORCE-trained network's behaviour with human psychophysics results underscores the potential for achieving human-like perception and anticipation of isochronous sequences through semi-supervised (predictive) learning in generic recurrent networks without specialized timing mechanisms. Future research should focus on networks' capacity for more complex rhythm perception tasks.

Topic Area: PERCEPTION & ACTION: Other

F124 - Comparative fMRI reveals differences in the functional specializations of the visual cortex for animacy in dogs and humans

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The animate-inanimate category distinction is one of the general organizing principles in the primate high-level visual cortex. Much less is known about the visual cortical representations of animacy in non-primate mammals, for which the relative importance of vision among sensory modalities have not increased as dramatically during evolution as for certain primates, including humans. Conducting the same fMRI experiment with dogs (N=15) and humans (N=13), we investigated how animacy structures neural responses in the visually responsive cortex of the two species. All conditions (videos displaying dogs, humans, cats or cars in natural settings) were matched for low-level visual features. Univariate analyses identified in both species animate-sensitive bilateral occipital and temporal regions, separable from functionally determined early visual areas. More animate-sensitive voxels responded maximally to conspecific than heterospecific stimuli in both dogs and humans. Dog-, human- and cat-sensitive regions overlapped less in dog than in human brains. Multivariate tests revealed categorical representations in both species for dog, human and cat stimuli as well, and these overlapped less in dogs than in humans. The regions exhibiting these categorical representations for animate conditions largely overlapped with univariate animacy-sensitive clusters. Together, these findings that the animate-inanimate distinction is important not only in primate, but more generally in mammalian visual perception. But a key species difference, that neural representations for animate stimuli are less concentrated in dogs than in humans suggests that certain underlying organizing principles that support the visual perception of animacy in primates may not play a similarly important role in all mammals.

Topic Area: PERCEPTION & ACTION: Vision

F125 - Testing the predictive coding in visual perception using Multivariate EEG analyses

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The predictive coding theory of the brain posits that our brain generates predictions about upcoming percepts to facilitate sensory processing. However, the underlying neural mechanism remains unclear. One possibility is that the predicted percept is instantiated by anticipatory neural activity in the sensory regions. Alternatively, it might be instantiated through activity-silent mechanisms. To test this, we used multivariate decoding analyses to examine whether the predicted percept could be decoded from EEG activity prior to the onset of the predicted percept or from the activity generated by

a visual "ping" (Wolff et al., 2017). Specifically, participants saw a picture prime (e.g., chair or a glass of drink; picture prime) followed by a letter-by-letter presentation of a three-letter word (e.g., s-i-t or s-i-p) that only differed in the last letter. Participants' task was to anticipate the upcoming letter based on the picture prime and judge whether the word spelled out matched semantically with the picture prime. The picture prime and the word matched semantically 80% of the time. In addition, a large high-contrast patch (perceptual ping) appeared immediately preceding the presentation of the last letter in 20% of the trials. Preliminary results (n=16) suggest that the last letter can be decoded reliably above chance from the pattern of EEG activity among the parieto-occipital electrodes prior to the letter onset but not from the activities elicited by the ping. Overall, our preliminary results suggest that the predictive coding of upcoming visual percepts relies on active neural signals rather than activity-silent signals.

Topic Area: PERCEPTION & ACTION: Vision

F126 - Natural action representations in the mind and brain

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Humans rapidly extract information about other people's actions in many natural settings. How does the brain process this complex information, from perceptual details to abstract concepts? To address this, we curated a naturalistic dataset of 95 short videos and sentences depicting everyday human actions. We then labeled each action with four semantic features categorizing actions at different levels of abstraction, ranging from action verbs (e.g., chopping) to broad action classes (e.g., manipulation) and the actions' target (e.g., an object). We also annotated the stimuli with other relevant perceptual and action-specific features. In two behavioral experiments, participants arranged the videos and sentences according to their similarity in meaning. The broadest semantic features, particularly the actions' target, explained the most unique variance in behavioral similarity judgments across vision and language. We next collected temporally and spatially resolved neural data (EEG and fMRI) while participants viewed the videos and sentences. We found that actions were processed along a temporal gradient in the brain, from perceptual features to semantic information about the actions' target and class. We mapped these semantic features to areas in lateral occipitotemporal cortex. Finally, using cross-decoding across videos and sentences, we identified a late (500 ms) modality-invariant neural response. Together, our results characterize the computations underlying natural action understanding in the mind and brain, and highlight the shared representations of human actions across vision and language.

Topic Area: PERCEPTION & ACTION: Vision

F127 - A High-Resolution Study of Positive and Negative Retinotopic Codes in the Hippocampus

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Position-dependent activity in response to stimulation of the retina, or retinotopic coding, has long been considered a unique feature of the visual system. However, recent work has shown that higher-order cortical areas, including the default network, show retinotopic sensitivity in the form of decreasing signal during stimulation of their visual receptive field (Szinte and Knapen 2020; Klink et al., 2021). Motivated by this negative coding's possible relevance to perception-memory interactions (Steel*, Silson* et al. 2023) and recent observations of retinotopic sensitivity in the hippocampus (Silson et al., 2021), here we characterize positive and negative retinotopic responses to visual stimuli in the hippocampus. We explored this region's positive and negative retinotopic responses using high-resolution (7T, 1.8mm isotropic) population receptive field (pRF) mapping data from the Natural Scenes Dataset (Allen et al. 2022). On average across participants, 42% of hippocampal voxels exhibited a retinotopic response, and 43% of these voxels were negative in valence. Consistent with prior work, positive pRFs showed a significant contralateral visual field bias (i.e., left hippocampus tended to represent the right visual field) ($p<0.05$), while negative pRFs were more foveal. Interestingly, resting state functional connectivity analyses showed that positive and negative hippocampal pRFs co-fluctuate more strongly with congruently signed cerebral pRFs. This work suggests the importance of visual coding in structuring the interaction between the hippocampus and cerebral cortex, and adds support for the view that negative pRFs may play an important role in hippocampally-dependent cognitive processes like episodic memory and scene construction.

Topic Area: PERCEPTION & ACTION: Vision

F128 - Lateral prefrontal 'gaze' signals encode future head and hand motion during visually guided reach.

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Lateral prefrontal cortex (LPFC) is associated with executive function, working memory and response selection. There is evidence that posterior LPFC is concerned with the high-level selection of specific motor repertoires, but it is not known if the LPFC is involved in the planning and coordination of the motion of specific effectors. Could LPFC encode context-dependent, coordinated, effector-specific motor strategies? We investigated this question by recording from the posterior lateral prefrontal cortex (pLPFC; spanning Brodman areas 45, 46, & 8a) while two Rhesus monkeys performed head-unrestrained reaches toward visual targets. Many (208 / 499) task-related neurons showed time-locked gaze- (and later reach) related responses, but surprisingly these 'gaze' responses disappeared (35 / 84 neurons) or diminished during gaze shifts toward the same targets without reach. Further, an in-depth spatial analysis (based on model fits to neural response fields) confirmed that these 'gaze' responses were not what they appeared to be. In direct contrast to the saccade system, gaze displacement models provided the worst fits to the data. Instead, pLPFC 'gaze' neurons preferentially coded skeletomotor motion, either future head (49%) or hand (33%) motion, with reach codes predominating later in the task. This is an important demonstration that signal timing does not always reflect spatial tuning in the same neurons. We conclude that many pLPFC 'gaze' responses are not involved in gaze control, but rather reflect gaze inputs that trigger complex head-hand repertoires: in other words, a high-level neural mechanism for eye-head-hand coordination.

Topic Area: PERCEPTION & ACTION: Vision

F129 - Perceiving a single face in a crowd: Insights from image reconstruction

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Face ensemble processing – or crowd perception – involves synthesizing a summary representation (e.g., an average expression) across an array of faces which circumvents visual working memory limitations. However, little is known about how single face targets are processed within an ensemble. To address this, in our study participants viewed face ensembles either without a central face (n = 32), or with a central face while attention was focused centrally (n = 38) or distributed across the entire ensemble (n = 38). Critically, the emotional expression of central faces was either consistent or inconsistent (i.e., having either the same or different valence for central versus surround faces, respectively). Participants completed an expression similarity-rating task between ensembles and single-face probes. Similarity data were then used to generate an expression-based face space and to yield image reconstructions of summary ensemble representations. Reconstructions were compared against the central face, the surrounding exemplars, and the pixelwise surround average. We found that focused attention enhances target face representation without altering that of the surround. We also found that the ensemble summary dominates ensemble percepts, as revealed by reconstruction, but not during focused attention to target faces within inconsistent ensembles (e.g., happy target face surrounded by faces with negative valence). These findings not only provide a more robust understanding of crowd perception, but offer insights into the interaction between single face targets and surrounding ensembles. Critically, our work is among the first to show how single faces are represented within the context of ensemble processing.

Topic Area: PERCEPTION & ACTION: Vision

F130 - Pre-stimulus alpha oscillations contain representations of expected visual shapes

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Our prior knowledge greatly influences how we perceive the world. However, it remains unclear how the brain keeps predictions online prior to stimulus onset. Here, we

combined magnetoencephalography (MEG) and decoding techniques to investigate the neural dynamics of pre-stimulus sensory predictions. Participants were engaged in a shape discrimination task, while auditory cues predicted which specific abstract shape would likely appear. We trained a shape decoder on data from a separate localiser run, and applied this decoder to the time window after the predictive auditory cues, but before shape onset, to test for neural representations of expected shapes. Frequency analysis revealed significant oscillatory fluctuations in the pre-stimulus decoded time series, predominantly in the alpha band (10 – 11Hz). We created baseline measurements of alpha power by training the decoder 1) with pseudo-randomised labels and 2) on different shapes than those used in the main experiment, to rule out effects of non-specific alpha oscillations. Furthermore, we found that this stimulus-specific alpha power was linked to expectation effects on behavioural accuracy and on post-stimulus neural shape representations. Previous research has already shown that the raw power of alpha oscillations modulate perception. While our results are consistent with these observations, they additionally demonstrate that alpha fluctuations can contain stimulus-specific contents which predict behavioural performance and sensory encoding. Together, these findings show that sensory predictions are embedded in the alpha frequency band and can modulate perception through their oscillatory dynamics, providing a neural mechanism through which the brain generates and deploys predictions.

Topic Area: PERCEPTION & ACTION: Vision

F131 - Is attentional capture by a color singleton modulated by visuo-motor associations?

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In visual scenes, relevant items are selected while irrelevant ones are ignored, thanks to attentional selective processes. However, attention can be captured by a salient, irrelevant item, which disturbs behavior in a visual search task. It was shown that perceptual saliency could be modulated by previous experience with a feature (e.g., value-association or selection history (Sha & Jiang, 2016)), but results are controversial. Furthermore, acting upon a feature is a particular, overt form of feature selection and it modulates target salience (Weidler & Abrams, 2014). In this work, we focused on the motor aspect of selection history and investigated modulations of attentional capture and motor activation by previously established visuomotor associations. Participants first learnt arbitrary color-response associations in a training phase requiring left or right index finger button presses. In a later testing phase (only executed with the right hand), the same colors and a control one served as distractors in a visual search paradigm, in which the target was now defined by its shape. We recorded behavioral performance, eye movements and muscular activity of the effectors involved. In the testing phase, we applied single-pulse Transcranial Magnetic Stimulation to measure the cortico-spinal excitability of the (unused) left index finger. Colored distractors significantly slowed down responses, increased error rate and induced oculomotor capture in the testing phase. Interestingly, previously targeted colored distractors enhanced the corticospinal excitability in the now task-irrelevant motor effector, when compared to the control color. These results support the hypothesis of a motor involvement in action-enhanced attentional capture.

Topic Area: PERCEPTION & ACTION: Vision

F132 - Average Sound Level can be Extracted from Visual Scene Ensembles without Reliance on Visual Contrast

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Visual summary statistics for groups (i.e., ensembles) of faces or objects can be rapidly extracted to optimize visual processing, without reliance of visual working memory (VWM). Moreover, auditory summary statistics can be extracted for the frequency of logarithmically spaced tones (Piazza et al., 2013), as well as sound textures (McDermott et al., 2013). However, no study has examined if the combination of these sensory cues can be statistically extracted from more natural settings. To address this, we examined if observers could extract the average apparent sound level (i.e., how quiet or loud a scene would feel) from groups of scenes, and additionally investigated whether lower-level features such as visual contrast mediated this process. Participants rated the average sound level of scene ensembles, with either gray-scaled visual stimuli (Exp. 1) or gray-scaled visual stimuli with a 75% contrast reduction (Exp. 2). In both experiments, we varied set size by randomly presenting 1, 2, 4, or 6 scenes to participants on each trial, and measured VWM capacity using a 2-AFC task. Participants were able to accurately extract average sound level in both experiments, with all 6 scenes being integrated into their summary percepts. This occurred without relying on VWM, as less than 1.3 scenes were remembered on average. These results reveal that computing cross-modal summary statistics (i.e., average sound level) does not rely on lower-level visual features (i.e., contrast). Overall, these results reveal the flexibility of ensemble coding to encode multisensory features, through high-level cognitive processes.

Topic Area: PERCEPTION & ACTION: Vision

F133 - Average Temperature can be Extracted from Visual Scene Ensembles without Reliance on Contrast

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Summary statistics for groups (i.e., ensembles) of faces or objects can be rapidly extracted to optimize visual processing, without reliance of visual working memory (VWM). Recently, Tharmaratnam and colleagues (VSS 2019) demonstrated that average scene content and spatial boundary of scene ensembles can also be extracted. Furthermore, Jung and Walther (2021) have shown that non-visual attributes (i.e., apparent temperature: how hot or cold a scene would feel) of single scenes are represented in the prefrontal cortex and are accurately rated by observers. Given the flexibility of ensemble encoding, we examined if temperature summary statistics could be extracted by human participants, and whether lower-level features like visual contrast mediated this process. Participants rated the average temperature of scene ensembles, with either gray-scaled stimuli (Exp. 1) or gray-scaled stimuli with a 75% contrast reduction (Exp. 2). In both experiments, we varied set size by randomly presenting 1, 2, 4, or 6 scenes to participants on each trial, and measured VWM capacity using a 2-AFC task. Participants were able to accurately extract average temperature in both experiments, with all 6 scenes being integrated into their summary statistics. Consistent with previous results, this occurred without relying on VWM, as less than 1 scene was remembered on average. These results reveal that computing cross-modal summary statistics (i.e., average temperature) does not rely on lower-level visual features (i.e., contrast). Overall, these results suggest that rapid multisensory ensemble processing occurs through higher cognitive processes, while being independent from one's VWM.

Topic Area: PERCEPTION & ACTION: Vision

F134 - Memory mechanisms associated with serial dependency in visuomotor integration

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In several tasks, events in the current trial are biased toward events from previous trials, an effect named Serial Dependence (SD). Memory traces responsible for SD might be activity-silent, however, recent studies proposed that such patterns can be revealed in electroencephalogram (EEG) using high-energy stimuli (henceforth ping) to uncover information stored in synaptic weights. It remains unclear which features the ping should have and whether this applies to tasks not explicitly engaging memory. We had participants perform a coincident timing task with concomitant EEG recordings. Participants responded to a target hitting a barrier after moving at a constant speed. The intertrial time included a dynamic kinetogram-like stimuli, a white flash, or nothing as a ping. The difference between interception and response times was fed into multiple linear regressions with current and previous trial times as predictors. The previous trial coefficient is a measure of SD, and was significant in all conditions. There was no difference in SD between conditions. We aim to decode previous trial times from the intertrial EEG data to study ping characteristics, expecting that the dynamic condition will provide better decoding than the flash. This will be done by training a classifier in the activity evoked by the ping and testing if it can classify the time to contact in the previous trial. We will perform exploratory analysis looking for patterns in the current trial that may give information about the previously seen trial, and for correlations between decoding strength and SD.

Topic Area: PERCEPTION & ACTION: Vision

F135 - The effect of affect: modulation of facial expression representations by affective scenes

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Prior research has demonstrated the perceptual benefits of viewing certain facial expressions within relevant affective contexts. However, a systematic investigation of how the affective context provided by different scenes impacts a wider range of expressions remains to be undertaken. Here, we address this challenge by assessing the structure of expression face space in the context of scenes varying in valence and level of arousal. To this aim, adult participants (n=114) with normal expression recognition ability rated the pairwise similarity of 15 different facial expressions of two male actors (e.g., happy satiated, smiling sardonic, sad, arrogant). Facial images were displayed against scenes from five affective categories (i.e., amusement, awe, disgust, fear and neutral). Further, in a control experiment, participants rated the same expression pairs against versions of the same scene images transformed to eliminate the semantic content of the scenes while preserving low-level image properties. Chiefly, our results revealed that fear-evoking contexts systematically impacted the structure of face space relative to a neutral context. While the size of this effect varied as a function of facial identity (i.e., specific male actor), the effect was traced to a common subset of expressions (i.e.., insecurity and disgust) whose representations were significantly modulated by fear contexts. Further, the effect was eliminated after removing the semantic content of scene images. In summary, our results shed light on the impact of affective context on emotional expression representations and, notably, provide evidence for the role of fear in face perception.

Topic Area: PERCEPTION & ACTION: Vision

F136 - The Neural Representation of Other-Race Faces

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The other-race effect (ORE) refers to the typical benefit of recognizing faces of one's own-race compared to other-race faces. While behavioural aspects of ORE have been extensively studied, its neural mechanism remains less understood. The current study addresses this challenge by applying multivariate pattern analysis and image reconstruction to electroencephalography (EEG) data in adults with normal face recognition abilities. Specifically, we examined the neural representation of own- and other-race faces in East Asian and Caucasian participants (N = 40) who viewed own- and other-race face stimuli. Our behavioural results confirmed the ORE, by showing enhanced recognition of own-race faces among participants. EEG pattern analysis revealed higher decoding accuracy for own-race faces in both participant groups, consistent with the behavioural findings. Moreover, we found a significant correlation between behavioural measures of the ORE and decoding performance across participants. Furthermore, EEG-based facial image reconstruction revealed systematic differences in the visual content of own- versus other-race face representations. Thus, our research advances the understanding of ORE with respect to its neural underpinnings and its representational basis.

Topic Area: PERCEPTION & ACTION: Vision

F137 - Ventral-Dorsal Stream Interactions Supporting Functional Object Grasps

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Visual cues drive inferences necessary for everyday object-directed actions. For instance, when grasping a hammer to pound a nail, one grasps its handle off of its center of mass, rather than at its midpoint. How are visual cues integrated with a representation of the goal of an object-directed action in order to constrain where and how to grasp the object? This study tested the role of interactions between the ventral and dorsal visual pathways in translating visual cues into functionally appropriate object-directed actions. In Study 1, participants were shown a pair of 3D novel objects on every trial during fMRI scanning; the pair was either the same or different in surface texture (rough/smooth), shape (same shape or isomer), or material property (made of metal, wood or stone). Consistent with prior findings, we found strong preferences for shape processing in the lateral occipitotemporal areas and of surface texture and material properties in ventral occipitotemporal areas. In Study 2, we created real 3D objects such that their weight distribution was systematically related to surface color. Participants were scanned before and after two sessions of behavioral training in a real-world grasping task to learn the color-weight mappings. We found a robust behavioral learning effect that was tightly related to the emergence of neural responses, with training, in the collateral sulcus and anterior intraparietal sulcus. These studies show that interactions between the collateral sulcus and aIPS support the integration of surface visual cues of objects into functionally appropriate object directed grasps.

Topic Area: PERCEPTION & ACTION: Vision

F138 - Modularity of Brain Networks for Egocentric and Allocentric Memory-guided Reaching.

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The brain encodes targets for reaching in egocentric (EGO) and/or allocentric (ALLO) reference frames (Byrne and Crawford 2010). Differences in the cortical activation, but not functional organization, of these two representations have been described (Chen et al., 2014; Neggers et al., 2006). Based on previous findings, we expected increased integration & hubness in the ventral visual stream in ALLO brain networks. Here, we performed a secondary analysis of an event-related fMRI task (Chen et al., 2014). The paradigm consisted of 3 tasks with identical stimulus display but different instructions: remember absolute target location (EGO), remember target location relative to a visual landmark (ALLO), and a nonspatial control, color report. We performed a graph theoretical analysis (GTA) on contrast reduced, time-series data during the memory delay period. GTA measures, including the hubness, clustering coefficient, and efficiency were found, as well as the organization of the network into modules. EGO and ALLO brain networks showed increased functional segregation & integration, relative to control. In both tasks, the network was largely segregated into occipito-dorsal-parietal (ODP) and & temporo-frontal (TF) networks modules. ALLO network demonstrated significantly higher modularity and hubs in the ODP module, than EGO. When the subtracting the common baseline correlation, the EGO showed segregation of occipital brain areas from the OPD module, but ALLO did not. Our results demonstrate that rather than increased ALLO encoding of visual reach targets in the ventral stream, there is increased specialization in the interaction between early visual brain areas and dorsal parietal brain areas.

Topic Area: PERCEPTION & ACTION: Vision

F139 - Illusory Contour Integration in Children with Autism Spectrum Disorder and Their Unaffected Siblings

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Contour integration (CI) is a fundamental process by which the brain links visual elements into coherent visual objects. CI can be probed using illusory visual stimuli such as Kanisza figures (described below). The illusory objects perceived from these stimuli involve feedback systems, and thus provide a test of top-down processing integrity, which is impaired in autism spectrum disorder (ASD). Neurotypical CI of these stimuli takes place in two phases: an earlier "perceptual phase" and a later "conceptual phase." Previous electrophysiologic work demonstrates that children with ASD exhibit marked attenuation of both phases of CI. However, research on CI remains limited in younger children and is nonexistent in siblings of individuals with ASD. Inclusion of this latter cohort can aid in determining whether observed differences are related to heritable mechanisms. Electroencephalography (EEG) data were acquired while children aged 8-12 (ASD, N=33; Neurotypical, N=16; Unaffected Siblings, N=19) passively viewed Kanisza figures consisting of inducers aligned either randomly (non-contour stimuli) or such that an illusory square is perceived (illusory contour stimuli). Preliminary inspection of EEG data suggest that later phases of CI are intact in all groups, whilst early phase CI effects are absent, including in the neurotypical cohort. This suggests that early and

automatic CI processes are not yet fully developed in this age group, who perhaps rely on later effortful phases of CI. Additional analyses on illusory contour effects in the gamma frequency band will also be presented, as gamma is linked to perceptual binding and is often reduced in ASD.

Topic Area: PERCEPTION & ACTION: Vision

F140 - Cortico-cortical recurrent processes mediate convex figure context effects and cortico-thalamic recurrent processes resolve figure-ground ambiguity

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Previous theory held that image factors like convexity were sufficient for unambiguous figure assignment. However, for unmasked 100-ms displays, we found that the probability of perceiving a figure on the convex side of a border is only slightly higher than chance for two-region displays and increases with the number of display regions. These convexity context effects (CCEs) were observed only when concave regions were homogeneously colored; convex region homogeneity was irrelevant. A Bayesian observer replicated the CCEs by supplementing convexity with a homogeneous background prior and predicted that classic displays with homogeneous convex and concave regions are ambiguous. We examined the temporal evolution of CCEs by presenting pattern masks after 100-ms displays at ISIs of 0, 50, or 100 ms. We expected the masks would add noise to recurrent processing, delaying the outcome of processes in which they play a role. In Exp. 1 participants viewed two- and eight-region displays with homogeneous convex regions. In Exp. 2 they viewed displays with heterogeneous convex regions. CCEs developed over time and emerged earlier in Exp. 2 than Exp. 1 supporting the ambiguity prediction and implicating recurrent processing in CCEs and ambiguity resolution. In Exp. 3, displays and masks were presented to different eyes, thereby delaying subcortical mask interference up to 100ms. Now CCEs emerged at the same time for both display types suggesting that corticofugal recurrent processes resolve the ambiguity of homogeneous convex displays. Our results add to evidence that perceptual organization entails recurrent processing and reveal that corticofugal feedback resolves ambiguity.

Topic Area: PERCEPTION & ACTION: Vision

F141 - Deciphering Neural Choreography: Theta and High-Alpha Phase-Locking Dynamics Unveil Face Perception in Ambiguous Stimuli

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Previous studies have established phase synchronization as a fundamental mechanism for integrating local features into coherent perceptions. In this study, we employed a novel paradigm and dynamic graph analysis based on electroencephalography (EEG) to track neural dynamics associated with perceiving a face or not while keeping the stimuli identical. Thirty participants underwent a pretest to establish perceptual thresholds for detecting faces within images overlaid with visual noise. These thresholds were then applied in an EEG experiment with the same task, focusing on images with 50% and 75% detection probabilities. In the high-alpha band, we observed increased coupling (110-325 ms post-stimulus) between left occipito-temporal and right parieto-occipital regions when an ambiguous stimulus was perceived as a face, indicating conscious face perception. Subsequently, the failure to perceive a face results in enhanced theta band phase synchronization between left and right occipito-temporal face-selective areas, along with increased high-alpha band coupling between left prefrontal and right occipito-temporal regions. The theta synchronization, which occurs earlier, may be linked to the ongoing assembly of individual pieces of facial information, while the later increased high-alpha coupling suggests potential top-down modulation on visuospatial attention for gathering more information. Additionally, we identified left lateralized prefrontal-occipital couplings in the theta band related to the informational content of the stimulus, irrespective of whether the inherent face was perceived or not. These findings reveal distinct temporal dynamics in phase synchronization at specific frequencies, indicating a specialized system for face perception during integrated information processing across the frontal and visual cortex, resolving ambiguities.

Topic Area: PERCEPTION & ACTION: Vision

F142 - Redundant target effects in the hemianopic field of patients with primary visual cortex lesions

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The redundant target effect (RTE) refers to the observation that simple response times are faster when two targets are presented simultaneously than when a single target is presented. Previous studies have demonstrated an RTE for a variety of visual stimuli (e.g., dots, words, faces), but it is unknown how simple response times may be modulated for images of different categories, and how potential category modulations interact with visual field location. The systems involved in processing different categories can have dissociable retinotopic or laterality biases (e.g., faces lateralized to the right hemisphere, tools to the left hemisphere). We present an RTE study using images from visual categories known to differentially involve dissociable brain regions and pathways: including neutral and fearful faces, animals, tools, and low, medium and high spatial frequency sinusoidal gratings. All stimuli were contrast normalized, matched for overall luminance, and presented against an isoluminant background. We tested a sample of healthy neurotypical controls and an individual presenting with right homonymous hemianopia after a focal stroke affecting left striate cortex. For all participants, RTE magnitudes varied by image category and across the visual field, suggesting that even in a simple detection task there are dissociable forms of processing for different classes of visual inputs. The presence of an RTE when redundant stimuli were presented in the blind field of the individual with hemianopia suggests that simple detection for some types of visual images can be processed in the absence of an experience of seeing.

Topic Area: PERCEPTION & ACTION: Vision

F143 - Neuronal population activity related to inhibition-of-return saccadic phenomena

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Inhibition of return (IOR) is a phenomenon whereby the saccadic eye movements show a lower probability of returning to previously explored parts of a scene. IOR likely depends on the interactions between the neuronal populations involved in eye movement planning and short term memory. However, the brain circuitry level understanding of mechanisms underlying IOR in the human brain is still incomplete. We took advantage of a wide electrode coverage in epileptic patients undergoing pre-surgical evaluation of epileptic foci to measure population level activity (high frequency activity, HFA; 70-200 Hz) distinguishing saccades that return to previously explored areas (return saccades), relative to saccades directed towards non-explored areas (non-return saccades). On individual trials, participants explored naturalistic scenes, searching for hidden targets. The analysis was done on 10602 saccades (16 datasets, 15 subjects), and a total of 536 electrodes. Overall, 12.3 ± 0.6% of saccades were classified as 'return', defined as ending up within the arbitrary radius of 150 pixels (15%/11% of the scene height and width, respectively) from any of the previous saccade end points during the same scene exploration. A distributed network of local populations shows significantly different pre-saccadic HFA, depending on the saccade category (return or no return), with the higher proportion in the occipital lobe (23%), relative to temporal (10%) and frontal lobe (8%). These findings suggest the IOR might result from a balance between the activity of distributed networks promoting return to previously explored or exploration of new parts of a scene, respectively.

Topic Area: PERCEPTION & ACTION: Vision

F144 - Mapping neural similarity spaces for scenes with generative adversarial networks

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Recent progress in vision science has focused on characterizing how the perceptual similarity of visual stimuli is reflected in the similarity of neural representations. While such neural similarity spaces are well-established in simple feature domains (e.g., orientation columns in V1), a correspondent finding with complex real-world stimuli has yet to be demonstrated. We explored this topic using scene wheels (Son et al. 2021), an AI-generated continuous scene stimulus space in which various global scene properties changed gradually along a circular continuum. Participants were shown scene wheel images during fMRI scanning with a continuous carry-over design to provide stable estimates of scene-specific neural patterns. After scanning, participants rated pairwise perceptual similarity for the same scene wheel images. We performed representational similarity analysis by comparing the similarity of scene-specific voxel patterns across multiple high-level visual regions as measures of physical (angular distances in the scene wheels; pixel correlation), perceptual, and semantic similarity (category). We found that for scene wheels constrained to a single scene category (e.g., dining room), the neural patterns in visual cortex mainly represented the physical similarity of the scenes. However, when the scene wheels contain notable category boundaries (e.g., dining rooms and living rooms), both perceptual and category similarity structures were present in neural pattern similarity. These results provide important evidence that similarity structures defined by the complex feature spaces of real-world scenes are coded in neural representations and that such neural representations flexibly code for physical, perceptual, and categorical information.

Topic Area: PERCEPTION & ACTION: Vision

F145 - Peripheral awareness correlates with performance in the random dot motion task

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Introduction: The random dot motion ("Dots") task is a well-established psychophysical paradigm for determining sensitivity to the orientation of moving stimuli in the *center* of their visual field. We wanted to determine whether performance in the Dots task predicts performance in a task assessing peripheral awareness, i.e. sensitivity to the orientation of objects in the *periphery* of the visual field. Methods: We designed a novel task in which participants were asked to assess the overall orientation of lines in a visual display. In all trials, less than 50% of the central lines were coherently oriented at one angle, and greater than 50% of the peripheral lines were coherently oriented at a different angle; hence, the correct response was always the dominant orientation of peripheral lines. From trial to trial, we modulated the proportion of coherently oriented central and peripheral lines, as well as the ratio of central to peripheral lines. We recruited 61 volunteers to complete both this task ("Lines") and the Dots task, 49 of whom we included in our analyses. Results: As expected, accuracy significantly decreased as the proportion of coherently oriented central lines increased. Furthermore, participants who performed well in the Dots task also tended to provide accurate responses in the Lines task. That is, there was no significant difference between the correlation of difficulty & accuracy in the Lines task and the correlation of difficulty & accuracy in the Dots task. Conclusions: Perceptual sensitivity to stimuli in the center of the visual field predicts peripheral awareness.

Topic Area: PERCEPTION & ACTION: Vision

F146 - Relating variability in scalp EEG to variability in cortical morphology

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Electroencephalography (EEG) is a widely used brain imaging modality that makes it possible to measure brain signals with minimal cost and invasiveness. A fundamental limitation to the usefulness of EEG is the challenge of relating signals measured at the scalp to the underlying cortical generators. Here we use previously collected EEG that was acquired under a Steady-State Visual Evoked Potentials (SSVEP) paradigm as participants (n=13) were viewing a stimulus set of regular textures. These data were acquired on two separate sessions, and the experimental design makes it possible to separately measure early visual responses related to image-level changes in the stimulus and more higher-level responses driven by symmetries within textures. We see substantial variability among individuals in early and especially in higher-level responses which clearly exceeds the variability between sessions. Because the underlying set of cortical areas that respond to symmetry is well-documented, it is possible to model the cortical sources of both low-level and higher-level symmetry-driven responses in individual participants. We do this based on structural MRI data for each of our participants and aim to quantify the extent to which variability in underlying cortical morphology determine variability in low-level and higher-level responses measured at the scalp. Specifically, we test whether features such as size of visual regions of interest, cortical thickness, and orientation of cortical surface can effectively predict the strength of responses.

Topic Area: PERCEPTION & ACTION: Vision

F147 - Neural representation of discrete and continuous ratios: An fMRI study

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We often rely on relative magnitudes (ratios and proportions) to make decisions. For example, we can tell from battery icons how much charge is left by comparing the length of the filled bar to the length of the full battery icon, regardless of the overall size of the icon. This leaves the question of how humans process ratios across different formats. Some authors have proposed that all ratios are processed by a perceptually based "ratio processing system" (RPS; Lewis et al., 2016). Though some neuroimaging studies have shown a spatial overlap in brain areas processing ratios across different formats, the assumption that all non-symbolic ratios (e.g., ratios depicted using length or numerosity) have a common representation via the RPS is currently untested. Therefore, the aim of this study was to investigate the neural representation of discrete and continuous ratios using fMRI. Thirty participants completed a ratio match-to-sample task on discrete (sets of dots) and continuous (line lengths) magnitudes while in the MRI scanner. Using representational similarity analysis, we tested a series of models representing low- and high-level features on a range of areas from primary visual cortex to parietal and frontal cortex. Preliminary results suggest that ratios are not represented similarly across these different formats, thereby contracting the RPS theory. In conclusion, this study tested a fundamental assumption composing the RPS theory. Results have implications for theories of ratio processing and how these can be leveraged to improve teaching of fractions.

Topic Area: PERCEPTION & ACTION: Vision

F148 - EEG criticality measures of excitation/inhibition balance show that plasticity regulation during wakefulness is distinct from during sleep

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Visual perception demonstrates adult plasticity in response to experience, yet the neural processes underlying the regulation (metaplasticity) of these changes are only beginning to be understood. One proposal is that excitatory and inhibitory activity is carefully balanced, with the brain typically acting within a narrow critical range to gate neuroplasticity. Such criticality can be computationally defined using time series measures of a signal's self-affinity, and prior work has used EEG recordings to demonstrate these measures' links to pharmacological interventions and to psychological diagnoses. Here we examine the use of EEG criticality measures of excitation and inhibition during visual perceptual training and the consolidation thereof. Participants were sequentially trained on two versions of a texture discrimination task which have been shown to interfere with one another. In contrast to previously reported results linking greater excitation-dominance during REM sleep to higher interference, during awake rest we observed that interference was more likely to occur in the presence of inhibition-dominance in both theta-band ($\rho = .47$) and alpha-band ($\rho = .36$). Given the previously-observed role of theta oscillations in executive processing and the reduction of alpha power during sleep, the dissociation we observed may be due to different mechanisms of consolidation occurring during wakefulness as compared to sleep. These results further demonstrate the utility of EEG-based criticality measures of excitation/inhibition balance in understanding the brain's regulation of its plasticity, with this method of inquiry having the potential to be broadly applicable in the study of plasticity and metaplasticity. Acknowledgements: NIH (R01EY031705, R01EY019466, R01EY027841)

Topic Area: PERCEPTION & ACTION: Vision

F149 - Category learning induces transfer of perceptual learning by steering Feature-Based Attention

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Visual Perceptual Learning (VPL; often defined as long-term performance increase due to visual experience) is highly specific to trained features. Previous work found that category learning can cause VPL to transfer across features to stimuli from the same category as the trained stimulus (Category-learning Induced Transfer of VPL or CIT-VPL; Wang et al., 2018, Current Biology). However, the mechanism of transfer is unknown. Based on work showing that Feature-Based Attention (FBA) can increase within-category stimulus similarity (Brouwer and Heeger, 2013), here we postulate that CIT-VPL occurs through FBA. We test this hypothesis utilizing two category structures that differ in the optimal FBA allocation strategy: Rule-Based (RB) and Information-Integration (II). RB structures benefit from targeting FBA to specific feature values while II structures do not. We use these structures to test three predictions from the theory: 1) RB structures will cause greater VPL transfer than II structures, 2) changes in visual cortex GABA concentration will correlate with VPL transfer, and 3) changes in functional connectivity between visual cortex and the inferior frontal junction (a region involved in controlling FBA) will correlate with VPL transfer. Across two experiments, the results confirmed the predictions of the theory. We then implement a neural network model that learns to apply feature-specific feedback (gain) modulation during category learning. We demonstrate that feedback connections enable the network to show the same behavior as human participants. Overall, this work provides computational, neural, and behavioral evidence for feature-based attention being the mechanism for category-learning induced transfer of VPL.

Topic Area: PERCEPTION & ACTION: Vision

F150 - Comparative analysis of optimization trends in dorsal and ventral stream using computation models

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visual information processing into two distinct neural streams: the dorsal stream, responsible for action, and the ventral stream, responsible for perception. The dorsal stream is instrumental in translating visual characteristics into motor commands, typically modelled as a regression task in artificial neural networks (ANNs), specifically in tasks like grasping. Conversely, the ventral stream converts retinal images into abstract representations for object recognition, typically modelled as a classification task in ANNs. There exists a hypothesis that differences between these two streams are rooted in variations in their optimization processes. Neural networks trained for object classification or robotic grasp movements exhibit different response properties, but these differences are often ascribed to network architecture and training variations. To assess the impact of task-specific training differences, we devised a novel map-based ANN and a task-agnostic double-log loss function suitable for classification and visual grasp analysis. Our method penalizes boundary predictions for both tasks, enabling a direct comparison between classification and grasping networks following identical optimization rules. For a qualitative understanding of the distinctions between the two pathways, we applied Guided Backpropagation, we discovered that the classification network emphasizes local information of object parts and surface features, while the grasp network focuses on global features. The emergence of properties resembling dorsal and ventral streams suggests that our approach provides an equitable and task-agnostic method for comparing optimization trends across action-based and perception-based learning agents. This methodology contributes to the quantitative modelling of the visual cortex.

Topic Area: PERCEPTION & ACTION: Vision

F151 - How does categorization reshape representational geometry in the brain?

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When we look for something of a particular category (e.g. a lost pair of keys), we differentially attend to some features of objects at the expensive of others. What kind of influence does this selective attention have on the neural representation of stimulus features? One hypothesis is that categorization causes us to attentionally weight whole stimulus dimensions. Another is that categorization modulates perception resulting in greater local discriminability between stimuli spanning the categorical divide. Previous findings favoring these hypotheses have tended to focus on different brain regions (e.g. medial temporal lobe vs early visual cortex) without directly comparing these two alternatives or assessing how the effects of selective attention unfold over time. We carried out a simultaneous fMRI-EEG study in which participants (N = 12, two sessions each) carried out two categorization tasks of simple stimuli that variety in their orientation and spatial frequency. We then isolated a variety of regions of interest (ROIs), focusing on early and high-level visual areas in the ventral visual stream, as well as areas associated with conceptualization and memory, including the anterior and medial temporal lobes. Representational similarity analysis was used to compare the neural dissimilarities in these ROIs to the EEG signal, as well as a large range of categorization models of behavior that varied in the form of selective attention. We found that different attentional weighting models better captured the effect of categorization task with respect to behavior and spatiotemporal characteristics of the neural responses, both within and between participants.

Topic Area: PERCEPTION & ACTION: Vision

F152 - Pupil behaviors in body dysmorphic disorder: an exploration of square wave jerks and pupil diameter

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Body dysmorphic disorder (BDD) involves a preoccupation with perceived defects or flaws of one's physical appearance, which may be attributable to abnormalities in visual and neural processing. Square wave jerks (SWJs) and variations in pupil diameter (PD) have previously been implicated in other psychiatric disorders for their associations with underlying neurological mechanisms and emotional arousal; however, very little is known about these phenomena in BDD. This study examines SWJs and variation in PD to determine if individuals with BDD have an increased rate of SWJs and greater pupil variability. 19 healthy controls (HCs) and 27 BDD participants were recruited from the Centre of Addiction and Mental Health (CAMH) in Toronto, Canada. Eye tracking data were obtained for a 1-minute fixation task and measures for dysmorphic concern, depression, anxiety, and changes in mood state were collected. 3 outliers (BDD participants) were excluded from PD analysis. BDD participants had a significantly increased frequency of SWJs than the HCs (BDD mean = 14.04, SD = 11.817; HC mean = 8.53, SD = 12.469; p = 0.031). However, there was no significant difference (p = 0.225) in the PD variation between BDD (mean = 3.14, SD = 0.474) and HC subjects (mean = 3.17, SD = 0.432). Across all participants, SWJ frequency was positively correlated with dysmorphic concern (p = 0.035), measured with the Dysmorphic Concern Questionnaire. This investigation found that SWJ frequency was associated with BDD and dysmorphic concern; however, further research with increased sample size is necessary to validate these findings.

Topic Area: PERCEPTION & ACTION: Vision

F153 - A quick glance: Associations between body dysmorphic concerns and eye gaze behaviour during facial image viewing

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Individuals with body dysmorphic disorder (BDD) are preoccupied with misperceived flaws in their appearance, particularly pertaining to their face and head area, which may be attributable to aberrant visual attention. This study examined eye behaviours as participants viewed their own or an unfamiliar face. We hypothesized that (1) participants would exhibit shorter fixation duration (FD) when observing their own versus others' faces and (2) individuals with greater symptom severity will display shorter FD when viewing their own versus others' faces. Thirty-six adults (n=16 healthy controls, n=12 subclinical, n=8 BDD) viewed images of themselves and unfamiliar faces. Eye-tracking was recorded using the Eyelink 1000 Plus. The Dysmorphic Concern Questionnaire (DCQ), a self-rated scale that measures BDD symptom severity, was administered

before the task. To evaluate the impact of image type (self versus other) and BDD symptom severity on fixation duration, a linear mixed model was applied. Image type had a significant impact on FD (p=<0.001), such that viewing one's face was associated with lower FD compared to viewing others' (β=-0.13). The interaction between image type and DCQ was also significant (p=0.012); specifically, there was a positive relationship between DCQ and FD for own faces. However, DCQ score alone was not significantly related to FD (p=0.235). In sum, shorter FD when viewing one's face reflects multiple brief fixations, suggesting visual scanning of various facial details, which is specific to viewing one's face. The results provide insights into the relationship between patterns of visual attention and dimensional distortions of appearance.

Topic Area: PERCEPTION & ACTION: Vision

F154 - Mapping contour properties across visual cortex

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Detecting and integrating contours that delineate the boundaries of objects, surfaces, and other scene elements is a crucial function of what is loosely called "mid-level vision". This study investigates how the brain processes these contours and their properties, using the high-resolution Natural Scenes Dataset (Allen et al., 2021). We analyzed the BOLD activity of eight participants viewing images of objects and scenes within V1, V2, V3, and hV4. Using the population receptive fields of individual voxels, we sample contour properties in a spatially specific manner to construct individual regressors for each voxel. This technique, first described by Roth et al. (2022), allows us to determine to what extent voxels within the visual cortex contribute to the representation of contour properties within their receptive field across thousands of images. When analyzing the salient contours in the images, we find a strong preference for horizontal orientations, consistent with the importance for scene layout, such as the horizon line. This preference contrasts with an alternative analysis based on orientation-specific Fourier energy in the photographs, which showed a primarily radial organization of orientation preference. We present direct comparisons of the two methods. The technique of sampling contour properties with spatial specificity opens avenues for exploring various other contour properties, such as contour curvature, contour junctions, as well as relationships between contours, such as parallelism and symmetry. Observing the neural representations of these properties across visual regions will bring us closer to a mechanistic understanding of how our perceptual information is organized in mid-level vision.

Topic Area: PERCEPTION & ACTION: Vision

F155 - Neural Representations of face recognition in biological and artificial systems: Insights from MEG and CNNs

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Artificial neural networks, inspired by brain structure and function, have surpassed human performance in various tasks, but the link between Artificial Intelligence and neuroscience is still underexplored. Combining these fields has offered mutual reinforcement, especially in the field of Neuro-AI, where comparing artificial and biological systems in cognitive tasks, such as visual categorization, has yielded promising insights. Face-recognition, however, is less explored in this context. Do Convolutional Neural Networks (CNNs) trained for face-recognition mimic neural dynamics of face-recognition in brain circuits? A question addressed only by a handful of studies, which in non-human primate mainly focus on the IT-cortex, and in humans, largely rely on fMRI/behavioral-data. Here we compare human brain activity collected using Magnetoencephalography (MEG) during a face-recognition task to activations across seven CNNs. Compared to previous work, we leverage the high temporal resolution of MEG and source reconstruction techniques to compare these models to the brain across time, frequency, and space. Out of the tested models, FaceNet emerged as the most brain-like model during face-recognition. Crucially, training on face-recognition, rather than on object-recognition or both simultaneously, was necessary and sufficient for high model-brain similarity. In terms of temporal alignment, peak similarities were observed around 170ms which corresponds to the M170-component linked with face perception. Examining the Fusiform-Face-Area (FFA), we observed that, compared to an untrained model, the similarity to FaceNet trained on face recognition significantly increased in certain FFA-regions. Our study provides novel insights into the spatio-temporal similarity patterns between artificial and biological neural responses associated with face-recognition.

Topic Area: PERCEPTION & ACTION: Vision

F156 - Perceiving natural images may consume less cognitive resources: evidence from image memorability, edge magnitudes, and spectral content

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Theories have suggested that perceiving natural scenes requires less cognitive resources compared to perceiving urban scenes, leading to the cognitive benefits of interacting with natural environments. While studies have shown that natural environments have restorative benefits, the hypothesized mechanisms have not been rigorously tested. Here, we investigated whether perceiving natural scenes may consume less cognitive resources. First, we conducted a continuous recognition task to probe the memorability of images and found that natural images are less remembered, suggesting that fewer cognitive resources are used to process them. Next, using a Canny edge detection algorithm, we analyzed the number and significance of edges in the images and found that the proportion of edges with higher gradient magnitude is smaller in natural images. This suggests that the number of edges essential to capture scene information is smaller for natural images, aligning with theories that suggest perceiving natural images consumes less cognitive resources. Finally, we analyzed the spectral properties of the images by applying a discrete cosine transform to 8x8 pixel tiles. We found that natural scenes have a larger proportion of their spectral energy in high-frequency coefficients. As the human visual system may be less sensitive to high-frequency information, this implies that natural images have less information that will be processed and thus less taxing. In conclusion, we found that natural scenes are less memorable, have less strong edges, and contain more high-frequency information than man-made scene images. These findings are consistent with theories positing that perceiving natural images is less taxing.

Topic Area: PERCEPTION & ACTION: Vision

F157 - Layer-dependent feedback in a grasping neural network increases robustness to noise

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Top-down predictions from generative models in the brain are conveyed through cortical layer-specific feedback connections during visual perceptual tasks. However, there is a dearth of understanding of the contribution of feedback when visual input is used for action planning, such as object grasping. Recent evidence shows that advanced object shape and movement representations during grasping also involve the reactivation of earlier visual areas, indicating that feedback connections carry information from downstream stages of visuomotor processing to the earlier stages in the visual stream. We investigated the contribution of such neural feedback to the visuomotor control of grasping by using convolutional neural networks, trained to compute grasp positions for real-world objects, as a modelling framework. To make these models computationally and structurally more similar to the human cortex, we added generative feedback loops to a custom feedforward backbone, carrying advanced representations to early layers of the network. When evaluated on images with additive Gaussian noise, after multiple forward and backward passes through the network, we observed an improvement in performance for the network with predictive coding dynamics in comparison to the feedforward baseline. We also find that this performance-enhancing effect under adverse conditions (1) decreases with increasing distance between the feedback source and target layers, and (2) relies on a balance between the relative contributions of local recurrence and top-down feedback. To conclude, our simulations show that introducing biologically plausible predictive coding dynamics improves model robustness to noisy visual stimuli in a neural network model optimized for grasp prediction.

Topic Area: PERCEPTION & ACTION: Vision

F158 - Beyond Object recognition : The Role of Visual-Semantic Representations in Understanding the Ventral Visual Stream

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In visual cognitive neuroscience, there are two main theories about the function of the ventral visual processing stream (VVS). One suggests that it serves to classify objects (classification hypothesis) by learning categorical representations, which can then be indexed into the human semantic system to allow for the retrieval of other information; the other suggests that the VVS generates intermediate distributed representations from which people can generate verbal descriptions, actions, and other kinds of information (distributed semantic hypothesis). The classification hypothesis suggests that the visual system is isolated from the brain's semantic system in terms of computations, hence Deep Convolutional Neural Networks trained on categorization seem to be good models of the VVS. However, the distributed semantic hypothesis suggests that the visual system is integrated with other systems such as language, praxis, etc. To adjudicate between these competing hypotheses, we trained two deep convolutional AlexNet models on 330,000 images belonging to 86 categories, representing the intersection of Ecoset images and the semantic norms collected by the Leuven group. One model was trained to produce category labels(classification hypothesis), and the other to generate all of an item's semantic features (distributed semantic hypothesis). The two models learned very different representational geometries throughout the network. We also estimated the human semantic structure of the 86 classes by using a triadic comparison task. The representations acquired by the feature-generating model aligned better with human-perceived similarities amongst images, and better predicted human judgments in a triadic comparison task. The results thus support the distributed semantic hypothesis.

Topic Area: PERCEPTION & ACTION: Vision

F159 - Moderate-to-high intensity group exercise improves cognitive function of stroke survivors

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Background: Post-stroke exercise need to be encouraged to facilitate optimal recovery and to improve both physical and mental health. However, stroke survivors are easily predisposed to sedentary lifestyle due to physical impairment and functional compromise. Moreover, many clinicians as well as patients tend to be discouraged by exercise-related risk of injury of falls or comorbidities. Methods: This study is a randomized controlled trial. Subjects were randomly assigned to either intervention or control group. Subjects in intervention group completed 16 sessions of 90-minute moderate-to-high intensity group-based exercise for 8 weeks. Subjects in control group completed 45-minute low intensity home-based exercise, 4 times a week, for 8 weeks. Korean version of Montreal Cognitive Assessment (MoCA-K) were measured at baseline and postintervention in each group. Results: Total 32 stroke survivors were enrolled in the study and 18 were randomized to group-based moderate-to-high exercise and 14 were randomized to home-based low intensity exercise. Intervention group showed high compliance as well as high attendance rate. Adverse event was only 2 uneventful falls in 1 subject. After 8 weeks of moderate-to-high intensity group exercise, MoCA-K score were significantly improved in the intervention group after 8-week of moderate-to-high intensity exercise. Conclusions: Moderate-to-high intensity group-based exercise is feasible and safe and improves cognitive function of chronic stroke survivors.

Topic Area: OTHER