Pre-Data-Collection Poster Satellite Abstract Booklet (VSS 2024)

Sunday Morning

Banyan Breezeway, 8.30am – 12.30pm

33.355. Testing generalization from static to dynamic faces using magnetoencephalography (MEG)

Sebastian Montesinos, Shruti Japee, Chris Baker

National Institutes of Health

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. The current study investigates the extent to which representations evoked during the presentation of static stimuli generalize to dynamic movies that involve those same stimuli. To probe this question, we use magnetoencephalography (MEG) to compare the time course of signals while participants view static frames and dynamic movies of human faces. The static frames of faces vary in terms of the orientation of the head on its axis, while the movies show these faces moving from one orientation to another, passing through frames presented during the still trials. Time-resolved MEG decoding methods allow us to compare brain MEG signal patterns evoked by 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.

33.356. Hearing with the eyes: decoding natural sounds from gaze position

Héctor Sánchez Meléndez, Ryan Ruhde, Grace Edwards, Chris I Baker

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The visual system is modulated by auditory processing, with early visual cortex responding to natural sounds and spoken language. Additionally, the eyes exhibit a host of meaningful responses to auditory information, including spoken stories, grammatical processing, and even imagery of music. Here we examine if the eyes also reflect information about natural sounds. We plan to use a behavioral paradigm with eye tracking in which participants will hear four exemplars of naturalistic sounds from four categories: animals, man-made objects, natural environments, and man-made environments. Participants will be instructed to look at a gray screen and attend to these sounds with the goal of completing a memory task at the end of the experiment. To engage naturalistic gaze patterns during perception of the sounds, the

participants will be told the eye tracker will be used to determine arousal during the experiment. Our design affords the exploration of when eye-movements might become informative of naturalistic sounds. We will determine if we can decode i) broadly between single items (animal and man-made objects) versus environmental soundscape (natural and man-made environments), ii) at the category level (animals, man-made objects, natural environments, man-made environments), or iii) at the exemplar level. This study will expand upon previous work to demonstrate how the eyes are driven by sensory input beyond vision. A significant difference in eye-movements between auditory stimuli would underscore the importance of eye tracking, even when using non-visual stimuli.

33.357. Uncovering Altered Visual Pathways and Connectivity Patterns in Schizophrenia during Ambiguous Object Recognition

Anh Pham, Cheryl Olman

University of Minnesota

Prior research demonstrates variation in performance of different visual tasks in people with psychosis compared to the general population. We hypothesize that one of the neural mechanisms underlying this difference is reduced efficacy of connections between primary visual cortex (V1) and lateral occipital complex (LOC), and between frontal areas and visual areas. A 3T fMRI study (Pokorny et al., 2021) revealed altered interaction between visual and prefrontal brain regions for both schizophrenia patients (SCZ) and their relatives (SREL) compared to controls (CON) when viewing images that manipulating high-level features while controlling low-level properties (Olman et al., 2019). A 7T follow-up fMRI study replicates this with participants drawn from the same groups and with the same stimuli, but with an improved baseline condition. Planned analyses will (1) use general GLM to detect brain regions involved in discriminating between meaningful and meaningless objects and (2) use generalized PPI to estimate task-dependent connectivity between these regions and V1. Our hypothesis predicts these GLM results: SCZ and SREL will exhibit lower contrast between meaningless and random noise in LOC compared to CON, indicating weaker figure modulation in SCZ. Additionally, we expect SCZ's middle frontal gyrus (MFG) involvement will depend on meaningful image presence due to difficulty in separating objects from clutter in the meaningless condition. Generalized PPI findings also expect reduced V1-LOC connectivity in SCZ and SREL, suggesting the hypothesis that genetic liability for schizophrenia is expressed as effective long-range connections in the brain.

33.358. Effect of Feedback on V1 Receptive Field Tuning

Anmol Kaur, Cheryl A. Olman, PhD

University of Minnesota

33.359. Socially-relevant non-linguistic audiovisual stimuli for perceptual and cognitive experiments

Abigail L. Noyce, Mira Devgan, Barbara G. Shinn-Cunningham

Carnegie Mellon University

Humans' two primary sensory systems, vision and audition, are often studied by different teams, funded by different agencies, and each considered in isolation. However, in daily life, we most often encounter rich, complex input, with multiple visual, auditory, and multisensory sources present. Despite broad

consensus that multisensory interactions are valuable to study, there are surprisingly few established paradigms for doing so. In particular, there are few paradigms that are more complex and realistic than tones paired with simple shapes, but simpler and more controlled than audiovisual speech. Here, we propose a new set of audiovisual stimuli that can be used to investigate shared and sensory-specific processes in humans. These stimuli are derived from natural audiovisual speech, but all semantic content has been stripped from the audio track, leaving only the prosody. We first collected a corpus of “talking head” English-language clips from YouTube, sampling broadly across racial and gender categories, and more narrowly across ages. We then used Praat’s “hum” function to replace the speech track with a neutral vowel /a/ that tracks the pitch, loudness, and other prosodic features of the sound. Corresponding visual stimuli can include the original complete video, an extraction of key facial features, or a simple shape that tracks the pitch and loudness of the audio. Our future projects using this stimulus corpus include investigations of perceptual and memory sensivity to visual, auditory, and multi-sensory features, as well as seeking evidence of shared vs separate neural representations across sensory systems.

33.360. Testing model predictions for a pursuit detection task

Maria Kon, Sangeet Khemlani, Andrew Lovett

Navy Center for Applied Research in Artificial Intelligence, U.S. Naval Research Laboratory

VSS 2024 poster 23.370 (“Detecting pursuit in dynamic visual scenes”) introduced a new task to study pursuit detection and reported results of an experiment with this task, which measured response time and accuracy while varying set size to test judgments of whether a pursuit was present or absent. A computational model fit the data well and made specific errors at times that matched those made by humans. However, this work has two limitations: (1) model parameter values could have overfit the data, and (2) the stimuli had relatively simple motion patterns. We designed a follow-up experiment to test three chasing subtlety conditions (the pursuer moves directly towards its target; up to 30 degrees away from a direct path; and up to 60 degrees away). The model predicts shorter latencies for the smaller set size across first two chasing subtlety conditions, and a large increase in latency for the 60 degree condition. The model makes novel predictions regarding response times when no chase is present: long and uniform latencies for larger set sizes and shorter latencies for the small set size with the 30 degree condition. The model also predicts which specific videos will result in more errors based on whether one object appears to be moving towards another during a critical time window. To determine strengths and deficits in the model, we plan to empirically test model predictions about general data patterns and the timing and types of specific errors.

33.361. Tactile substitution of visual information for guiding locomotion

Sina Feldmann, Qiwu Zhang, Chiang-Heng Chien, Brian Free, Benjamin B. Kimia, William H. Warren

Brown University

People with low or impaired vision often rely on assistive devices to help guide locomotion and avoid obstacles and dropoffs. While common aids such as the long cane are useful over a short range (2-3 steps), effective aids for intermediate ranges are lacking. There is a need for assistive devices that provide intuitive information for locomotor guidance, such as the direction of goals, obstacles, and clear pathways. Our research aims to compare different methods for coding spatial information in a simple vibro-tactile belt. The belt is equipped with 16 motors evenly-spaced around the waist, 22.5 degrees apart. Preliminary experiments will determine the accuracy and precision of directional perception from vibrating motors. Participants will receive tactile vibration and click on a computer display to indicate the perceived direction in space corresponding to the source of stimulation. To investigate the spatial resolution of perceived direction, and the hypothesis of tactile 'hyperacuity', the vibration pattern will be manipulated: (a) one motor vibrating at a fixed frequency and intensity, (b) 3 to 5 vibrating motors with a Gaussian distribution of intensity resulting in different spatial intervals between motors, (c) variation in the sigma of the Gaussian, i.e. the number and intensities of adjacent vibrating motors. Each stimulus will be repeated ten times, randomized within blocks. This will enable us to estimate the spatial resolution of perceived direction, depending on the direction and type of vibration. The results will be used to design intuitive methods of coding spatial information in a vibro-tactile belt.

33.362. Depth-dependent activation profile of primary visual cortex while listening to spoken language

Sophia Lipetzky (1), Grace Edwards (1), Anna Seydell-Greenwald (2), Elisha P. Merriam (1), Laurentius Huber (1) Ella Striem-Amit (3), Chris I. Baker (1)

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In congenitally blind populations there is increased activity in the primary visual cortex (V1) while listening to spoken language, suggestive of cross-modal plasticity. However, recent evidence of V1 activation by spoken language in sighted individuals (Seydell-Greenwald et al., 2023) suggests pre-existing connectivity between V1 and regions associated with language comprehension. Given the auditory nature of the stimulus, the V1 activation must reflect cortico-cortical feedback originating from non-visual areas. Here, we plan to use 7T fMRI to characterize the depth-dependent activation profile of V1 while listening to spoken language. Following the method of Seydell-Greenwald et al., 2023, we will present sighted participants with audio recordings of forward and reversed speech while participants maintain fixation. Using the Vascular Space Occupancy (VASO) sequence to measure cerebral blood volume, we will contrast forward versus backward speech to examine the location of activity associated with language comprehension across cortical columns in V1. First, we predict a general increased activity in V1 for forward versus backward language, replicating Seydell-Greenwald et al., 2023. Second, as feedback to V1 is typically associated with activity in infragranular and supragranular layers of the cortex, we predict an increased superficial and deeper percent signal change across the cortical column during language comprehension.

Tuesday Afternoon

Banyan Breezeway, 2.45pm – 6.45pm

56.355. Examining Visual Crowding in Glaucoma under Varying Luminance Conditions

Dilce Tanriverdi, Nomdo M. Jansonius, Frans W. Cornelissen

University Medical Center Groningen

Glaucoma, a leading cause of irreversible blindness worldwide, is characterized by the progressive degeneration of retinal ganglion cells and optic nerve fibers, resulting in visual impairment and potential blindness (Tham et al., 2014). Low-luminance conditions exacerbate visual difficulties reported by glaucoma patients (Enoch et al., 2020). Visual crowding refers to the reduced ability to recognize objects when these are surrounded by visual clutter (Bouma, 1970). It can be considered a laboratory test approximating many aspects of vision in daily life.
Individuals with glaucoma exhibit heightened levels of crowding in peripheral vision (Ogata et al., 2019), a phenomenon that may shed light on their experienced visual challenges in low luminance conditions. Employing well-defined psychophysical tasks (Harrison and Bex, 2015), we will assess peripheral crowding magnitude and extent across various luminance conditions ranging from scotoipc to photopic. Our study population will consist of early-stage glaucoma patients exhibiting mild visual field loss, alongside age and sex-matched healthy controls.
We hypothesize that crowding in glaucoma patients is particularly pronounced under low luminance conditions, potentially elucidating their perceptual difficulties and offering insights into diagnostic and rehabilitative strategies.

56.356. Elucidating the role of posterior STS in facial expression processing using transcranial random noise stimulation

Nellie Simmonds, Grace Edwards, Chris Baker, Shruti Japee

Laboratory of Brain and Cognition, National Institute of Mental Health

In our daily lives, we encounter dozens of facial expressions while communicating with others. Our ability to accurately recognize and interpret these facial expressions is an important component of non-verbal communication that guides our social interactions and transcends linguistic barriers. In the brain, the posterior superior temporal sulcus (pSTS) is thought to be involved in the processing of social stimuli, such as facial expressions. In the current study, we plan to use high-frequency transcranial random noise stimulation (hf-tRNS) to examine whether the pSTS plays a critical role in facial expression processing. Previous work has suggested that hf-tRNS may enhance cortical excitability, leading to improvements in attention, memory, and perception. In this experiment, we plan to apply hf-tRNS to right pSTS while participants perform a challenging expression and identity recognition tasks on dynamic facial expression videos degraded with noise. Performance on the expression task will be compared between active and sham stimulation conditions, and against performance on an identity recognition task completed in a separate run. We hypothesize that compared to sham stimulation, hf-tRNS applied to pSTS will increase accuracy for expression recognition but not for identity recognition. Results from this study will provide insight into the causal role of pSTS in facial expression processing.

56.357. Geo-mentum: Exploring a Geometric Bias Using Representational Momentum

Dominique Lopiccolo(1), Yacin Hamami(3,4), Marie Amalric(5), Alon Hafri(1,2)

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Geometric reasoning is a fundamental human capacity, requiring both deductive and spatial reasoning. Despite its significance, the mechanisms underlying it are unclear. Recently, Hamami and Amalric discovered a bias in geometric reasoning: participants seemed unable to utilize spatial scaling during diagram-based deductive inference tasks. Does this bias reflect an intuitive assumption about scaling or a fundamental visuospatial constraint? We address this question by leveraging the effects of representational momentum (RM)—a memory bias whereby objects are misremembered as further along in their trajectory than they actually were. Participants will view geometric figures undergoing scaling followed by a mask and a syllogism. For example: the dot was on circle α and inside circle β; must the two circles always intersect? Participants must decide whether a conclusion necessarily follows from a set of premises (valid inference) or not (invalid inference). Crucially, some diagrams require scaling the figures to determine that an inference is invalid. We hypothesize that for these diagrams, starting the scaling process via RM will "break" participants' bias not to scale and improve performance. To explore the mechanism behind the bias, we vary the relative scaling direction of figures such that to invalidate the conclusion, participants need to continue scaling in either the same direction of the expected RM effect or its opposite. If performance improves in both conditions, this reflects an assumption not to scale. If improvement depends upon scaling direction, this reflects a fundamental visuospatial constraint. Altogether, our study will elucidate how visuospatial representations interact with deductive reasoning.

56.358. Contributions of the human middle temporal area and dorsal premotor cortex to the timing of moving-target interceptions: a theta burst stimulation study

Justin R. McCurdy, Deborah A. Barany

Department of Kinesiology, University of Georgia

56.359. Time-resolved MEG decoding of facial information from naturalistic images

Lilly J. Kelemen, Nellie Simmonds, Lina Teichmann, Chris Baker, Jessica Taubert, Shruti Japee

Laboratory of Brain and Cognition, National Institute of Mental Health

The information we glean from faces is essential to providing context for our daily interactions. Different types of facial information such as identity, age, gender, race, and expression help us know who a person is and how they are feeling. Many previous studies of face processing have focused on determining which brain regions are involved in extracting different types of facial information, but less is known about the timing of this processing. Further, many of these studies have relied on highly controlled, posed images of faces that are not representative of the wide variety of faces and expressions we encounter in daily life. In

the current study, we aim to use naturalistic face stimuli to understand when humans process distinct aspects of faces. Participants will be shown images from the Wild Faces Database (WFD)—a set of one thousand unposed images depicting facial expressions in a naturalistic setting—during a magnetoencephalography (MEG) scan. Analysis of behavioral judgements during an odd-one-out triplet task of the WFD images has previously revealed distinct dimensions of facial information. Here, we plan to examine the temporal profiles of brain activity elicited by these dimensions using time-resolved analysis of the MEG data. Results from this study will shed light on when different types of facial information are extracted and provide insight into how faces provide context in our everyday social interactions.

56.360. Investigating Meaningfulness in Visual Working Memory

Woohyeuk Chang, Ed Awh

University of Chicago

56.361. Investigating the effect of alpha frequency transcranial alternating current stimulation over the right prefrontal cortex on attentional blink

Sahereh Varastegan, Weiwei Zhang

University of California, Riverside

Dynamic attentional mechanisms that filter and selectively prioritize relevant information for further processing (e.g., retention in working memory) are crucial for goal-directed behavior. However, attention can falter under the strain of Rapid Serial Visual Presentation (RSVP), leading to what is known as the attentional blink. Some recent neuroimaging findings have demonstrated the involvement of top-down attentional control and working memory, particularly alpha neural oscillations within the frontoparietal network, in attentional blink. Specifically, alpha band neural activity in the right frontal areas tends to decline in anticipation of RSVP sequences. In our ongoing experiments, we aim to test how 10 Hz transcranial Alternating Current Stimulation (tACS) over the right dorsolateral prefrontal cortex (DLPFC) affects attentional blink. Participants will receive 20 minutes of 10 Hz tACS stimulation at an intensity of 2mA concurrently with the attentional blink task in the active stimulation condition. Their performance will be compared with the sham stimulation which involves a brief application of transcranial random noise stimulation for 30 seconds, accompanied by a 10-second fade-in/fade-out period. Given previous findings on the relationship between decreased alpha synchronization and heightened attentional blink magnitude, we hypothesize that modulating alpha synchronization through tACS will influence the extent of the attentional blink.

56.362. Investigating curvature selectivity in biologically plausible and deep learning models

Jacob Morra, James Elder

York University

Curvature selectivity is the preferential activation of neurons in the visual system to local contour features. It is known that such selectivity arises in V4 of the non-human primate brain; however, a descriptive model of the neural computations behind this phenomenon has not been presented. Recently proposed

computational and computer vision models have shown promise for their capacities to predict neural responses in the visual system. We look to exploit their recent successes, to test the implicit hypothesis that such models – i.e. ResNet-18 (with and without recurrence), ViT, and Winter et al. 2023 – are “brain-like”, through the lens of optical illusions. We consider a little-known stimulus, the “circle-polygon” illusion: a peripherally-presented switching (at a frequency of 2Hz) between two circles of the same size and eccentricity; the first with an inverse-gradient pattern; the second with a thick black border. We will present each model with the stimulus, and also with circle and polygon silhouettes over a range of positions and scales. We will then evaluate whether stimulus presentation induces the progression of spatial activations towards those of circle-preferring or polygon-preferring neurons. We hypothesize that only recurrent computational models can capture the inhibitory and facilitatory interactions needed for simulating adaptation as a pre-condition for experiencing the illusion. Through this investigation we will learn which features and conditions are important in order to develop a comprehensive model of curvature selectivity in early visual processing (V4) neurons.