VSS2023: Pre-Data-Collection Poster Satellite

[1] Investigating layer-specific responses to mental imagery and perception in ventral occipital temporal cortex

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Mental imagery is known to activate the same category-selective regions in ventral occipitotemporal cortex (VOTC) that respond when visually perceiving people and places – i.e., the fusiform face area (FFA) and parahippocampal place area (PPA), respectively. However, the nature of the “overlap” between mental imagery and perception in these regions is not known. We are in the pilot phase of using a cutting-edge functional MRI (fMRI) method called vascular space occupancy (VASO) to dissociate representations associated with perception (feedforward and feedback information) and mental imagery (feedback information only) across layers in the FFA and PPA. Across several scan runs, participants will see the names of famous faces and places followed by either a picture (perception), or a white frame (mental imagery) during separate task blocks. We will separate the data into even and odd runs and then use one half of the data to localize the FFA and PPA, and the other to investigate the responses across layers within each region. We predict that mental imagery will elicit the strongest responses in the superficial and deep layers of the corresponding category-selective regions that receive feedback signals from higher-order brain regions but not in the middle layers that receive feedforward signals from early visual cortex. In contrast, viewing pictures of famous faces and places will elicit the strongest responses in the middle layers. By dissociating feedforward and feedback information across layers of VOTC, this work will provide a first functional account of the laminar circuitry in high-level visual areas in humans.

[2] Dense longitudinal neuroimaging to evaluate neural mechanisms of early learning

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The first year of formal schooling is an extraordinary period of learning that has consequences for major life outcomes, yet the neural changes that occur throughout this critical year and their relationships to foundational learning are unknown. The aim of the current work is to evaluate brain changes that occur for visual symbol processing with letters and digits by acquiring multiple within-child brain scans throughout the first year of schooling. We propose a practical method for dense longitudinal neuroimaging centered around the following question: How does neural selectivity for visual categories emerge in children during their first year of schooling? To acquire data that reflects the information typically perceived by children and to make existing fMRI procedures more suitable for young children, we are designing a stimulus set composed of still frame images from televised educational programming. These images will be annotated and segmented for several object categories. Throughout

their first grade year, participants will complete 12 functional brain scans while free-viewing images from this stimulus set. Data will be analyzed to estimate functional selectivity for multiple object categories, including letters and digits. Findings have the potential to transform current understanding concerning the time course of early learning and to provide vital information concerning the optimal timing of educational interventions.

[3] Cultural Determinants of Pain Expression: Investigating Cross-Cultural Display Rules

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Effective communication of pain is crucial for human survival, and facial expressions are an important aspect of such communication. However, accurately interpreting others' pain is a challenging task and is often underestimated. The field of visual perception suggests that recognition of objects depends on the overlap between the observer's mental representation and the stimulus. Applied to facial expression of pain, success of such decoding partly relies on the observer's prior knowledge and experiences, as a facial pattern not corresponding to its expectations could disrupt communication. Cultural norms could potentially affect the display of pain expression, with collectivist cultures promoting stoicism and individualistic cultures allowing for a wider range of pain intensities. The present study aims to capture the expectations of participants from diverse cultural backgrounds regarding pain expression. Participants will be presented with various scenarios depicting individuals experiencing different pain levels and be required to evaluate the emotional state of the person depicted (valence, intensity, free labeling). They will also need to select the facial expression that matches their expectations and adjust its intensity accordingly. The degree of discrepancy between their assessment of the emotional state and the intensity of the chosen facial display will serve as a perceptual measure of expressivity norms. By using a cluster approach, we aim to identify natural patterns of display rules and examine whether these match the cultural and contextual differences proposed in the existing literature. By doing so, the study aims to improve our understanding of the cultural determinants of pain expression.

[4] Influence of perceptual grouping on comparison processes in visual working memory

Hanane Ramzaoui, Melissa R. Beck

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[5] ToyWorld: Task-dependent viewing behavior in controlled videos

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[6] The role of visuomotor experience in shaping visual evoked responses to action consequences

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[7] Probing working memory pointers by examining contralateral delay activity with moving and updating stimuli

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A current theoretical idea is that object-based pointers as a critical component of visual working memory (VWM) (Ngiam, 2023). These pointers are similar in conception to FINSTs (Pylyshyn, 1989) and object files (Kahenman et al., 1992) – the featural content has to be bound to its spatiotemporal context to be retained in VWM. Recent research has uncovered multivariate neural signals tracking the number of content-independent pointers (Thyer et al., 2022). Another such signal is the contralateral delay activity (CDA), an event-related potential that increases in amplitude with working memory load. Past research has linked the CDA to the number of object-based pointers (Balaban et al., 2019), but it is currently unclear whether the CDA tracks the number of pointers themselves, or the number of tracked objects. In this study, we hope to examine this by measuring the CDA with dynamic stimuli – those that are updating its location and its content. The number of moving objects will be contrasted with the number of to-be-remembered features (e.g. two moving stimuli that had three shapes). We can then examine whether the CDA tracks the number of attended objects or the amount of to-be-remembered objects. This experiment hopes to better link the CDA to the VWM system, and provide insights on attentional tracking and storage in VWM.

[8] Using non-invasive brain stimulation and transfer tasks to reveal dissociable components of visual perceptual learning

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Visual perceptual learning (VPL), the improvement in a visual task following practice, has long been considered the product of neural plasticity in early sensory regions. However, recent neuroimaging and electrophysiology evidence suggests that VPL can be associated with different types of plasticity, pertaining to characteristics of the stimulus and the task, and observed in sensory and parietal/prefrontal areas, respectively.

With most of this evidence being correlational, the question remains whether these plasticity changes are indeed manifestations of different learning mechanisms.

To answer this question, we plan to use neurostimulation to selectively modulate the activity of cortical regions involved in task- and feature-related plasticity in VPL.

Specifically, we plan to use transcranial random noise stimulation (tRNS), a form of non-invasive brain stimulation that has been successfully used to enhance VPL effects, to selectively boost stimulus- and task-related components by targeting occipital and parietal regions, respectively, while participants perform an orientation discrimination task.

Assessment tasks, measuring transfer of learning to untrained stimuli and tasks, will be used to evaluate the effects of different stimulation regions. Specifically, boosting stimulus-related component through early visual cortex (occipital) stimulation might generalize learning to an untrained task that uses the same stimulus (orientation detection), while boosting task-related component by stimulating higher-level regions (posterior parietal cortex) involved in task processing might generalize learning to untrained stimuli used in the same task (symmetrical dot patterns). Causal evidence of differential involvement of brain regions in different aspects of VPL can help inform and develop more sophisticated models of VPL.

[9] 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 interactions with the people around us. 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 plan to convert dynamic video stimuli of various facial expressions into random dot kinematograms using the underlying optic flow information in the videos. Participants will be shown the kinematogram videos and asked to label the facial expression. In addition, to determine when during the video the expression can be reliably recognized, participants will be shown differing lengths of the kinematogram videos and asked to categorize the expression. The resulting psychometric curves will allow us to determine how much motion information is sufficient for expression recognition. Data obtained from kinematogram videos will be compared to those obtained using the original intact videos. The kinematogram videos will also be used to examine the temporal decoding of facial expressions using magnetoencephalography (MEG). Results from this study will provide insight into whether underlying facial motion cues (in the absence of facial features) are sufficient for us to recognize facial expressions.

[10] Predictive and memory effects of spatial updating

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Updating spatial representations by moving through an environment has been researched for decades, yet it is unclear how predictive processing of space plays a role. While some studies point to view dependent recognition, others have shown that under certain circumstances view independent performance can be produced.

In the current study, we will take advantage of immersive environments to examine whether spatial representations are updated when moving. Participants will view various categories of indoor spaces (e.g., bedroom, kitchen, etc.) built into a 4m x 4m room template with a door on each wall. A hallway enclosing the room will allow transitions between viewpoints while blocking the view of the room when moving.

In a fully crossed factorial design, we will manipulate view change produced by: (1) participants travelling to the next position (i.e., 90°, 180° and 270° from start), and (2) room rotation (forward (+90°), backward (-90°) or expected). For each trial, participant will view the room while completing a spatial task (i.e., indicating which of two spheres is closer), travel down the hallway to the next position and complete the spatial task again.

If the representation is updated with movement, then rotated views (-90° and +90°) would produce slower spatial processing than the expected view. However, if updating facilitates processing regardless of position occupied after movement, then performance should be higher after reversed (-90) than forward (+90°) view rotation. This immersive paradigm allows us to disambiguate predictive processing of expected views from the effects of spatial updating on memory representations.

[11] Role of attention in ensemble based average discrimination of animacy

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[12] Strategies of route discovery in novel environments using local visual features

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