ORAL SESSION: Learning and Memory

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Oral Sessions

Presentations

Rethinking repetition suppression as a metric of learning

When the same stimulus is presented twice, its repetition leads to a reduction of neural activity (Gross et al., 1967). This observation is commonly referred to as repetition suppressions (RS), and provides an important tool to investigate brain representations. Observing RS in a given area is commonly interpreted as that area being sensitive, or 'representing' repeated features of the stimulus. Because of this appealing aspect, RS has been used across many domains to investigate learning-related changes in brain representations, including during motor sequence learning (Wymbs & Grafton, 2015). Here we re-examined the changes in RS across 5 weeks of motor sequence learning in a longitudinal fMRI experiment. We additionally assessed the nature of RS by investigating not only the change in overall activity, but also the changes in the multivariate activity patterns.

Presenter

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Neural correlates of individual differences in story understanding

When multiple people encounter the same story, each person's understanding tends to be different. Previous studies suggest that the process of story understanding may be associated with dynamic reconfiguration of large-scale functional networks [1,2,3]. In this study, we examined regional and whole-brain network neural signatures indicative of individual differences in the process of story understanding.

Presenter

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A Gradient from Long-term Memory to Novel Cognition

Human cognition is flexible, supporting decisions that are novel as well as those that arise from long-term memory. Traditionally, these aspects of cognition are ascribed to dichotomous neural systems supported by default mode (DMN) and multiple-demand (MDN) networks. In reality, however, most situations are neither completely familiar, nor entirely new, highlighting the need to understand how cognition is constrained in a graded fashion. A contemporary account proposes a connectivity gradient along the cortical surface that captures the transition from heteromodal DMN, through MDN regions, to unimodal regions. We asked whether brain responses changed systematically along the connectivity gradient as we parametrically varied the global semantic similarity of items within a feature matching task to create a 'task gradient', from conceptual combinations that were highly overlapping in long-term memory to trials that only shared the goal-relevant feature.

Presenter

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Disuse-driven plasticity is specific to the somatomotor and cingulo-opercular networks

Disuse, i.e., depriving brain circuits of their normal interactions with the external world, is a powerful driver of plasticity (Wiesel and Hubel 1965, Merzenich, Kaas et al. 1983). We previously found that disused circuits show distinct patterns of spontaneous activity. Casting the right upper extremity for two weeks (Fig. 1a) causes loss of normal functional connectivity (FC) between disused somatomotor regions (e.g., left primary somatomotor cortex, left putamen, right motor cerebellum) and the corresponding regions of the opposite hemisphere (Fig. 1b,c). We also observed large, spontaneous pulses of activity propagating through the disused circuit (Fig. 1d). Here we examine changes in spontaneous activity across the whole brain to obtain a comprehensive view of disuse-driven plasticity.

Presenter

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Stress modulates the link between striatal GABA and hippocampal activity during motor learning

Previous research has demonstrated that experimentally-induced stress modulates activity in the hippocampus and the striatum (Schwabe et al., 2012; Wirz et al., 2017), two structures known to be critically involved in the initial learning and subsequent consolidation of movement sequences (Albouy et al., 2015, 2013). These earlier investigations, however, have largely focused on BOLD responses, and no study to date has examined the effects of stress and learning on the levels of striatal and hippocampal gamma-aminobutyric acid (GABA), the primary inhibitory neurotransmitter in the brain. This knowledge gap is surprising given the known role of GABA in neuroplasticity subserving learning and memory (e.g. Boy et al., 2010; Kolasinski et al., 2018; Stagg et al., 2011). The current study thus examined: a) the effects of learning and experimentally-induced stress on striatal and hippocampal GABA levels; and b) how learning- and stress-related modulations of striatal and hippocampal GABA levels relate to learning and memory at the behavioral and neural level using task-based fMRI.

Presenter

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Telling the truth from false memories by restudy: The role of parietal cortex

Restudy could help with differentiating studied material (i.e., true recognition of targets) from unstudied but semantically related material (i.e., false recognition of lures) in the recognition test, because restudy would increase recollective distinctiveness (Gallo, 2006). Recent fMRI studies reported the neural activation and global pattern similarity in the parietal cortex associated with both true and false recognition, but the neural difference between true and false recognition was also reported in the parietal cortex (McDermott et al., 2017; Ye et al., 2016). The current study explored whether restudy would improve recollection by increasing the neural pattern similarity (NPS) for targets, and decreasing the NPS for lures in the parietal cortex at retrieval. Using functional magnetic resonance imaging (fMRI) and multi-voxel pattern analysis, we tested the following hypothesis. As compared with the control condition (C), the restudy condition (RS) would increase true recognition and reduce false recognition, associated with stronger NPS for targets than for lures in the parietal cortex.

Presenter

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