SOBP Computational Psychiatry Satellite 2021

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Online

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Program

8.00 - 9.15	Opening Remarks	
9.15 - 11.00	**Neuronal computation underlying inferential reasoning**	Helen Barron
11.00 - 12.30	Lunch break	
12.30 - 14.30	**Decoding rest: Measuring spontaneous and sequential memory reactivations (replay) in psychiatric disorders**	Matthew Nour
14.30 - 15.00	Coffee break	
15.00 - 17.00	**The recursive mind: implications for memory, mood, and emotional disorders**	Michael Kahana
17.00 - 18.00	Discussion & Closing remarks	

Abstracts

Neuronal computation underlying inferential reasoning

Dr. Helen Barron[1]
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The author declares no conflict of interest.

Every day we make decisions critical for adaptation and survival. We repeat actions with known consequences. But we also draw on loosely related events, to infer and imagine the outcome of entirely novel choices. These inferential decisions are thought to engage a number of brain regions, however the underlying neuronal computation remains unknown. In this talk I will show how a cross-species approach in humans and mice can be used to reveal the functional anatomy and neuronal computation underlying inferential decisions. I will show that during successful inference, the mammalian brain uses a hippocampal prospective code to forecast temporally-structured learned associations. Moreover, during resting behaviour, short-timescale coactivation of hippocampal cells represent inferred relationships in sharp-wave/ripples, thereby “joining-the-dots” between events that have not been observed together but lead to profitable outcomes. Computing mnemonic links in this manner may provide a general mechanism to build a cognitive map that stretches beyond direct experience, thus supporting flexible behavior.

Decoding rest: Measuring spontaneous and sequential memory reactivations (replay) in psychiatric disorders

Dr Matthew M Nour[2]
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The author declares no conflict of interest.

An ability to build structured mental maps of the world underpins our capacity to imagine relationships between objects that go beyond experience. Such an ability, however, also relates to the human capacity to worry about potential futures, and to become preoccupied by beliefs about how other people and entitles might be connected. Neural representations of this sort are supported by sequential memory reactivations in hippocampus during off-task rest periods, known as replay. Findings characterizing the properties of hippocampal memory reactivations have come from landmark studies using invasive neural recordings in behaving animals. However, recent methodological advances in multivariate neural decoding now permit detection of specific representational content and temporal structure in spontaneous neural reactivations in humans, using magnetoencephalography (MEG) and electroencephalography (EEG). This enables investigators to establish a link between off-task (resting) neural activity and on-task cognition. Given the wealth of functional neuroimaging evidence suggesting abnormal 'resting state' abnormalities in common psychiatric disorders, and the relative paucity of theoretical accounts linking such abnormalities to symptom generation, this approach may potentially yield much-needed insights into the neural mechanisms underlying common psychiatric disorders.

In this session I will present a technical overview of the current state-of-the art methodological approaches to investigating temporal structure in spontaneous offline memory reactivations in humans, using M/EEG. I will also present results from the first application of this methodology in a clinical sample comprising patients with a diagnosis of schizophrenia. Schizophrenia is proposed to reflect a compromise in structured mental representations, and animal models report abnormal replay. I will discuss a new in which we tasked patients and control participants to infer unobserved relationships between objects by reorganizing visual experiences containing these objects, during MEG. During a post-task rest session, controls exhibited spontaneous neural reactivation of presented objects that replayed inferred relationships. Replay was coincident with increased ripple power in hippocampus. Patients showed reduced replay and augmented ripple power relative to controls, convergent with animal models. These abnormalities were linked to impairments in behavioral acquisition and neural representation of task structure. The findings support an hypothesis that a replay deficit in schizophrenia might contribute to an impoverished cognitive map of the environment, and highlight the potential power of multivariate decoding approaches to understanding off-line neural computation in psychiatry.

The recursive mind: implications for memory, mood, and emotional disorders

Prof. Michael Kahana[1],
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The author declares no conflict of interest.

I will present a tutorial review of computational models of human memory, including similarity-based models, associative models, and context-based generalizations of these classic models. I will then discuss retrieved context theories of episodic memory and the notion of recursion. The recursive nature of these models provides a mechanism whereby thoughts become memories, and memories guide thoughts. By incorporating emotional features into memories, recursion provides a basis for understanding persistent mood states and their dependence on experience. In the second half of my tutorial I will show how such models can account for findings regarding persistent negative mood after chronic stressors, intrusive memories of painful events, and the efficacy of cognitive-behavioral therapies.