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Doctoral Dissertation Defense

Abstract

The Role of the Prefrontal-Hippocampal Circuit in the Memory for Sequences of Events

by

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Our capacity to establish unique episodic memories rests largely on our ability to recall sequences of events. While different experiences might be comprised of the same objects (e.g., colleagues and a Zoom screen) and settings (e.g., the home or office), the unique temporal components of these experiences is what allows us to differentiate events in sequences. That is to say, memory critically includes information about “when” an event occurred, in addition to the “what” and “where”. Sequence memory provides a representation of the order of events as they occur within an experience and underlies our ability to “play-back” those experiences. However, the neurobiological underpinnings of the temporal organization of memory and behavior remains poorly understood. The focus of this dissertation is to understand the neurobiological role of the mPFC-HC circuit in sequence memory by using chemogenetics, electrophysiology, and optogenetics. In Chapter 1, I begin by reviewing the literature of the neurobiology of time in memory focusing on sequences of events. This chapter elaborates on candidate temporally-structured neural events that could underlie our ability to encode temporal content as well as some basic systems architecture for time in memory. In Chapter 2, I test the role of sex and estrous cycle in learning and overall performance on a new version of the cross-species validated sequence memory task using two odor sequences. Sex and estrous cycle were not major factors during training and testing stages of the sequence memory task. In Chapter 3, to further my investigations of the neurobiology of sequence memory I develop a novel 3D-printable stereotaxic device for rats called the RatHat. The RatHat provides more accuracy and reliability then traditional stereotaxic surgeries allowing for multisite implants critical to studying sequence memory. In Chapter 4, I explore the causal roles of mPFC projections to RE and PER using DREADDs (AAV-hM4Di) in sequence memory. I provide evidence showing that suppressing synaptic activity in the mPFC→RE or mPFC→PER pathway abolishes sequence memory demonstrating their critical roles, and that these pathways regulate ongoing retrieval strategies. In Chapter 5, I examine the neural correlates (single-units, ensembles, and local field potentials) of sequence memory in mPFC, RE and HC. I found that RE neurons send monosynaptic projections to CA1 triggering mPFC-HC interactions in the beta band enabling network states conducive to successful sequence memory. Overall, this dissertation for the first time delivers a detailed understanding of the functional circuitry of mPFC-HC in the memory for sequences of events. It aims to aid in future investigations into mechanisms of temporal dysfunction in mental health disorders such as schizophrenia, ADHD, and/or Alzheimer's’s disease.

Date: July 11, 2022
Time: 10AM – 12PM
Place: AHC3-110
Department: Psychology, Cognitive Neuroscience
Major Professor: Dr. Timothy A. Allen

Zoom: https://fiu.zoom.us/j/4586654991?pwd=QXJoZVNUUTVaRjgyWUhVczJ5SVRaQT09
Meeting ID: 458 665 4991
Passcode: MJDefense1