SFB 1315
Mechanisms and Disturbances in Memory Consolidation:
From synapses to systems

Tuesday

APR 13, 2021
4:00 pm CET

ZOOM ID: 7754910236
Register at:
SFB1315.ifb@hu-berlin.de

SFB 1315 LECTURE SERIES 2019-2022

NEURAL CIRCUITS AND NEUROPHYSIOLOGY FOR LEARNING AND MEMORY

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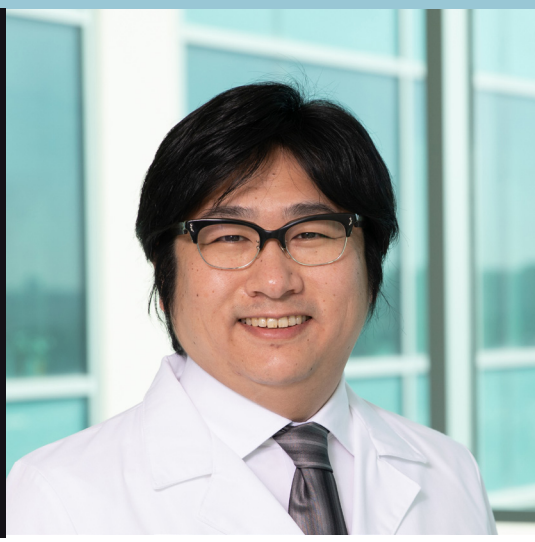

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In humans and animals, episodic memory requires the concerted association of objects, space and time coordinated by the entorhinal cortex (EC)-hippocampal (HPC) network. It remains unknown how the EC-HPC network spatially and temporally associates the diverse set of information (where, what, when and who) in a single episode. Using advanced mouse genetics combined with viral tracing, in vitro and in vivo electrophysiology, in vivo calcium imaging and optogenetics, I search specific neuronal circuits for encoding each components (where, what, when and who) of episodic memory.

In my talk, first, I present neural circuits mechanisms for the association of temporally discontinuous events by mapping and characterizing an unsuspected neuronal circuit within the EC-HPC network. It has been believed that episodic memories initially require rapid synaptic plasticity within the hippocampus for their formation and are gradually consolidated in neocortical networks for permanent storage. However, the neural circuits that support neocortical memory consolidation have thus far been unknown.

As second topic, I present that neocortical prefrontal memory engram cells, which are critical for remote contextual fear memory, were rapidly generated during initial learning through the input from the deep layer of entorhinal cortex. After their generation, the prefrontal engram cells, with support from hippocampal memory engram cells, became functionally mature with time. These experimental evidences provide new insights into the functional reorganization of neural circuits underlying systems consolidation of episodic memory. An empathic ability to vicariously experience the other's fearful situation, a process called observational fear (OF), is critical to survive in nature and function in society. OF can be facilitated by both prior similar fear experience in the observer and social familiarity with the demonstrator. However, the neural circuit mechanisms of the experience-dependent OF (Exp OF) have so far been unknown.

As my third topic, I present that hippocampal-basolateral amygdala (HPC-BLA) circuits, without involving anterior cingulate cortex, which is considered as a center of OF, mediate Exp OF. Dorsal HPC neurons generate the fear memory engram cells in BLA encoding prior similar fear experience, which are essential for Exp OF. On the other hand, ventral HPC neurons send information about observing the fearful experience in the familiar demonstrator to reactivate BLA fear engram cells for Exp OF. Our study provides neural mechanisms underlying memory-dependent perception-action coupling for Exp OF.

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