Patterned Stimulation of Dorsal Mossy Cells Stabilizes Fear Memory

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The hippocampus is one of the critical brain regions for learning and memory. The dentate gyrus (DG), the first relay station of the hippocampus, receives multimodal sensory inputs from cortical areas and participates in pattern separation and contextual fear memory. The DG is composed of two types of glutamatergic neurons, the granule cells (GCs) and the hilar mossy cells (MCs), as well as several types of GABAergic interneurons (INs). The axons of MCs project to both local and distant lamellae of the DG, and differentially modulate GC and IN activity in the local and distant DG. Activation of ventral MCs primarily excites GCs in the dorsal DG via longitudinal axonal projections whereas excitation of MC commissural (COM) projections preferentially recruits INs, thereby suppressing GC activity via feedforward inhibition.

Long-term potentiation (LTP) is a synaptic substrate underlying learning and memory. Repetitive stimulation of MC axons induces LTP at MC-to-GC synapse via increasing excitation/inhibition balance in GCs, thereby enhancing GC output. Preliminary data from our lab showed that the patterned stimulation of MC COM projections augment the recall of contextual fear memory.