Life Sciences Seminar

Optogenetic analysis of amygdala-prefrontal connections in learning

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The basolateral amygdala (BLA) and the medial prefrontal cortex (mPFC) are play key roles in coordinating the acquisition and extinction of learned fear associations. Strong reciprocal monosynaptic excitatory connections link these two regions, forming a recurrent synaptic circuit that is thought to carry important information regarding salient sensory cues during learning. Whereas mPFC input to BLA was shown to play a major role in fear extinction, the reciprocal pathway has received less attention. To address the role of this pathway in fear learning, we examined the utility of inhibitory optogenetic tools for silencing synaptic terminals. Surprisingly, we found that while proton-pumping microbial rhodopsins are effective in silencing evoked release, they induce a paradoxical increase in spontaneous neurotransmission under minutes-long light stimulation. Furthermore, experiments utilizing chloride-conducting channelrhodopsins showed that the reversal potential for chloride in the axon is depolarized relative to the resting membrane potential, leading to excitation upon light activation of these optogenetic tools in the axonal compartment. We therefore devised an optogenetic stimulation protocol that triggers long-term synaptic depression in BLA axonal terminals onto mPFC cells. In behaving mice, synaptic depression of BLA inputs to the mPFC impaired the consolidation of cued, but not contextual associations. Induction of synaptic depression in this pathway during extinction training led to suppression of neuronal responses to fear-associated cues in mPFC units, and facilitated extinction learning. Our findings demonstrate the pivotal role of the monosynaptic BLA input to the mPFC in the consolidation and extinction of cued fear memories.

Friday, May 19, 2017 11:00am - 12:00pm
Mondi Seminar Room 2, Central Building

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