

Brain substrates for socially-induced complex associative learning

In social species such as mice, social defeat is an ethologically relevant experience that shapes behavior. Beyond eliciting immediate defensive responses, defeat can act as a reinforcer, enabling associations between environmental cues and the context in which it occurs. While neural circuits responding to social defeat are well characterized, how social valence is transferred to associative learning relevant brain areas such as the dorsal hippocampus (dHPC) and basolateral amygdala (BLA) remains unclear.

Here, we investigate whether social defeat can drive not only direct associative learning but also mediated learning. We developed a sensory preconditioning paradigm in which two neutral stimuli (light and tone) are first paired, and the light is subsequently associated with social defeat. Direct and mediated learning are then assessed in a different context. Using automated behavioral analysis (DeepLabCut and Keypoint MoSeq), we show that mice form both direct and indirect associations, demonstrating that social defeat can induce complex associative learning.

Furthermore, we performed fiber photometry recordings across brain regions involved in social behavior and complex associative learning, including orbitofrontal cortex, hippocampus, and basolateral amygdala. Preliminary results reveal widespread increases in excitatory activity and enhanced correlated responses during both forms of learning, in line with our behavioral results.

Future work will examine brain-wide activity patterns for the expression of direct and mediated learning and cell-type-specific contributions to these processes in the hippocampus. Together, our findings establish a novel framework for studying socially induced higher-order learning and will provide insight into how social experiences shape associative brain circuits.