

A neural mechanism for deprivation state-specific expression of relevant memories in *Drosophila*

Motivational states modulate how animals value sensory stimuli and engage in goal-directed behaviors. The motivational states of thirst and hunger are represented in the brain by shared and unique neuromodulatory systems. However, it is unclear how such systems interact to coordinate expression of appropriate state-specific behavior. We show that the activity of two brain neurons expressing leucokinin (LK) neuropeptide is elevated in thirsty and hungry flies, and that LK release is necessary for state-dependent expression of water and sugar-seeking memories. LK inhibits two types of mushroom body (MB)-innervating dopaminergic neurons (DANs) to promote thirst-specific water-memory expression, whereas it activates other MB-innervating DANs to facilitate hunger-dependent sugar-memory expression. Selection of hunger- or thirst-appropriate memory emerges from competition between LK and other neuromodulatory hunger signals at the level of the DANs. Therefore, coordinated modulation of the dopaminergic system allows flies to prioritize the expression of the relevant state-dependent motivated behavior.