Research

Research Overview

Nervous systems transform sensory signals and internal states into actions. Learning is a process by which this transformation is altered, producing different actions from the same stimulus. We study learning using the Drosophila model system. Flies can be trained to avoid an odor by pairing its presentation with electric shocks. This aversive memory is stored in a brain structure called the mushroom body that comprises roughly 2500 neurons per hemisphere. Olfactory signals arrive at the mushroom body neurons and cause a small fraction to fire action potentials. Pain signaling is thought to arrive via dopamine action on receptors linked to a calcium-stimulated adenylate cyclase. Elevated calcium resulting from action potentials coinciding with dopamine receptor activity are hypothesized to synergistically raise cyclic AMP levels. Cyclic AMP then mediates a range of synaptic plasticity responses that alter the fly's response to that odor.

We showed that aversive inputs in the mushroom body are mediated by dopaminergic cells in a single posterior cluster, projecting to restricted domains in the mushroom body. Our novel single-fly behavioral assay reveals differences between Pavlovian and operant conditioning. As there is no molecular framework for how action-contingency could influence learning, we are commencing a screen to find new genes and neurons that are involved in one process but not the other.

We can accept students through several programs, including the *Duke_NUS doctoral program and a variety of programs offered by the A*STAR Graduate Academy.*

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