

042C

Using light as an unconditioned stimulus to investigate associative learning by the pharynx in *C. elegans*

Eugene L.Q. Lee, Bob Horvitz

HHMI, Dept. Biology, MIT, Cambridge, MA 02139 USA

keyword: Learning, Pharynx, Behavior, Circuit

Although many molecular components and neural-circuit processes involved in learning and memory have been identified, there is still little understanding of how cellular changes occur with precise temporal and spatial resolution. Previous studies of associative learning in *C. elegans* have paired stimuli such as odors, temperature and food. However, the timing of presentation and removal of these stimuli is difficult to control precisely, and the learning process occurs over relatively ill-defined and long time periods. The complete neural circuits over which learning occurs through these stimuli are also broad and may span many neurons.

Previous studies in our laboratory have described neural circuits in the pharynx that control how *C. elegans* inhibits pharyngeal pumping and initiates spitting in response to noxious stimuli such as ultraviolet light (UV) or hydrogen peroxide. This behavior is robust and tightly time-locked to the presentation of the light stimulus. The temporal precision of a light stimulus also allows the analysis of learning processes over shorter timescales. Furthermore, the pharyngeal nervous system is a simple and defined local circuit. This simplicity greatly facilitates analyses to uncover the circuitry behind learning and memory formation at the level of single cells and small networks.

We are currently performing classical conditioning of *C. elegans* by pairing light (as the unconditioned stimulus) with various chemicals neutral to worms and scoring pharyngeal pumps and spits as the readout for learning. We have replicated the light-responsive behavior in a microfluidic chip that allows the imaging of neural responses with simultaneous and precise delivery of light and chemical stimuli to the worm.

By pairing UV and other stimuli in an associative learning paradigm, we hope be able to investigate the temporal and spatial dynamics of learning as it happens in real-time in vivo.