Worm Meeting: Neuronal development, synaptic function, and behavior.

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Light induces a pharyngeal gag reflex by *C. elegans*

Steve Sando, Nikhil Bhatla, and Bob Horvitz.

Despite lacking the photoreceptor molecules identified in other organisms, *C. elegans* avoids violet and ultraviolet light (Edwards *et al.*, 2008, PLoS Biol., 6:e198) (Ward *et al.*, 2008, Nature Neurosci. 11:916), suggesting a previously uncharacterized mode of light detection might be present in the worm. This avoidance behavior depends on the gustatory receptor homolog *lite-1*, but the molecular mechanism of light-detection is unknown.

Previous work in our laboratory has shown that the pharynx of *C. elegans* also responds to light (Bhatla and Horvitz, 19th International *C. elegans* Meeting, 2013). When exposed to bright light, worms rapidly inhibit pumping via the pharyngeal neurons I1 and I2 and the gustatory receptor homologs *lite-1* and *gur-3*. Bhatla and Horvitz suggested that light acts via generation of an oxidant, perhaps the reactive oxygen species (ROS) hydrogen peroxide. This mechanism of light-detection would be novel.

We have observed that during light exposure worms emit bubbles from their mouths, as if reversing pharyngeal flow during a gag reflex. Bubbling occurs several seconds after pumping inhibition, during a transient burst of pumps dependent on the M1 neuron (burst pumping). Using high frame-rate videos, we observed the light-response of worms eating mineral oil. Light reversed the flow of oil in the pharynx, causing spitting. We identified a difference between feeding and burst pumping that might lead to spitting: during feeding, which is comprised of rhythmic contractions of pharyngeal muscle that draw food inwards, the anterior-most region of pharyngeal muscle 3 (pm3) relaxes before the rest of the procorpus, closing the anterior end of the pharynx and trapping food (Fang-Yen *et al.*, 2009, PNAS, 106: 20093); however, during burst pumping the anterior-most region of pm3 remains contracted. This contraction holds the anterior end of the pharynx open, permitting expulsion of material when the corpus relaxes. In some circumstances, light induces vomiting of intestinal contents.

We are interested in the cellular mechanisms of the pharyngeal light-response and the molecular mechanism of light-detection. We are pursuing this problem using behavioral and genetic analyses, neuronal ablations, and heterologous expression of *lite-1* and *gur-3* in *Xenopus* oocytes. Studying the pharyngeal light-response might reveal ways the neuromuscular system encodes behavior and also identify molecular pathways for the detection of ROS, physiologically important molecules implicated in many aspects of biology and disease.