Title: Circuit mechanisms of action selection and motor coordination in *Drosophila* larvae

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Abstract

Animals adaptively respond to a sensory stimulus by choosing an ethologically relevant behavior and subsequently activating a number of muscles in a highly coordinated manner. We use *Drosophila* larvae as a model to study the neural circuitry underlying action selection and motor coordination. In this system, systematically identified sparse GAL4 lines enable researchers to apply functional and physiological analyses to single classes of interneurons. Furthermore, recently developed electron microscopy (EM) reconstruction platforms enable one to map neural connections that provide basic principles of a given behavior. In this talk, I will present our recent findings including the following.

1. Circuits driving forward versus backward locomotion in response to a tactile stimulus  
Larvae escape by backward locomotion when touched on the head, while they crawl forward when touched on the tail. We identified a class of segmentally repeated second-order somatosensory interneurons, whose activation in anterior and posterior segments elicit backward and forward locomotion, respectively. Our results show that homologous command-like interneurons induce distinct escape behaviors by matching their receptive field to appropriate motor programs via segment-specific circuits.

2. Network modules mediating coordinated propagation of motor activity  
Larval locomotion consists of rhythmic waves of muscular contraction that propagate along the body segments. We identified two network modules regulating the propagation of motor activity along neighboring segments, both of which consist of inhibitory and excitatory segmental interneurons coupled via an intersegmental synaptic connection. One module sends signals in a feedforward manner to the next segment and inhibits its premature motor activation. The other module sends signals in a feedback manner to the previous segment and inhibits its motor activity.