EXCITATORY AND INHIBITORY PATHWAYS WITH DIFFERING DYNAMICS IN *DROSOPHILA* OLFACTORY RECEPTORS

French, Andrew S., Schuckel, Julia*, Torkkeli, Paivi H.

Olfactory receptor dynamics can provide important clues about mechanisms of sensory transduction, about the range of olfactory information that is transmitted to the central nervous system, and about the roles of olfaction in behavior. The *Drosophila melanogaster* olfactory system provides a useful model for studying olfactory mechanisms because of its wide repertoire of experimental tools, including genetics, behavior and electrophysiology.

Characterizing the dynamic properties of sensory receptors requires control and measurement of the stimulus over a frequency bandwidth that equals or exceeds the receptor response. We used random binary on-off sequences to deliver fluctuating concentrations of odorant chemicals to *Drosophila* antennae, while recording from single olfactory sensilla using tungsten electrodes. Odorant chemicals (15 µl at 1-10% in mineral oil) were evaporated from filter paper into a primary air stream containing propylene as a tracer gas. This stream was released by a flow valve into a secondary air stream that diluted both odorant and tracer by a factor of about ten, while delivering laminar air flow to the antenna at flow rates of 40-50 ml/s and velocities of 1-1.5 m/s. Propylene tracer concentration was measured by a miniature photoionization detector with its probe located within 2 mm of the antenna, providing a surrogate measure of odorant concentration at the antenna. Reliable frequency response functions were obtained between odorant concentrations and single unit action potentials recorded from large basiconic sensilla on the third antennal segment.

Frequency response functions for a group of six odorants fell clearly into two groups, with opposite response polarities and different dynamics. Compounds causing increased action potential firing (positive odorants) with increased concentration had band-pass responses, while compounds with the opposite effect (negative odorants) had low-pass responses. Inhibitory olfactory responses in *Drosophila* have been reported before, but not well characterized because they are not easily detected with simple puff application systems. Preliminary experiments with mixtures of odorants indicate suppression of positive responses by negative odorants, suggesting at least two signaling pathways that interact before transduction to receptor current. Possible models of olfactory transduction are discussed.