LINEAR AND NONLINEAR ANALYSIS OF ANTENNAL RESPONSES TO TURBULENT PHEROMONE PLUMES IN TWO MOTH SPECIES

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In addition to molecular specificity, olfactory systems may detect the dynamic properties of odor signals as their concentrations change with time. However, the dynamic properties of olfactory systems in general are poorly understood. Dynamic properties of pheromone plumes are known to be behaviorally important in some moths for inducing upwind flight, but little is known about the time dependent properties of odor transduction or the mechanisms that limit receptor dynamic sensitivity. Moth antennae have numerous sensilla for the detection of air-borne odorants, including host plant odorants and sex pheromones. Sensillar morphologies are complex, but antennal sensilla of male moths that detect female pheromones usually contain 1-3 sensory neurons, with each neuron being highly sensitive and specific to a single pheromone component.

We stimulated male antennae of two moth species, *Cadra cautella* and *Spodoptera exigua*, with pheromone plumes in a wind tunnel while recording electroantennograms (EAG) and the concentration of a surrogate plume (propylene, which mimics a pheromone plume) using a photoionization detector (PID). To stimulate the antennae with odor signals having broad temporal bandwidth, we produced turbulent pheromone plumes by inserting mechanical baffles into the wind tunnel. Frequency response functions and coherence functions between PID and EAG signals were used to measure the dynamic responses of the two species to pheromone blends and to individual pheromone components.

A single time constant filter function fitted the responses of both species, but *S. exigua* was about three times faster than *C. cautella*. Responses to individual pheromone components were significantly different in *S. exigua* but not in *C. cautella*. We also fitted the data with a simple block-structured nonlinear cascade. This supported the simple filter model but also suggested that the response saturates at an early stage of chemotransduction.

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