

ORAL PRESENTATION

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# Multiple roles of inhibition in the olfactory system

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Olfactory stimuli are vast in number and defy simple description. In contrast to light or sound, no low dimensional basis suffices to represent chemical stimuli. And yet, the olfactory system maps the complex and high-dimensional world of chemical stimuli into unique and reproducible ensembles of neuronal activity. This mapping includes multilevel processing and involves complex strategies for information encoding. In the insect, olfactory receptor neurons (ORNs) synapse onto a smaller group of excitatory projection neurons (PNs) and inhibitory local neurons (LNs) in the antennal lobe (AL). The odor information is then transferred to the mushroom body (MB), a structure analogous to the olfactory cortex and where olfactory memories are formed. Inhibitory circuits of the AL and the MB shape the odor representation as it progresses through the olfactory system.

Drawing on results obtained with biophysical network models, I will discuss the role played by feedback and feedforward inhibition in shaping odor-driven responses of olfactory neurons. Using model of the locust olfactory system we described the role of the fast feedback GABA<sub>A</sub>-type inhibition in generating odor triggered AL oscillations. Our study suggested that the transient nature of PN synchronization could be explained by variations in inhibitory drive from inhibitory LNs to specific groups of PNs over the duration of the odor-elicited response and we established a relationship between an important structural property of an inhibitory AL network, its colorings, and the dynamics it constrains. We showed that our description allows the explicit identification of the groups of inhibitory interneurons in the insect AL that switch, during odor stimulation, between activity and quiescence to provide transiently synchronized response of the PNs. This description optimally matches the perspective of the downstream KCs looking for

synchrony in ensembles of pre-synaptic cells. We further found that feedback inhibition provided by the giant GABAergic neuron (GGN) is sufficient to maintain sparse but varied excitation in the KCs across range of odor concentrations. Our study revealed how multiple forms of synaptic inhibition differentially contribute to process information in the olfactory system.

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