Abstract View

# EFFECTS OF A SYNAPTIC LEARNING RULE ON THE SPARSENESS OF ODOR REPRESENTATIONS IN A MODEL OF THE LOCUST OLFACTORY SYSTEM.

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Recordings from the mushroom body demonstrate high specificity in Kenyon cell (KC) responses during odor processing. We explored the possibility that a form of plasticity may control and tune synaptic weights to the mushroom body to provide specificity of KCs' responses to familiar or meaningful odors. To test our hypothesis, we compared two potential mechanisms: (1) spike-rate dependent plasticity (SRDP) learning mechanism; and (2) spike-timing dependent plasticity (STDP), both in a network model that included a one-dimensional layer of simplified KCs each receiving N partially overlapping inputs with realistic spike trains. The input to the KCs was characterized by slow temporal patterns and transient synchronization between spike trains in different afferents, as observed experimentally. In the model, mechanisms 1 and 2 yielded similar patterns of spiking in KCs, which usually included a small proportion of 'odor-specific' neurons, independent of the initial (pre-training) synaptic weights to the KCs. However, at high initial weights greater specificity was attained in the network with the STDP-based learning rule. When the networks were trained by a set of multiple odors, the STDP network responded to any single odor from the set with firing patterns that were highly similar to those in the network trained by this odor alone. The SRDP network could reproduce this behavior only partially. The finding indicates that STDP preserves the network's ability to respond with different patterns for different odors from a training set. The study suggests a possible role for synaptic plasticity in enabling efficient decoding of afferent temporal patterns and in favoring sparsening of odor representations, as observed in the locust mushroom body.

Citation:
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