Modeling behavior in different delay match to sample tasks in one simple network.

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Amit, Y, Yakovlev V, Hochstein S. 2013.

Abstract:

Delay match to sample (DMS) experiments provide an important link between the theory of recurrent network models and behavior and neural recordings. We define a simple recurrent network of binary neurons with stochastic neural dynamics and Hebbian synaptic learning. Most DMS experiments involve heavily learned images, and in this setting we propose a readout mechanism for match occurrence based on a smaller increment in overall network activity when the matched pattern is already in working memory, and a reset mechanism to clear memory from stimuli of previous trials using random network activity. Simulations show that this model accounts for a wide range of variations on the original DMS tasks, including ABBA tasks with distractors, and more general repetition detection tasks with both learned and novel images. The differences in network settings required for different tasks derive from easily defined changes in the levels of noise and inhibition. The same models can also explain experiments involving repetition detection with novel images, although in this case the readout mechanism for match is based on higher overall network activity. The models give rise to interesting predictions that may be tested in neural recordings.

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