Adapting to a changing world.

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The relevance of synchrony in neural computation can be explored by investigating which classes of computation can, in principle, be readily achieved through the development of synchrony. For instance, in a series of papers, Hopfield and Brody have explored\cite{1} a model network for olfaction using a biologically realistic architecture, where integrate-and-fire neurons with similar sensory stimuli synchronize their spike times, thereby achieving the recognition of a single, static olfactory pattern – odor. In their many are equal paradigm, the development of synchrony in a particular subset of neurons is readily identified by the spiking of higher level (‘cortical’) neurons.

We extend their approach to achieve odor separation\cite{2} – the ability to detect the simultaneous presence of multiple odors, with different odor sources, and which therefore have different intensity fluctuations in time. We incorporate a simple model of adaptation that allows the network to be sensitive to components in the stimuli that change together, rather than the overall static characteristics of the stimuli. The collective response binds objects in the stimuli in terms of their common variation.

The interplay between cohering and decohering effects allows for rich dynamic responses that include reliable transient synchronous firing patterns that are readily detected by higher level cortical model neurons. The success of this algorithm for dynamic pattern recognition suggests that understanding the regulation of adaptation may be very important for processing dynamic stimuli.

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References