Bocconi

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Bocconi University
Room COMMON ROOM
Via Röntgen 1, Milano (2° floor)

A Network Mechanism for Perceptual Learning

Speaker

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Abstract

Organisms continually tune their perceptual systems to the features they encounter in their environment. We have studied how this experience reorganizes the synaptic connectivity of neurons in the olfactory (piriform) cortex of the mouse. We developed an approach to measure synaptic connectivity in vivo, training a deep convolutional network to reliably identify monosynaptic connections from the spike-time cross-correlograms of 4.4 million single-unit pairs. This revealed that excitatory piriform neurons that respond similarly to each other are more likely to be connected. We asked whether this like-to-like connectivity was modified by experience but found no effect. Instead, we found a pronounced effect of experience on the connectivity of inhibitory interneurons. Following repeated encounters with a set of odorants, inhibitory neurons that responded differentially to these stimuli both received and formed a high degree of synaptic connections with the cortical network. The experience-dependent organization of inhibitory neuron connectivity was independent of the tuning of either their pre- or their postsynaptic partners. These results suggest the existence of a cell-intrinsic, non-Hebbian plasticity mechanism that depends only on the odor tuning of the inhibitory interneuron. A computational model of this network reorganization predicts that it increases the dimensionality of the entire network's responses to familiar stimuli, thereby enhancing their discriminability. We confirmed that this network-level property is present in physiological measurements, which showed increased dimensionality and separability of the evoked responses to familiar versus novel odorants. Thus a cell-intrinsic plasticity mechanism acting on inhibitory interneurons may implement a key component of perceptual learning: enhancing an organism's discrimination of the features particular to its environment.

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