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Neural coding: A single neuron's perspective

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Abstract (169/170)

What any sensory neuron knows about the world is one of the cardinal questions in Neuroscience. Information from the sensory periphery travels across synaptically coupled neurons as each neuron encodes information by varying the rate and timing of its action potentials (spikes). Spatiotemporally correlated changes in this spiking regimen across neuronal populations are the neural basis of sensory representations. In the somatosensory cortex, however, spiking of individual (or pairs of) cortical neurons is only minimally informative about the world. Recent studies showed that one solution neurons implement to counteract this information loss is adapting their rate of information transfer to the ongoing synaptic activity by changing the membrane potential at which spike is generated. Here we first introduce the principles of information flow from the sensory periphery to the primary sensory cortex in a model sensory (whisker) system, and subsequently discuss how the adaptive spike threshold gates the intracellular information transfer from the somatic post-synaptic potential to action potentials, controlling the information content of communication across somatosensory cortical neurons.

Keywords (3-12 max)

Information processing; Action potentials; Somatosensory cortex; Whiskers; Neuronal representations; Spike threshold; Intracellular information transfer;

Highlights (<5 max; 85 characters/each)

1. Neurons communicate information in rate and timing of action potentials (spikes)
2. In sensory systems, information content depends on the distance from the periphery
3. At the network level, inhibition powerfully shapes the information content
4. In single neurons the spike threshold controls intracellular information transfer
5. The spike threshold is not constant, it adapts to the rate of incoming synaptic input