

Neural coding in the primary olfactory cortex

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The primary olfactory (piriform) cortex is a phylogenetically-ancient three-layered structure that is the first cortical destination of olfactory information. The comparatively simple architecture of the piriform cortex (PC) suggests that it may be a valuable model system for the study of cortical sensory processing. In order to better understand the physiological basis of neural coding in the PC, we have begun by exploring the electrical properties of its component neurons. We have focused on two main classes of neurons in the PC: (i) the densely-packed principal neurons in Layer II that receive direct synaptic input from the olfactory bulb; and (ii) GABAergic interneurons. Mice were anaesthetised with 2% isoflurane in O₂ prior to decapitation and preparation of PC slices. Our experiments showed that Layer II principal cells comprise two functionally distinctive types, superficial pyramidal (SP) cells and semilunar (SL) cells. SP cells fire bursts of action potentials and receive strongly-facilitating synaptic inputs from the olfactory bulb. SL cells fire regular trains of action potentials and receive non-facilitating inputs from the bulb. These properties cause SP and SL cells to respond in characteristic ways to 'naturalistic' trains of afferent stimulation, modelled on *in vivo* recordings. Together, SP and SL cells had the effect of dispersing the firing rate and latency of output action potentials to an extent that depended on the strength of the input. In a second series of experiments, we have found that the PC contains at least five classes of GABAergic interneurons that can be distinguished on the basis of their morphology, firing properties, synaptic connections, and the presence of gap junctions. The neuronal heterogeneity we have identified in the piriform cortex is likely to underlie coding strategies used for the representation of odours.