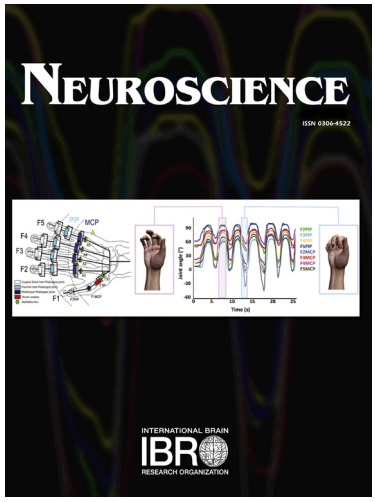

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Organization of sensory feature selectivity in the whisker system

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Abstract

Our sensory receptors are faced with an onslaught of different environmental inputs. Each sensory event or encounter with an object involves a distinct combination of physical energy sources impinging upon receptors. In the rodent whisker system, each primary afferent neuron located in the trigeminal ganglion innervates and responds to a single whisker and encodes a distinct set of physical stimulus properties – features – corresponding to changes in whisker angle and shape and the consequent forces acting on the whisker follicle. Here we review the nature of the features encoded by successive stages of processing along the whisker pathway. At each stage different neurons respond to distinct features, such that the population as a whole represents diverse properties. Different neuronal types also have distinct feature selectivity. Thus, neurons at the same stage of processing and responding to the same whisker nevertheless play different roles in representing objects contacted by the whisker. This diversity, combined with the precise timing and high reliability of responses, enables populations at each stage to represent a wide range of stimuli. Cortical neurons respond to more complex stimulus properties – such as correlated motion across whiskers – than those at early subcortical stages. Temporal integration along the pathway is comparatively weak: neurons up to barrel cortex are sensitive mainly to fast (tens of milliseconds) fluctuations in whisker motion. The topographic organization of whisker sensitivity is paralleled by systematic organization of neuronal selectivity to certain other physical features, but selectivity to touch and to dynamic stimulus properties is distributed in "salt-and-pepper" fashion.

Keywords

Vibrissa; coding; receptive field; information; somatotopy; map