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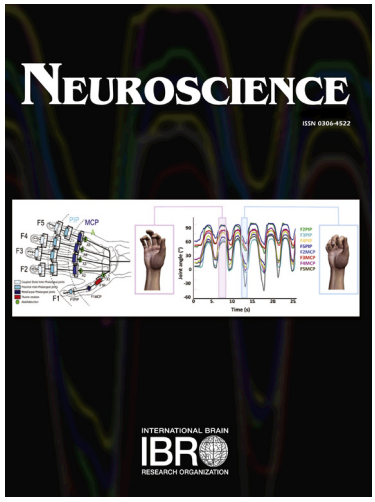

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Organization of orientation-specific whisker deflection responses in layer 2/3 of mouse somatosensory cortex

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Abstract

The rodent whisker-barrel system is characterized by its patterned somatotopic mapping between the sensory periphery and multiple regions of the brain. While somatotopy in the whisker system is established, we know far less about how preferences for stimulus orientation or other features are organized. Mouse somatosensation is an increasingly popular model for circuit-based dissection of perceptual decision making and learning, yet our understanding of how stimulus feature representations are organized in the cortex is incomplete. Here, we used in vivo two-photon calcium imaging to monitor activity of populations of layer (L) 2/3 neurons in the mouse primary somatosensory cortex during deflections of a single whisker in two orthogonal orientations (azimuthal or elevational). We split the population response to whisker deflections into an orientation-specific component and a non-specific component that reflected overall excitability in response to deflection of a single whisker. Orientation-specific responses were organized in a locally heterogeneous and spatially distributed manner. Correlations in the stimulus independent trial-to-trial variability of pairs of neurons were higher among neurons that preferred the same orientation. These correlations depended on similarity in both orientation-specific and non-specific components of responses to single whisker deflections. Our results shed light on L2/3 organization in mouse somatosensory cortex, and lay a foundation for dissecting circuit mechanisms of perceptual learning and decision-making during orientation discrimination tasks.

Keywords: rodent whisker system; neural coding; barrel cortex; orientation tuning; two-photon calcium imaging; noise correlation.