Spatiotemporal interactions influence precision of coding by single- and multiple neurons in the rat barrel cortex

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Response integration across the spatiotemporal receptive field (RF) is a general feature of sensory coding, and has an important role in shaping responses to naturalistic stimuli. Coding of spatiotemporally distributed stimuli by the primary somatosensory cortex (SI) of the rat vibrissa pathway is strongly influenced by such integration across the vibrissa array. Motivated by the high capacity of the vibrissa pathway for transmission and processing of textural information, the goal of this study is to quantify the effect of response integration on the precision with which spatiotemporally distributed deflections are encoded. Using a spatiotemporal paired-pulse paradigm, it is shown that, in addition to attenuating the magnitude of the single-cell firing-rate response to a subsequent vibrissa deflection, post-stimulus suppression also increases the delay of the associated response by as much as a factor of two. Moreover, preliminary data show that the temporal spread of the response positively correlates with the degree of firing-rate attenuation. These results demonstrate that, by evoking varying amounts of cortical suppression, spatiotemporal interactions can influence the coding precision of single neurons. Temporal precision of coding may also be improved through joint observation of multiple cells. For simultaneously recorded pairs of neurons, time-locking of post-stimulus responses to each other within a single trial was significantly larger than that due to the common stimulus across trials. There is evidence that this extra degree of time-locking decreases as the level of response suppression increases. These findings indicate that spatiotemporal interactions constrain the textural information carried by groups of neurons in a way likely to be important in the natural setting.

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