Functional transformations of odor inputs in the mouse olfactory bulb

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Abstract:

Sensory inputs from the nasal epithelium to the olfactory bulb (OB) are organized as a discrete map in the glomerular layer (GL). This map is then modulated by distinct types of local neurons and transmitted to higher brain areas via mitral and tufted cells. Little is known about the functional organization of the circuits downstream of glomeruli. We used in vivo two-photon calcium imaging for large scale functional mapping of distinct neuronal populations in the mouse OB, at single cell resolution. Specifically, we imaged odor responses of mitral cells (MCs), tufted cells (TCs) and glomerular interneurons (GL-INs). Mitral cells population activity was heterogeneous and only mildly correlated with the olfactory receptor neuron (ORN) inputs, supporting the view that discrete input maps undergo significant transformations at the output level of the OB. In contrast, population activity profiles of TCs were dense, and highly correlated with the odor inputs in both space and time. Glomerular interneurons were also highly correlated with the ORN inputs, but showed higher activation thresholds suggesting that these neurons are driven by strongly activated glomeruli. Temporally, upon persistent odor exposure, TCs quickly adapted. In contrast, both MCs and GL-INs showed diverse temporal response patterns, suggesting that GL-INs could contribute to the transformations MCs undergo at slow time scales. Our data suggest that sensory odor maps are transformed by TCs and MCs in different ways forming two distinct and parallel information streams.

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