DISSECTING THE ROLES OF GABA AND DOPAMINE FROM CO-TRANSMITTING INHIBITORY INTERNEURONS IN THE OLFACTORY BULB

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Background: Processing of sensory information relies on inhibitory interneurons. Further, inhibitory interneuron signaling is disrupted in many neurodevelopmental disorders including those with sensory abnormalities. Yet much remains unknown regarding the mechanisms by which inhibitory interneurons modulate sensory information. One important yet poorly understood subgroup of sensory inhibitory interneurons are short axon cells in the olfactory bulb which release both GABA and dopamine. The objective of this study was to identify how these co-transmitting inhibitory interneurons in the olfactory bulb modulate olfactory coding.

Materials/Methods: We used intersectional genetics to selectively block GABA or dopamine release from short axon cells. We then used behavioral measures of olfaction to investigate the role of each of these neurotransmitters in olfactory behaviors. Finally, we used optogenetic slice electrophysiology to evaluate underlying circuit mechanisms

Results: We found that short axon cell function is necessary for odor detection, but either GABA or dopamine release from short axon cells is sufficient. In contrast, both GABA and dopamine are necessary for odor discrimination. Short axon cells modulate olfactory behaviors by making monosynaptic connections onto excitatory interneurons, but not directly onto projection cells or other short axon cells. We also identified a novel excitatory feedback loop from projection cells onto short axon cells.

Conclusions: This study identifies novel circuit connections that expand our previous understanding of the inhibitory interneuron network in the glomerular layer of the olfactory bulb and demonstrates functional implications for these connections suggesting new mechanisms by which inhibitory interneuron disruption could cause sensory impairments in neurodevelopmental disorders.