Tracing visual processing streams in the zebrafish brain

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Abstract

Retinal images are transmitted to the brain via the axons of retinal ganglion cells (RGCs). These projections build representations of the identity and location of visual objects. RGCs project to about a dozen brain regions. In a systematic attempt to delineate the visual processing pathways in the larval zebrafish, we constructed a comprehensive map of the connectivity between RGCs and retinorecipient areas. By unbiased sparse genetic labeling and in vivo imaging, we identified > 70 RGC types based on the combination of axonal targets and dendrite stratification patterns. This number far exceeds current estimates of RGC diversity derived from work in other vertebrates. We found that a dot moving horizontally across an LED screen evoked prey-capture maneuvers in immobilized fish. This response is selectively tuned to size and speed of the stimulus. By two-photon GCaMP6 imaging, we identified a pretectal area that responded robustly to the optimal prey stimulus. Laser ablations showed that this area is necessary for prey-catching behavior. Interestingly, the RGCs linked to this area fall into just two morphological classes. Thus, a specific retinofugal pathway, dedicated to prey detection, may provide input to an elementary object recognition circuit in the fish brain.

Keywords: zebrafish brain, visual processing pathways

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