From Behavior to Neural Circuits: Dissecting Prey Capture in Zebrafish

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Abstract:

Zebrafish larvae rely on their visual system to hunt and capture prey objects, such as paramecia. Detection of a small moving object evokes a series of stereotyped orienting turns and swims that allow the larva to approach the prey, followed by a final swim coupled with jaw opening to create suction and consume the paramecium, the strike. We have begun to dissect the neural circuits involved in the initial orienting phase of prey capture. Using a head-fixed preparation, we can present visual stimuli while recording tail movements, and objectively classify the behavior. Eye convergence occurs in the first phase of hunting behavior, and is one of the hallmarks of prey capture. The eyes will remain converged throughout all stages of hunting, and convergence increases as the larva approaches the prey, suggesting that it might function to keep the object in the high-acuity region of the retina. Based on observations of freely swimming larvae, the strike is specifically triggered when the larva is quite close to its prey, but the mechanism used to determine the distance remains unknown. How does the larva keep the eyes fixed on the prey during hunting, and what cues does it use to gauge distance to the prey? To address these questions, we are studying the behavior in freely swimming as well as head-fixed larvae, and using simultaneous functional imaging and behavior to begin to identify the circuit elements involved.