# Startled fish escape using several distinct neuronal circuits

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A fast knee-jerk "ballistic" escape response and a more considered "delayed" escape response are mediated by distinct and parallel neuronal pathways in zebrafish, according to a study published October 15 in the open-access journal *PLOS Biology* by Harold Burgess of the Eunice Kennedy Shriver National Institute of Child Health and Human Development, and colleagues.

Escape behaviors are defensive responses to threats. Many species execute very fast ballistic escape reactions to avoid imminent danger. But some species possess multiple modes of escape, including less powerful responses characterized by delayed initiation and less vigorous motor activity. There has been little work characterizing circuits that mediate delayed escape responses, and how sensory cues are integrated within escape circuits remains poorly understood. To resolve these questions, Burgess and colleagues conducted an unbiased screen to identify specific neurons that drive delayed escape responses in zebrafish.

The researchers used high-speed video to analyze escape responses triggered by acoustic or vibrational stimuli in free-swimming zebrafish larvae. They found that rather than a ballistic response, less dangerous threats elicit a delayed escape response, characterized by flexible trajectories, and driven by a cluster of just 38 neurons in the hindbrain (19 on each side), which are completely separate from the fast-escape pathway.

Neurons that initiate rapid ballistic escape responses receive direct auditory input and directly drive motor neurons; by contrast, the input and output pathways for delayed escapes are indirect, providing an opportunity for the brain to integrate several different types of sensory information. These results show that decision-making in the vertebrate escape system is enabled by parallel pathways for ballistic responses and flexible delayed actions. According to the authors, this circuit of 38 escape neurons may represent an evolutionarily ancient pathway for defensive responses to threats sensed via acoustic or vibrational cues.

**More information:** Gregory D. Marquart et al, Prepontine non-giant neurons drive flexible escape behavior in zebrafish, *PLOS Biology* (2019). [DOI: 10.1371/journal.pbio.3000480](http://dx.doi.org/10.1371/journal.pbio.3000480)

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