

# 'Freeze or flee' reactions run in fish families

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Trinidadian guppies. Credit: Dr Tom Houslay

Families of fish tend to share similar reactions to stressful situations, new research shows.

University of Exeter scientists examined how Trinidadian guppies reacted to [stress](#)—did they [freeze](#) or flee?—and also measured their

hormonal responses.

The study found that some [fish](#) tend to produce more of the [hormone cortisol](#), and that these fish are more likely to flee—while others produce less [cortisol](#) and tend to freeze. This pattern runs in families.

The findings could help in the breeding of less-stressed fish for aquaculture ([fish farming](#)) and other captivity such as aquariums.

"In the wild, an instinct to flee can help a fish escape from danger, and a rush of cortisol helps them cope with that stress," said lead author Dr. Tom Houslay, of the Centre for Ecology and Conservation (CEC) on Exeter's Penryn Campus in Cornwall.

"But in captivity, this reaction is unhelpful—a chronic, high-cortisol stress response is harmful to health and welfare.

"Our finding of a genetic link between the hormonal (cortisol) and behavioral (freeze or flee) reactions suggests fish could be selected for breeding based on their freeze or flee response.

"By selecting fish that tend to freeze in a stressful situation, you create a genetic stock with a lower cortisol stress response."

This approach is simpler than other breeding methods, some of which depend on blood sampling to identify genetic patterns.

"We need to stop thinking of fish as being all the same," said Professor Alastair Wilson, also from the CEC at the University of Exeter.

"Individuals and groups of close genetic relatives vary, and by taking account of this we can selectively breed captive fish with lower stress and better health."

Biologists have long believed that this "integration" of behavioral and hormonal responses must exist, but few formal genetic tests have been carried out.

In this study—by a team including the University of Alabama—researchers tested hormonal reactions by placing individual guppies in isolation for an hour. For a social fish like the guppy, the handling and isolation is likely to be a mild stressor.

During a stress response, elevated [cortisol levels](#) help to shift the body's energy balance in order to cope with the stressor. This aids recovery, and prepares the body for any further stressor. Cortisol is a necessary part of coping with stress, but if this response is used too frequently then it can lead to health problems.

Cortisol leaks out through guppies' gills, so their hormones were measured by testing the water after they returned to their usual tank.

Behavior was tested separately, also by placing each guppy in a new tank, and seeing whether they tended to stay still (freeze) or swim around trying to escape (flee).

Hundreds of fish were observed in the study, and researchers looked at the "family tree" of each to see how genetic relatedness correlated with behavioral and hormonal similarities.

The paper is published in the journal *eLife*.

**More information:** Thomas M Houslay et al, Genetic integration of behavioural and endocrine components of the stress response, *eLife* (2022). [DOI: 10.7554/eLife.67126](https://doi.org/10.7554/eLife.67126)

Provided by University of Exeter

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