# Scientists use robots to reveal how predatory fish cope with unpredictable prey

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Fish interacting with robot. Credit: Dr Christos Ioannou

Scientists at the University of Bristol have demonstrated how predators overcome their preys' erratic behavior by adapting their own during the hunt.

The study, published today in scientific journal *PNAS*, challenges the

well-held theory that behaving unpredictably helps animals survive encounters with predators.

Instead of simply fleeing directly away from a predator, many prey species from across the animal kingdom choose to escape in a surprisingly wide range of directions. Scientists have long suspected that this unpredictability helps them evade capture by keeping predators guessing about the prey's next move.

By studying how real predatory fish (blue acara cichlids) attack robotic prey, researchers from Bristol's School of Biological Sciences were able to experimentally test this idea. Rather than confirming that unpredictable escape tactics are beneficial to prey, the new research suggests that predators can neutralize this strategy by flexibly adjusting their own behavior.

Like many real prey hiding from predators, the robotic prey started each experiment motionless, before eventually fleeing once the cichlid predator got too close. But unlike real prey, their escape direction could be programmed in advance. This key design feature enabled the researchers to vary how predictable the prey's escape direction was over a series of interactions with the predators.

Lead author Dr. Andrew Szopa-Comley explained: "Using robotic prey allowed us to present individual predators with one of two prey escape strategies: 'predictable' prey which repeatedly escaped in the same direction from one interaction with the predator to the next, or 'unpredictable' prey which escaped in random directions."

Predators facing predictable prey adjusted their speed of approach according to the prey's escape direction, going faster when prey were heading directly away from them and more slowly if prey were fleeing sideways. This adjustment occurred before the prey even started to

escape, suggesting that the predators were able to anticipate the prey's behavior, based on their experience of previous interactions. By contrast, predator individuals facing unpredictable prey did not adjust their approach speed to match the prey's escape angle.

And yet surprisingly, over the length of a whole pursuit, predators faced with unpredictable prey performed just as well as those hunting predictable prey. Despite being deprived of reliable information on the prey's likely escape direction, predators faced with unpredictable prey were able to compensate by accelerating more in the later stages of the pursuit.

Senior author Dr. Christos Ioannou, associate professor of behavioral ecology, said: "Our results suggest that the predators in our study were able to overcome the potential downsides of facing prey which behave unpredictably. From the prey's point of view, this raises the question of whether unpredictable behavior is as widely beneficial as was originally thought."

These findings are potentially significant for the evolution of prey escape behavior. They suggest that the behavioral characteristics of the predator, including its capacity to counteradapt, may be crucial in determining whether being unpredictable is beneficial to prey.

Dr. Szopa-Comley added: "One of the key messages from our research is that predators are capable of dynamically adjusting their behavior in a way that can have dramatic consequences for the success of prey survival strategies."

**More information:** Andrew W. Szopa-Comley et al, Responsive robotic prey reveal how predators adapt to predictability in escape tactics, *Proceedings of the National Academy of Sciences* (2022). DOI: 10.1073/pnas.2117858119

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