

INSIDE JEB

Remarkable archerfish recognise that unfamiliar insects are animals



An archerfish viewing a computer screen showing an image of an insect and a leaf to test recognition. Photo credit: Svetlana Volotsky.

Lurking beneath overhanging foliage, archerfish have one thing on their mind: taking a well-aimed pot-shot at the next insect that settles within range. Squirting a ballistic jet of water, the tenacious assassins precisely target their victims, ready to dine. ‘Object recognition is critical for animal survival’, says Ronen Segev from Ben-Gurion University of the Negev, Israel, explaining that distinguishing dinner is an essential life skill. But how do these remarkable fish differentiate a tasty treat from an unpalatable plant? ‘It’s a complex task’, says Segev, who was curious to find out which visual features archerfish depend on when identifying a delicious nibble. He and his colleagues, Svetlana Volotsky, Ohad Ben-Shahar and Opher Donchin, also from Ben-Gurion University of the Negev, began showing images of appetising insects, flowers and leaves to archerfish to find out how the aquatic snipers distinguish fauna from flora.

Fortunately, the fish are quite content to squirt at images on a computer screen, so Segev and Volotsky first encouraged the

archerfish to take fire at a circle on a screen, in return for a food pellet reward. Then, Volotsky trained the snipers to aim at images of one specific spider viewed from a range of angles while trying to distract it with an image of a piece of vegetation. Once the fish were reliably spitting at the spider images, she tested whether they were capable of recognising the spider from any random direction by offering the fish a completely new view of the spider, which they hadn’t seen before, beside an image of a piece of vegetation or another spider. If the fish had really learned to recognise their spider, it would still take a shot at it, even if it was seeing it from an unfamiliar angle. Impressively, the archerfish were still able to select their target spider, regardless of the direction of view; they can definitely recognise individual objects. But could the fish learn from experience to categorise an insect that they had never seen before as an animal?

This time, Volotsky trained the fish to spit at images of insects, ranging from ants and beetles to flies and spiders, while

trying to distract them with images of plants. Once the fish were dependably taking shots at the insects, she tried outwitting them by presenting them with images of unfamiliar insects, to find out whether the fish could recognise that any old insect is an animal. Astoundingly, the fish still targeted the insect images, even though they had never seen those creatures before. ‘Archerfish can generalise from examples to make object recognition of natural object classes’, says Segev.

But how were the determined fish able to learn to distinguish plants from animals? This time, Volotsky, Ben-Shahar, Donchin and Segev teamed up to break down images of insects, flowers and leaves into 18 different features. Then, they built a computer program (known as a support-vector machine), which can learn to classify different types of information, that reproduced the fish’s decision-making process to find out which features are necessary for archerfish to distinguish between animals and plants. Impressively, the fish only needed six essential features, including the loose perimeter encircling the object, how jagged or smooth the shape is and the texture of its surface, to distinguish animals from plants, with the first two factors being the most significant. And this is quite remarkable because, apparently, we use a similar, albeit slightly more elaborate, strategy to recognise each other’s faces.

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Kathryn Knight
kathryn.knight@biologists.com