Fish fail to see reflections as rivals

Not all cichlids react aggressively to their reflections, casting doubt on the use of mirrors in behavioural studies

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10 October 2014

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A Diana's hogfish (*Bodianus diana*) attacks its reflection in a mirror.

Mirrors are often used to elicit aggression in animal behavioural studies, with the assumption being that creatures unable to recognize themselves will react as if encountering a rival. But research suggests that such work may simply reflect what scientists expect to see, and not actual aggression.

For most people, looking in a mirror does not trigger a bout of snarling hostility at the face staring back. But many animals do seem to react aggressively to their mirror image, and for years mirrors have been used to trigger such responses for behavioural research on species ranging from birds to fish.

“There’s been a very long history of using a mirror as it’s just so handy,” says Robert Elwood, an animal-behaviour researcher at Queen’s University in Belfast, UK. Using a mirror radically simplifies aggression experiments, cutting down the number of animals required and providing the animal being observed with an ‘opponent’ perfectly matched in terms of size and weight.

But in a study just published in *Animal Behaviour*[1], Elwood and his team add to evidence that many mirror studies are flawed. The researchers looked at how convict cichlid fish (*Amatitlania nigrofasciata*) reacted both to mirrors and to real fish of their own species.

This species prefers to display their right side in aggression displays, which means that they end up alongside each other in a head-to-tail configuration. It is impossible for a fish to achieve this with their own reflection, but Elwood reasoned that fish faced with a mirror would attempt it, and flip from side to side as they tried to present an aggressive display. On the other hand, if the reflection did not trigger an aggressive reaction, the fish would not display such behaviour as much or as frequently.

What the researchers actually observed was the latter. Elwood compares this to a boxer in the ring: if the boxer thinks that they are trading blows with a real opponent, they will move quickly and stay on their toes. “If it’s just posturing in front of a mirror, a boxer can stand around and pose for ages,” he says.

Call for reflection

Earlier this year, Valentina Balzarini, a behavioural ecologist at the University of Berne, and her colleagues published a paper on mirror aggression in three cichlid species from Lake Tanganyika in Africa. They found that in only one — *Neolamprologus pulcher* — did the mirror elicit similar aggressive responses to a real opponent[2].

In contrast to the species studied by Elwood's team, *N. pulcher* rely on frontal, rather than lateral asymmetric, displays, which may contribute to the different responses in mirror studies. Thus, whereas mirrors can be useful for studies investigating "a gross measure of aggression", says Balzarini, they need to be carefully validated for individual species.

"The biggest problem is that we are testing for a behaviour that requires a series of actions and reactions from at least two participants, in a setting that only includes one individual," says Balzarini. "I am thrilled by these last years' questioning of mirror tests, especially from the neurobiological point of view."

In 2010, Russell Fernald, who studies cichlids at Stanford University in California, and his colleague Julie Desjardins analysed gene expression in the brains of fish reacting to a mirror[3]. They found higher levels of brain activation in areas associated with fear, which were not seen in fights with real fish, even though other indicators such as levels of hormones were similar in both cases. This, says Fernald, clearly showed that fighting a mirror is different from fighting a fellow fish, from the perspective of the fish.

"I think that scientists generally underestimate the cognitive skills of fish," he told *Nature*. "We have shown that cichlid fish can do logical reasoning. Fish can infer social rank by observation alone[4]. So why should they be fooled by a mirror?"

So for fish at least, uncertainty now hangs over the use of mirrors in animal behavioural research. Elwood says, "I don't want to say they couldn't be used in any research. In research in aggression and displays it could be questioned."

For, in aggression studies, as the last line of his paper says, "mirrors do not reflect reality".

Nature | doi:10.1038/nature.2014.16099

References

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