To punish or not to punish: Lessons from reef fish and saber-tooth blennies

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Researchers have experimentally shown that some species of reef fish will enact punishment on the parasitic saber-tooth blennies that stealthily attack them from behind and take a bite, even though their behavior offers no immediate gain. The study, published online on November 4 in *Current Biology*, shows that punishment ultimately serves all members of the reef fish species well.

In future attacks, blennies are more likely to go after "free-riding" individuals that don't take the time or expend the energy to punish their enemies, the researchers show, suggesting that reef fish punish blennies for reasons that are self-serving. Their self-serving behavior nonetheless creates a "public good." When given a choice, blennies are more apt to switch to another species for their next attack after their previous fare has punished them.

"Our study shows that public goods may arise due to self-serving behavior and without any consideration of the benefits to other group members," said Andrea Bshary of the University of Neuchâtel in Switzerland.

Cooperation in groups can be difficult to explain, since it would seem that "free riders" would win out as they take advantage of the efforts of their peers without contributing themselves. Human studies have explained this conundrum in two ways. Those who contribute may gain from the positive reputation it affords them, which may increase others' willingness to help them at another time. Alternatively, people might

cooperate if cheaters can be punished. That raises another question: When does it make sense to punish, given that punishment has immediate costs to both the punisher and the punished?

To explore that question, Bshary and her colleague Redouan Bshary turned to scalefin anthias and the blennies they are known to chase. In this case, it was clear that the reef fish couldn't be acting out of concern for their close kin, because the shoaling fish are generally unrelated to one another.

In laboratory tests, the researchers showed that blennies were less likely to target a colored Plexiglas plate that had earlier chased them off than one that didn't. This showed the chasing behavior to be a bona fide example of punishment; chasing blennies has no immediate benefit, because the parasites almost always bite once per attack. The punishment instead leads to future gains as blennies become less likely to attack punishers.

In observational studies in a natural setting, the researchers found that punishment increased the likelihood that blennies would go for another species in their next attack. This means that all members of a species win when one of them punishes a blenny. Finally, the researchers showed in experiments that at least some blennies could tell the difference between look-alike pairs of plates in which one "punished" them and the other did not, and they would selectively bite nonpunishers. As a result, free riders are at a disadvantage.

The findings in fish suggest that humans, too, might sometimes appear to work together in the real world for reasons that are directly self-serving at their core, the researchers say. They point out that their study differs in an important regard from standard tests of game theory in humans in that the blennies interacted with only one individual of their own choosing. In human experiments, people often interact in groups.

"As a consequence," the researchers write, "it is always clear which individual of a shoal has to punish the blenny for its cheating. A victim cannot expect others to do the punishment, because they did not have a negative experience. We think that such conditions often apply to humans as well, in which punishment is a self-serving response to being cheated while benefiting the community as well. A person whose house gets broken into or who gets attacked by robbers will have to take action (call the police or fight back) even though all the neighbors may profit from this."

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