Evolution punishes selfish jerks in long run, study finds

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Courtesy of Michigan State University
and World Science staff

Two biologists have published evidence that evolution doesn't favor the selfish—disproving, they claim, a theory popularized last year.

"We found evolution will punish you if you're selfish and mean," said Michigan State University biologist Christoph Adami, lead author of the new study, published in the Aug. 1 issue of *Nature Communications.*

"For a short time and against a specific set of opponents, some selfish organisms may come out ahead. But selfishness isn't evolutionarily sustainable."

Much of the last 30 years of research has focused on how cooperation evolved, since it's found in many forms of life, from single-cell organisms to people. The theory of evolution offers no obvious answers as to why. Biologists follow Charles Darwin in supposing that the best-adapted organisms in a given environment will eventually win out and dominate the gene pool. But these "fittest" organisms by no means would seem to obviously include "nice guys" or cooperators, who put themselves at a disadvantage in many respects.

One way to address the question is through game theory, a branch of applied mathematics used in biology, economics, political science and elsewhere. Game theory studies winning strategies for parties involved in situations where their interest conflict. Computer simulations can be devised to assess the results of different strategies.

Adami and colleagues used the "prisoner's dilemma game" as a computer model to study cooperation. In the game, two people are arrested for a crime. Police offer each person a deal: snitch on your friend and go free while the friend spends six months in jail. If both prisoners snitch, they both get three months in jail. If they both stay silent, they both get one month in jail for a lesser offense. If the two prisoners get a chance to talk to each other, they can establish trust and are usually more likely to cooperate because then both of them only spend one month in jail. But if they're not allowed to communicate, the best strategy is to snitch because it guarantees the snitcher doesn't get the longer jail term.

The game lets scientists study a basic question competitors face: do I act selfishly or do I cooperate? Cooperating would do the most good for the most individuals, but it might be tempting to be selfish and freeload, letting others do the work and take the risks.

Last year, two leading physicists published a paper showing their newly discovered strategy—called zero-determinant, or ZD—gave selfish players a guaranteed way to beat cooperative players. This would pose new problems for explaining the evolution of cooperation.

“The paper caused quite a stir,” said Adami. “The main result appeared to be completely new, despite 30 years of intense research in this area.” That paper was published in the June 26, 2012 issue of the journal *Proceedings of the National Academy of Sciences.*

Adami and co-author Arend Hintze, also of Michigan State, questioned whether following the ZD strategy would essentially eliminate cooperation and create a world full of selfish beings. They used high-powered computing to run hundreds of thousands of games and found, they said, that ZD strategies can never be the product of evolution.

While ZD strategies offer advantages when used against non-ZD opponents, they don’t work well against other ZD opponents, they said.

“In an evolutionary setting, with populations of strategies, you need extra information to distinguish each other,” Adami said. ZD strategies only worked if players knew who their opponents were and adapted their strategies accordingly, he added.

“The only way ZD strategists could survive would be if they could recognize their opponents,” Hintze said. “And even if ZD strategists kept winning so that only ZD strategists were left, in the long run they would have to evolve away from being ZD and become more cooperative. So they wouldn’t be ZD strategists anymore.”

The research also makes that case that communication and information are necessary for cooperation to take place. “Standard game theory doesn’t take communication into account because it’s so complicated to do the math for the expected payoffs,” Adami explained.

But “we think communication is the reason cooperation occurs. It’s generally believed that there are five independent mechanisms that foster cooperation. But these mechanisms are really just ways to ensure that cooperators play mostly with other cooperators and avoid all others. Communication is a universal way to achieve that. We plan to test the idea directly in yeast cells.”