

# **Cheating has long-term consequences in the evolution of cooperation**

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Freeloaders can live on the fruits of the cooperation of others, but their selfishness can have long-term consequences, reports an evolutionary biologist from The University of Texas at Austin in a new study.

“There is a historical dimension to cooperation,” says Dr. Sam Brown, the Human Frontier Science Foundation Fellow in the Section of Integrative Biology. “The act of a cooperator can continue to give benefits even after the cooperator is dead. Conversely, cheating will have consequences in the future.”

Standard models of the evolution of cooperation assume that the benefits of cooperative versus selfish behavior depend only on the current abundance of cooperators in the population.

Brown has developed a new model showing that cooperators and cheaters can co-exist in a dynamic boom and bust state in the presence of long-lasting resources, known as “durable goods.”

Durable goods can outlast their producers, and then be passed on to future generations. They include things like antibiotics produced by populations of bacteria to kill off neighboring bacteria and public parks or buildings built by humans.

In the presence of a durable good, cheaters can increase in numbers with no immediate consequences. For example, cheaters could still enjoy the shelter of an ant nest or a building for some time even if it is not being

maintained.

“But freeloaders can also increase so rapidly that in a generation’s time the whole building collapses,” says Brown.

“If you have social dilemmas [where there are cooperators and cheaters] mediated by these longstanding, durable entities like buildings, ant’s nests, or biofilms in bacteria, then you introduce an instability,” he says. “It’s almost as if there is a pact with the devil, because you pay nothing now for your cheating, but you pay double tomorrow, because everyone’s cheating and the costs come home to roost.”

With environmental pollution, for example, there is a delay in costs to cheaters that pollute, particularly if the environment is in a relatively pristine condition. Cheaters gain in the short-term by increasing their resources without dire effect. But over time, more and more cheaters pollute and it can suddenly become a problem.

Brown says that this new model recognizing the ubiquity of durable goods will have diverse consequences across many fields, including ecology, economics, medicine and political science.

His next step will be to test the ideas from his models in bacterial systems.

Source: University of Texas at Austin

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