Betrayal or cooperation? Analytical investigation of behavior drivers

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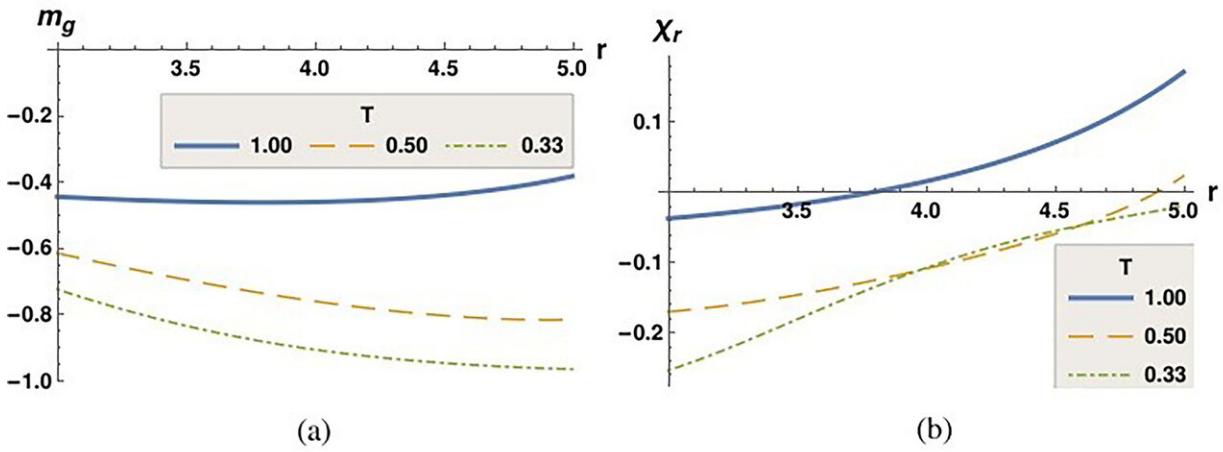

(a) (b)

At the macroscopic level, there are numerous examples of people cooperating to form groupings. Yet at the basic two-person level, people tend to betray each other, as found in games like the prisoner's dilemma, even though people would receive a better payoff if they cooperated among themselves. The topic of cooperation and how and when people start trusting one another has been studied numerically, and in the journal Chaos, researchers investigate what drives cooperation analytically.This image shows plots of (a) game magnetization mg, and (b) reward susceptibility χr versus reward payoff (r) for different game temperatures T. Rest of payoffs are: t = 5,s = 0 and p = 1. Credit: Colin Benjamin and Aditya Dash

When looking at humanity from a macroscopic perspective, there are numerous examples of people cooperating to form societies, countries,

religions, and other groupings.

Yet at the basic two-person level, people tend to betray each other, as found in social dilemma games like the prisoner's dilemma, even though people would receive a better payoff if they cooperated among themselves.

The topic of cooperation and how and when people start trusting one another has been studied by various researchers who have addressed this problem numerically. In a paper in *Chaos*, researchers investigate what drives cooperation analytically.

In order to investigate what happens when an infinite number of people, instead of two people, play a game like the prisoner's dilemma, the researchers mapped the two-player game to a two-spin ID Ising model, which is a 1D line of interacting spins in the presence of an external magnetic field.

Spins can either point clockwise, which is up, or counterclockwise, which is down. The net difference between the fraction of spins pointing up to those pointing down provides the analytic result for the magnetization.

"Game magnetization is an excellent measure of how in the overall scheme of things the total number of players respond to different payoffs," said Colin Benjamin, one of the authors. "In our work, we go beyond game magnetization and look at game susceptibility, too."

An analytical result for susceptibility probes the net change in the fraction of players adopting a certain strategy for both classic and quantum social dilemmas and pinpoints the real drivers of cooperative behavior, which can vary given the situation.

The findings in this research can be applied to analytical solutions to numerous other social dilemma games, such as rock-paper-scissors, Battle of the Sexes, or Stag Hunt. The mapping to ID Ising model can help understand cooperative behavior in many other social dilemmas as well.

"One future area to explore is that of recent COVID-19 infection dynamics," said Benjamin. "A lot of numerical work has been done to explore COVID-19 infection dynamics using tools of evolutionary game theory. An analytical model, however, is lacking."

More information: "Thermodynamic susceptibility as a measure of cooperative behavior in social dilemmas," *Chaos*, aip.scitation.org/doi/10.1063/5.0015655

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