

Rock-paper-scissors a parable for cycles in finance, fashion, politics and more

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Using a grown-up version of the rock-paper-scissors game, Indiana University cognitive scientists offer a new theory of the group dynamics that arise in situations as varied as cycles of fashion, fluctuations of financial markets, eBay bidding wars and political campaign strategies.

In a study written about this week in *PLOS ONE*, the researchers analyzed situations in which each person's decision depends on what they think other people will decide, looking at the riddle of "what you think I think you think I think."

What they found, said Seth Frey, doctoral candidate in the Department of Psychological and Brain Sciences in the IU College of Arts and Sciences, is that "people playing this kind of game subtly influence each other, converging on similar ways of reasoning over time. The natural analogy for the process is to a flock of birds veering in concert."

"Anticipation," he said, "may be the motor that keeps fads running in circles. It could be a source of the violent swings that we see in financial markets. Anyone in a bidding war on eBay may have been caught in this dynamic. If the bidders are tweaking their increasing bids based on the tweaks of others, then the whole group may converge in price and determine how those prices rise. The process isn't governed by the intrinsic value of that mint-condition Star Wars lunch box, but on the collective dynamics of people trying to reason through each other's thoughts."

Robert Goldstone, professor in the Department of Psychological and Brain Sciences, said they wanted "an elegant parable in a laboratory context" of the kind of real-world situations when people are trying to assess what other people are deciding. The researchers are interested in what the entire group looks like when everybody is trying to second guess everybody else.

"At a core level," he said, "people's guesses do converge, and that's interesting because dominant models suggest otherwise."

Nash equilibrium, for example—the influential theory of John Nash, a mathematician portrayed in several films and the book "A Beautiful Mind"—would predict that everyone will end up at random places with equal probability for each round. It's a theory, Goldstone said, "that assumes full rationality, full ability to reason about what you know I know you know I know."

Instead, "we are getting this systematic behavior, which is not random," he said. "Even though people are trying to beat each other out, they end up in synchronicity."

Whether looking at benign social habits or mass panics, Frey and Goldstone conclude, social theorists have always treated group behavior as though it resulted from a kind of mindlessness. But this lesson from rock-paper-scissors suggests that the most sophisticated reasoning can be caught up in the subtleties of social interaction.

The study, "Cyclic Game Dynamics Driven by Iterated Reasoning," is available online at [PLOS ONE](#).

Rock-paper-scissors revisited

In the experiment, Frey and Goldstone introduce a version of rock-paper-scissors they call "the mod game." In each round, they gave small groups of five or six IU psychology undergraduates a choice of numbers from 1 and 24. Participants earned money for picking a number exactly one greater than a number chosen by someone else, with the choices wrapped around in a circle so that 1 beat 24.

Each student had to anticipate what others were going to pick, and pick the next number up, keeping in mind that everyone else was thinking the same thing. In this game of one-upmanship, the best performers aren't the ones who think the most steps ahead, but the ones who think just the right number of steps ahead—about two, as it turned out in the experiment.

Experimental economists predict that sufficiently experienced people will continually increase the number of steps by which they think ahead. But this did not happen in the mod game. Instead, when participants were shown each previous round's results, they tended to cluster in one part of the circle of choices and start bounding around it in sync. Groups produced a compelling periodic orbit around the choices, reminiscent of the cultural pendulum swinging back and forth, bringing, say, mustaches in and out of fashion.

The cycling behavior consistently got faster with time. With more experience, people learned to think further ahead, so the economic prediction was partly correct. But the increase was much less dramatic than economists might have thought: After 200 rounds of the mod game, the average number of thinking steps increased by only half a step, from 2 to 2.5. Moreover, the synchronicity that occurs in this game turned out to benefit everyone; a tighter grouping of choices meant a higher density of money to be earned in each round.

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Sciences, directs the Percepts and Concepts Laboratory in the Department of Psychological and [Brain Sciences](#) at IU Bloomington. Seth Frey is a graduate student in the lab.

More information: [dx.plos.org/10.1371/journal.pone.0056416](https://doi.org/10.1371/journal.pone.0056416)

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