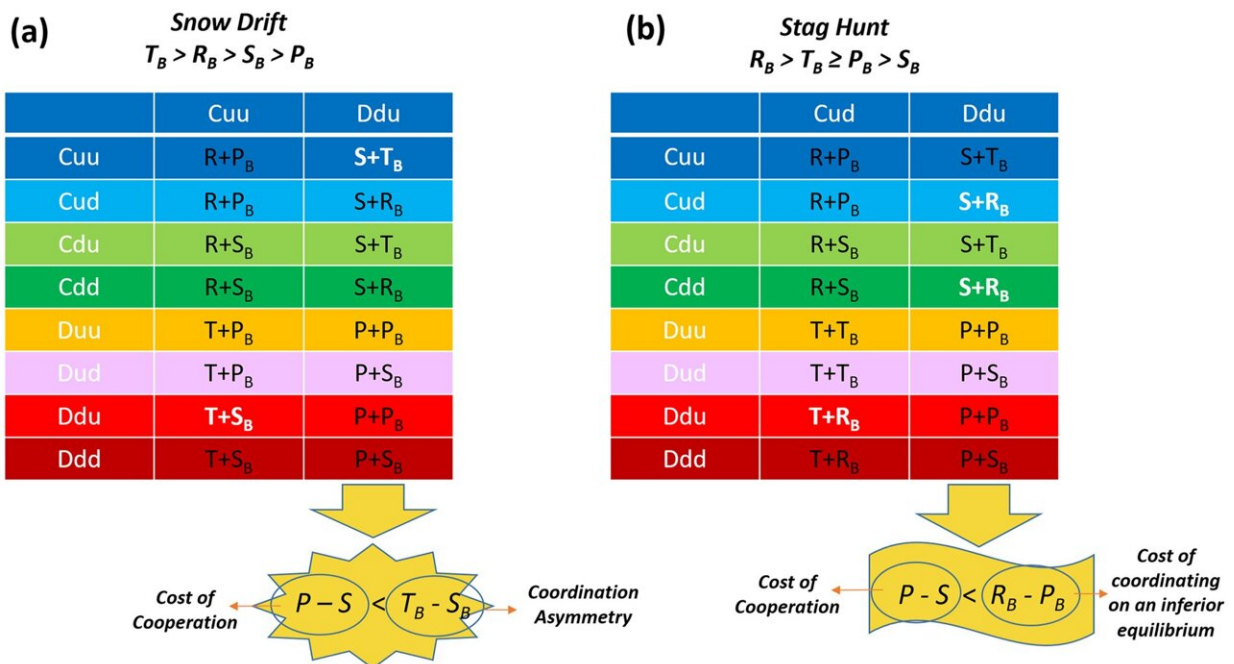


Study shows how moral behavior pays off in the end

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Simple rules for the existence of a cooperative Nash equilibrium. A: A cooperative Nash equilibrium in which defectors play softly with cooperators and cooperators play hard with defectors when the game B is a Snow Drift game exists when the cost of cooperation is smaller than the coordination asymmetry defined as the payoff difference of hard and soft strategies in the Snow Drift game. B: A cooperative Nash equilibrium, when the game B is a Stag Hunt game, exists when the cost of cooperation is smaller than the cost of coordinating on an inferior equilibrium, defined as the payoff difference of the superior and inferior equilibria in the Stag Hunt game. These conditions can be derived by requiring the payoff of Nash strategies (shown in white) to be larger than all the other payoffs in the same column. Credit: *PLOS Computational Biology* (2022).

Selfless behavior and cooperation cannot be taken for granted. Mohammad Salahshour of the Max Planck Institute for Mathematics in the Sciences (now at Max Planck Institute of Animal Behavior), has used a game theory-based approach to show why it can be worthwhile for individuals to set self-interests aside.

One of the most fundamental questions facing humanity is: why do we behave morally? Because it is by no means self-evident that under certain circumstances we set our self-interest aside and put ourselves in the service of a group—sometimes to the point of self-sacrifice. Many theories have been developed to get to the bottom of this moral conundrum.

There are two well-known proposed solutions: that [individuals](#) help their relatives so that the common genes survive (kin selection), and that the principle of "you scratch my back and I'll scratch yours" applies. If people help each other, everyone benefits in the end (principle of reciprocity).

Prisoner's dilemma combined with a coordination game

Mathematician Mohammad Salahshour of the Max Planck Institute for Mathematics in the Sciences in Leipzig, Germany, has used the tools of game theory to explain the emergence of moral norms—because game theory studies how people make rational decisions in conflict situations. For Salahshour, the question at the outset was: why do moral norms exist in the first place? And why do we have different, or even contrasting

moral norms?

For example, while some norms such as "help others", promote self-sacrificing behavior, others, such as dress codes, appear not to have much to do with curbing selfishness. To answer these questions, Salahshour coupled two games: first, the classic prisoner's dilemma, in which two players must decide whether to cooperate for a small reward or betray themselves for a much larger reward (social dilemma).

This game can be a typical example of a social dilemma, where success of a group as a whole requires individuals to behave selflessly. In this game everybody loses out if too many members of a group behave selfishly, compared to a scenario in which everybody acts altruistically. However, if only a few individuals behave selfishly, they can receive a better outcome than their altruistic team members.

Second, a game that focuses on typical decisions within groups, such as a coordination task, distribution of resources, choice of a leader, or conflict resolution. Many of these problems can be ultimately categorized as coordination or anti-coordination problems.

Without coupling the two games, it is clear that in the Prisoner's Dilemma, [cooperation](#) does not pay off, and self-interested behavior is the best choice from the individual's perspective if there are enough people who act selflessly. But individuals who act selfishly are not able to solve coordination problems efficiently and lose a lot of resources due to failing to coordinate their activity.

The situation can be completely different when the results of the two games are considered as a whole and there are moral norms at work which favor cooperation: now cooperation in the prisoner's dilemma can suddenly pay off because the gain in the second game more than compensates for the loss in the first game.

Out of self-interest to coordination and cooperation

As a result of this process, not only cooperative behavior emerges, but also a social order. All individuals benefit from it—and for this reason, moral behavior pay off for them. "In my [evolutionary model](#), there were no selfless behaviors at the beginning, but more and more moral norms emerged as a result of the coupling of the two games," Salahshour reports.

"Then I observed a sudden transition to a system where there is a lot of cooperation." In this "moral state", a set of norms of coordination evolve which help individuals to better coordinate their activity, and it is precisely through this that social norms and moral standards can emerge.

However, coordination norms favor cooperation: cooperation turns out to be a rewarding behavior for the individual as well. "A moral system behaves like a Trojan horse: once established out of the individuals' [self-interest](#) to promote order and organization, it also brings self-sacrificing cooperation".

Through his work, Salahshour hopes to better understand social systems. "This can help improve people's lives in the future," he explains. "But you can also use my game-theoretic approach to explain the emergence of social norms in social media. There, people exchange information and make [strategic decisions](#) at the same time—for example, who to support or what cause to support."

Again, he said, two dynamics are at work at once: the exchange of information and the emergence of cooperative strategies. Their interplay is not yet well understood—but perhaps [game theory](#) will soon shed new light on this topical issue as well.

The research was published in *PLOS Computational Biology*.

More information: Mohammad Salahshour et al, Interaction between games give rise to the evolution of moral norms of cooperation, *PLOS Computational Biology* (2022). [DOI: 10.1371/journal.pcbi.1010429](https://doi.org/10.1371/journal.pcbi.1010429)

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