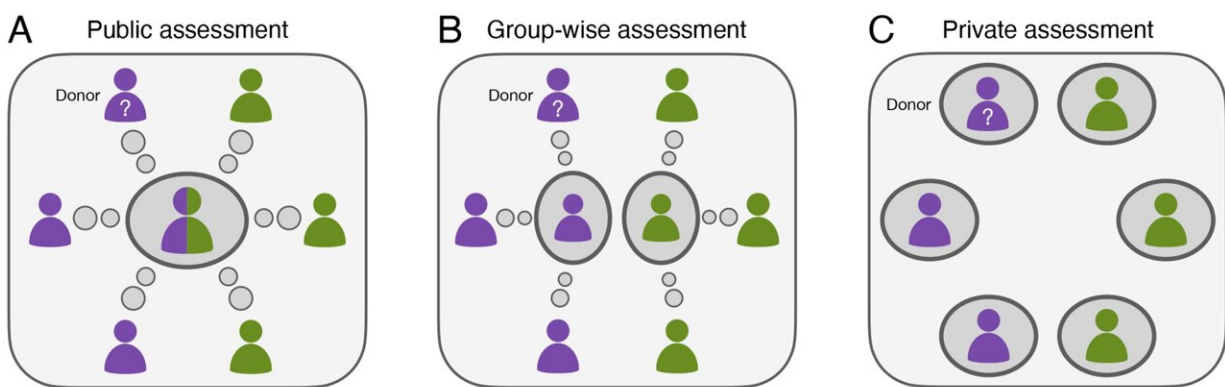


New model evaluates how reputation and indirect reciprocity affect cooperative behaviors

March 4 2024, by Nathi Magubane



D Summary of monitoring systems

	Type	Observers	Assessments	Description
Individual reputations	Public	1	N	A randomly chosen observer assesses each donor based on their action toward a random recipient and the recipient's individual reputation. The observer broadcasts the reputations of each individual to the entire population.
	Group-wise	K	$N \times K$	A randomly chosen observer from each group assesses every donor based on her action toward a random recipient and the recipient's individual reputation. Each observer broadcasts the reputations of individuals to her group.
	Private	N	$N \times N$	Every individual assesses every donor independently based on her action toward a random recipient and the recipient's individual reputation.
Stereotyped reputations	Public	1	K	A randomly chosen observer assesses a randomly chosen donor in each group based on her action toward a random recipient and the stereotyped reputation of the recipient's group and assigns the resulting reputation as a stereotype to the donor's group. The observer broadcasts the stereotype of each group to the entire population.
	Group-wise	K	$K \times K$	A randomly chosen observer from each group assesses a randomly chosen donor in each group based on her action toward a random recipient and the stereotyped reputation of the recipient's group and assigns the resulting reputation as a stereotype to the donor's group. Each observer broadcasts the stereotyped reputations to her group.
	Private	N	$K \times N$	Every individual assesses a randomly and independently chosen donor in each group based on her action toward a random recipient and the stereotyped reputation of the recipient's group; and then assigns the donor's reputation as the stereotype of her group.

Monitoring systems for individual and stereotyped reputations. Credit: *PLOS Computational Biology* (2024). DOI: 10.1371/journal.pcbi.1011862

In the complicated world of human interactions, helping others can come back around, a concept known as indirect reciprocity. It's like a societal credit score, where one's good deeds build up a good reputation, prompting others to return the favor in the future. But what if this credit score wasn't just a single individual's but shared with a group they're associated with?

In a paper published in [PLOS Computational Biology](#), Mari Kawakatsu, a postdoctoral researcher in the Plotkin Research Group at the University of Pennsylvania, and Sebastián Michel-Mata, a graduate researcher at Princeton University, investigated the extent to which [stereotypes](#) undermine indirect reciprocity.

"Prior work has shown that [cooperation](#) can be sustained when individuals condition their behavior on the [reputation](#) of each individual they're interacting with," Kawakatsu says. "But in a large society, it might be cognitively costly to keep track of everyone's past actions to determine their individual reputations. Instead, people might rely on proxies based on group memberships, like stereotypes. So, we developed a model of indirect reciprocity based on group-level reputations and studied when and how the use of stereotypes helps or harms cooperation."

In explaining the team's rationale, senior author Joshua Plotkin of Penn's School of Arts & Sciences analogizes with a scenario describing a loan applicant, known for their dedication to weightlifting, stepping into a bank, their financial fate hanging not just on their own creditworthiness but also on the collective reputation of weightlifters as perceived by the bank.

When the bank leans on stereotypes, simplifying its decision-making process by attributing the traits of a group to an individual, the nuances of personal behavior and reliability can be overshadowed, he says. If the

stereotype is positive—perhaps weightlifters are seen as disciplined and committed—the loan applicant benefits from a [halo effect](#), their individual merits amplified by the perceived virtues of their group.

This symbiosis of individual and stereotyped reputations can streamline interactions, yet it carries the risk of inaccuracies, glossing over the unique aspects of the person in question, Plotkin explains. The situation grows more complex and potentially unfair when the stereotype is negative, casting a shadow over the applicant's genuine qualifications and efforts. In this light, the bank's reliance on group-based reputations, while efficient, can lead to a skewed assessment of creditworthiness, undermining indirect reciprocity.

To model the effects of stereotypes on [cooperative behavior](#), Kawakatsu and the team used a game-theoretic approach wherein two types of reputations are used: one assigned to individuals and one assigned to groups. A donor can decide whether to help or not based on either the receiver's individual reputation or the stereotyped reputation of the group to which the receiver belongs.

To develop a stereotype, the donor observes a random member of the recipient's group and assigns a reputation to the entire group based on this single observation. This approach simplifies decision-making but introduces the risk of inaccuracies in the reputational feedback loop, which is central to indirect reciprocity.

The model suggests that individuals might rely on generalized stereotypes rather than specific individual actions when individual-level information is costly to access. This reliance on stereotypes is described as "sticky," meaning that, once the use of stereotypes is adopted, it tends to persist within the population, even when using individual-based reputations might lead to more optimal outcomes for cooperation.

"The model shows that stereotypes can significantly reduce the level of cooperation. When individuals rely on stereotypes, they may 'free ride' on the perceived general reputation of their group without contributing positively themselves," says co-author Taylor Kessinger, a postdoctoral researcher in the Plotkin Research Group.

"This behavior can lead to a decrease in overall cooperation, as individuals are less likely to engage in cooperative behaviors if they believe their personal actions will not be recognized on an individual basis but will instead be overshadowed by group-based stereotypes."

"Even if individuals recognize that using individual-based reputations could lead to better cooperative outcomes, the entrenched nature of stereotyping behavior can make it challenging for the population to shift away from this approach," Kawakatsu says.

Plotkin, however, points out that stereotypes can sometimes enhance cooperation in their [mathematical model](#), if they are shared more broadly than individual reputations. The findings reveal insights into the dynamics of cooperation, suggesting that while stereotypes usually disrupt the feedback loop necessary for sustaining cooperation, the level of cooperation also depends on how widely information is shared.

"As a next step, we're interested in learning more about how cognitively inexpensive information-gathering methods, like gossip, can help communities reach consensus about their views of others," Kawakatsu says.

More information: Mari Kawakatsu et al, When do stereotypes undermine indirect reciprocity?, *PLOS Computational Biology* (2024).

[DOI: 10.1371/journal.pcbi.1011862](https://doi.org/10.1371/journal.pcbi.1011862)

Provided by University of Pennsylvania

Citation: New model evaluates how reputation and indirect reciprocity affect cooperative behaviors (2024, March 4) retrieved 27 April 2024 from

<https://phys.org/news/2024-03-reputation-indirect-reciprocity-affect-cooperative.html>

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