Journal of Personality and Social Psychology

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Aleta Pleasant and Pat Barclay

Online First Publication, November 14, 2024. https://dx.doi.org/10.1037/pspi0000470

CITATION

Pleasant, A., & Barclay, P. (2024). Mutual cooperation gives you a stake in your partner's welfare, especially if they are irreplaceable. *Journal of Personality and Social Psychology*. Advance online publication. https://dx.doi.org/10.1037/pspi0000470

AMERICAN PSYCHOLOGICAL ASSOCIATION

Journal of Personality and Social Psychology:
Interpersonal Relations and Group Processes

ISSN: 0022-3514

https://doi.org/10.1037/pspi0000470

Mutual Cooperation Gives You a Stake in Your Partner's Welfare, Especially if They Are Irreplaceable

Aleta Pleasant and Pat Barclay
Department of Psychology, University of Guelph

Why do we care so much for friends—much more than one might predict from reciprocity alone? According to a recent theory, organisms who cooperate with each other come to have a stake in each other's well-being: A good cooperator is worth protecting—even anonymously if necessary—so they can be available to cooperate in the future. Here, we present three experiments showing that reciprocity creates a stake in a partner's well-being, such that people are willing to secretly pay to protect good cooperative partners, if doing so keeps those partners available for future interaction. Participants played five rounds of a cooperative game (Prisoner's Dilemma) and then received an opportunity to help their partner, without the partner ever knowing. In Experiments 1 and 2, participants were more willing to help a cooperative partner if doing so kept that partner available for future rounds, compared to when the help simply raised the partner's earnings. This effect was specific to cooperative partners: The type of help mattered less for uncooperative partners or for recipients that participants did not directly interact with. In other words, an ongoing history of reciprocity gave people a stake in their partner's good condition but not their partner's payoff. Experiment 3 showed that participants had less stake in their partners if those partners could be easily replaced by another cooperator. These findings show that reciprocity and stake are not separate processes. Instead, even shallow reciprocity creates a deeper stake in a partner's well-being, including a willingness to help with zero expectation of recognition. Future work should examine how one's stake in partners is affected by ecological factors that affect the gains of cooperation and the ease of finding new partners.

Keywords: fitness interdependence, cooperation, reciprocal altruism, mutualism, anonymous helping

Supplemental materials: https://doi.org/10.1037/pspi0000470.supp

Why do people help nonrelatives? In terms of the proximate psychological mechanisms, people are motivated to help by their empathic concern for others (e.g., Batson et al., 1997), the warm glow they get when helping (e.g., Andreoni, 1990), the oneness or "self-other merging" they feel with recipients (Cialdini et al., 1997; Whitehouse et al., 2014), a foresighted concern for their reputation as a good person (e.g., Semmann et al., 2004), and other internal emotions including shame and guilt (e.g., de Hooge et al., 2008; Ketelaar & Au, 2003). We can collectively call these our "cooperative sentiments." There are benefits for possessing cooperative sentiments and acting on them—these benefits are the "ultimate cause" or "evolutionary function," which historically caused cooperative sentiments to evolve and could currently cause them to be learned (Barclay, 2012; Scott-Phillips et al., 2011). But what are those benefits, that is, what is the function of helping behavior?

The best-known function of nonkin helping is reciprocity: People who help others tend to receive help (e.g., Axelrod, 1984; Trivers, 1971). However, reciprocity does not seem to characterize a lot of human helping, either on the level of proximate psychology or of evolutionary function. People often feel warmth toward—and help—people whom they have not yet interacted with (reviewed by Raihani & Bshary, 2015). People sometimes help others who will never know about the help (e.g., Raihani, 2014) and therefore cannot be influenced by it. When asked, people report close bonds toward friends, teammates, and others like members of the same

Francesca Righetti served as action editor.

Pat Barclay https://orcid.org/0000-0002-7905-9069

This work was supported by the Social Sciences and Humanities Research Council (Grants 430287 and 430853 awarded to Pat Barclay). The authors thank the Social Sciences and Humanities Research Council of Canada for funding, Cody Fogg for piloting some related ideas, Yuta Kawamura for programming assistance, the makers of oTree software, and the members of the Barclay lab for useful discussion (Laura Frielingsdorf, Angelica Nascimento de Oliveira, Amanda Rotella, Adam Sparks, and Savannah Yerman).

Aleta Pleasant played a lead role in investigation and software and an equal role in formal analysis, methodology, visualization, and writing–original draft. Pat Barclay played a lead role in conceptualization, data curation, funding acquisition, project administration, supervision, validation, and writing–review and editing and an equal role in formal analysis, methodology, visualization, and writing–original draft.

Correspondence concerning this article should be addressed to Pat Barclay, Department of Psychology, University of Guelph, 50 Stone Road East, Guelph, ON N1G 2W1, Canada. Email: barclayp@uoguelph.ca

army company (e.g., Whitehouse et al., 2014), and they seem to help because of these bonds. In fact, when people keep track of favors given and received, it tends to hurt—not help—friendships because it implies that the relationship is a shallow one instead of a deeper friendship (Clark & Mills, 1979). Does this mean that reciprocity is less important in human friendships and helping than researchers have previously believed?

Perhaps reciprocity needs to be better integrated with other ultimate functions of helping, in particular with a stake in others' welfare. Helpers often have a stake in a recipient's welfare: If A provides benefits to B, intentionally or not, then B has a vested interest in helping A so that A is in a better position to provide such benefits (Roberts, 2005). This principle has been invented numerous times under various names, including stake (Roberts, 2005), pseudoreciprocity (Connor, 1986), by-product reciprocity (Sachs et al., 2004), partnership (Eshel & Shaked, 2001), group augmentation (Kokko et al., 2001), interdependence (Aktipis et al., 2018; Brown & Brown, 2006),[1] irreplaceability (Tooby & Cosmides, 1996), and vested interests (Barclay & Van Vugt, 2015). Stake can occur within species, such as when villagers have a vested interest in the soldiers who guard their city and thus benefit from helping those soldiers stay fed, alert, and able to defend the city. It can also occur between species, such as when a tree provides useful shade to those underneath it, such that the shaded organisms benefit from feeding and protecting the tree from herbivores. This is not reciprocity and requires no reputation: The soldiers and the tree can be unaware that their presence benefits others or that they have received help from others; they just act in their own best interest (i.e., stand on guard for their own defense or for a paycheck, grow taller and produce more leaves). But as long as their presence benefits others, then those others have a stake in helping.

Many human interactions are characterized by a stake in another's welfare. For example, spouses have a stake in each other's welfare because they are each other's means to reproduction, and each may take care of their mutual offspring. If one group member provides a public good that others benefit from, such as hunted food that is shared widely in foraging societies, then other group members have a vested interest in helping that good-provider and in nursing them back to health so they can keep providing the public good (Gurven et al., 2000). If two organisms have the same enemy, then one may benefit from helping the other to better fight the common enemy ("the enemy of my enemy is my friend"; Mesterton-Gibbons & Dugatkin, 1992). For example, soldiers rely heavily on each other to survive battles and consequently take great risks to help keep each other alive (Whitehouse et al., 2014). More generally, organisms have a stake in fellow group members whenever larger groups provide better protection against predators and outgroups, more efficient foraging, more sources of information, or any other such benefits (Kokko et al., 2001).

Reciprocity Creates a Stake in One's Partner(s)

It is often hard to tell the difference between stake and reciprocity, and close relationships may have elements of both. In fact, a reciprocity-based relationship can develop into a stake-based relationship: In an established reciprocal relationship, each party has a stake in maintaining the mutually beneficial reciprocal relationship. As such, each party would benefit from unilaterally helping to ensure that the other remains well enough to continue the reciprocity (Barclay, 2020). What starts out as a relationship based on reciprocity can become one based at least partly on stake. This is consistent with how people form friendships: Relationships with acquaintances start based on reciprocity, and as they deepen into friendship, people stop tracking favors and become willing to help unconditionally (Clark & Mills, 1979; see also Roberts & Renwick, 2003). Thus, if it appears that some of the above examples could involve explicit reciprocity instead of stake, then this is not a weakness—it is the main point of this article that one leads to the other.

Some additional examples can help explain how reciprocity—or anticipation of reciprocity—can create a stake in one's partner. Imagine a small-town farmer and grocer engaged in a purely economic exchange: The grocer gives the farmer money in exchange for produce. Despite its pure economic nature, each party has a stake in the other's welfare: The farmer needs a distributor, and the grocer needs a supplier. If the farmer's tractor breaks down or the grocer's shop burns down, then the other's business will suffer. As such, the grocer benefits from preventing harm to the tractor and the farmer benefits from preventing fire or from rebuilding the shop—all well outside the bounds of their reciprocal exchange—so that their economic exchange can continue. Each has a stake in helping the other and in preventing harm against them.

A similar argument holds with other examples, like two allies supporting each other in conflict, two parents caring for mutual offspring, or two people in a small-scale subsistence society sharing food or resources (e.g., "osotua" relationships among the Maasai, Aktipis, 2016; Aktipis et al., 2011). The relationship could be based entirely on reciprocity: Each party helps the other solely out of expectation that the other do the same. However, if one becomes incapacitated, the other loses a source of aid. As such, it is worthwhile for the other to prevent that incapacitation—well outside the bounds of the relationship—if the cost of doing so is outweighed by the long-term value of the relationship. At the same time, it is only worth helping a reciprocator: It is not worth it to save a partner if that partner were to start defecting, for example, if the farmer stopped producing quality food, if an ally refused to aid in conflict or in a time of need, if a friend stopped returning favors, or if a (divorced) coparent stopped caring for their mutual offspring.

How much is a reciprocal partner worth, and how big a cost is it worth spending to save them? Barclay (2020) provided a very simple model based on partners exchanging help in a Prisoner's Dilemma-like scenario. If it costs c to confer benefit b on someone, then two people helping each other will earn $b - c$ in each round of interaction. If they can expect to interact for n future rounds on average, and these are jeopardized by a partner's incapacitation, then it is worthwhile to spend any cost up to $n(b - c)$ to save a partner and prevent that incapacitation.[2] This simple model shows that organisms should be more willing to help partners who provide more benefits (high b),

[1] This is sometimes called "fitness interdependence" (e.g., Aktipis et al., 2018) because one party's well-being increases another party's fitness, that is, their reproductive success. However, strictly speaking, their *fitness* may be irrelevant: If someone provides you with benefits, then you have a stake in their *well-being* (i.e., keeping them in good condition to provide benefits), but usually not their *reproduction* (Barclay, 2020). Therefore, a better term would be "well-being interdependence" or "condition interdependence": Your condition depends on their condition, but your reproduction does not depend on their reproduction.

[2] Individuals do not need to know the exact length of the interaction: If the interaction has a probability w of continuing after each round, then $n = 1/(1 - w)$, such that it is worthwhile to pay any cost up to $(b - c)/(1 - w)$ (Barclay, 2020).

are easy to help (low c), and with whom they might interact for a long time (high n).

Anonymous Helping as a Test for Stake

Reciprocity and stake-based helping are similar in many ways. In theory, they can both occur within species or between species. They can both involve helping in the same currency or in different currencies like food versus bodily grooming versus coalitional support (e.g., Schino, 2007). They might sometimes even be triggered by the same proximate psychological mechanisms (e.g., same brain areas, same emotions like "attitudinal reciprocity"; de Waal, 2000), though this remains to be empirically tested.

There is, however, one key difference between reciprocity and stake-based helping: The latter does not need to be observed to be worthwhile. In reciprocity, both parties must notice that their partner cooperated and then selectively cooperate with those who are seen to reciprocate (Cosmides & Tooby, 1992). This is not the case with stake-based helping: The recipient can be oblivious about receiving help. With stake-based helping, the helper is repaid by the fact that they have helped the recipient to keep providing benefits (Barclay, 2020) or to become better at doing so.

For example, if you benefit from a tree's shade, then it pays to protect that tree from herbivores, even if the tree has no way of detecting your help. Your help need not be observed for it to be worthwhile—it is help without any expectation of recognition or gratitude because you are repaid by the ongoing existence of shade. In the example of economic exchange, if the farmer's tractor is at risk of breaking down, then it is worthwhile for the grocer to repair it or prevent damage (e.g., by improving roads), even if the farmer will never know what the grocer did or how it helped—the grocer's help is repaid by the fact the economic exchange continues unabated. If the grocery burns down, then the farmer benefits from rebuilding it, even if she has to do so secretly at night. Such unobserved helping would not be worthwhile for reciprocity reasons alone, because, by definition, unobserved helping cannot trigger reciprocity. As such, if helping cannot be detected by the recipient, then that is more indicative of stake than of reciprocity (unless it is a mistake; see Barclay & Van Vugt, 2015).

Another key difference between reciprocity and stake-based helping is the goal of helping: to pay back past help (reciprocity) or to maintain or increase a partner's ability to help (stake). With stake, organisms have little interest in their partner's payoff, utility, or reproduction—only in their partner's condition and ability to help (Barclay, 2020). As such, people may increase others' payoffs out of reciprocity, but not because of stake. (The exception is if people somehow have a stake in others' payoffs or reproduction, as opposed to just their condition, state, or well-being.) Thus, if helping is selectively given when it keeps a partner around or improves their condition, but not when it simply increases a recipient's payoff or reproduction, then that is more indicative of stake than reciprocity.

The Present Studies

This article tests the idea that having a reciprocal relationship with someone will give people a stake in the recipient, such that they will be more willing to anonymously help good reciprocators than defectors or people they have not interacted with. However, people obviously also reciprocate helping more often toward cooperators than defectors (e.g., Axelrod, 1984). As such, we need to distinguish between increased helping due to reciprocity and increased helping due to stake. We do so in two ways.

First, we compare two different forms of helping: help that affects the recipient's ability to continue the interaction versus help that simply affects the recipient's payoff. Stake-based helping will preferentially affect the former, whereas reciprocity will affect both forms of help equally (assuming equal costs and benefits). Second, we only use unobserved helping as our dependent variable—not observed helping—because the former cannot elicit reciprocation. True, people might make a mistake and anticipate reciprocation even when they are anonymous (see "mistakes," e.g., Barclay & Van Vugt, 2015), but if so, then this should happen equally in all conditions—there is no reason for such mistakes to occur more frequently with one kind of help (i.e., with help that keeps a partner available for interactions). Thus, we predict that people will be most likely to anonymously help those with whom they have a history of successful reciprocity (as opposed to no such history), but only when doing so affects the other's ability to keep reciprocating (e.g., ability to maintain the interaction).

In three experiments, we let participants establish (non-)cooperation by having pairs play several rounds of a Prisoner's Dilemma Game involving money. After several rounds, one partner has the chance to anonymously help the other, such that the other partner will never know they needed or received help. In Experiment 1, this anonymous helping can either increase the partner's earnings (Control Condition) or increase the partner's likelihood of remaining in the game for future rounds (Interdependence Condition). We predict that people will be more likely to help in the Interdependence Condition than in the Control Condition, but only in cooperative pairs—there is no reason to help keep an uncooperative partner around. Experiment 2 replicates Experiment 1 and adds an Asocial Control Condition where participants first interact with a computer before having the chance to anonymously help a human partner. Experiment 3 tests the replaceability of the partner (Barclay, 2020): We predict that people will be most likely to help irreplaceable cooperative partners, less likely to help cooperative partners who can be replaced by other cooperators, and least likely to help uncooperative partners (especially if those uncooperative partners can be replaced). All hypotheses and analyses were preregistered at https://osf.io/q3s2u/?view_only=43cb3cab12064f459d966a96f77dc3ad, which also hosts the data. We report how we determined our sample size, all data exclusions, all manipulations, and all measures in our experiments.

Experiment 1

Experiment 1: Method

Participants, Earnings, and Power Analysis

We recruited 700 participants from the online crowdsourcing website MTurk, 478 of whom passed our comprehension checks and participated (171 females, 301 males, six did not disclose their gender; age range = 18–70, $M_{age} = 36.79 \pm SD = 11.03$ years). Of the comprehension failures, 4% (8/222) did not respond and 60% (133/222) failed because they gave implausible responses that did not correspond to any payoffs in the instructions, suggesting that they did not read the instructions. As such, our comprehension check was passed by 87% of participants who gave sensical

responses. Based on our power analysis conducted with G*Power, we ran a total of 238 participants who made a consequential helping decision (119 helpers per condition; Erdfelder et al., 1996). We collected data until we had a minimum of 50 cooperative dyads in each condition, which would give us 85% power to detect a difference in proportion of 50% versus 80% (G*Power 3.1.9.7; Erdfelder et al., 1996). We oversampled to ensure that we had enough who passed the comprehension checks. The sample size was unequal between conditions because participants chose their own level of cooperativeness.

Participants received a base pay of $1 USD for participation, plus additional money throughout the game based on their decisions and the decisions of their partners; earnings ranged from $1 USD–$1.62 USD (M = $1.26 USD ± SD = $0.15 USD). Participants did not know each other and could not communicate. There was no deception in any of the experiments: Everything we told the participants was true. These methods were approved by the Research Ethics Board of the University of Guelph.

Experimental Task: Prisoner's Dilemma With an Opportunity to Secretly Help

Participants were paired to play a seven-round Prisoner's Dilemma Game online using oTree software (Chen et al., 2016; see Supplemental Material for the game instructions). Participants begin the game with an endowment of 10¢. In each round, participants independently chose to either cooperate or defect. If both chose to cooperate, they both received 4¢. If one partner chose to cooperate and the other chose to defect, the cooperator lost 2¢ and the defector gained 8¢. If both defected, then neither earned additional money that round. With this payment structure, mutual cooperation pays better than mutual defection, but an individual can earn more in any one round by defecting, regardless of what their partner did that round. These stakes are fairly typical on MTurk and other crowdsourcing sites. Participants did not know the number of rounds they would play.

After the fifth round, one randomly selected member of each pair received an opportunity to secretly help their partner, that is, the partner would never know if they received help, or even that there was an opportunity to do so. In the Control Condition, this opportunity to help was as follows: "Would you like to pay 3¢ to increase your partner's final earnings by 7¢?" In the Interdependence Condition, this opportunity was as follows: "Your partner only has a 10% chance of surviving into the next round. If your partner survives, you will both continue to the next round. If your partner does not survive, then there will be no more rounds because you will have no one to interact with. Would you like to pay 3¢ to increase your partner's chance of survival from 10% to 90%?" We chose these ratios (3¢–7¢ and 3¢ to an 80% increase in survival) to be roughly equivalent in terms of their effects on one's partner. Because cooperative partners earn 4¢/round, an 80% increased chance of survival is worth an expected 3.2¢/round, which across two rounds equals 6.4¢ to one's partner. Participants were explicitly told the following: "Your partner does not know you have been asked this question, and your response to it will remain anonymous."

Postexperimental Survey

After seven rounds of the Prisoner's Dilemma, participants responded to a researcher-generated exit survey. This survey included a comprehension check, demographic questions (age, sex), and 4 Likert scale measures of perceived interdependence (−3 to +3; e.g., "What was good for my partner was good for me") drawn from Ayers et al. (2023). See Supplemental Material for the survey.

In the main task, only one member of each pair had received the chance to secretly help their partner. To collect secret helping decisions from all participants, we asked the remaining participants the hypothetical question of what they would do if they were given the opportunity to secretly help their partner. In the Control Condition, this was as follows: "Imagine you had the opportunity to pay 3¢ to increase your partner's final earnings by 7¢, would you?" In the Interdependence Condition, this was as follows:

> Imagine you were still playing the game and your partner only had a 10% chance of surviving into the next round, but you could pay 3 cents to give them a 90% chance of surviving. If they survived, you would both continue to the next round. If they did not survive, then there would be no more rounds because you would have no one to interact with. Would you have been willing to pay 3 cents to increase their probability of survival from 10% to 90%?

As preregistered, we used the results of these hypothetical questions as a robustness check, and they were similar to those of the incentivized question in the main task—see Supplemental Results for details.

Statistical Analyses

We analyzed the data using R Version 3.6.1 (R Core Team, 2019), along with the packages reghelper (Hughes, 2020) and car (Fox & Weisberg, 2019), and confirmed them with a manual calculation of Fisher's exact test with confidence intervals. Because people only have an incentive to save good partners (Barclay, 2020), we categorized each pair as either cooperative or uncooperative based on whether the pair had mutually cooperated in most of the five rounds before the secret opportunity to help (Coperative dyads: ≥3 rounds of mutual cooperation; Uncooperative dyads: ≤3 rounds of mutual cooperation). We present odds ratios and their 95% confidence intervals.

The analysis in the main text deviates from our preregistered analyses for Experiment 1 because we realized afterward that Fisher's exact tests are easier to present. We present our preregistered analyses in Supplemental Material as robustness checks, because they produce the same results as those in the main text. The analyses for Experiments 2 and 3 follow the preregistrations for those experiments. All data and analysis plans are available at https://osf.io/q3s2u/?view_only=43cb3cab12064f459d966a96f77dc3ad.

Experiment 1: Results

If reciprocity creates stake, partners will be more willing to pay a personal cost to anonymously increase a good partner's availability or survival (relative to when helping does not increase availability). In support of this preregistered prediction, partners in cooperative dyads were more willing to help a partner in the Interdependence Condition relative to the Control Condition (83% vs. 49%, Fisher's exact test $p = .0002$, $OR = 5.09$, 95% CI [2.02, 13.90]; see Table 1). By contrast, if a relationship lacks reciprocity, each partner has little stake in their partner's well-being, so it matters little whether the

Table 1
Proportion of Help Provided in Cooperative and Uncooperative Dyads in Experiment 1

Type of dyad	Interdependence Condition Proportion help	Control Condition Proportion help	*OR* [95% CI]
Cooperative dyads	45/54 (83%)	31/63 (49%)	**5.09*** [2.02, 13.90]**
Uncooperative dyads	34/65 (52%)	23/56 (41%)	**1.57 [0.72, 3.45]**
OR [95% CI]	**4.50*** [1.80, 12.24]**	**1.39 [0.63, 3.06]**	

Note. CI = confidence interval. Values in bold represent the odds ratio and 95% confidence interval of the comparison of proportions.
*** $p < .001$.

help increases a partner's availability. In support of this prediction, within uncooperative dyads, helping did not differ between the Interdependence Condition and the Control Condition (52% vs. 41%, $p = .27$, $OR = 1.57$, 95% CI [0.72, 3.45]). There was more helping in cooperative dyads than uncooperative dyads in the Interdependence Condition (83% vs. 52%, $OR = 4.50$, 95% CI [1.80, 12.24]), but not in the Control Condition (49% vs. 41%, $OR = 1.39$, 95% CI [0.63, 3.06]); this effect is not just a selection bias because it also occurs among first-round cooperators (see Supplemental Analysis S.5). As predicted, the effect of a cooperative partner (compared to an uncooperative partner) is greater in the Interdependence Condition, which is significant with a directional test and in our robustness checks (interaction $z = 1.83$, one-tailed $p = .035$; see also Supplemental Analyses S.3 and S.4.1–S.4.3).

The Supplemental Material presents three successful robustness checks: Supplemental Material S.4.1 compares completely cooperative versus uncooperative dyads (i.e., five rounds of mutual cooperation or defection), Supplemental Material S.4.2 includes the hypothetical decisions from participants who did not have the opportunity to anonymously help, and Supplemental Material S.4.3 presents an analysis of the number of rounds of mutual cooperation (i.e., not just binary coding). The Supplemental Material also presents a secondary preregistered analysis showing that perceived interdependence predicts people's willingness to secretly help a partner (Supplemental Material S.6).

Experiment 1: Discussion

The results supported our main hypothesis: When pairs have a history of reciprocal cooperation, they come to have a stake in each other's welfare. This stake makes them more willing to help—even secretly—but only if doing so keeps that good partner available for future cooperation. When helping only increases a partner's earnings but not their survival or availability, prior cooperation matters less. In other words, reciprocity creates a stake in a partner's good condition.

One limitation of Experiment 1 is that the Control Condition and the Interdependence Condition required different wording (e.g., a partner's "survival"), which could have affected participants' time horizons, perceptions of mortality, or desire to cooperate to overcome a common threat (e.g., Barclay & Benard, 2013, 2020). Alternately, participants might have perceived the incentives differently—their partner would receive 7¢ versus an unspecified number of additional rounds. Experiment 2 overcame this limitation by using the same wording and structure of the helping decision but by comparing people who do versus do not interact.

Experiment 2

Experiment 2 had two goals. First, it replicated Experiment 1. Second, it added an additional Control Condition to ensure that Experiment 1's results were not just due to the wording of the question or the incentives. More specifically, Experiment 2 included an Asocial Condition: Helping decisions had the exact same wording and incentives as the Interdependence Condition, except they were directed toward someone with whom the participant did not directly interact.

Experiment 2: Method

Participants, Earnings, and Power Analysis

We recruited 741 participants from the online crowdsourcing website Prolific Academic, 592 of whom (80%) passed our comprehension checks and participated (237 females, 348 males, seven did not disclose their gender; age range = 18–69, M_{age} = 25.72 ± SD = 8.34 years). Participants received a base pay of $1.09 USD for participation, plus additional money throughout the game based on their decisions and the decisions of their partners; earnings ranged from $1.09 USD to $1.86 USD ($M$ = $1.44 USD ± SD = $0.24 USD); this is slightly higher than Experiment 1 because of the different platform and inflation. We used the proportions of help from Experiment 1 to conduct our power analysis in G*Power (Erdfelder et al., 1996). We required a minimum of 53 cooperative dyads in each of the Control Condition and the Interdependence Condition and 53 dyads in the Asocial Condition to achieve a power of .95 to detect an odds ratio of 4.50 at $\alpha = .05$. Participants also completed a similar postexperimental survey to that in Experiment 1, except using Ayers et al.'s (2023) complete interdependence scale on a 1–7 Likert scale.

Experimental Task and Conditions

Experiment 2 used the same seven-round Prisoner's Dilemma as in Experiment 1, and it had the same opportunity to secretly help one's partner after Round 5. The Control and Interdependence Conditions were the same, except that we raised the cost of helping: It now costs 5¢ to help, which raised either the partner's earnings by 7¢ (Control Condition) or the partner's chance of being available in future rounds from 10% to 90% (Interdependence Condition).

Most importantly, we added a second Control Condition: the Asocial Condition. In the Asocial Condition, participants did a task with a computer, which did not involve cooperation. Instead of cooperating or defecting each round, participants chose to do "A" or

"B," and the computer would randomly select "A" or "B." If both selected A, then the participant earned 10¢. If the participant selected "A" and the computer selected "B," then the participant lost 2¢. If the participant selected "B," they earned 4¢ regardless of what the computer selected. We chose these payoffs so the average value per round was equal to the value per round in a mutually cooperative dyad in the other conditions (i.e., 4¢/round). This allowed us to standardize the value of helping a participant; thus, any difference we find cannot be attributed to a difference in the effect it has on one's partner. We told participants in the Asocial Condition that they were "paired" with another person, but this only meant that the other person did the same task at the same time. After five rounds, participants in the Asocial Condition received the same opportunity to secretly help as in the Interdependence Condition: They could pay 5¢ to increase their "partner's" probability of survival from 10% to 90%. However, unlike the Interdependence Condition, they had no history of reciprocation with that partner and no potential benefit from future cooperation with them.

Experiment 2: Results

As in Experiment 1, players in cooperative dyads were more willing to secretly help a partner in the Interdependence Condition relative to the Control Condition (91% vs. 63%, Fisher's exact test $p = .001$, $OR = 5.56$, 95% CI [1.79, 20.85]; see Table 2). Unlike in Experiment 1, uncooperative dyads were also more willing to help in the Interdependence Condition than in the Control Condition (68% vs. 49%, Fisher's exact test $p = .04$, $OR = 2.20$, 95% CI [1.01, 4.86]), though this effect was smaller than for cooperative dyads (see Supplemental Section S.4). As in Experiment 1, there was more helping in cooperative dyads than uncooperative dyads in the Interdependence Condition, but not in the Control Condition (Interdependence: 91% vs. 68%, Fisher's exact test $p = .004$, $OR = 4.46$, 95% CI [1.49, 16.25]; control: 63% vs. 49%, Fisher's exact test $p = .18$, $OR = 1.75$, 95% CI [0.77, 4.07]; interaction $z = 1.63$, directional one-tailed $p = .05$). These effects largely replicate Experiment 1, are confirmed with the same robustness checks, and are even stronger among first-round cooperators, and the interaction is highly significant in multiple internal meta-analyses (see Supplemental Material S.3, S.4, S.5).

The novel addition of Experiment 2 is the Asocial Condition, which allows us to test whether the higher helping in the interdependence question is simply due to the nature of the question (i.e., to help a partner "survive"). As predicted, cooperative dyads were more willing to secretly help in the Interdependence Condition than in the Asocial Condition, whereas uncooperative dyads were equally likely to help in both conditions (cooperative: 91% vs. 69%, Fisher's exact test $p = .008$, $OR = 4.35$, 95% CI [1.38, 16.51]; uncooperative: 68% vs. 69%, Fisher's exact test $p = 1.0$, $OR = .98$, 95% CI [0.43, 2.23]). This shows that it is specifically the experience of reciprocated cooperation that gives people enough stake to secretly help their partner survive and be available, not the nature of the question nor unreciprocated cooperation.

Experiment 2: Discussion

Experiment 2 replicated Experiment 1. Experiment 2 also showed that it is specifically past cooperation that makes people more willing to help a partner survive (i.e., continue the game), not just the nature of the question. Past cooperation makes a partner valuable and therefore worth paying to save.

Experiment 3

So far, there is one unstated assumption in our logic: that good partners cannot easily be replaced. In some environments, it is easy to find new partners; in other environments, it is hard. Also, while some environments have many cooperators, other environments have few. Barclay's (2020) mathematical model predicts that both of these should affect people's willingness to save an existing partner. In particular, when cooperators are common, organisms will have less stake in an existing good partner, because any replacement partner will be just as good as an existing good partner. When it is easy to replace a partner, organisms have less stake in those partners because one will not be alone for long. Therefore, when cooperators are common and it is easy to start new relationships, people will be less willing to save their existing partners. In fact, one might even benefit from hastening the demise or departure of a bad partner, so that one can replace them with a better partner! By contrast, when cooperators are rare, any replacement partner is likely to be bad, so it is worth keeping a good partner around.

Experiment 3 tests these hypotheses by adding replacement partners: If a participant's current partner does not survive in the game, they can be paired with someone new for any subsequent rounds. This replacement partner can be either a cooperator or a defector. Our preregistered prediction is that the presence of a good replacement will make people less willing to save a good partner, but the presence of a bad replacement will not have that effect. Similarly, we predict that the presence of replacement partners will also make people less willing to save a bad partner—why save a bad partner if you could replace them with someone better?

Table 2
Proportion of Help Provided in Cooperative and Uncooperative Dyads in Experiment 2

Type of dyad	Interdependence Condition Proportion help	Control Condition		Asocial Condition	
		Proportion help	*OR* versus Interdependence	Proportion help	*OR* versus Interdependence
Cooperative dyads	48/53 (91%)	34/54 (63%)	**5.56** [1.79, 20.85]**	37/54 (69%)	**4.35** [1.38, 16.51]**
Uncooperative dyads	49/72 (68%)	27/55 (49%)	**2.20* [1.01, 4.86]**		**0.98 [.43, 2.23]**
OR [95% CI]	**4.46** [1.49, 16.25]**	**1.75 [.77, 4.07]**			

Note. CI = confidence interval. Dyads in the Asocial Condition cannot be classified as cooperative or uncooperative because there is no interaction. Values in bold represent the odds ratio and 95% confidence interval of the comparison of proportions.
* $p < .05$. ** $p < .01$.

Experiment 3: Method

Participants, Earnings, and Power Analysis

We recruited 2,167 participants from the online crowdsourcing website Prolific Academic, 1,429 of whom completed the experiment and passed our comprehension checks (533 females, 883 males, 13 others or prefer not to respond; age range = 15–73, M_{age} = 27.0 ± *SD* = 9.0 years). Most people who "failed" the comprehension check completed no questions (412/736, 56%), for example, because they dropped out or could not start the experiment because the session did not fill in time; another 42 (6%) gave nonsensical answers, such that our comprehension checks were passed by at least 83% of people who seriously attempted. Participants received a base pay of £0.84 for participation, plus additional money throughout the game based on their decisions and the decisions of their partners; this additional money ranged from £0.01 to £0.48 (*M* = £0.17 ± *SD* = £0.08).[3]

As in Experiment 2, we preregistered that we would collect data from 53 cooperative dyads for each type of replaceability (see the next section for the experimental conditions). According to G*Power (Erdfelder et al., 1996), this would give us 95% power to detect a difference in proportion of 90% versus 60%. We had uneven sample sizes across conditions because the classification of a dyad depended on participants' past behavior, and the classification of a replacement partner depended on that person's prior behavior—most replacement partners were cooperative, such that we have many more of those dyads. We collected data until we had at least 53 pairs in all conditions where partners were replaced, which were the most theoretically important.

Experimental Task and Conditions

Experiment 3 used the same seven-round Prisoner's Dilemma and payoffs as in Experiments 1 and 2, including the secret opportunity to help after Round 5. We kept the same Interdependence and Asocial Conditions as before, where there were no replacement partners. However, we added two new variations on the Interdependence Condition, in which participants could replace a partner who did not survive. This replacement partner had previously played a one-round online Prisoner's Dilemma with someone else. Thus, participants in these two conditions would play the final rounds of the Prisoner's Dilemma either with their existing partner if that partner survived or with someone else if their existing partner did not survive.

In the Bad Replacement Condition, the replacement partner had defected in their one-round Prisoner's Dilemma; participants could infer that this defector was probably a bad partner, so their existing good partner could not be simply replaced with another good partner. In the Good Replacement Condition, the replacement partner had cooperated in that one-round Prisoner's Dilemma; participants could infer that this cooperator was probably a good partner, so their existing good partner was replaceable. See Supplemental Section S.7 for the screenshots.

In all three interactive conditions (Interdependence, Bad Replacement, Good Replacement), we categorized dyads as being either cooperative or uncooperative in the first five rounds (cooperative: ≥3 rounds in mutual cooperation vs. ≥3 rounds with some defection). Thus, we had a total of six conditions where participants interacted (cooperative vs. uncooperative dyads in the Interdependence, Bad Replacement, and Good Replacement Conditions), plus the Asocial Condition as a control seventh condition. We predicted that participants would be more likely to help keep a good partner alive if they could not replace their partner or if the replacement was a defector than if the replacement was another cooperator (cooperative partners: Interdependence Condition ≈ Bad Replacement Condition > Good Replacement Condition). We also predicted that participants would be less likely to help keep a bad partner alive if they could be replaced, especially if the replacement was a cooperator (uncooperative partners: Interdependence Condition > Bad Replacement Condition > Good Replacement Condition).

Experiment 3: Results

Helping Good Partners When Replacements Are Available

As predicted, participants were less willing to help a cooperative partner when there was a good replacement available than when there was no replacement or a bad replacement (Good Replacement vs. Interdependence: 76% vs. 100%, Fisher's exact test $p < .001$, $OR = 35.01$, 95% CI [2.09, 586.65]; Good Replacement vs. Bad Replacement: 76% vs. 92%, Fisher's exact test $p = .01$, $OR = 3.88$, 95% CI [1.28, 11.79]; Tables 3 and 4). Participants were slightly less willing to help a cooperative partner when there was a bad replacement available than when there was no replacement, but this was only marginally significant due to ceiling effects (Bad Replacement vs. Interdependence: 92% vs. 100%, Fisher's exact test $p = .057$, $OR = 9.91$, 95% CI [0.52, 188.76]).

Helping Bad Partners When Replacements Are Available

Our predictions were also confirmed about uncooperative partners. Participants were more willing to help an uncooperative partner if there was no replacement available than if there was a replacement, regardless of whether that replacement partner was bad or good (Interdependence vs. Bad Replacement: 68% vs. 37%, Fisher's exact test $p = .004$, $OR = 3.62$, 95% CI [1.56, 8.42]; Interdependence vs. Good Replacement: 68% vs. 31%, Fisher's exact test $p < .001$, $OR = 4.77$, 95% CI [2.15, 10.56]). Contrary to our predictions, there was no significant difference between the Bad Replacement and Good Replacement Conditions (37% vs. 31%, Fisher's exact test $p = .48$, $OR = 1.32$, 95% CI [0.66, 2.63]).

Comparisons With No Interaction (Asocial Condition)

Cooperative Partners. Participants were more willing to help a good partner they could not replace, or could not replace with a good partner, than to help a "partner" they did not interact with (Interdependence vs. Asocial: 100% vs. 62%, Fisher's exact test $p < .001$, $OR = 66.06$, 95% CI [3.86, 1130.00]; Bad Replacement vs. Asocial: 92% vs. 62%, Fisher's exact test $p < .001$, $OR = 7.42$, 95% CI [2.33, 23.70]). However, when they could replace their partner with another good partner, they were only marginally more willing to help their partner than they were to help someone they did not interact with (Good Replacement vs. Asocial: 76% vs. 62%, Fisher's

[3] Twenty-two participants had a base pay of £1.00, and 10 had a base pay of £1.27 because their groups took much longer and Prolific demanded they be paid accordingly. If a participant dropped out or their session did not fill in time, they received only their base pay but no additional money.

Table 3
Proportion of Help Provided in Cooperative and Uncooperative Dyads in Experiment 3

Experimental condition	Cooperative partner	Uncooperative partner
Interdependence Condition	100% $(54/54)_{A}$	68% $(28/41)_{Bb}$
Bad Replacement Condition	92% $(49/53)_{a}$	37% $(22/59)_{c}$
Good Replacement Condition	76% $(82/108)_{B}$	31% $(28/90)_{c}$
Asocial Condition	62% $(33/53)_{b}$	

Note. Conditions are significantly different if they do not share a subscript letter and are marginally significantly different if they share the same subscript letter but only in a different case (i.e., uppercase vs. lowercase); see statistics in Table 4. Dyads in the Asocial Condition cannot be classified as cooperative or uncooperative because they did not interact.

exact test $p = .094$, $OR = 1.91$, 95% CI [0.94, 3.89]). This suggests that when participants could replace their partner with someone equally good, they valued their existing partner only slightly more than their baseline value for people—their partner's replaceability undermined most of their stake in that partner.

Uncooperative Partners. Participants were more willing to help a "partner" they did not interact with than to help an uncooperative and replaceable partner, regardless of whether the replacement was bad or good (Asocial vs. Bad Replacement: 62% vs. 37%, Fisher's exact test $p = .014$, $OR = 2.78$, 95% CI [1.29, 5.97]; Asocial vs. Good Replacement: 62% vs. 31%, Fisher's exact test $p < .001$, $OR = 3.65$, 95% CI [1.79, 7.45]). This suggests that participants have *less* stake in replaceable bad partners than they do in random other people. However, it seems to be just the replaceability that has this effect: Participants were approximately equally willing to help an irreplaceable but uncooperative partner and a "partner" they did not interact with (Interdependence vs. Asocial: 68% vs. 62%, Fisher's exact test $p = .66$, $OR = 1.31$, 95% CI [0.55, 3.09]).

Helping Good Versus Bad Partners

Unsurprisingly, participants were more willing to pay to help cooperative partners than uncooperative partners in all conditions (Interdependence: 100% vs. 68%, Fisher's exact test $p < .001$, $OR = 51.63$, 95% CI [2.96, 900.53]; Bad Replacement: 92% vs. 37%, Fisher's exact test $p < .001$, $OR = 20.60$, 95% CI [6.54, 64.92]; Good Replacement: 76% vs. 31%, Fisher's exact test $p < .001$, $OR = 6.48$, 95% CI [3.49, 12.04]). Unlike in Experiments 1 and 2, this was expected in all conditions because helping would keep that good partner around (we did not run the Control Condition in Experiment 3 because it was largely redundant with the Asocial Condition).

Experiment 3: Discussion

Experiment 3 shows that people have less stake in their partners when those partners can be replaced. In particular, participants paid to help their partner less often if there was a *good* replacement available. These results held for both good and bad existing partners: Good partners are not as valuable if they can be replaced by someone equally good, and bad partners are detrimental if there is someone better to interact with instead. In fact, when participants could replace a bad partner, this made them less willing to help that bad partner than to help someone with whom they had no interactions.

General Discussion

Across three experiments, we showed that reciprocity creates a stake in one's partner: Pairs of reciprocators were more likely to anonymously help each other than were pairs of nonreciprocators or pairs who had not interacted—but only when that helping would keep the good partner available and able to continue reciprocating. Prior cooperation had much less effect when anonymous helping only increased a partner's earnings instead of their ability to keep reciprocating. This supports our hypothesis that people come to have a stake in their reciprocal partners and become willing to help them even outside the reciprocal relationship, if doing so will preserve that reciprocal relationship. In other words, reciprocity creates stake. However, participants' stake in their partner depended on that partner being irreplaceable (Tooby & Cosmides, 1996): Participants were less willing to help their partners if they could easily replace that partner with another cooperator.

The Supplemental Material presents evidence on the underlying proximate psychological mechanisms. Participants felt more interdependent with their partners if they had experienced previous cooperation, and it appears that experiencing mutual cooperation caused perceived interdependence rather than vice versa (Cohen's d ranging from 0.93 to 1.59; see Supplemental Material S.6.1). Furthermore, perceived interdependence was correlated with participants' helping behavior in all conditions and experiments (Cohen's d ranging from 0.54 to 1.09; see Supplemental Material S.6.2). As such, perceived interdependence could be one proximate

Table 4
Odds Ratios [and 95% CI] of Comparisons Between Conditions of Help Provided in Experiment 3

Experimental condition	Interdependence Condition	Bad Replacement Condition	Good Replacement Condition	Asocial Condition
Interdependence Condition	51.63^{***} [2.96, 900.53]	3.62^{**} [1.56, 8.42]	4.77^{***} [2.15, 10.56]	1.31 (n.s.) [0.55, 3.09]
Bad Replacement Condition	$9.91^{\dagger}$ [0.52, 188.76]	20.60^{***} [6.54, 64.92]	1.32 (n.s.) [0.66, 2.63]	2.78^{*} [1.29, 5.97]
Good Replacement Condition	35.01^{***} [2.09, 586.65]	3.88^{*} [1.28, 11.79]	6.48^{***} [3.49, 12.04]	3.65^{***} [1.79, 7.45]
Asocial Condition	66.06^{***} [3.86, 1130.00]	7.42^{***} [2.33, 23.70]	$1.91^{\dagger}$ [0.94, 3.89]	No comparison, see note

Note. CI = confidence interval. Comparisons below the diagonal (green fill) represent cooperative dyads in different conditions, comparisons above the diagonal (blue fill) represent uncooperative dyads in different conditions, and comparisons in the diagonal (no fill) represent the cooperative versus uncooperative dyads within the same condition. Dyads in the Asocial Condition cannot be classified as cooperative or uncooperative because they did not interact; the same condition is compared with both cooperative and uncooperative dyads in other conditions. Statistics represent the odds ratios [and 95% confidence intervals of the odds ratios] and the p values of Fisher's Exact test. For raw data, see Table 3. n.s. = not significant. See the online article for the color version of this table.
$^{\dagger} p < .10$. $^{*} p < .05$. $^{**} p < .01$. $^{***} p < .001$.

psychological mechanism that promotes cooperation and whose ultimate function is to cause people to reap the long-term benefits of stable reciprocal cooperation. Future work should examine how aware people are about how self-serving their actions are, or even how self-serving their emotional responses are.

We also differentiate between help that improves another's condition or ability to reciprocate and help that simply increases another's payoff—people have a stake in the former but not often in the latter. In the real world, this could be instantiated as a partner's embodied or social capital versus their reproduction—good condition may increase one's reproduction, but reproduction will rarely increase one's condition. We look forward to future work that differentiates between these two types of gains, for example, by differentiating between cooperation that relies on observation and reputation (e.g., reciprocity, signaling) and cooperation that relies on some stake in the recipient, and how the two types interact (e.g., Barclay, 2020; Rotella et al., 2020). We also look forward to future studies on how others judge stake-based cooperation compared to other types of cooperation; stake-based helping should only be judged positively by the recipient, for whom it predicts future cooperation (Barclay et al., 2021), but not by third parties, for whom it represents an ulterior motive (see Lin-Healy & Small, 2012, 2013).

Factors That Affect the Amount of Stake

How much stake do you have in a partner? This depends on how good and how replaceable they are. Experiment 3 showed that people will save a cooperative partner if that partner cannot be replaced, or if the only replacement is a defector, but were less willing to save their partner if other cooperators are available. The quality of partners and ease of replacing them can vary between individuals, pairs, and cultures.

On a cultural level, it is easier to find new social partners in some ecologies and some cultures. Friendships start with low cooperation that builds over time as trust deepens (see "Raise the Stakes" models of cooperation; Roberts & Renwick, 2003; Roberts & Sherratt, 1998), but cultures vary in both the initial cooperation and the rate of deepening. For example, some cultures have "high relational mobility," which means that people are socially mobile and can easily change associates, whereas other cultures have "low relational mobility" and tend to keep the same associates for their lifetime (e.g., Thomson et al., 2018). Also, people are more cooperative in some cultures than others, such as people in collectivistic countries showing lower general trust toward strangers than people in individualistic countries (e.g., Yamagishi, 2017). Our results suggest that people will have more stake in their partners in societies with low relational mobility or with low general trust: It is harder to find good replacement partners in such societies, and it takes longer to rebuild the new relationship to the depth of the previous one. When there is a risk of partnerships ending, people may actively signal their stake in others' welfare to be trusted by others, and they may demand more signals from others that they are valued (Barclay et al., 2021).

Furthermore, some socioecological circumstances require more cooperation than others, such as when the subsistence style requires collaborative hunting, cooperative barn-building, mutual defense, risk-pooling, or other such forms of mutual cooperation. All else equal, the more that people rely on others for their survival and well-being, the more stake they will have in each other. For example, we might predict people to have more stake in others when disasters, droughts, and hardships are more common such that reciprocal cooperation creates a useful form of risk-pooling. These ideas could be tested in future cross-cultural studies.

On an individual level, some people are more desirable as social partners: They have higher "market value" because they are more willing or more able to provide benefits to their partners (Barclay, 2013, 2016). Because they are more desirable, they can replace a partner more easily than someone of lower market value could. As such, all else equal, someone of high market value would correspondingly have a less stake in each partner. But the quality of one's partner matters too: The higher the quality of one's current partner relative to other potential partners, the more stake one has in that partner, and the more willing one will be to save them instead of replacing them.

In some cases, one's current partner might be *less* useful than others—one might benefit from actively replacing them. In these cases, we can say that one has a negative stake in that partner. This is predicted by Barclay's (2020) model of stake and was found in Experiment 3: Participants were less willing to save an uncooperative partner if that partner would then be replaced. This principle likely applies in both friendships and romantic relationships: People with many attractive options will care less for their current partners and might benefit from the relationship's end if that allows them to start a new relationship. People especially have a negative stake in any relationship categorized by conflict: When people reciprocate negative acts (e.g., revenge), it creates a negative stake in their partner, such that each person benefits from the other's demise.

Partner Choice and the Replaceability of Partners

The above discussion highlights a potential drawback of people freely choosing their social partners: It undermines one's stake in a partner. Researchers in many disciplines view partner choice as a positive force in the evolution of cooperation: When people can leave uncooperative partners, it forces defectors to start cooperating lest they be abandoned (e.g., Aktipis, 2004, 2011; Bull & Rice, 1991; Enquist & Leimar, 1993; Hayashi & Yamagishi, 1998; McNamara et al., 2008; Page et al., 2005; Schuessler, 1989; Sherratt & Roberts, 1998; Vanberg & Congleton, 1992), albeit at the cost of increased inequality (Stallen et al., 2023). Partner choice also creates competition over partners, such that it can pay to be more generous than others in order to attract partners (Barclay, 2004, 2011, 2013; Barclay & Willer, 2007; McNamara et al., 2008; Sylwester & Roberts, 2010), and it pays to compete over any trait that might signal one's cooperativeness (e.g., environmentalism: Barclay & Barker, 2020, though see Batistoni et al., 2022). However, the present study shows that people will have less stake in their partners if they can choose to replace them with someone else, which undermines cooperation. We need more theoretical and empirical work to reconcile these forces and to determine the net effect of partner choice under different circumstances.

One possibility is that partner choice results in people being more overtly cooperative to retain partners and to signal their value to others (i.e., more signaling-based cooperation), but it results in people valuing each partner less and being less willing to help when unobserved (i.e., less stake-based cooperation). This could be instantiated in more deliberative cooperation but less intuitive cooperation (Kiyonari et al., 2000; Rand et al., 2012). Uncalculated

cooperation (e.g., "cooperating without looking"; Hoffman et al., 2015; Jordan et al., 2016) could be driven by perceptions of interdependence—we help people whom we value without calculating the costs and benefits because we simply value their welfare. Future studies should test whether the presence of partner choice has a positive effect on deliberative cooperation but a negative effect on spontaneous or uncalculated cooperation, or a positive effect on observable cooperation but a negative effect on unobservable cooperation.

Limitations

Our studies have several strengths, including multiple replications of the main effect and over 3,000 total participants. However, there are obviously some limitations. First, our study used a crowd-sourced online population, so all the standard caveats about such a sample apply, such as the participants not being representative of humanity (though see Paolacci & Chandler, 2014). However, given that the present study is based on a mathematical model that is general enough to apply to any species or indeed any kingdom of life (Barclay, 2020), we would predict to find the same general principles in any society or subculture and be subject to the cultural differences discussed above.

Second, we used an online economic game, which is not as ecologically valid as studying real friendships (e.g., Baumard & Sperber, 2010; Hagen & Hammerstein, 2006). While this allows us to better control and quantify the interaction (Pisor et al., 2020), our participants would have less psychological stake in their partners than with real-life friends due to both the short interaction and the anonymity. However, this is arguably a strength: If we can find stake-based helping after even a short bout of online reciprocity, then how much stake-based helping will people do after years of reciprocation with real-life friends? Future studies can use longitudinal designs to test our findings within developing friendships.

Third, we only used anonymous helping, but real-world helping is rarely anonymous. This was a deliberate methodological choice to show that the helping was due to stake—the anonymity reduces the chance that the helping is caused by reciprocity (see below). In the real world, it may be hard to differentiate reciprocity-based helping from stake-based helping, but that is partly the point of this article—reciprocity is one way that people come to have a stake in their partners. Future studies can use other methods to tease apart stake-based helping and reciprocity-based helping.

Fourth, we cannot completely rule out the possibility that people provided anonymous help in our studies out of reciprocity (instead of stake), in that they might have misunderstood the task or assumed that their partner would find out about the help (see "mistakes" in Barclay & Van Vugt, 2015; Delton et al., 2011). However, even if some anonymous helping was a mistake in reciprocity, it would not explain why there were more mistakes in our Interdependence Condition or fewer mistakes when partners were replaceable. As such, the best explanation is that the higher helping was caused by participants' stake in keeping good partners around, rather than just a desire to reciprocate.

Fifth, the stakes were relatively low. Such stakes are common on platforms like MTurk and Prolific but are less than most real-world helping. However, the stakes were low in all experimental conditions, and there is no a priori reason to expect they would affect cooperation in one condition more than another. Furthermore, this experiment was based on a mathematical model (Barclay, 2020), which works regardless of whether the stakes are trivial or literally life and death. As such, we expect our effects to generalize to larger stake sizes, but this is an empirical question for further research.

Conclusions

Our results show the process by which people come to intrinsically value their social partners: What starts as a purely reciprocal exchange can become much deeper, such that people will even be willing to anonymously help those partners to ensure that the reciprocity can continue. The less replaceable the partner, the more willing people are to help them. This links two of the main explanations for the evolution of nonkin cooperation: Reciprocity is just one way that people can come to have a stake in others' well-being.

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Received January 26, 2024
Revision received June 13, 2024
Accepted June 17, 2024 ■