

# People have systematic expectations linking social relationships to patterns of reciprocal altruism

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## Abstract

In two-person asymmetric coordination dilemmas, both people are better off if they coordinate, but one person benefits more than the other. When these interactions recur, people can form expectations to balance who is better off *over time*. What does it mean when asymmetric social interactions recur, and what can we learn from how people solve these dilemmas? We hypothesize that people expect social interactions to recur when two people are in a social relationship, and that knowing about the symmetry of the social relationship influences the stable solution to asymmetric coordination dilemmas over time. We report two experiments where participants read stories and answered questions about social interactions between two people. In Experiment 1, participants infer that two people are in a social relationship when there is a sequence of altruistic interactions between them, and specifically infer an asymmetric relationship when one person always performs the altruistic action, and a symmetric relationship when the two people alternate performing the altruistic action. In Experiment 2, participants equally expect alternating and repeating altruistic actions when the relationship is symmetric, but expect repeating actions (following a precedent) when the relationship is asymmetric. Our results suggest that people are able to use knowledge of relationships to generate shared expectations for coordinating on recurrent altruistic social interactions, and vice versa.

**Keywords:** social cognition; social relationships; hierarchy; coordination

## Introduction

Sarah and Alison want to go out to eat after work. They have two options near their workplace: a Chinese restaurant, and an Indian restaurant. However, Sarah prefers the Chinese restaurant, while Alison prefers the Indian restaurant. If Sarah and Alison want to coordinate to eat together, they have two options: They can both go to the Chinese restaurant, or both go to the Indian restaurant.

Unfortunately, Sarah and Alison cannot satisfy both of their preferences at the same time. If they want to coordinate, one person has to end up better off than the other: If they go to the Chinese restaurant, Sarah is better off, and if they go to the Indian restaurant, Alison is better off. That is, each of these two restaurant choices results in an *asymmetric* payoff. This problem is an example of the two-player asymmetric coordination dilemmas people encounter, and resolve, frequently in everyday life (Luce & Raiffa, 1957).

Asymmetric coordination dilemmas have been studied extensively in game-theoretic contexts (e.g., Schelling, 1980; Crawford, Gneezy, & Rottenstreich, 2008; O'Connor, 2019; Fehr & Fischbacher, 2003). Since both people would rather interact than fail to coordinate (i.e. not interact), both have

some incentive to choose the role that benefits the other but preserves the interaction (Fehr & Fischbacher, 2003). Yet these incentives may be unequally distributed. For example, if one person has less to lose from failing to coordinate, then they can demand and expect to receive better offers in both explicit and implicit negotiations (Pinkley et al., 2019; Schaerer, Teo, Madan, & Swaab, 2020; Van Dijk, De Dreu, & Gross, 2020). Conversely, for a person who cannot afford not to coordinate, their optimal choice is then to choose the role that benefits the other. As a result, when one of the two people has more power or influence, both parties will expect that person to take the more advantaged role in the interaction. This phenomenon is termed ‘tacit coordination’ (De Kwaadsteniet, Homan, Van Dijk, & Van Beest, 2012). In one study, participants were told a story about a professor and a student who agreed to meet at a train station, but forgot to specify which train station. Participants anticipated that both the student and the professor would initially go to the train station that was more convenient for the professor (De Kwaadsteniet & Van Dijk, 2010).

## Coordinating over recurrent interactions

In these asymmetric coordination dilemmas, when two people must coordinate on a single interaction, it is inevitable that one person benefits more than the other. When asymmetric interactions between the same two people recur over time, though, the *sequence* creates a distinct challenge and opportunity. For example, if Sarah and Alison can form a stable coordination over time (i.e. go out to eat every Thursday after work), this repeated interaction could offer large cumulative benefits. How do people coordinate over recurrent interactions?

One potential solution is to alternate — reciprocating the generous or altruistic action — thus balancing out who is better off over time. For example, if Sarah and Alison’s restaurant choices are governed by reciprocity, on Thursdays they could alternately satisfy either Sarah’s preference or Alison’s preference. Given an expectation of continued interactions, reciprocity allows people to coordinate over time to make their long-term payoffs approximately equal, even if the payoff for each individual interaction is unequal. Expectations of direct reciprocity are fundamental assumptions in many models of altruistic or prosocial decision making (e.g., Dufwenberg & Kirchsteiger, 2004). In fact, both adults and children use turn-taking strategies in a variety of contexts, switching

off who benefits on each turn (Lau & Mui, 2012; Helbing, Schönhof, Stark, & Hołyst, 2005; Melis, Grocke, Kalbitz, & Tomasello, 2016; Neill, 2003; Nowak & Sigmund, 1994), and children use these strategies in asymmetric coordination games (Grueneisen & Tomasello, 2017). Even preverbal infants expect that gifts (e.g. one character gives the other an apple) will be reciprocated (Tatone & Csibra, 2020). Turn taking has also been observed in non-human animals (e.g., Harcourt, Sweetman, Manica, & Johnstone, 2010).

Another potential solution to recurrent interactions is to select actions according to precedent; i.e. a solution where the same person always performs the generous or altruistic action. For example, Sarah and Alison may go to the Chinese restaurant every time, always satisfying Sarah's preferences. A benefit of this solution is that it is simple to follow, and therefore unlikely to lead to miscoordination. Sarah and Alison are unlikely to accidentally go to different restaurants and miss each other completely. Evolutionary models suggest that when large numbers of people repeatedly meet in asymmetric coordination dilemmas, subdividing people into sub-groups or categories with assigned and repeating roles leads to more frequent coordination and thus higher cumulative payoffs for members of both groups (O'Connor, 2019). Indeed, empirically, people assigned by experimenters to arbitrary sub-groups did learn to repeatedly choose the same role in iterated asymmetric coordination games (Mohseni, O'Connor, & Rubin, 2021). As a consequence, overall coordination rates increased and all participants' payoffs increased, though participants in one group benefited more than participants in the other. In general, establishing a precedent is a powerful force for stabilizing expectations in social interactions (Lewis, 1969; Millikan, 2005; Hawkins, Goodman, & Goldstone, 2019).

### Choosing a solution

Thus, both reciprocity (alternating roles) and precedent (repeating roles) are potential solutions to recurrent asymmetric social interactions. How do people know which type of solution to use or expect?

Based on observations drawn from across cultures and historical periods, the anthropologist David Graeber speculated that people intuitively expect solutions to repeated asymmetric interactions to depend on the type of social relationship (Graeber, 2012). Two people who repeatedly engage in the same type of interaction over time are probably in a persistent social relationship. Social relationships can be between equals, as between friends, neighbors, business partners or citizens of the same city or country; but social relationships can also be hierarchically structured, as between teachers and students, leaders and followers, employers and employees, or parents and children (Fiske, 1992). People can use patterns of social interaction to create, maintain and express the type of social relationship they are in (Rai & Fiske, 2011). Alternately reciprocating gifts and support over time maintains balance, in the long run, between two people's payoffs from their interactions, and thus can express a relationship between

equals. Conversely, repeatedly following a precedent can express the stable difference in a hierarchical relationship. Expectations for interactions in a hierarchy are expressed "in terms of custom and precedent: How much did we pay last year? How much did our ancestors have to pay?" Graeber wrote. "Whenever the lines of superiority and inferiority are clearly drawn and accepted by all parties as the framework of a relationship, and relations are sufficiently ongoing that we are no longer simply dealing with arbitrary force, then relations will be seen as being regulated by a web of habit or custom." In fact, following a precedent need not always directly benefit of the person who is higher in the social hierarchy: In caregiving or philanthropic relationships, for example, the individual with more resources or capacity repeatedly plays the altruistic role in the interaction (Graeber, 2012).

Although intuitively plausible, the hypotheses that people identify social relationships based on iterated asymmetric interactions, and form expectations for asymmetric interactions based on social relationships, have not been directly tested empirically (Figure 1). In this paper, we tested these hypotheses in two behavioral experiments where participants read stories and answered questions about altruistic social interactions between two people. In all scenarios, both characters benefit from the interaction or prefer to do the activity together, rather than not doing it at all or acting separately or independently. Yet in each interaction, one character gains more benefits, or pays less costs, than the other. In Experiment 1, participants read about sequences of social interactions and answered questions about the symmetry of the social relationship. In Experiment 2, participants read about a social relationship and one interaction, and answered questions about what is likely to happen the next time the two people interact.

## Experiments

**Participants** All participants were recruited on Prolific and pre-screened to be adult fluent English speakers from the United States. Participants gave informed consent, and all procedures were approved by the MIT Committee on the Use of Humans as Experimental Subjects. For both experiments, participants received \$5 for completing the task, for an estimated pay of \$15/hour.

**Implementation and open practices** Both experiments were implemented using the jsPsych library (De Leeuw, 2015), and all analyses were conducted in R using the lme4, lmerTest, and emmeans packages (Bates, Mächler, Bolker, & Walker, 2014; Kuznetsova, Brockhoff, & Christensen, 2017; Lenth, Singmann, Love, Buerkner, & Herve, 2018). All stimuli, data, and code are available at <https://osf.io/sqpr6>.

### Experiment 1: Inferring relationship symmetry from social interaction sequence

In Experiment 1 (Figure 2), participants read stories describing either no recurrent social interaction, recurrent social interactions governed by precedent, or recurrent social inter-

# asymmetric coordination problems

If two people coordinate, one is better off. If they don't coordinate, both are worse off.

Sarah and Alison each prefer different food, but also want to go to dinner together.

Neither goes out for dinner	Sarah and Alison go to Chinese
Sarah and Alison go to Indian	Sarah goes to Chinese and Alison goes to Indian

Sonia and Liana have a group project. At least one person has to do a detailed check.

Neither does detailed check	Sonia does detailed check
Liana does detailed check	Each one does detailed check independently

Over iterated actions, two solutions to asymmetric payoffs are **alternating** or **repeating** roles.

**Our question: How do people know which type of solution to expect?**

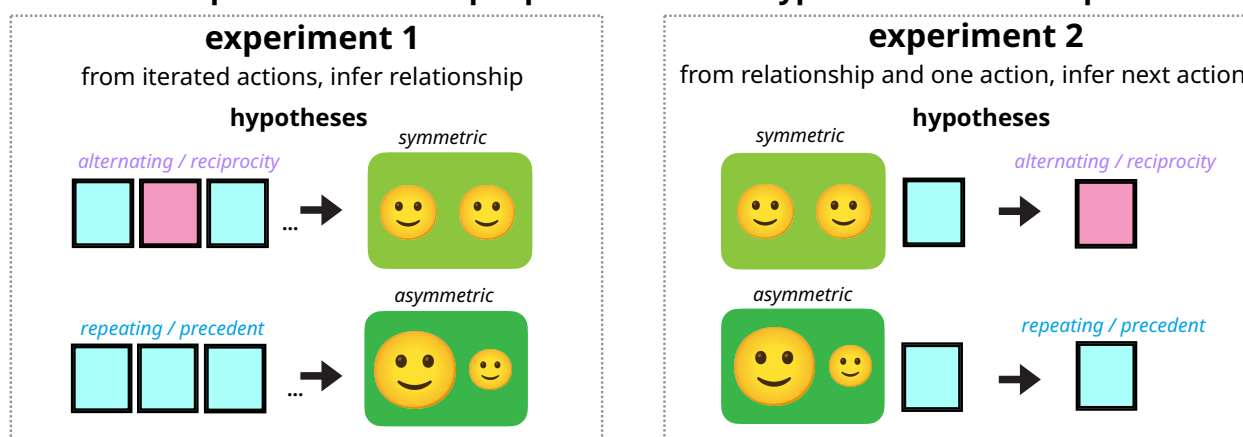


Figure 1: Experimental design and hypotheses.

actions governed by reciprocity. For each story, participants evaluated their perceived likelihood of the two characters in the story being in an asymmetric relationship, a symmetric relationship, and no relationship. We predicted that participants would use different types of recurrent social interaction to evaluate the presence of and the symmetry of the relationship. The preregistration for Experiment 1 is available at <https://osf.io/hmkg2>.

## Methods

**Participants** We recruited 60 participants (27 female; ages 20-72, M(SD) age = 40.0(12.6)) for Experiment 1, and excluded 4 participants who did not pass an attention check or indicated at the end of the experiment that they did not understand the instructions.

**Procedure** Each participant read 18 stories, each story belonging to a unique scenario consisting of a set of generous or altruistic actions that one person can do for another in the context of an interaction (e.g. buying coffee during a work meeting, preparing a meal and cleaning after, deferring to the other's preference). For all scenarios, the two characters in-

teracting were the same gender, as indicated by names and pronouns.

For each scenario, we manipulated the history of social interactions ('precedent', 'reciprocity', or 'no interaction'). In the 'precedent' condition, one character repeatedly conducted same generous or altruistic action for the other character, over recurrent interactions. In the 'reciprocity' condition, the two characters alternated doing the generous or altruistic action for the other, over recurrent interactions. In the 'no interaction' condition, the two characters performed the action by themselves, in parallel, without interacting with each other. See Figure 2A for a sample scenario with all three conditions.

Participants evaluated the likelihood of the two characters being in (1) an asymmetric relationship, (2) a symmetric relationship, and (3) no relationship, using a 7 point Likert scale ranging from 1 ("Extremely unlikely") to 7 ("Extremely likely")<sup>1</sup>. Participants were instructed that "in an asymmetric relationship, one person is higher in rank, importance, or in-

<sup>1</sup>All analyses were conducted using participants' raw Likert ratings. For both experiments, as a check for robustness, we re-analyzed our data normalizing participants' ratings on each trial to sum up to 1.

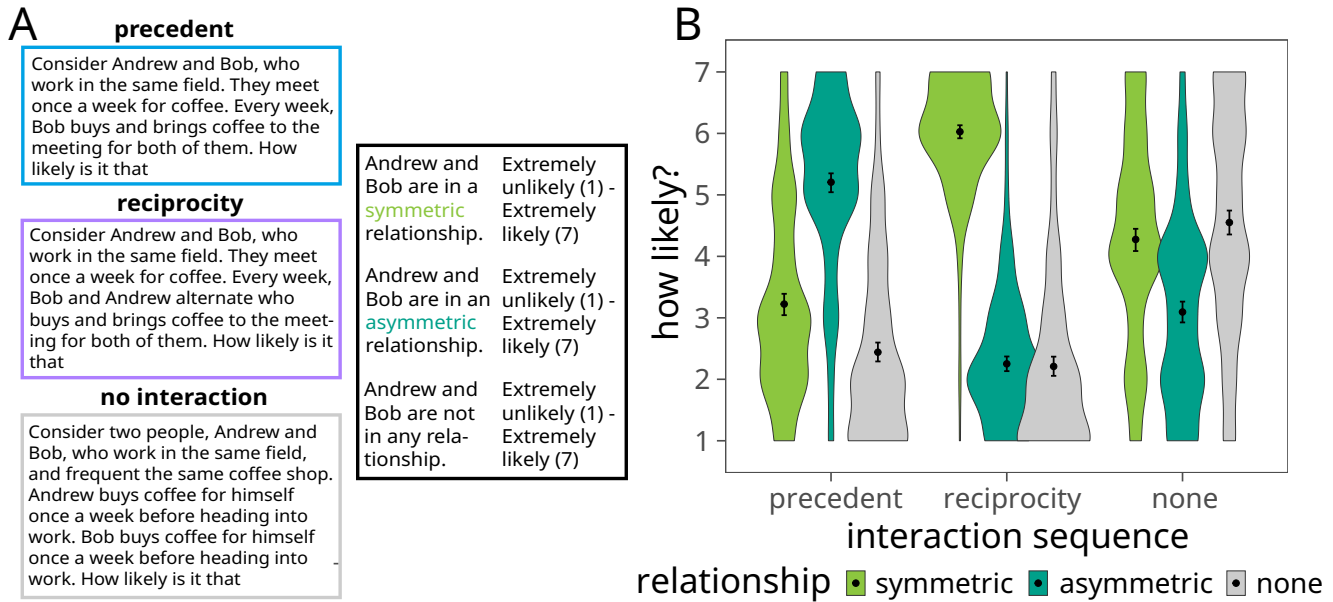


Figure 2: Experiment 1. **(A)** Sample scenario, where two characters coordinate by deciding who buys coffee for both of them. The left column shows the possible stories (in the ‘precedent’, ‘reciprocity’, and ‘no interaction’ conditions) that participants could see for each scenario, and the right column shows the three responses participants answered for each story (which was the same on all of the trials). Each participant only saw one of the stories for each scenario. For each story, participants rated the probability that the two characters are in an asymmetric relationship, a symmetric relationship, and not in any relationship. **(B)** Experiment 1 results. Participants rated asymmetric relationships as more likely when the interaction sequence was governed by precedent, symmetric relationships as more likely when the interaction sequence was governed by reciprocity, and no relationship as more likely when the two characters didn’t engage in a recurrent altruistic interaction. Error bars correspond to 95% bootstrapped confidence intervals.

fluence than the other,” and that “in a symmetric relationship, the two people are equal in rank, importance, or influence.”

Each trial consisted of one story. The assignment of scenarios to conditions was counterbalanced across participants. The trial sequence was randomized.

## Results

**Participants expect the presence of a relationship when there is a sequence of altruistic social interactions** First, we were interested in the expectations participants have about the presence of a social relationship when there is a recurrent sequence of altruistic social interactions, compared to when there is no recurrent sequence of altruistic social interactions. We ran a linear mixed-effects model predicting participants’ Likert scale ratings, including categorical fixed effects for social interaction and relationship, along with their interaction, and random intercepts for each scenario and participant. We ran pairwise contrasts comparing participants’ reported likelihood of the ‘no interaction’ condition to both the ‘precedent’ and ‘reciprocity’ conditions’, and comparing the ‘no relationship’ response to both the ‘asymmetric’ and ‘symmetric’ responses.

When there was a recurrent social interaction, participants expected that there was a relationship ( $M = 4.18$ ,  $SE = 0.06$ ,

CI: [4.06, 4.30]), over no relationship ( $M = 2.34$ ,  $SE = 0.07$ , CI: [2.19, 2.48]),  $t(2905) = -26.85$ ,  $p < 0.001$ . When there was no interaction sequence, participants expected no relationship ( $M = 4.55$ ,  $SE = 0.09$ , CI: [4.37, 4.73]), over a relationship ( $M = 3.69$ ,  $SE = 0.07$ , CI: [3.55, 3.84]),  $t(2903) = 8.88$ ,  $p < 0.001$  (Figure 2B).

**Participants expect asymmetric relationships when interactions are governed by precedent, and symmetric relationships when interactions are governed by reciprocity** Now that we know that participants expect a social relationship when there is a sequence of altruistic interactions, we examine the type of social relationship that they expect. We focus on the conditions where there is a recurrent altruistic social interaction (‘precedent’ and ‘reciprocity’), and responses that describe the presence of a social relationship (‘asymmetric’ and ‘symmetric’). We used a linear mixed-effects regression model to predict participants’ ratings, including categorical fixed effects of interaction sequence (‘precedent’ vs. ‘reciprocity’) and relationship response (‘asymmetric’ vs ‘symmetric’) along with their interaction, and random intercepts for each scenario and participant. We found evidence of an interaction effect ( $b = -1.44$ ,  $t(1276.7) = -40.53$ ,  $p < 0.001$ ) (Figure 2B). Participants expected asymmetric relationships

to be more likely when social interactions are governed by precedent, than when they are governed by reciprocity. Participants expected symmetric relationships to be more likely when social interactions are governed by reciprocity, than when they are governed by precedent.

## Experiment 2: Inferring next social interaction from relationship symmetry

The results for Experiment 1 suggest that people systematically make inferences about social relationships from patterns of social interactions. People expect a social relationship to be present when there is a recurrent sequence of altruistic interactions. Specifically, they expect that relationships are asymmetric when the interactions are governed by precedent, and that relationships are symmetric when the interactions are governed by reciprocity.

Now, we want to see if people make analogous inferences in the other direction. Specifically, given one altruistic action, and information about the symmetry of the relationship, do people form expectations of recurrent altruistic interactions? We predicted that participants will use information about the social relationship to predict what will happen next in the social interaction. The preregistration for Experiment 2 is available at <https://osf.io/fxwbh>.

### Methods

**Participants** We recruited 60 participants (26 female; ages 20-62,  $M(SD)$  age = 36.2(12.5)), as above, and excluded 1 who did not pass an attention check.

**Procedure** Each participant read 18 stories, as in Experiment 1. Each story described a single generous or altruistic social interaction that one character performed for the other. The relationship between the characters was described as ‘asymmetric’ or ‘symmetric’, or omitted any information about the relationship (‘no info’). The assignment of scenarios to conditions was counterbalanced across participants. See Figure 3A for a sample scenario with all three conditions.

For each story, participants reported their perceived likelihood of the two characters expecting (1) the same person performing the action the next time (‘repeating’), (2) the opposite person performing the action the next time (‘alternating’), and (3) the interaction not happening again (‘none’), all using a 7 point Likert scale ranging from 1 (‘‘Extremely unlikely’’) to 7 (‘‘Extremely likely’’).

### Results

**Participants expect repeating actions in asymmetric relationships** To test our primary prediction, we used a linear mixed-effects regression model to predict participants’ ratings. We included categorical fixed effects of relationship condition (‘asymmetric’ vs ‘symmetric’) and the next interaction (‘alternating’ vs. ‘repeating’), and random intercepts for each scenario and participant. We found evidence of an interaction ( $b = -0.51$ ,  $t(1331.7) = -13.29$ ,  $p < 0.001$ ) (Figure 3B).

In a linear mixed-effects model including all three levels of each factor, pairwise contrasts showed that in the ‘symmetric’ condition, participants were not more likely to predict alternating ( $M = 4.75$ ,  $SE = 0.09$ , CI: [4.58, 4.93]) or repeating ( $M = 4.49$ ,  $SE = 0.09$ , CI: [4.31, 4.67]) actions,  $t(3095) = -2.58$ ,  $p = 0.194$ . Similarly, with no explicit information about relationships, participants equally predicted alternating ( $M = 4.61$ ,  $SE = 0.09$ , CI: [4.43, 4.78]) and repeating ( $M = 4.75$ ,  $SE = 0.09$ , CI: [4.57, 4.93]) actions,  $t(3095) = 1.38$ ,  $p = 0.905$ . Only for ‘asymmetric’ relationships was there a difference between type of next interaction: Participants were less likely to predict alternating ( $M = 3.48$ ,  $SE = 0.09$ , CI: [3.30, 3.65]) and more likely to predict repeating ( $M = 5.25$ ,  $SE = 0.09$ , CI: [5.07, 5.43]) actions;  $t(3095) = 17.290$ ,  $p < .001$ .

Participants did expect a continued social interaction over no continued social interaction, both with ( $t(3095) = -33.92$ ,  $p < .001$ ) and without ( $t(3095) = -25.91$ ,  $p < .001$ ) explicit information about the relationship (Figure 3B).

### Discussion

In this paper, we examined people’s expectations of coordination on sequences of altruistic actions in recurrent social interactions. We examined social relationship symmetry as one way people may form shared expectations about how to coordinate on these action sequences. Experiment 1 investigated how people reason about relationships given information about social interactions between two people. We found that people expected asymmetric relationships when actions are governed by precedent, and symmetric relationships when actions are governed by reciprocity. Experiment 2 investigated how people reason about the next social interaction, given one social interaction between two people and information about their social relationship. We found that people expected repeating actions (i.e. governed by precedent) when the relationship is asymmetric, and equally expected alternating and repeating actions when the relationship is symmetric and when they didn’t know about the relationship. Put together, our results suggest that people not only systematically evaluate relationship symmetry based on sequences of social interactions, but also use knowledge of relationship symmetry to predict future social interactions.

In the asymmetric coordination problems that we focused on, two people engaging in one single interaction inevitably leaves one person better off. According to many game-theoretic models, reciprocity offers a solution to this problem: Expectations of future reciprocity can foster altruism and generosity in the present, because the sequence of interactions provides an opportunity for the two people to balance the payoffs over time (e.g., Dufwenberg & Kirchsteiger, 2004; Delton, Krasnow, Cosmides, & Tooby, 2011). Indeed, evolutionary models favor agents who reciprocate generous actions but exit from interactions with defectors (Fudenberg & Maskin, 2009). Human participants perform similarly in these games, sustaining altruism and generosity in repeating

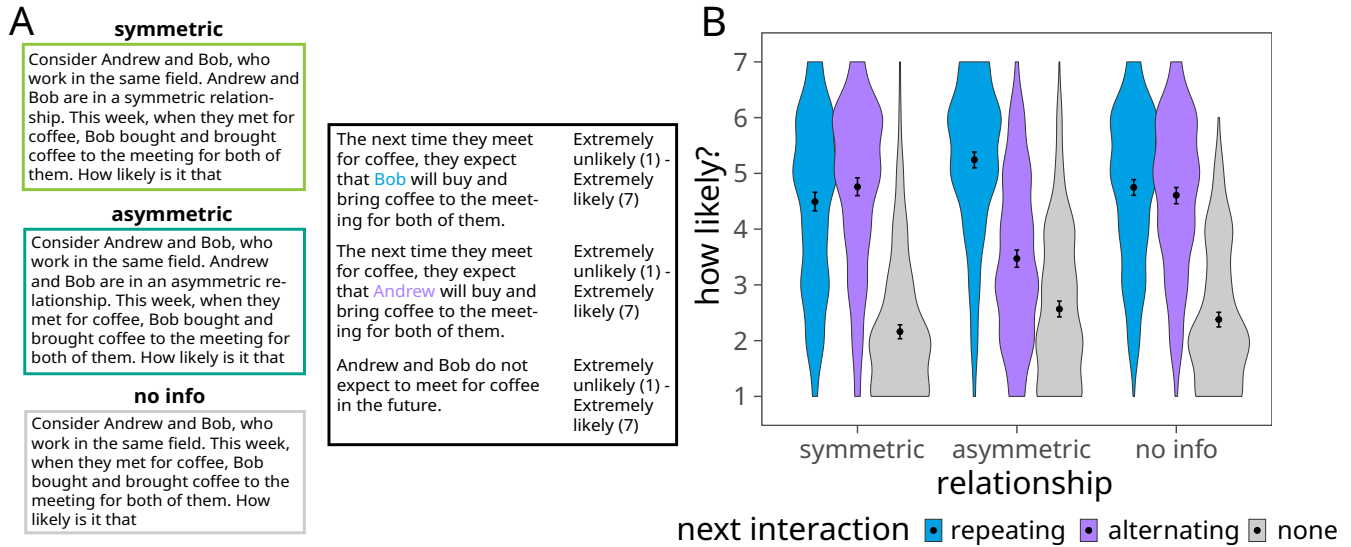


Figure 3: Experiment 2. (A) Sample scenario, where two characters coordinate by deciding who buys coffee for both of them. The left column shows the possible stories (in the ‘symmetric’, ‘asymmetric’, and ‘no info’ conditions) that participants could see for each scenario, and the right column shows the three responses participants had to answer for each story (which is the same for all of the trials). Each participant only saw one of the stories for each scenario. For each story, participants rated the likelihood that the same person performs the altruistic action next time, that the opposite person performs the altruistic action next time, and that the interaction does not recur. (B) Experiment 2 results. Participants rated the repeating action as more likely when the relationship was asymmetric. When the relationship was symmetric, or when there was no information about the relationship, participants did not predict one type of relationship over the other. Error bars correspond to 95% bootstrapped confidence intervals.

interactions — especially when they expect to interact with the same individual in the future — and use partner choice to avoid prior defectors (Barclay, 2016).

However, in these models and experiments describing repeated interactions, anonymous strangers are paired up temporarily and their interactions are highly constrained. All individuals are equal in status, and are not in a social relationship. Real-world social interactions, however, are embedded in persistent social relationships and social categories. Our results showed that for quotidian asymmetric interactions, like buying coffee, choosing a restaurant, or preparing a meal, participants actually *did not* expect that recurrent interactions would always be governed by reciprocity. Quite the opposite: Two people recurrently following a precedent was considered somewhat likely, across the board. When the two people were in an asymmetric relationship, following a precedent became highly likely.

One key question that our experimental design did not address is how the direction of the relationship asymmetry (i.e. which person is higher in status) relates to the assignment of roles in the interaction (i.e. which person accepts less benefit or pays higher cost to sustain the interaction). It may seem intuitive that the higher status partner always occupies the advantaged role (e.g. the boss chooses the restaurant, the lower ranked police officer does the burdensome paperwork). However, observation and anecdotal evidence suggest that the

opposite pattern is also highly prevalent. For example, in contemporary American universities, it is common that when professors eat with their students, the professor buys the food at every meeting. “If charitable donations become the basis for any sort of social relation, it will not be one based on reciprocity. If you give some coins to a panhandler, and that panhandler recognizes you later, it is unlikely that he will give you any money — but he might well consider you more likely to give him money again,” Graeber (2012) observed. “It seems essential to the nature of charity that it can never lead to reciprocity. Even if it turns out that the pathetic-looking beggar is really a god wandering the earth in moral form, or Harun al-Rashid, your reward will be entirely disproportionate... It’s easier to imagine a panhandler giving you a fortune than returning an exact equivalence.”

Using hypothetical scenarios, here we provided strong empirical evidence for Graeber’s assertion that people associate two types of social relationships (asymmetric and symmetric) with two sequences of social interactions (precedent and reciprocity). In future research, we will investigate how people use this knowledge to create, sustain, and change their social relationships.

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