Cooperators benefit through reputation-based partner choice in economic games

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Explaining unconditional cooperation, such as donations to charities or contributions to public goods, continues to present a problem. One possibility is that cooperation can pay through developing a reputation that makes one more likely to be chosen for a profitable cooperative partnership, a process termed competitive altruism (CA) or reputation-based partner choice. Here, we show, to our knowledge, for the first time, that investing in a cooperative reputation can bring net benefits through access to more cooperative partners. Participants played a public goods game (PGG) followed by an opportunity to select a partner for a second cooperative game. We found that those who gave more in the PGG were more often selected as desired partners and received more in the paired cooperative game. Reputational competition was even stronger when it was possible for participants to receive a higher payoff from partner choice. The benefits of being selected by a more cooperative partner outweighed the costs of cooperation in the reputation building phase. CA therefore provides an alternative to indirect reciprocity as an explanation for reputation-building behaviour. Furthermore, while indirect reciprocity depends upon individuals giving preference to those of good standing, CA can explain unconditional cooperation.

Keywords: competitive altruism; reputation; cooperation; indirect reciprocity

1. INTRODUCTION

Research on cooperation has shown that people are more generous when they are watched by someone or even when they are exposed to images of eyes (Bateson *et al.* 2006; Bereczkei *et al.* 2007). Also, the rate of cooperation increases when the identity of the individual is revealed (Andreoni & Petrie 2004). Considering these findings, generosity and fairness appear to be context-dependent behaviours expressed in the presence of reputational incentives.

One reason why it might pay to be seen to cooperate is indirect reciprocity (Alexander 1987). Experiments have found that people do indeed prefer to help those who help others (e.g. Milinski *et al.*

2002). Moreover, investing in reputation pays in the long run: despite the initial expense, individuals benefit by receiving more cooperation from others in subsequent rounds of indirect reciprocity (Wedekind & Braithwaite 2002). However, problems remain with indirect reciprocity as a general explanation for reputation building (Roberts 2008). In particular, indirect reciprocity depends upon cooperation being conditional upon a recipient also being a cooperator, so cannot explain displays of unconditional cooperation.

An alternative theory for reputation formation is that of competitive altruism (CA; Roberts 1998). This theory stresses the role of partner choice for profitable relationships and is based on a two-stage process in which individuals first have a chance to build up reputations through making generous displays, and secondly choose partners for further interactions. CA postulates that individuals seek to acquire the best cooperators as partners. According to biological market theory, such cooperative pairing will be assortative (Noë & Hammerstein 1994). Hence, the benefits for cooperative individuals are twofold: first, they are paired with the chosen partner (one of the best cooperators), and second, they gain profits from these highly cooperative partnerships.

In support of CA, research has shown that people were more cooperative when they expected to play a dyadic trust game with a chosen partner later than when they knew they would not be able to choose a partner or when they did not expect to play a further game (Barclay 2004). Another study demonstrated that participants contributed more when their contributions were to be revealed to others than when they remained anonymous. It also found that status and social prestige increased in proportion to donations made to the group (Hardy & Van Vugt 2006). Finally, by varying whether contributions were anonymous or public and whether participants had a choice of partner, Barclay & Willer (2007) demonstrated that participants' contributions were related to the motivation to gain cooperative reputation (see the electronic supplementary material). The study also provided evidence for a preference for the most cooperative players. However, none of these studies has demonstrated net monetary benefits from investing in a cooperative reputation.

Here, we investigate the benefits coming from reputation in the form of partner choice and payoffs from interactions with partners. The study also involves varying the potential gains to be made from a partner to test whether we find an increase in contributions when reputation building is followed by higher potential rewards.

We conducted two experiments referred to as the main experiment and the supporting experiment. The supporting experiment's aim was to demonstrate that (i) public information and (ii) partner choice increased cooperative reputation-building behaviour. Our findings were consistent with those of earlier studies including Barclay & Willer (2007) and are therefore described in the electronic supplementary material. The main experiment consisted of two stages in which participants first had an opportunity to build up reputation (stage 1) and could then make use of the information about other players' reputations
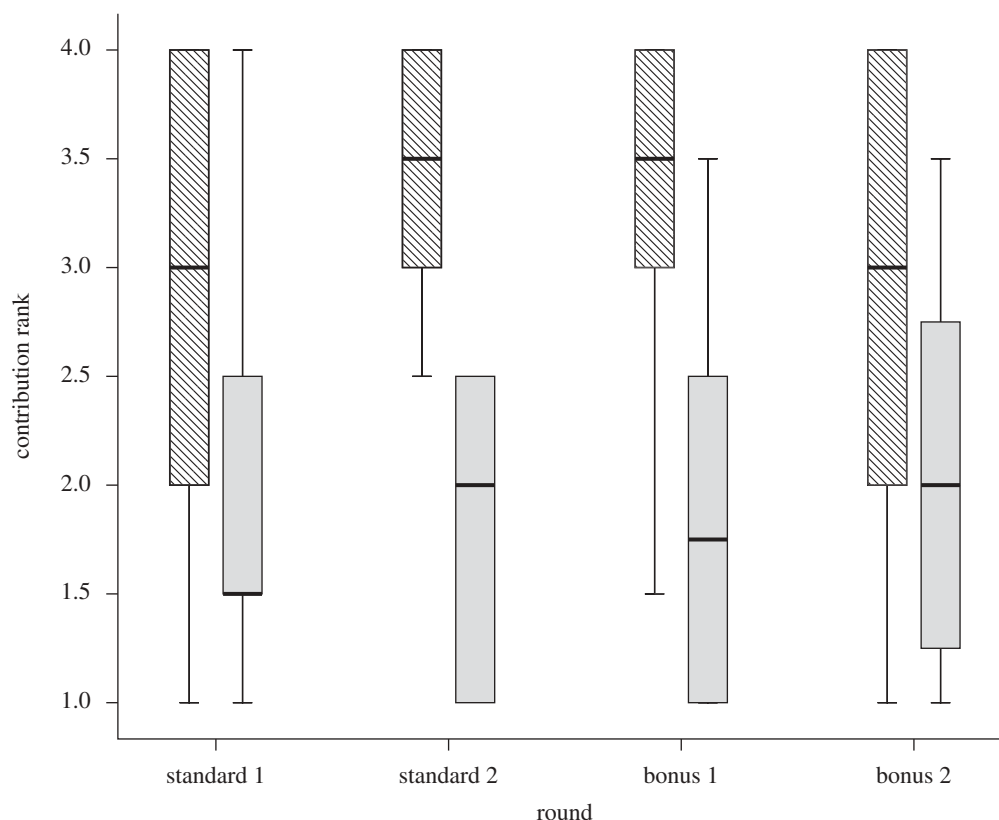
Figure 1. Boxplots presenting differences between contribution ranks of participants who played with random (striped boxes) or desired partners (grey boxes). Mann–Whitney U tests were significant at $p < 0.05$ in the standard 1 round and at $p < 0.01$ in all other rounds.

in order to choose partners for further interactions. In stage 2 there were two reward levels in order to vary the incentive to invest in reputation.

2. MATERIAL AND METHODS

We recruited 10 groups of four participants, 14 men and 26 women (mean age = 23.92, s.d. = 3.73) from Newcastle University. Participants were rewarded according to their earnings with an average of £6.12 (s.d. = £1.15) per participant.

The experiment involved playing public goods games (PGGs) in a two-stage within-subjects design. In each round participants were endowed with 10 laboratory pounds. Participants could contribute any amount of this money to a common pool. The sum of the contributions was doubled and shared equally among the players irrespective of how much they contributed (each invested pound yielded only 50p to the investor). In stage 1, participants played in groups of four, whereas in stage 2 they played in pairs. Participants' contributions from stage 1 were not revealed to other players until stage 2. There were two conditions in stage 2: in the standard condition, the amount in the pool was multiplied by 2 before distributing it to participants, while in the bonus condition it was multiplied by 8. In both cases, although the game retained the form of PGG, there was no social dilemma. In the standard condition, each invested pound yielded exactly £1 back; so an individual's gain was only affected by their partners' contributions. In the bonus condition, the rational choice was to contribute the whole allocation to the pool because each individual benefited from their own contribution (each invested pound yielded £4). The incentive to acquire a cooperative partner was greater in the bonus condition because if both partners invested everything, the final profit could reach four times that of the standard condition.

Upon arrival, four participants were led to computers separated by screens and assigned nicknames. The experiment was conducted with the software Z-TREE (Fischbacher 2007). Participants read the instructions, in which the nature of stage 1 and stage 2 was explained, and played one trial round in which they all were asked to contribute £5. After that, participants played stage 1 which

consisted of four rounds of PGGs. In two rounds, participants were informed that their contributions would be revealed in stage 2 before choosing a partner for a round with the standard gain. In the other two rounds, participants were informed that their contributions would be made public before choosing a partner for a round with the bonus gain. For each round participants were allocated 10 laboratory pounds. The order of conditions in stage 1 was balanced across participants. In stage 1, participants did not receive any feedback on how much money other players contributed. In stage 2, participants played four rounds of PGG and before each round they received a paper slip from the experimenter which contained other players' contributions from the corresponding round in stage 1. Participants were asked to choose the player they would like to be paired with for either a game with a standard or a bonus gain. Participants were allowed to play with the chosen person only if the person chose them as well. If only two individuals chose each other, the other two automatically formed the second dyad. If no individuals chose each other, then all individuals were arbitrarily assigned partners. The conditions in stage 2 were presented in the same order for all participants in a group but their order of presentation was balanced across groups (see electronic supplementary material).

3. RESULTS

Participants were ranked within a group according to their contribution (1 = top contributor). Participants' rank was significantly negatively correlated with the number of times they were chosen as a desired partner in all four rounds—standard rounds: $r_s = -0.34$, $p < 0.05$ and $r_s = -0.73$, $p < 0.01$; bonus rounds: $r_s = -0.57$, $p < 0.01$ and $r_s = -0.61$, $p < 0.01$. The ranks of participants who were paired with a chosen partner were significantly lower than of participants who were assigned a partner in all four rounds (figure 1). Further analyses were conducted on the
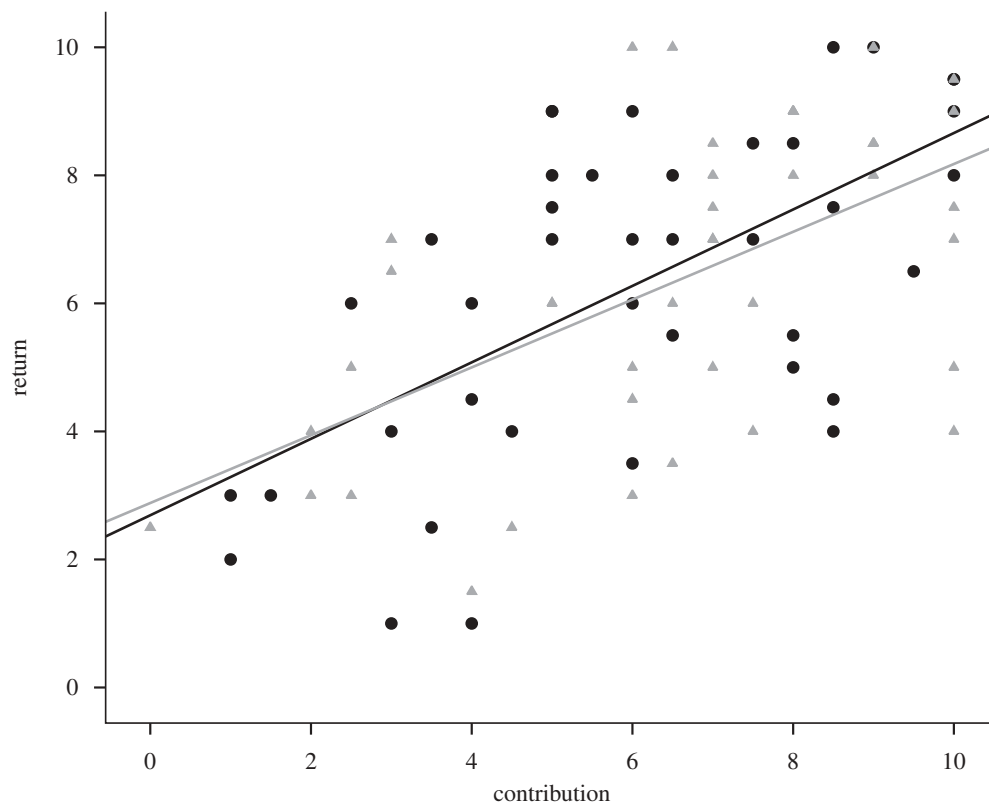
Figure 2. Relationship between participants' contributions in stage 1 and their partners' contributions in stage 2. Regression lines were fitted for the standard condition (black circles and black line), return = 2.69 + 0.59 × contribution; and for the bonus condition (grey triangles and grey line), return = 2.88 + 0.57 × contribution.

averages of contributions over the two rounds of each condition. Investments made by participants in stage 1 were strongly and significantly correlated with investments by their partners in stage 2 ($r_s = 0.59$, $p < 0.01$ for the standard rounds; and $r_s = 0.57$, $p < 0.01$ for the bonus rounds; figure 2). Wilcoxon-signed ranks test revealed that participants contributed significantly more in the bonus rounds (Mdn = 7) than in the standard rounds (Mdn = 6), $z = -1.66$, $p = 0.048$, one-tailed.

4. DISCUSSION
The results support the predictions of CA theory that those who develop a reputation for generosity acquire cooperative partners and receive more in return from them than less generous individuals (Roberts 1998). This is, to our knowledge, the first empirical evidence for profits coming from reputation-building in CA. Barclay & Willer (2007) demonstrated reputation-building but they used a one-shot social dilemma in stage 2, in which the best strategy was to exploit a cooperative partner. They therefore found high levels of dishonest reputation-building: cooperative individuals in stage 1 did not necessarily cooperate in stage 2. By contrast, there was no incentive to exploit a partner in our stage 2 because neither condition represented a social dilemma: in the standard condition there was no net cost to cooperating, while in the bonus condition cooperating was mutually beneficial. Furthermore, our design allowed repeated interactions between the same individuals which encouraged maintaining reputation. This design more properly reflects

the logic of CA which is about attracting a partner for cooperative interactions.

The fact that not all participants contributed fully in stage 2 is consistent with the previous findings of sub-optimal behaviour (e.g. Saijo & Nakamura 1995). Research on individual differences also shows that people belong to one of the three groups: spiteful, payoff-maximizing and altruistic (Kurzban & Houser 2005). This may explain why cooperative individuals in stage 1 continued to be more cooperative in stage 2, while less-generous participants who could not play with their desired player acquired partners who refrained from contributing, even though it was in their own interest.

As expected, reputational competition was stronger when it was possible for participants to receive a higher payoff from partner choice; however, this effect was rather weak. We speculate that participants in the bonus round may have decided that giving more would only increase the cost without providing greater long-term benefits (compare Bergstrom & Lachmann 1997).

Note that our experiment differs fundamentally from those on indirect reciprocity (e.g. Milinski *et al.* 2002; Wedekind & Braithwaite 2002) in that the benefits of reputation-building come from assortative partner choice followed by directly reciprocal cooperative interactions. This is a crucial difference because it provides a different mechanism for reputation-building. Indirect reciprocity relies on the use of 'moral assessments' by which individuals decide who is a worthy recipient, despite never having the opportunity to receive back. CA, in contrast, relies on the benefits

of obtaining the most profitable partnerships. Here, we empirically showed that people can indeed reap benefits from investing in reputation through CA. The significance of this finding is that displays of cooperation can be seen as an adaptive strategy, even when they are not reciprocated either directly or indirectly.

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