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Pseudocompetition among groups increases human cooperation in a public-goods game

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Economic games are often used in an attempt to reveal the underlying preferences or motivations that govern human behaviour. However, this approach relies on the implicit assumption that individuals are rational and fully aware of the consequences of their decisions. We examined behaviour in a standard economic game that is often used to measure social preferences: the public-goods game. We found that giving information to individuals about the relative success of their group led to (1) significantly higher levels of cooperation and (2) emotional responses to group success. This is despite the fact that group success had no effect on the payoffs in our game, and so knowledge of group success should not influence the behaviour of rational players. Consequently, these results suggest that cues of group competition have an automatic or unconscious effect on human behaviour that can induce increased within-group cooperation. More generally, this framing effect emphasizes the potential problem with drawing biological conclusions from the quantitative comparison of cooperation levels in economic games with the predictions of theory. Instead, our results emphasize the advantage of testing theory by qualitatively comparing behaviour across treatments, and with regard to expected adaptations and expected ontogeny.

Economic games are used to examine the behavioural motives and social preferences of humans (Camerer 2003; Fehr & Fischbacher 2003; Henrich et al. 2005). The results of such experiments can be interpreted with either a qualitative or a quantitative approach (Davies et al. 2011). The qualitative approach examines differences in behaviour between treatments, which typically have different payoff structures for the game that is being played. For example, individuals cooperate more when the relative cost of cooperation is decreased (Isaac & Walker 1988). In contrast, the quantitative approach compares the quantitative level of behaviour within a specific game or treatment with that predicted by theoretical models (Levine 1998; Fehr & Fischbacher 2003; Camerer & Fehr 2006). For example, humans cooperate in one-shot economic games at a rate higher than the rate that would maximize their financial gain, which has been argued to suggest that humans are uniquely altruistic in a way that cannot be explained by evolutionary theory (Fehr & Rockenbach 2004; Gintis et al. 2005). The deductions from this quantitative approach typically rely on the implicit assumption that individuals are rational and fully aware of all the consequences of their decisions (Fehr & Fischbacher 2005; Dufwenberg et al. 2011).

However, there is increasing evidence that individuals adjust their behaviour 'irrationally', in response to aspects of how the experiment are presented that do not alter payoff structures. Examples of such 'framing effects' include individuals showing increased cooperation in the presence of images resembling human eyes (Haley & Fessler 2005; Bateson et al. 2006; Burnham & Hare 2007; Rigdon et al. 2009; Ernest-Jones et al. 2011), or decreased cooperation when a game is labelled the 'Wall Street game' instead of the 'community game' (Liberman et al. 2004). The point here is that these experimental manipulations do not alter the payoffs of the games, and hence should not alter the strategy that rational individuals play. Consequently, the fact that they do either reveals features of the environment that people find salient when making such decisions (because of learning and/or an evolved predisposition), or suggests which norms and strategic beliefs they hold (Camerer 2003; Henrich et al. 2004; Dufwenberg et al. 2011). Put simply, framing effects show the psychological baggage that people bring to games from the real world, and if they are common, then the quantitative approach will lead to error (Burnham & Johnson 2005; Hagen & Hammerstein 2006; Binmore & Shaked 2010).

We tested whether humans adjust their behaviour in response to cues of competition between groups when playing a standard public-goods game, which is used as a model for collective action problems (Ledyard 1995). Theory predicts that competition between groups can favour cooperation, because more cooperative

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groups will be more successful, and hence will lead to more successful individuals (Hamilton 1975; Choi & Bowles 2007; Bowles 2009). Consistent with this, the implementation of group competition in public-goods game experiments leads to individuals identifying their groupmates as collaborators, and cooperating with them at a higher rate (Nalbantian & Schotter 1997; Baron 2001; Bornstein 2003; Gunnthorsdottir & Rapoport 2006; Tan & Bolle 2007; Puurtinen & Mappes 2009; Burton-Chellew et al. 2010). This suggests that people may be adapted to respond facultatively to cues of group competition. However, this previous experimental work has typically lowered the cost of cooperation, which is known to increase cooperation, and/or explicitly linked payoffs to relative group performance. Therefore we cannot be sure that people respond to cues of group competition per se as opposed to changes in the way costs and benefits are either calculated or presented.

We made participants play a standard public-goods game twice, with the only difference being the information that we provided during the game about how their group did relative to the other groups. In typical public-goods games individuals can contribute monetary units (MU) to a group fund to produce benefits that are shared equally by all members of their group, including themselves, and regardless of differences in contribution levels. In our games, participants were in groups of four, and every MU contributed was doubled by the experimenter before being shared among the four players; thus the individual return on contributions was −0.5 MU for every MU contributed. In each experimental session we also had four such groups of four players, and we made participants play the game for two sets of 10 rounds, with the group compositions randomly shuffled each round. Importantly, our instructions and payoffs were identical for both sets of games (treatments). Instead, we merely varied the additional information we provided to participants after each round of play, by either showing them, in rank order, the contributions and earnings of all four members of their group (‘within-group information’), or the sum contributions and earnings of all four groups, in rank order (‘among-group information’, Fig. 1). This difference between treatments makes no structural differences to the game played (payoffs are unaffected) and thus rational participants should behave no differently. In contrast, if people’s decisions are partly governed by predispositions (‘psychological baggage’), then we expect cooperation to be relatively higher with among-group information. Furthermore, we complemented our behavioural data with measurements of the participants’ emotional responses after each round of decision making.

METHODS

We carried out six experimental sessions, each with 16 participants, at the Centre for Experimental Social Sciences (CESS), Nuffield College, University of Oxford, implemented with z-Tree (Fischbacher 2007). The experimental design and procedure were approved by the CESS. The identity of all participants and their responses were anonymous to the experimenters. Participant payment and recruitment were conducted entirely by the CESS staff, and participants were paid anonymously. The 96 participants had never taken part in an experiment involving public-goods games at CESS and were students (48 females, 46 males, two unknown). We used a standard (linear) public-goods game (Marwell & Ames 1979, 1980; Ledyard 1995), and in each round of play we gave each participant an endowment of 40 MU (100 MU = £1), a fraction of which (0–40 MU) they could contribute to a group project, keeping the remainder. We doubled the sum total of contributed MU for each group, before sharing out the resultant MU equally among the four group members. Thus, for each MU contributed to the group project, each of the four group members received 0.5 MU, including the contributor (who had contributed 1 MU and thus made a net loss of −0.5 MU for every MU contributed).

Our experiment involved two treatments, across which we held the monetary payoffs constant, but varied the information given after each round of play (Fig. 1). In both treatments we reminded participants of their contribution, and informed them of their income from that round, making explicit that their income was the sum total of their retained MU, plus any MU they received back from the group project. This information, along with the sum contributions of their groupmates, was supplied to all participants; it is consistent with the information provided in many public-goods game experiments. Additionally, in the within-group information treatment, we also displayed the same information for all three other group members, ordering the players according to their earnings, with the highest earning player at the top (Fig. 1a), whereas in the among-group information treatment we displayed the same information but at the level of the group rather than at the individual level (Fig. 1b). Consequently, the difference between the two treatments is that the within-group information treatment shows participants how they performed (contributions and earnings) relative to the other members of their group, whereas the among-group treatment, which includes the same information pertaining to the focal individual, also shows participants how their group did relative to all the other groups.

We made each participant play each treatment for 10 consecutive rounds, reversing the order between sessions. In each round we randomly and anonymously assigned the 16 participants to one of four groups of four players, and so reputation effects were not possible (Nowak & Sigmund 1998; Wedekind & Milinski 2000). We presented the same instructions to all participants (available upon request), and started game play only after every participant had successfully completed, with advice when required, a comprehension test (available upon request). At the end of the first treatment, we verbally informed all participants that, ‘You will now play the exact same game again, for the same number of rounds, but this time you will receive different information at the end of each round’. The time delay between treatments was 60 s. Overall, the monetary reward obtained ranged from £6.60 to £13.60 with a mean of £10.40.

We measured our participants’ emotions at the end of each round of decision making by asking them how (1) happy or annoyed they were and (2) how proud or ashamed they were (they could not be both proud and ashamed nor both happy and annoyed). Participants reported their emotions on a scale of 0–10, with 5 being the neutral midpoint between the two emotional extremes (5 = neutral, 4/6 = little or mildly, 3/7 = quite, 2/8 = happy/annoyed/proud/ashamed, 1/9 = very and 0/10 = extremely). The emotions were presented as mutually exclusive, with participants being allowed to report that they were happy, annoyed or neutral and ashamed, proud or neutral.

After the experiment, we asked each participant to complete a questionnaire which (1) included a 10-question personality test (Gosling et al. 2003) that provides a rough measure of five standard personality variables (Agreeableness, Conscientiousness, Emotional stability, Extroversion and Openness), (2) asked their gender and whether they knew about game theory or not and (3) asked them to choose from a list of phrases the one that best described their motivations during the experiment (Making myself the maximum money possible; Making other people the maximum money possible; Making everyone the maximum money possible; Making myself more money than other people; Other), and to choose their most desired outcome from a list of hypothetical outcomes (Everybody makes a maximal and equal amount; You