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What makes people cooperate? Individual differences in BAS/BIS predict strategic reciprocation in a public goods game

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ABSTRACT

Heterogeneity in contribution levels within public goods games (PGGs) is indicative of individual self- or other-regarding preferences. Reward and punishment mechanisms have been demonstrated to affect contributions in the PGGs. This paper examines whether dispositional sensitivities to rewards and punishments (BIS and BAS) explain some behavioural heterogeneity in PGGs. Seventy-two participants took part in a sequential PGG, in which, prior to making a decision about contributing, participants received information about how much their co-players had donated, which was manipulated either as high or low. They also completed the Carver and White BIS/BAS scales. Participants contributed more when other members of their group contributed a high proportion of the initial endowment and less when others gave a low amount. When participants knew that their group members had contributed a high amount, BAS Reward Responsiveness was significantly negatively correlated with the contribution levels, while BIS-anxiety was positively related to a lower proportion of zero contributions. The findings are interpreted in relation to strategic responding in the PGGs. Motivational traits, such as those conceptualized in Reinforcement Sensitivity Theory, are proposed to underlie pro-social behavioural preferences.

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1. Introduction

Why do people cooperate at the levels they do? Exploring this question has been a central concern in biology (Nowak, 2006), psychology (Dovidio, Piliavin, Schroeder, & Penner, 2006) and economics (Fehr & Gintis, 2007). Within economics (Andreoni, 1990; Crumpler & Grossman, 2008; Fehr & Fischbacher, 2003; Fehr & Gaechter, 2000, 2002; Fehr & Gintis, 2007), psychology (Ferguson, Farrell, & Lawrence, 2008) and biology (Nowak, 2006; West, Grifin, & Gardner, 2007) reward and punishment contingencies have been implicated as a mechanism underlying levels of cooperation (see Post, Underwood, Schloss, & Hurlbut, 2002). The focus on reward and punishment suggests that studying traits reflecting variation in sensitivity to reward and punishment should contribute to our understanding of human cooperative behaviour. Reinforcement Sensitivity Theory (RST) (Gray & McNaughton, 2000) proposes that sensitivities to rewards and punishment explain the variation in personality traits and as such this paper examines the relationship between traits within this theoretical framework and behaviour in a public goods game (PGG).

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1.1. Public goods games (PGGs) and Reinforcement Sensitivity

PGGs provide an experimental model to explore peoples' preferences towards pro-social or selfish actions (Fehr & Gintis, 2007). In a standard PGG, participants are required to divide their initial endowment (real money) between a personal account and a public account, which they share with their group members. The amount entered into the public account is multiplied (usually by a factor of 2), then divided and re-distributed equally to all the group members regardless of the amount that they contributed. If everyone contributes, it maximizes the return, but each individual cannot be confident that others will also contribute. This creates an option either to cooperate (i.e. give something into the public good) or to free ride (i.e. give zero or very small amounts to the public good but reap the benefits of others' investments). Even though over multiple anonymous trials the tendency is towards free riding (Fehr & Gintis, 2007), a large proportion of individuals make non-zero contributions (e.g. ~50% of their endowment, Keser & van Winden, 2000) into the public good, which is a puzzle in behavioural economics. Free riding is reduced when the possibility of reputation building is created or there is a risk of punishment (Fehr & Gintis, 2007; Nowak, 2006; Rockenbach & Milinski, 2006; West et al., 2007). Reciprocation, or acting as you expect others to behave, is one predominate mechanism that drives contributions in the PGG (see Falk & Fischbacher, 2006, for a discussion).

Given the focus on rewards and punishments as part of the explanation for cooperation it is argued that traits associated with reward and punishment should predict performance on PGGs. In this respect, the revised account of RST (Gray & McNaughton, 2000) is particularly pertinent. The RST suggests three motivational systems based on variation in sensitivities to reward and punishment which explain various individual behavioural outcomes. These systems are: Behavioural Activation System (BAS); Flight-Fight-Freeze-System (FFFS); and Behavioural Inhibition System (BIS). When a reward (either social, such as money, or physiological, such as food) is presented, BAS is involved in calculating approach behaviour. Individuals high in BAS-trait are more likely to choose behaviours with higher rewards, such as to free ride and get a larger profit (i.e. financial reward). BIS is responsible for actions when goal conflict is present. After receiving inputs from both BAS and FFFS, BIS calculates what is beneficial: to approach a goal or to avoid a punishment by withdrawing. By inhibiting one or several ongoing behaviours in favour of the others BIS performs computations of risk assessment for benefits/losses expected from the outcomes. When there is no evident punishment possible (such as in a standard PGG), BIS might receive two reward-related inputs: approaching immediate reward or a greater delayed reward through the means of cooperation.

1.2. Individual differences in strategies within PGGs: The roles of BIS and BAS

Distinctive behavioural strategies are observed in PGGs, which may be grouped as either self-regarding (free riding) or other-regarding (e.g. reciprocation, conditional cooperation) strategies (e.g. Bardsley & Moffatt, 2007; Fehr & Gintis, 2007; Fischbacher, Gaechter, & Fehr, 2001). Similar other-regarding (altruists: maximize benefits for others; and co-operators: maximize joint group benefits) and self-regarding (individualists: maximize their own benefits; and competitors: maximize their relative advantage to other players) strategies have been reported in the social value orientation literature (Liebrand & McClintock, 1988; Van Lange, Agnew, Harinck, & Steemers, 1997; Van Lange, Otten, Bruin, & Joireman, 1997). While these classifications of participants' strategies are important, no trait-like mechanisms that may underlie these patterns is suggested (e.g. Burlando & Guala, 2005; Fischbacher et al., 2001). As an initial step forward in this regard this paper explores the role of BIS and BAS.

Scheres and Sanfey (2006) looked at BAS effects on performance in a Dictator Game (DG) and an Ultimatum Game (UG). Both games involved two players: a proposer and a recipient, with the proposer dividing their initial endowment between themselves and the recipient. While in the DG the recipient has no power over the decision, in the UG they can refuse the offer in which case neither party gets anything. If people are strategic, they should give less in the DG (as the recipient cannot reject the offer) but more in the UG (to ensure that the recipient does not reject the offer) and the difference between contributions in UG and DG should be larger. Scheres and Sanfey (2006) showed that BAS Reward Responsiveness (BAS-RR) was associated with strategic giving: predicting lower offers in the DG (but not the UG), as well as a larger discrepancy of individual contributions in UG and DG: thus high BAS-RR was linked to a strategy to maximize rewards.

The present experiment extends this work drawing on a design used by Bardsley and Sausgruber (2005) who demonstrated that when participants knew that their own group gave a high average proportion of their endowment they donated more compared to a low average contribution condition (evidence in favour of reciprocation). Thus this design allows us to examine if BAS-RR individuals act strategically to maximize their rewards when they have full knowledge that others from their group have given a high proportion of their endowment. The experiment is a series of one-shot PGGs, where participants do not know each other, and know that in each game they might be playing with different participants. Thus anonymity is maintained and there is no option for reputation building or tit-for-tat responding. The optimal strategy to maximize reward would be to give less: be more self-regarding. This should not be the case when others contributed a small amount, as there is less to be gained by defecting. Thus it is hypothesised that when participants know that their group partners contributed high amounts, high BAS-RR should be related to reduced contributions. It is important to note here that if we consider a repeated PGG scenario (where participants play with the same group partners over a number of rounds) the predictions regarding BAS-RR would have been opposite, as the strategy to maximize reward in such a context would be to invest more into public good, which should result in greater cooperation predicted by BAS-RR.

While there are no studies examining the role of BIS within economic games, Hirsh and Peterson (2009) showed that neuroticism, which is linked to BIS (Corr & McNaughton, 2008), was associated with greater cooperation in a repeated Prisoners Dilemma (PD) game. Furthermore, an fMRI study by McCabe, Houser, Ryan, Smith, and Trouard (2001) demonstrated that cooperative behaviour occurs through a neural network, which provides binding joint attention to mutual gains with inhibition of immediate reward: those who cooperate inhibit the dominant response of getting a quick smaller reward in order to gain a larger delayed reward by the means of cooperation. Thus, we test the prediction that BIS should be associated with more cooperative behavioural strategies in the one-shot games studied here. BIS-related traits do not imply strategic behaviour, but rather high BIS is linked to a state of a greater inhibitory intensity, thus we do not predict different effect of BIS in one-shot or repeated games.

2. Method

2.1. Participants and procedure

Participants were 72 undergraduates (mean age 20.5, ranged 18–40, 58% female), drawn from different departments, mainly psychology. Questionnaires were administrated using online software prior to the experiment. The experiment took place in the computer room, where all participants, in groups of 8 or 16, were seated in the individual booths with dividers. They were told that they would not know about any individual's contributions or meet after the experiment. After finishing the experiment participants were debriefed and paid individually. They received £5 as a show-up fee and they had an opportunity to earn up to £4.25 extra. On average, participants received £7.6 for a one-hour experiment. The experiment was programmed using Z-Tree (Fischbacher, 2007). One participant was excluded from relevant analyses due to missing questionnaire data.

2.2. Measures of motivational orientations

BIS/BAS: The Carver and White (1994) BIS/BAS questionnaire was used. This contains 24 items to be rated on a four-point scale assessing (1) avoidance orientation: BIS (α =.71); (2) approach orientation (BAS): overall BAS (α =.84), plus subscales BAS Drive (α =.74), BAS Fun Seeking (α =.75) and BAS Reward Responsiveness (α =.89). Because our predictions concerning BIS-effects on performance fit both the original (Gray, 1987) and revised account (Gray & McNaughton, 2000), we also used a split of a BIS scale suggested by Heym, Ferguson, and Lawrence (2008), into BIS-anxiety (α =.81) and FFFS-fear (α =.75).

2.3. The public good game (PGG)

The experiment comprised four practice and 22 experimental trials. No deception was involved in this study, as the trials were organized in a Conditional Information Lottery (see Bardsley, 2000 for a discussion). That is, participants were informed that all trials except for one (a real trial) would not be played with people in the room and for the non-real trials all information appeared on the computer screen would be defined by the experimenter. Only the earnings from the real trial counted towards their final payment and participants were aware of this. In debrief participants stated that they were unable to detect which was the real trial and had treated all trials as if they were real.

Each trial consisted of an anonymous sequential one-shot PGG where participants played in the groups of four. In keeping with the original design of Bardsley and Sausgruber (2005), there were two key parameters to each trial: (1) player position (first or last mover) and (2) group membership (A and B). The first movers were not aware of the contributions of their own group before they made their contribution. The last mover, however, was aware of the average contributions made by their group members before they made the contribution. On each trial there were three first movers and one last mover.

The group membership could be either Group A or Group B. According to the rules, those who played in the Group B, prior to their decisions, saw the average contribution of the participants in Group A. In this way, when participants were on the first movers position, prior to their decision they saw the average contribution of another group (Group A), while when they were in the last movers position, they saw both the average contribution of another group (Group A) and their own group (Group B).

The feedback about both "my" (B) and "other" (A) groups means contribution levels were manipulated as high, medium or low proportion of the initial endowment. In line with the design of Bardsley and Sausgruber (2005) we were interested in high versus low feedback manipulations while participants were on the last mover position, but we also had medium feedback trials, as well as first mover position trials as "masks" to insure that the experimental trials of interest were not salient for participants. Additional analyses with medium trials did not affect the significance of any results. Mean group contributions were drawn randomly from a normal distribution with 17.5 average for high, 10 for a medium and 3.5 for low condition with a standard deviation of a 1 MU. There were a number of different combinations of feedback, which produced different trial types. This study focuses on the last mover trials with the feedback about contributions of "my" group, which was manipulated to be either "high" (four trials) or "low" (four trials). In addition to the information about their own group contributions, in each of four high "my" group trials participants were provided with the information about "other" group (Group A) average contributions: it was either high (two trials) or low (two trials). Likewise, for four low "my" group last mover trials, in two trials the feedback about "other" group was provided as high and in two it was provided as low. All participants underwent exactly the same experimental schedule (i.e. had the same number of trials of each type). The full experimental schedule is available upon request from the first author. The order of the trials was randomized for each participant. To exclude the possibility of hearing when other participants were making decisions, everybody was required to enter a number (the prompt appeared on the screen) all the time while waiting for others' decisions.

In each game each participant had to divide their initial endowment of 20 MU (equal to £2) into the private and the group account. After everybody made their decisions, the investments were calculated based on the following pay-off function:

$$\pi_i = 20 - g_i + 0.5\sum_{j=1}^{4} g_j,$$

where a pay-off (π) for a participant i is defined by their contribution (g) and the sum of contributions of other players.

Participants received individual feedback of how much they earned at the end of each trial. Prior to making their decision participants were also asked how much they thought their group would contribute on average.

To investigate the effect of traits on behaviour we used both contribution levels and the proportion of zero contributions as they have been previously described to be associated with different behavioural strategies in the PGGs (e.g. Bardsley & Moffatt, 2007; Keser & van Winden, 2000).

3. Results

3.1. Descriptive statistic

Table 1 provides the means, standard deviations (SD) for all personality and motivational traits. All variables were normally distributed except for BAS-RR ($Z = 1.91$, $p < .01$, Kologorov–Smirnov test for normality of the distribution) which was treated as non-parametric for all subsequent analyses.

3.2. Effects of the information about the contribution of others on individual behaviour

To explore the relationship between group contribution and position a 2 (Other Group Contribution: high or low) by 3 (Position: first mover, last mover with "my" group high, and last mover "my" group low) repeated measures ANOVA was conducted. There were significant main effects of both Other Group Contribution ($F_{(1,71)} = 13.85$, $p < .001$) and Position ($F_{(2,70)} = 67.08$, $p < .001$) and a significant interaction between the two ($F_{(2,70)} = 12.49$, $p < .001$). Planned comparisons revealed that the contribution levels on the first movers position were significantly different when participants received the information of "other" groups level of feedback as either high or low ($F_{(1,71)} = 40.11$, $p < .001$). Such that when the Other Group Contribution was high they gave more ($M = 10.04$ MU) and when it was low they gave less ($M = 7.5$ MU). When participants were on the last mover position, there was no significant effect of Other Group Contribution both with "my" group high ($p = .319$) and "my" group low feedback ($p = .840$). These analyses show that the information about other group contribution affects only contributions on the first mover position but not the last mover position.

To further explore the effects of "other" group and "my" group contributions in the last mover positions – which are the focus of this study – a 2 (My Group: high or low) by 2 (Other Group: high or low) repeated measures ANOVA was conducted. There was a significant main effect of the "my" group contribution ($F_{(1,71)} = 126.38$, $p < .001$), no significant effect of "other" group contribution feed-

Table 1
The means and standard deviations (SD) for all motivational variables.

Scale	Mean (SD)
BAS Overall	2.95 (.48)
BAS Drive	2.66 (.59)
BAS Fun Seeking	2.90 (.65)
BAS Reward Responsiveness	3.31 (.69)
BIS	2.91 (.68)
BIS-anxiety	3.09 (.70)
FFFS-fear	2.69 (.80)

back and no significant interactions. Regardless of what the other group contributed, participants on the last mover position contributed more if their own group contributed high on average, and less if their group contributed low on average: results are depicted in Fig. 1. As there was no effect of other group contributions manipulation when participants were last movers, for all subsequent analyses contributions were averaged across "my" group high and "my" group low conditions.

We have demonstrated that people's contribution levels changed in response to high or low contributions of others in their group, which may be interpreted as evidence for reciprocation (Bardsley & Sausgruber, 2005). On closer inspection it was observed that in the low feedback trials the contribution levels matched the feedback about the group contribution (15% of the endowment: the difference between group average and individual contributions is not significantly different, one-sample t-test $t(71)=.09$, ns). However, in the high feedback trials after seeing that their group contributed 85% of endowment, participants only increased their contributions to the public good to 55% of endowment, which is significantly lower than their group had given ($t(71) = -8.33$, $p < .0001$, one-sample).

3.3. Influence of personality traits

Contribution levels: Consistent with the prediction BAS-RR was negatively correlated with the contributions in the high "my" group feedback last mover position ($\rho = -.269$, $p < .05$). This correlation indicates that those high in reward responsiveness gave less when they knew that others in their group had contributed a large proportion of their endowment. There were no other significant effects.

Non-zero contributions: When the Carver and White BIS scale was scored as two scales assessing BIS-anxiety and FFFS-fear (Heym et al., 2008), BIS-anxiety was negatively associated with the proportion of zero contributions in the last mover high "my" group feedback condition ($\rho = -.243$, $p < .05$). Thus high BIS-anxiety participants were cooperative as they tended to contribute something (not zero), when they knew that others from their group had contributed on average a large proportion of their endowment. There were no other significant effects.

4. Discussion

These results demonstrate, consistent with the predictions, that individual differences in basic motivational mechanisms, associated with sensitivity to reward and behavioural inhibition explain variation in cooperation and free riding in a PGG. Specifically, within the context of a one-shot game, BAS-RR is related to the strategic use of self-regarding behaviour (reduced contributions) while BIS-anxiety (Heym et al., 2008) is related to less free riding. These findings are interpreted in relation to strategic responding in the PGGs, as well as in the light of recent theorising about traits as evolved motivational responses to environmental contingencies.

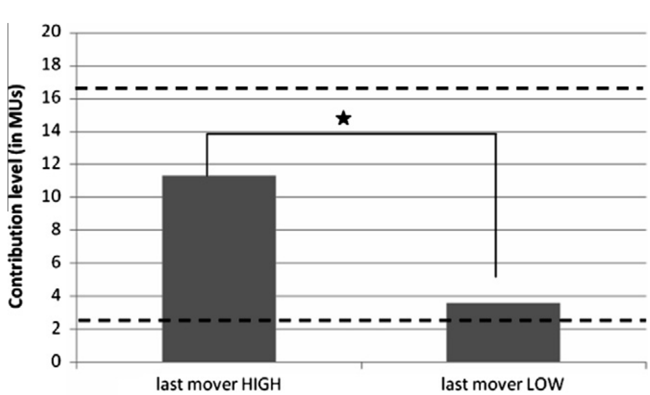

Fig. 1. Reciprocation effect: contribution levels. Dotted lines represent high and low contribution feedback.

4.1. Strategic reciprocation as the main mechanism of giving the PGGs

In line with the wealth of previous findings (e.g. Croson, 2007; Falk & Fischbacher, 2006), a form of reciprocation has been shown as a dominant mechanism explaining voluntary contribution levels in PGGs. Specifically, participants were affected by the feedback about the level of contribution in their group: while they fully reciprocated on average to the cooperation of others (gave the same amount as their group) when the cost was low, they gave significantly less than others on average, when they were provided with the information that their group partners gave a high amount. This suggests that people reciprocate fully in environments when known costs are low, while when reciprocation requires high costs, people are less willing to do so (Ferguson et al., 2008). However, it must be noted here that the absolute amount of giving is still larger if people are provided with the information that the average giving of others is high.

4.2. Pro-social and selfish choices predicted by basic motivational orientations

We have demonstrated that individual differences in motivational traits associated with reward and punishment do influence performance in the PGGs. BAS-RR was negatively associated with contribution levels, specifically when participants knew that others from their group contributed a large proportion of their endowment: those high on BAS-RR gave less. BIS-anxiety (Heym et al., 2008) however, showed a negative relationship with the proportion of non-zero contributions. This indicates that BIS-anxiety is related to reduced free riding, suggesting that behavioural inhibition plays a role in moderating the contribution levels in the PGG, and more broadly, in the decision whether to cooperate or not. In this PGG, perhaps those who are low in BIS are less likely to inhibit the dominating response of getting an immediate reward, especially in the situation when the reward is high (high feedback last mover trials) (see McCabe et al., 2001).

4.3. Motivational traits and reaction norms

A further interpretation of the results reported here is to treat behavioural outcomes as motivated strategic responses to particular environmental contingencies (Buss, 2009; Penke, Denissen, & Miller, 2007). Borghans, Duckworth, Heckman, and ter Weel (2008) have suggested that a trait is more likely to be expressed when there is an incentive for it. Dall, Houston, and McNamara (2004) have coined the term '*conditional state-dependent behaviour*' to describe how organisms tactically choose to act in the given conditions. Moreover, ecologists have developed the idea of reaction norms as the '… function relating a phenotypic response of a genotype to a change in the environment' (Van Oers, de Jong, van Noordwijk, Kempenaers, & Drent, 2005, p. 1197), and extended by Denissen and Penke (2008) to suggest that broader personality domains reflect individual differences in motivation to react to environmental contingencies, with each domain being more or less sensitive to respond to different environments. The results described here fit this conceptualization well. If BAS evolved through motivational systems designed to maximize rewards, within an anonymous PGG, with no opportunity for reputation building or punishment, rewards are strategically best achieved by contributing less especially when it is known that others have contributed a large amount. BIS on the other hand could have evolved to avoid punishment, and in the PGG it is best achieved by strategically minimizing long-term loss (i.e. reduced free riding). Thus within the context of this conditional-state-dependent strategy, we speculate that free riding and reciprocity reflect strategically evolved responses dependent on basic BIS/BAS motivational systems.

4.4. Individual differences and implications for economics

The experimental findings presented here can potentially contribute to the economic literature by uncovering mechanisms underlying pro-social behaviours, such as cooperation. Classifying behaviours into different types as is routinely done in behavioural economics requires assuming that a qualitative difference in terms of personality traits underpins such behaviours as free riding and cooperating. Whether these are distinct stable forms of behaviour is an empirical question and one that psychology is in a good position to test with techniques such as taxometrics (Ferguson, 2008; Ferguson et al., 2009; Ruscio, Haslam, & Ruscio, 2006). The possibility that behaviour reflects a strategic response motivated by basic approach/avoidance systems, can help to further explain cooperation even when mechanisms based on norms of fairness and inequality aversion (e.g. Falk & Fischbacher, 2006; Fischbacher et al., 2001) are less likely to operate (e.g. the PGG here was anonymous with no reputation building possibilities). Furthermore, given the strategic nature of reputation building, we expect that basic motivational traits will affect behaviour as well if reputation building is possible. Hirsh and Peterson (2009) have demonstrated that more cooperation in a repeated PD game was predicted by the enthusiasm facet of extraversion. Furthermore, Boone, De Brabander, and van Witteloostuijn (1999) reported a significant relationship between sensation seeking (Zuckerman, 1991) and cooperation in a repeated PD. As both extraversion and sensation seeking have been linked to the cluster of "sensitivity to reward" traits (Depue & Collins, 1999), we would expect that BAS-traits predicts cooperation and reputation building in the repeated PGG scenario, but not in a one-shot game like the game reported here. Finally, the application of the well-defined mathematical paradigms of behavioural economics to the study of individual differences will help to further our understanding of the strategic nature of individual differences.

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