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Spontaneous giving and calculated greed

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Cooperation is central to human social behaviour[1–9]. However, choosing to cooperate requires individuals to incur a personal cost to benefit others. Here we explore the cognitive basis of cooperative decision-making in humans using a dual-process framework[10–18]. We ask whether people are predisposed towards selfishness, behaving cooperatively only through active self-control; or whether they are intuitively cooperative, with reflection and prospective reasoning favouring 'rational' self-interest. To investigate this issue, we perform ten studies using economic games. We find that across a range of experimental designs, subjects who reach their decisions more quickly are more cooperative. Furthermore, forcing subjects to decide quickly increases contributions, whereas instructing them to reflect and forcing them to decide slowly decreases contributions. Finally, an induction that primes subjects to trust their intuitions increases contributions compared with an induction that promotes greater reflection. To explain these results, we propose that cooperation is intuitive because cooperative heuristics are developed in daily life where cooperation is typically advantageous. We then validate predictions generated by this proposed mechanism. Our results provide convergent evidence that intuition supports cooperation in social dilemmas, and that reflection can undermine these cooperative impulses.

Many people are willing to make sacrifices for the common good[5–9]. Here we explore the cognitive mechanisms underlying this cooperative behaviour. We use a dual-process framework in which intuition and reflection interact to produce decisions[10–15,18]. Intuition is often associated with parallel processing, automaticity, effortlessness, lack of insight into the decision process and emotional influence. Reflection is often associated with serial processing, effortfulness and the rejection of emotional influence[10–15,18]. In addition, one of the psychological features most widely used to distinguish intuition from reflection is processing speed: intuitive responses are relatively fast, whereas reflective responses require additional time for deliberation[15]. Here we focus our attention on this particular dimension, which is closely related to the distinction between automatic and controlled processing[16,17].

Viewing cooperation from a dual-process perspective raises the following questions: are we intuitively self-interested, and is it only through reflection that we reject our selfish impulses and force ourselves to cooperate? Or are we intuitively cooperative, with reflection upon the logic of self-interest causing us to rein in our cooperative urges and instead act selfishly? Or, alternatively, is there no cognitive conflict between intuition and reflection? Here we address these questions using economic cooperation games.

We begin by examining subjects' decision times. The hypothesis that self-interest is intuitive, with prosociality requiring reflection to override one's selfish impulses, predicts that faster decisions will be less cooperative. Conversely, the hypothesis that intuition preferentially supports prosocial behaviour, whereas reflection leads to increased selfishness, predicts that faster decisions will be more cooperative.

As a first test of these competing hypotheses, we conducted a one-shot public goods game[5–8] (PGG) with groups of four participants. We recruited 212 subjects from around the world using the online labour market Amazon Mechanical Turk (AMT)[19]. AMT provides a reliable subject pool that is more diverse than a typical sample of college undergraduates (see Supplementary Information, section 1). In accordance with standard AMT wages, each subject was given US$0.40 and was asked to choose how much to contribute to a common pool. Any money contributed was doubled and split evenly among the four group members (see Supplementary Information, section 3, for experimental details).

Figure 1a shows the fraction of the endowment contributed in the slower half of decisions compared to the faster half. Faster decisions result in substantially higher contributions compared with slower decisions (rank sum test, $P = 0.007$). Furthermore, as shown in Fig. 1b, we see a consistent decrease in contribution amount with

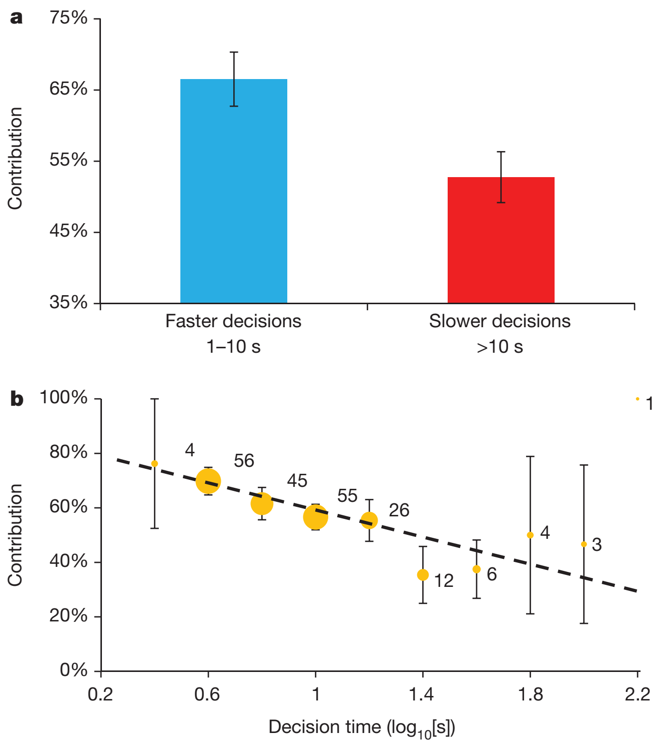

Figure 1 | Faster decisions are more cooperative. Subjects who reach their decisions more quickly contribute more in a one-shot PGG ($n = 212$). This suggests that the intuitive response is to be cooperative. **a**, Using a median split on decision time, we compare the contribution levels of the faster half versus slower half of decisions. The average contribution is substantially higher for the faster decisions. **b**, Plotting contribution as a function of $\log_{10}$-transformed decision time shows a negative relationship between decision time and contribution. Dot size is proportional to the number of observations, listed next to each dot. Error bars, mean ± s.e.m. (see Supplementary Information, sections 2 and 3, for statistical analysis and further details).

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increasing decision time (Tobit regression, coefficient = −15.84, $P = 0.019$; see Supplementary Information, sections 2 and 3, for statistical details). These findings suggest that intuitive responses are more cooperative.

Next we examined data from all of our previously published social dilemma experiments for which decision time data were recorded[7,20–22]. In these studies, conducted in the physical laboratory with college students, the experimental software automatically recorded decision times, but these data had not been previously analysed. To examine the psychology that subjects bring with them into the laboratory, we focused on play in the first round of each experimental session. In a one-shot prisoner's dilemma ($n = 48$)[20], a repeated prisoner's dilemma with execution errors ($n = 278$)[21], a repeated prisoner's dilemma with and without costly punishment ($n = 104$)[22], and a repeated PGG with and without reward and/or punishment ($n = 192$)[7], we find the same negative relationship between decision time and cooperation (see Supplementary Information, section 4, for details). These results show the robustness of our decision-time findings: across a range of experimental designs, and with students in the physical laboratory as well as with an international online sample, faster decisions are associated with more prosociality.

We now demonstrate the causal link between intuition and cooperation suggested by these correlational studies. To do so, we recruited another 680 subjects on AMT and experimentally manipulated their decision times in the same one-shot PGG used above. In the 'time pressure' condition, subjects were forced to reach their decision quickly (within 10 s). Subjects in this condition have less time to reflect than in a standard PGG, and therefore their decisions are expected to be more intuitive. In the 'time delay' condition, subjects were instructed to carefully consider their decision and forced to wait for at least 10 s before choosing a contribution amount. Thus, in this condition, decisions are expected to be driven more by reflection (see Supplementary Information, section 5, for experimental details).

The results (Fig. 2a) are consistent with the correlational observations in Fig 1. Subjects in the time-pressure condition contribute significantly more money on average than subjects in the time-delay condition (rank sum, $P < 0.001$). Moreover, we find that both manipulation conditions differ from the average behaviour in the baseline experiment in Fig. 1, and in the expected directions: subjects under time-pressure contribute more than unconstrained subjects (rank sum, $P = 0.058$), whereas subjects who are instructed to reflect and delay their decision contribute less than unconstrained subjects (rank sum, $P = 0.028$), although the former difference is only marginally significant. See Supplementary Information, section 5, for regression analyses.

Additionally, we recruited 211 Boston-area college students and replicated our time-constraint experiment in the physical laboratory with tenfold higher stakes (Fig. 2b). We find again that subjects in the time-pressure condition contribute significantly more money than subjects in the time-delay condition (rank sum, $P = 0.032$). We also assessed subjects' expectations about the behaviour of others in their group, and find no significant difference across conditions (rank sum, $P = 0.360$). Thus, subjects forced to respond more intuitively seem to have more prosocial preferences, rather than simply contributing more because they are more optimistic about the behaviour of others (see Supplementary Information, section 6, for experimental details and analysis).

We next used a conceptual priming manipulation that explicitly invokes intuition and reflection[23]. We recruited 343 subjects on AMT to participate in a one-shot PGG experiment. The first condition promotes intuition relative to reflection: before reading the PGG instructions, subjects were assigned to write a paragraph about a situation in which either their intuition had led them in the right direction, or careful reasoning had led them in the wrong direction. Conversely, the second condition promotes reflection: subjects were asked to write about either a situation in which intuition had led them in the wrong direction, or careful reasoning had led them in the right direction. Consistent with the seven experiments described above, we find that contributions are significantly higher when subjects are primed to promote intuition relative to reflection (Fig. 2c; rank sum, $P = 0.011$; see Supplementary Information, section 8, for experimental details and analysis).

These results therefore raise the question of why people are intuitively predisposed towards cooperation. We propose the following mechanism: people develop their intuitions in the context of daily life, where cooperation is typically advantageous because many important interactions are repeated[1,2,21,22], reputation is often at

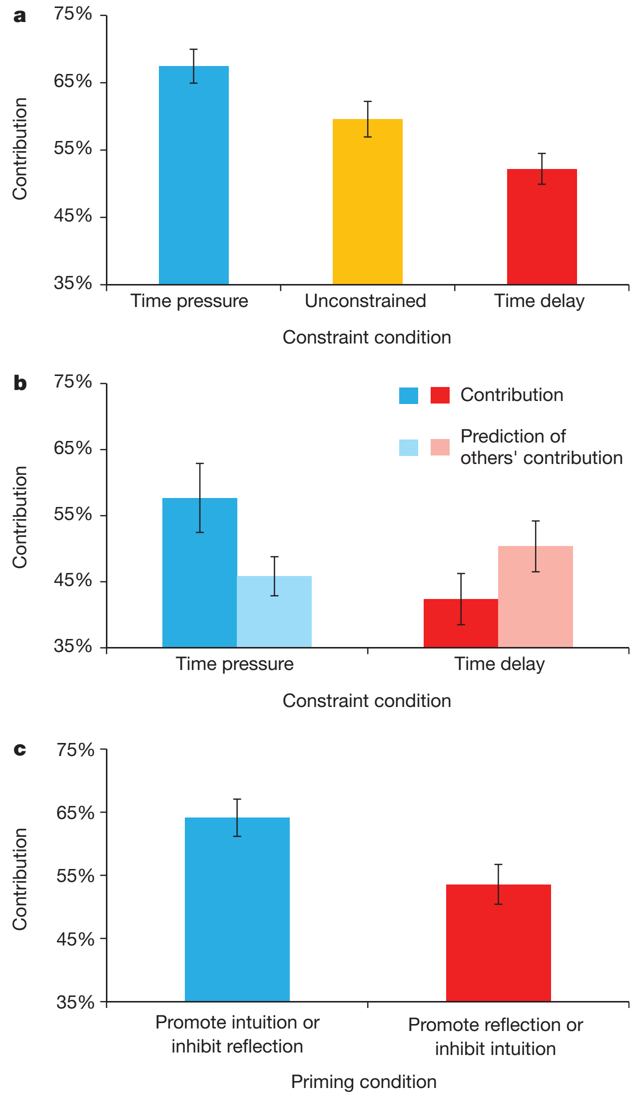

Figure 2 | Inducing intuitive thinking promotes cooperation. a, Forcing subjects to decide quickly (10 s or less) results in higher contributions, whereas forcing subjects to decide slowly (more than 10 s) decreases contributions ($n = 680$). This demonstrates the causal link between decision time and cooperation suggested by the correlation shown in Fig. 1. **b**, We replicate the finding that forcing subjects to decide quickly promotes cooperation in a second study run in the physical laboratory with tenfold larger stakes ($n = 211$). We also find that the time constraint has no significant effect on subjects' predictions concerning the average contributions of other group members. Thus, the manipulation acts through preferences rather than beliefs. **c**, Priming intuition (or inhibiting reflection) increases cooperation relative to priming reflection (or inhibiting intuition) ($n = 343$). This finding provides further evidence for the specific role of intuition versus reflection in motivating cooperation, as suggested by the decision time studies. Error bars, mean ± s.e.m. (see Supplementary Information, sections 5–7, for statistical analysis and further details).

stake[3,5,6,20] and sanctions for good or bad behaviour might exist[4,6–8]. Thus, our subjects develop cooperative intuitions for social interactions and bring these cooperative intuitions with them into the laboratory. As a result, their automatic first response is to be cooperative. It then requires reflection to overcome this cooperative impulse and instead adapt to the unusual situation created in these experiments, in which cooperation is not advantageous.

This hypothesis makes clear predictions about individual difference moderators of the effect of intuition on cooperation, two of which we now test. First, if the effects described above result from intuitions formed through ordinary experience, then greater familiarity with laboratory cooperation experiments should attenuate these effects. We test this prediction on AMT with a replication of our conceptual priming experiment. As predicted, we find a significant interaction between prime and experience: it is only among subjects naive to the experimental task that promoting intuition increases cooperation (Fig. 3a; see Supplementary Information, section 9, for experimental details and statistical analysis).

This mechanism also predicts that subjects will only find cooperation intuitive if they developed their intuitions in daily-life settings in which cooperation was advantageous. Even in the presence of repetition, reputation and sanctions, cooperation will only be favoured if enough other people are similarly cooperative[2,3]. We tested this prediction on AMT with a replication of our baseline correlational study. As predicted, it is only among subjects that report having mainly cooperative daily-life interaction partners that faster decisions are associated with higher contributions (Fig. 3b; see Supplementary Information, section 10, for experimental details and statistical analysis).

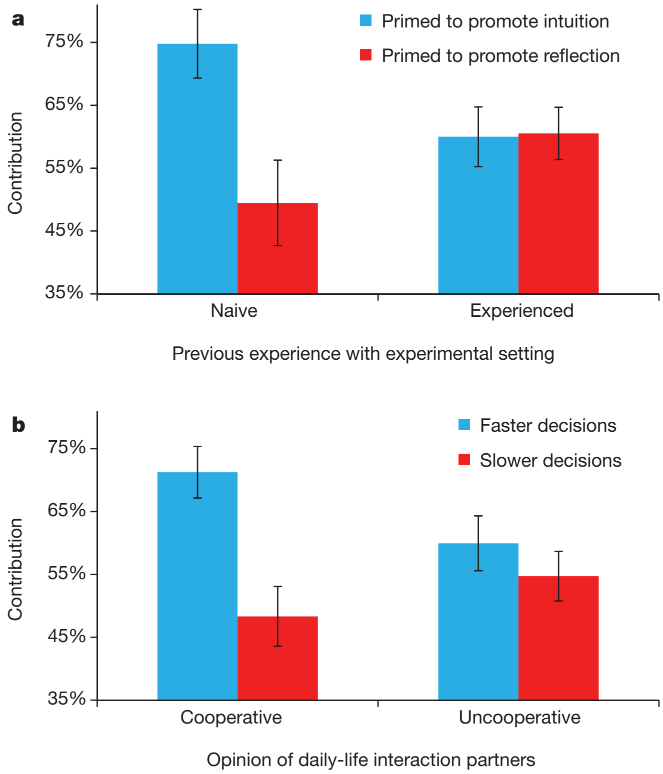

Figure 3 | Evidence that cooperative intuitions from daily lift spill over into the laboratory. Two experiments validate predictions of our hypothesis that subjects develop their cooperative intuitions in the context of daily life, in which cooperation is advantageous. **a**, Priming that promotes reliance on intuition increases cooperation relative to priming promoting reflection, but only among naive subjects that report no previous experience with the experimental setting where cooperation is disadvantageous ($n = 256$). **b**, Faster decisions are associated with higher contribution levels, but only among subjects who report having cooperative daily-life interaction partners ($n = 341$). As in Fig. 1a, a median split is carried out on decision times, separating decisions into the faster versus slower half. Error bars, mean ± s.e.m. (see Supplementary Information, sections 9 and 10, for statistical analysis and further details).

Thus, there are some people for whom the intuitive response is more cooperative and the reflective response is less cooperative; and there are other people for whom both the intuitive and reflective responses lead to relatively little cooperation. But we find no cases in which the intuitive response is reliably less cooperative than the reflective response. As a result, on average, intuition promotes cooperation relative to reflection in our experiments.

By showing that people do not have a single consistent set of social preferences, our results highlight the need for more cognitively complex economic and evolutionary models of cooperation, along the lines of recent models for non-social decision-making[17,24–26]. Furthermore, our results suggest a special role for intuition in promoting cooperation[27]. For further discussion, and a discussion of previous work exploring behaviour in economic games from a dual-process perspective, see Supplementary Information, sections 12 and 13.

On the basis of our results, it may be tempting to conclude that cooperation is 'innate' and genetically hardwired, rather than the product of cultural transmission. This is not necessarily the case: intuitive responses could also be shaped by cultural evolution[28] and social learning over the course of development. However, our results are consistent with work demonstrating spontaneous helping behaviour in young children[29]. Exploring the role of intuition and reflection in cooperation among children, as well as cross-culturally, can shed further light on this issue.

Here we have explored the cognitive underpinnings of cooperation in humans. Our results help to explain the origins of cooperative behaviour, and have implications for the design of institutions that aim to promote cooperation. Encouraging decision-makers to be maximally rational may have the unintended side-effect of making them more selfish. Furthermore, rational arguments about the importance of cooperating may paradoxically have a similar effect, whereas interventions targeting prosocial intuitions may be more successful[30]. Exploring the implications of our findings, both for scientific understanding and public policy, is an important direction for future study: although the cold logic of self-interest is seductive, our first impulse is to cooperate.

METHODS SUMMARY

Across studies 1, 6, 8, 9 and 10, a total of 1,955 subjects were recruited using AMT[19] to participate in one of a series of variations on the one-shot PGG, played through an online survey website. Subjects received $0.50 for participating, and could earn up to $1 more based on the PGG. In the PGG, subject were given $0.40 and chose how much to contribute to a 'common project'. All contributions were doubled and split equally among four group members. Once all subjects in the experiment had made their decisions, groups of four were randomly matched and the resulting payoffs were calculated. Each subject was then paid accordingly through the AMT payment system, and was informed about the average contribution of the other members of his or her group. No deception was used.

In study 7, a total of 211 subjects were recruited from the Boston, Massachusetts, metropolitan area through the Harvard University Computer Laboratory for Experiment Research subject pool to participate in an experiment at the Harvard Decision Science Laboratory. Participation was restricted to students under 35 years of age. Subjects received a $5 show-up fee for arriving on time and had the opportunity to earn up to an additional $12 in the experiment. Subjects played a single one-shot PGG through the same website interface used in the AMT studies, but with tenfold larger stakes (maximum earnings of $10). Subjects were then asked to predict the average contribution of their other group members and had the chance to win up to an additional $2 based on their accuracy.

These experiments were approved by the Harvard University Committee on the Use of Human Subjects in Research.

For further details of the experimental methods, see Supplementary Information.

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