Fast but not intuitive, slow but not reflective:

Decision conflict drives reaction times in social dilemmas

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Abstract

When people have the chance to help others at a cost to themselves, are cooperative decisions driven by intuition or reflection? To answer this question, recent studies have tested the relationship between reaction times and cooperation, reporting both positive and negative correlations. To reconcile this apparent contradiction, we argue that decision conflict (rather than the use of intuition or reflection) drives response times, leading to an inverted-U shaped relationship between reaction time and cooperation. Studies 1-3 show that intermediate decisions take longer than both extremely selfish and extremely cooperative decisions. Studies 4 and 5 find that the conflict between self-interested and cooperative motives explains individual differences in reaction times. Manipulating conflictedness causes longer reaction times and more intermediate decisions, and reaction times mediate the relationship between conflict and intermediate decisions. Finally, Studies 6 and 7 demonstrate that conflict is distinct from reflection by manipulating the use of intuition (vs reflection). Experimentally promoting reliance on intuition increases cooperation, but has no effects on decision extremity or feelings of conflictedness. In sum, we provide evidence that reaction times should not be interpreted as a direct proxy for the use of intuitive or reflective processes, and dissociate the effects of conflict and reflection in social decision-making.

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Decision conflict drives reaction times in social dilemmas

Are humans faster to act cooperatively and help others, or to act selfishly and help themselves? And what do fast choices reveal about the processes underlying social decision-making? Recently, psychologists and economists have applied dual-process theories of decision-making (Chaiken & Trope, 1999; Kahneman, 2011; Sloman, 1996; Stanovich & West, 2000) to explain reaction times and behavior in social dilemmas. In addition to experimental studies that manipulate cognitive processes (Rand, Greene, & Nowak, 2012), researchers have used correlational studies of reaction times to infer whether cooperation is based on intuitive or reflective processes (Zaki & Mitchell 2013). While converging *experimental* evidence supports the claim that intuitive processes typically favor cooperation (e.g. Rand et al., 2014), *correlational* studies testing the relationship between reaction times and cooperation have produced inconsistent results. Some studies have found that cooperative decisions are faster than selfish ones (Cappelen, Nielsen, Tungodden, Tyran, & Wengström, 2014; Lotito, Migheli, Ortona, 2013; Nielsen, Tyran, & Wengström, 2014; Rand et al., 2012), while other studies have reported the opposite pattern (Fiedler, Glöckner, Nicklisch, & Dickert, 2013; Lohse, Goeschl, & Diederich, 2014; Piovesan and Wengström, 2009).

To explain these contradictory results, we argue that decision conflict, rather than the extent of intuitive versus reflective processing, drives reaction times in social dilemmas. In social dilemmas, people feel conflicted when they do not have a clear preference, and are torn between selfish and cooperative goals. Evidence accumulation models (Klauer, 2014; Ratcliff & Smith, 2004) predict that individuals with conflicting goals are slower to reach a decision and are more likely to select an intermediate response. If reaction times are driven mostly by decision conflict, then we would expect an inverted-U pattern, with *extreme* responses occurring more quickly than *intermediate* ones. In contrast, dual process models of reaction times predict a linear pattern where cooperative decisions occur more quickly or slowly than selfish decisions. The present studies 1) critically test whether reaction times are related to decision conflict or the use of intuitive (or reflective) processes; and 2) investigate the relationship between conflict and dual-process models of decision-making.

Intuitive cooperation in social dilemmas

Social dilemmas are situations that involve a conflict between self-interest and the collective good (Rand & Nowak 2013; Van Lange, Joireman, Parks, & Van Dijk, 2013). In the typical dilemma, the decision to cooperate is beneficial for the collective and costly for the individual. Such dilemmas can occur in the contexts of close relationships, organizations, and societies at large. Researchers in the social sciences have extensively studied the psychology of social dilemmas using the Prisoners Dilemma (PD) and Public Goods Game (PGG), basic economic situations that measure the willingness to cooperate with a specific partner and a group, respectively.

Recently, psychologists and economists have investigated the cognitive underpinnings of cooperation in social dilemmas by applying the framework of dual-process theories, which distinguish between intuitive and reflective styles of decision-making (Chaiken & Trope, 1999; Kahneman, 2011; Sloman, 1996; Stanovich & West, 2000). Intuitive processes tend to be fast, automatic, efficient, and emotional. Reflective processes are slow, controlled, effortful, and based on calculative reasoning. Because intuitive processes occur quickly and efficiently, they are not affected by the availability of time and cognitive resources (e.g., manipulations of time pressure and concurrent cognitive load tasks). In contrast, the role of reflective processes is reduced when decisions are made under time pressure or when fewer working memory resources are available (e.g., under cognitive load).

There is converging evidence that many humans are intuitively cooperative and reflectively selfish (Zaki & Mitchell, 2013). In a series of causal experiments, Rand and colleagues (2012) found that encouraging participants to respond intuitively, either by requiring them to respond under time pressure or by cognitively priming an intuitive mindset, increased cooperation. Further studies replicated the finding that intuitive thinking increases cooperation (Rand et al., 2014; Rand & Kraft-Todd, 2014), even when social dilemmas are framed as competitive interactions or are played with out-group members (Cone & Rand, 2014; Rand, Newman, & Wurzbacher, 2014). Similarly, other work has found that cognitive load increases egalitarian sharing (Cornelissen, Dewitte, & Warlop, 2011; Roch, Lane, Samuelson, Allison, & Dent, 2000; Schulz, Fischbacher, Thöni, & Utikal, 2014) and honest behavior (Van't Veer, Stel, & Van Beest, 2014). To explain the processes underlying intuitive cooperation, Rand et al. (2014) proposed the Social Heuristics Hypothesis (SHH), which states that decision-makers tend to adopt strategies that are beneficial in their everyday social interactions as intuitive, default responses (Peysakhovich & Rand, in press).

Reaction times, cooperation, and extreme decisions

In addition to studies that experimentally manipulate the use of cognitive processes, researchers have also used correlational reaction time studies to determine if cooperation is intuitive or reflective (e.g., Rand et al., 2012). Processing speed is one of the primary features used to differentiate intuition and reflection (Kahneman, 2011), and reaction times are an appealing research tool because they are quantifiable and can be measured unobtrusively (Rubenstein, 2007; 2013). Beyond the domain of social dilemmas, researchers have relied on reaction time correlations to understand the role of intuitive thinking in a wide range of social and economic behaviors (Frederick, 2005; Greene, Nystrom, Engell, Darley, & Cohen, 2004; Rubenstein, 2007; Tamir & Mitchell, 2013).

Consistent with experimental studies that manipulated time pressure and cognitive load, several studies have reported a negative correlation between reaction times and cooperation (Cappelen et al., 2014; Lotito et al., 2013; Nielsen et al., 2014; Rand et al., 2012), which has been interpreted as evidence that intuition favors cooperation. However, counterexamples show that reaction times are sometimes *positively* correlated with cooperation. Piovesan and Wengström (2009) measured reaction times in dictator games and found that selfish decisions were faster than prosocial ones. Similarly, Lohse et al. (2014) found that selfish decisions in a real-world PGG were faster than cooperative ones. Using eye-tracking methods to study decision-making in binary choice dictator games, Fiedler et al. (2013) found that strictly selfish individuals made decisions quickly because they spent less time attending to the outcomes of other players, consistent with previous reaction time studies (Dehue, McClintock, & Liebrand, 1993; Liebrand & McClintock, 1988).

The current research explains these inconsistent results by proposing that reaction times may be influenced by variables other than the extent of intuitive versus reflective processing. For example, theories of *conflict* in judgment and decision-making (Baron, Gürçay, Moore, & Starcke, 2012; Diederich, 2003) suggest we should not expect a linear relationship between reaction time and cooperation. Rather, there may be a linear relationship between reaction time and *decision extremity*, with extreme decisions (both selfish and cooperative) occurring more quickly than intermediate ones. This would produce an inverted-U pattern of reaction times that has been observed in social-cognitive (Akrami, Hedlund, & Ekehammar, 2007; Austin, 2009;

Kupier, 1981; Markus, 1977) and psychophysical tasks (Brown, Marley, Donkin, & Heathcote, 2008; Mignault, Bhaumik, & Chaudhuri, 2009; Mignault, Marley, & Chaudhuri, 2008; Monahan & Lockhead, 1977).

This inverted-U pattern of reaction times is consistent with evidence accumulation models of decision-making (Klauer, 2014; Ratcliff, 1985; Ratcliff & Smith, 2004). These models posit that decision-makers begin at an initial reference point and continue to acquire new pieces of information that increase or decrease the perceived values of different options. This process continues until the value of one option has reached a suitable threshold, at which point a decision is made. Accumulator models predict that low-conflict decisions (where one option is strongly favored over the others) occur quickly, and high-conflict decisions (where the options are similarly attractive) require more time (Krajbich & Rangel, 2011). The extent to which an individual feels uncertain or conflicted about the different options predicts slower reaction times and less extreme choices (Baron et al., 2012; Diederich, 2003; Kleiman & Hassin, 2011; Krajbich, Oud, & Fehr, 2014; Tyebjee, 1979). Accordingly, we propose that feelings of conflict can explain reaction times and decision extremity in social dilemmas.

Decision conflict and reflection

Different programs of research have interpreted reaction times as evidence of reflective thinking (Greene et al., 2004; Rand et al., 2012; Rubenstein, 2007; 2013) and as feelings of uncertainty or conflict (Baron et al., 2012; Frank, Samanta, Moustafa, & Sherman, 2007). It is unclear to what extent these interpretations of reaction times are conceptually independent or related. Does reflective thinking lead to feelings of conflict and intermediate decisions? Or are reflection and conflictedness orthogonal dimensions of the decision process?

One perspective suggests that there is a dependent relationship between reflection and conflictedness. Reflective thinking, which involves the rational weighing of pros and cons, may lead individuals to greater feelings of conflict and intermediate responses (Ariely & Norton, 2011), whereas intuition may favor extreme, low-conflict decisions (Gigerenzer, Todd, & ABC Research Group, 1999). Another perspective suggests that reflection and conflict are orthogonal: Individuals may feel highly conflicted when making intuitive decisions, such as when individuals experience conflicting emotions (Fong, 2006; Hong & Lee, 2010). Similarly, many reflective decisions may involve little or no conflict because one option is strongly favored over the others.

Understanding the relationship between reflection and conflict is important for the interpretation of reaction times in social dilemmas and other areas where reaction times have been used as an indicator of cognitive processes, such as social perception (Jackson, Brunet, Meltzoff, & Decety, 2006; Krueger, 2003; Tamir & Mitchell, 2013), moral judgment (Baron et al., 2012; Crockett, Kurth-Nelson, Siegel, Dayan, & Dolan, 2014; Greene et al., 2004; Wisneski, Lytle, & Skitka, 2009), economic decision-making (Frederick, 2005; Rubenstein, 2007; 2013), cognitive neuroscience (Ersner-Hershfield, Wimmer, & Knutson, 2009; Frank et al., 2007; Polezzi et al., 2008), and clinical and health psychology (Fishbach & Shah, 2006; Kemps, Tiggemann, Martin, & Elliott, 2013).

Overview of the present research

The present studies investigate the psychological processes underlying reaction times in social dilemmas. We propose 1) that conflictedness, rather than the use of intuition versus reflection, drives reaction times; and 2) that conflictedness and reflection have orthogonal effects on decision-making. Dual-process models (Rand et al., 2014) predict that cooperative decisions occur more quickly than selfish decisions. In contrast, the central prediction of conflict-based models (Krajbich & Rangel, 2011) is that reaction times follow an inverted-U pattern, with extreme decisions occurring more quickly than intermediate decisions. Studies 1-3 compare the dual-process and conflict-based models by testing for a linear versus inverted-U pattern of reaction times. On finding the inverted-U pattern predicted by conflict models, we examine its robustness and generalizability. Building on these results, Studies 4 and 5 test whether this inverted-U pattern is driven by feelings of conflictedness. We use correlational and experimental studies to support a model where reaction times mediate the effects of conflict on decision extremity. Finally, Studies 6 and 7 address whether conflict and reflection are orthogonal concepts. We examine whether encouraging the use of intuition through time pressure or cognitive mindset priming influences feelings of conflict and decision extremity.

Studies 1-3: Reaction times and extreme decisions

Models of conflict in decision-making predict that reaction times in social dilemmas should follow an inverted-U pattern (Diederich, 2003), with extreme decisions occurring more quickly than intermediate ones. Studies 1-3 tested the relationship between reaction times and the willingness to cooperate with a specific partner (PD; Study 1) and a group (PGG; Studies 2 and 3). Reaction times were observed in one-shot (Studies 1 and 2) and repeated (Study 3) social dilemmas, and decisions were observed in both online (Study 1) and laboratory samples (Studies 2 and 3).

Study 1

Our first study measured the relationship between reaction times and contributions in the dyadic PD. In this game, participants were randomly assigned to partners and received endowments that they could share or keep. When a participant decided to share some or all of her money, the shared amount was doubled by the experimenter and given to the partner. This means that participants received extra earnings when both partners were willing to share money, but each player was always individually better off by sharing nothing.

Method.

International workers were recruited from MTurk (*N* = 324, average age = 19.4; 45% women). We did not collect participants' nationalities, but 238 (73.5%) participants were native English speakers. In our studies, we did not conduct *a priori* power analyses, but the planned sample sizes were based on previous studies that tested the correlation between reaction times and cooperation (Rand et al., 2012). In this and the following studies, we did not conduct statistical analyses prior to the completion of data collection.

The instructions for the Prisoners Dilemma (PD) were based on those presented in Yamagishi et al. (2013). Players were randomly assigned to partners and received 40 cents that they could keep or send to their partners. After reading the instructions, participants proceeded to a second screen where they provided their response by typing the amount of money they wished to send. The number of seconds spent on this screen was the measure of reaction time. After decisions were made, subjects completed a series of personality measures that were not analyzed in this report. One-in-ten participants were paid based on their decisions, and no deception was employed.

Results and discussion.

Our analyses looked at the relationship between decision extremity and decision time. The average reaction time was 10.1 seconds (*SD* = 11.7). Reaction times were log10 transformed to account for a heavily right-skewed distribution. The average level of cooperation was 19.6 out of 40 cents (*SD* = 14.2) and the average log-transformed reaction time was .91 (*SD* = .25). To define extremity, we created a variable that measured the absolute distance between the level of cooperation and the intermediate, midpoint response (Brandt, Evans, & Crawford, 2015). Participants who contributed 20 out of 40 cents were minimally extreme and those who contribute everything (40 cents) or nothing (0 cents) were maximally extreme, *M* = 11.08 out of 20, *SD* = 8.9. The levels of cooperation and extremity were scaled so that each variable ranged from 0 to 1.[1]

We conducted a multiple regression estimating reaction times with the levels of extremity and cooperation as predictors, $F(2, 321) = 4.85$, $p = .008$, adjusted $R^2 = .023$. Consistent with our hypothesis, extreme decisions were significantly faster than intermediate decisions, $b_{unstandardized} = –.081$, $SE = .031$, $p = .011$, $\beta_{\text{standardized}} = –.141$. See Figure 1 for an illustration of this relationship. Cooperative decisions were also marginally slower than selfish decisions, $b = .072$, $SE = .040$, $p = .071$, $\beta = .099$, but this trend was not replicated in subsequent studies. We also tested an additional model including the interaction of cooperation and extremity, but across our studies there was no evidence of an interaction effect.[2]

To test the robustness of our results, we also conducted analyses where we tested the linear and quadratic effects of cooperation on reaction times. Reassuringly, these analyses also supported the inverted-U pattern. These analyses are included in the Supplemental Materials.

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[1] In all of our regression analyses, these variables were also centered to range from -.5 to +.5.
[2] In some studies, we observed that fully intermediate responses (50% cooperation) were slightly faster than partially intermediate responses (e.g., 25% cooperation). This pattern was observed in studies where responses were made using text-boxes or sliders, but not in studies where decisions were made using radio-buttons. This suggests that this difference was due to the physical processes involved in entering partially intermediate responses.

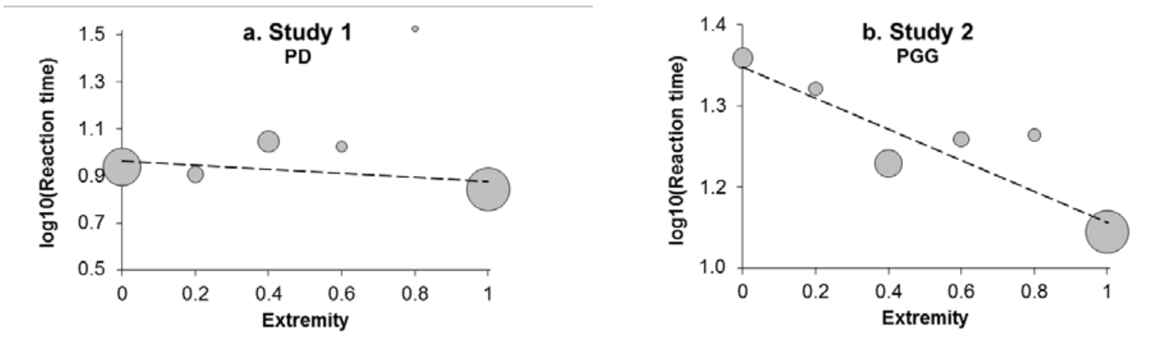

Figure 1. *Extremity, rather than cooperation, predicted faster reaction times in the PD (a) and PGG (b). Responses were binned into six categories, with dot size proportional to the number of observations in each category.*

Study 2

Building on the results of Study 1, we measured reaction times and decisions in the PGG, an economic game measuring cooperation in groups (i.e., an n-person PD). In the PGG, players receive endowments that they can keep or contribute to the group’s common project. Contributed money is multiplied and then shared equally among the group members. This means that the group can potentially turn a collective profit if everyone contributes, but each group member is individually better off by contributing nothing and free-riding off others’ contributions. To test the generalizability of the inverted-U pattern, Study 2 was conducted with university students who played the PGG in a controlled laboratory setting.

Method.

Participants (*N* = 156) were recruited through the Harvard Business School Computer Lab for Experimental Research (CLER) for experiments conducted at the Harvard Decision Sciences Laboratory. The average age was 21.7 years (*SD* = 2.9) and 53.2% were women. Each participant was paid a $15 show up fee and earned additional money based on his or her choices

(125 points = $1). Participants completed the experiment using Z-tree at partitioned computers. The experiment was originally conducted as a pilot for an unrelated project.

In the PGG, players received 400 points they could keep or contribute to the group; contributions were doubled and split equally among the four group members. The instructions for the PGG were extensive, and participants were required to answer a series of comprehension questions before making a decision. Reaction times were recorded at the decision screen.

Results and discussion.

In the PGG, the average reaction time was 19.4 seconds (*SD* = 13.2), the average log-transformed reaction time was 1.20 (*SD* = .25) and the average level of cooperation was 178.6 points of 400 (*SD* = 159.9). We used the same approach outlined in Study 1 to measure decision extremity, *M* = 145.46 out of 200, *SD* = 68.81. We tested a multiple regression with reaction time as the dependent variable and levels of cooperation and extremity as predictors, $F(2, 150) = 5.71$, $p = .004$, adjusted $R^2 = .058$. Extreme responses were significantly faster than intermediate responses, $b = –.20$, $SE = .058$, $p = .001$, $\beta = –.26$. There was no relationship between the level of cooperation and reaction times, $b = –.028$, $SE = .051$, $p = .58$, $\beta = –.043$.

Study 3

The previous studies measured reaction times in one-shot games; Study 3 tested the inverted-U in a repeated social dilemma. Arguably, reaction time differences might be limited to the first round of a repeated interaction. Previous studies have found that reaction times are negatively correlated with cooperation in repeated interactions, though the size of this correlation sometimes diminished or disappeared with experience (Rand, Fudenberg, & Dreber, in press; Rand et al., 2012). However, social-cognitive and psychophysical experiments find that the inverted-U pattern of reaction times is robust even after a large number of trials (e.g., Akrani et al., 2007), leading us to hypothesize that the relationship between reaction times and decision extremity would also be observed in a repeated social dilemma and would not diminish with task experience.

Method.

Participants were recruited through the Harvard Business School Computer Lab for Experimental Research (CLER), *N* = 28. Participants completed the study as part of a single experimental session. The experimental conditions were similar to those described in Study 2.

At the beginning of the experiment, each participant read instructions about the PGG similar to the instructions for the control condition reported in Rand et al. (2009). Participants were randomly assigned to groups of four. The PGG lasted for 36 rounds and participants remained in the same groups throughout the game. To simulate an infinitely repeated game, participants were not informed about the total number of rounds. At the beginning of each round, participants could contribute between 0 and 20 points to the group, with contributions multiplied by a factor of 1.6 and shared equally among the four group members. Participants made their contribution decisions using text-boxes and reaction times were recorded at the decision screen. After making each decision, participants were informed of the choices made by the other players in their group, and their resulting payoff.

Results and discussion.

In the repeated PGG, there were a total of *N* = 1,008 decisions. The average reaction time was 4.5 seconds (*SD* = 2.77), the average log-transformed reaction time was .59 (*SD* = .21); the average level of cooperation was 9.53 points of 20 (*SD* = 8.31); and the average level of extremity was 7.56 out of 10 (*SD* = 3.64). Over the course of the repeated interaction, both average reaction times (*r* = –.312, *df* = 34, *p* = .064) and average rates of cooperation (*r* = –.825, *df* = 34, *p* < .001) decreased.

We used multilevel modeling to account for the non-independence of observations within participants and the randomly assigned groups. A linear model was estimated predicting log-transformed reaction times with random intercepts estimated for participants (*n* = 28, Level-2) and groups (*n* = 7, Level-3). To control for the effect of experience on reaction times, game round was also entered as a predictor, scaled to range from –.5 to +.5. There were 36 rounds in total: this means that decisions made during round 1 were coded as –.5 and decisions from round 36 were coded as +.5.

Findings were consistent with our previous analyses of one-shot games: Extreme decisions were significantly faster than intermediate decisions, *b* = –.10, *SE = .019*, *p* < .001. Cooperative decisions were not significantly faster than selfish decisions, *b* = –.001, *SE = .016*, *p* = .98. Reaction times also became significantly faster in the later rounds of the experiment, *b* = –.10, *SE = .020*, *p* < .001, but there was no significant interaction between extremity and game round, *b* = .041, *SE = .060*, *p* = .49. There was substantial variability in reaction times between participants (σ = .054, *SE* = .021) and groups (σ = .063, *SE* = .012). These data demonstrate that the inverted-U pattern observed in Studies 1 and 2 extends to repeated social dilemmas and does not diminish with task experience (see Figure 2).

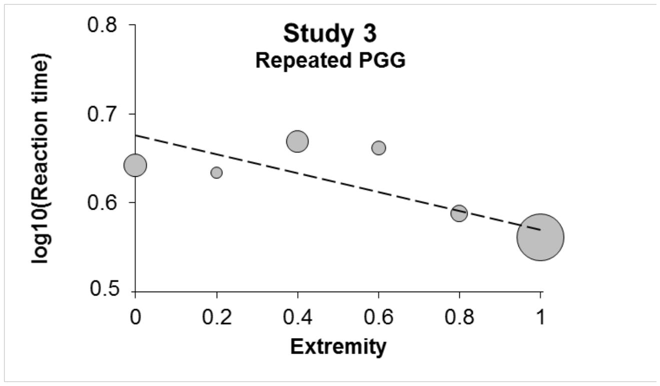

Figure 2. *Extreme decisions were significantly faster than intermediate decisions in the repeated PGG.*

Studies 4 and 5: Decision conflict and intermediate responses

Studies 1-3 found consistent evidence for the inverted-U pattern of reaction times in social dilemmas: extreme decisions were significantly faster than intermediate ones. The following studies test whether feelings of conflictedness are related to reaction times and decision extremity. Evidence accumulation models predict that feelings of conflict lead to longer reaction times and intermediate decisions (Krajbich et al., 2014; Krajbich & Rangel, 2011); decisions are fast and extreme when one option is strongly preferred over the others. In the context of social dilemmas, we propose that decision conflict is defined by the relative pull of self-interested and cooperative motives. Conflict is greatest when the decider does not have a clear preference to pursue either self-interest or the collective good. Unconflicted individuals unambiguously favor cooperative or self-interested motives, whereas conflicted individuals are influenced by both self-interested and cooperative motives.

Study 4

In Study 4, we measured feelings of conflictedness, reaction times, and cooperation in the PGG.

Pre-test.

We defined conflictedness as the (lack of) difference in motives to pursue self-interest and the collective good. To test the validity of this definition, we conducted a supplemental study where we asked an additional sample of 120 MTurk workers to read about a hypothetical PGG and measured decision conflict (“how conflicted do you feel about your decision?”), as well as their motives to pursue self-interest (“how much do you care about earning the highest payoff for you personally?”) and the collective good (“how much do you care about earning the highest payoff for the group as a whole?”). These three questions were presented to participants in a randomized order.

Our definition of conflict assumes that participants feel most conflicted when selfish and cooperative motives are equally strong. To test this definition, we measured the absolute difference between the selfish and cooperative motives. As predicted, this absolute difference in motives was *negatively* correlated with feelings of conflictedness, $r(118) = –.50$, $p < .001$. Participants who strongly favored one goal (either pursuing self-interest or the collective good) had larger difference scores and felt less conflicted about their decisions in the PGG.

Method.

We recruited 303 American participants on MTurk to play a PGG. As in Study 2, the PGG was a single one-shot game involving four players. In this study, participants could contribute between 0 and 40 cents to the group’s common project. Decisions were made using radio buttons in 10 cent increments. Task comprehension was assessed prior to playing the PGG. Of the 303 subjects, 273 correctly answered both comprehension questions. To avoid selection effects, our analysis includes all subjects, but our results are consistent when we exclude the participants with incorrect responses. Following the PGG, decision conflict was assessed by asking “How conflicted did you feel when making your decision?” using a 10-point Likert scale going from “Very little” to “Very much”.

Results and discussion.

First, we replicated the inverted-U reaction time pattern observed in previous studies. We estimated a regression with extremity and cooperation predicting reaction time, $F(2, 301) = 8.32$, $p < .001$, adjusted $R^2 = .046$. Consistent with our previous results, extreme decisions occurred more quickly than intermediate decisions, $b = -.19$, $SE = .049$, $p = .001$, $\beta = -.23$. There was no significant relationship between the level of cooperation and reaction times, $b = .036$, $SE = .036$, $p = .31$, $\beta = .057$.

Next, we turned to decision conflict. The relationship between conflict and both reaction times and decision extremity are shown in Figure 3. On average, participants felt moderately conflicted about their cooperation decisions, $M = 4.10$, $SD = 2.9$. Ratings of conflictedness were Z-transformed for the following analyses. The correlation between reaction times and self-reported conflict was positive, $r(304) = .32$, $p < .001$. We estimated separate regressions using conflictedness to predict decision extremity and cooperation: Extreme decisions were less conflicted than intermediate decisions, $b = -.068$, $SE = .018$, $p = .001$, $\beta = -.21$. There was no significant relationship between the level of cooperation and conflictedness, $b = -.029$, $SE = .026$, $p = .26$, $\beta = -.066$.

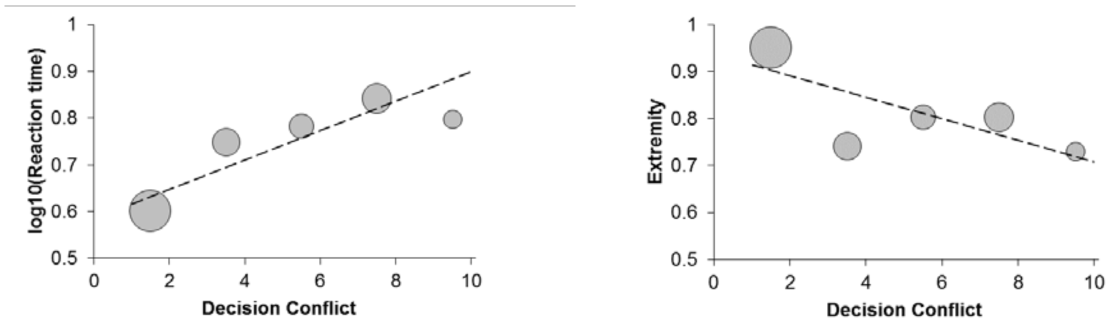

Figure 3. *Participants who felt conflicted about their decisions in the PGG had longer reaction times and were less likely to select an extreme response.*

We then asked if reaction times mediated the relationship between conflict and intermediate responses, testing a mediational model using the bootstrapping method (Hayes, 2013). In this model, conflict was the independent variable (X); log-transformed reaction time was the mediator (M); and decision extremity was the dependent variable (Y)

The mediational model was estimated with 1,000 iterations using the PROCESS macro for SPSS. The estimated indirect effect of reaction time on intermediate responses was –.017 (*SE* = .0074) with a 95% confidence interval of –.036 to –.01. The confidence interval did not include zero, indicating that reaction times significantly mediated the effect of conflict on intermediate responses. Conflicted individuals took longer to reach a decision, and in turn, were less likely to select an extreme response. The estimated direct effect of conflictedness on intermediate responses was –.049 (*SE* = .019) with a 95% confidence interval of –.087 to –.012. The confidence interval of the direct effect did not include zero, indicating that reaction times *partially* mediated the relationship between conflict and extreme responses.

Study 5

Our next study was an experimental test of the hypothesis that feelings of conflict lead to longer reaction times and intermediate decisions. Study 5 measured reciprocity decisions in the

Trust Game (TG: Berg, Dickhaut, & McCabe, 1995; Evans & Krueger, 2009). The TG takes place in two stages and involves two roles, the trustor and the trustee. In the first stage of the game, the trustor receives an endowment that she can keep or send to the trustee. Any invested money is tripled by the experimenter and given to the trustee. In the second stage, the trustee decides how much of the tripled investment, if any, to share with the trustor.

We relied on the sequential structure of the TG to experimentally manipulate the trustee's feelings of conflictedness. In the second stage of the game, the trustee learns how much money was sent by the trustor. As the level of initial trust by the trustor increases, the trustee becomes more willing to reciprocate, in part because she feels more of an obligation to help the first player (Pillutla, Malhotra, & Murnighan, 2003). Thus higher levels of initial trustor trust lead to stronger motives for the trustee to pursue cooperative goals, and the trustee should feel most conflicted when the first player shows an intermediate level of trust. If the trustor shows minimal trust, then the trustee has little motive to pursue cooperation and self-interested motives are dominant. If the trustor shows maximal trust, then the trustee has a strong motive to cooperate. But when the trustor transfers only an intermediate amount, neither self-interested nor cooperative motives are dominant for the trustee (Pillutla et al., 2003), and so decision conflict is high.

By this logic, extreme initial trust decisions by the trustor should predict shorter trustee reaction times and more extreme trustee reciprocity decision. In contrast, we expected that trustees would feel most conflicted when responding to intermediate levels of trust by the trustor, and that they correspondingly would take longer to reach a decision and be more likely to make intermediate reciprocal decisions.

Pre-test.

To test our assumption that the initial level of trust would influence decision conflict, with participants feeling most conflicted about responding to intermediate levels of trust, we conducted a pre-test. In this study, 120 Mturk workers read about a hypothetical TG from the perspective of the trustee. We asked participants how conflicted they would feel about responding to each of the four possible levels of trust, and measured their motives to pursue self-interest ("how much do you care about earning the highest payoff for you personally?") and cooperative goals ("how much do you care about sharing the money equally with Player 1?"). Responses were made on a 10-point scale and means are reported in Table 1. We then computed the absolute difference between these motives. We randomized the order of the three questions and the order in which participants evaluated the four levels of initial trust, with each level of trust presented on a separate screen.

Similar to previous studies of the TG (Pillutla et al., 2003), increasing the initial level of trust *increased* the motive to pursue cooperation and *decreased* the motive to pursue self-interest. Critically, we hypothesized that the absolute difference between these two motives would be smallest (and feelings of conflict would be greatest) for the two intermediate levels of trust. To test this, we compared the two intermediate levels of trust (20 and 30 cents) with the two extreme levels of trust (10 and 40 cents). When there was an intermediate level of trust, the absolute difference in selfish and cooperative motives was significantly smaller, $t(118) = 5.71$, $p < .001$, and feelings of conflictedness were significantly greater, $t(118) = 2.90$, $p = .004$. These results strongly support our use of the initial level of trust as a situational manipulation of decision conflict.

Table 1. *The effects of initial trust on conflict and interpersonal motives (Study 5 pre-test)*

	Initial trust (amount invested out of 40 cents)			
	10 cents	20 cents	30 cents	40 cents
Self-interested motive	7.48 (2.86)	6.78 (2.69)	6.64 (2.80)	6.31 (3.09)
Cooperative motive	4.30 (3.00)	6.01 (2.92)	6.83 (2.70)	7.48 (3.00)
Absolute difference	5.04 (3.14)	3.80 (2.86)	3.66 (2.98)	4.55 (3.19)
Conflictedness	3.10 (2.49)	3.63 (2.71)	3.55 (2.52)	3.26 (2.79)

Method.

We recruited 503 American participants on MTurk to play a Trust Game. There were two roles in the game, trustor and trustee. The average age was 31.9 years (*SD* = 9.74) and 38% were women. Participants received a payment of 50 cents for completing the study and a bonus based on their decisions. In this report, we focus only on the decisions of trustees, *N* = 235, whose level of conflict we experimentally manipulated.[3]

At the beginning of the experiment, participants were randomly assigned to the role of trustor or trustee. Trustors received an endowment of 40 cents that they could keep or send to the trustee, with the knowledge that any sent money was tripled by the experimenter. Trust decisions were made in increments of 10 cents. Participants assigned to the role of trustee decided how much of the invested money to share with the trustor. Trustees indicated how they would respond to each of the four possible non-zero levels of trust (Pillutla et al., 2003). Thus, each trustee made a total of four reciprocity decisions, presented in a random order, although trustees were only paid based on the actual behavior of their partner in the TG. Before making each reciprocity

[3] The average level of investment was 21.6 cents out of 40 (*SD* = 15.73). More specifically, there were 62 participants who invested nothing, 35 who invested 10 cents, 58 who invested 20 cents, 22 who invested 30 cents, and 92 who invested the full 40 cents.

decision, trustees indicated how conflicted they felt about the decision. Trustees could share up to 50% of the tripled investment in increments of 10%. Decisions were made using radio-buttons and reaction times were measured at the decision screen. The actual outcomes of the interaction were revealed to participants when data collection for the experiment was completed.

Results and discussion.

Trustees made reciprocity decisions for each of the four possible levels of initial trust, total N = 940 decisions. Table 2 reports the descriptive statistics for our variables of interest. As in the previous studies, reciprocity and extremity were scaled from 0 to 1, and feelings of conflictedness were Z-transformed.

Table 2. *The effects of initial trust on reciprocity, conflictedness, reaction times, and intermediate responses (Study 5)*

	Initial trust (amount invested out of 40 cents)			
	10 cents	20 cents	30 cents	40 cents
Reciprocity	.26 (37)	.50 (.37)	.57 (.39)	.64 (.43)
Extremity	.85 (.27)	.64 (.35)	.72 (.31)	.86 (.27)
Conflictedness	3.10 (2.57)	3.38 (2.50)	3.50 (2.74)	3.31 (2.88)
Reaction times (sec)	7.38 (8.31)	9.61 (9.45)	11.12 (25.54)	7.44 (10.05)
Log10 reaction times	.71 (.34)	.82 (.37)	.82 (.38)	.70 (.34)

Our first set of analyses focused on the *between-person* effects of conflict, replicating the mediation analyses reported in Study 4. We tested a model where average reaction times (M) mediated the effects of average conflictedness (X) on average decision extremity (Y). This means that conflictedness ratings, reaction times, and decision extremity were averaged over four decisions. These variables were then standardized and a mediational model was estimated using the PROCESS macro for SPSS (Figure 4A). The estimate of the indirect effect of reaction times was –.0078, with a 95% confidence interval of –.018 to –.001, indicating significant mediation. The direct effect of conflict on decision extremity was –.055, with a 95% confidence interval from –.083 to –.028, suggesting that reaction times partially mediated the effects of conflictedness. Participants who felt more conflicted took more time to reach their decisions and consequently selected responses that were less extreme.

Our second set of analyses tested for evidence that the experimental manipulation of conflictedness caused longer reaction times and intermediate responses. First, we conducted a preliminary test to verify that the initial level of trust influenced trustees' feelings of conflictedness in the expected direction. We predicted that trustees would feel most conflicted when responding to intermediate levels of trust (i.e., when the trustor invested 20 or 30 cents). A multilevel random-intercept model was used to estimate the effect of the initial level of trust on feelings of conflictedness. As expected, trustees felt significantly more conflicted when they responded to intermediate (compared to extreme) levels of trust, $b = .236$, $SE = .07$, $p < .001$.

Next, we estimated a multilevel mediational model focusing on *within-person* decisions to test whether within-person differences in conflict also predicted longer reaction times and intermediate reciprocity decisions. To avoid confounding between- and within-person sources of variance, reaction-times and conflictedness ratings were centered within-person. A mediational model was estimated using the gsem builder in Stata 13 (Figure 4B). In this model, person-centered conflictedness was the independent variable (X); person-centered reaction time was the mediator (M); and decision extremity was the dependent variable (Y). Random-intercepts were estimated for reaction times and reciprocity. The estimate of the indirect effect of reaction times was –.053 (*SE* = .0089) with a 95% confidence interval of –.079 to –.035, evidence of a significant mediation effect. The direct effect of conflictedness was also significant (*p* < .001), indicating that reaction times partially mediated the relationship between conflict and extreme responses.

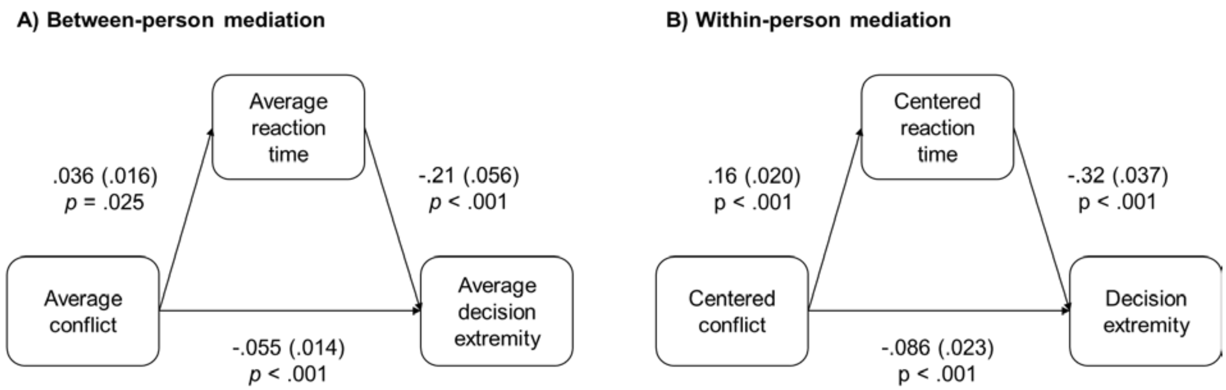

Figure 4. *Reaction times significantly mediated the effects of conflictedness on extreme reciprocity decisions (Study 5). A) Trustees who felt more conflicted, on average, took longer to respond and were more likely to select extreme responses. B) Trustees felt most conflicted when responding to an intermediate level of trust, and feelings of conflictedness predicted within-person differences in reaction times and extreme reciprocity decisions.*

Studies 6 and 7: Experimental manipulations of intuition and reflection

Across five studies, fast reaction times predicted extreme, rather than cooperative, decisions. Studies 4 and 5 furthermore suggested that reaction times are related to decision conflict. These findings raise questions about whether conflict is distinct from the use of intuitive or reflective processes. It is not clear to what extent slow, conflicted decisions are also reflective, or if conflict and reflection are independent dimensions of the decision process. To distinguish between these possibilities, we tested the effects of experimentally manipulating the use of intuition (vs reflection) on decision extremity and feelings of conflictedness.

Study 6

To test the effects of manipulating intuition (vs reflection), we reanalyzed data from Rand et al., 2014's previously compiled 15-experiment meta-analysis of studies where participants were forced to respond intuitively (time pressure) or reflectively (time delay). Time pressure manipulations are commonly used to encourage the use of intuitive processing (Evans & Curtis-Holmes, 2005; Kahneman, 2011; Suter & Hertwig, 2011) and they have been used in various programs of research over the past forty years (Zur & Breznitz, 1981; Betsch, Fiedler, & Brinkmann, 1998; De Dreu, 2003; Kruglanski & Freund, 1983; Shalvi, Eldar, & Bereby-Meyer, 2012; Wright, 1974). Individuals under time pressure describe their process of decision-making in terms of intuition (Roberts et al., 2014) and the effects of time pressure are similar to those of cognitive load manipulations (Roch et al., 2000) and priming manipulations that indirectly facilitate intuitive reasoning (Rand et al., 2012). Note that time pressure effects are fundamentally different from reaction time correlations, because they involve an experimental manipulation of the decision-making process.

Previous analyses have not tested the effects of time pressure on decision extremity (e.g. Rand et al., 2014). If conflict and reflection are related, then the effects of time pressure should resemble the inverted-U pattern of reaction times. In other words, time pressure should increase decision extremity (i.e., increase both extremely cooperative and extremely selfish decisions). However, if reflection and conflict are independent, then time pressure should increase extreme cooperation, but decrease extreme selfishness. It is also important to ask if time pressure changes the inverted-U pattern of reaction times. When decisions occur under time pressure, are extreme decisions still slower than intermediate decisions? If conflictedness and reflection are independent, then the inverted-U pattern of reaction times should be observed even under time pressure. Coupled with evidence from Studies 1-3, this double dissociation would suggest that the psychological processes underlying self-paced reaction times (e.g., conflictedness) are not related to the use of intuition or reflection.

Method.

We considered the 6,913 cooperation decisions made under time pressure or time delay from the 15 studies of Rand et al. (2014). Each study involved a decision about how much one would be willing to contribute to give a greater benefit to one or more others, as well an experimental manipulation of reaction time. Participants were randomly assigned to either a time pressure condition (in which they were instructed to decide as quickly as possible, and typically given 10 seconds at most to decide) or a time delay condition (in which they were instructed to carefully consider their decision, and typically asked to stop and think for at least 10 seconds before deciding). See Rand et al. (2014) for further details on study selection.

Results and discussion.

For the following analyses, we estimated multilevel random-intercept models to account for study-level variation in cooperation (level-2; $n = 15$). To avoid selection effects, we included subjects that did not obey the time constraint (as per Tinghög et al., 2013). Cooperation and decision extremity were scaled to range from 0 to 1 (cooperation: $M = .54$, $SD = 41$; extremity: $M = .64$, $SD = .38$). Time pressure significantly increased cooperation ($b = .035$, $SE = .0094$, $p < .001$), but had no significant effect on decision extremity ($b = .002$, $SE = .0054$, $p = .58$). The predicted effects of time pressure on cooperation and extremity are shown in Figure 5.

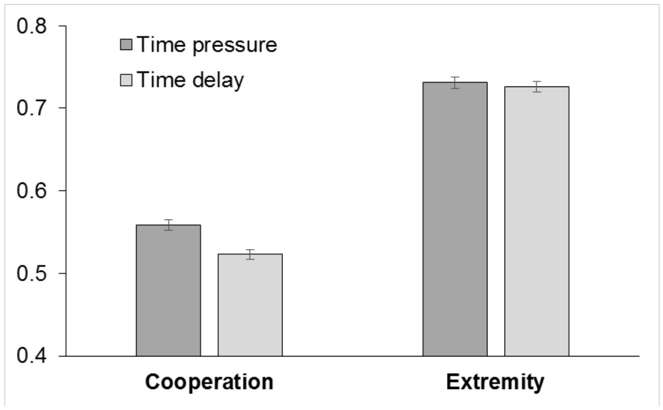

Figure 5. *The manipulation of time pressure significantly increased cooperation, but had no effect on decision extremity. This figure displays the predicted means of cooperation and extremity based on multilevel models controlling for differences between studies. Error bars denote standard error of the predicted means.*

To better understand the effects of time pressure on extremity, we used multilevel logistic regressions to test its effects on the rates of fully cooperative and fully selfish decisions. These analyses focused only on the participants who contributed everything (fully cooperative) or nothing (fully selfish). Significantly *more* people selected fully cooperative responses under time pressure compared to time delay (b = .128, SE = .053, Z = 2.45, p = .014). Conversely, significantly *fewer* people selected fully selfish responses under time pressure (b = –.25, SE = .061, Z = –3.92, p < .001). These results are consistent with the idea that time pressure and extremity are independent.

We also tested whether the manipulation of time pressure alters the relationship between reaction times and decision extremity, estimating a model that predicted reaction times with the following predictors: decision extremity, experimental condition [–.5 = time delay; .5 = time pressure], and their interaction. Consistent with Studies 1-3, extreme decisions were significantly faster than intermediate ones, b = –.051, SE = .022, p = .024. Reassuringly, decisions were also faster in the time pressure condition, b = –.40, SE = .007, p < .001. Interestingly, there was a significant interaction between extremity and experimental condition, $b = -.18$, $SE = .032$, $p < .001$.

To better understand the interaction between extremity and experimental condition, we conducted separate analyses on the relationship between reaction times and extremity *within* the time pressure and time delay conditions. Interestingly, there was a significant negative relationship between extremity and reaction time within each condition. Extremity and reaction times were, however, more strongly related within the time pressure condition ($b = -.19$, $SE = .020$, $p < .001$) than within the time delay condition ($b = -.096$, $SE = .025$, $p < .001$). This difference is not surprising, as the time delay instructions add noise to the measurement of reaction times. These results suggest that manipulating the use of intuition versus reflection influences cooperation behavior, but has no effect on decision extremity and does not qualitatively alter the relationship between extremity and reaction times (See Figure 6).

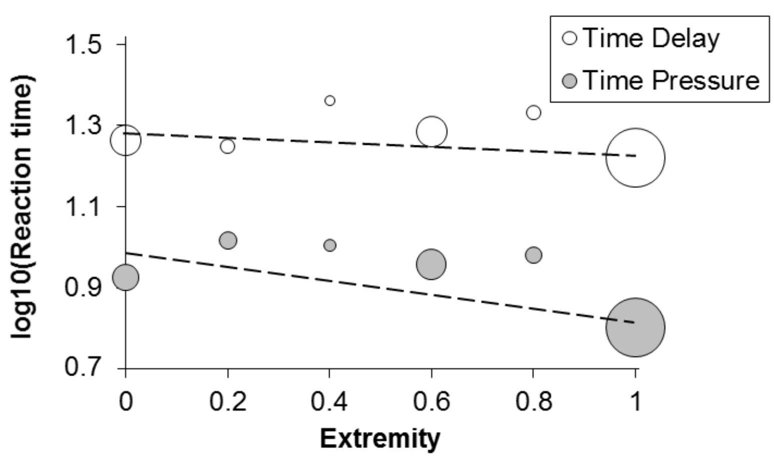

Figure 6. *The relationship between decision extremity and reaction times was observed within the time pressure and time delay conditions.*

Study 7

In the previous study, applying time pressure increased cooperation, but had no effect on decision extremity. Moreover, extreme decisions were associated with fast reaction times in both the time pressure and time delay conditions. We interpreted the effects of time pressure in terms of the use of intuitive (vs reflective) processes, but these results could also be related to the specific, incidental effects of manipulating decision speed. For example, participants under time pressure may have felt greater negative affect or arousal at the moment of decision-making (Garbarino, & Edell, 1997; Zur & Breznitz, 1981). Hence, we conducted a final study providing convergent validity with Study 6’s time pressure results. To do so, we examined the effect of manipulating the use of intuition (vs reflection) using a conceptual priming procedure.

Method.

We performed novel analyses of an experiment originally reported as Study 8 of Rand et al. (2012). In this experiment, 864 participants completed a conceptual priming task, played a one-shot PGG, and completed a demographics questionnaire. Participants were recruited from Mturk (see Rand et al., (2012) for further details).

The conceptual priming of intuition and reflection used an induction approach first introduced in Shenhav, Rand, and Greene (2012). In a 2 x 2 design, subjects were asked to write 8-10 sentences about a situation in which they adopted one of two cognitive approaches (intuition vs. reflection) and where that approach led to one of two outcome valences (positive vs. negative). This means that there were two conditions designed to promote reliance on intuition (the intuition-positive and reflection-negative conditions) and two conditions promoting reflection (the intuition-negative and reflection-positive conditions). The four experimental conditions are illustrated in Table 3.

Table 3. *Conceptual priming conditions (Study 7)*

		Outcome valence	
		Positive	Negative
Cognitive approach	Intuition	Pro-intuition	Pro-reflection
	Reflection	Pro-reflection	Pro-intuition

Following this induction, subjects played a one-shot PGG. The rules of the PGG were similar to those reported in previous studies. Unfortunately, reaction times were not recorded in this study.[4] After deciding how much money to contribute to the group, subjects completed the same decision conflict measure used in Studies 4 and 5; data from this measure were not previously analyzed.

Results and discussion.

Of the 864 participants, 343 wrote at least 8 sentences as instructed. The analyses of Rand et al. (2012) focused on only those participants. To avoid possible selection effects, our analyses included all 864 observations. Cooperation and extremity were scaled from 0 to 1.

The effects of intuition on cooperation and extremity

We tested whether conceptually priming intuition had a similar effect on contribution decisions to that of time pressure in Study 6, where the manipulation of time pressure increased cooperation but had no effect on extremity. To begin, we compared the two pro-intuition conditions with the two pro-reflection conditions. Consistent with Study 6, encouraging the use of intuition significantly increased cooperation. Participants in the pro-intuition conditions

[4] Ma, Liu, Rand, Heatherton, and Han (2015) found that manipulating the use of intuition with a similar cognitive priming procedure did indeed lead to faster reaction times.

contributed more money to the group (*M* = .60, *SD* = .38) than those in the pro-reflection conditions (*M* = .53, *SD* = .38), *t*(862) = 2.86, *p* = .004, *d* = .19.

Next, we used a 2 x 2 ANOVA to test the separate effects of cognitive approach (intuition vs reflection) and outcome valence (positive vs negative) on cooperation. As predicted by the idea that the intuition-positive and reflection-negative conditions increase intuition (and intuition-negative and reflection-positive conditions increase reflection), there was a significant cognitive approach by valence interaction, *F*(1, 860) = 8.44, *p* = .004, η^2 = .01. Given the significant interaction, we focused on the simple effects of cognitive approach (intuition vs reflection) within the positive and negative valence conditions. When participants wrote about experiences with negative outcomes, those who wrote about relying on intuition contributed *significantly less* (*M* = .55, *SD* = .38) than those who wrote about using reflection (*M* = .64, *SD* = .38), *t*(454) = 2.48, *p* = .014, *d* = .23. On the other hand, when participants wrote about experiences with positive outcomes, those who wrote about relying on intuition contributed *marginally more* (*M* = .58, *SD* = .40) than those who wrote about using reflection (*M* = .51, *SD* = .39), *t*(406) = 1.66, *p* = .097, *d* = .16.[5] This pattern of results, displayed in Figure 7, supports the conclusion that participants who were encouraged to rely on intuition (the intuition-positive and reflection-negative conditions) contributed more than participants who were encouraged to rely on reflection (the reflection-positive and intuition-negative conditions).

[5] Additional experiments also found greater cooperation in the intuition-positive condition compared to the reflection-positive condition (Lotz, 2015; Study 9 from Rand et al., 2012).

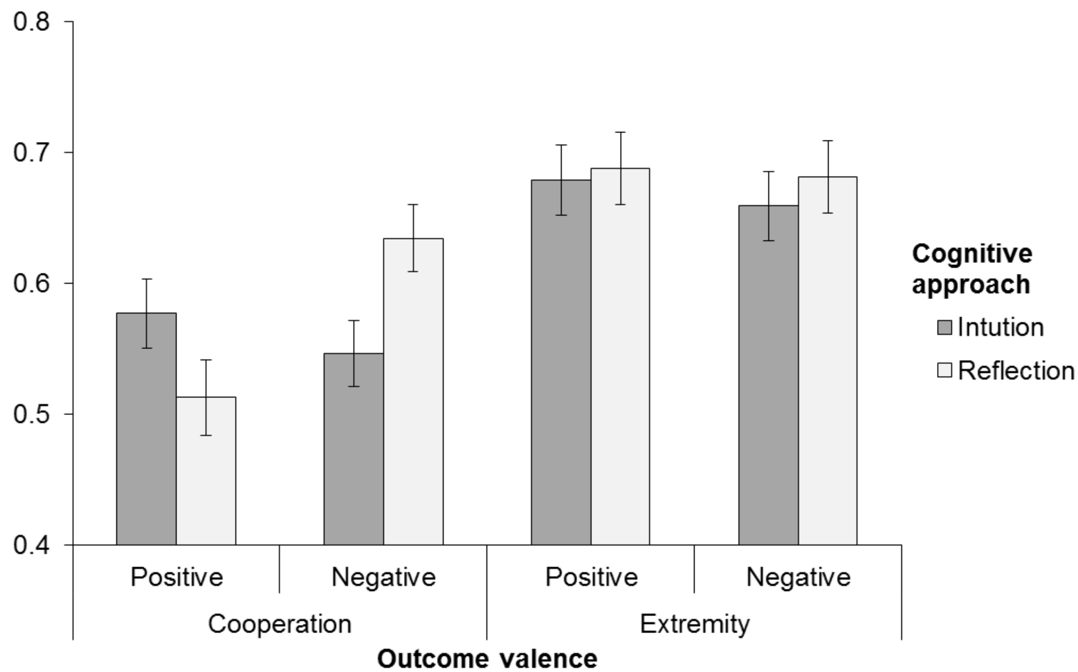

Figure 7. *Participants assigned to the two pro-intuition conditions (intuition-positive and reflection-negative) were significantly more cooperative than participants in the two pro-reflection (intuition-negative and reflection-positive) conditions, but there was no significant difference in extremity. Error bars denote standard error of the mean.*

We also tested the effects of cognitive approach and outcome valence on decision extremity. Decisions in the two pro-intuition conditions were *not* significantly more extreme (M = .68, SD = .40) than decisions in the pro-reflection conditions (M = .67, SD = .38), $t(862)$ = .298, p = .76, d = .02. Similar results were obtained using a 2 x 2 ANOVA: There was no significant main effect of cognitive approach, $F(1, 860) = .32$, $p = .57$, $\eta^2 < .001$; no significant main effect of outcome valence, $F(1, 860) = .24$, $p = .63$, $\eta^2 < .001$; and no cognitive approach by valence interaction, $F(1, 860) = .059$, $p = .81$, $\eta^2 < .001$. Thus, while manipulating the use of intuition versus reflection influenced cooperation, it had no effect on decision extremity.

Intuition and feelings of conflictedness

We also replicated the finding that extreme decisions are less conflicted than intermediate decisions. First, we tested the effect of conflict on decision extremity: Consistent with our previous studies, higher levels of conflict predicted less extreme decisions, $b = –.061$, $SE = .013$, $p < .001$, $\beta = –.154$. We also tested the effect of conflict on cooperation and found that higher levels of conflict predicted lower levels of cooperation, $b = –.047$, $SE = .013$, $p = .006$, $\beta = –.120$.

Finally, we tested the relationship between the use of intuition and feelings of conflictedness. Levels of conflict were similar in the two pro-intuition ($M = 4.79$, $SD = 2.90$) and two pro-reflection ($M = 4.54$, $SD = 2.87$) conditions, $t(862) = 1.27$, $p = .21$, $d = .08$. Similar results were obtained when we estimated a 2 x 2 ANOVA: Cognitive approach had no significant effect on feelings of conflict, $F(1, 860) = .32$, $p = .57$, $\eta^2 < .001$. Participants who wrote about negative experiences felt marginally more conflicted than participants who wrote about positive experiences, $F(1, 860) = 3.27$, $p = .071$, $\eta^2 = .004$, but there was no significant interaction between cognitive approach and outcome valence, $F(1, 860) = 1.25$, $p = .26$, $\eta^2 = .001$. These results further support the conceptual independence of decision conflict and cognitive reflection.

General Discussion

Previous studies have produced inconsistent results as to whether reaction times are positively (Lohse et al., 2014; Piovesan & Wengström, 2009) or negatively (Cappelen et al., 2014; Lotito et al., 2013; Nielsen et al., 2014; Rand et al., 2012) correlated with cooperation. We reconcile this difference with the hypothesis that reactions times are driven primarily by conflictedness, and thus extreme, rather than cooperative, decisions occur quickly. In our studies, there was consistent evidence of an inverted-U relationship between reaction time and cooperation: extreme decisions occurred more quickly than intermediate ones. This pattern was found in economic games measuring cooperation and reciprocity; occurred in one-shot and repeated interactions; was robust to different response formats; was observed in both MTurk and laboratory samples; and was not affected by the experimental manipulation of time pressure.

Studies 4 and 5 found that fast reaction times and extreme decisions were influenced by decision conflict. In the context of social dilemmas, feelings of conflict were related to the relative strengths of self-interested and cooperative motives. Individuals who felt conflicted about the decision to cooperate took longer to reach a decision and were less likely to select an extreme response, with reaction times significantly mediating the effects of conflict on decision extremity. These findings were observed for both within- and between-subject differences in conflict, suggesting that conflict is shaped by both individual dispositions (Evans & Revelle, 2008; Kieslich & Hilbig, 2014; Peysakhovich, Nowak, & Rand, 2014; Van Lange, 1999) and situational variables (Evans & Krueger, 2014; Parks, Joireman, & Van Lange, 2013; Rauthmann et al., 2014).

To address if the effects of conflict are related to (or orthogonal to) the use of reflection, Studies 6 and 7 tested the effects of experimentally manipulating intuition. Forcing participants to respond intuitively increased cooperation but had no consistent effect on decision extremity. Moreover, the inverted-U pattern of reaction times persisted even when participants were forced to respond quickly or slowly, and priming the use of intuition increased cooperation but did not significantly change feelings of conflict. These experimental results are consistent with the conclusion that intuitive thinking increases cooperation (Rand et al., 2014) and suggest that there is an important dissociation between the effects of reflection and conflict in decision-making. Given this discrepancy, self-paced reaction times should not be treated as a proxy for the degree of reflection.

Cooperation, conflict, and reflection

The present studies further clarified the effects of intuitive and reflective processes in social dilemmas. Intuition predicted cooperation, but not the tendency to select extreme responses. Conflict predicted less extremity, but had no effect on the level of cooperation. To better understand the determinants of cooperation and decision extremity, it will be important for future research to address the integration of dual-process and conflict-based models of decision-making (Klauer, 2014; Krajbich et al., 2014).

Studies 6 and 7 found that manipulating the use of intuition increased cooperation, but did not influence decision extremity or conflict. We defined conflict in terms of the relative strengths of self-interested and cooperative motives. This definition suggests that encouraging intuition shifts the balance of these motives, either by strengthening the cooperative motive or weakening the selfish motive. This shift may increase feelings of conflict for some individuals, but decrease conflict for others. Behaviorally, manipulating the use of intuition may therefore cause some participants to shift from extreme selfish responses to intermediate responses (e.g., 0 to 50% cooperation), while others shift from intermediate decisions to extreme cooperative decisions (e.g., 50 to 100% cooperation).[6] Future research is needed to directly test this explanation. Within-subject experiments and methods that measure cooperation in real-life contexts (Hofmann, Wisneski, Brandt, & Skitka, 2014) may be needed to fully understand the interplay of conflict and reflection.

Our findings also raise questions about how decisions in social dilemmas are related to the specific dimensions used to describe intuitive and reflective processes. Experiments applying

[6] Encouraging the use of intuition may sometimes have an indirect, *secondary* effect on the level of decision extremity. For example, if encouraging intuition increases the level of cooperation from 90 to 100%, then both cooperation and decision extremity will increase. Using the same logic, encouraging intuition can also lead to situations where cooperation increases and extremity decreases. The key pattern that emerges is that intuition and conflict have consistent primary effects, while the directions of the possible secondary effects vary.

dual-process theories to economic decision-making have primarily relied on the manipulation of time pressure or cognitive load (Kahneman, 2003), procedures that emphasize the distinction between effortless and effortful processes. Critics have noted that the dimensions described by dual-process theories are often misaligned (Keren & Schul, 2009; Kruglanski & Gigerenzer, 2011). For example, reflective thinking tends to be conscious and effortful, but some decisions are conscious and effortless, whereas others are unconscious and effortful. This raises the possibility that other dimensions differently influence cooperation. Social psychologists have investigated the roles of non-conscious (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Kleiman, & Hassin, 2011; Wong & Hong, 2005) and affective (Hertel, Neuhof, Theuer, & Kerr, 2000; Kirchsteiger, Rigotti, & Rustichini, 2006; Knapp & Clark, 1991; Lount, 2010) processes in social dilemmas. It is important for future research to conduct fine-grained analyses to learn more about the specific effects of experimental manipulations used to study intuition and reflection, and to use process-tracing (Evans & Krueger, 2014; Fiedler et al., 2013; Halevy & Chou, 2014) and physiological methods (Zaki & Mitchell, 2013) to better understand how people reconcile the conflict between self-interest and the collective good.

Reaction times in social dilemmas

Across our studies, reaction times followed an inverted-U pattern, with extreme decisions occurring more quickly than intermediate decisions. This inverted-U pattern reconciles the inconsistent findings of previous studies, which found both positive (Lohse et al., 2014; Piovesan & Wengström, 2009) and negative (Cappelen et al., 2014; Lotito et al., 2013; Nielsen et al., 2014; Rand et al., 2012) correlations between reaction times and cooperation: Depending on the distribution of decisions, an inverted-U pattern can produce negative *or* positive correlations (Simpson, 1951). Researchers will observe a negative linear correlation between reaction times and cooperation when there are many extreme cooperative decisions and few extreme selfish decisions (Rand et al., 2012). On the other hand, a positive linear correlation will be observed when there are many extreme selfish responses and few extreme cooperative responses (Piovesan & Wengström, 2009).

The present studies focused on decisions involving a continuum of possible responses, but the distinction between extreme and intermediate responses can also be applied to explain reaction time differences in binary choice dilemmas, where the decision to cooperate is all-or-nothing. In a binary choice dilemma, both selfish and cooperative decisions can occur quickly, depending on the specific payoffs of each alternative (Krajbich, Bartling, Hare, & Fehr, 2015). Our results suggest that cooperation will occur quickly to the extent that it is perceived as an "extreme" option.[7] Similarly, it may be possible to alter or reverse the inverted-U pattern in continuous dilemmas by changing the decision environment. In the present studies, a plausible explanation for why extreme responses were fast is that they were associated with the execution of simple strategies, such as maximizing self-interest or the collective good. In other environments, these simple strategies may produce fast, intermediate decisions.

The psychological interpretation of reaction times

A number of recent studies have tested the relationship between correlational reaction times and cooperation in social dilemmas (Cappelen et al., 2014; Evans & Krueger, 2011; Fiedler et al., 2013; Lotito et al., 2013; Lohse et al., 2014; Nielsen et al., 2014; Piovesan & Wengström, 2009; Rand et al., 2012). More generally, reaction times have been used to study social perception (Jackson et al., 2006; Krueger, 2003; Tamir & Mitchell, 2013), moral judgment (Baron et al., 2012; Crockett et al., 2014; Greene et al., 2004; Wisneski et al., 2009), economic

[7] For example, Kiselich and Hilbig (2014) found that selfish decisions were more conflicted than cooperative decisions in a number of binary choice dilemma. We would expect to find the opposite pattern in a binary dilemma where the selfish decision was perceived as extreme.

decision-making (Frederick, 2005; Polezzi et al., 2008; Rubenstein, 2007; 2013), cognitive neuroscience (Ersner-Hershfield et al., 2009; Frank et al., 2007; Kim & Lee, 2011) and clinical and health psychology (Crean, de Wit, & Richards, 2000; Fishbach & Shah, 2006; Kemps et al., 2013).

Across these programs of research, different studies have interpreted reaction times as evidence of reflective thinking (Greene et al., 2004; Kim & Lee, 2011; Rand et al., 2012; Rubenstein, 2007; Sherbino et al., 2012; Thompson, Prowse-Turner, & Pennycook, 2011) or as evidence of conflict and uncertainty (Baron et al., 2012; Frank et al., 2007; Krajbich et al., 2014). We found that correlational reaction times were primarily related to feelings of conflict, and the extent to which participants strongly preferred one option over others. Moreover, the effects of conflict on reaction times were dissociable from the manipulation of intuition versus reflection. Conflict caused intermediate responses; reflection increased selfishness and had no effect on decision extremity. Based on these findings, researchers in experimental psychology and economics should be reluctant to interpret slow reaction times as evidence of reflective thinking.

Concluding remarks

Understanding the cognitive processes underlying human cooperation is an important goal for researchers in the fields of social psychology and behavioral economics (Rand & Nowak, 2013; Van Lange et al., 2013; Zaki & Mitchell, 2013). We revealed an important dissociation between correlational analyses of reaction times and experimental manipulations of cognitive processes. In our studies, extreme decisions were fast, but not intuitive. These results have implications for how researchers and decision-makers interpret reaction times and the underlying cognitive processes that influence cooperation in social dilemmas.

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