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Signaling Emotion and Reason in Cooperation

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Abstract

We explore the signal value of emotion and reason in human cooperation. Across four experiments utilizing dyadic prisoner dilemma games, we establish three central results. First, individuals infer prosocial feelings and motivations from signals of emotion. As a result, individuals believe that a reliance on emotion signals that one will cooperate more so than a reliance on reason. Second, these beliefs are generally accurate—those who act based on emotion are more likely to cooperate than those who act based on reason. Third, individuals' behavioral responses towards signals of emotion and reason depends on their own decision mode: those who rely on emotion tend to conditionally cooperate (that is, cooperate only when they believe that their partner has cooperated), whereas those who rely on reason tend to defect regardless of their partner's signal. These findings shed light on how different decision processes, and lay theories about decision processes, facilitate and impede cooperation.

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Cooperation is essential to social life, but can be threatened by the relentless pursuit of self-interest and by beliefs about whether others will cooperate or pursue their self-interest. When do individuals determine that another is cooperative and respond in kind?

Past behavior is certainly a strong signal of future behavior: people cooperate more with others who have behaved cooperatively (Barclay & Willer, 2007; Milinski, Semmann, & Krambeck, 2002) and who have punished the selfishness of others in the past (e.g., Barclay, 2006; Jordan, Hoffman, Bloom & Rand, 2016). Even the mere endorsement of moral positions focused on respecting the wishes and desires of others can enhance trust and cooperation (Everett, Pizarro, & Crockett, 2016). Cooperation also improves when individuals expect that others are cooperative or when they observe others behaving prosocially (e.g., Frey & Meier, 2004; Nook, Ong, Morelli, Mitchell, & Zaki, 2016). But in the absence of information about others' behavior, what interpersonal cues do people use to infer that others are cooperative, and how do those cues influence people's own behavior? In the present research, we examine how actors' decision processes inform others about their cooperativeness.

Specifically, we examine the contrast between emotion and reason as opposing decision processes that could influence the dynamics of cooperation. From early philosophy to modern day dual process theories, decision-making has been characterized by two competing processes: one more affective and intuitive and the other more reason-based and deliberative (i.e., System 1 vs. System 2; Chaiken, & Trope, 1999; Epstein, 1994; Evans & Stanovich, 2013; Kahneman, 2011; Sloman, 1996). This framework captures a key distinction in how people think and has been used to model how people make decisions in a variety of domains including problem solving (e.g., Fetterman & Robinson, 2013; Kahneman, 2011), consumer decision-making (e.g., Shiv & Fedorikhin, 1999), person perception (Tamir et al., 2016), and moral judgment (e.g.,

Adam, Obodaru, & Galinsky, 2015). Yet, prior research has not directly examined how relying on signals of decision processes influences cooperation. Although there is a growing body of research that examines how intuition versus deliberation affects decision-makers' own choices about cooperation (e.g., Rand, Greene, & Nowak, 2012; Rand, 2016), there is little work on how others react to *signals* of these processes. Furthermore, there is no work that examines how those who *rely on* emotion and reason react to others' signals in dynamic cooperative contexts. The present research addresses this gap. As such, we provide new insights on how dual process models of decision-making influence cooperation and social life more broadly. Moreover, we deepen our understanding of lay intuitions about emotion and reason, and gain insight into the specific feelings, thoughts, and mental processes associated with these decision processes.

Emotion and Reason

Consistent with existing research on the dual process framework (Evans & Stanovich, 2013; Kahneman, 2011; Sloman, 1996), and a long line of empirical research (Brewer, 1988; Haidt, 2001; Hsee et al, 2003; Greene et al, 2001; Pham et al., 2001; Shiv & Fedorikhin, 2002; Tversky & Griffin, 1991), we conceptualize emotion and reason as competing decision modes. Specifically, we assume that the degree to which a person relies on emotion to make a decision is inversely related to the degree to which a person relies on reason.

Past theorizing and empirical evidence provide conflicting views about whether emotion or reason is better for promoting cooperation. Emotion has been characterized as both prosocial and antisocial. For instance, in *The Theory of Moral Sentiments* (1790/1976), Adam Smith argued for the importance of emotion as a driver of moral behavior, claiming that emotion guides individuals to take socially adaptive actions above-and-beyond what reason would otherwise

dictate (see also, Frank, 1988). Consistent with this view, a large body of work demonstrates that feelings of sympathy and empathy often inspire prosocial deeds (Batson, 1990; Darwin, 1872/1965; Davis, 1994; de Waal, 1996; Frank, 1988; Hume, 1777/1960; Loewenstein & Small, 2007; McDougall, 1908; Rand, Kraft-Todd, & Gruber, 2015; Slovic, 2007; Smith, 1790/1976). Furthermore, emotional responses to norm violations can promote long-term cooperation (Camerer 2003; Dawes, McTavish, & Shaklee, 1977; Jordan et al., 2015). However, emotions can also distort prosocial decisions. Feelings of sympathy and empathy can cause individuals to allocate their resources in non-optimal ways (Bloom, 2017; Small, 2010). For example, victims and causes that elicit emotional reactions receive greater support than more consequential, but less affectively appealing causes (Kogut & Ritov, 2005; Small & Loewenstein, 2003). Furthermore, certain emotions, such as fear, greed, or anger, may prompt individuals to behave selfishly and avoid cooperating or sharing resources with others (Coombs, 1973; Dawes, Orbell, Simmons, & de Kragt, 1986; Pillutla & Murnighan, 1996).

Reason has likewise been associated with both prosocial and antisocial tendencies. For example, utilitarian philosophers argue that relying on reason produces the greatest social good (Baron, 1993; Bentham, 1843/1948; Singer, 2009, 2015), and can act as a check on whether one's intuitions and emotions lead to inefficient outcomes (MacAskill, 2015; Singer, 2015). Furthermore, rationalist theories of moral judgment suggest that moral decisions are ultimately an outcome of intentional reflection and deliberation (e.g., Kohlberg, 1969), and many have argued that prosocial behavior requires the deliberative extension of self-control (Loewenstein, 1996, 2000). However, the opposite pattern has been documented empirically. Greater deliberation often leads to lower rates of cooperation in economic games (for a meta-analysis, see Rand, 2016) and focusing on calculation can increase selfishness (Small, Loewenstein &

Slovic, 2007; Wang, Zhong, & Murnighan, 2014) and unethical behavior (Zhong, 2011). For example, Wang and colleagues (2014) found that simply doing a calculative task lowered offers in the dictator game and increased rates of deception in a modified ultimatum game.

The actual relationship between emotion, reason, and cooperativeness notwithstanding, a growing body of theoretical and empirical research suggests emotion is *perceived* as promoting the greater good. For centuries, scholars and philosophers have posited that emotions serve as observable cues of a person's true intentions (Darwin, 1872/1965; Frank, 1988; Smith, 1790/1976). Consistent with these arguments, emotional expressions signal trustworthiness and commitment across contexts ranging from negotiations to marriage (Frank, 1988; Reed, Zeglen, & Schmidt, 2012). Moreover, donors to charity are perceived as more generous and moral the more they are motivated by emotion and the more they reap emotional benefits from donating (Barasch, Levine, Berman & Small, 2014). Thus, there is good reason to expect that reliance on emotion will signal greater cooperation than reliance on reason, but this has not yet been tested directly.

This expectation dovetails with research on the signal value of reaction times, as well as research on the signal value of discrete emotions. Recent work on reaction times suggests that those who make moral decisions slowly are seen as less moral and trustworthy (e.g., Critcher, Inbar, & Pizzaro, 2013; Jordan et al., 2016). These results, however, are driven by inferences regarding the deciders' level of decision conflict between self-interest and cooperation, rather than inferences about the use of reason versus emotion (Evans & Van de Calseyde, 2017). A large body of research has also explored how discrete emotional expressions signal one's intentions and future behavior. For example, expressions of happiness and anger signal one's intentions to compete or concede and thus influence negotiation behavior (Van Kleef et al.,

2004), and expressions of contempt signal one's internal feelings and thus influence the trajectory of romantic relationships (Gottman & Levenson, 2000). This research demonstrates that people are sensitive to cues of emotion in social settings and modify their judgments and decisions based on these cues. Across contexts, ranging from strategic interactions (e.g., de Melo, Carnevale, Read, & Gratch, 2012; Filipowicz et al., 2011; Keltner & Haidt, 1999; Lelieveld, et al., 2012; Van Kleef, de Dreu, & Manstead, 2004) to personal relationships (e.g., Clark & Taraban, 1991), people are motivated to detect others' emotions, whether from their faces (e.g., Ames & Johar, 2009; Ekman, Friesen, & Ellsworth, 1972; Tomkins, 1962), body language (e.g., Ekman, 2004; Meeren, van Heijnsbergen, & de Gelder, 2005), or words (e.g. Gill et al., 2008; Hancock, Landrigan, & Silver, 2007). In contrast to this research, we examine inferences from people's reliance on emotion, broadly, as a decision mode, rather than their reliance on any particular emotion. That is, we do not specify any discrete emotions that actors experience in the decision-making context; rather, we explore how individuals infer specific emotions from information about others' general decision-making mode.

Research Overview

We examine three central research questions regarding the signal value of emotion and reason in cooperative decision-making. First, we ask what emotion and reason signal to others (Research Question 1 (RQ1), Studies 1-4). Specifically, we examine specific lay intuitions about emotion-based and reason-based decision-making (Study 1) and we examine the degree to which emotion and reason are perceived to signal cooperative behavior (Studies 1-4). Second, we explore whether others' inferences about the signal value of emotion and reason are correct. Specifically, we examine whether there actually is a relationship between an individual's

decision mode (i.e., their reliance on emotion or reason) and their tendency to cooperate (RQ2, Studies 2-3). Third, we examine people's reactions to signals of emotion and reason (RQ3, Studies 2-4). In particular, we investigate how people who make decisions using emotion versus reason respond to individuals who signal emotion and reason in cooperative contexts. Thus, this is the first work to examine *who* reacts to these decision process cues and in what circumstances.

We explore the above research questions in four experiments using dyadic prisoners' dilemma (PD) games in which one player provides a signal about whether emotion or reason guided their decisions. In Study 1, we examine observers' judgments of these signals. In Studies 2-4, we examine how other PD players respond to these signals. All studies were incentive compatible, such that individuals' (chances of earning) bonus payments were contingent on their actions. The Institutional Review Board at the University of Pennsylvania confirmed the protection of the rights of human subjects involved. Across our studies, planned sample sizes were based on previous studies using PD games (e.g., Rand et al., 2012). We report all measures and conditions we administered, and we did not conduct statistical analyses prior to the completion of data collection.

Study 1

Study 1 seeks to provide initial insight into lay intuitions about emotion and reason as decision modes in cooperative decision making. In this study, we examine the specific emotions and motivations associated with making decisions based on emotion versus reason, and we examine whether information about emotion-based versus reason-based decision processes leads to broad inferences regarding System 1 versus System 2 decision-making.

Method

Three-hundred sixty-four individuals (44.2% female; mean age = 37) recruited through Amazon Mechanical Turk, participated in this study for $.50 and a possible bonus payment.

Participants first learned about the PD. In the PD we described, each participant received 30 lottery tickets that they could transfer to their partner (cooperate) or keep for themselves (defect). Each lottery ticket gave participants a chance to win a $75 bonus. Any tickets transferred by the participant were doubled by the experimenter (to 60 lottery tickets) and then became part of their partner's earnings. This means that participants received extra earnings when both partners were willing to transfer their tickets, but each player was always individually better off by not transferring. We provide the exact instructions of the PD in Appendix A. The Nash equilibrium of this PD is mutual defection; each participant is individually better off defecting. After reading the instructions, participants proceeded to a second screen where they answered four questions to check their comprehension of the PD game rules. If a participant failed the comprehension check, they had the opportunity to take it again. If they failed twice, they were not allowed to proceed with the study.

We told participants that they would either play the PD or predict the behavior of a person who had played the PD in the past. However, all participants in this study actually predicted the behavior of a former participant who had played the PD in a past study, who we called Person A (henceforth referred to as "Player A"). Participants in this study did not play the game.

Participants learned that if they correctly predicted Player A's behavior (Transfer or Don't Transfer), they would be entered into a lottery for a $75 bonus.[1] They then read a short

[1]To pay participants based on their decisions, we matched them with probabilistic partners based on the results from Study 2 (Player A), which was run prior to the present study. See supplemental materials for payment details of each study.

description explaining, “Sometimes, people make decisions based on **emotion**. Other times, people make decisions based on **reason**.” After this description, they received a signal of the decision mode from Player A. Specifically, we informed participants that we had asked Player A, “How did you make your decision?” [open-ended]. Participants then saw a screenshot of Player A’s response. We randomly assigned participants to one of two conditions (*emotion* or *reason)*: They saw that Player A had typed either “based on emotion” or “based on reason” In response to the open-ended question. See Appendix B for stimuli.[2]

Participants then predicted whether Player A had cooperated or defected. After making this prediction, participants were asked to indicate the emotion that Person A felt most when making his/her decision. Participants chose from a drop-down list including: None, Excitement, Compassion, Empathy, Happiness, Guilt, Regret, Fear, Greed, and Other. We note that these measures do not capture the full range of positive and negative emotions typically measured in emotions research (e.g., the PANAS; Watson, Clark, & Tellegen, 1988), but rather a narrower set that we deemed relevant to a Prisoner’s Dilemma context. If participants selected “Other” they were asked to indicate the most prevalent emotion using a free-response text box.

Then, participants rated the extent to which Person A felt each of the emotions listed above, using rating scales anchored at 1 (not at all) and 7 (extremely). We ran a factor analysis (Principle Axis Factoring, Varimax Rotation) on all specific emotion ratings and found that they loaded onto three separate factors: empathy (empathy, compassion, greed (reverse-coded); α = .76), negative emotions (fear, guilt, regret; α = .72), and happiness (happiness, excitement; r = .60).

[2]Because we are interested in lay theories of emotion and reason, we manipulate emotion and reason in an “all-or-none” fashion (i.e., Player A either relied on emotion *or* reason). However, Study S1 conceptually replicates this when describing the manipulation in more continuous terms (i.e., Player A relied *mostly* on emotion or *mostly* on reason; see supplemental materials).

On the next page of the survey, participants made judgments about the extent to which the target was focused on their own or others' outcomes: "Person A was focused on maximizing his/her partner's outcomes", "Person A was focused on maximizing his/her own outcomes" (reverse-scored), "Person A was focused on maximizing his/her and his/her partner's joint outcomes", and "Person A was focused on making the ethical decision" (1 = strongly disagree to 7 = strongly agree; averaged to form a measure of *Perceived prosocial motivation*; $\alpha = .84$).

Then, participants judged the extent to which the target relied on different processes associated with System 1 versus System 2 decision-making: "Person A made his/her decision intuitively", "Person A made his/her decision quickly", "Person A made his/her decision deliberatively", "Person A made his/her decision slowly," "Person A made his/her decision by relying on his/her heart", "Person A made his/her decision by relying on his/her brain" (1 = strongly disagree to 7 = strongly agree). A factor analysis (Principle Axis Factoring, Varimax Rotation) on these judgments revealed no commonalities. Thus, we examine each item separately. As manipulation checks, participants also judged the degree to which "Person A made his/her decision by relying on emotion" and "Person A made his/her decision by relying on reason" (1 = strongly disagree to 7 = strongly agree).

Finally, participants answered a few demographic questions and an open-ended question that asked them to describe their emotions and reasoning during the study.

Results

Below, we examine how one's decision mode (reliance on emotion versus reason) affects predictions of cooperation, as well as other inference about the person's specific emotions and motivations. Table 1 depicts the correlations between all measures.

Predictions of cooperation (RQ1). Participants who learned that Player A made a PD decision using emotion were more likely to predict that Player A cooperated (60.7%) than those who learned that Player A made their decision using reason (23.2%; $\chi^2(1) = 52.38$, $p < .001$).

Inferred discrete emotions. We first examine the frequency with which participants chose each discrete emotion as the emotion that Person A felt most when making his decision. A chi-squared test for independence revealed that actors were perceived to experience different emotions across the two conditions; $\chi^2(9) = 137.40$, $p < .001$. Participants were much more likely to infer compassion and empathy, and somewhat more likely to infer guilt and fear, from the signal of emotion, compared to the signal of reason (see Table 2 for frequencies).

It is worth noting that compassion, empathy, and guilt were the inferred discrete emotions that most strongly correlated with predicted cooperation (see Table 3 for details). Specifically, 93.6% of participants who believed that Player A primarily felt compassion believed that Player A cooperated, and 90% of participants who believed that Player A primarily felt empathy believed that Player A cooperated. In other words, the inferred emotions that are most commonly associated with emotional decision-makers over rational decision-makers are primarily the emotions that people most associate with greater cooperation.

Levels of discrete emotions. Next, we examine the *levels* of different emotions that participants inferred as a function of decision mode. A repeated measures ANOVA with Decision Mode (emotion, reason) as the between-subjects factor and Emotion Type (empathy, negative emotion, happiness) as the within-subjects factor revealed a main effect of Decision Mode, $F(1,362) = 114.12$, $p < .001$**,** such that participants inferred greater levels of all emotions from the emotion signal than from the reason signal. This was qualified by a significant Decision Mode x Emotion Type interaction, $F(2,362) = 4.14$, $p = .016$, such that the effect of Decision

Mode was larger for inferred empathy, $F(1,362) = 68.23$, $p < .001$, than for negative emotion, $F(1,362) = 43.14$, $p < .001$, which was greater than the effect of Decision Mode on happiness $F(1,362) = 27.16$, $p < .001$. We present corresponding descriptive statistics in Table 4. Consistent with the inferred discrete emotion results, empathy was also the emotion that most strongly correlated with predicted cooperation (see Table 1 for details).

Perceived prosocial motivation. A one-way ANOVA revealed a main effect of Decision Mode on perceived prosocial motivation, $F(1,362) = 74.71$, $p < .001$**,** such that participants believed Player A was more focused on others when Player A had made his/her decision using emotion rather than reason (see Table 4).

Mental processes. One-way ANOVAs revealed significant main effects of Decision Mode on the following mental processes: the degree to which the target relied on emotion and reason (the manipulation checks), made his/her decision intuitively, quickly, deliberatively, and relied in his/her heart and brain; Fs > 7.5, $ps < .01$. A one-way ANOVA also revealed a marginal main effect of Decision Mode on the degree to which the target made his/her decision slowly, $F(1, 362) = 3.34$, $p = .068$. All effects were in the predicted direction – the signal of emotion was associated with greater levels of intuition, quickness, reliance on one's heart, and reliance on emotion than the signal of reason, and the signal of reason was associated with greater levels of deliberation, slowness, reliance on one's brain, and reliance on reason than the signal of emotion (see Table 4).

Interestingly, our results further suggest that the term "emotion" is more strongly associated with cooperation than other System 1 constructs. For example, the correlation between "Relying on emotion" and "Predicted cooperation" (r = .369) was significantly stronger than the correlation between "Intuitively" and "Predicted cooperation" ($r = .225$), $z = 2.08$, $p =$

.037, and likewise stronger than the correlation between "Quickly" and "Predicted cooperation" (r = -.014), z = 5.01, p < .001. Conversely, our results suggest that reason is more strongly associated with defection than other System 2 constructs. Specifically, the correlation between "Relying on reason" and "Predicted cooperation" *(*r = -.270), was marginally significantly stronger than the correlation between "Deliberately" and "Predicted cooperation" (r = -.137), z = 1.85, p = .064, and was significantly stronger than the correlation between "Slowly" and "Predicted cooperation" (r = .119), z = 5.37, p < .001. Table 1 depicts all correlations.

Discussion

Study 1 offers initial evidence that reliance on emotion signals cooperation, thus providing insight into RQ1. Specifically, this study reveals that people predict that a person who made their decision by relying on emotion was more likely to cooperate than a person who made their decision by relying on reason. This study also provides insight into the specific inferences that underlie this prediction: People believe that those who rely on emotion (in the context of a PD) experience higher levels of prosocial emotions such as empathy and compassion, rather than selfish emotions, such as greed, and are more focused on others than those who rely on reason. Importantly, the discrete emotions that people most inferred from the emotion signal (but not the reason signal) – empathy and compassion – had the same (positive) relationship with perceived cooperativeness. This suggests that, for our purposes of exploring signaling of cooperativeness, it is sufficient to contrast emotion and reason as broad signals of decision mode, rather than describing signals of a wide range of specific emotions. We use this operationally simpler approach in our subsequent studies.

Study 1 also explores whether lay theories of emotion and reason correspond to judgments of other dual process dichotomies. We find that they do. Signals of emotion are associated with higher levels of intuition, quickness, and reliance on one's heart, whereas signals of reason are associated with higher levels of deliberation, slowness, and reliance on one's brain. However, we also find that the emotion-reason dichotomy more strongly signals differences in cooperation than other dual process dichotomies. Although it is possible that these results are driven by the fact that we directly manipulate emotion and reason, rather than related processes, a supplementary study provides further evidence of the unique signaling strength of emotion and reason. Specifically, in online supplement Study S2, we manipulated signals of intuition and deliberation as well as signals of emotion and reason. Although signals of intuition and deliberation were also associated with cooperation and defection respectively, they were weaker signals than signals of emotion and reason. We conjecture that this difference is because the terms "emotion" and "reason" are more commonly used in daily life, and thus may be more salient and simpler for participants to understand. For example, the emotion/reason distinction is often taught at a young age – e.g., "listen to your head" versus "listen to your heart" – unlike the concept of automatic, intuitive processes versus controlled, deliberative processes. In addition, these terms carry slightly different lay meanings, as demonstrated by the fact that emotion is more associated with prosocial feelings than other System 1 terms (see Table 1 for correlations). Thus, we focus on this distinction (rather than other dual process dichotomies) in this paper.

Interestingly, our results also suggest that people do indeed see emotion and reason as competing constructs, consistent with our theoretical conceptualization. As depicted in Table 1, we find a strong negative correlation between the degree to which Player A was perceived as relying on emotion and the degree to which Player A was perceived as relying on reason (r = -

.807, $p < .001$). We also note that we replicated the main results from this study in another supplemental study in which we omitted any description of emotion and reason as opposing decision processes and merely described the decision process as "emotion" in one between-subjects condition and "reason" in the other condition (see online supplementary materials, Study S3). This study suggests that our results do not hinge on explicitly highlighting emotion and reason as competing decision modes.

Study 2

In Study 2, we had participants report their own decision modes and react to the decision modes of others when making their own PD decisions. Thus, beyond the insights about what emotion and reason signal to others (RQ1), we also examine whether they do indeed predict cooperation (RQ2) and how they influence others' behavior (RQ3). In addition, we include a control condition in this study to examine inferences people naturally make when no signal about decision mode is provided.

Method

We recruited 498 participants (33.7% female; mean age = 33) through Amazon Mechanical Turk to play a sequential prisoner's dilemma game (PD) with a partner, following a nearly identical procedure as that used in Study 1.[3]

Participants were assigned to one of two roles: Player A or Player B. The first 196 participants to enroll proceeded through the study were assigned to the role of Player A. Each

[3]For Player As in Study 2, payoffs were points (which were each worth $.01), rather than lottery tickets. For Player Bs in Study 2, and in all other studies, payoffs were lottery tickets, as in Study 1. For Player Bs in Study 2, each lottery ticket gave participants a chance to win a $75 bonus. In Studies 3 and 4, each lottery ticket gave participants a chance to win a $25 bonus.

Player A decided whether to defect or cooperate. After making their decisions, Player As reported their decision mode. Specifically, they read a simple description before reporting their decision mode: "Sometimes, people make decisions emotionally, based on feelings. Other times, people make decisions rationally, based on reason" and then answered the question "Did you make your decision emotionally or rationally?" Player A selected either "Emotionally" or "Rationally." Player As then answered a few demographic questions and an open-ended question asking them to explain what they thought the purpose of the study was.

The remainder of the participants (n = 302) were assigned to the role of Player B. Player Bs also played the PD, but before making their decisions they learned about Player A's decision mode. Player Bs were randomly assigned to one of three conditions: *emotion*, *reason*, or *control*. In the *control* condition, Player Bs did not learn any information about Player A's decision mode. In the *emotion* and *reason* conditions, Player Bs learned that Player A had either relied on emotion or reason to make his decision. The exact stimuli participants saw can be viewed in Appendix C.[4] Importantly, Player Bs did not learn Player A's decision, only Player A's decision mode.

Player Bs then made their own decisions of whether to cooperate or defect. Player Bs were also asked to predict what Player A's decision had been, and to report their own decision mode by answering the same question as Player As. Finally, Player Bs answered some demographics and an open-ended question asking them to explain what they thought the purpose of the study was.

[4]We note that in Studies 2, 3, and 4, we used the terms "emotionally" and "rationally" to denote reliance on emotion and reason, rather than "based on emotion" and "based on reason" as in Study 1. We find consistent results across all studies, suggesting our effects are not contingent on these specific word choices.

Note that we randomly assigned Player Bs to learn their partner's decision mode. That is, Player Bs were not directly paired (i.e., not paired using a one-to-one ratio) with Player As from the first survey. Instead, we matched Player Bs with probabilistic partners based on the actual rates of cooperation among Player As. This procedure ensured that we had an even distribution of Player Bs in our three experimental conditions, while also maintaining the realism and incentives of direct pairing. See supplemental materials for the pay-out probabilities across conditions. Note that these calculations and probabilities were only known to the experimenter; participants were only aware of the classic PD pay-out structure, as described above.

Results

Although we administered our study to Player As prior to Player Bs, we present our results in the following order to parallel our research questions: First, we examine what emotion and reason signal by exploring Player Bs' predictions of Player As' behavior. Second, we examine whether emotion and reason are actually correlated with cooperation by exploring Player As' self-reported decision modes and PD decisions. Third, we examine how Player Bs respond to Player As' signals of emotion and reason.

RQ1: What do emotion and reason signal? Player Bs who learned that their partner (Player A) made a PD decision using emotion were more likely to predict that their partner cooperated (62.0%) than were Player Bs who learned that their partner had used reason (24.8%; $\chi^2(1) = 28.40$, $p < .001$). Player Bs were also more likely to believe that their partner cooperated when their partner used emotion compared to the control condition (31.7%; $\chi^2(1) = 18.55$, $p < .001$). However, there was no difference between the control condition and the reason condition ($\chi^2(1) = 1.20$, $p = .27$). In other words, emotion was perceived to be positive signal of

cooperation, but reason was not perceived to be a negative signal of cooperation, relative to no signal.

RQ2: Does decision mode correlate with cooperation? A total of 23.0% of participants reported making their PD decision by relying on emotion. Player As who made their decision by relying on emotion were indeed more likely to cooperate than Player As who made their decision by relying on reason (64.4% vs. 27.2%; $\chi^2(1) = 21.00$, $p < .001$).[5] Therefore, Player Bs' inferences were generally correct.[6]

RQ3: How do people respond to signals of emotion or reason? Player Bs who learned that their partner (Player A) made a PD decision using emotion were also more likely to cooperate (36.0%) than were Player Bs who learned that their partner had used reason (18.8%; $\chi^2(1) = 7.46$, $p = .006$). Player Bs were also more likely to cooperate when their partner provided no signal (the control condition: 34.7%) than when their partner had used reason ($\chi^2(1) = 6.47$, $p = .011$). However, there was no difference between the control condition and the emotion condition ($\chi^2(1) = .040$, $p = .84$). In other words, signals of reason negatively impacted cooperation, but signals of emotion did not positively impact cooperation relative to no signal.

Interestingly, when asked to predict Player A's behavior, 62% of Player Bs who received an emotion signal believed that Player A had cooperated, but they only responded with cooperation 36% of the time. To better understand this discrepancy, we explored the relationship between Player Bs' own decision modes and their partners' signaled decision modes. Specifically, we examined whether Player Bs responded differently to Player A's signal as a

[5]This result holds when controlling for the gender of the participant. In a logistic regression on cooperation (1 = cooperate, 0 = defect), including decision mode (1 = emotion, 0 = reason) and gender (1 = female, 0 = male), we found a marginal effect of gender ($B = .54$, $SE = .32$, $p = .09$), and a significant effect of decision mode ($B = 1.50$, $SE = 37$, $p < .001$). Across our studies, we find that deciding emotionally predicts cooperation independent of gender.

[6]Player Bs decision mode was also correlated with their decisions (72.2% of emotional decision makers cooperated vs. 20.6% of rational decision makers cooperated; $\chi^2(1) = 56.57$, $p < .001$).

function of their own decision mode using logistic regression. For simplicity, these analyses exclude the *no signal* control condition to focus on the interaction of interest. We include analyses with the control condition in the online supplemental materials. Furthermore, although we focus our analyses only on the emotion and reason conditions, we depict the control condition in Figure 1 for completeness.

In the first two regressions (Table 5 Panel A, Models 1a & 2a), we separately entered Player A's Signal (1 = emotion, 0 = reason) and Player B's Own Decision Mode (1 = emotion, 0 = reason) as independent variables, and Player B's cooperation behavior (1 = cooperate, 0 = defect) as the dependent variable. We found that both Player A's Signal and Player B's Own Decision Mode significantly influenced cooperation, (ps < .001). In the third regression (Model 3a), we simultaneously entered Player A's Signal and Player B's Own Decision mode as independent variables, and Player B's cooperation behavior as the dependent variable. We found a significant effect of Player B's Own Decision Mode such that emotional participants are more likely to cooperate (B = 2.41, SE = .45, OR = 11.15, p < .001), and no effect of Player A's Signal on Player B's tendency to cooperate (B = 0.42, SE = .37, OR = 1.52, p = .26).

In the fourth regression (Model 4a), we entered Player B's Own Decision Mode, Player A's Signal, and their interaction as independent variables, and Player B's cooperation behavior as the dependent variable. We found a marginal interaction between Player A's Signal and Player B's Own Decision Mode (B = 1.62, SE = .996, OR = 5.07, p = .10; see Figure 1 Panel A). Player Bs who reported using reason did not appear to react to their partner's signal. When receiving an emotion signal, rational Player Bs cooperated 19.2% of the time and when receiving a reason signal, they cooperated 17.0% of the time, ($\chi^2(1)$= .13, p =.72). In other words, Player Bs who relied on reason defected unconditionally—no matter their partner's signal. However,

Player Bs who relied on emotion were influenced by their partner's signal. Emotional Player Bs responded with cooperation at different rates depending on the decision mode of Player A: when receiving an emotion signal, they cooperated 81.5% of the time, but when receiving a reason signal, they cooperated only 42.9% of the time, ($\chi^2(1) = 4.26$, $p = .04$). That is, they were more likely to cooperate with people who signaled emotion and to defect with people who signaled reason. Taken together, these results suggest that the benefits of *signaling* emotion depend on who is being signaled to—the signals influence those who use emotion themselves, but not those who use reason.

This pattern of conditional cooperation does not appear to be driven by how Player B's decision mode impacts their prediction of Player A's behavior. We ran a logistic regression on Player B's prediction of Player A's cooperation behavior, including Player A's Signal and Player B's Own Decision Mode as independent variables (Table 5 Panel B, Model 3b). We found a marginal effect of Player B's Own Decision Mode ($B = 0.79$, $SE = .43$, $OR = 2.20$, $p = .06$), such that emotional Player Bs were more likely to expect their partner to cooperate, and a significant effect of Player A's Signal ($B = 1.47$, $SE = .32$, $OR = 4.35$, $p < .001$), such that Player Bs were more likely to believe their partner cooperated when their partner is emotional. However, there was no interaction between Player A's Signal and Player B's Own Decision Mode ($B = 0.79$, $SE = 1.01$, $OR = 2.21$, $p = .43$; see Table 5 Panel B, Model 4b and Figure 1 Panel B). In other words, Player B's own decision mode does not differentially influence their beliefs about the signal value of emotion and reason; Player B's own decision mode simply influences how they react to others' signals.

Discussion

In this study, we examine the actual and perceived relationship between decision modes and cooperation. We find that emotion is – and is perceived to be – a stronger signal of cooperation than reason. In other studies reported in the online supplemental materials (see Studies S1 & S4), we find that these results are robust to order effects and to different measures of emotion and reason. For example, we find that emotion predicts cooperation, regardless of the order in which people report their decision mode versus make their cooperation decision. In addition, as mentioned previously, we also replicate our effects when we use a continuous measure to capture the degree to which a person relied on emotion versus reason to make a decision.

In this study, we find that signaling emotion generally increases cooperation. Importantly, however, we find preliminary evidence that this result hinges on individuals' own decision modes: decision makers who rely on reason do not respond to signals, but decision makers who rely on emotion respond to signals of emotion with increased cooperation.

We note that we relied on self-report measures to assess decision mode in Study 2. Thus, our results must be interpreted in light of several limitations. First, the association between reported decision-mode and behavior is correlational in nature and may be driven by a third variable, or the relationship may reflect lay beliefs about the relationship between emotion, reason, and cooperation rather than a causal effect of deciding emotionally (or rationally) on cooperation. Second, Player As' and Player Bs' decision modes were not completely independent. Indeed, the signal Player Bs received influenced their own reported decision mode, such that individuals were more likely to report the same decision mode as their partner ($r = .27$, $p < .001$).

Furthermore, although the interaction between one's own decision mode and a partner's signal is intriguing, our ability to draw conclusions is limited. We had relatively low power in this study because few Player Bs reported making their decision using emotion (16.9% of participants, $n = 34$), and the p-value of the interaction was thus only marginally significant. To address these limitations, in the next study we manipulate participants' decision modes directly.

Study 3

Study 3 has two goals. First, it aims to provide greater insight into RQ2 by manipulating decision mode directly and examining how emotion and reason causally influence cooperation. Second, it further probes RQ3 in a design with greater statistical power, by examining how Player B's decision mode interacts with Player A's signal to affect Player B's cooperation decision.

Method

In Study 3, 692 participants (54.5% female; mean age = 34), recruited through Amazon Mechanical Turk, played a PD with a partner. In this study, all participants (Player Bs) received a signal of their partner's (Player A's) decision mode. However, rather than asking participants their own decision mode, we manipulated it by instructing participants either to rely on reason or to rely on emotion when making their decisions. Specifically, participants read:

> Sometimes people make decisions by using logic and relying on their reason. Other times, people make decisions by using feeling and relying on their emotion.
>
> [Sometimes people make decisions by using feeling and relying on their emotion. Other times, people make decisions by using logic and relying on their reason.]
>
> Many people believe that reason [emotion] leads to good decision-making. When we use logic, rather than feelings, we make rationally satisfying decisions [When we use

feelings, rather than logic, we make emotionally satisfying decisions].

Please make your transfer decision by **relying on reason**, rather than emotion [**relying on emotion**, rather than reason].

In this study, we followed the strategy method (e.g., Ashraf, Bohnet, & Piankov, 2006) by having each participant considered both the case for which their partner, Player A, used emotion to make their decision and the case for which their partner used reason to make their decision (order was counter-balanced). Specifically, for each case, they were first asked to predict what decision Player A made (cooperate or defect). Then, they were reminded to make their own decision by either relying on emotion or reason (depending on what they had been instructed previously). Finally, they decided whether to cooperate or defect.

After participants made their predictions and decisions, they answered a three-item (α = .89) manipulation check to indicate the extent to which they relied on emotion and reason when making their decisions: "How did you make your decisions?" (1 = using only emotion, 7 = using only reason, reverse-scored), "To what extent did you rely on your feelings when making your decisions?" (1 = not at all, 7 = a great deal), and "To what extent did you rely on reason when making your decisions?" (1 = not at all, 7 = a great deal, reverse-scored). Participants then concluded the study by completing some demographic items, and explaining what they thought the purpose of the study was. We calculated pay-outs in a similar manner to Study 2 (see supplemental materials for details).

Results

Manipulation check. The manipulation check confirmed that participants who were told to use emotion reported relying more on emotion (M = 4.44, SD = 1.42) than individuals who

were told to rely on reason (M = 2.51, SD = 1.18; $F(1, 690) = 381.75$, $p < .001$, d = 1.48).

RQ1: What do emotion and reason signal? Because participants considered both a partner who used emotion and a partner who used reason, we conducted a within-subject analysis to test RQ1. When participants learned that their partner made a PD decision using emotion, they were more likely to predict that their partner cooperated (62.1%) than when they learned that their partner had used reason (32.9%; McNemar's test $p < .001$).

RQ2: Does decision mode correlate with cooperation? Participants in the emotion condition were more likely to cooperate than participants in the reason condition, both when they were playing with a partner who made their decision using emotion (57.0% vs. 31.5%; $\chi^2(1) = 45.37$, $p < .001$) and when they were playing with a partner who made their decision using reason (46.9% vs. 33.2%; $\chi^2(1) = 13.43$, $p < .001$).

RQ3: How do people respond to signals of emotion or reason? To test whether or not participants who made their PD decision using emotion responded differently to their partner's signal than participants who made their decision using reason, we ran a series of logistic regressions on participants' cooperation decision (1 = cooperate, 0 = defect, see Table 6 Panel A). In these analyses, we clustered standard errors at the participant level, to account for multiple observations per participant (each participant made a decision about what to do if their partner cooperated and if their partner defected).

In the first two regressions (Models 1a & 2a), we separately entered participant's (Player B's) Own Decision Mode (1 = emotion, 0 = reason) and their partner's (Player A's) Signal (1 = emotion, 0 = reason) as independent variables. In Model 1a, we found a marginal effect of Player A's Signal (B = .17, SE = .09, OR = 1.18, p = .075), such that participants were more likely to cooperate with Player A's who used emotion. In Model 2a, we found a significant effect of

Player B's Own Decision Mode (B = .81, SE = .12, OR = 2.25, p < .001), such that participants who used emotion were more likely to cooperate than were participants who used reason. In the third regression (Model 3a), we simultaneously entered Player B's Own Decision Mode and Player A's Signal as independent variables and found similar results: a marginal effect of Player A's Signal (B = 0.17, SE = .10, OR = 1.19, p = .075) and a significant effect Player B's Own Decision Mode (B = .81, SE = .12, OR = 2.25, p < .001).

In the fourth regression (Model 4a), we entered Player B's Own Decision Mode, Player A's signal, and their interaction as independent variables. Importantly, we found a significant interaction between Player A's Signal and Player B's Own Decision Mode (B = .48, SE = .19, OR = 1.62, p = .013). The nature of this interaction parallels the patterns in Study 2, providing further evidence that the benefits of *signaling* emotion depend on the signal-receiver's own decision mode. Specifically, participants who used reason tended to defect at similar rates regardless of whether their partner made their decision using emotion (31.5%) or reason (33.2%; McNemar's test p = .645). However, participants who used emotion were more likely to cooperate when their partner signaled emotion (57.0%) than when their partner signaled reason (46.9%; McNemar's test p = .004). Figure 2, Panel A shows the frequency of cooperation as a function of participants' own decision mode and their partner's signal.

We also ran a parallel series of logistic regressions on participants' predictions of their partners' cooperation, similar to Study 1 (1 = cooperate, 0 = defect, see Table 6 Panel B). In the first three regressions (Models 1b-3b), we found no effect of Player B's Own Decision Mode, but we found significant effects of Player A's Signal (ps < .001), such that participants were more likely to predict that partners who used emotion had cooperated than partners who used reason. In the fourth regression (Model 4b), we found an unpredicted significant interaction

between Player A's Signal and Player B's Own Decision Mode (B = -.55, SE = .25, OR = .58, p = .032). The pattern of this interaction did not mirror Player Bs' own cooperation decision, and thus cannot be driving the cooperation results. Specifically, participants who used reason were more likely than participants who used emotion to predict emotional Player As had cooperated, but were *less* likely to predict partners who used reason had cooperated. Figure 2 Panel B displays these results.

Discussion

Study 3 confirms the pattern of conditional cooperation seen in Study 2, providing further evidence that behavioral responses to signals of emotion and reason hinge on participants' own decision modes. People who themselves use emotion are more likely to cooperate with partners who use emotion, whereas participants who use reason tend to defect unconditionally. Importantly, however, both people who use emotion and people who use reason believe that emotional partners cooperated. Thus, it appears that people who rely on emotion follow typical patterns of conditional cooperation (i.e., cooperating more when they believe others have cooperated; e.g., Frey & Meier, 2004; Kocher, Cherry, Kroll, Netzer, & Sutter, 2008), whereas people who rely on reason do not.

By experimentally manipulating decision mode, we also demonstrate that emotion and reason have causal effects on cooperation and we rule out the possibility that the effects in Study 2 were driven by third variables or self-reports of decision mode. Furthermore, and consistent with Study 1, our results suggest that people see emotion and reason as competing constructs, consistent with our theoretical conceptualization. Specifically, we find a strong negative correlation between the degree to which participants reported relying on emotion and the degree to participants reported relying on reason (r = -.665, p < .001).

Study 4

The purpose of Study 4 is to examine whether a partner's signaled decision mode has an effect on behavior when the signaler's decision (cooperate or defect) is already known. This enables us to tease apart whether decision mode signals affect signal-perceivers' behavior merely because they signal how a person behaved, or whether over and above this, people have a preference for cooperating with others who rely on particular decision modes (i.e., emotion). For example, it could be that relying on emotion generally signals something positive about a person's character that would make people more likely to cooperate with emotional individuals, independent of inferences about emotional individuals' cooperative intent. To examine this possibility, we independently manipulate both the decision mode and the cooperation decision of participants' PD partners, and we provide both pieces of information to participants.

Method

In Study 4, 544 participants (56.3% female; mean age = 35), recruited through Amazon Mechanical Turk, played a PD with a partner. In this study, all participants received a signal from a partner (whom we called "Person B"). We randomly assigned participants to condition in a 3 (Partner's Decision Mode: emotion vs. reason vs. no signal) x 2 (Partner's Decision: cooperate vs. defect) between-subjects design. As in Study 3, participants received a signal about how their partner made their decision (using emotion or reason), or they received no signal about how their partner made their decision. In addition, all participants learned their partner's actual decision in the PD (whether they cooperated or defected). Both of these pieces of information

were presented as screenshots (as if from their partner's screen) and were on the same page (see Appendix D for stimuli).

After seeing their partner's signaled decision mode and decision, participants made their own decision in the PD (to cooperate or defect), and reported their own decision mode using a single dichotomous choice, as in Study 2. Then, participants answered two manipulation checks: one about their partner's decision mode ("How did your partner make their decision?" with 3 options: Emotionally, Rationally, or I did not learn how my partner made their decision) and one about their partner's decision ("What did your partner decide to do?" with 3 options: Transfer points, Do not transfer points, I did not learn what Person B decided to do). Participants then concluded the study by completing some demographic items, and explaining what they thought the purpose of the study was.

Results and Discussion

The manipulation checks confirmed that most participants correctly recognized their partner's decision (84.2% answered correctly) and decision mode (80.5% answered correctly).

To test how their partner's signaled decision mode and their partner's decision influenced participants' own cooperation, we ran a series of logistic regressions on participants' own cooperation decisions (1 = cooperate, 0 = defect), including Partner's Decision (1 = cooperate, 0 = defect), Emotion Signal (dummy-coded, 1 = emotion, 0 otherwise), Reason Signal (dummy-coded, 1 = reason, 0 otherwise), and the interactions between emotion and reason signal and partner's decision. This allowed us to examine the effects of signaling both emotion and reason, relative to no signal.

Not surprisingly, when we only included Partner's Decision as an independent variable (Table 7, Model 1), we found that participants were more likely to cooperate with someone who had cooperated (B = 2.12, SE = .21, OR = 8.36, p < .001). This effect remained significant when we included Emotion Signal, Reason Signal, and their interactions with Partner's Decision in the model (ps < .001; Table 7, Models 2-4). However, we found no main or interaction effects of Emotion Signal or Reason Signal (ps > .27; Table 7, Models 2-4). Figure 3 displays cooperation decisions for all conditions.

These results suggest that knowing whether one's partner relied on emotion or reason does not influence cooperation above and beyond its value in signaling that partner's behavior.

General Discussion

In this research, we demonstrate that making decisions by relying on emotion is, and is perceived to be, a signal of cooperation. People assume that individuals who rely on emotion rather than reason have cooperated, and indeed, those who rely on emotion are more likely to cooperate. This pattern holds true both when decision modes are measured and when they are experimentally manipulated. These signals, however, only influence cooperation when the individual's behavior is unknown. When behavior is already known, these signals become uninformative. These results suggest that the signal value of emotion versus reason arises from its function in communicating information about people's cooperation, rather than their character more broadly.

This research adds to our understanding of cooperation and signaling in several important ways. Whereas prior work on signaling has examined inferences made about discrete emotions (de Melo, Carnevale, Read & Gratch, 2014; Frank, 1988; Reed et al., 2012) or the magnitude of

emotion (Barasch, Levine, & Schweitzer, 2014), we build on dual-process approaches of decision making and examine the *contrast* between emotion and reason. This is the first work that we know of to examine how the basic cue of whether a decision maker relies on emotion or reason affects cooperative decisions. As a result, we contribute new insight to dual-process models of cooperation (Rand, 2016).

We also deepen our understanding of lay intuitions about emotion and reason. We find that people associate one's reliance on emotion with prosocial motivations and feelings such as empathy and compassion, rather than selfish emotions, such as greed. Alternatively, people associate one's reliance on reason with an absence of emotion. We find that although signals of emotion and reason are generally associated with other System 1 versus System 2 constructs (e.g., intuition and deliberation, decision quickness and slowness), emotion and reason are particularly strong signals of cooperative (and non-cooperative) intent. Finally, we find that people infer that emotion and reason are negatively correlated, consistent with our conceptualization of these constructs and a long history of research on dual-process systems.

This work not only sheds light on the role of emotion and reason in cooperation, but also highlights the importance of understanding when and why individuals rely on signals of cooperation when making their own decisions. While previous work has explored conditional cooperation patterns in social dilemmas (demonstrating that people are more likely to cooperate if it is known that others cooperated; e.g., Frey & Meier, 2004; Kocher et al., 2008), we show that conditional cooperation is only evident among those who use emotion to make their decisions, but not among those who use reason. Specifically, those who use emotion are more likely to cooperate with individuals who signals emotion than with individuals who signals reason. Those who use reason, on the other hand, are unselectively *noncooperative*, which is

beneficial in the short run, but could lead to low payouts in the long run. In other words, people respond differently to signals of cooperation as a function of their own way of making the decision. Thus, we expand upon prior work on dual processes in cooperation, which focused on main effects of each process (e.g., System 1 leading to greater cooperation; Rand, Greene, & Nowak, 2012). These observations validate the predictions of a set of formal evolutionary game theory models where emotional or intuitive processes implement behaviors that are advantageous in typical settings – namely, settings where players interact repeatedly (Bear & Rand, 2016). In these contexts, the optimal strategy is conditional cooperation (e.g., tit-for-tat) rather than just cooperation in general. Consistent with these theories, we demonstrate that emotion favors conditional cooperation.

Future Directions

There are a number of open questions remaining about how individuals interpret and send signals of emotion and reason. One question is whether signals of emotion and reason have the same effect in single versus repeated cooperative interactions. In any single interaction, it is usually in an actor's short-term interest to defect; thus, reason may be associated with defection for this reason (consistent with our results). However, in repeated interactions, it is in an actor's best interest to establish a norm of mutual cooperation. Therefore, in repeated interactions, reason may be associated with cooperation to a greater degree, perhaps even more so than emotion. Nevertheless, preliminary evidence (see online supplemental materials, S5) suggests that even in a repeated decision context, emotion is perceived to be a better signal of cooperation. More work is needed to uncover the dynamics of signaling emotion and reason in sustained, repeated interactions.

Second, it would be interesting to examine whether individuals strategically signal emotion in cooperative settings. Given that individuals share the intuition that emotion signals cooperation, we might expect that they would feign emotionality to convince others that they have cooperated and to coerce others to respond with greater cooperation (e.g., Frank, 1988). Alternatively, individuals might not consider the signal value of emotion when making their decisions, or anticipate some other cost of signaling emotion. Future research is needed to fully understand individuals' strategic behavior in this context.

Furthermore, future research should more deeply explore *why* individuals who rely on emotion versus reason respond differently to signals of cooperation. It seems that rational decision makers believe in optimizing their own short-term outcomes, which produces unconditional defection. But what explains emotional decision makers' responses? One possibility is that individuals who rely on emotion feel sympathetic towards others who they believe have cooperated, but feel angry towards others who they believe have defected. In other words, the emotions they feel may differ based on the signals they receive. Alternatively, it is possible that individuals who rely on emotion always feel a drive to cooperate, but do not want to be exploited by rational counterparts. Finally, it is possible that emotional people simply like emotional partners more than rational partners (perhaps because emotional partners are more like them), and thus cooperate more with them.

Conclusion

In summary, we provide empirical evidence that emotion is, and is perceived to be, a signal of cooperation. Furthermore, individuals who rely on emotion to make their own decisions respond to signals of emotion with increased cooperation. Thus, these results contribute to the

long-standing debate on the role of emotion and reason in promoting the public good, ultimately demonstrating that emotion signals cooperation better than reason.

Context of the Research

While a large body of research has studied what influences cooperation (e.g., individual differences, motivational and contextual factors), there is far less work on what *signals* cooperation. That is, what interpersonal cues lead people to predict that others are cooperative? In the present work, we explore this question by focusing on a fundamental dual-process distinction in decision making: emotion versus reason. Levine, Barasch, Berman, and Small joined Rand to bridge past research streams. Specifically, Barasch et al, (2014, *JPSP*) examine inferences about moral character from emotion, and Rand examines cooperative decision making through the lens of dual-process theories (for review, see Rand, 2016, *Psych Sci*). Discussions about connections between the two areas inspired the current paper.

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Tables

Table 1.

Correlation Table (Study 1)

	Emotion Signal	Prosocial Motivation	Empathy	Negative Emotion	Happiness	Intuitively	Quickly	Deliberately	Slowly	Relying on heart	Relying on brain	Relying on emotion	Relying on reason
Predicted cooperation	.379**	.756**	.720**	-0.058	.225**	.175**	-0.014	-.137**	.119*	.409**	-.294**	.369**	-.270**
Emotion Signal		.414**	.398**	.327**	.264**	.481**	.143**	-.352**	-0.096	.759**	-.775**	.845**	-.800**
Prosocial Motivation			.789**	0.034	.238**	.226**	-0.096	-.206**	.210**	.446**	-.351**	.435**	-.314**
Empathy				0.091	.271**	.199**	-.110*	-.224**	.209**	.476**	-.330**	.419**	-.332**
Negative Emotion					.159**	.133*	-0.078	-.240**	.129*	.274**	-.278**	.273**	-.272**
Happiness						.135**	0.003	-0.083	0.077	.253**	-.136**	.250**	-.111*
Intuitively							.281**	-.193**	-.137**	.485**	-.414**	.496**	-.435**
Quickly								0.037	-.630**	.215**	-.147**	.212**	-.180**
Deliberately									0.071	-.370**	.482**	-.346**	.423**
Slowly										-.133*	.184**	-0.094	.207**
Relying on heart											-.735**	.849**	-.757**
Relying on brain												-.766**	.850**
Relying on emotion													-.807**

Note. Cells display Pearson's correlations; ** $p < .01$; $p < .05$. **Bold** indicates manipulated variable.

Table 2.

Observer's prediction of the discrete emotion that Player A felt the most when making his/her decision, based on Player A's signal of emotion vs. reason (Study 1)

Discrete emotion inferred from Player A's signal	% choosing each inferred emotion within **Reason Signal**	% choosing each inferred emotion within **Emotion Signal**
*None	40.30%	0.50%
*Compassion	3.30%	22.40%
*Empathy	4.40%	23.00%
Greed	26.50%	23.50%
Happiness	3.30%	2.20%
Excitement	6.10%	5.50%
*Guilt	1.70%	6.60%
Regret	0.60%	0.50%
*Fear	7.20%	14.80%
*Other	6.60%	1.10%
Total	100.00%	100.10%

Note. *Indicates that participants inferred a particular discrete emotion with different frequencies across conditions, $p < .05$.

Table 3.

Observers' predictions of Player A's cooperation decision based on observers' prediction of the discrete emotion that Player A felt the most (Study 1)

Discrete emotion inferred from Player A's signal	% **Predicting cooperation, based on each inferred discrete emotion**
None	23.0%
Compassion	93.6%
Empathy	90.0%
Greed	5.5%
Excitement	61.9%
Happiness	60.0%
Guilt	86.7%
Regret	0.0%
Fear	12.5%
Other	35.7%

Table 4.

Observers' inferences about Person A's emotions, motives, and processes, as a function of Person A's signal of emotion vs. reason (Study 1)

		Reason Signal (*n* = 181)	**Emotion Signal** (*n* = 183)	
		M (SD)	*M (SD)*	*Cohen's d*
	Empathy	2.91 (1.23)	4.27 (1.85)	-0.87***
	Happiness	3.01 (1.65)	3.86 (1.47)	-0.55***
	Negative Emotion	1.85 (1.09)	2.68 (1.32)	-0.69***
Motives	**Prosocial Motivation**	2.93 (1.37)	4.23 (1.50)	-0.91***
	Intuitively	3.33 (1.74)	5.07 (1.44)	-1.09***
	Quickly	4.3 (1.49)	4.77 (1.37)	-0.29**
	Relying on heart	2.29 (1.52)	5.64 (1.36)	-2.32***
	Relying on emotion	2.12 (1.42)	6.21 (1.15)	-3.15***
	Deliberately	5.55 (1.33)	4.42 (1.67)	0.75***
	Slowly	3.67 (1.53)	3.39 (1.39)	0.19^{+}
	Relying on brain	6.19 (0.87)	3.21 (1.49)	2.45***
	Relying on reason	6.28 (1.17)	2.73 (1.49)	2.66***

Note. $^{+}p = .068$; $^{**}p < .01$, $^{***}p < .001$.

Table 5.

Logistic Regression on Actual and Predicted Cooperation Decision (Study 2)

Panel A: Player B's Actual Cooperation Decision

	1a	2a	3a	4a
	-1.462***	-1.519***	-1.716***	-1.584***
	(.255)	(.202)	(.275)	(.274)
	.887**		.419	.146
	(.329)		(.370)	(.405)
		2.540***	2.411***	1.296+
		(.438)	(.450)	(.812)
				1.624O
				(.996)
Nagelkerke R-Squared	.053	.257	.265	.281

Panel B: Player B's Prediction of Player A's Cooperation Decision

	1b	2b	3b	4b
	-1.112***	-.476***	-1.176***	-1.127***
	(.231)	(.159)	(.235)	(.240)
	.160***		1.470***	1.375***
	(.309)		(.317)	(.336)
		1.213***	.788#	0.211
		(.400)	(.426)	(.870)
				0.794
				(1.014)
Nagelkerke R-Squared	.181	.064	.201	.205

Note. $^{+}p = .110, {}^{o}p = .103, {}^{\#}p = .064$, $^{**}p < .01$, $^{***}p < .001$. Decision mode is coded such that 1 = emotion and 0 = reason. Cooperation decision is coded such that 1 = cooperate and 0 = defect. Standard errors appear in parentheses.

Table 6.

Logistic Regression on Actual and Predicted Cooperation Decision (Study 3)

Panel A: Player B's Actual Cooperation Decision

	1a	2a	3a	4a
	-.410***	-.736***	-.824***	-.697***
	(.078)	(.089)	(.104)	(.112)
	.166^{+}		.173^{+}	-.077
	(.093)		(.097)	(.139)
		.812***	.814***	.573***
		(.123)	(.124)	(.157)
				.483*
				(.194)
Nagelkerke R-Squared	.001	.029	.030	.033

Panel B: Player B's Prediction of Player A's Cooperation Decision

	1b	2b	3b	4b
	-.711***	-.124*	-.739***	-.881***
	(.081)	(.058)	(.091)	(.117)
	1.210***		1.206***	1.478***
	(.127)		(.127)	(.185)
		.053	.058	.340*
		(.088)	(.097)	(.162)
				-.547*
				(.255)
Nagelkerke R-Squared	.063	< .001	.063	.066

Note. ^{+}p =.075, *p < .05, ** $p \leq .01$, *** $p \leq .001$. Decision mode is coded such that 1 = emotion and 0 = reason. Cooperation decision is coded such that 1 = cooperate and 0 = defect. Standard errors appear in parentheses and are clustered at the participant level.

Table 7.

Logistic Regression on Cooperation Decisions (Study 4)

	1	2	3	4
Constant	-1.796*** (0.175)	-1.695*** (0.222)	-1.518*** (0.276)	-2.006*** (0.307)
Partner's Decision	2.124*** (0.213)	2.127*** (0.214)	1.851*** (0.348)	1.875*** (0.377)
Emotion Signal		-0.146 (0.245)	-0.466 (0.424)	-0.450 (0.452)
Reason Signal		-0.164 (0.245)	-0.415 (0.425)	-0.450 (0.454)
Partner's Decision x Emotion Signal			0.485 (0.519)	0.210 (0.559)
Partner's Decision x Reason Signal			0.382 (0.519)	0.410 (0.556)
Participant's Own Decision Mode				2.037*** (0.258)
Nagelkerke R-Squared	0.27	0.27	0.27	0.41

Note. *$p < .05$, ** $p < .01$, *** $p < .001$. Partner's decision is coded such that 1 = cooperate and 0 = defect. Emotion signal is coded such that 1 = emotion and 0 = reason or control. Reason signal is coded such that 1 = reason and 0 = emotion or control. Cooperation decision is coded such that 1 = cooperate and 0 = defect. Standard errors appear in parentheses.

Figures

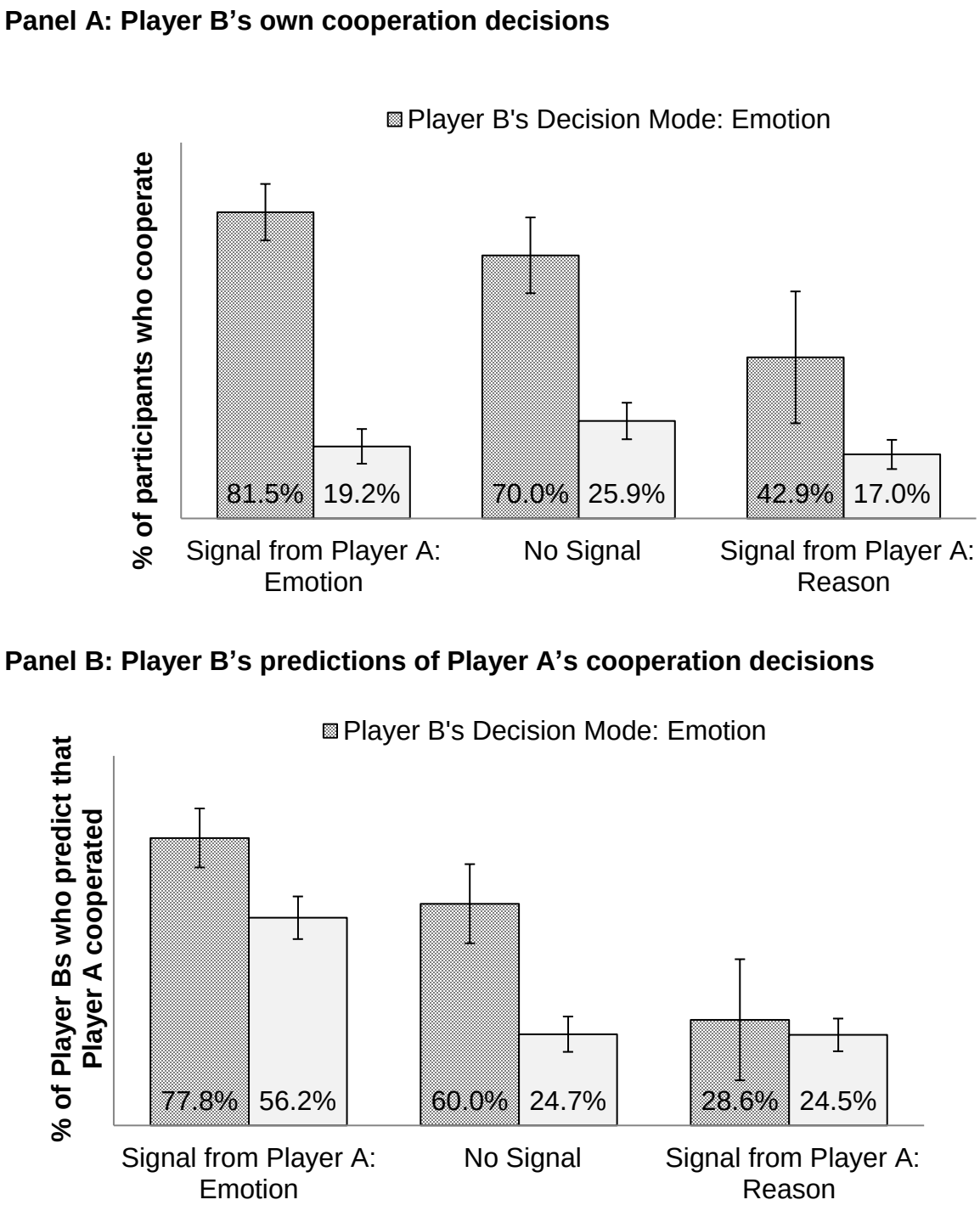
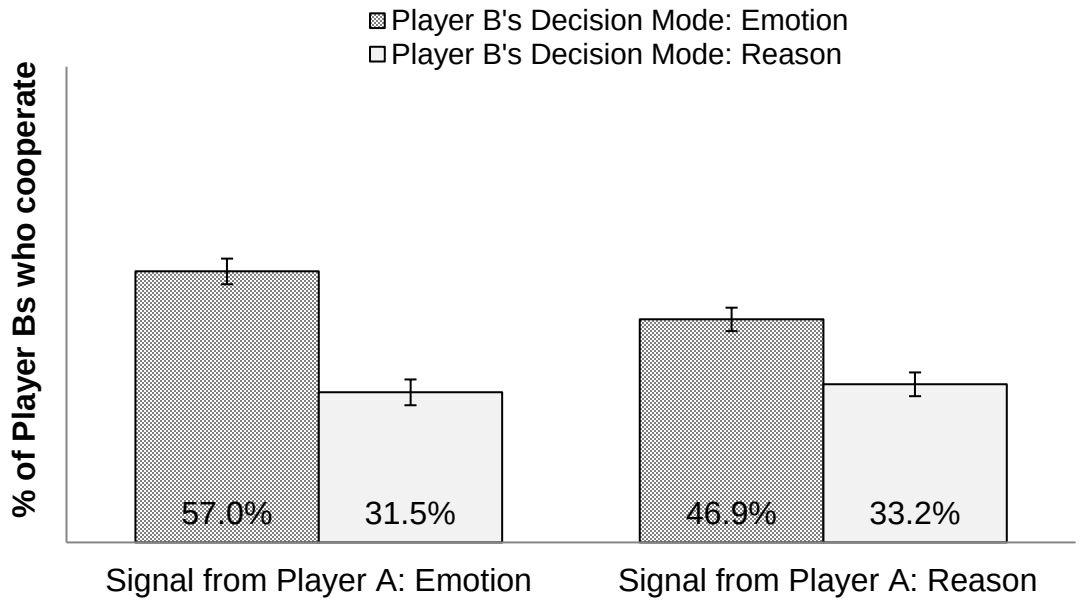


Figure 1. Study 2 results. Panel A represents Player B's cooperation decision, as a function of Player B's decision mode and Player A's signal. Panel B represents Player B's prediction of Player A's cooperation decision, as a function of Player B's decision mode and Player A's signal. Error bars reflect +/- 1 SE.

Panel A: Player B's own cooperation decisions



Panel B: Player B's predictions of Player A's cooperation decisions

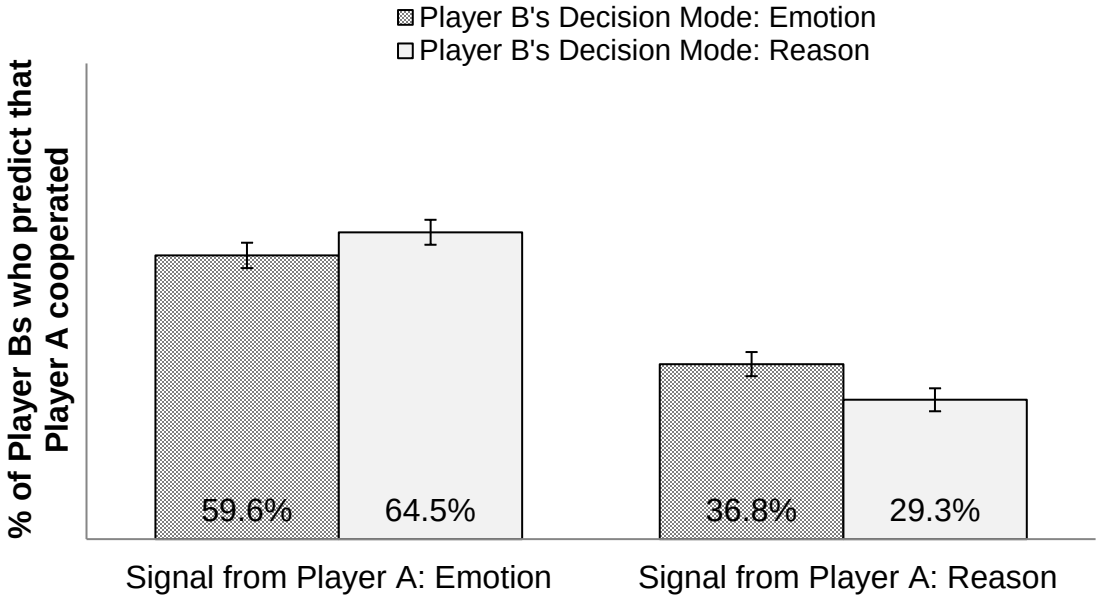


Figure 2. Study 3 results. Panel A represents Player B's cooperation decision, as a function of Player B's decision mode and Player A's signal. Panel B represents Player B's prediction of Player A's cooperation decision, as a function of Player B's decision mode and Player A's signal. Error bars reflect +/- 1 SE.

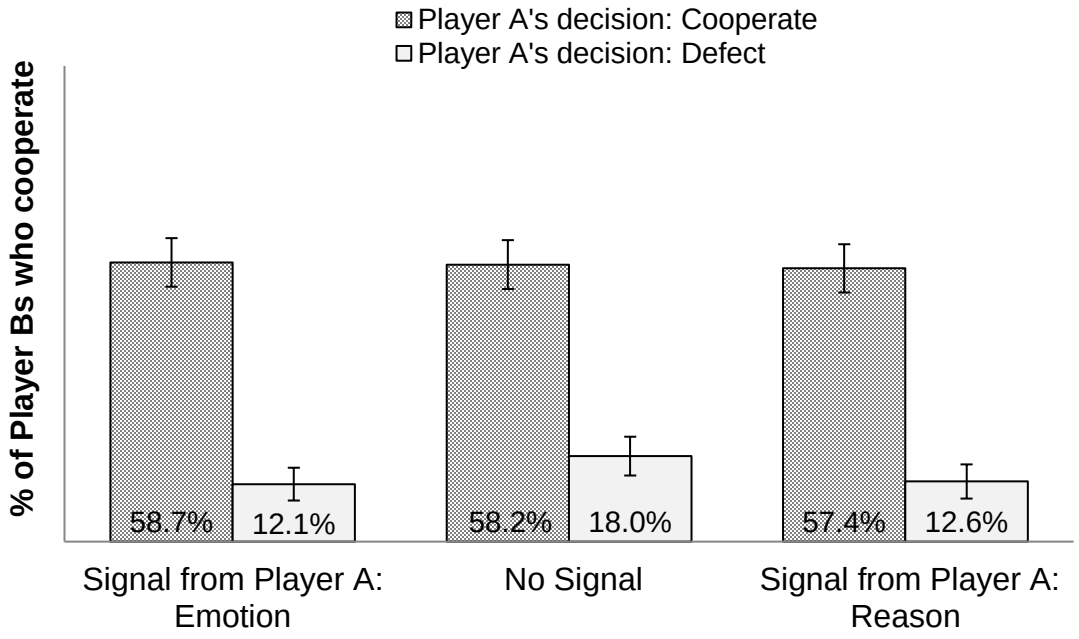


Figure 3. Study 4 results. Player B's cooperation decision, as a function of Player A's own decision and Player A's signal. Error bars reflect +/- 1 SE.

Appendix A

Instructions for Prisoner's Dilemma game (Study 1)

In this interaction you are matched with another person.

You will be Person A, and your partner will be Person B.

Both of you start with 30 lottery tickets.
The more lottery tickets you have, the more chances you have of winning a $75 bonus.

You (Person A) and Person B will both make a choice:
Whether or not to transfer your 30 lottery tickets to the other person, in which case they will get 60 lottery tickets.

If you both choose to transfer, you each get 60 lottery tickets.
If neither of you transfer, you each get 30 lottery tickets.

But if you transfer while the other person does not, you get 0 lottery tickets while the other person gets 90 lottery tickets.
And if you do not transfer while the other person does, you get 90 lottery tickets while the other person gets 0 lottery tickets.

Appendix B

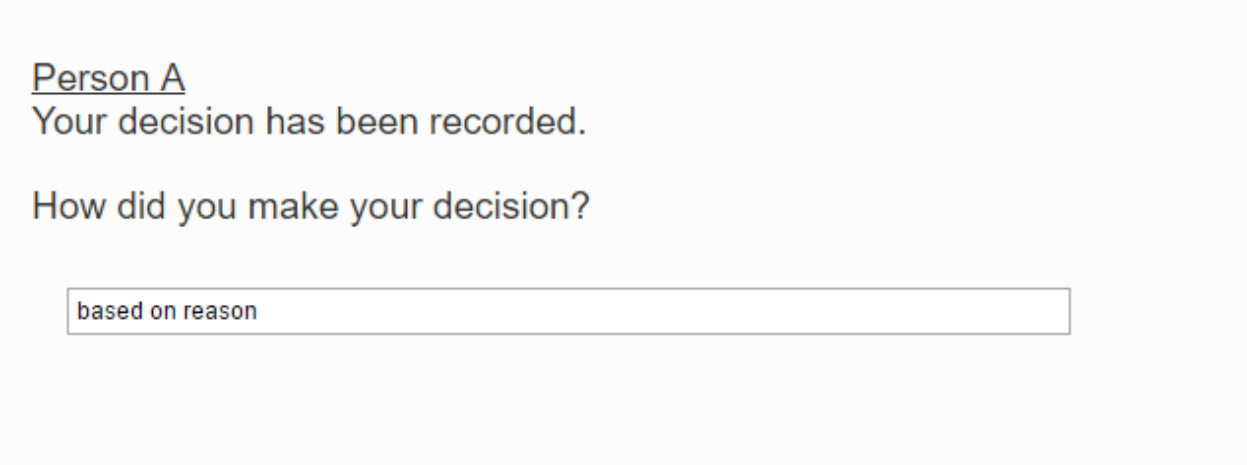
Decision Mode Signal (Study 1)

Sometimes, people make decisions based on **emotion**.
Other times, people make decisions based on **reason**.

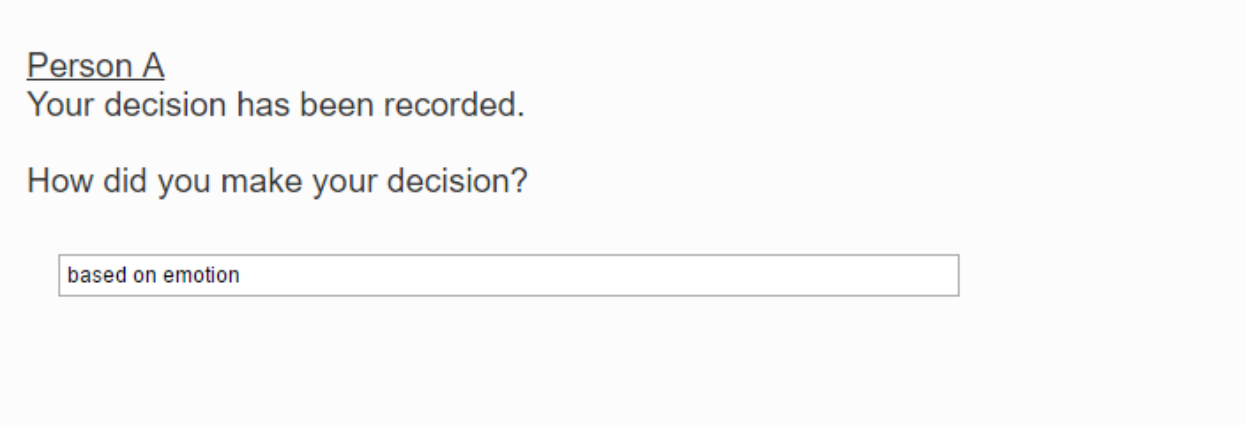
We asked players of this game to answer a few questions about whether they made their decision based on emotion or based on reason. These responses were not shared with their partners. However, we are making them available to you now that the game is over.

Below you will learn how Person A made his/her decision.

[Reason condition]



[Emotion condition]



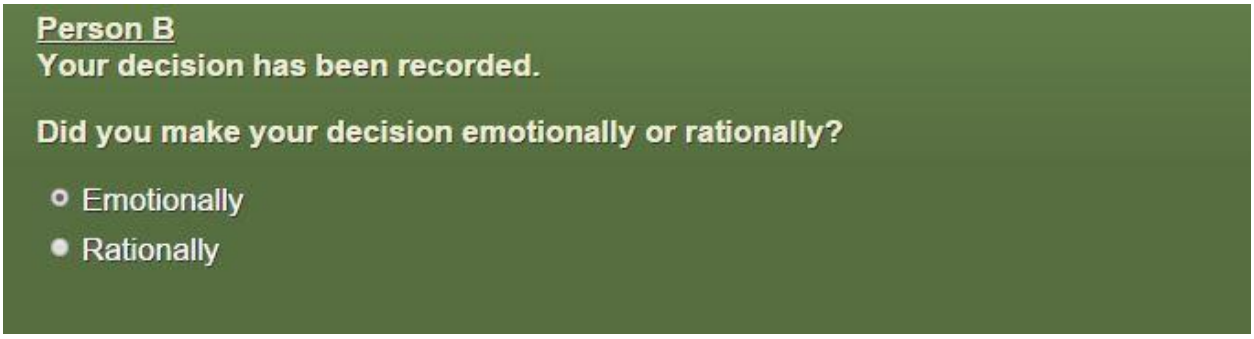
Appendix C

Decision Mode Signal (Study 2)

Sometimes, people make decisions **emotionally**, based on feelings.
Other times, people make decisions **rationally**, based on reason.

Person B answered a question about whether s/he made his/her decision emotionally or rationally.

Person B's response is below.



Note. Participants in the role of Player B were actually called "Player A" within Studies 2-4, to make the PD easier to understand from the participants' point of view. Thus, all participants were told they were Player A and would be matched with a Player B. In the manuscript, we refer to Player A as the participant who made a decision and provided a signal, and Player B as the participant who made a decision after receiving a signal from his/her partner.

Appendix D

Example Stimulus Used in Study 4 (Emotion Signal, Cooperate Decision Condition)

Person B has already made his/her decision of whether to Transfer points to you.

Before you make your decision, you will learn two things about Person B:

---

1) Whether Person B made his/her decision emotionally or rationally ---

Sometimes, people make decisions **emotionally**, based on feelings.
Other times, people make decisions **rationally**, based on reason.

---

2) What Person B decided --- To transfer or not to transfer.

--page break--

- Person B made his/her decision **Emotionally**
- Person B made his/her decision **Rationally**

- Person B **Transferred** 30 points
- Person B **Did Not Transfer** 30 points