Power of Joint Decision-Making in a Finitely-Repeated Dilemma

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Abstract:

Teams are known to behave differently from individuals, but whether they behave more cooperatively or selfishly is still unsettled in the literature. We let subjects form two-person pairs and play a finitely-repeated two-player public goods game with other pairs, where each person knows the identity of the partner in their pair, and then compare the pairs' behavior with the behavior of individuals in the same game played against individuals. Pairs contribute significantly more than individuals, especially when they are matched with other pairs for the entire periods. Possible factors that drove this result are discussed in the paper.

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I. Introduction

One of the most asked questions in economics is how people can cooperate with others in dilemma situations. Experiments in the past several decades have intensively studied people's cooperation behaviors. On the one hand, the literature suggests that some people prefer to cooperate in dilemma situations. For instance, some individuals attempt to cooperate even in one-shot dilemma games, or in earlier periods of finitely repeated dilemma games when they individually make cooperation decisions (e.g., Ledyard 1995, Zelmer 2003, Chaudhuri 2011). But on the other hand, it has also shown that we may need some institutions to sustain cooperation as cooperation usually gradually declines over time.[2] Various institutions are proven to be effective in encouraging people to cooperate in finitely-repeated dilemma games. Examples include costly punishment (e.g., Fehr and Gächter 2000 and 2002), nonmonetary punishment (e.g., Masclet et al. 2003), sorting (e.g., Gunnthorsdottir et al. 2007, Gächter and Thöni 2010) and endogenous group formation (e.g., Page, Putterman and Unel 2005, Kamei and Putterman forthcoming). However, almost all of these studies on institutions to enhance cooperation are conducted by using individuals as the decision-making unit. Cooperation decisions are often made by pairs in reality. Examples where a pair of people makes a single decision either to act cooperatively or selfishly in dilemma situations are readily available in our everyday life. For instance, many decisions couples make at home are made jointly. A couple may jointly decide either to clean up after their dog or leave it behind when walking their dog. They may also jointly decide to play music loudly at night or keep it at a low volume. In another situation, two university friends that always hang out together may decide to speak loudly or keep quiet at a library. When eating at a cafeteria, they may jointly decide to return their trays where they are supposed to or just leave them on a table. How do people's joint cooperation decisions − by joint cooperation decision we mean a single decision made by a pair of individuals − differ from individual cooperation decisions? Does letting people make decisions in pairs help sustain cooperation norms in a dilemma situation? Do people's joint cooperation decisions differ by the probability of being matched with the same counterparts again in the future?

[2] One main reason of this decay is that cooperators give up cooperating with others after seeing the defection or free-riding by their partners (Fischbacher and Gächter 2010).

This paper experimentally addresses the above research questions by using a finitely-repeated two-player dilemma game with two kinds of matching protocols: (a) partner matching between two pairs and (b) stranger matching within a community.[3] Both matching protocols are prevalent in the real world. Imagine, for example, that two couples are living in a duplex property (a house that has separate entrances for two households). Their interactions with each other would last for some time. Also, imagine another situation where a pair lives in a house in an area in which community events are occasionally held. They would meet with other pairs rather randomly when the pair participates in some of the events.

Action choices of pairs and individuals in repeated dilemma setups can be different, considering the large volume of experimental research on team behaviors.[4] The literature, for example, suggests that (a) people choose more materially beneficial options when they make decisions with a partner or in a team, (b) teams may exhibit less myopic loss aversion, (c) teams may be more likely to overcome coordination failure than individuals, (d) members in a team may exhibit some social effects such as shame and a desire to be respected from their team members (e.g., Charness and Sutter 2012 for a survey). However, to our knowledge, there is no agreement among scholars whether people behave more cooperatively or selfishly when they decide on their action choices as a pair or in a team in a non-strategic environment, where each decision-making unit does not interact with another one.

In a non-strategic environment, Cason and Mui (1997) and Luhan et al. (2009) explored how teams behaved differently from individuals using a dictator game. While Cason and Mui (1997) find that teams behave more pro-socially than individuals, Luhan et al. (2009) find that teams behave more selfishly than individuals. The joint decision-making protocols used are different between the two studies. In Cason and Mui (2007), "Every team was called to the front of the room and excused to the hallway to discuss their decision and fill out the form in private" (page 1471). This process diminishes social distance within (and across) team members. By contrast, in Luhan et al. (2009), each subject was not informed of their team members' identities

[3] Each decision-making unit is matched with the same decision-making unit during the entire session in the partner matching protocol. By contrast, each decision-making unit is randomly matched with another decision-making unit from round to round in the stranger matching protocol.

[4] In this paper, we use the term "team" ("team decision-making") to generally express a decision-making unit whose size is more than one (decision-making whose unit has more than one subject). By contrast, we use the term "pair" ("joint decision-making") to refer to a decision-making unit whose size is exactly two (decision-making whose unit has exactly two subjects).

and "the communication within each team was possible exclusively via an electronic chat program" (page 30). Luhan et al. (2009) provide a possible reason for the difference in the result between Cason and Mui (1997) and Luhan et al. (2009): "The differences between both approaches might induce different degrees of social distance (within and across teams), which could trigger the different results."

More recently, there is some research involving strategic environments, where each agent plays against a counterpart. Kagel and McGee (forthcoming) compared two-person pairs and individuals by letting the subjects play multiple finitely-repeated prisoner's dilemma games. They used a joint decision-making protocol that made the social distance between the subjects remained large. That is, the subjects' identities were kept anonymous and their communication was through electronic chat systems similar to Luhan et al. (2009). Kagel and McGee (forthcoming) find that in the first super-game (finitely-repeated prisoner's dilemma game), pairs behave more selfishly than individuals, as is consistent with the findings of Luhan et al. (2009).[5] But, what happens if people make action choices together as a pair when they know who they have in their pairs? This is worth investigating as there are many real-world situations where people make joint decisions while knowing their decision-making partners. Most of the decisions made at firms and at households are made in teams. When these decisions are made, the decision-makers know who their team members are but may not know the teams they are dealing with in person. For this reason, we employ a joint decision-making protocol that is closer to Cason and Mui (1997) but keep the social distance across pairs anonymous.

Our experiment is based on a framework of a finitely-repeated, two-player public goods game (a continuous version of prisoner's dilemma game).[6] Each group contains two decision-making units that simultaneously decide allocation amounts using their endowments between their private accounts and group account. Our design is set so that it is privately optimal for each decision-making unit to contribute nothing to their group account. We design two joint-decision treatments and two individual-decision treatments. In the two joint-decision treatments, each subject is randomly paired with another subject at the beginning of the experiment; and they

[5] Pairs learned more quickly to cooperate with other pairs from super-game to super-game, however. In the later super-games, pairs cooperate significantly more than individual players.

[6] We chose a finitely-repeated game as the framework of our study. We acknowledge that in some real-world interactions people's interactions can be described as infinitely-repeated interactions, however. We use a finitely-repeated setup because economic theory provides a clearer prediction when games are played finitely.

form a decision-making unit. They are informed of the true identity of their assigned partner. Specifically, each subject is informed of the seat number of their partner and they sit next to each other. The pairing is fixed during the entire session. Regarding matching across pairs, in one treatment, a partner matching protocol is used. In the other treatment, a stranger matching protocol is used. Each pair is given an ample time — one minute in each period — to discuss their joint allocation amounts, and then jointly decides how much to contribute to their group accounts. Before entering the communication stage in each period, subjects are also asked to answer hypothetical contribution amounts that they would choose as pairs if they could decide pair allocation amounts unilaterally without communicating with their partners (under the condition that the two individuals in pairs equally share the resulting pair payoff as in the main part of the experiment). We include this elicitation task in order to study (a) how a subject's willingness to contribute changes because of our joint-decision format, which has two aspects: one that she has another person in a team and the other that her decision also affects that person's payoff, and (b) how their personal preferences are affected by their partners through communication. The two control treatments are designed to be comparable to the corresponding joint-decision treatments. In the control treatments, each subject is given an endowment and then simultaneously and independently decides contribution amounts to their group accounts, either under the partner matching with another individual or under the stranger matching within a session.

Our experiment finds that pairs behave significantly more cooperatively than individuals in the control treatments, as is consistent with Cason and Mui (1997). The difference is especially large when each pair repeatedly plays the dilemma games with a fixed pair. Under the partner matching procedure, most pairs establish long-sustained, highly cooperative relationships with their matched pairs until near the known end period. This is in sharp contrast with the corresponding individual-decision treatment with the partner matching protocol in which contribution amounts quickly decline in the earlier rounds and then stay at a low level until the end period.

An exploration of the subjects' contribution preferences elicited before they communicated with their partners in each period finds two effects that the joint decision-making protocol has on the dynamics of people's cooperation behavior. First, the subjects on average have higher contribution amounts in their mind when they have been paired with someone as a decision-making unit, compared with the individuals in the individual-decision treatments. This suggests that the joint-decision format in that (i) one has a partner in his pair and (ii) what he decides on also affects the partner in his pair may enhance people's willingness to cooperate. Such an effect has also been reported in a non-strategic workplace environment when a team-based compensation scheme is used (see Babcock et al. 2015). Second, we find evidence that the attitudes of a person in a pair can be affected by her partner through communication. Our data shows that when each pair is matched with another pair in the entire experiment, both self-regarding and other-regarding pairs increase their willingness to contribute after communication. However, when the stranger matching protocol is used, while other-regarding pairs raise their willingness to contribute after communication, the self-regarding pairs decrease their willingness to contribute as the more cooperative in pairs reduce their willingness to contribute significantly after communication.

We also find that, the subjects in both joint-decision and individual-decision treatments exhibit conditional contribution behaviors. The larger amounts their counterparts contributed in the last period, the larger amounts they contribute in the current period. The conditional cooperative reaction to their last-period counterparts' contribution decisions is stronger in the joint-decision treatments than in the corresponding individual-decision treatments. This also explains the paired subjects' significantly higher cooperation behavior in our experiment.

The rest of the paper proceeds as follows: Section II describes our experimental design. Section III briefly provides predictions along with related literature. Section IV reports results, and Section V concludes.

II. Experimental Design

The design frame of our experiment is a two-player linear public goods game.[7] We employ the between-subject design.[8] We set up two sets of two treatments (four treatments in

[7] We use a two-player public goods game, instead of a standard prisoner's dilemma game, because subjects have more flexibility in selecting the degree of cooperation in the public goods game, rather than a binary choice of "cooperate" and "defect." This feature allows us to analyze the subjects' behavior more precisely. I acknowledge that the difference in the game may affect subjects' decision. For instance, it is known that subjects usually contribute around 40% to 60% of their endowments in the initial period of public goods games, depending on experimental parameters (e.g., Chaudhuri 2011). The average cooperation rate in the very first period of finitely-repeated prisoner's dilemma games is lower in past studies (e.g., Andoreoni and Miller 1993).
[8] The subjects are not informed of other treatment conditions.

total). Each set consists of a joint-decision treatment and an individual-decision treatment. The design of individual-decision treatment is identical to the corresponding joint-decision treatment other than the feature that the subjects make decisions alone. The first set of two treatments uses a partner matching protocol while the second set uses a stranger matching protocol (see TABLE 1). In the joint-decision treatments, two individuals act as one decision-making unit, which we refer to as a "pair." Two two-person pairs (four subjects in total) are grouped and interact with each other. We denote this set of two pairs "group" in the joint-decision treatments. In the individual-decision treatments, a "group" consists of two individuals that make decisions individually.[9] The number of interactions is 15 in all of the treatments.[10]

The joint-decision treatments in each set are named the "Joint Decision, Partner" (dubbed J-P) treatment and the "Joint Decision, Stranger" (dubbed J-S) treatment. In those two treatments, each subject is randomly paired with another subject at the beginning of the experiment. They are then informed of the identity of their matched partners.[11] The pairing is fixed throughout the entire experiment. In the J-P treatment, we use a partner matching protocol for group formation. That is, each pair is randomly and anonymously matched with another pair at the onset of the experiment to form a group; and the grouping becomes fixed throughout the entire experiment. By contrast, a stranger matching protocol is used in the J-S treatment: each pair is randomly matched with another pair in every period by the computer.

In the J-P and J-S treatments, each pair is given an endowment of 40 points and makes a joint allocation decision between their private account and group account in every period. Only non-negative integers are allowed for their contribution amounts. The payoff consequence follows the standard linear public goods game (see Eq. (1) below). A pair obtains 1 point for each point the pair allocates to their private account; and the pair and their matched pair each

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[9] In order to avoid confusion, we separate the meaning of the terms "group size" and "the number of decision-making units." The former refers to the number of subjects in a group and the latter refers to the number of subject(s) that make decisions either individually or jointly. While both numbers are the same in the treatments where subjects make decisions individually, the "group size" is 4 and "the number of decision-making units" is 2 in the joint-decision treatments.
[10] Subjects were clearly informed of the number of periods at the beginning of the experiment.
[11] In order to ensure that pairs were randomly formed, each subject was asked to draw a slip of paper with a seat number before the start of the experiment and sit at the seat with the number indicated on the paper. Two subjects that were seated next to each other became a pair. No communication was permitted during this pairing process until the joint decision stage described later.

obtain 0.8 points for each point the pair allocates to their group account. In short, the payoff of pair i in period $t \in \{1, 2, \ldots, 15\}$ is calculated by:

$$\pi_{i,t} = 40 - C_{i,t} + 0.8 \cdot (C_{i,t} + C_{j,t}), \tag{1}$$

where $C_{i,t} \in \{0,1,2,\ldots,40\}$ is the joint contribution amount of pair i in period t, and pair j is pair i's matched pair in period t. Each member in pair i obtains half of $\pi_{i,t}$ as his or her period t payoff.

The procedure in which each pair decides their joint allocation amounts is as follows: subjects in the J-P and J-S treatments are given one minute to freely discuss their strategies and decisions with their partners using an electronic chat system in each period. Although their partners sit next to them, they are not allowed to communicate verbally and are only permitted to communicate with each other via chat windows.[12] This ensures that the content of communication within pairs is their private information. Once the communication stage is over, each individual in a pair privately and simultaneously submits an amount they wish to allocate to the group account using their computer terminal. If a subject and his partner in the pair submit the same allocation amount, then the amount becomes their pair's joint allocation amount to the group account for this period. If the subject and his partner submit different amounts, then one of the two amounts will be selected with a probability of 50% by the computer.[13] Both subjects will

[12] As explained later, the sessions were conducted at an experimental laboratory at the University of Michigan. In this laboratory, there are partitions between desks, which made it easy for us to implement this rule.

[13] This rule was applied to a small number of the pairs in the experiment. In 24 out of 240 (= 16 pairs × 15 periods) joint decisions (10.0% of the decisions) in the J-P treatment and in 32 out of 240 joint decisions (13.3% of the decisions) in the J-S treatment, two subjects in pairs submitted different amounts after the communication stage. A closer look at the subjects' dialogues indicate that only nine cases (3.8% of the joint decisions) in the J-P treatment and four cases (1.7% of the joint decisions) in the J-S treatment were due to clear disagreements. The remaining cases where different amounts were submitted were due to the following three reasons. First, some pairs intentionally submitted different amounts or did not make any efforts in agreeing a joint allocation amount although they communicated with each other. An example of this case is by Pair 10 in the J-P treatment in period 9:

> Subject 39: ...so no to the 20?
> Subject 38: i'm thinking we can put different amouts and just let the computer decide?
> Subject 39: ohhhh, ok. thats fine.
> Subject 39: i'll put 20 each time
> Subject 38: ill do 0

Second, some pairs agreed on what they would jointly allocated, but two members submitted different amounts. An example of this case is the decision of Pair 22 in the J-S treatment in period 1; they agreed to jointly contribute 40 points in chats. However one of them typed 39 while the other typed 40. Lastly, some pairs did not make enough communications as to what specific amounts to allocate. For example, the two members of Pair 22 in the J-S treatment submitted different amounts for the most of the periods after period 1, while chatting about unrelated topics. All dialogues are available on online sources.

be informed of what amount their pair partners submitted before being informed of their interaction outcome with the other pair.

In the J-P and J-S treatments, we elicit hypothetical contribution amounts the subjects prefer to make as pairs before entering the communication stage in each period. Specifically, we ask them what amount they would choose if they could decide their pair's allocation amounts unilaterally based on the 40 points without communicating with their partners (the payoff would still be split in half based on Eq. (1)). This elicitation task is not incentivized in order to avoid making this elicitation task salient.[14]

We set up an individual-decision treatment to correspond to each of the J-P and J-S treatments. In the "Individual Decisions, Partner" treatment (dubbed I-P) and the "Individual Decisions, Stranger" treatment (dubbed I-S), subjects play two-person public goods games 15 rounds. Each subject is given an endowment of 40 points in each period, as is each pair in the J-P and J-S treatments. Two subjects in each group then simultaneously and independently decide contribution amounts to their group account. Their allocation amounts must be integers between 0 and 40. To make the I-P (I-S) treatment parallel to the J-P (J-S) treatment, the payoff consequence of each subject's decision is set as half of a pair's payoff in the joint-decision treatment.[15] That is, subject *k* obtains 0.5 points for each point she allocates to her private account; and she and her partner each obtain 0.4 points for each point she allocates to her group account. Note that the marginal per-capita return (MPCR) is 0.8 in both the joint-decision and individual-decision treatments. In short, the payoff of subject *k* in period $t \in \{1, 2, \ldots, 15\}$ is expressed by:

$$\pi_{k,t} = 0.5 \cdot \left[\left(40 - c_{k,t}\right) + 0.8 \cdot \left(c_{k,t} + c_{l,t}\right)\right]$$

$$= 0.5 \cdot \left(40 - c_{k,t}\right) + 0.4 \cdot \left(c_{k,t} + c_{l,t}\right), \tag{2}$$

where $c_{k,t} \in \{0,1,2,\ldots,40\}$ is the contribution amount of subject *k* in period *t*, and subject *l* is subject *k*'s matched individual in period *t*. The I-P and I-S treatments use the partner matching

[14] In addition, this questionnaire is included only on the subjects' computer screen. At the onset of the experiment, they are told that some additional questions related to the experiment may be asked while the experiment is in progress.

[15] Making per-subject payoff consequences the same between individuals and pairs is usually used in related studies, including Cason and Mui (1997) and Luhan *et al.* (2009).

protocol and the stranger matching protocol, respectively. The matching process is identical to the corresponding joint-decision treatments explained above. As in the joint-decision treatments, the subjects are informed of the outcome of their interactions at the end of each period.

Finally, at the end of the experiment, all subjects are asked their reasoning behind their allocation decisions.

III. Predictions and Behavioral Considerations

Predictions based on standard theory for the four treatments are straightforward. Contributing zero points to their group account is a strictly dominant strategy for each subject. Thus, mutual full free riding is a unique Nash Equilibrium in each treatment ($C_{k,t} = 0$ for all k and t for the joint-decision treatments; $c_{j,t} = 0$ for all j and t for the individual-decision treatments).

As mentioned in Section I, however, established evidence from past finitely-repeated dilemma game experiments suggests that some subjects may attempt to cooperate in earlier periods. But the cooperation rate will most likely keep declining over the periods when subjects individually make allocation decisions in our environment.[16] This dynamic can be rationalized if we assume that some subjects have other-regarding preferences (see Sobel (2005) for a survey) or that they at least believe that some subjects do so. One can presume that the same behavior can be seen when subjects make decisions jointly under the assumption that pairs behave the same way as individuals do.

However, we would expect a higher level of cooperation with our joint decision-making protocol because of possible social effects. In a study where they conducted two field experiments to investigate the effects of having peers in non-strategic environments, Babcock et al. (2015) confirm that team-based compensation system make people work harder. They argue that this phenomenon was caused by the social effects that they defined as "those that are related in a direct way to the utility an individual derives from interacting with others, including but not limited to effects from altruism, guilt, shame, embarrassment, commitment devices, fear of social punishment, or a desire to be liked or respected." As the joint decision-making format in our study renders one's decision inevitably relevant to her pair partner's payoff, the same or similar

[16] More cooperation-oriented subjects are quickly discouraged if they see others free ride (e.g., Fischbacher and Gächter 2010).

social effects can be expected in a strategic environment like ours. Further, each person has full knowledge on the identity of their pair partner in our design. This reduces the social distance within pairs, which presumably increases the impact of social effects.

The significance of the social effects can be examined by comparing (a) the subjects' hypothetical pair contribution amounts elicited prior to communicating with their partners in the joint-decision treatments with (b) the subjects' individual contribution amounts in the corresponding individual-decision treatments. The subjects' pre-communication willingness to contribute in the J-P and J-S treatments can be inflated *even from period 1* if playing as a pair has effects on their preferences.

QUESTION 1: *Are the average hypothetical contribution amounts elicited before the discussion with partners in the J-P (J-S) treatment higher than the average contributions by individuals in the I-P (I-S) treatment?*

Apart from the social effects discussed above, there is another possible reason that people's decisions made jointly as a pair can be different from those made individually in repeated dilemma situations. It is known that people in teams tend to have deeper insights and better understanding of the nature of interactions, which enables them to choose more materially beneficial options, in comparison to when they make decisions alone (see Charness and Sutter for a survey).[17] In this sense, there are two possible opposing predictions regarding how making decisions jointly affects people's behavior in our strategic context. On the one hand, pairs may behave more in line with what standard theory predicts if joint decision-making strengthens their game theoretic reasoning. For instance, Kocher and Sutter (2005) find that teams learn to submit lower numbers in beauty-contest games more quickly than individuals do when they repeat the games.[18,19] If something similar happens in our environment, cooperation will decline more quickly in the J-P (J-S) treatment than in the I-P (I-S) treatment. One the other hand, letting subjects make decisions jointly may contribute to sustaining cooperation in repeated dilemma situations. First, if pairs believe that not all subjects are selfish, then they may consider that free-

[17] Note that the number of subjects in a team is more than two in the majority of previous research. We acknowledge that some implications found in previous studies may not extend to our environment.
[18] The size of a decision-making unit is three, and the number of decision-making units in a group is five in Kocher and Sutter unlike our setup.
[19] Also see Cooper and Kagel (2006). They find that teams play more strategically than individuals in signaling game experiments.

riding in earlier periods is not the best strategy if they want to maximize their total payoff across the 15 periods, as is the logic by Kreps et al. (1982).[20] Pairs may, understanding the features of the games more deeply, expect that if they discourage their matched pairs by free-riding, it would deteriorate their relationships with their matched pairs, by which they may end up obtaining lower payoffs as a group in the rest of the interactions. Each pair would be materially better off if they could successfully build a trustful relationship and encourage their matched pair(s) to keep cooperating with them.[21] Thus, pairs in the joint-decision treatments might value building such trustful relationships more highly compared with a gain from one-time defection.[22] As a result, they might attempt to reciprocate cooperation behavior of their matched pairs more strongly than individuals do. Note, however, that they may attempt to severely milk their established relationships with their matched pairs near the end period if they are primarily strategically motivated. Second, some studies have shown that teams tend to exhibit less myopic loss aversion than individuals in a risky situation (e.g., Sutter, 2007). In our environment, a pair incurs a loss if the pair decides to cooperate but their matched pair(s) does not reciprocate the intention. However, as in the past studies, pairs may be more forward-looking and be more willing than individuals to take risks in investing in encouraging their matched pairs to cooperate by sending signals to them via their own high contributions. These considerations lead to the following specific question in our study:

QUESTION 2: *Are the pairs' contributions more sustained in the J-P (J-S) treatment than the individuals' contributions in the I-P (I-S) treatment?*

If QUESTION 2 has an affirmative answer, then we could furthermore expect that building a trustful relationship would be easier for pairs in the treatment with the partner matching protocol as each pair repeatedly interacts with the same pair in every round. In the J-S treatment, unlike the J-P treatment, a pair meets with a specific pair in two consecutive periods with a probability of 14.3% (= 1/7 × 1/7 × 100% × 7 potential pairs). The difference in the re-

[20] Joint or team decision-making can be helpful in overcoming coordination failure among subjects. For example, Feri *et al.* (2010) find that groups are more likely to choose mutually beneficial, Pareto-efficient equilibrium among multiple equilibria when playing weakest-link games.

[21] A pair in the J-P and J-S treatments obtains 40 points if the pair and their matched pair both contribute 0 points to their group account. By contrast, they obtain 64 points if they and their matched pair both contribute 40 points to the group account. (The pair profit is divided by half between two individuals in a pair.)

[22] Gillet *et al.* (2009), using three teams with a team size of three in each interaction unit, find that teams make decisions in a less myopic manner than individuals in repeated common pool resource problems when teams make joint decision via unanimity rule.

matching probability could impact the timing of the subjects' end-game defection. In the J-S treatment, even if a pair exploits their already-established trustful relationship within a community by defecting in some later period, the probability that they will meet with that pair again in the rest of the periods is small. This means that they have higher incentives to defect than pairs in the J-P treatment. This consideration leads to our third specific question:

QUESTION 3: *Is cooperation more sustained in the J-P treatment than in the J-S treatment?*

Lastly, the opportunity to make a joint decision may also affect the subjects' cooperative attitudes due to what psychologists call group polarization in our strategic environment, as is shown in non-strategic environments (e.g., Cason and Mui, 1997; Luhan et al. 2009). Group polarization refers to the situation in which "after deliberation, people are likely to move toward a more extreme point in the direction to which the group members were originally inclined" (page 60, Sunstein 2007).[23] Cason and Mui (1997) discussed the two dominant theories, the Persuasive Argument Theory (PAT) and the Social Comparison Theory (SCT), and tested these theories by using team-based dictator games. The PAT states that team decision-making process is influenced by the persuasiveness of arguments. Accordingly, it predicts that initially self-regarding pairs become more self-regarding; and likewise, initially other-regarding pairs become more other-regarding because individuals in pairs would find arguments that support their original views more convincing during the course of their discussion. By contrast, the SCT states that people tend to gather more information as to what a socially desirable action is when interacting with others and behave in a socially desirable manner. Accordingly, it predicts that all pairs, whether self-regarding or other-regarding, become more other-regarding after they communicate with pair partners (See Cason and Mui 1997 for the detail). The subjects' behavior in the team dictator game in their study was more consistent with the SCT.[24]

In this paper, we examine which theory better explains our data by using a method similar to the one employed by Cason and Mui (1997) as group polarization may affect how cooperation evolve in the experiment. We classify a pair as a self-regarding pair if the average of

[23] See also Moscovici and Zavalloni (1969). They let subjects discuss some topics with others and had them unanimously give opinion or judgment ratings for each item. They find that "the polarization effect will be greater when the group must commit itself to a given position, than when it is asked to express an "objective" judgment" (on page 134). Recall that each pair in our joint-decision treatments must commit a single allocation amount in a given period.

[24] In Luhan et al. (2009), teams made more selfish choices as joint decisions were influenced by the most selfish players in teams.

their hypothetical pre-communication contributions across all periods ($\bar{C}_{pair}^{hypo} = \frac{1}{30}\sum_{t=1}^{15}\sum_{i=1}^{2} C_{i,t}^{hypo}$, where i =1, 2 refers to each of the two persons in a pair) is less than the session average of $\bar{C}_{pair}^{hypo}$. Likewise, we classify a pair as an other-regarding pair if $\bar{C}_{pair}^{hypo}$ is greater than the session average of it. The SCT predicts that the pairs' contribution amounts made jointly after communication will be greater than the pre-communication willingness to contribute, both for the self-regarding and other-regarding pairs. The PAT predicts that the pairs' contribution amounts made jointly after communication are greater (smaller) than their pre-communication hypothetical contribution amounts for the other-regarding pairs (the self-regarding pairs).

IV. Results

Two sessions per treatment were conducted at the University of Michigan in Ann Arbor. A total of 96 subjects participated in the experiment.[25] No subject participated in more than one session. The experiment was programmed in z-tree (Fischbacher 2007). All instructions were neutrally framed.[26] Subjects were asked to answer a number of control questions to confirm their understanding of the experiment.

A. Average Contribution by Treatment

We first compare the average contributions between the J-P (J-S) and I-P (I-S) treatments (FIGURE 1).[27] First, both the levels and the trends of average contributions substantially differ between the individual-decision and joint-decision treatments under the partner matching protocol. The average contributions in the J-P treatment begin at around 70% of the endowment,

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[25] Solicitation messages were sent via ORSEE (Online Recruitment System For Economic Experiments), which was developed by Greiner (2003), to all eligible potential subjects. Subjects then voluntary signed up for the experiment. Most participants were undergraduate students at the University of Michigan. The average payoff (except the participation payment) was \$14.35 with a standard deviation of \$2.05. The number of female subjects was 57 (59%). The sessions in the I-S and I-P treatments lasted a little over 30 minutes, and the sessions in the J-P and J-S treatments lasted around 80 minutes (including payment to the subjects). As explained in Section 4.D, another 34 subjects participated in additional treatments. The recruiting procedure in the additional treatments was exactly the same as that in the original treatments.

[26] For example, terms having neutral connotation, such as "group account" and "allocate," instead of "public account" and "contribute," were used. See Appendix A for the instructions of the J-P treatment.

[27] Average payoffs in the joint-decision (individual-decision) treatments are simply linear transformations of average contributions based on Equation (1) (Equation (2)).

increase gradually, and then remain at a level of around 80% of the endowment until period 13. As usual in the standard public goods or prisoner's dilemma game experiments, strong end game defection is seen in the J-P treatment (Andreoni 1988, Andreoni and Miller 1993). This observation on the end-game effect suggests that the high cooperation level in the J-P treatment partially stems from the subjects' strategic motives. By sharp contrast, in the I-P treatment, the average contributions decline steadily over the periods. The differences in the average contribution between the J-P and I-P treatments are significant in all periods except periods 1, 2 and 15 – the end period (Appendix TABLE B.1).[28] A regression analysis, shown in TABLE 2, confirms that the overall declining trend of contribution amounts in the I-P treatment is significant but it is not in the J-P treatment. In this analysis, we use a Tobit model as the right- and left-censored observations (i.e., 40 and 0) are not negligible as usual in public goods game experiments. We control for individual effects by including random effects.

RESULT 1: *Average contributions are sustained at a high level in the J-P treatment. By contrast, they are in a significantly decreasing trend in the I-P treatment.*

Second, the levels of average contributions are substantially different between the individual-decision and joint-decision treatments under the stranger matching protocol as well (Panel (b) of FIGURE 1). A regression analysis confirms that the overall difference in the contribution level between the two treatments is statistically significant (columns (3) and (4) of TABLE 2). However, average contributions are in declining trends over the periods in both the J-S and I-S treatments. Consequently, the average contributions are often significantly higher in the J-S treatment than in the I-S treatment in the first eight periods, but not in later periods (Appendix TABLE B.1).

RESULT 2: *Average contributions are often significantly higher in the J-S treatment than in the I-S treatment in the first eight periods in the experiment. They are in significantly decreasing trends in both the J-S and I-S treatments.*

[28] Also see the coefficient estimates of variable (i) in columns (1) and (2) of TABLE 2.

B. Hypothetical Contributions in the Joint-Decision Treatments and Potential Driving Forces behind the Pairs' Inflated Contributions

Potential driving forces behind the difference in the subjects' contribution behavior between the J-P (J-S) and I-P (I-S) treatments can be explored by using the hypothetical contribution amounts elicited before the communication stage in the joint-decision treatments. As outlined in Section III, we first explore potential effects of making a single decision as a pair in the joint-decision treatments by comparing (i) period 1 hypothetical contribution amounts in the J-P (J-S) treatment with (ii) period 1 individual contribution amounts in the I-P (I-S) treatment. The period 1 hypothetical contribution amounts are the subjects' willingness to cooperate as pairs before entering the first communication stage.[29] Our data indicates that the average period 1 hypothetical contribution amounts are not statistically different between the two joint-decision treatments (28.2 points in the J-P treatment versus 27.2 points in the J-S treatment). But, the average hypothetical contributions in the J-P and J-S treatments are both higher than the average contributions in the I-P and I-S treatments, respectively, although the difference is statistically significant only between the J-S and I-S treatments (see Appendix TABLE B.1). This suggests that the fact that two persons act as a pair in the joint-decision treatments may enhance their willingness to contribute to their group accounts.

RESULT 3: *The average period 1 pre-communication hypothetical contribution in the J-P (J-S) treatment is higher (significantly higher) than the average period 1 contribution in the I-P (I-S) treatment.*

A period-by-period exploration of the average pre-communication contribution preferences shows that the trends are similar to those of the average realized joint contribution amounts in each of the J-P and J-S treatments (FIGURE 1) —the subjects' pre-communication willingness to contribute stays at a high level in each of the two joint-decision treatments.[30] A

[29] We can also measure this effect by comparing these two kinds of decisions in periods 2 to 15. But, pre-communication hypothetical contribution amounts elicited in periods 2 to 15 may be affected by their partners' preferences the subjects learned through communication in the past periods. Test results for such comparisons in each of periods 2 to 15 are, nevertheless, reported in Appendix TABLE B.1.

[30] The average hypothetical contributions in the J-P treatment are significantly higher than the average contributions in the I-P treatment in most periods, except the very early periods and near the end period. The average hypothetical contributions in the J-S treatment are often significantly higher than the average contributions in the I-S treatment until period 8. See Appendix TABLE B.1 for the details.

potential factor that helped sustain the subjects' willingness to cooperate is the effects of communication, especially group polarization, considering that the social distance within pairs is small in our joint decision-making system (Cason and Mui 1997). Our data, especially the J-P treatment, seem to be more consistent with the SCT, as in Cason and Mui (1997), given that the average realized joint contribution amounts are slightly higher than the average hypothetical contributions in most periods in that treatment. This could mean that especially those with the lower willingness to contribute in pairs may have been more affected by their partners, including the self-regarding pairs.

As discussed in Section III, we now investigate whether the SCT or the PAT better fits our data. Out of 16 pairs in the J-P treatment, six pairs are classified as the self-regarding pairs and ten pairs are classified as the other-regarding pairs. Our raw data appears to suggest that the SCT better explains the J-P treatment data. The percentages of periods in which the self-regarding pairs on average increased and decreased the joint contribution amounts from the average pre-communication hypothetical contribution amounts of the two individuals in a pair are 35.6% and 18.9%, respectively. The other-regarding pairs contributed more than the average pre-communication contribution amounts in 14.0% of the total periods, and they contributed less for 8.0% of the total periods. The average shifts in contributions of pairs before and after communication are 3.31 points and 1.31 points, both of which are positive, for the self-regarding and other-regarding pairs, respectively. These upward shifts in the level of contributions appear to be consistent with the Social Comparison Theory. By contrast, the impact of communication in the J-S treatment appears to be different from the J-P treatment. Out of the 16 pairs in the J-S treatment, 8 pairs are classified as the self-regarding pairs and the other 8 pairs are classified as the other-regarding pairs. While we see an increase in the contribution amounts allocated by the self-regarding pairs from the average pre-communication hypothetical contribution amounts in 14.2% of the total periods, they were less in 20.8% of the total periods. The other-regarding pairs contributed more than their average pre-communication contribution amounts in 28.3% of the total periods and they contributed less in 24.2% of the total periods. The average shifts in contributions are small: -.21 points and .083 points for the self-regarding and other-regarding pairs, respectively.[31]

[31] See Appendix TABLE B.2.

In order to investigate how each individual shifts their willingness to contribute through the communication stage as well as whether the pairs' shifts in their contributions through communication are significant, we conduct a regression analysis in which the dependent variable is the contribution amount that subject *i* submits *after* the communication stage in period *t* (which we denote as $C_{i,t}$) minus the hypothetical contribution amount that subject *i* submitted *before* communicating with her partner in that period (which we denote as $C_{i,t}^{hypo}$), for each of the self-regarding and other-regarding pairs. Independent variables include (a) the positive deviation of hypothetical contributions in period *t* (= $max\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}$) and (b) the negative deviation of hypothetical contributions in period *t* (= $min\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}$). A linear regression model is used as the left or right-censored observations are very few in this specification.[32] As shown in TABLE 3, our data shows that, regardless of whether a pair is self-regarding or other-regarding, the subjects who had more selfish preferences than their pair partners (those who input smaller hypothetical contribution amounts than their pair partners) significantly raise their willingness to contribute after communication (see the coefficient estimates of variable (a)). But at the same time, the pair partners who have more pro-social preferences than their partners reduce their willingness to contribute after communication (see the coefficient estimates of variable (b)). The mean reverting phenomenon might mean that the subjects generally do not hold firm attitudes. For example, Sunstein (2007) argues that: "if most of the members do not have entirely fixed positions, there is likely to be real movement toward the middle" (page 82). Nevertheless, the relative strength between the former effect on the less cooperative and the latter effect on the more cooperative is different between the J-P and J-S treatments, and its overall patterns are contrasted between the two treatments. On the one hand, for each of the self-regarding and other-regarding pairs, the former positive effect on the less cooperative is larger than the latter negative effect in the J-P treatment (it is significantly larger for the other-regarding pairs in that treatment), which leads to a significant upward shift in the cooperative attitudes of pairs. This pattern in the J-P treatment is more consistent with the SCT than the PAT and it could have helped sustain mutual cooperation within their groups. By contrast, in the J-S treatment, the latter negative effect is significantly larger than the former

[32] The numbers of left(right)-censored observations (i.e., -40 and 40) of $C_{i,t} - C_{i,t}^{hypo}$ are only 5(22) and 2(3) for the J-P and J-S treatments, respectively.

positive effect at the 10% level for the self-regarding pairs, which leads to a downward shift in the self-regarding pairs' contribution. The former positive effect is, however, larger (although insignificantly) than the latter negative effect for the other-regarding pairs, which leads to an upward shift in the pair contribution amounts. This pattern in the J-S treatment is more consistent with the PAT, rather than the SCT, and this would be damaging to the sustenance of cooperation norms due to the self-regarding pairs' more selfish action choices after communication. This result seems to suggest that how group polarization operates may depend on matching protocols in a strategic environment. The difference in the pattern of group polarization between the J-P and J-S treatments may be the cause for the difference in the trend of cooperation summarized in RESULTs 1 and 2 between the two treatments.

RESULT 4: *The results from the J-P treatment is more consistent with the Social Comparison Theory, rather than the Persuasive Argument Theory, as is the case in Cason and Mui (1997). By contrast, in the J-S treatment, the pairs' shifts in contributions are more consistent with the Persuasive Argument Theory.*

C. Reciprocation to Counterparts' Last-Period Cooperative Actions

Another possible factor that may account for the high contributions with the joint decision-making system is that the pairs in the joint-decision treatments, especially in the J-P treatment, reciprocate their matched pairs' willingness to cooperate more strongly. Suppressing their temptation to defect and responding positively to their counterparts' intentions to cooperate could be a key for people to build trustful relationships with their matched counterparts and to obtain potentially better material outcomes.

In order to investigate the degree of the pairs' (individuals') reciprocation for cooperation behavior by their matched pairs (individuals), we perform a regression analysis where the dependent variable is joint or individual contribution amounts in period $t \in \{2, 3, \ldots, 15\}$. Independent variables include their period $t - 1$ matched counterparts' contribution amounts in period $t - 1$. We use a Tobit model as a non-negligible fraction of the subjects contributed 0 or 40, while we control for individual effects by including random effects. As shown in TABLE 4, regardless of the matching protocols, both pairs and individuals exhibit statistically significant conditional contribution behavior, as is shown in many related studies (e.g., Fischbacher et al.

2001).[33] However, the level of the conditional willingness to contribute differs by the decision process. That is, the pairs in the J-P (J-S) treatment exhibit significantly (weakly significantly) stronger conditional willingness to contribute than the individuals in the I-P (I-S) treatment. This result suggests that the pairs' stronger conditional willingness to cooperate may have helped them establish cooperative relationships with their matched pairs in the joint-decision treatments.[34]

RESULT 5: *The conditional willingness to contribute in the J-P (J-S) treatment is significantly (weakly significantly) stronger than that in the I-P (I-S) treatment.*

D. Comparing the Effectiveness of the Joint Decision-Making System with that of an Informal Punishment Institution

One may wonder how the effectiveness of our joint decision-making system compares to that of other institutions that may sustain cooperation in dilemma situations. To explore this question, we additionally conducted two treatments, each of which was exactly identical to the I-P and I-S treatments except that it had a standard informal punishment stage after the individual contribution stage (e.g., Fehr and Gächter 2000, 2002).[35] We refer to the two additional treatments as the "I-P-Punishment" treatment and the "I-S-Punishment" treatment. As in the I-P and I-S treatments, the payoff consequence of a subject's decision in the I-P-Punishment (I-S-Punishment) treatment was set as half of the J-P (J-S) treatment. That is, in the punishment treatments, the payoff of subject *i* in period *t* was calculated as:

$$\pi_{i,t} = 0.5 \cdot \left[max\left\{\left(40 - c_{i,t}\right) + 0.8 \cdot \sum_{l=1}^{2} c_{l,t} - 3p_{j\rightarrow i,t}, 0\right\} - p_{i\rightarrow j,t}\right]$$

[33] The subjects' responses to a post-experiment, open-ended question provide additional evidence on the subjects' conditional contribution behavior and their reputation building motives. This question reads: "On what basis did you make allocation decisions?" Many subjects in each treatment gave either conditional behavior or building trustful relationships with the other pairs as important factors to obtain a higher total payoff. We acknowledge, however, that these responses could have been contaminated by their experiences in the experiment and thus can be used for suggestive evidence only. The details are omitted to conserve space. See online Appendix C for all subjects' responses.

[34] The motives behind RESULTs 4 and 5 are mixed between strategic ones (e.g., pairs behave cooperatively to obtain higher material payoffs) and non-strategic ones (e.g., pairs behave cooperatively because they feel a moral obligation to do so), as evidenced by the strong end-game defection in the J-P treatment (FIGURE 1).

[35] Two sessions per each additional treatment were conducted at the University of Michigan. One session of the I-P-Punishment treatment had 8 subjects and the other had 10 subjects. Each session in the I-S-Punishment treatment had eight subjects as in the I-S treatment.

$$= max\{0.5 \cdot (40 - c_{i,t}) + 0.4 \cdot \sum_{l=1}^{2} c_{l,t} - 1.5p_{j\to i,t}, 0\} - .5p_{i\to j,t}.$$

Here, j is the period t matched counterpart of subject i, and $p_{j\to i,t}$ is the punishment points given from subject j to subject i in period t. In other words, in the informal punishment stage, for each punishment point assigned by a subject, 1.5 points were deducted from the punished and 0.5 points were deducted from the punisher. See Appendix D for the instructions of the I-P-Punishment treatment for reference.

Our data shows that neither the average contributions nor the average payoffs are significantly different between the J-P and I-P-Punishment treatments.[36] In addition, while the average contributions are almost identical between the J-S and I-S-Punishment treatment, the average payoff in the J-S treatment is higher, although insignificantly, than that in the I-S-Punishment treatment.[37] This additional data suggests a high potential of joint decision-making in deterring people's opportunistic behavior in dilemma situations when the social distance within pairs is small.

RESULT 6: *The average contribution in the J-P treatment (J-S treatment) is not significantly different from that in the I-P-Punishment treatment (I-S-Punishment treatment).*

E. A Comparison against Kagel and McGee (forthcoming) and Some Discussions

In order for a group not to be trapped by the standard free-riding dynamics, establishing a mutually cooperative relationship in earlier periods is essential (e.g., Fischbacher and Gächter 2010). Successful initiations of mutually cooperative relationships were well observed in the earlier periods in the J-P treatment (RESULTs 1 and 3). The subjects' behavior in the J-P treatment is different from the standard free-riding dynamics or from the ones in the first super-

[36] The average contributions are 30.8 points and 31.8 points in the J-P and I-P-Punishment treatments, respectively. The difference in the average contribution is not significant according to a random-effect Tobit regression (p-value = .724, two-sided); here, a Tobit model was used as the number of left/right-censored observations are not negligible. The average payoffs are 29.2 points and 29.4 points in the J-P and I-P-Punishment treatments, respectively. The difference in the average payoff is also not significant according to a random effect linear regression (p-value = .449, two-sided). See Appendix E for period-by-period comparisons using Mann-Whitney tests.
[37] The average contributions are 21.3 points and 21.4 points in the J-S and I-S-Punishment treatments, respectively. The difference in the average contribution is not significant according to a random-effect Tobit regression (p-value = .724, two-sided). The average payoffs are 26.4 points and 24.5 points in the J-S and I-S-Punishment treatments, respectively. The difference in the average payoff is also not significant according to a random effect linear regression (p-value = .449, two-side). See Appendix E for period-by-period comparisons using Mann-Whitney tests.

game in Kagel and McGee (forthcoming), where each subject was anonymously paired with another subject at the onset of the experiment and the pairing stayed fixed over the entire experiment. How can we explain the difference in the cooperation dynamics between our study and Kagel and McGee (forthcoming)? As mentioned earlier, one important difference between our study and Kagel and McGee (forthcoming) is the social distance within pairs. To investigate how the difference in social distance between the two studies may affect the subjects' reasoning, we analyze pair dialogues in the J-P treatment, using the same cording categories adopted by Kagel and McGee (forthcoming) –TABLE 5 of their paper, and compare against them.[38] Since our paper uses a public goods game, rather than a prisoner's dilemma game, we define that contributing more than half of the endowment (i.e., 20 points) as "cooperate" and assign codes from C1 to C5, dependent on the contents of the conversations. Contributing less than or equal to half of the endowment is treated as "defect" and codes from D1 to D6 are assigned to them. More than one code is assigned if relevant.[39]

In the J-P treatment, ten out of 16 pairs (62.5% of the pairs) contributed more than 20 points to their group account in period 1. All these 10 pairs were coded either C1 ("If we cooperate other team might/will cooperate") or C3 ("It's in our best interest to cooperate without discussion of the logic behind cooperating") in that period, whose ratio is significantly higher than the corresponding ratio (70.6%) in period 1 of Kagel and McGee (forthcoming) at the 10% level (*p*-value = .0574, two-tailed two-sample test of proportions). As for the six pairs that

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[38] This comparison is not perfect as a number of important design pieces are different between the two studies. For example, our paper uses a public good game but Kagel and McGee (forthcoming) uses a prisoner's dilemma game. The subjects in the J-P treatment in our study played only one finitely-repeated public goods game while the subjects in Kagel and McGee (forthcoming) played multiple finitely-repeated prisoner's dilemma games. The duration of chats is one minute per period in our study, but it was three minutes in each of the first two periods and 1.5 minutes after period 2 in Kagel and McGee (forthcoming). Therefore, I acknowledge that these comparisons can be treated as suggestive evidence only as we cannot rule out the possibility that the difference in the subjects' behavior came from the difference in the experimental design.

[39] The analysis in this subsection is based on the author's cording results. Codes were not assigned if there were no codes that were appropriate for the subjects' dialogues. We acknowledge that although the method to code dialogues is a novel and useful way to analyze data, subjective judgement is involved; and thus, analyses provided in this subsection may need to be treated as suggestive evidence. In addition to the author's coding, a graduate student at Bowling Green State University also independently assigned codes for each chat. In 58 periods out of the 240 periods' data (16 pairs × 15 periods), the codes assigned by the graduate student did not completely coincide with the author's assigned codes. Note that in Kagel and McGee, two independent coders assigned codes and likewise in around 24% of the periods the two coders assigned different codes. However, the general distribution of codes was similar between the author and the graduate student. The author assigned C1, C2, C3, C4, C5, D1, D2, D3, D4, D5 and D6 for 96, 7, 19, 28, 2, 13, 14, 14, 18, 2 and 5 periods, respectively, whereas the graduate student assigned C1, C2, C3, C4, C5, D1, D2, D3, D4, D5 and D6 for 97, 1, 16, 21, 1, 12, 12, 1, 8, 0 and 2 periods, respectively. The cording results by the author and the graduate student can be found in the online data files along with the chat data.

contributed less than or equal to 20 points to their group account in period 1, no pair was coded D1 ("It's the safest choice"), which would presumably involve discussing some selfish motives, in that round. The ratio of being coded D1 (0.0%) is significantly lower than the corresponding ratio (91.7%) in Kagel and McGee at the 1% level (*p*-value = .000, two-tailed two-sample test of proportions). Instead, two out of the six defecting pairs were corded D3 ("Defecting but planning to cooperate if other does so."), which is more included towards cooperation. For example, the following dialogue of pair 11 is classified as D3:

Subject 41: I think we should start with a small amount like 10 points
Subject 41: and see how much the other pair puts in before we put in a bigger amount
Subject 42: Okay

In addition, three defecting pairs was coded D4 ("It's in our best interest – defection without any logic behind the doing so"). For example, the dialogues of pair 16 are classified D4:

Subject51: let's add 20 to gropu
Subject50: how much you think we should put im
Subject50: i added 20 too
Subject50: yea

These closer looks at the dialogues imply that our subjects seem to be more cooperation-oriented and be reluctant to talk selfish intentions, compared with the subjects in Kagel and McGee (forthcoming). This seems to suggest that the closer social distance in our joint decision-making protocol may have stimulated their pro-social attitudes. This is similar to the earlier quantitative finding summarized in RESULT 4.

Since the cooperation rate in the very first period was higher in our study than in Kagel and McGee (forthcoming), the chance that those who chose "defect" met with those who chose "cooperate" in earlier periods of the experiment was higher in our study (see FIGURE 1 in our paper and FIGURE 2 of Kagel and McGee (forthcoming)).[40] In fact, all of the defecting pairs were matched with cooperating pairs in period 1; and then, in period 2, four out of the six defecting pairs raised contributions to a level higher than 20 points in our study. In addition, out

[40] See RESULT 3 and footnote 7 for potential causes of the difference in the initial cooperation rate between ours and Kagel and McGee (forthcoming).

of the pairs who chose “cooperate” but encountered ones who selected “defect” in period 1, four kept contributing more than 20 points (two contributed less than or equal to 20 points) in the following period. Accordingly, the number of those who contributed more than 20 points is constantly either 12 or 13 from period 2 through periods 13 in the experiment. (For example, the numbers of cooperating pairs are 13, 12, 13 and 13 in periods 2, 3, 4 and 5, respectively.)

V. Conclusions

This paper experimentally compared cooperation behavior in a finitely-repeated dilemma situation between pairs and individuals under two matching protocols – partner matching of two pairs and stranger matching in a community. The individuals in the pairs are informed of who their pair partners are. Our results show that regardless of the matching protocols, pairs on average contribute significantly more than individuals do, as is consistent with Cason and Mui (1997). The power of joint decision-making is especially strong under the partner matching protocol. Almost all pairs successfully establish long-lasting, cooperative relationships with their matched pairs over the periods in the J-P treatment. By contrast, individuals in the I-P treatments fail to build such relationships and continue to decrease their contributions to their group accounts over the periods. The data taken from our elicitation task shows that subjects in the joint-decision treatments have significantly higher willingness to contribute even before communicating with their partners, compared against the subjects in the individual-decision treatments. The data also shows a possibility of group polarization. Those who initially prefer to contribute smaller amounts than their pair partners raise their willingness to contribute significantly after communicating with the partners, which lifts the pair contribution amounts above the pairs’ mean pre-communication hypothetical contribution amounts especially in the J-P treatment. Finally, we also find that pairs reciprocate their matched pairs’ intentions to cooperate significantly more strongly than individuals in the corresponding individual-decision treatments.

People often make a single decision jointly with another person whose identity they know as a pair in our real life. Our study shows a possibility that such a joint decision-making process may help people overcome dilemmas and achieve mutual cooperative relationships with others. Nevertheless, there are many future research possibilities. For instance, what happens if more than two persons, instead of a two-person pair, make a single decision in repeated dilemmas or they play different games, such as non-linear public goods games? What happens if social distance across pairs is also close unlike our study? More investigations to compare cooperation behaviors between individuals and teams with different experimental parameters or in more complex environments are also desired.

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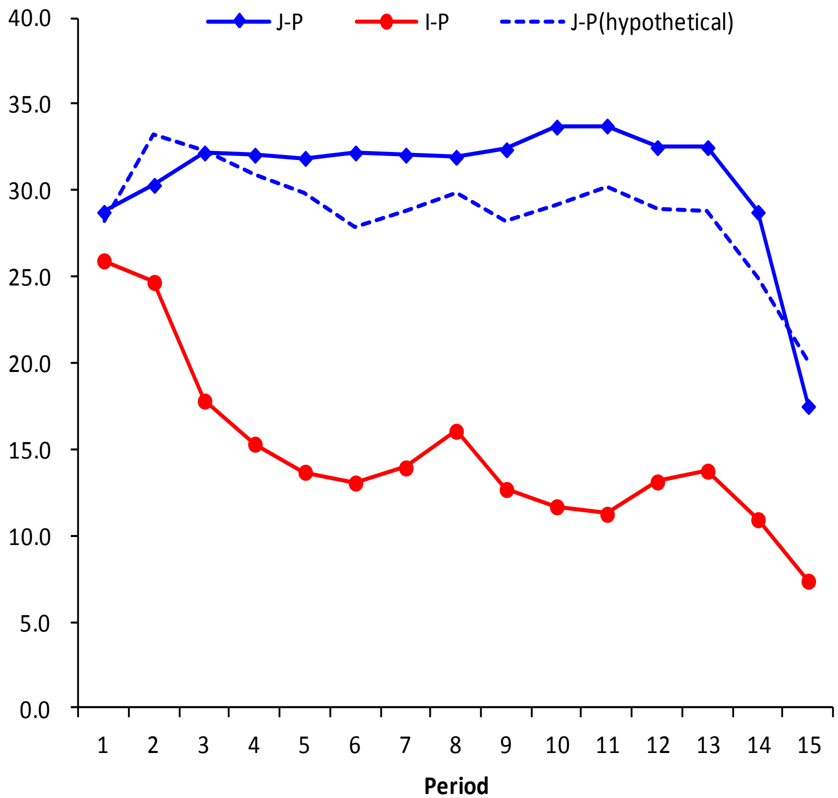
TABLE 1: Summary of Treatments

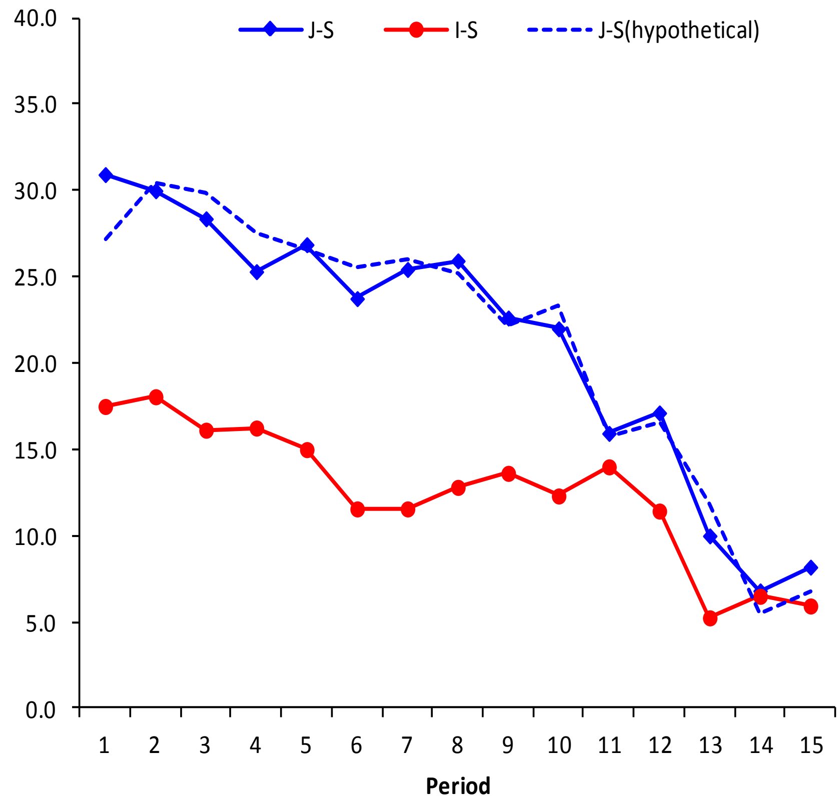
Treatment name	Decision	Number of subjects per session	Number of decision-making units in a group	Prob. of meeting with a specific counterpart (pair, individual) in a period	Endowment	Per-point return from private acc't	Per-point return from group acc't	Avg. Contribution[#1]
I. Treatments with Partner Matching Protocol								
J-P	Joint	16	2 pairs (4 persons)	100%	40 per pair	1 per pair (0.5 per person)	0.8 per pair (0.4 per person)	30.8 (77.1%)
I-P	Individual	8	2 persons	100%	40 per person	0.5 per person	0.4 per person	14.8 (36.9%)
II. Treatments with Stranger Matching Protocol								
J-S	Joint	16	2 pairs (4 persons)	14.3% (1/7×100%)	40 per pair	1 per pair (0.5 per person)	0.8 per pair (0.4 per person)	21.3 (53.2%)
I-S	Individual	8	2 persons	14.3% (1/7×100%)	40 per person	0.5 per person	0.4 per person	12.5 (31.3%)

Notes: We also conducted two additional treatments (named the "I-P-Punishment" treatment and the "I-S-Punishment" treatment) in order to compare the efficiency of the joint-decision system in the J-P and J-S treatments to that of an informal sanctioning institution. See Section 4.D for the description.
[#1] The numbers in parenthesis are the average contributions as percentages of the endowment.

FIGURE 1: Trends of Average Contributions



(a) Partner Treatments



(b) Stranger Treatments

Notes: The dash lines indicate the average hypothetical contribution amounts elicited before communicating with their partners in the joint-decision treatments. Appendix TABLE B.1 reports period-by-period Mann-Whitney test results for the differences in the average contribution across the treatments.

TABLE 2: The Effects of Joint Decision-Making on Enhancing Contributions

Dependent variable: The contribution amount of subject *i* in period *t*.

Independent Variable	Partner Treatments: J-P treatment versus I-P treatment (1)	(2)	Stranger Treatments: J-S treatment versus I-S treatment (3)	(4)
(i) Joint Decision-Making Dummy {= 1 for the J-P and J-S treatment; 0 otherwise}	49.2*** (12.7)	29.7** (13.7)	18.8** (8.55)	34.5*** (9.49)
(ii) Period {= 1, 2, …, 15}	---	-2.85*** (.53)	---	-1.55*** (.34)
(iii)Variable (i) × Variable (ii)	---	2.37*** (.76)	---	-2.07*** (.51)
Constant	5.51 (8.73)	27.4 (9.40)	4.51 (6.05)	17.7*** (6.55)
# of Observations	480	480	480	480
Log likelihood	-847.6	-830.9	-1200.1	-1145.0
Wald Chi-squared	14.92	41.76	4.82	105.4
Prob > Wald Chi-squared	.0001	.0000	.0282	.0000
Chi-squared test (two-sided) for H_0: (ii) + (iii) = 0				
Chi-squared	---	0.75	---	84.57
Prob > Chi-squared	---	.3866	---	.0000***

Notes: Random effects Tobit regressions. The number of left(right)-censored observations is 142(205) in columns (1) and (2). The number of left(right)-censored observations is 159(108) in columns (3) and (4).

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 3: Shifts in Contribution Amounts after Communication

Dependent variable: The contribution amount subject *i* submitted after the communication stage minus the pre-communication hypothetical contribution amount by subject *i* in period *t*.

Independent Variable	J-P treatment		J-S treatment	
	Self-regarding pairs (1)	Other-regarding pairs (2)	Self-regarding pairs (3)	Other-regarding pairs (4)
(a) The positive deviation of hypothetical contributions in period *t* $\{= max\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}\}$	.51* (.18)	.74*** (.063)	.30*** (.11)	.52** (.23)
(b) The negative deviation of hypothetical contributions in period *t* $\{= min\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}\}$	.32 (.14)	.15*** (.025)	.70*** (.12)	.20* (.12)
Constant	2.49 (2.43)	-.12 (.29)	.38** (.16)	-.78 (.58)
# of Observations	180	300	240	240
R-squared	.5035	.4902	.3044	.2444
Two-sided F (Wald chi-squared) test for (a) = (b)				
F (Wald chi-squared)	.34	126.29	3.25	.90
Prob > F (Wald chi-squared)	.5989	.0000***	.0714*	.3440

Notes: Linear regressions. A Hausman specification test did not reject the null hypothesis that individual effects were appropriately modeled by random effects for each of columns (2) to (4) while it rejected the null for column (1). Considering the specification test results, we included fixed effects in columns (1) and random effects in columns (2), (3) and (4). Standard errors were clustered by group level in columns (1) and (2) and by session level in columns (3) and (4).

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 4: Conditional Contribution Behavior by the Matching Protocol

Regression Results

Dependent variable: The contribution amount of pair (individual) i in period $t \in \{2, 3, \ldots, 15\}$.

Independent Variable	Partner Treatments: J-P treatment versus I-P treatments (1)	(2)	Stranger Treatments: J-S treatment versus I-S treatments (3)	(4)
(i) The contribution amount by the period $t - 1$ counterpart of pair (individual) i	.92*** (.17)	.70*** (.18)	.54*** (.089)	.37*** (.12)
Variable (i) × Joint Decision-Making Dummy {= 1 for the J-P and J-S treatments; 0 otherwise}	----	.65** (.26)	----	.32* (.17)
Constant	7.42 (7.28)	2.76 (6.74)	3.38 (4.51)	2.93 (4.35)
# of Observations	448	448	448	448
Log likelihood	-743.0	-740.1	-1098.6	-1096.8
Wald Chi-squared	31.11	37.63	36.13	39.39
Prob > Wald Chi-squared	.0000	.0000	.0000	.0000

Notes: Random effects Tobit regressions. The number of left(right)-censored observations is 139(190) in columns (1) and (2), and 155(96) in columns (3) and (4).

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Not for Publication

Supplementary Online Appendix for Kamei, 2015,

"Power of Joint Decision-Making in a Finitely-Repeated Dilemma"

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Table of Contents

Appendix A: Instructions in the J-P treatment

The following are instructions for the J-P treatment.

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the $5 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. If you have a question, raise your hand. One of us will come to answer your question.

During the experiment, your earnings will be calculated in points. At the end of the experiment, points will be converted to U.S. dollars at the following rate:

1 point = 3.6 cents

(This means that around 27.8 points will be exchanged for 1 dollar of real money). At the end of the experiment your total earnings (including the $5 for participation) will be paid out to you in cash.

During the entire experiment, you are paired with a participant next to you. Your pair and another randomly assigned pair form a group. This means that you are in a group with 3 other participants. **You will be part of the same group throughout the entire experiment**. No one knows which other pair (other 2 participants) is in their group, and no one will be informed which other pair was in which group after the experiment.

This experiment has 15 periods. In each period, each pair will be given an **endowment of 40 points** and will make an allocation decision based on the endowment. We will first explain the nature of the interactions and will then describe how you make decision as a pair.

Your decision as a pair:

Each pair simultaneously decides how to use the endowment every period. There are 2 possibilities:

1. **You, as a pair, can allocate points to a group account.**
2. **You, as a pair, can allocate points to a private account.**

For this purpose, each pair will be asked to indicate the number of points they want to allocate to the group account. The remaining points (40 minus their allocation to the group account) will be automatically allocated to their private account. The earnings of your pair depend on the total number of points in the group account and the number of points in your pair's private account.

How to calculate your earnings:

The earnings of your pair from the private account are equal to the number of points your pair allocates to the private account. That is, **for each point your pair allocates to the private account your pair obtains 1 point as earnings**. For example, the earnings of your pair from the private account equal 3 points if it allocates 3 points to it. The points your pair allocates to your private account do not affect the earnings of the other pair.

The earnings of your pair from the group account equal the **sum** of points allocated to the group account by your pair and the other pair multiplied by 0.8. That is, **for each point your pair allocates to the group account, your pair and the other pair each get 0.8 points as earnings**. For example, if the sum of points in the group account is 20, then your earnings from the group account and the earnings of the other pair each equal to 16 (= 20 × .8) points.

In summary, your pair's earnings can be calculated with the following formula:

40 – (points your pair allocates to the group account) + 0.8 * (sum of points allocated by your pair and the other pair to the group account)

You and your partner in your pair each obtain **half** of the earnings that your pair obtains in this period.

Note that your pair receives 1 point as earnings for each point your pair allocates to the private account. If your pair instead allocates 1 extra point to the group account, the earnings of your pair from the group account increase by 0.8 * 1 = 0.8 points; and your pair's earnings from the private account decrease by 1 point. However, by allocating 1 extra point to the group account, the earnings of the other pair also increase by 0.8 points. Therefore, the total group earnings increase by 0.8 * 2 = 1.6 points. Note that your pair also obtains earnings from points allocated to the group account by the other pair in your group. You obtain 0.8 * 1 = 0.8 points for each point allocated to the group account by the other pair.

Example:

Suppose your pair allocates 15 points to the group account, and the other pair in your group allocates 20 points to it. In this case, the sum of points in the group account is 15 + 20 = 35 points. Therefore, each pair obtains earnings of 0.8 * 35 = 28.0 points from the group account.

The earnings of your pair in this case are: 40 – 15 + (28.0) = 53.0 points. You and your partner each obtain 53/2 = 26.5 points.

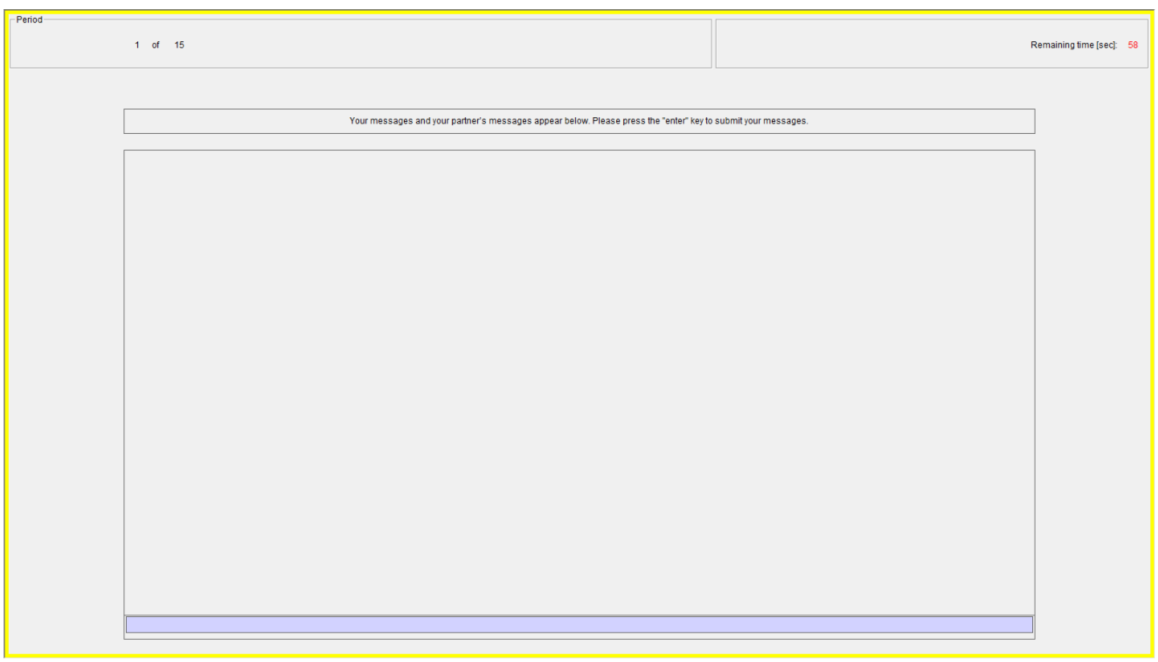
The other pair's earnings are: 40 – 20 + (28.0) = 48.0 points. Thus, each person in this pair obtains 48/2 = 24 points.

At the end of each period, you are informed of (1) the outcome of the allocation decisions along with (2) the information concerning the other pair's joint allocation amount.

How to decide allocation amounts in your pair:

At the beginning of each period, you and your partner in your pair have 1 minute to communicate using the computer to jointly decide the allocation amount for the period. Specifically, you can send any messages via a chat window as illustrated below. Although your partner sits next to you, you are not allowed to communicate during the entire experiment except this communication stage (via the computer screen).

An example of the computer screen:



In the communication stage, any kind of offensive language is prohibited. With a clear violation of this rule you will be deducted 10 dollars from your today's payment. Once the communication stage is over, you and your partner each submit your agreed joint allocation decision on your computer screen. In case that you do not agree what you allocate as a pair, you can submit whatever amount you prefer to allocate as a pair to your group account. If both you and your partner submit the same (agreed) amount, then the amount becomes your pair's joint allocation decision in this period. If you and your partner submit different amounts, then one of the two is randomly selected by the computer as your pair's joint allocation decision. Once both of you press the "OK" button to submit your pair's allocation decision, you will be informed of what allocation amount your partner submitted before you are informed of the outcome of the allocation stage in the period.

Summary:

At the onset of the experiment, you are paired with a person next to you. Your pair is randomly matched with another pair (2 individuals), forming a group of 4 individuals. The group assignment and your pairing do not change during the entire experiment; and you will play the following interactions 15 times with the 3 other participants. In each period,

(1) you and your partner in your pair communicate using a chat window to discuss how to allocate as a pair (you have one minute for this purpose);

(2) you and your partner in your pair each submit preferred (agreed) allocation amount of your pair. If you and your partner submit the same allocation amount, then the amount becomes your pair's joint allocation decision. If the allocation amount you submit is different from that your partner submits, then one of the two submitted allocation amounts is randomly selected by the computer. Once you and your partner submit your pair's allocation decision, you and your partner will be informed of what each of you submitted as your pair's joint decision.

(3) you will be informed of your pair's earnings in the period, along with the allocation decision of the other pair in your group. The earnings of your pair are dependent on (b) the number of points in your pair's private account and (b) the total allocation amounts to the group account by your pair and the other pair in your group. Your earnings in the present period are half of your pair's total earnings. See the equation on page 2 for how your pair's total earnings are calculated.

At the end of the experiment, you will be paid based on your accumulated earnings.

You may also be asked to answer some additional questions related to the experiment.

Please raise your hand if you have any questions. Once all questions have been answered, the experiment will begin.

Comprehension questions:

Please answer the following questions to check your understanding of the instructions. Please raise your hand if you have any questions.

1. Suppose that each of the 2 pairs in your group allocates 0 points to the group account.

a) How much does your pair earn? ___________________

b) How much do you earn? ___________________

c) How much does the other pair earn? ___________________

d) How much does each member in the other pair earn? ___________________

2. Suppose that each of the 2 pairs in your group allocates 20 points to the group account.

a) How much does your pair earn? ___________________

b) How much do you earn? ___________________

c) How much does the other pair earn? ___________________

d) How much does each member in the other pair earn? ___________________

3. Suppose that the other pair in your group allocates 20 points to the group account.

a) How much does your pair earn if your pair allocates 0 points to the group account? ______________
In this case, how much do you earn? ______________

b) How much does your pair earn if your pair allocates 20 points to the group account? ______________
In this case, how much do you earn? _____________

c) How much does your pair earn if your pair allocates 40 points to the group account? ______________
In this case, how much do you earn? _____________

Appendix B: Additional Tables

TABLE B.1: *Period-by-period Average Contribution by Treatment*

(1) Partner Treatments

Treatment name	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15
I. Avg. Contribution															
a. I-P	25.9	24.7	17.8	15.3	13.7	13.1	13.9	16.1	12.7	11.7	11.3	13.1	13.8	10.9	7.4
b. J-P	28.8	30.3	32.2	32.1	31.9	32.2	32.1	31.9	32.4	33.7	33.8	32.5	32.5	28.8	17.5
II. Avg. Hypothetical Contribution Elicited Before the Communication Stage															
c. J-P	28.2	33.3	32.3	30.9	29.9	27.9	28.8	29.8	28.3	29.2	30.2	28.9	28.8	25.0	20.0
III. Mann-Whitney Tests[#1]															
H_0: a = b *p*-value (2-sided)	.603	.245	.020**	.017**	.022**	.027**	.039**	.045**	.015**	.019**	.014**	.031**	.031**	.049**	.226
H_0: a = c *p*-value (2-sided)	.785	.091*	.008***	.023**	.030**	.042**	.061*	.069*	.048**	.032**	.021**	.076*	.053*	.125	.105

(2) Stranger Treatments

Treatment name	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15
I. Avg. Contribution															
a. I-S	17.5	18.1	16.1	16.3	15.0	11.6	11.6	12.8	13.6	12.3	14.0	11.4	5.3	6.5	5.9
b. J-S	30.9	30.0	28.4	25.3	26.9	23.8	25.4	25.9	22.6	22.0	15.9	17.1	10.0	6.8	8.2
II. Avg. Hypothetical Contribution Elicited Before the Communication Stage															
c. J-S	27.2	30.4	29.9	27.5	26.5	25.6	26.1	25.2	22.1	23.3	15.8	16.6	11.9	5.5	6.8
III. Mann-Whitney Tests[#1]															
H_0: a = b															
p-value (2-sided)	.008***	.020**	.073*	.154	.063*	.081*	.030**	.035**	.225	.140	.958	.751	1.000	.915	.825
H_0: a = c															
p-value (2-sided)	.044**	.018**	.045**	.066*	.045**	.027**	.031**	.074*	.188	.114	.916	.244	.205	.709	.913

Notes: Regression results measuring the average treatment effects of joint decision-making are found in TABLE 2 of the manuscript. [#1] 16 average pair contributions in the J-P (J-S) treatment and 16 individual contributions in the I-P (I-S) treatment were compared for period 1. As for periods 2 to 15, average group contributions were used for the tests as the individuals' or pairs' contribution decisions could be correlated within groups. The Mann-Whitney tests results in periods 2 to 15 for the stranger treatments (Panel (2)) can only be used as suggestive evidence because the subjects' decisions could be correlated within sessions.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE B.2: *Tests of the PAT and SCT in the Joint-Decision Treatments*

	J-P treatment		J-S treatment	
	Self-regarding pairs	Other regarding pairs	Self-regarding pairs	Other regarding pairs
The number of pairs	6	10	8	8
Average hypothetical contribution across all periods	15.9	36.5	15.0	27.7
Shifts after communication[#1]				
(a) The # of cases where $C_{pair_k,t} > \frac{1}{2}\sum_{i=1}^{2} C_{i,t}^{hypo}$ (other-regarding shift)[#2]	32	21	17	34
(b) The # of cases where $C_{pair_k,t} = \frac{1}{2}\sum_{i=1}^{2} C_{i,t}^{hypo}$[#2]	40	117	78	57
(c) The # of cases where $C_{pair_k,t} < \frac{1}{2}\sum_{i=1}^{2} C_{i,t}^{hypo}$ (self-regarding shift)[#2]	18	12	25	29
Average per-period shift from their hypothetical contribution amount[#3]	3.31	1.31	-.21	.083

Notes: We treat a pair as a self-regarding pair if the pair's average hypothetical contribution across all periods is less than the average hypothetical contribution in the session. We treat a pair as an other-regarding pair if the pair's average hypothetical contribution across all periods is greater than the average of hypothetical contributionss in the session. See Section III of the manuscript. [#1] Each subject made 15 decisions in the experiment. Thus, the sums of cases (a), (b) and (c) are 15 times the numbers of pairs in the corresponding columns. [#2] The right hand sides of the equations are the averages of pair *k*'s two members' pre-communication hypothetical contributions in period *t*. The left hand sides of the equations are pair *k*'s joint contribution in period *t*. [#3] Each number in this row equals the average of $\frac{1}{15 \cdot K}\sum_k \sum_{t=1}^{15}\left[C_{pair_k,t} - \frac{1}{2}\sum_{i=1}^{2} C_{i,t}^{hypo}\right]$, where *K* is the number of pairs in the corresponding column (which is 6, 10 or 8).

Remark: See TABLE 3 of the manuscript regarding how each person was affected by her partner within their pair.

Appendix C: Additional Data for the Subjects' Reasoning

All subjects were asked to answer the following open-ended question: "On what basis did you make allocation decisions?" They answered privately using their computer terminals (The following comments are exactly what they wrote. We did not edit their responses. Each comment is by different subject.)

1. Partner Treatments

[J-P Treatment:]

"Whatever would maximize my points"

"Conversation with my partner."

"Maximum outcome"

"maximal payoff"

"Tried to get all point in group until last 2 rounds"

"I made allocation decisions based on what was best for the entire group until round 14 when I thought that allocating 0 was the best decision because they might try to play a trick on us and not allocate anything to the group."

"What could get me and my partner the maximum payout."

"earning the most money for my partner and i"

"I gave the other pair a chance to work together and they accepted so we just kept giving 40 to the group account and it was mutually beneficial."

"The main driver behind my allocation decision was maintaining cooperation between our group and the group with which we were paired. Although we could have made more profits by allocating less money to the group account, and thus being less cooperative, this would have led to a breakdown of our cooperative relationship and made the outcomes of each period completely unpredictable, which i believe would have led to less profits in the long run."

"Trying to get the most number of points in the end of the experiment as possible."

"I feel pretty generous, but I was weary at first. After the fourth round I was comfortable with putting in all the points"

"if both groupgs contribute 40, we will each get the most points"

"What I expected others to do. eventually felt failed by the people in the room bidding 0."

"We made decisions through group compromise and through what we thought the other group was going to do."

"greatest possible earnings"

“I decided to earn as many points as possible; even though I know the fact that the other pair will earn much.”

“Getting max points for both pairs”

“random chance”

“We made decisions based on what the other groups did in the past. Initially I wanted to put 40 in the group and hoped that the other group would too so we could both make the most money. But that didn't happen, so we had to be conservative to avoid making less than 20 points. Which was disappointing because we both could have been better off.”

“My partner and I both decide together.”

“At first, I put in a small amount and waited to see what the other pair put before making future decisions. Since they put in 40, I increased the number of points I put in to 40 for the next two times, but they started putting 0 every time. After that, I mostly just put 0 every time because the other pair was not contributing to the group account.”

“Mathematically. Group outcome was higher if we all pooled in, and assumption that they would be smart enough to do the same.”

“I wanted to make the most amount of money.”

“Best outcome for the group leading to a larger expected outcome for everyone”

“We wanted stability between my pair and the other pair....largest group fund seemed like the best decision. Yes, American dollars with the group fund took a hit of 0.8 compared to personal points keeping their actual value but in the end, group account being highest seemed the best”

“I agreed early with my partner that we want the other pair to continue allocate high amounts between 30 and 40, so we allocate 35-40 points.”

“We first started with establishing a sense of trust, so the other team bid higher throughout the 15-round period. We knew that since we weren't randomly assigned, this would be key. so, we bid high, and continued to bid high once the other team did the same (they caught onto our plan quickly).”

“Well the first round was mainly to get a better idea of what the group was thinking, so we only gave 20. But then once we say that they did 40, we immediately decided to do the same.”

“based on the other pair's decision. if they are not selfish and contribute to the group account, I'd do the same too.”

“Based on my partners, and other pair's previouse decisions.”

“building trust, mirroring their actions, worried about last round good faith or psychopath leveraging”

[I-P treatment:]

“basis on the result”

“I accepted 20 points per round gladly and put all of my points into my private account and let my counterpart put money into the group account for me.”

“After completing the worksheet, I had a better understanding of how much I would earn depending on different allocations. I started using one of the higher risk, more beneficial strategies and allocated half of my points to the group. However, when I saw that others weren't reciprocating, I changed my allocations to 0.”

“Initially tried to allocate all of my points into group account, but when partner did not cooperate after ~5 rounds, I decided to allocate all my points to my private account”

“wanted to see what the other person decided and then attempted to match it”

“In the beginning, I wanted to allocated as many points to the group account for a mutual benefit”

“I tried to contribute to the group fund originally, but my partner wasn't contributing anything so I maximized my benefit by keeping all of my points”

“My intution”

“I based my decisions partly on my partner's decisions and the fact that I would get more points if my partner and I both allocated to the group account, but more points individually if i allocated all to my private account”

“On first it was kind of random, but towards the end there was a range that the allocations fell to and I just followed along with that.”

“what numbers that I tried produced the most amount of total earnings and I repeated those numbers”

“I made full allocations to group pool for first three rounds, when it became apparent that my partner was unwilling to do the same I withrew my allocations to the group pool on principal.”

“Solve the optimization problem - balance individual earnings with group earnings”

“what would maximize my earnings”

“Based on my trust that the other person would allocate all resources to group account.”

2. Stranger Treatments

[J-S Treatment:]

“Started off near the midpoint and adjusted from there based on how the rounds were going”

“partner”

“If both pairs gave 40 points to the group, each individual would maximize their total points.”

“We picked 40 and went with it”

“To generate the greatest level of earnings”

“40 was a mutual benefit to the most people and thus the best choice”

“The most is to be gained if everyone gives all, so we gave all.”

“Share the profits to start in order to gain trust, and then take it all when either everyone is trusting or everyone is doing the same thing you are.”

“previous interactions”

“jesus”

“$$$”

“at first trying to get people to play towards getting the best outcomes for both pairs. then once groups seemed to be playing for the good of the team, took advantage towards last few rounds to try to maximize our pair's gains.”

“discuss with pair partner”

“Came to agreement with partner.”

“PLAYING IT SAFE”

“Logic? It was the best decision to hold on to as many points as possibe”

“After pairing up with the first couple of teams, we noticed not many people were pushing for 40 in fear of losing points. So, we chose a decision lower every time.”

“I wanted to balance out making the most with giving some up to keep everyone from "going negative" very early on. I guess just undercut people a tiny bit while keeping overall contributions high.”

“Tried to comply with my paartner”

“luck”

“Me and my partner both started out with 15 so we agreed to put in 15 majority of the time.”

"based on what I thought others would do"

"tested the highs and lows, then decided it was more interesting to choose at random"

"Whatever my partner and I felt like doing is what we did. We agreed on basiclaly every round, until finally we decided to both enter random #s and let the computer choose!"

"Upon discussing with my partner and then get our compromise and also evaluating from the previous rounds."

"I wanted to try to get as close to a dollar earning each round without risking too much."

"My partner and I based our decisions on what the general trend of the group was."

"Based on pprevious rounds and the opinions of my partner"

"discussion with partner"

"I wanted to spread a generosity ethos."

[I-S treatment:]

"my earnings"

"At first I allocated 40 to the group account, but people were not allocating much to the group, so I started allocating 0 to the group and 40 to private account."

"Began with the best thing for both of us (allocating most or all), when I saw they weren't doing the same I moved to allocating nothing"

"I knew to get the optimal amount of points, both people would have to allocate 40 points to make it 80, which would give both os uf 32 points."

"Figuring out what would be the maximum for both persons"

"depending on previous round decisions"

"Based on previous results"

"I picked 0 every time."

"Based on former decision of my partner"

"To make the most money"

"I tried to see how the numbers were changing and tried to put values that wuld give me the biggest number."

"I went in a pattern. So I started at 20 and then went down in increments of 5 to zero and once I reached zero I started from 20 again but instead went up in increments of 5. I repeated this process until the experiment was finished."

“I wanted to maximize my points by putting 20 points in the group account expecting that the other person would also put 20 points. But when after a few rounds the other person started allocating 0 points I started allocating 0 points to te group account to assure myself at least 20 points in each round. I knew that both can get 32 points by putting 40 each in the group account but no one was really doing that so i stuck to putting 0 points to the group account”

“random and feeling”

“because the experiment was anonymous, there were no negative reprocussions for putting in 0 just about every time, whatever anybody else put into the group was simply my gain”

“Whether or not my last earning were high or low, if I should allocate more or less tot eh group account.”

Appendix D: The Additional Treatments – Instructions for the I-P-Punishment treatment

The following are instructions for the I-P-Punishment treatment.

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the $5 guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. If you have a question, raise your hand. One of us will come to answer your question.

During the experiment, your earnings will be calculated in points. At the end of the experiment, points will be converted to U.S. dollars at the following rate:

1 point = 3.6 cents

(This means that around 27.8 points will be exchanged for 1 dollar of real money). At the end of the experiment your total earnings (including the $5 for participation) will be paid out to you in cash.

In the experiment, all participants are randomly divided into **groups of 2 individuals**. This means that you are in a group with another participant. **You will be part of the same group throughout the entire experiment**. No one knows which participant is in their group, and no one will be informed who was in which group after the experiment.

This experiment has 15 periods. In each period, each group member, yourself included, will be given an **endowment of 40 points**. You will then make an allocation decision based on the endowment and reduction decision.

Your first decision:

You and your counterpart simultaneously decide how to use the endowment. There are 2 possibilities:

1. **You can allocate points to a group account.**
2. **You can allocate points to a private account.**

For this purpose, you will be asked to indicate the number of points you want to allocate to the group account. The remaining points (40 minus your allocation to the group account) will be automatically

[2] Instructions of the I-S-Punishment treatment are available from the author upon request.

allocated to your private account. Your earnings depend on the total number of points in the group account and the number of points in your private account.

How to calculate your earnings:

Your earnings from your private account are equal to the number of points you allocate to the private account multiplied by 0.5. That is, **for each point you allocate to the private account you get 0.5 points as earnings**. For example, your earnings from your private account equal 2 points if you allocate 4 points to it. The points you allocate to your private account do not affect the earnings of your counterpart.

Your earnings from the group account equal the **sum** of points allocated to the group account by you and your counterpart multiplied by 0.4. That is, **for each point you allocate to the group account you and your counterpart each obtain 0.4 points as earnings**. For example, if the sum of points in the group account is 20, then your earnings from the group account and your counterpart's earnings from the group account each equal to 8 (= 20 × .4) points.

Your earnings can be calculated with the following formula:

0.5 * {40 – (points you allocate to the group account)}

+ 0.4 * (sum of points allocated by you and your counterpart to the group account)

Note that you get 0.5 points as earnings for each point you allocate to your private account. If you instead allocate 1 extra point to the group account, your earnings from the group account increase by 0.4 * 1 = 0.4 points and your earnings from your private account decrease by 0.5 points. However, by allocating 1 extra point to the group account, the earnings of your counterpart also increase by 0.4 points. Therefore, the total group earnings increase by 0.4 * 2 = 0.8 points, which is greater than 0.5. Note that you also obtain earnings from points allocated to the group account by your counterpart. You obtain 0.4 * 1 = 0.4 points for each point allocated to the group account by your partner.

Example:

Suppose you allocate 15 points to the group account and your counterpart allocates 10 points to the group account. In this case, the sum of points in the group account is 15 + 10 = 25 points. Thus, each group member obtains earnings of 0.4 * 25 = 10.0 points from the group account.

Your earnings are: 0.5 * {40 – 15} + (10.0) = 22.5 points.

Your counterpart's earnings are: 0.5 * {40 – 10} + (10.0) = 25.0 points.

Your earnings might be reduced by the decisions of your counterpart in the next stage explained below.

Your second decisions:

Once everybody reviews the outcome of the allocation stage and clicks the "Continue" button, each member is given an opportunity to reduce their counterpart's earnings at their cost. Your earnings **decrease by 0.5 points** for each reduction point you assign to your counterpart; but, by doing so, **1.5 points will be deducted from the earnings of your counterpart**. Your earnings could also be reduced by your counterpart. For each reduction point you receive from your counterpart, your earnings will decrease by 1.5 points. If you don't want to reduce the earnings of your counterpart, you can assign 0 reductions points to him or her.

There are some restrictions for your reduction decisions in this stage. First, your reductions given to your counterpart cannot make their earnings in the present period less than zero. However, each member incurs the cost of giving reduction points to their partner. As a result, you may obtain negative earnings (see the formula of calculating your earnings below for details). If you receive negative earnings, these points will be deducted from your earnings in other periods. Second, your reduction points must be integers between 0 and 20. After this stage, your earnings are calculated as:

Part 1: Earnings from the allocation stage minus 1.5 × reductions given by your counterpart, or 0 if it is negative

-- minus --

Part 2: 0.5 * Reduction points you assign to reduce the earnings of your counterpart

Note that you incur the cost in Part 2 even if it causes your net earnings for the period to be negative.

At the end of each period, you are informed of (a) the number of reduction points you received from your counterpart along with (b) your final earnings in the period.

At the end of the experiment, you will be paid based on your accumulated earnings over the 15 periods.

Please raise your hand if you have any questions. Once all questions have been answered, the experiment will begin.

Comprehension questions:

Please answer the following questions to check your understanding of the instructions. Please raise your hand if you have any questions.

1. Suppose you and your counterpart allocate 0 points to the group account.

a) How many points do you have after the allocation stage? ____________________

b) How many points does your counterpart have after the allocation stage? ____________________

2. Suppose you and your counterpart allocate 20 points to the group account.

a) How many points do you have after the allocation stage? ____________________

b) How many points does your counterpart have after the allocation stage? ____________________

3. Suppose your counterpart allocates 20 points to the group account.

a) How many points do you have after the allocation stage if you allocate 0 points to the group account? _______________

b) How many points do you have after the allocation stage if you allocate 20 points to the group account? ______________

c) How many points do you have after the allocation stage if you allocate 40 points to the group account?

____

4. Answer the following questions.

a) How much does it cost you if you assign 4 reduction points to your counterpart? _____________

b) How many points are deducted from your counterpart's earnings if you assign 4 reduction points to her? _____________

Appendix E: The Additional Treatments – Basic Data (The I-P-Punishment and I-S-Punishment treatments)

TABLE E.1: Period-by-period Average Contributions

(1) Partner Treatments

Treatment name	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15
I. Avg. Contribution															
A. I-P	25.9	24.7	17.8	15.3	13.7	13.1	13.9	16.1	12.7	11.7	11.3	13.1	13.8	10.9	7.4
B. J-P	28.8	30.3	32.2	32.1	31.9	32.2	32.1	31.9	32.4	33.7	33.8	32.5	32.5	28.8	17.5
C. I-P-Pun -ishment	27.2	31.9	34.7	30.8	29.0	30.6	34.1	33.7	33.3	33.4	31.9	32.8	31.7	31.7	30.6
II. Mann-Whitney Tests															
H_0: A = C[#1]															
p-value (2-sided)	.784	.1429	.0028***	.0256**	.0628*	.0247**	.0103**	.0146**	.0183**	.0067***	.0150**	.0238**	.0395**	.0201**	.0057***
H_0: B = C[#2]															
p-value (2-sided)	.7409	.5873	.6365	.8388	.9167	.5661	.9141	.6766	.9103	.9101	.6757	.8576	.8109	.7782	.0858*

(2) Stranger Treatments

Treatment name	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15
I. Avg. Contribution															
A. I-S	17.5	18.1	16.1	16.3	15.0	11.6	11.6	12.8	13.6	12.3	14.0	11.4	5.3	6.5	5.9
B. J-S	30.9	30.0	28.4	25.3	26.9	23.8	25.4	25.9	22.6	22.0	15.9	17.1	10.0	6.8	8.2
C. I-S-Pun -ishment	20.1	20.0	19.2	18.7	20.8	19.6	20.3	23.3	21.4	24.6	23.4	20.9	25.4	23.9	19.1
II. Mann-Whitney Tests															
H_0: A = C[#1]															
p-value (2-sided)	.515	.8323	.3417	.4913	.3041	.0352**	.0449**	.0655*	.1138	.0307**	.0922*	.0345**	.0009***	.0015***	.0232**
H_0: B = C[#2]															
p-value (2-sided)	.0158**	.0558*	.0288**	.2194	.3019	.4349	.3263	.5966	.8441	.6778	.2527	.5885	.0121**	.0013**	.0560*

Notes: [#1] Individual contributions were compared between the I-P (I-S) and I-P-Punishment (I-S-Punishment) treatments for period 1. As for periods 2 to 15, group-level average contributions were compared between the two treatments. [#2] Pair average contributions in the J-P (J-S) treatment and individual contributions in the I-P-Punishment (I-S-Punishment) treatment were compared for period 1. Group-level average contributions were compared between the two treatments as for periods 2 to 15. The Mann-Whitney tests results in periods 2 to 15 for the stranger treatments (Panel (2)) can only be used as suggestive evidence because the subjects' decisions could be correlated within sessions.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE E.2: Period-by-period Average Payoffs

(1) Partner Treatments

Treatment name	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15
I. Avg. Contribution															
A. I-P	27.8	27.4	25.3	24.6	24.1	23.9	24.2	24.8	23.8	23.5	23.4	23.9	24.1	23.3	22.2
B. J-P	28.6	29.1	29.7	29.6	29.6	29.7	29.6	29.6	29.7	30.1	30.1	29.8	29.8	28.6	25.3
C. I-P-Pun -ishment	28.1	29.6	30.4	29.2	28.7	29.2	30.2	30.1	30.0	30.1	29.6	29.8	29.5	29.5	27.5
II. Mann-Whitney Tests															
H_0: A = C[#1]															
p-value (2-sided)	.945	.1429	.0028***	.0256**	.0628*	.0247**	.0103**	.0146**	.0183**	.0067***	.0150**	.0238**	.0395**	.0201**	.0108**
H_0: B = C[#2]															
p-value (2-sided)	.7536	.5873	.6365	.8388	.9167	.5661	.9141	.6766	.9103	.9101	.6757	.8576	.8109	.7782	.1188

(2) Stranger Treatments

Treatment name	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15
I. Avg. Contribution															
A. I-S	25.3	25.4	24.8	24.9	24.5	23.5	23.5	23.8	24.1	23.7	24.2	23.4	21.6	22.0	21.8
B. J-S	29.3	29.0	28.5	27.6	28.1	27.1	27.6	27.8	26.8	26.6	24.8	25.1	23.0	22.0	22.5
C. I-S-Pun -ishment	23.9	25.1	22.9	24.4	24.1	23.6	25.5	26.0	24.4	25.6	22.9	23.9	27.1	26.6	21.4
II. Mann-Whitney Tests															
H_0: A = C[#1]															
p-value (2-sided)	.494	.5982	.6728	.9578	.8715	.7520	.1394	.1553	.7518	.2691	.7926	.1706	.0016***	.0061***	.6330
H_0: B = C[#2]															
p-value (2-sided)	.0321**	.0346**	.0200**	.0917*	.1843	.1709	.2926	.3424	.5280	.6337	.9162	.9580	.0353**	.0061**	.7087

Notes: [#1] Individual contributions were compared between the I-P (I-S) and I-P-Punishment (I-S-Punishment) treatments for period 1. As for periods 2 to 15, group-level average contributions were compared between the two treatments. [#2] Pair average contributions in the J-P (J-S) treatment and individual contributions in the I-P-Punishment (I-S-Punishment) treatment were compared for period 1. Group-level average contributions were compared between the two treatments as for periods 2 to 15. The Mann-Whitney tests results in periods 2 to 15 for the stranger treatments (Panel (2)) can only be used as suggestive evidence because the subjects' decisions could be correlated within sessions.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.