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, and then compare the pairs' behaviour with the behaviour of individuals in the same game played against individuals. We vary treatments by the matching protocol between decision-making units (partner or stranger matching). Our data show that when the matching is fixed for all periods, pairs are able to sustain cooperation at high levels while individuals steadily decrease contributions from period to period. By sharp contrast, when pairs are randomly matched with other pairs in every period, they quickly decrease contributions over the periods, as is the case for individuals with the stranger matching protocol.

JEL classifications: C73, C92, D70

1. Introduction

One of the most frequently 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 behaviours. On one hand, the literature suggests that some individuals attempt to cooperate even in one-shot dilemma games, or in earlier periods of finitely repeated dilemma games when they make cooperation decisions individually (e.g. Ledyard, 1995; Chaudhuri, 2011). But on the other hand, we may need some institutions to sustain cooperation as cooperation usually declines gradually over time. 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, 2002), nonmonetary punishment (e.g. Masclet *et al.*, 2003), sorting (e.g. Gunnthorsdottir *et al.*, 2007) and endogenous group formation (e.g. Page *et al.*, 2005). However, most of these studies are conducted using individuals as the decision-making unit. Cooperation decisions are often made by pairs in reality. Examples where a pair of individuals makes a single decision either to act cooperatively or selfishly are readily available in our everyday lives. 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 jointly 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 through communication − 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?

This paper experimentally addresses the above research questions by using a finitely-repeated two-player dilemma game under two matching protocols: (1) partner matching between two pairs and (2) stranger matching within a community.[1] Both matching protocols are prevalent in the real world. Imagine, for example, that two couples are living in a duplex (semi-detached) property. Their interactions with each other would last for some time. Also, imagine another situation where a pair lives in a house in an area where community events are occasionally held. They would meet with other pairs rather randomly when the pair participates in some events.

Action choices of pairs who make joint decisions through communication are known to be different from those of individuals (see, e.g., Charness and Sutter [2012] for a survey). 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 a desire to be respected from their team members. The literature, however, does not provide a clear prediction in the context of repeated dilemma games. Studies related to finding (a) imply that pairs may behave more in line with what the standard game theory predicts because the joint-decision format strengthens people's game theoretic reasoning. This kind of team behaviour has been seen, for example, in beauty contest games (Kocher and Sutter, 2005), ultimatum games (Robert and Carnevale, 1997; Bornstein and Yaniv, 1998), centipede games (Bornstein *et al.*, 2004), and trust games (Kugler *et al.*, 2013). In contrast, literature related to finding (c) implies that pairs may be more likely than individuals to build a cooperative relationship with others unlike the standard game theoretic prediction. Evidence that supports this idea has been seen in common-pool resource problems (Gillet *et al.*, 2009), Stackelberg market games (Müller and Tan, 2013) and weakest-link games and average-opinion games (Feri *et al.*, 2010).

Our experiment uses a framework of a finitely-repeated, two-player public goods game. However, we acknowledge that some real-world interactions can be described as infinitely-repeated interactions. We use a finitely-repeated setup because economic theory provides a clearer prediction when games are played finitely. Each group contains two decision-making units that simultaneously decide how many points to allocate to the group account. It is privately optimal for each decision-making unit to contribute nothing to the group account.

[1] Each decision-making unit is matched with the same decision-making unit for all rounds in the partner matching protocol. By contrast, each decision-making unit is randomly matched with another decision-making unit in every round in the stranger matching protocol.

Two joint-decision treatments and two individual-decision treatments are designed. We employ a joint decision-making format where social distance within pairs is small. The reason for the close social distance is that most decisions made by firms or by households are made in teams; and when these decisions are made, the decision-makers know who their team members are (but they may not know the teams they are dealing with in person). In the two joint-decision treatments, two persons in a pair sit next to each other in a laboratory. The pairing is fixed during the entire experiment. 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 jointly decides how many points to contribute through communication. The two control treatments are designed so that they are comparable to the corresponding joint-decision treatments. In the control treatments, each subject is given an endowment and then simultaneously decides a contribution amount in every period, under either the partner or stranger matching.

Our experiment shows that regardless of the matching protocol, pairs behave significantly more cooperatively than individuals. However, the pairs' contribution dynamics differ substantially by matching protocol. Under the partner matching procedure, most pairs establish long-sustained, highly cooperative relationships with their matched pairs until the last few periods of the game. This is in clear contrast with the pairs' behaviour under the stranger matching procedure in which pairs decrease contribution amounts quickly over the periods. In the control treatments, where the decision-making units are individuals, individuals' contribution amounts quickly decline over the periods irrespective of the matching protocol.

Our joint decision-making format has two aspects: (i) each individual in a pair is aware of his partner's identity and (ii) two individuals communicate with each other to agree on joint contribution amounts. In order to separate the impact of aspect (i) from that of aspect (ii), we conducted two additional treatments, whose structure is identical to that of the original joint-decision treatments except that aspect (i) is removed. In these two treatments, pairs are randomly and anonymously formed as decision-making units. Two clear results were found. First and more importantly, the data indicate a larger difference in pairs' reputation building behaviour between the two matching protocols when subjects are not informed of who their pair partners are. When the partner matching protocol is used, pairs are able to sustain cooperative relationships at high levels with their matched pairs. However, under the stranger matching protocol, the level of pairs' cooperation becomes even lower than that of individuals' in the corresponding individual-decision treatment. These results suggest that the long-lasting cooperative relationship seen with the joint decision-making process under the partner matching is driven by aspect (ii). Second, we also find that regardless of the matching protocol, the levels of pairs' contribution amounts become lower once the anonymity is preserved within pairs. This underscores potential importance of close social distance within pairs on boosting cooperation.

The main contributions of this paper are two-fold. First, this paper contributes to a large body of literature on dilemma games and on team decision-making by providing evidence that pairs may be forward-looking and attempt to build good reputations when pair members decide on joint contribution amounts through communication in a public goods game. This finding is consistent with the ideas that (1) teams are more competent than individuals in resolving coordination failure or dilemmas as has been shown in another context (Feri *et al.,* 2010; Gillet *et al.*, 2009; Müller and Tan, 2013) and (2) teams are less myopic loss averse than individuals (Sutter, 2007, 2009; Bougheas *et al.*, 2013). Second, we further disentangle the impact of communication and that of close social distance within pairs in a repeated dilemma situation.

The rest of the paper proceeds as follows: Section 2 describes our experimental design. Section 3 provides related literature and hypotheses. Section 4 reports results, and Section 5 concludes.

2. Experimental Design

The experiment is built on a two-player linear public goods game.[2] We set up two sets of two treatments. Each set consists of one joint-decision treatment and one individual-decision treatment. The first set uses a partner matching protocol while the second set uses a stranger matching protocol (TABLE 1). In the joint-decision treatments, two individuals act as a decision-making unit, which we refer to as a 'pair.' Two two-person pairs are grouped and interact with each other. We denote this set of two pairs 'group.' In the individual-decision treatments, a group consists of two individuals that make decisions individually. The number of interactions is 15 in all of the treatments.

2.1. Joint-Decision Treatments

[2] This framework is chosen because subjects have more flexibility in selecting the degree of cooperation in the public goods game than a prisoner's dilemma game.

The joint-decision treatments are named as the 'Joint Decision, Partner' (J-P) and 'Joint Decision, Stranger' (J-S) treatments. In these treatments, each subject is randomly paired with another subject at the beginning of the experiment. The pairing is fixed throughout the entire experiment. They are then informed of the identity of their matched partners and sit next to each other.[3] In the J-P treatment, 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 for the full set of periods. In contrast, in the J-S treatment, each pair is randomly matched with another pair in every period.

In the J-P and J-S treatments, each pair is endowed with 40 points and decides how many points to allocate to the group account in every period. Only non-negative integers are allowed for their contribution amounts. While a pair obtains one point for each point the pair allocates to their private account, the pair and the matched pair each obtain 0.8 points for each point the pair allocates to their group account. The payoff of pair *i* in period *t* is expressed as:

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

where *j* is pair *i*'s matched pair in period *t* and $C_{i,t}$ is the contribution amount of pair *i* in period *t* . Each member $k \in \{1, 2\}$ in pair *i* obtains half of $\pi_{i,t}$ as his/her period *t* payoff:

$$\pi_{i,t}^{k} = \pi_{i,t}/2 = 0.5 \cdot (40 - C_{i,t}) + 0.4 \cdot (C_{i,t} + C_{j,t}). \tag{1'}$$

The joint decision-making procedure 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. This ensures that the content of communication within pairs is their private information. Note that there is no communication across the pairs in this stage. Once the communication stage is over, each individual privately and simultaneously submits an amount they wish to contribute. If a subject and his partner in the pair submit the same amount, then the amount becomes the pair's joint contribution amount for this period. If the subject and

[3] Each subject drew a slip of paper with a seat number and sat at the seat with the number indicated on the paper. Two subjects that were seated next to each other formed a pair. No communication was permitted during this pairing process.

his partner submit different amounts, then one of the two amounts will be selected randomly.[4] Subjects will be informed of what amount their pair partners submitted before being informed of their interaction outcome in each period.

We elicit hypothetical contribution amounts the subjects prefer to contribute as pairs before entering the communication stage in each period. Specifically, subjects answer what amount they would choose if they could decide their pair's allocation amounts unilaterally without communicating with their partners (assuming the payoff would be split in half as in Eq. (1')). This elicitation task is not incentivised.[5]

2.2. Individual-Decision Treatments

We set up an individual-decision treatment to correspond to each joint-decision treatment. In the 'Individual Decisions, Partner' (I-P) and 'Individual Decisions, Stranger' (I-S) treatments, subjects play the same two-player public goods games 15 rounds. Subjects are each endowed with 40 points in each period, and then simultaneously decide contribution amounts to the group account. Their contribution amounts must be non-negative integers. 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. Specifically, 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 the group account.[6] The marginal per capita return (MPCR) is thus 0.8 in all the four treatments. In short, the payoff of subject *k* in period *t* is expressed as:

[4] This rule was applied to a small number of the pairs in the experiment. In 24 (32) of 240 joint decisions in the J-P (J-S) treatment, subjects in pairs submitted different amounts. The data indicate that only nine (four) cases in the J-P (J-S) treatment were due to clear disagreements. The remaining cases were due to one of the following three reasons. First, some pairs intentionally submitted different amounts (gaming). Second, some pairs agreed on what they would jointly contribute, but two members submitted different amounts. Lastly, some pairs did not make enough communication as to what to allocate (e.g., chatting about unrelated topics).

[5] This questionnaire is included only on the subjects' computer screen to avoid making this task salient. An alternative to eliciting hypothetical contributions could be to make the pre-communication question incentive-compatible by letting the same individuals make individual decisions and decisions in pairs in an alternate order. We did not employ this method primarily because this makes the design more complex, but also because our focus is on the pairs' action choices.

[6] Another possible design may be one where each subject is endowed with 20 points, is matched with another subject, and then simultaneously makes contribution decision with the same MPCR in each period. We did not employ this design because it would not be perfectly comparable to the joint-decision treatments where the endowment is 40 points and each subject in a pair receives half of the pair's payoff (see Eq. (1')).

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

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

where subject *l* is *k*'s matched individual in period *t* and $c_{k,t}$ is the contribution amount of subject *k* in period *t*. The I-P and I-S treatments use the partner matching and stranger matching protocols, respectively. The matching process is identical to the corresponding joint-decision treatments.

3. Related Literatures and Hypotheses

Predictions based on standard theory are straightforward. Contributing nothing to the group account is a strictly dominant strategy for each individual/pair. Thus, full free riding is the unique Nash Equilibrium in each treatment ($C_{i,t} = 0$ for all *i* and *t* for the joint-decision treatments; $c_{k,t} = 0$ for all *k* and *t* for the individual-decision treatments).

As mentioned in Section 1, however, established evidence from prior finitely-repeated dilemma game experiments suggests that some individuals may attempt to cooperate in earlier periods. But their contributions amounts would decline steadily towards the end of the experiment when subjects individually make allocation decisions in our environment. This contribution dynamic can be rationalised if we assume that some subjects have other-regarding preferences or they believe that some subjects do so (Kreps *et al.*, 1982).

The contribution behaviour of pairs can be different from that of individuals, however. 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 (e.g. Charness and Sutter, 2012). In this sense, there are two possible opposing hypotheses. On one hand, pairs may behave more in line with what standard theory predicts if joint decision-making strengthens subjects' game theoretic reasoning. There is prior experimental evidence that suggests this possibility. For instance, Maciejovsky *et al.* (2013) let four two-person pairs trade cards in the Monty Hall problems in a double auction format. They find that pairs trade cards at prices closer to the rational level than individuals. Robert and Carnevale (1997) find that two-person proposer pairs offer less than proposer individuals in ultimatum games. In repeated beauty-contest games, Kocher and Sutter (2005) let three-person teams play against four other teams and find that teams learn to submit lower numbers more quickly than individuals do when they repeat the games.[7] In centipede games, Bornstein *et al.* (2004) find that three-person teams exit the games significantly earlier than individuals. Kugler *et al.* (2013) compare three-person teams with individuals in a two-player trust game, finding that teams send significantly less than individuals do. Lastly, Sutter *et al.* (2013) let three-person teams play 18 different one-shot normal-form games against randomly changed counterparts. His finding is that teams are more likely than individuals to choose Nash strategies.

Our study is also related to experiments that compare teams and individuals in auctions and contests. The literature suggests that when people make decisions in teams, they become more competitive and aggressive (e.g. Cason *et al.*, 2013; Sutter *et al*., 2009).

Based on these past studies, we could hypothesise that the level of cooperation would decline more quickly in the J-P (J-S) than in the I-P (I-S) treatment.

Hypothesis 1: *The levels of contributions are lower and decline more quickly over the periods in the J-P (J-S) than in the I-P (I-S) treatment.*

On the other hand, letting subjects make decisions jointly may contribute to sustaining cooperation, due to our 'repeated' setup. If pairs believe that not all subjects are selfish, then they may consider that free-riding in earlier periods is not beneficial if they want to maximise their total payoff across the 15 periods (Kreps *et al.*, 1982). Studies that show the possibility of teams' strategic reputation building, to our knowledge, all use teams whose size is more than two except Kagel and McGee (2016). First, in weakest-link games and average-opinion games with the partner matching protocol, Feri *et al.* (2010) find that three-person teams are more likely than individuals to choose a mutually beneficial, Pareto-efficient equilibrium. In our study, although mutual cooperation is not an equilibrium for the material payoff, pairs may be able to achieve a higher level of cooperation than individuals if pairs realise that cooperative relationships could be collapsed if they discourage the counterparts from cooperating by own free-riding. There is also some experimental evidence which shows that teams may have abilities to even resolve dilemmas. For instance, in repeated common pool resource problems, Gillet *et al.* (2009) find that three-person teams make decisions in a less myopic manner than individuals when the teams make joint decisions via unanimity rule. Kagel and McGee (2016) compare two-person pairs and

[7] We note that Sutter (2005) show that this strategic behavior of teams may vanish if team size is two.

individuals by letting the subjects play multiple supergames (finitely-repeated prisoner's dilemma games). They find that although pairs behave more selfishly than individuals in the first supergame, the pairs learn more quickly than individuals to cooperate from supergame to supergame, and consequently pairs cooperate significantly more than individual players in the later supergames.[8] Müller and Tan (2013) let three-person teams play a Stackelberg market game against other teams 15 times. Their finding is that teams are more likely than individuals to establish dynamic collusion.

These past experiments in repeated coordination games and dilemma games lead to the following alternative hypothesis:

Hypothesis 2: *The levels of contributions are higher and are more sustained in the J-P (J-S) than in the I-P (I-S) treatment.*

Note that even if Hypothesis 2 holds, pairs may attempt to severely milk their established relationships near the end period if they are primarily strategically motivated.

If Hypothesis 2 is correct, then we could expect that building a trustful relationship would be more easily achieved in the J-P than in the J-S treatment. While each pair interacts repeatedly with the same pair in the J-P treatment, each pair in the J-S treatment meets with a specific pair in two consecutive periods with a probability of only 14.3%. The difference in the re-matching probability could impact the timing of end-game defection. With the smaller re-matching probability, pairs in the J-S treatment have higher incentives to defect than pairs in the J-P treatment.

Hypothesis 3: *Contributions are more sustained at high levels in the J-P than in the J-S treatment.*

Lastly, we note that our paper is related to prior experimental work that compares teams and individuals in a non-strategic risky environment. This is because contributing to the group account involves a risk: a pair incurs a loss if the pair contributes a large amount but their counterpart does not reciprocate. The literature provides conflicting evidence that supports both Hypotheses 1 and 2. On one hand, some studies have shown that teams tend to exhibit less

[8] We cannot derive a hypothesis directly from Kagel and McGee (2016), as pairs play only one finitely-repeated game in our study.

myopic loss aversion than individuals in a risky situation (e.g. Sutter, 2007; Sutter, 2009; Bougheas *et al.*, 2013). If this is applicable to our experiment, pairs may be more willing than individuals to take risks in investing in encouraging their matched pairs to cooperate via own high contributions. On the other hand, some studies have shown that pairs are more risk averse than individuals (e.g. Masclet *et al.*, 2009; He *et al.*, 2012).

Shupp and Williams (2008) study conditions under which teams are more or less risk averse, finding that it may depend on the winning probabilities of lotteries. They find that three-person teams are more risk averse than individuals with lotteries whose winning probabilities are low but are less risk averse with lotteries whose winning probabilities are high. This finding supports Hypothesis 3.

4. Results

Two sessions per treatment were conducted at the University of Michigan. A total of 194 subjects participated in the experiment.[9] No subject participated in more than one session. The experiment, except instructions, was programmed in the z-Tree software (Fischbacher, 2007). All instructions were neutrally framed (see Appendix A). Subjects were asked to answer control questions to confirm their understanding of the experiment.

4.1. The Impact of Joint Decision-Making

We first compare the average contributions between the J-P (J-S) and I-P (I-S) treatments.[10] First, both the levels and the trends of average contributions substantially differ between the I-P and J-P treatments (FIGURE 1(a)). The average contributions in the J-P treatment begin at around 70% of the endowment, 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). The end-game effect suggests that the high level of contributions in the J-P treatment could stem from the pairs' strategic motives. By sharp contrast, in the I-P treatment, the average contributions decline steadily over the periods. According to Mann-Whitney tests,

[9] 98 out of the 194 subjects participated in the additional treatments. Solicitation messages were sent via ORSEE (Greiner, 2015) to all eligible potential subjects. The average payoff (except the show-up fee) was $14.14.
[10] Average per-subject payoffs in the joint-decision (individual-decision) treatments are linear transformations of average contributions based on Eq.(1') (Eq.(2)).

the differences in the average contribution between the J-P and I-P treatments are significant at the 5% level in all periods except periods 1, 2 and 15 (Panel II(a), Appendix TABLE B.1). The clear difference between individuals and pairs resonate with the idea that pairs are less myopic loss averse than individuals (e.g. Sutter, 2007, 2009; Bougheas *et al.*, 2013).

Result 1: *Average contributions stay 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 cooperation are different between the J-S and I-S treatments as well (FIGURE 1(b)). However, average contributions are in a strong declining trend in the J-S treatment. Consequently, the average contributions are often significantly higher in the J-S than in the I-S treatment in the first eight periods, but not in later periods (Panel II(b), Appendix TABLE B.1).

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

Feri *et al.* (2010) show that teams are more likely than individuals to overcome coordination failure in repeated *coordination games*. Results 1 and 2 suggest that their finding can extend to an environment where *dilemma games* are finitely repeated.

We note that Results 1 and 2 contrast pairs' contribution dynamics between the two matching protocols. Initial contributions made by pairs were very high irrespective of the matching protocol, but they maintained the high levels of contributions only with the partner matching protocol. Consequently, the differences in the level of contributions between the J-P and J-S treatments became larger and larger over the periods: they become statistically significant from periods 11 through 14 (Panel II(c) of Appendix TABLE B.1). This behavioural pattern was not observed for the I-P and I-S treatments. Individual players steadily decreased cooperation over the periods in both of the individual-decision treatments. These results are consistent with Shupp and Williams (2008) because in our study, contributing a large amount is less risky under the partner matching than under the stranger matching since each pair stays with a specific pair throughout the experiment in the former matching protocol.

4.2. Effectiveness of Joint Decision-Making when Social Distance is Large

Our joint decision-making format has two different aspects from the corresponding individual-decision treatments: (i) each subject knows the identity of their pair partner, and (ii) two persons in a pair communicate with each other to jointly make decisions in every period. Which aspect drives Results 1 and 2? If aspect (i) drives these results, then once the close social distance within pairs is removed, the strength of pairs' contribution behaviour may become similar to or even be less than that of individuals' contribution behaviour.

There are two possible effects that aspect (i) have. First, aspect (i) may affect pairs' cooperative attitudes due to social effects. The literature suggests that close social distance may strengthen people's pro-social behaviour. For instance, in a study where they conducted two field experiments to investigate the effects of having peers, Babcock *et al.* (2015) confirm that a team-based compensation system makes people work harder. Since each person is aware of the identity of their pair partner and the joint decision-making format in our study renders one's decision inevitably relevant to her pair partner's payoff, similar social effects can be expected also in our environment.

Second, communication may shift the pairs' cooperative attitudes upward thanks to aspect (i) through what psychologists call group polarisation, as has been shown in non-strategic environments (e.g. Cason and Mui, 1997; Luhan *et al.*, 2009). Group polarisation refers to the tendency 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). Prior research suggests a possible positive interaction effect between close social distance and communication. The two-person pairs in the dictator game in Cason and Mui (1997), where individuals are aware of the identity of each other within pairs, sent money significantly more than individuals. By contrast, in Luhan *et al.* (2009), where each individual was not informed of each team member's identity, three-person teams made more selfish choices. The effect of close social distance was also reported in gift-exchange games (e.g. Kocher and Sutter, 2007).

In order to disentangle the impact of aspect (i) and that of aspect (ii), we conducted two additional treatments: the 'Joint Decision, Partner, Anonymous' (J-P Anonymous) and 'Joint Decision, Stranger, Anonymous' (J-S Anonymous) treatments. The J-P Anonymous and J-S Anonymous treatments are identical to the J-P and J-S treatments, respectively, except that each subject is not informed of the identity of their partner (see the instructions in Appendix A). Specifically, each subject was anonymously matched with another subject in a session, forming a pair. In the additional treatments, subjects did not know at which seat their partners sat in a room. They were instructed that they were not allowed to give their partner any information that could identify themselves.[11]

The additional data indicate that although pairs' level of contribution decreases 16.6% on average (TABLE 1), pairs' contribution dynamics in the J-P Anonymous treatment are similar to those in the J-P treatment (FIGURE 2(a)). The average contributions in the J-P Anonymous treatment begin at a little above 60% of the endowment, and gradually increase until period 11. Although the levels of average contributions are slightly lower in the J-P Anonymous than in the J-P treatment, the average contributions are still often significantly higher than those in the I-P treatment (Panel II(a), Appendix Table B.1). This suggests that aspect (ii) – the joint decision-making through communication – drove Result 1.

Pairs' contribution behaviours drastically change under the stranger matching protocol once aspect (i) is removed. As shown in FIGURE 2(b), the average contributions in the J-S Anonymous treatment are slightly lower than even those in the I-S treatment. As a result, the levels of average contributions are significantly lower in the J-S Anonymous than in the J-S treatment from period 1 through 10 (Panel II(b), Appendix Table B.1). This suggests that the pairs' strong cooperation behaviour observed in the J-S treatment was driven by aspect (i) – close social distance.

Result 3: *Pairs' strong contribution behaviour is well sustained in the J-P Anonymous treatment as seen in the J-P treatment. The strong contribution behaviour seen in the earlier periods of the J-S treatment is not observed in the J-S Anonymous treatment.*

We also conducted a regression analysis to formally study the treatment effect of aspect (i) and that of aspect (ii) on pairs' contribution behaviours. For this purpose, independent variables include (a) the Joint Decision-Making dummy and (b) the Close Social Distance dummy. Our estimation method is an ordered logit regression model. We selected this method because it permits us to include both individual random effects and session clustering. As shown

[11] No subjects violated this rule in the experiment.

in TABLE 2, we confirm Results 1–3. First, the Joint Decision-Making dummy obtains significantly positive coefficients under the partner matching protocol, but it fails to do so under the stranger matching protocol. Second, the Close Social Distance dummy obtains significantly (weakly significantly) positive coefficients under the partner (stranger) matching protocol.[12]

4.3. Pairs' Pre-communication Willingness to Contribute

The impact of the communication process and that of close social distance can be further explored using hypothetical contribution amounts elicited from subjects.

4.3.1. Pre-communication Willingness to Contribute and Social Distance

We analyse the impact of close social distance by comparing period 1 hypothetical contribution amounts between the J-P and J-P Anonymous treatments, and likewise between the J-S and J-S Anonymous treatments. The only difference between the J-P (J-S) and J-P Anonymous (J-S Anonymous) treatments is whether subjects are aware of the identity of their pair partners. The period 1 hypothetical contribution amounts are the subjects' willingness to contribute as pairs before entering the first communication stage. Thus, these are the ones not affected by partners' preferences the subjects would learn through communication.

As shown in Appendix TABLE B.3, the data indicate that the average period 1 hypothetical contribution amount is significantly larger in the J-S than in the J-S Anonymous treatment (see FIGURES 1(b) and 2(b) also). This suggests a clear impact of having close social distance on pair members' cooperative attitudes. The period 1 pre-communication willingness to contribute is also larger in the J-P than in the J-P Anonymous treatment (FIGURES 1(a) and 2(a)) although the difference is not significant (p-value = .1156, two-sided). A likely reason for the lack of significance under the partner matching is that subjects already exhibited relatively high willingness to contribute even in the J-P Anonymous treatment (23.8 points). The 23.8 points is significantly larger than the average hypothetical contribution in the J-S Anonymous treatment (16.8 points) with two-sided p-value of $.0238 < .05$. This difference between the J-P

[12] An alternative estimation model is a tobit regression model. We performed random effect tobit regressions as a robustness check, finding that the effect of joint decision-making on enhancing cooperation is robust (Appendix Table B.2).

Anonymous and J-S Anonymous treatments can be interpreted as subjects' strategic motives to build cooperative reputations with partner matching.

Result 4: *The average period 1 pre-communication willingness to contribute is significantly higher (insignificantly higher) in the J-S (J-P) than in the J-S Anonymous (J-P Anonymous) treatment. It is significantly higher in the J-P Anonymous than in the J-S Anonymous treatment.*

4.3.2. The Impact of Communication

We discussed that a likely factor that helps sustain pairs' strong willingness to contribute under the partner matching is the impact of communication (Section 4.2). In this subsection, we explore the impact of communication in more depth by classifying each pair as 'self-regarding' or 'other-regarding' following Cason and Mui (1997). Specifically, we classify a pair as self-regarding if the average of the pair's 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* refers to each person in a pair) is less than the session average of $\bar{C}_{pair}^{hypo}$. Likewise, we classify a pair as other-regarding if $\bar{C}_{pair}^{hypo}$ is greater than the session average of it.

Out of 16 pairs in the J-P, J-P Anonymous, J-S and J-S Anonymous treatments, six, eight, seven and eight pairs, respectively, were classified as self-regarding; ten, eight, nine and eight pairs, respectively, were classified as other-regarding. As shown in Appendix TABLE B.4, our data suggest that in both the J-P and J-P Anonymous treatments, both self-regarding and other-regarding pairs on average shifted pair contribution amounts upward through communication. By clear contrast, under the stranger matching protocol, both kinds of pairs in the J-S Anonymous treatment and self-regarding pairs in the J-S treatment on average shifted joint contribution amounts downward through communication.

To investigate how much each individual shifted their willingness to contribute, we also conducted a regression in which the dependent variable is the contribution amount that subject *i* submitted after communication in period *t* (which we denote as $C_{i,t}$) minus the hypothetical contribution amount that subject *i* submitted before communication (which we denote as $C_{i,t}^{hypo}$), for each of the self-regarding and other-regarding pairs.[13] Independent variables include (a) the positive deviation of hypothetical contributions within pairs in period t (= $max\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}$) and (b) the negative deviation of hypothetical contributions within pairs in period t (= $min\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}$). As shown in TABLE 3, our data show that, regardless of whether a pair is self-regarding or other-regarding, the subjects who had more selfish preferences than their pair partners are more likely to raise their willingness to contribute after communication (see variable (a)). It also shows that the pair partners who had more pro-social preferences than their partners are more likely to reduce their willingness to contribute after communication (see variable (b)). The mean reverting phenomenon might mean that people do not hold firm attitudes (e.g. Sunstein, 2007). Nevertheless, its overall patterns are contrasted between the matching protocols. On one hand, the former positive effects on the less cooperative are larger than the latter negative effects under the partner matching protocol, except for the self-regarding pairs in the J-P Anonymous treatment. This suggests that communication helps shift pairs' cooperative attitudes upward with partner matching.[14] On the other hand, under the stranger matching protocol, the latter negative effects are much larger than the former positive effects, except for the other-regarding pairs in the J-S treatment, which leads to a downward shift in pairs' contributions. These results are consistent with our aggregate results shown in Results 1–3.[15]

Result 5: *The subjects who had lower (higher) pre-communication willingness to contribute than their pair partners raise (decrease) their willingness to contribute after communication. Communication shifts pairs' willingness to contribute upward or sustains it at higher levels under the partner matching protocol. Oppositely it shifts pairs' willingness to contribute downward under the stranger matching protocol.*

[13] Recall that subjects in the joint-decision treatments each submit their (agreed) pair contribution privately after communication.

[14] Results in TABLE 3 can be attributed to the effects of communication and/or those of pairs' experiences in the past periods. To investigate the pure impact of communication, we also conducted the same regressions by using data only from period 1, although the analysis is suggestive only due to small sample size. We find that the overall patterns of coefficient estimates in the J-P and J-P Anonymous treatments are similar to those in TABLE 3(I).

[15] We also estimated random effect tobit regressions for the same specifications as a robustness check, similarly finding that strong positive effects on the less cooperative drives Results 1 and 3 under the partner matching protocol (Table B.5).

4.4. Reciprocation to Counterparts' Last-Period Cooperative Actions

Another possible factor that may also account for the high efficiency of the joint decision-making format under the partner matching is that pairs reciprocate their matched pairs' willingness to contribute more strongly. To investigate the degree of the pairs' (individuals') reciprocation for cooperation behaviour by their matched pairs (individuals), we estimated the degree of partial correlations between own contribution amounts in period t and their period $t-1$ counterparts' contribution amounts in period $t-1$ using a regression method. As shown in TABLE 4, regardless of the treatment condition, both pairs and individuals exhibit significantly positive conditional contribution behaviours. However, the strength of the conditional willingness to contribute differs by the decision-making process: regardless of the matching protocol, pairs exhibit stronger conditional willingness to contribute than individuals in the individual-decision treatments.[16] However, despite the pairs' strong conditional behaviours, the pairs in the J-S and J-S Anonymous treatments were not able to establish long-sustained cooperative relationships in the experiment (Results 2 and 3). These suggest that the pairs' stronger reciprocation alone does not explain the high efficiency of the J-P and J-P Anonymous treatments. Combined with analyses reported in Sections 4.2 and 4.3, it is more reasonable for us to interpret the pairs' high efficiency under the partner matching protocol as pairs' strategic reputation building behaviour.

Result 6: *Regardless of the treatment condition, both pairs and individuals exhibit significantly strong conditional willingness to contribute.*

4.5. Comparing the Joint Decision-Making System with an Informal Punishment Institution

A rich body of literature shows that informal punishment institutions, where a member of a group punishes another member, are effective for enforcing cooperation norms under some conditions (e.g. Fehr and Gächter, 2000, 2002). One may wonder how the effectiveness of the joint decision-making system compares to that of informal punishment institutions. This comparison is useful because it applies to real-world situations where planners have to decide what kinds of norms they aim to develop in small-group interactions. For instance, a manager of

[16] The difference is significant for each comparison (Panel (ii)). However, the result in Panel (ii) is suggestive only because the significant levels depend on which regression method we employ. By contrast, the result in Panel (i) is robust as to which regression method we adopt.

a firm may want to decide which social norm to promote, either one that allows workers to punish their peers' misbehaviour (informal punishment) or another that encourages workers to engage in team work (joint decision-making), in her unit.

We additionally conducted two treatments to compare efficiency between the two institutions. The additional treatments are identical to the I-P and I-S treatments except that the former have a standard informal punishment stage after the contribution stage in each period (e.g. Fehr and Gächter, 2000, 2002). We call the two additional treatments the 'I-P-Punishment' and 'I-S-Punishment' treatments.[17] As in the I-P and I-S treatments, the payoff consequence of a subject's decision ($\pi_{i,t}$) is set as half of the J-P and J-S treatment:

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

$$= max\left\{0.5 \cdot \left(40 - c_{i,t}\right) + 0.4 \cdot \sum_{l=1}^{2} c_{l,t} - 1.5p_{j\rightarrow i,t}, 0\right\} - .5p_{i\rightarrow j,t}. \quad (3)$$

Here, *j* is the period *t* interaction counterpart of subject *i*, and $p_{j\rightarrow i,t}$ is the punishment points given from subject *j* to *i* in period *t*. In other words, for each punishment point assigned by a subject, 1.5 points are deducted from the punished and 0.5 points are deducted from the punisher.[18]

The data show that neither the average contributions nor the average payoffs are significantly different between the J-P or J-P Anonymous treatment, on the one hand, and the I-P-Punishment treatment on the other hand. In the I-P-Punishment treatment, average contributions begin at a little below 70% of the endowment and are sustained at around 75% to 85% of the endowment over the course of plays.[19]

Under the stranger matching protocol, the overall average contribution in the I-S-Punishment treatment (21.4 points) is almost identical to that in the J-S treatment (21.3 points)

[17] Two sessions per each additional treatment were conducted.

[18] See Appendix C for the instructions.

[19] The differences in the average contribution between the J-P or J-P Anonymous treatment and the I-P-Punishment treatment are not significant in all periods except period 15 (Panel (1) of Appendix TABLE D.1). The differences in the average payoff between these treatments are also not significant (Panel (1) of Appendix TABLE D.2).

but is higher than in the J-S Anonymous treatment (8.5 points).[20] The overall average payoff in the J-S treatment is higher, although insignificantly, than that in the I-S-Punishment treatment.[21]

In short, joint decision-making is as powerful as informal punishment not only in dilemma situations where people repeatedly interact with the same players, but also in situations where they interact with different players in each period if social distance within pairs is small.

Result 7: *Neither the average contributions nor the average payoffs in the J-P and J-P Anonymous treatments are significantly different from those in the I-P-Punishment treatment in all periods except period 15. The same holds for a comparison between the J-S and I-S-Punishment treatments, except in earlier periods or near the end of the experiment.*

5. Conclusions

This paper compared contribution behaviours in a finitely-repeated dilemma situation between pairs and individuals under two matching protocols. The individuals in the pairs were informed of who their pair partners were. Our data indicated that regardless of the matching protocol, pairs on average contributed significantly more than individuals did. However, pairs' contribution dynamics differed by matching protocol. On one hand, almost all pairs successfully established long-lasting cooperative relationships with their matched pairs under the partner matching. On the other hand, pairs quickly declined contribution amounts over the periods under the stranger matching.

We also conducted two additional joint-decision treatments by keeping social distance within pairs large. The additional data revealed that the pairs' maintenance of high contributions under the partner matching can be attributed to the communication process itself, not to close social distance within pairs. However, we also found positive impact of close social distance especially under the stranger matching.

According to the literature on repeated dilemma games, establishing a cooperative relationship in earlier periods is recognised as essential because cooperators are easily discouraged by seeing others free ride (e.g. Fischbacher and Gächter, 2010). Pairs' intention to

[20] Average contributions gradually and steadily increase with informal punishment in the I-S-Punishment, unlike the J-S treatment (Panel (2) of Appendix Table D.1).

[21] The average payoffs were 26.4, 22.6 and 24.5 points in the J-S, J-S Anonymous and I-S-Punishment treatments, respectively.

build cooperative reputations can be checked also by looking at the subjects' dialogues, although we acknowledge that classifying subject dialogues is challenging work and it is not the focus of this paper.[22] For instance, we can compare the reasoning of members in less cooperative pairs between the J-P Anonymous and J-S Anonymous treatments in period 1. There are ten out of 16 pairs and 15 out of 16 pairs who contributed less than or equal to 50% of the endowment in period 1 in the J-P Anonymous and J-S Anonymous treatments, respectively. In the J-P Anonymous treatment, five out of the 10 pairs explicitly talked about the merit of mutual cooperation.[23] By contrast, in the J-S Anonymous treatment, only two out of the 15 pairs explicitly stated the advantage of mutual cooperation. This appears to suggest that a larger fraction of pairs with low cooperative dispositions are prepared to raise contributions (if the other pairs do so) in the J-P Anonymous than in the J-S Anonymous treatment. This may mean that the difference in the matching protocol directly affects pairs' willingness to build a cooperative reputation. This observation is in fact consistent with our findings seen in Sections 4.3 and 4.4. In summary, our tentative conclusion is that pairs are more likely to take a risk in building a cooperative reputation under the partner matching protocol, where it is presumably easier to establish a trustful relationship by such behavioural changes, than under the stranger matching. So, why do people have such strategic reputation building behaviour in mind in the first place? The answer may be that pairs' attitudes are influenced and/or their beliefs are affected by the matching protocol. Nevertheless, we cannot answer this fundamental question only from our study. Further experiments to explore pairs' behavioural principles remain for future research.

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[22] In an earlier version of this paper, nevertheless, we made some analyses of the chat dialogues using the coding classification developed by Kagel and McGee (2016). Some results are found in Kamei (2015).

[23] For instance, one pair discussed as follows:

Person A: hey
Person A: should we start with like 20 or something in the middle?
Person B: i think that would be good to start
Person A: okay cool
Person B: it would be most beneficial for everyone if we both put all of our money in the group i think but idk if they will do that so maybe play it safe for now.

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TABLE 1: *Summary of Treatments*

Treatment[2]	Decision	Number of subjects per session	Number of decision-making units per group	Re-matching probability with a specific counterpart	Identity within pair	Endowment	Per-point return from private acc't	Per-point return from group acc't	Avg. Contribution[3]
I. Partner Matching Treatments									
I-P	Individual	8	2 persons	100%	----	40 per person	0.5 per person	0.4 per person	14.8 (36.9%)
J-P	Joint	16	2 pairs	100%	Know each other	40 per pair	1 per pair (0.5 per person)	0.8 per pair (0.4 per person)	30.8 (77.1%)
J-P Anonymous[1]	Joint	16	2 pairs	100%	Anonymous	40 per pair	1 per pair (0.5 per person)	0.8 per pair (0.4 per person)	25.7 (64.3%)
II. Stranger Matching Treatments									
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%)
J-S	Joint	16	2 pairs	14.3% (1/7×100%)	Know each other	40 per pair	1 per pair (0.5 per person)	0.8 per pair (0.4 per person)	21.3 (53.2%)
J-S Anonymous[1]	Joint	16	2 pairs	14.3% (1/7×100%)	Anonymous	40 per pair	1 per pair (0.5 per person)	0.8 per pair (0.4 per person)	8.50 (21.3%)

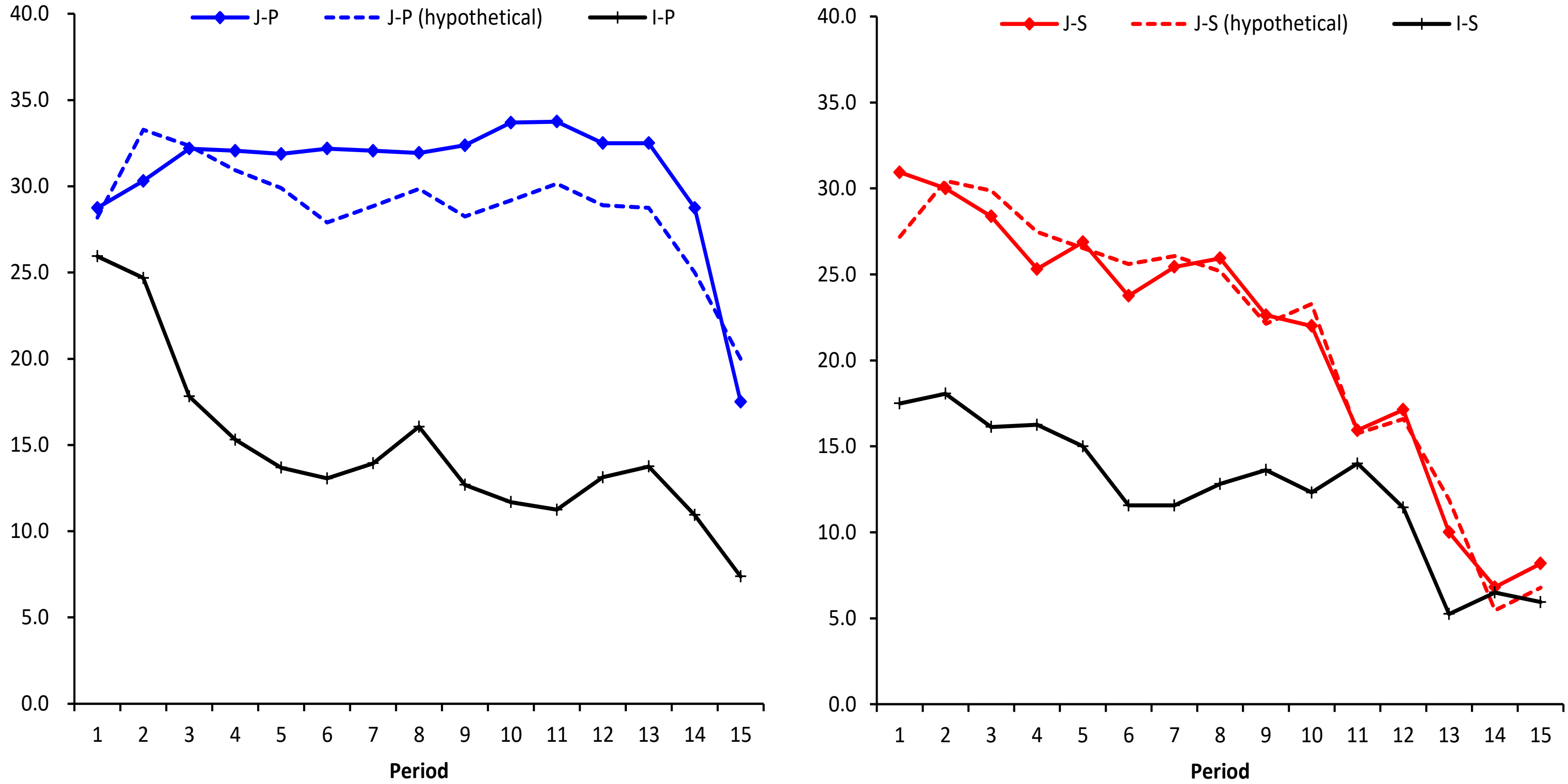
Notes: [1] The J-P Anonymous and J-S Anonymous treatments are additional treatments (see Section 4.2).

[2] We also conducted two additional individual-punishment treatments (see Section 4.5).

[3] The numbers in parenthesis are the average contributions as percentages of the endowment.

Source: Average contributions are based on the author's calculations of the experiment data.

FIGURE 1: *Joint Decision-Making and the Trends of Contributions*

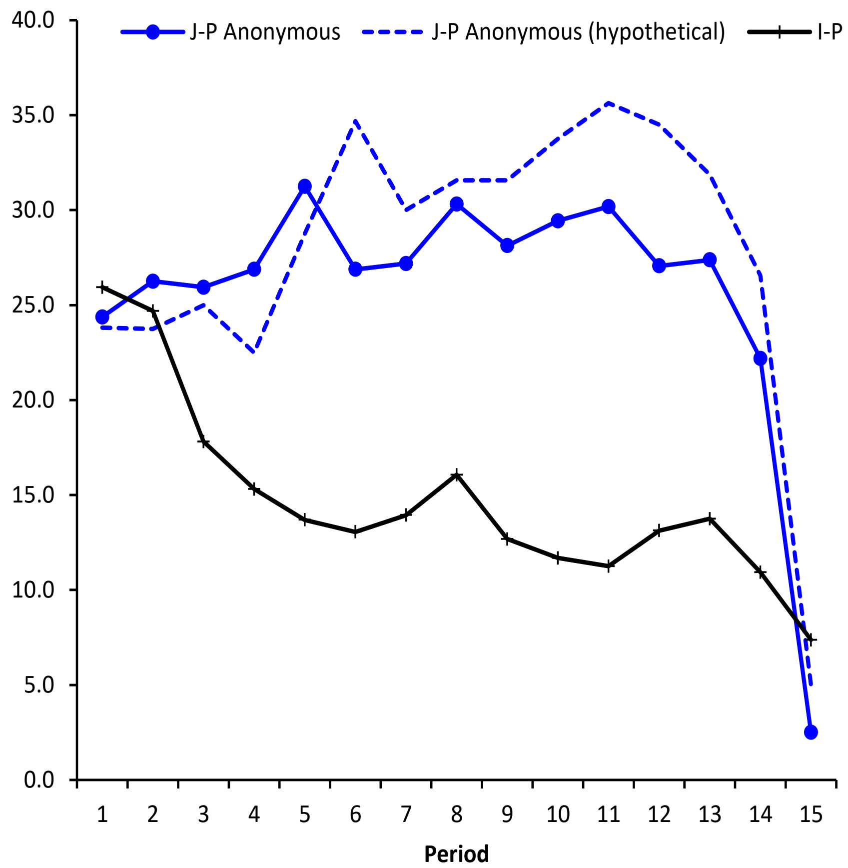


(a) J-P treatment (b) J-S treatment

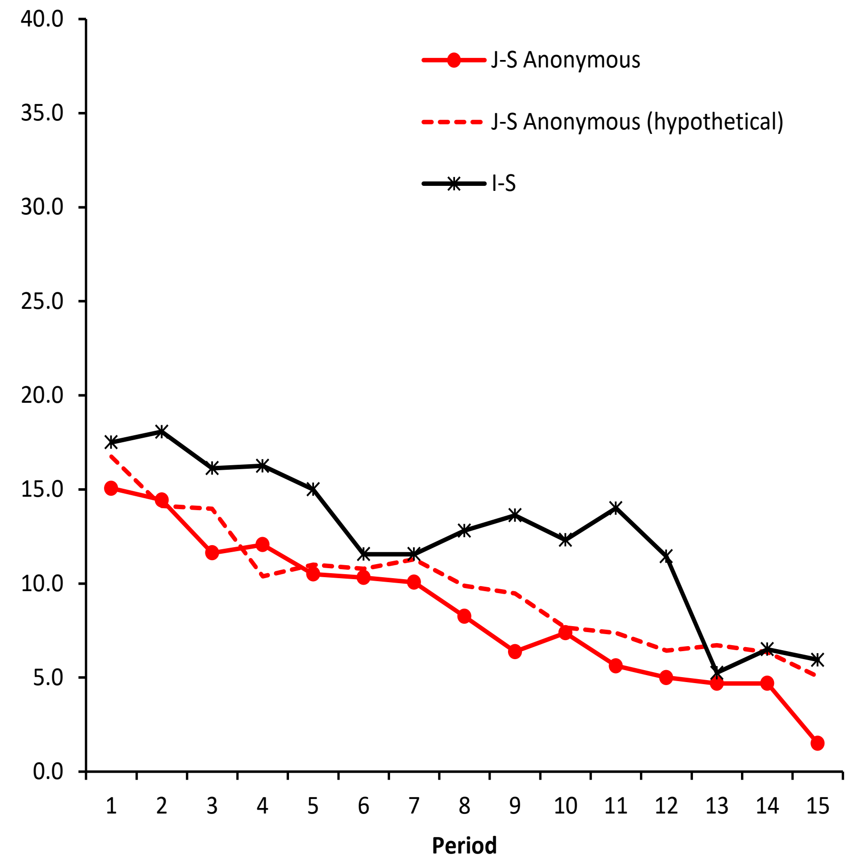
Notes: The dash lines indicate average hypothetical contribution amounts elicited before communication in the joint-decision treatments.

Source: Author's calculations based on the experiment data.

FIGURE 2: *The Impact of Joint Decision-Making when Anonymity is Preserved within Pairs*



(a) J-P Anonymous treatment



(b) J-S Anonymous treatment

Notes: The dash lines indicate average hypothetical contribution amounts elicited before communication in the joint-decision treatments.

Source: Author’s calculations based on the experiment data.

TABLE 2: *Treatment Effects of Joint Decision-Making and Close Social Distance*

Dependent variable: Contribution amount of pair (individual) *i* in period *t* in the joint-decision (individual-decision) treatments.

Data:	Partner Matching (J-P, J-P Anonymous, and I-P)				Stranger Matching (J-S, J-S Anonymous, and I-S)			
Independent Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Joint Decision-Making Dummy {= 1 for the J-P, J-P Anonymous, J-S and J-S Anonymous treatments}	2.02** (1.01)	2.07** (.94)	1.18*** (.33)	1.24*** (.36)	-.48 (.88)	-.36 (.82)	-.20 (1.16)	-.058 (.99)
(b) Close Social Distance Dummy {= 1 for the J-P and J-S treatments}	1.28*** (.23)	1.30*** (.28)	.73** (.31)	.74*** (.26)	2.32* (1.25)	2.06* (1.11)	3.86** (1.91)	3.55** (1.76)
(c) Period {= 1, 2, …, 15}	---	---	-.11 (.13)	-.11 (.13)	---	---	-.15 (.12)	-.15 (.12)
(d) Period 15 Dummy {= 1 for period 15}[2]	-3.37*** (.085)	-3.38*** (.85)	-3.51*** (1.23)	-3.51*** (1.23)	-2.42*** (.49)	-2.42*** (.49)	-.90*** (.25)	-.90*** (.25)
Variable (a) × Variable (c)	---	---	.11 (.14)	.11 (.14)	---	---	-.051 (.12)	-.050 (.12)
Variable (b) × Variable (c)	---	---	.071 (.067)	.071 (.067)	---	---	-.16** (.069)	-.16** (.068)
Control Variables[1]	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	720	720	720	720	720	720	720	720
Log likelihood	-954.5	-954.2	-947.5	-947.2	-1386.1	-1383.1	-1312.8	-1310.0

Notes: Random effects ordered logit regressions with standard errors clustered by session id. Cut points are omitted to conserve space.

[1] Control variables include a female dummy which equals 1 (0) if a subject is female (male) and an econ dummy which equals 1 (0) if a subject is (is not) an economics major.

[2] We also ran the same regressions without having the Period 15 Dummy as a robustness check. Results are omitted to conserve space since coefficient estimates change little.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author's calculations based on the experiment data.

TABLE 3: *Shifts in Contribution Amounts after Communication*

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

(I) Partner Matching Treatments

	J-P treatment				J-P Anonymous treatment			
	Self-regarding pairs		Other-regarding pairs		Self-regarding pairs		Other-regarding pairs	
Independent Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) $max\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}$	.12***	.12***	.18***	.18***	.064***	.066***	.31***	31***
	(.014)	(.012)	(.029)	(.030)	(.014)	(.013)	(.039)	(.040)
(b) $min\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}$	.070***	.063***	.060***	.059***	.075***	.078***	.26***	.26***
	(.025)	(.020)	(.010)	(.010)	(.0053)	(.0087)	(.035)	(.037)
Control Variables[1]	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	180	180	300	300	210	210	270	270
Log pseudo likelihood	-195.7	-191.2	-135.3	-134.9	-322.8	-321.3	-135.8	-135.8
Wald chi-squared test for H_0: (a) = (b)								
Wald chi-squared	1.59	3.23	9.93	9.67	1.56	7.95	144.20	274.92
Prob > Wald chi-squared	.2080	.0723*	.0016***	.0019***	.2115	.0048***	.0000***	.0000***

(II) Stranger Matching Treatments

	J-S treatment				J-S Anonymous treatment			
	Self-regarding pairs		Other-regarding pairs		Self-regarding pairs		Other-regarding pairs	
Independent Variable:	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(a) $max\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}$	.12***	.12***	.14**	.14**	.092	.094	.073**	.068**
	(.014)	(.016)	(.069)	(.064)	(.075)	(.072)	(.031)	(.029)
(b) $min\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}$	.35***	.35***	.060***	.057***	.25***	.25***	.30***	.31***
	(.056)	(.073)	(.0037)	(.0056)	(.072)	(.067)	(.055)	(.052)
Control Variables[1]	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	240	240	240	240	240	240	240	240
Log pseudo likelihood	-228.7	-228.1	-308.6	-307.7	-349.2	-348.9	-340.9	-337.6
Wald chi-squared test for H_0: (a) = (b)								
Wald chi-squared	27.95	16.03	1.21	1.43	1.16	1.23	7.03	8.61
Prob > Wald chi-squared	.0000***	.0001***	.2710	.2324	.2810	.2672	.0080***	.0033***

Notes: Random effects ordered logit regressions with standard errors clustered by session ID. Cut points are omitted to conserve space.

[1] Control variables include a female dummy and an econ dummy as in Table 2.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author’s calculations based on the experiment data.

TABLE 4: *Conditional Contribution Behaviour*

(i) Conditional Willingness to Contribute

Dependent variable: The contribution amount of pair (individual) i in period t in the joint-decision (individual-decision) treatments.

	Partner Matching			Stranger Matching		
	I-P	J-P	J-P Anonymous	I-S	J-S	J-S Anonymous
Independent Variable:	(1)	(2)	(3)	(4)	(5)	(6)
(a) Contribution amount by period $t-1$ counterpart of pair (individual) i	.051*** (.013)	.064*** (.012)	.060*** (.0049)	.033*** (.0059)	.048*** (.00076)	.103*** (.0037)
# of observations	224	224	224	224	224	224
Log likelihood	-350.3	-185.3	-282.8	-397.6	-391.9	-398.3

Notes: Random effects ordered logit regressions with standard errors clustered by session ID. Estimates of cut points were omitted to conserve space. All data except period 1 are used for the estimation.

*** Significant at the 1% level.

Source: Author's calculations based on the experiment data.

(ii) Testing the Differences in Coefficient Estimate of variable (a)

	I-P vs. J-P	I-P vs. J-P Anonymous	I-S vs. J-S	I-S vs. J-S Anonymous
	(1)	(2)	(4)	(5)
Chi-squared	7.92	13.55	35.86	11.38
Prob > Chi-squared	.0049***	.0002***	.0000***	.0007***

Notes: In column (1), we first ran a regression with the data of the I-P and J-P treatments while having the J-P treatment dummy, the interaction term between variable (a) and the J-P treatment dummy, and the interaction term between variable (a) and the I-P treatment dummy. We then performed a Chi-squared test comparing the two interaction terms. Chi-squared tests were performed likewise in columns (2) to (4).

*** Significant at the 1% level.

Source: Author's calculations based on the experiment data.

Not for Publication

Supplementary Online Appendix for Kamei:

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

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Appendix A: Instructions in the J-P treatment and the J-S Anonymous treatment

(1) Instructions for 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.

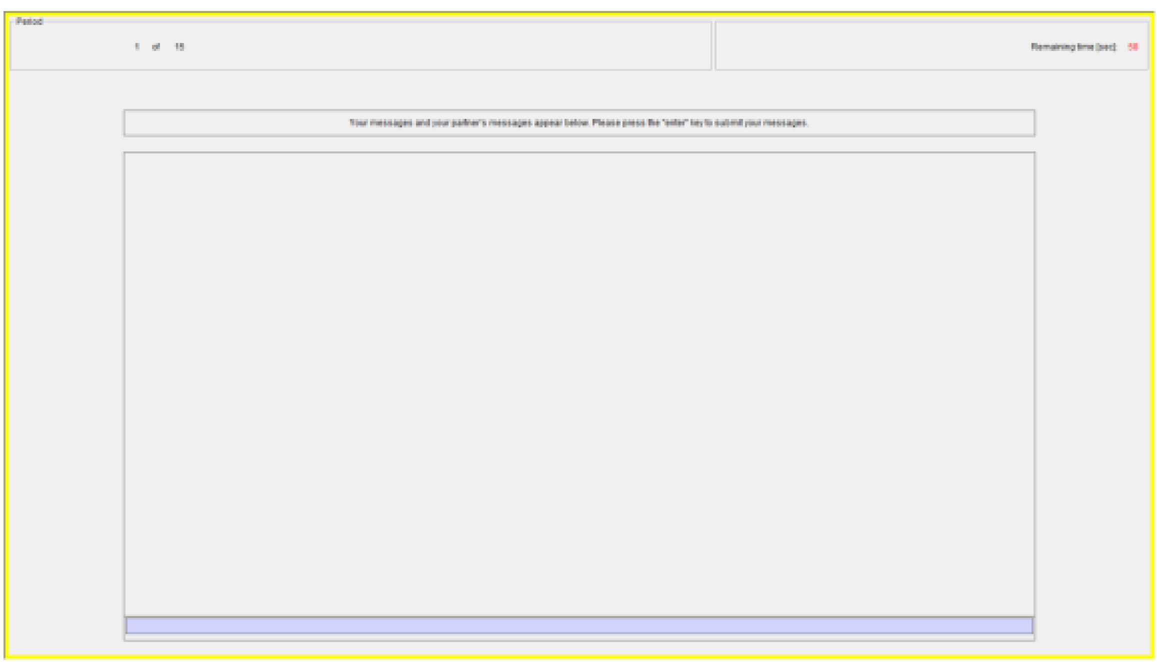
The other pair's earnings are: 40 – 20 + (28.0) = 48.0 points. Thus, each person in this pair obtains 48/2 = 24 points.

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 (a) 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? ______________

(2) Instructions for the J-S Anonymous treatment

The following are instructions for the J-S Anonymous 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.

At the onset of the experiment, you will be randomly paired with another participant. This pairing stays **fixed** throughout the experiment. Your pair will be **randomly matched with another pair each period** and will interact with each other. Once your interaction is over, your pair will move on to the next round and will be randomly matched with a new pair, with which your pair will have another interaction. Matching across pairs is completely random. This means that neither your decisions in the past nor your interaction outcomes affect the matching process. Your pair's randomly matched pair might be the one that you have already interacted with before or the one that you have never interacted with so far. No one knows which other pair (other 2 participants) is matched with your pair, and no one will be informed which other pair was matched with which pair 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.

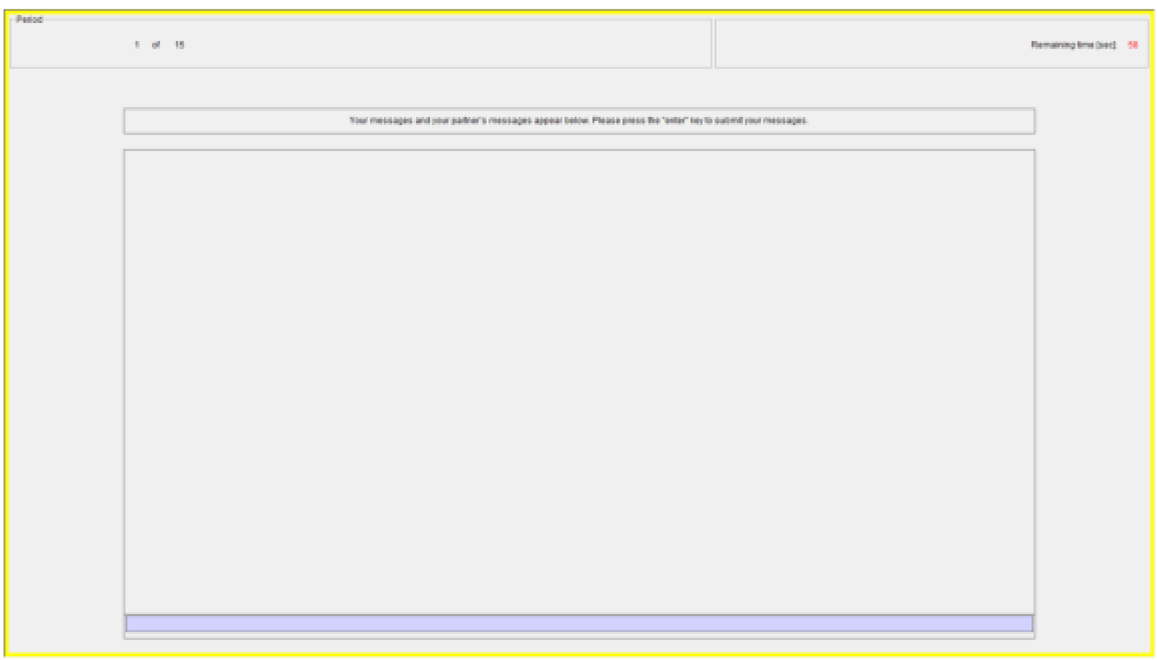
The other pair's earnings are: 40 – 20 + (28.0) = 48.0 points. Thus, each person in this pair obtains 48/2 = 24 points.

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.

An example of the computer screen:



In the communication stage, any kind of offensive language is prohibited. Also, you are not allowed to give your pair partner any information that could identify you, such as where you sit or what your name is. 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 randomly paired with another participant. Your pairing does not change during the entire experiment. Your pair is randomly matched with another pair (2 individuals) each period, and plays with that pair for 1 period. Once your interaction is over, you will move on to the next period and will be randomly matched with a new pair which will interact with each other. A new randomly assigned pair might be a pair with which your pair has interacted before or a pair with which your pair haven't interacted so far. 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 (a) 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 (including the Additional Joint-Decision 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 Amounts															
(i) Partner Matching															
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. J-P Anonymous	24.4	26.3	25.9	26.9	31.3	26.9	27.2	30.3	28.1	29.4	30.2	27.1	27.4	22.2	2.5
(ii) Stranger Matching															
d. 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
e. 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
f. J-S Anonymous	15.1	14.4	11.6	12.1	10.5	10.3	10.1	8.3	6.4	7.4	5.6	5.0	4.7	4.7	1.5
II. Mann-Whitney Tests[#1]															
(a) Comparisons within the partner matching treatments															
H_0: a = b *p*-value (2-sided)	.749	.245	.020**	.017**	.022**	.027**	.039**	.045**	.015**	.019**	.014**	.031**	.031**	.049**	.226
H_0: a = c *p*-value (2-sided)	.872	.750	.087*	.072*	.015**	.107	.107	.087*	.065*	.040**	.040**	.119	.119	.252	.160
H_0: b = c *p*-value (2-sided)	.558	.633	.381	.330	.660	.487	.562	.729	.856	.562	.432	.397	.397	.397	.038**

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
continued															
(b) Comparisons within the stranger matching treatments															
H_0: d = e															
p-value (2-sided)	.029**	.020**	.073*	.154	.063*	.081*	.030**	.035**	.225	.140	.958	.751	1.000	.915	.825
H_0: d = f															
p-value (2-sided)	.832	.459	.458	.343	.266	.792	.673	.429	.226	.289	.045**	.111	.487	.788	.197
H_0: e = f															
p-value (2-sided)	.005***	.006***	.007***	.040**	.018**	.065*	.012**	.005***	.016**	.020**	.091*	.166	.331	.626	.297
(c) Comparisons between the partner matching treatments and the corresponding stranger matching treatments															
H_0: a = d															
p-value (2-sided)	.125	.170	.525	.833	.751	.874	.915	.749	.527	.488	.593	.791	.633	.829	.869
H_0: b = e															
p-value (2-sided)	.519	.832	.550	.257	.234	.151	.131	.178	.187	.100	.021**	0.037**	.011**	.018**	.372
H_0: c = f															
p-value (2-sided)	.022**	.030**	.023**	.015**	.001***	.050**	.057*	.003***	.019**	.015**	.011**	.025**	.018**	.042**	.370

Notes: Regression results measuring the treatment effects of joint decision-making or close social distance are found in TABLE 2 of the paper and Appendix TABLE B.2. Average group contribution amounts were used for the Mann-Whitney tests as the individuals' or pairs' contribution decisions could be correlated within groups. The tests results in periods 2 to 15 for the stranger matching treatments can be used as suggestive evidence only because the subjects' decisions could be correlated within sessions.

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Source: Author's calculations based on the experiment data.

TABLE B.2: *The Treatment Effects of Joint Decision-Making and Close Social Distance* (supplementing TABLE 2 of the paper)

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

Data:	Partner Matching: the J-P, J-P Anonymous, and I-P treatments				Stranger Matching: the J-S, J-S Anonymous, and I-S treatments			
Independent Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Joint Decision-Making Dummy {= 1 for the J-P, J-P Anonymous, J-S, J-S Anonymous treatments; 0 otherwise}	46.5** (23.3)	47.9** (23.4)	53.7** (26.0)	55.2** (26.1)	-4.32 (6.43)	-3.01 (6.25)	1..37 (7.09)	2.64 (6.94)
(b) Close Social Distance Dummy {= 1 for the J-P and J-S treatments; 0 otherwise}	34.7 (24.1)	36.7 (24.5)	14.8 (27.9)	16.7 (28.1)	17.7*** (6.50)	15.4** (6.24)	28.6*** (7.62)	26.3*** (7.39)
(c) Period {= 1, 2, …, 15}	---	---	-3.28*** (1.05)	-3.28*** (1.05)	---	---	-1.38*** (.28)	-1.38*** (.28)
(d) Period 15 Dummy {= 1 for period 15; 0 otherwise}	-98.7*** (16.1)	-98.8*** (16.1)	-71.5*** (14.5)	-71.6*** (14.5)	-23.7*** (3.61)	-23.7*** (3.61)	-5.34* (3.16)	-5.35* (3.16)
Variable (a) × Variable (c)	---	---	-.84 (1.44)	-.85 (1.45)	---	---	-.73* (.38)	-.74* (.38)
Variable (b) × Variable (c)	---	---	2.04 (1.67)	2.06 (1.67)	---	---	-1.25*** (.44)	-1.24*** (.44)
Constant	17.8 (16.0)	13.8 (20.0)	41.1** (17.6)	37.0* (21.0)	8.36* (4.55)	6.12 (5.68)	18.5*** (5.04)	16.3*** (6.09)
Control Variables[1]	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	720	720	720	720	720	720	720	720
Log likelihood	-594.4	-594.1	-581.4	-581.1	-1300.4	-1297.9	-1217.3	-1214.9

Notes: Random effects tobit regressions. The numbers of left-censored (right-censored) observations are 199(463) in columns (1) to (4) and 244(256) in columns (5) to (8).

[1] Control variables include the female dummy which equals 1 (0) if a subject is female (male) and the econ dummy which equals 1 (0) if a subject is (is not) an economics major.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author's calculations based on the experiment data.

TABLE B.3: *Period-by-period Average Hypothetical Contribution Amount by Treatment (including the Additional Joint-Decision 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. Hypothetical Contribution Amounts															
(i) Partner Matching															
a. 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
b. J-P Anonymous	23.8	24.8	26.4	25.9	29.1	30.6	26.3	28.6	27.7	27.8	28.1	28.3	26.6	23.9	5.63
(ii) Stranger Matching															
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
d. J-S Anonymous	16.8	14.1	14.0	10.4	11.0	10.8	11.3	9.9	9.5	7.7	7.4	6.4	6.7	6.3	5.1
II. Mann-Whitney Tests[1]															
H_0: a = b *p*-value (2-sided)	.1156	.1003	.2557	.3299	.6272	.6534	.8660	.9107	.8262	.8225	.8262	.8262	.7830	.7448	.0649*
H_0: c = d *p*-value (2-sided)	.0009***	.0046***	.0063***	.0117**	.0100***	.0132**	.0312**	.0063***	.0062***	.0156**	.2066	.0404**	.3421	.3699	.9141

Notes: [1] Individual-level Mann-Whitney tests for period 1. Group-level Mann-Whitney tests for periods 2 to 15.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author's calculations based on the experiment data.

TABLE B.4: *Shifts in Pair Contribution through Communication (supplementing TABLE 3 of the paper)*

(1) The Original Treatments (the J-P and J-S 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 $C_{pair_k,t} = \frac{1}{2}\sum_{i=1}^{2} C_{i,t}^{hypo}$ (no shift)[#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 classified a pair as a self-regarding pair if the pair's average hypothetical contribution across all periods was less than the average hypothetical contribution in the session. We classified a pair as an other-regarding pair if the pair's average hypothetical contribution across all periods was greater than the average of hypothetical contributions in the session. [#1] Each subject chose actions 15 times 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 equation/inequalities are the averages of pair *k*'s two members' pre-communication hypothetical contributions in period *t*. The left hand sides of the equation/inequalities are pair *k*'s joint contribution amount 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).

Source: Author's calculations based on the experiment data.

(2) The Two Additional Treatments (the J-P Anonymous and J-S Anonymous treatments)

	J-P Anonymous treatment		J-S Anonymous treatment	
	Self-regarding pairs	Other-regarding pairs	Self-regarding pairs	Other-regarding pairs
The number of pairs	7	9	8	8
Average hypothetical contribution across all periods	14.0	34.6	5.51	14.1
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]	37	20	27	23
(b) The # of cases where $C_{pair_k,t} = \frac{1}{2}\sum_{i=1}^{2} C_{i,t}^{hypo}$ (no shift)[#2]	40	99	52	45
(c) The # of cases where $C_{pair_k,t} < \frac{1}{2}\sum_{i=1}^{2} C_{i,t}^{hypo}$ (self-regarding shift)[#2]	28	16	41	52
Average per-period shift from their hypothetical contribution amount[#3]	.266	.085	-.829	-1.792

Notes: We classified a pair as a self-regarding pair if the pair's average hypothetical contribution across all periods was less than the average hypothetical contribution in the session. We classified a pair as an other-regarding pair if the pair's average hypothetical contribution across all periods was greater than the average of hypothetical contributions in the session. [#1] Each subject chose actions 15 times 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 equation/inequalities are the averages of pair *k*'s two members' pre-communication hypothetical contributions in period *t*. The left hand sides of the equation/inequalities are pair *k*'s joint contribution amount 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 7, 8 or 9).

Source: Author's calculations based on the experiment data.

Remark: See TABLE 3 of the paper regarding how each person's decision was affected by her partner within their pair through communication.

TABLE B.5: *Shifts in Contribution Amounts after Communication (supplementing TABLE 3 of the paper)*

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*.

(I) The Partner Matching Treatments

	J-P treatment				J-P Anonymous treatment			
	Self-regarding pairs		Other-regarding pairs		Self-regarding pairs		Other-regarding pairs	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) The positive deviation of hypothetical contributions in period *t* $\{= max\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}\}$	2.93*** (.90)	2.97*** (.90)	6.03** (2.55)	5.96** (2.53)	1.37*** (.37)	1.40*** (.37)	1.38*** (.23)	1.38*** (.24)
(b) The negative deviation of hypothetical contributions in period *t* $\{= min\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}\}$	.11 (.53)	.14 (.52)	67.9 (7830.8)	60.8 (4313.4)	1.81* (1.01)	1.82* (1.01)	15.4 (1117.1)	15.6 (1140.5)
Constant	-63.9*** (21.4)	-54.7*** (20.5)	-137.2** (60.9)	-140.1** (63.1)	-35.8*** (9.90)	-28.2*** (9.48)	-19.5*** (4.37)	-20.6*** (5.61)
Control Variables[1]	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	180	180	300	300	210	210	270	270
Log pseudo likelihood	-102.5	-100.1	-63.8	-63.7	-170.4	-168.9	-118.9	-118.7
Wald chi-squared test for H_0: (a) = (b)								
Wald chi-squared	6.12	6.10	.00	.00	.18	.17	.00	.00
Prob > Wald chi-squared	.0134**	.0135**	.9937	.9899	.6715	.6844	.9900	.9900

(II) The Stranger Matching Treatments

	J-S treatment				J-S Anonymous treatment			
	Self-regarding pairs		Other-regarding pairs		Self-regarding pairs		Other-regarding pairs	
Independent Variable	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(a) The positive deviation of hypothetical contributions in period *t* $\{= max\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}\}$	1.78*** (.56)	1.83*** (.57)	1.47*** (.30)	1.48*** (.30)	.61*** (.14)	.61*** (.14)	.62*** (.15)	.50*** (.14)
(b) The negative deviation of hypothetical contributions in period *t* $\{= min\{C_{partner,t}^{hypo} - C_{i,t}^{hypo}, 0\}\}$	.33 (.74)	.37 (.74)	-.18 (.28)	-.22 (.28)	.40 (.24)	.40 (.24)	2.22** (1.01)	2.28** (1.04)
Constant	-34.3*** (8.17)	-39.4*** (10.4)	-27.6*** (6.10)	-23.9*** (6.74)	-11.3*** (2.77)	-11.7*** (4.45)	-13.3*** (3.49)	-21.6*** (4.42)
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	240	240	240	240	240	240	240	240
Log pseudo likelihood	-143.1	-142.2	-173.3	-172.2	-198.3	-198.3	-186.4	-179.3
Wald chi-squared test for H_0: (a) = (b)								
Wald chi-squared	2.20	2.28	12.85	13.50	.55	.55	2.42	2.83
Prob > Wald chi-squared	.1377	.1310	.0003***	.0002***	.4599	.4564	.1197	.0925*

Notes: Random effects tobit regressions. The numbers of left-censored (right-censored) observations are 142(27), 277(18), 166(24), 243(4), 215(5), 201(13), 199(2), 202(3) in columns (1) and (2), columns (3) and (4), columns (5) and (6), columns (7) and (8), columns (9) and (10), columns (11) and (12), columns (13) and (14) and columns (15) and (16), respectively.

[1] Control variables include the female dummy which equals 1 (0) if a subject is female (male) and the econ dummy which equals 1 (0) if a subject is (is not) an economics major.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author’s calculations based on the experiment data.

TABLE B.6: *Shifts in Contribution Amounts after Communication in Period 1 (supplementing TABLE 3 of the paper and Appendix TABLE B5)*

Results in TABLE 3 of the paper can be attributed not only to the impact of communication but also to the effects of pairs' experiences in the past. In order to study the pure impact of communication, we conducted the same regressions of TABLE 3 by using only period 1 observations. For this purpose, we first classified a pair as self-regarding (other-regarding) if the pair's period 1 average hypothetical contribution was smaller (greater) than the session average of it. We then performed regressions as below.

Dependent variable: The contribution amount subject *i* submitted after the communication stage minus the pre-communication hypothetical contribution amount by subject *i* in period 1.

(I) The Partner Matching Treatments

	J-P treatment				J-P Anonymous treatment			
	Self-regarding pairs		Other-regarding pairs		Self-regarding pairs		Other-regarding pairs	
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) The positive deviation of hypothetical contributions in period t $\{= max\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}\}$	.15 (.15)	.20 (.15)	3.72*** (.22)	5.73*** (.30)	.12 (.21)	.13 (.14)	.19 (.12)	.23** (.10)
(b) The negative deviation of hypothetical contributions in period t $\{= min\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}\}$	-.0052 (.020)	-.031*** (.0063)	.056 (.065)	.18*** (.056)	.042*** (.0033)	.051*** (.018)	-.051 (.093)	-.059 (.15)
Control Variables[1]	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	14	14	14	14	16	16	16	16
Log pseudo likelihood	-18.69	-17.34	-6.67	-4.76	-19.15	-18.43	-28.37	-27.86
Wald chi-squared test for H_0: (a) = (b)								
Wald chi-squared	.83	2.83	324.46	343.19	.14	.24	1.28	1.37
Prob > Wald chi-squared	.3620	.0925*	.0000***	.0000***	.7047	.6221	.2578	.2422

(II) The Stranger Matching Treatments

	J-S treatment				J-S Anonymous treatment			
	Self-regarding pairs		Other-regarding pairs		Self-regarding pairs		Other-regarding pairs	
Independent Variable	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(a) The positive deviation of hypothetical contributions in period *t* {$= max\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}$}	.30*** (.023)	.34*** (.061)	21.7*** (1.70)	22.3*** (1.70)	.15*** (.037)	.14** (.056)	.068 (.065)	.068 (.064)
(b) The negative deviation of hypothetical contributions in period *t* {$= min\{C^{hypo}_{partner,t} - C^{hypo}_{i,t}, 0\}$}	.078 (.061)	.13 (.11)	-3.35*** (.28)	-3.57*** (.28)	.043*** (.0090)	.057*** (.019)	.22* (.13)	.23** (.10)
Control Variables	No	Yes	No	Yes	No	Yes	No	Yes
# of observations	18	18	14	14	14	14	18	18
Log pseudo likelihood	-19.95	-17.26	-3.01	-1.91	-19.99	-19.16	-16.08	-16.02
Wald chi-squared test for H_0: (a) = (b)								
Wald chi-squared	33.07	15.83	160.26	170.66	16.25	1.24	6.59	19.84
Prob > Wald chi-squared	.0000***	.0001***	.0001***	.0000***	.0001***	.2655	.0102**	.0000***

Notes: Ordered logit regressions with standard errors clustered by session ID. Estimates of cut points were omitted to conserve space.

[1] Control variables include the female dummy which equals 1 (0) if a subject is female (male) and the econ dummy which equals 1 (0) if a subject is (is not) an economics major.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author’s calculations based on the experiment data.

Appendix C: The Additional Punishment 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.**

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

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

TABLE D.1: *Period-by-period Average Contribution and Comparison of the Additional Punishment Treatments against the Other Treatments*

(1) Partner Matching 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 Amounts															
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. J-P Anon--ymous	24.4	26.3	25.9	26.9	31.3	26.9	27.2	30.3	28.1	29.4	30.2	27.1	27.4	22.2	2.5
D. 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[#1]															
H_0: A = D															
p-value (2-sided)	.8058	.1429	.0028***	.0256**	.0628*	.0247**	.0103**	.0146**	.0183**	.0067***	.0150**	.0238**	.0395**	.0201**	.0057***
H_0: B = D															
p-value (2-sided)	.6947	.5873	.6365	.8388	.9167	.5661	.9141	.6766	.9103	.9101	.6757	.8576	.8109	.7782	.0858*
H_0: C = D															
p-value (2-sided)	.5166	.3967	.1092	.2777	.7602	.7994	.4979	.7604	.6933	.5167	.6276	.4831	.5174	.2288	.0014***

(2) Stranger Matching 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 Amounts															
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. J-S-Ano -nymous	15.1	14.4	11.6	12.1	10.5	10.3	10.1	8.3	6.4	7.4	5.6	5.0	4.7	4.7	1.5
D. 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[#1]															
H_0: A = D															
p-value (2-sided)	.5215	.8323	.3417	.4913	.3041	.0352**	.0449**	.0655*	.1138	.0307**	.0922*	.0345**	.0009***	.0015***	.0232**
H_0: B = D															
p-value (2-sided)	.0191**	.0809*	.0444**	.1706	.2216	.7520	.3998	.5979	.9162	.6717	.2258	.3987	.0235**	.0031**	.0710*
H_0: C = D															
p-value (2-sided)	.2857	.3431	.0723*	.0824*	.0385**	.0135**	.0238**	.0027***	.0053***	.0021***	.0053***	.0043***	.0008***	.0011***	.0016***

Notes: [#1] Group-level average contribution amounts were compared across the treatments. The Mann-Whitney tests results in periods 2 to 15 for the stranger matching treatments (Panel (2)) can be used as suggestive evidence only because the subjects' decisions could be correlated within sessions.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author's calculations based on the experiment data.

TABLE D.2: *Period-by-period Average Payoff and Comparison of the Additional Punishment Treatments against the Other Treatments*

(1) Partner Matching 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. Payoffs															
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. J-P Anon--ymous	27.3	27.9	27.8	28.1	29.4	28.1	28.2	29.1	28.4	28.8	29.1	28.1	28.2	26.7	20.8
D. I-P-Pun-ishment	28.1	29.6	30.4	29.2	28.7	29.2	30.2	30.1	30.0	30.0	29.6	29.8	29.5	29.5	27.5
II. Mann-Whitney Tests[#1]															
H_0: A = D															
p-value (2-sided)	.8058	.1429	.0028***	.0256**	.0628*	.0247**	.0103**	.0146**	.0183**	.0067***	.0150**	.0238**	.0395**	.0201**	.0108**
H_0: B = D															
p-value (2-sided)	.6947	.5873	.6365	.8388	.9167	.5661	.9141	.6766	.9103	.9101	.6757	.8576	.8109	.7782	.1188
H_0: C = D															
p-value (2-sided)	.5166	.3967	.1092	.2777	.7602	.7994	.4979	.7604	.6933	.5167	.6276	.4831	.5174	.2288	.0054***

(2) Stranger Matching 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. Payoffs															
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. J-S-Ano -nymous	24.5	24.3	23.5	23.6	23.2	23.1	23.0	22.5	21.9	22.2	21.7	21.5	21.4	21.4	20.5
D. 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[#1]															
H_0: A = D															
p-value (2-sided)	.7087	.5982	.6728	.9578	.8715	.7520	.1394	.1553	.7518	.2691	.7926	.1706	.0016***	.0061***	.6330
H_0: B = D															
p-value (2-sided)	.0191**	.0346**	.0200**	.0917*	.1843	.1709	.2926	.3424	.5280	.6337	.9162	.9580	.0353**	.0061**	.7087
H_0: C = D															
p-value (2-sided)	.9575	.9581	.6733	.3439	.2441	.5632	.1033	.0237**	.4005	.0578*	.2933	.1138	.0015***	.0016***	.1606

Notes: [#1] Group-level average payoffs were compared across the treatments. The Mann-Whitney tests results in periods 2 to 15 for the stranger matching treatments (Panel (2)) can be used as suggestive evidence only because the subjects' decisions could be correlated within sessions.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

Source: Author's calculations based on the experiment data.