Mutual Choice of Partner and Communication in a Repeated Prisoner's Dilemma

By

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"Where people seldom deal with one another, we find that they are somewhat disposed to cheat, because they can gain more by a smart trick than they can lose by the injury it does to their character. […] Wherever dealings are frequent, a man does not expect to gain so much by any one contract as by probity and punctuality in the whole, and a prudent dealer […] would rather choose to lose what he has a right to than give any ground for suspicion."

Adam Smith *Lectures on Jurisprudence* (1766/1978: 538–539)

1. Introduction

An important feature of markets is that individuals can choose their exchange partners. Exchange relationships form voluntarily based on expectations of mutual benefits and may dissolve if expectations are broken. The exchange situation opens for opportunistic behavior as most exchanges cannot be simultaneous - it takes some time from the point of agreement until the actual exchange is completed - and no contract can completely govern transactions. However, the expectation of repeated interactions may restrict opportunistic behavior. Exchange partners may behave well to increase the chances of keeping their current partner and to uphold their own reputation as a reliable exchange partner. The repeated nature of many exchange situations, and the mutuality of partner choice, constrains opportunistic behavior. A prudent dealer, as Adam Smith observed, may even "choose to lose what he has a right to than give any ground for suspicion."

Language is another mechanism that constrains opportunistic behavior in markets. According to standard game theory, talking is cheap and should not affect behaviour in an upcoming social dilemma situation. However, according to David Hume, people can make promises to cooperate - promises are conventions "which create a new motive, when experience has taught us, that human affairs wou'd be conducted for much more mutual advantages" (Hume, 1739/1985: 572). To make a promise is to express a purpose of conducting in a certain way, and a failure to do so leads to loss of trustworthiness. Through language, people can persuade one another to work together as exchange partners. Forming a partnership is a form of mutual promises in itself to follow rules of conduct in the situation. Talking can further persuade one another to abide by these rules of conduct.

In this paper, we examine the effect of mutual choice of partners and the effect of language through chat room communication in a repeated Prisoner's Dilemma game experiment. In the Choice condition, a participant is randomly assigned to a fixed group of eight subjects. Within each group of eight, subjects can propose a partner. If two participants choose each other, they play one round of the prisoner's dilemma game. In the next round, each participant can choose to continue the partnership simply by choosing the same partner. The partnership dissolves if one of them does not choose the previous partner. We compare the outcomes in the partner choice treatment to a baseline where pairs form randomly within a fixed group of eight participants. The information in both conditions is private; in each round we inform the subjects about their current partner's identity number and own payoff. Hence, the choice of partner in our experiment is based on private experience only, not reputation through third parties. To capture the effect of language on partnership formation, we also ran a chat treatment in both the choice and random conditions. In the fixed group of eight, participants could chat in a common chat room. In the choice condition, chat can be used to form and sustain pair of partnership within the fixed group of eight subjects. In the random condition, the chat is targeted towards the fixed group of eight.

Many scholars point out that markets resemble repeated Prisoner's Dilemma situations with the possibilities for mutual partner choice, and that the partner choice has a disciplining effect on opportunistic behaviour.[1] In the literature, there has been studied **many** different mechanisms for choosing partners. In some studies, subjects choose between groups (Ahn et al., 2009; Erhart & Keser, 1999; Brekke et al., 2011), in others, subjects' stated preferences for

[1] See Sen (1985); Tullock (1985,1999); Vanberg & Congleton (1992); Buchanan (1994); Ghosh & Ray (1996); McNamara et al. (2008); Izquierdo et al. (2014).

partners determine groups (Page et al., 2005) or groups are based on subjects' votes (Charness & Yang, 2014; Cinyabuguma et al., 2005). Also, some have studied auctioning of partners (Bayer, 2015; Coricelli et al., 2004), opting out of a social dilemma situation (Hauk & Nagel, 2001), and one-sided choice of partner (Huck et al., 2012). Even when subjects are unware of being sorted according to cooperativeness, endogenous matching tends to increase cooperation (Gunnthorsdottir et al., 2007; Rigdon et al., 2007). The ability for self-selection into and out of groups has also been shown to be important for realizing the gains from trade in similar market-like settings. In an extension of Kimbrough, Smith & Wilson (2010), Jaworski & Wilson (2013) study how subjects discover exchange and specialization in an open-ended environment and allow subjects to incur a cost to endogenously form groups. They find that specializing traders sort via migration and avoid plunderers.

We contribute to this literature on partner choice and voluntary group formation in social dilemmas. Our matching procedure is straightforward and involves no use of a computerized "middle-man" - subjects can mutually choose each other and only these choices determine who form a partnership. Our procedure resembles Tullock's (1999) experiment, where subjects could freely choose their partner in a prisoner's dilemma game. His experiment, however, did not use a control group, **and so could not isolate the effect of mutual partner choice**.

Language is a key ingredient in the human ability to work out social dilemma problems (Bickerton, 2014). Correspondingly, a large experimental literature demonstrates that communication increases cooperation in social dilemmas situations.[2] Out paper focuses on how participants use language to persuade one another to cooperate and maintain cooperation. In addition to our more standard chat treatment with random matching, we also study a setting where subjects may chat and choose their partners. This enables us to study whether communication is used for a different purpose when partner

[2] Communication may affect cooperation through shaping group identity and committing participants to cooperate (Balliet, 2009; Bochet et al., 2006; Isaac et al., 1988; Orbell et al., 1988; Kerr & Kaufman-Gilliland, 1994; Sally, 1995, McCloskey and Klamer, 1995). A game theoretic perspective is that communication influences cooperation as it may affect players' beliefs about other players' actions (Rabin, 1993; Rabin 1998).

choice is allowed – in such a setting, subjects could use communication to form trade relationships. We hypothesize that communication could increase the effect of partner choice through making it easier for cooperative subjects to find each other in the partner choice stage.

We find that both mutual partner choice and the ability to chat increase cooperation, compared to random matching. There is also a striking difference in the time pattern between partner choice and chat. The partner choice treatment starts out with a relatively high level of cooperation, but it levels off at the end. In the chat treatment, cooperation is relatively low in the beginning, but increases substantially over time. **We do not find a positive interaction effect between chat and partner choice. In fact, analyses of the chat transcripts suggest that subjects tend to use the chat for a similar purpose in both treatments with chat – establishing a** common **end in the fixed group of eight subjects – a strategy that serves them remarkably well.**

2. Experimental Design and Procedures

2.1. Experimental Design

The main aim of the experimental design is to test the effect of mutual choice of partners in a repeated prisoner's dilemma game of 30 rounds. We used a 2 x 2 between-subjects design, varying whether matching was random or based on mutual choice and whether chat room communication was allowed or not. In each experimental session, subjects were randomly assigned to one of two groups of eight subjects. This group remained fixed during the entire experiment. The subjects also randomly received a fixed identity number between 1 and 8.

The reason why we need ID-recognition in all treatments, including the baseline treatment with random matching, is to avoid confounding effects. If we had removed the ID-recognition feature from the baseline our baseline would be more similar to standard ones used in the literature (see e.g. Andreoni, 1988; Andreoni & Miller, 1993). However, comparing this to partner choice would pick up the effect of ID recognition itself, which both theoretically (Kandori, 1992) and empirically (e.g. Huck, 2012) has been shown to affect cooperative behaviour. To allow for a clean comparison, we therefore allow for ID-recognition also in the baseline condition.

We informed the subjects about the structure of the game, and before entering the game, they answered several control questions in order to ensure that they understood the payoff structure. The experiment did not proceed until all individuals had successfully answered the control questions.[3] The experiment was computerised using z-Tree (Fischbacher, 2007).[4] Table 1 displays the different treatments employed, along with the number of subjects in each condition.

Table 1

Main Features of the Experimental Design

MATCHING	CHAT	
	No	Yes
Random	**Random** 4 groups, 32 subjects	**Chat & Random** 4 groups, 32 subjects
Choice	**Choice** 4 groups, 32 subjects	**Chat & Choice** 4 groups, 32 subjects

In the Choice condition, each participant could choose her preferred partner. This was done by entering a number between 1 and 8 in a field on the screen. The default choice was the subject's own identity number. Each participant had only one choice every round, and choices were made simultaneously. In order to match with the preferred partner for certain, both subjects needed to choose each other as partners. Subjects not matched by mutual consent, were randomly matched with either other 'unsuccessful' subjects or subjects choosing their own

[3] Experimental instructions and control questions are provided in Appendices B and C.
[4] The program is available upon request.

identity number. Prior to entering the contribution stage, subjects were informed whether their preferred partner had chosen them or not and were informed about the identity number of their assigned partner. In the instructions, we chose the neutral term ‘person’ instead of ‘partner’ to avoid framing effects. The partner choice stage lasted for 10 seconds.

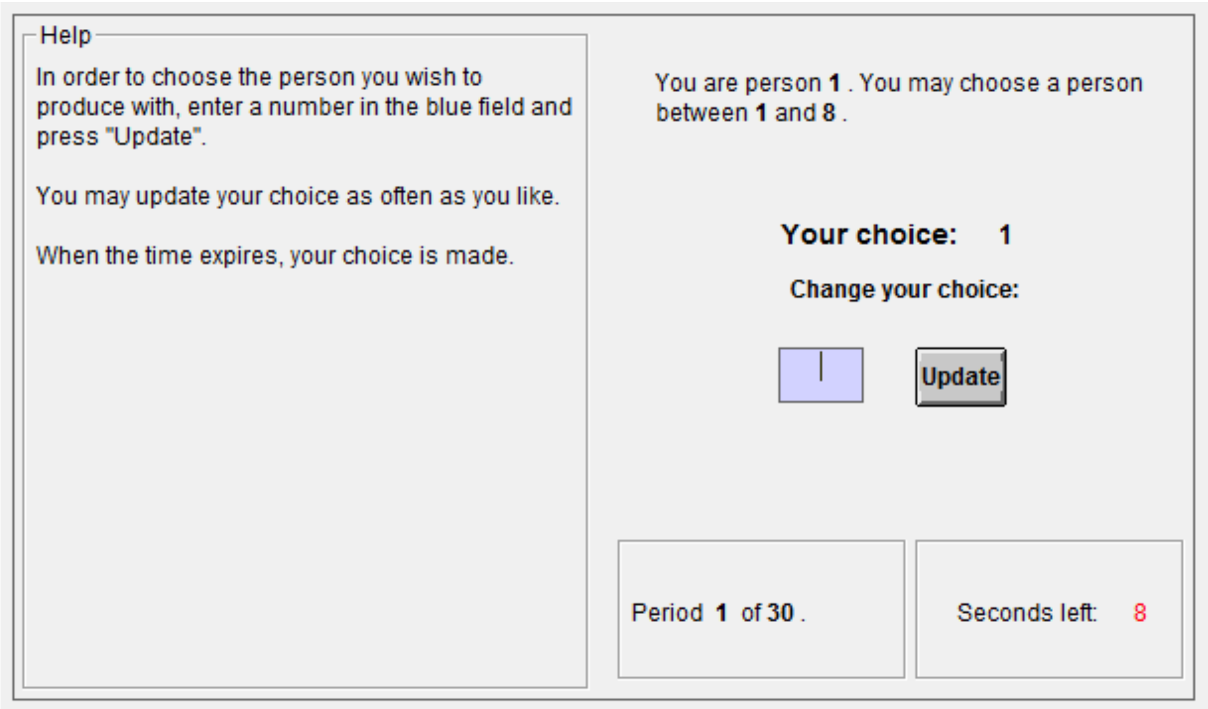

Figure 1. The partner choice stage

After being assigned a partner, the subjects entered the contribution stage. The stage game is a continuous-strategy prisoner’s dilemma (i.e. two-player public good game). In each round, each subject received an endowment of 20 private goods and chose how much of the endowment to use in production of a public good shared with her assigned partner. The default choice was set to zero contribution, so that the subjects needed to actively engage in production of the public good. In the instructions, we used the neutral terms ‘blue item’ for the private good and ‘red item’ for the public good. The instructions explained the stage game payoff structure as follows:

$$\pi_i = 20 - x_i + 0.7(x_i + x_j),$$

where π_i denote own payoff, and x_i and x_j denote own and partner's contribution, respectively. The marginal cost of contributing is 1, and the private marginal benefit is 0.7. As the marginal cost of contributing exceeds the marginal private benefit, subjects have incentives to keep their endowment in the stage game.

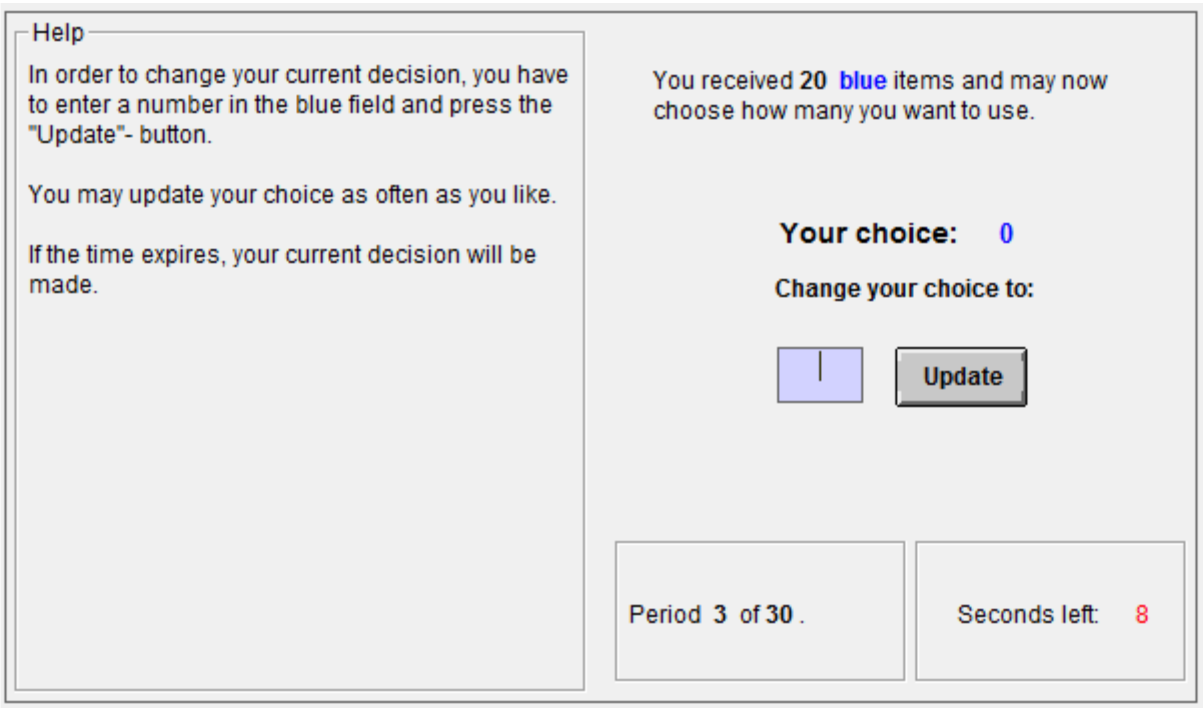

Figure 2. The contribution stage

After the contribution stage, all participants saw on their screen their own private history so far. They knew their previous payoffs and the identity of their previous partners. As this is a two-player game, each player may infer her partner's previous actions.

The Random matching condition is identical with the Choice condition expect that in each round the subjects were randomly assigned a partner drawn from the fixed group of eight participants. We chose this baseline for two reasons. First, it allows us to isolate the effect of choosing partners. By contrast, a fixed matching baseline would necessarily confound the effect of choice with the number of potential partners.[5] Second, we wanted to explore how reciprocal cooperation gets going. In the random matching condition, there is a low (but slightly positive) probability of interacting again with a given partner. In the partner choice condition, partnerships may transform from initially random to stable over time.

The Chat & Random condition was identical to the Random condition except that at the end of each round, all participants in the group of eight could communicate in a common chat room for 25 seconds. All subjects in this chat room observed each written message. Subjects were identifiable by their identity numbers. There were no other restrictions on the chat except that participants were asked not to give up their personal identity nor use improper language. Figure 3 displays the layout of the chat room.

[5] Suppose the effect of partner choice compared to a fixed matching baseline. This baseline would keep the number of stage game partners fixed but in order to allow for partner choice, the partner choice condition needs subjects to choose partners from a larger list of subjects. Then, the number of *potential* partners will systematically differ between the fixed matching baseline and the endogenous matching treatment. All behavioural mechanisms that impact on cooperation through the number of potential partners will then systematically differ between the baseline and choice condition. Thus, there is an omitted variable. However, with random matching, we hold both the number of stage game partners and potential partners fixed.

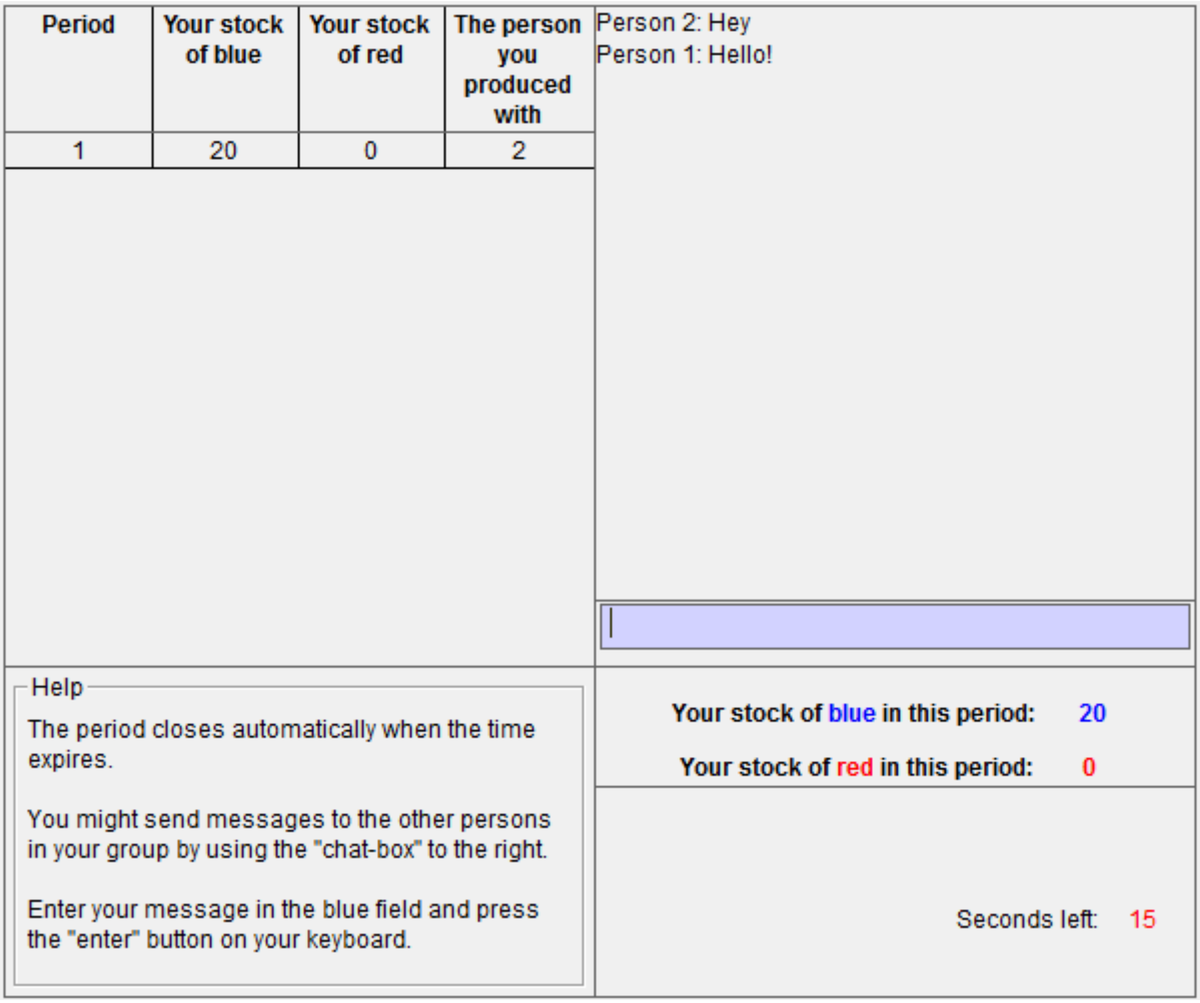

Figure 3. Information screen w/Chat. In the random matching condition, the northeast field was left blank.

In the final treatment, Chat & Choice, subjects were both allowed to choose a partner prior to the contribution stage and to communicate with all others in their group at the end of each round. Thus, chat was allowed prior to each matching decision (except initially). This made it possible to coordinate and form partnerships in the chat room. Thus, the players could resolve the coordination game inherent in the partner selection stage.

We summarise the sequences of the stage game as follows:

(1) Choice of partner. This phase is only for the conditions with partner choice (10 seconds) (Figure 1).
(2) Information about assigned partner (5 seconds).
(3) Production phase (10 seconds) (Figure 2).
(4) Information screen about received items and previous partner (Figure 3). For the Chat condition, there was a chat room in the northeast corner of the screen. In the no chat condition, this space on the screen was empty. This phase lasted 25 seconds for the Chat condition and 10 seconds without chat.

2.2.Experimental Procedures

Participants were recruited via email from a first-semester undergraduate student population of the social sciences, natural sciences and humanities faculties at the University of Bergen, Norway. A total of 128 students participated, 32 in each treatment. Each student participated in only one session. One session consisted of 16 subjects randomly divided into two groups of eight subjects. We ran eight sessions: four sessions on two consecutive days. Each day, we used the same session times, and we randomly assigned the order of treatments to the different times. The same experimenters, experimental setup and rooms were used.

The payment to participants followed a double blind procedure. Upon arrival, the participants were randomly assigned to a computer by drawing scraps of paper lettered from A to P). Participants were separated by dividing walls during the course of the experiment. When the experiment ended, all subjects answered control questions while one of the experimenters prepared the payments in closed envelopes in another room. He then gave a second experimenter the envelopes. Each participant left the room and exchanged her scrap of paper with the letter code with the corresponding envelope.

Each participant was paid 100 Norwegian kroner (16.8 US dollars at that time) for showing up on time. On average, the experiment lasted 45 minutes and participants earned a total of 204 Norwegian kroner (34.2 US dollars). This constitutes an average hourly payment of 272 Norwegian kroner (45.6 US dollars), well above the average hourly wage for undergraduate students in Norway.

3. Results

3.1. Overall Contributions

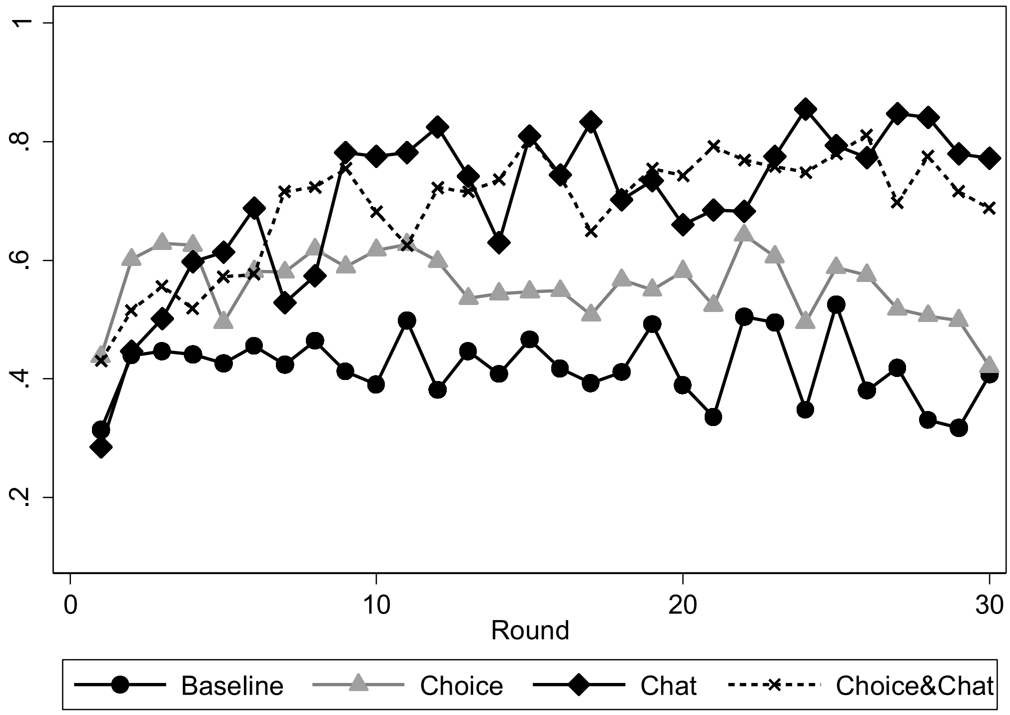

Figure 4. Average cross-sectional contributions over time (%), by treatment.

Partner choice increases the average contribution by 13.9 percentage points compared to the random matching condition, a 33.2% increase. This difference is statistically significant according to a Wilcoxon-Mann-Whitney test (p = 0.057, one-sided) and a Robust Rank Order test conducted on group averages (p = 0.05, one-sided).[6] The Robust Rank Order test relaxes the assumption of the Mann-Whitney test that the observations are drawn from populations with identical higher-order moments, and thereby allows for a clean interpretation of the test result even in a setting in which the population distributions have unequal shape (Feltovich, 2003). OLS regressions (Table A.1, Appendix A) also suggest a significant time-constant effect of partner choice on contribution ($p < 0.05$).[7]

[6] We use one-sided tests only in comparing partner choice to random matching and chat to random matching because prior theoretical and empirical literature allowed for a clear directional prediction in advance. For all other tests for which we had no clear directional prediction a priori we report two-tailed tests. All p-values for the non-parametric tests are from small-sample tables in Siegel and Castellan (1988).

[7] In the regression analysis, we cluster the standard errors on the group of eight potential interaction partners. These procedures correct for dynamic session effects resulting as the subjects interact repeatedly within fixed clusters (Fréchette, 2012). The regression results are robust to the Wild Cluster Bootstrap procedure suggested by Cameron et al. (2008) to deal with small sample bias in the cluster-robust variance estimator. Specifically, the null hypothesis

The positive effect of partner choice on contribution is noticeable as subjects in the partner choice condition, only have their own personal experience to go on. They only know the identity tags of previous partners and their own earnings. Moreover, to form a partnership both subjects need to pick each other, which is not easy to coordinate upon. Our baseline treatment itself has a rather high **and stable** cooperation level, possibly since identity tags are visible in this baseline (Kandori, 1992 and Huck, 2012). For these reasons, the effect of partner choice may be a lower bound. **Our estimates of the effect of partner choice is somewhat muted relative to Rigdon et al. (2007). They study a repeated two-person trust game where subjects are either i) randomly matched or ii) matched based on trust levels in the first rounds.[8] They observe a large treatment effect and a standard declining pattern of trust in the random condition. Subjects in our experiments are visible by an identity tag. Visibility of identity tags has been shown to stabilize cooperation in a repeated trust game with random matching (Huck et. al., 2012). Thus, our baseline is "stronger" than the standard baseline, which could cause the somewhat unusual stable pattern of contributions here and leave less room for a strong effect of partner choice. In contrast, in Rigdon et al. (2007) the baseline condition is more standard (identity tags are anonymous) and there is a downward trend in trust levels over time.**

Chat increases contributions considerably; on average, contributions are 28.2 percentage points higher (a relative increase of 67.4%). This increase is statistically significant according to both a Mann-Whitney test ($p = 0.014$, one-sided) and a Robust Rank Order test ($p < 0.01$, one-sided). The result also holds in linear regressions reported in Table A.1 in Appendix A. The chat increases the level of contributions ($p < 0.01$) and the difference increases over time ($p < 0.01$). This result mirrors previous findings that chat room communication improves

of no difference between Random matching and Choice is rejected against the alternative $\mu_{Choice} > \mu_{Random}$ at the 5 percent level.

[8]Subjects are unknown about the matching procedures; the instruction is the same in both conditions. This differ from our experiment as our subjects in the choice conditions knows the matching procedure.

contributions (Bochet et al., 2006; Oprea, Charness & Friedman, 2014), and that communication in general increases cooperation (Sally, 1995).

However, chat does not further increase the effect of partner choice. We cannot reject the null hypothesis that the effect of the chat is identical with and without partner choice opportunities (p> 0.10, interactions terms Choice*Chat and Round*Choice*Chat table A.1 in appendix A). We consider possible explanations for this finding in section 3.4 when analysing the chat transcripts.

3.2. First- and Last-Round Cooperation

To elaborate about the mechanisms behind our results, we start by considering the first and last round of the experiment separately. First-round contribution says something about whether treatment affects players' *expectations*. Reciprocators and free riders may expect future return from cooperating if they manage to attract cooperative partners, therefore increase their contributions, whereas cooperative types may anticipate greater contributions in this environment, and therefore contribute more. Last-round effects abstract for such expectation effects or reputational effects as there is no future in the game. Figure 5 displays the distribution of contributions over conditions disaggregated into the first and last rounds of the experiment.

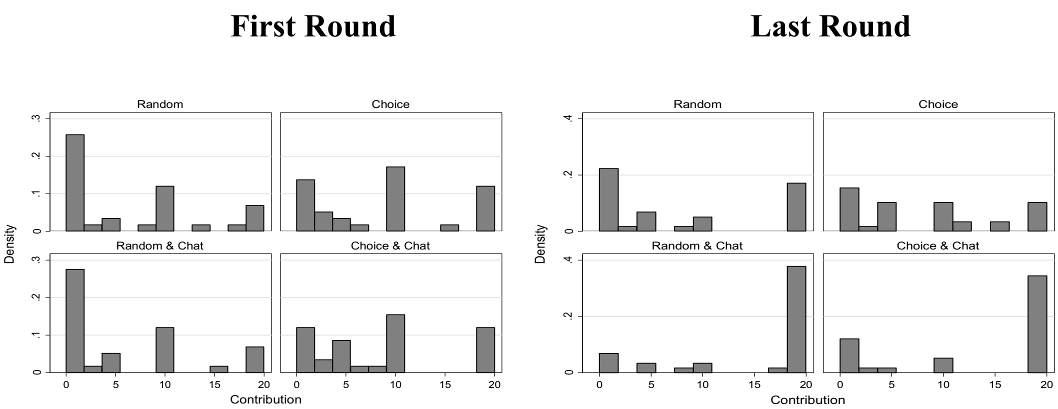

Figure 5. Distribution of contributions over conditions, first round and last round.

We expect higher contribution in the first round in the partner choice conditions than in random conditions. By giving up current earnings, subjects provide a costly signal that they want to be chosen as a partner in the future. Testing for this mechanism, we compare first-round contributions in the partner choice and random matching conditions.

In the first round, subjects in the Choice treatment on average contribute 12.3 percentage points more than subjects in the Random condition ($p = 0.064$, WMW, one-sided). Contributions in Chat & Choice are 14.5 percentage points higher than in Chat & Random ($p = 0.034$, WMW, one-sided).[9] Moreover, the pooled effect of partner choice is also statistically significant ($p < 0.01$, WMW, one-sided and OLS-regression). This difference in first-round contributions is consistent with the idea that partner choice evokes investments in a reciprocal partnership in the future.

An objection to this signalling interpretation is that a subject's contribution may reflect a reward for being chosen as a partner. Recall that before the subjects enter the contribution stage, they are informed whether they have been chosen by their preferred partner or randomly assigned. If chosen, the positive contribution could reflect a reward for being chosen. However, as there are no mutual matches in the first round, it seems as though we may rule out rewarding for being chosen as partner as an explanation.

In the last round, cooperation cannot be considered to be an investment signal because there is no future to invest in. Thus, expectations about future behaviour should not matter for subjects' decisions. There is, however, a history of play that may affect last-round contributions. As we inform the subjects about their partner's identity number, contributions in the last round could be an expression of reciprocity or altruism. Past play will also form players' beliefs about the partner's willingness to contribute and may therefore induce conditional cooperators to contribute (Fischbacher & Gachter, 2010).

[9] We also find significant differences in robust rank order tests ($p < 0.10$ comparing Random to Choice, $p < 0.05$ comparing Choice & Chat to Chat, one-sided tests), but not in a t-test ($p > 0.10$, one-sided).

Comparing the Choice and Random treatments, there is no difference in the last round (OLS regression, Table A.2 in Appendix A). Hence, the possibility of choosing a partner has no effect on contributions in the last round. This may either reflect the fact that conditional cooperators lose faith in their partner's willingness to contribute as they reach the last stage game (Fischbacher & Gachter, 2010) or that mimickers who so far cooperated for selfish reasons drop their contributions in the last round (Page et al., 2005). It is difficult to clearly distinguish between these possible explanations from our present design.

In the first round, the distribution of contributions seems to be almost identical for the conditions with and without chat. In fact, a Kolmogorov-Smirnov test fails to reject the null hypothesis that the two samples are drawn from the same probability distribution when comparing Chat to Random (p = 0.99) and Choice & Chat to Choice (p = 0.99). This suggests that the expectation of a chat room does not lead to differences in behaviour in the first round.

The Chat condition has a substantially higher level of contribution in the last round than the Random treatments do. The difference is 36.6 percentage points and statistically significant.[10] Hence, chat seems to have a lasting influence on cooperation.

3.3. Reciprocity Evolving

To probe deeper into the mechanisms behind the effect of partner choice, we analyse the dynamics of the partner choice condition. The partner choice opportunity may lead cooperative individuals to repeatedly match and avoid selfish types. Thus, we believe that reciprocity will play a greater role in this treatment as reciprocators may sort together and sustain reciprocal cooperation between them. In this section, we therefore test whether i) partner choice leads to greater partnership stability, ii) whether this partnership stability reflects sorting into pairs based

[10] $p = 0.014$ in a one-sided WMW on group averages in the la1st round, $p < 0.001$ in an OLS regression with clustered errors. The interaction term between Choice and Chat is -9.8 percentage points and is not significant ($p = 0.497$).

on differences in contribution patterns and iii) whether the overall effect of partner choice is driven by these mechanisms.

When subjects can choose partners, they may form lasting partnerships. Figure 6 confirms that this is indeed the case. The pattern in Figure 6 is confirmed by a linear regression reported in Table A.3 in Appendix A. Partner choice significantly increases the probability of keeping one's partner over time (p < 0.01, two-sided). **Also, non-parametric Spearman rank correlations conducted at the group level between round and the frequency of kept partners is high, positive and statistically significant in both the Choice (Spearman's ρ = 0.48, p < 0.01) and the Choice & Chat (Spearman's ρ = 0.50, p < 0.01) condition.**

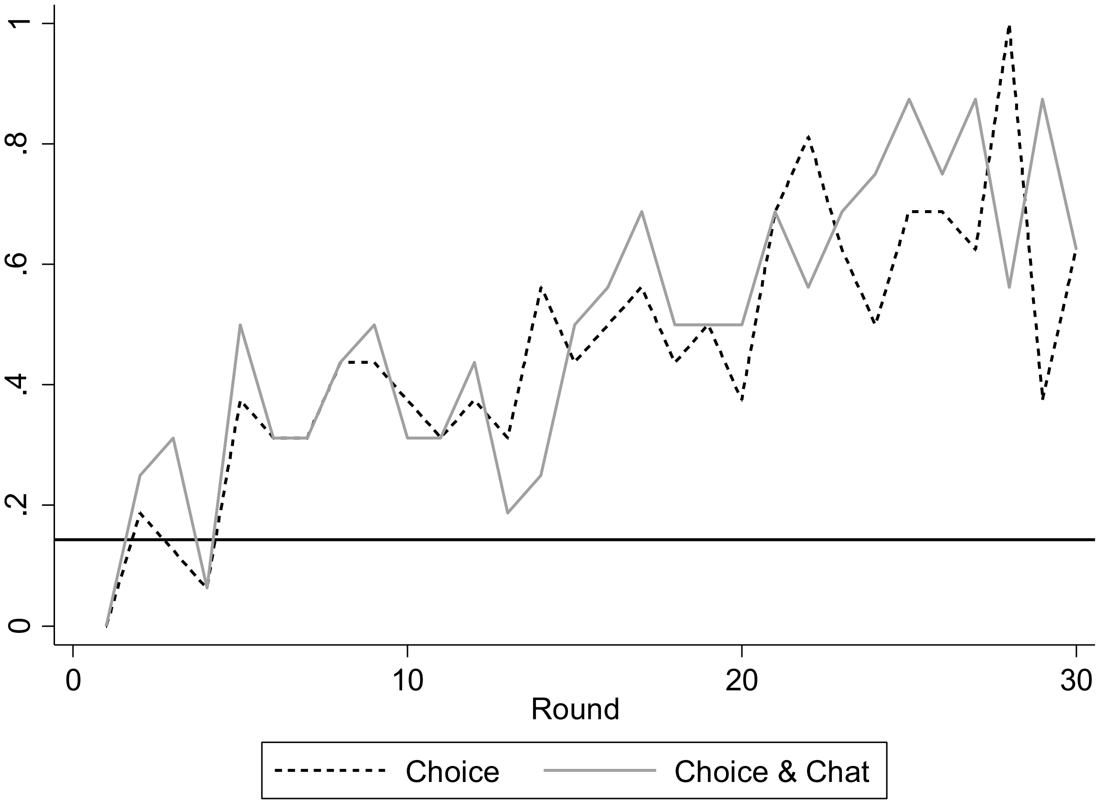

Figure 6. Frequency of kept partners in conditions with partner choice. The black line is the theoretical probability ($p = 1/7$) of keeping a partner assuming random pair formation.

Higher partnership stability reflects the fact that some players mutually agree to form a pair. Over the course of the experiment, 91.2% of all partner choices in the Choice treatment express a desire to find a partner to match with, whereas only 36.5% of these choices are successful.[11] Those who find each other tend to continue picking each other; if we consider individuals in mutually formed pairs in the last round of the game, these subjects on average kept their partner 84% of the time in the last ten rounds. Thus, some subjects entering into stable partnerships with their desired partner primarily drive the pattern in figure 6. The others express a desire to find a partner, but do not manage to find one and are therefore stuck with the other unsuccessful subjects.

If subjects sort together based on contribution patterns, we should expect higher correlation between own and partner's contribution in the condition with partner choice than with random matching. The overall pairwise correlation coefficient in the Choice condition is 0.36, whereas the corresponding number for the Random condition is only 0.05. As a test, we compute the pairwise correlation within each independent group of these two conditions. Then, we rank these group observations and test for distributional differences between the two conditions. A Wilcoxon-Mann-Whitney test suggests significantly greater (and positive) interdependence of observations in the Choice condition than the Random condition ($p = 0.03$, two-sided). This suggests that cooperators tend to sort together in the voluntarily chosen pairs.[12]

Also consistent with sorting, we see that the voluntarily formed pairs have much higher contribution levels than randomly formed pairs within the Choice condition. In fact, on average the contribution level in voluntary pairs is 36.3 percentage points higher than in the random pairs. Figure 7 displays the differences in contribution levels between pair types within the Choice condition.[13]

[11] For the Choice & Chat treatment, the corresponding figures are 87.1% and 46.6%, respectively.
[12] We also test in a linear regression (appendix A, table. A.3) whether partners are kept based on their previous contributions. We find a significant interaction between one's partner previous contribution choice and the Choice condition on the probability of keeping a partner ($p < 0.01$, two-sided).
[13] We observe the same patterns when comparing voluntarily and randomly formed pairs within the Choice & Chat condition.

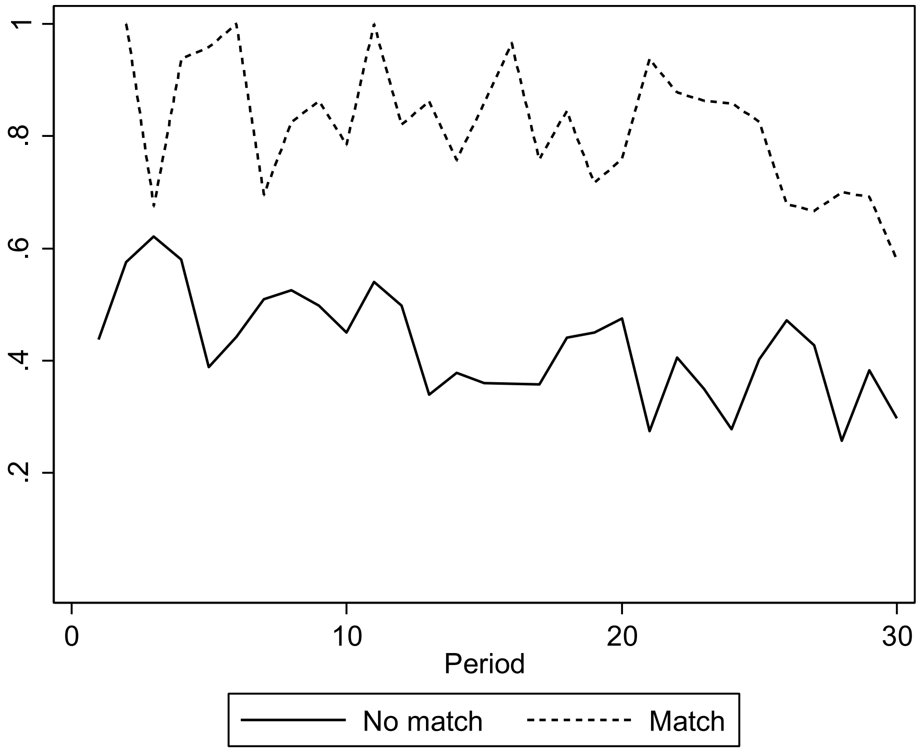

Figure 7 Average contribution (%), no match vs. match, Choice condition.

If the Choice condition allows reciprocal subjects to sort together and interact repeatedly, it also allows them to sustain reciprocity between them. However, in the Random matching condition subjects do not control their partners and so cannot sustain reciprocity in a systematic way. Thus the partner choice condition may lead to greater levels of reciprocity than the Random condition. To explore this possibility, we interact the treatment indicators with a feedback term (the last partner's chosen contribution) to test for differences in reciprocity between treatments. The interaction between partner choice and reciprocity is economically sizeable and statistically significant ($p < 0.01$, two-sided, OLS regression). Table 2 displays the regression results.

Table 2.

OLS Regressions, Individual Contribution in Round t (%)

	(1)	(2)
Choice	0.162**	-0.0166
	(0.0661)	(0.0611)
Chat	0.101**	0.114**
	(0.0447)	(0.0513)
Choice*Chat	-0.125	-0.105
	(0.0916)	(0.0976)
Round	-0.000983*	-0.00180**
	(0.000489)	(0.000764)
Round*Choice	-0.00117	-0.000980
	(0.00122)	(0.00103)
Round*Chat	0.0116***	0.00967***
	(0.00126)	(0.00112)
Round*Choice*Chat	-0.00170	-0.00303
	(0.00311)	(0.00188)
Last partner's contribution ($y_{j,t-1}$)		0.00312**
		(0.00113)
Choice*$y_{j,t-1}$		0.0150***
		(0.00396)
Chat*$y_{j,t-1}$		0.000335
		(0.00189)
Choice*Chat*$y_{j,t-1}$		-0.00250
		(0.00525)
Constant term	0.420***	0.407***
	(0.0417)	(0.0493)
Other controls	Yes	Yes
N	3840	3712

Cluster-robust standard errors in parentheses (clustered on group of 8)
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The variable $y_{j,t-1}$ captures the effect of a unit-change in the partner's last contribution choice on the percentage of the endowment contributed in round t

As shown in column 2 of table 2, the choice effect in Column (1) is now estimated to effectively zero. However, the interaction term between the previous partner's contribution and the choice option is large and statistically significant. These results suggest that reciprocal cooperation increases when partner choice is possible, possibly due to reciprocal subjects sorting together and avoiding free riders. As the effect of the Choice dummy shifts from positive to zero and the interaction term is large and significant, it seems as though this interaction accounts for the observed variation in contributions between the Choice and Random conditions.

3.4. Promises in the Chat Rooms

As previously noted, chat room communication greatly increases cooperation. This result is in line with previous findings (e.g. Bochet et al., 2006). We also noted that we do not find evidence in favour of a positive interaction effect between partner choice and chat room communication. In order to throw light on the mechanisms behind these results, we turn how the chat is used to shape cooperation.

In analysing the chat transcripts, we follow a similar procedure as Wilson and Harris (2017).[14] We divide the chat into three phases: (1) establishing a common end, (2) forming pairs to achieve a common end (this phase is only relevant for the conditions with partner choice), and (3) maintaining the cooperative spirit to achieve the common end established in phase 1. Our design allows us to compare how language is used in an environment with random matching within a fixed group of eight subjects (the Random & Chat condition) and a condition where there are partner choice opportunities within the fixed group of eight subjects (the Choice & Chat condition). Committing to cooperate prescribes that one should promise to oneself to perform certain actions. According to David Hume, when a man promises anything, he expresses a resolution of performing. Lab participants bring their conventions into the lab, and we expect to observe promises in the chat transcript.

[14] In Wilson and Harris (2017), the subjects had to discover the cooperative problem. In our design, we follow standard procedures and inform the subjects about the payoff structure. Note that providing this information does not guarantee that subjects understand the cooperative problem in the same way as the experimenter does. Hence, also in our experiment, subjects may still have to discover what is right to do in this situation.

In all groups - both in the random and choice conditions - we observe the first phase where subjects establish a common end. We observe the following chat in a group in the random condition in round 3:

7: Use 20 each time!

5: 20 blue?

6: I do

2: ALL IN BLUE

In another group, the subjects establish a common end of making the same choice. They started with 10 blue units in round 6 and gradually increased to 20 in round 11. We note that promises followed immediately after stating a common goal like "all use 20" followed up with promises like "I do" and "yes". Most subjects kept their promises, but not all. Also, in the Choice & Chat condition, subjects tend to focus on step (1), establishing of common end within the fixed group of eight, prior to focusing on their specific partnership. This is contrary to our initial hypothesis that subjects would use the chat to establish pairs and maintain a common end within this pair. Rather, in the Choice & Chat condition, subjects seem to first establish a common end, and thereafter form a partnership.

We observe formation of partnerships based on promises in all group except one, but relatively few subjects used the chat for this purpose. An example of this is the formation of a partnership between participants 1 and 7 from round 16 and onwards:

Round 16	1: choose 20 with me?
	7: I'm with you 1
Round 17	1: helo 7 choose 20

7: ok I choose 20 with 1

Round 18 7: Lovely 1

1: woho, you and me 7

7: once more num. 1!!

Both participants kept their promises. They continue to be partners and contribute 20 to the end of the game.

Maintaining the cooperative spirit depends on praise for cooperative actions and blame for non-cooperative actions. We observe both praising and blaming in all chat rooms. Examples are “lovely 1”, “Person 2, I do not like you”, and “8 is greedy”. In both the Random & Chat and the Choice & Chat condition, the chat transcripts reveal that participants try to persuade the other participants to continue to cooperate; “be solidary, take 20”, “guys, choose 20 blue”, “20 blue = CASHH”, “everything else (i.e. not contribute 20 blues) is mongo”, and “all give 20!”. **Also, in the maintaining phase, subjects use persuasion** embedded with promises like “I give 20 every round”, and a participant responding “Me too” in the random condition.

4. Conclusion

Our experiment demonstrates that mutual partner choice increases cooperation in a repeated prisoner’s dilemma game and facilitates the formation of lasting reciprocal partnerships. In most prisoner’s dilemma experiments, the experimenter sets the interaction structure (who plays with whom and for how long). In a repeated game, the structure is often either random matching or continuous interaction with the same partner throughout the game, with no opportunity to switch partners. A more market-like matching structure allows individuals to choose their partner. We show that allowing for partner choice changes the pattern of interactions from random matching to something that resembles fixed matching. This echoes a finding by Brown, Falk and Fehr (2004), who noted that, in a market setting, lasting business partnerships form in the absence of contractual enforcement.

We also show that communication in a chat room improves cooperation in repeated prisoner's dilemma situations. The chat transcripts reveal that subjects seem to use chat to establish a common end in both the random and choice conditions. In contrast to what we initially expected, subjects do not use the chat a lot in the process of finding partners to match with. Rather, the chat is used in a quite similar way in the two different conditions with a chat room – subjects tend to focus on establishing a common end at the level of the group of eight subjects, and thereafter focus mainly on maintaining that common end. They do this by engaging in promise giving and persuading others that the right thing to do is to cooperate. As chat is used in a similar way in the different conditions with chat opportunities, it is not puzzling that the effect of chat is similar in random and in the choice conditions. However, we cannot rule out the possibility that a different design setup would lead to a different result; In a setting where establishing a common end at the group level is infeasible (for instance if the chat is in pairs), it is possible that subjects would use the chat as we initially hypothesized.

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Appendix A: Regression tables

Table A.1

Estimates of Treatment Effects in Linear Regressions

	OLS
Choice	0.162**
	(0.0661)
Chat	0.101**
	(0.0447)
Choice*Chat	-0.125
	(0.0916)
Round	-0.000983*
	(0.000489)
Round*Choice	-0.00117
	(0.00122)
Round*Chat	0.0116***
	(0.00126)
Round*Choice*Chat	-0.00170
	(0.00311)
Constant term	0.420***
	(0.0417)
Demographic controls	Yes
N	3840

Cluster-robust standard errors in parentheses (cluster id: Group)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.2

Linear Regression on Last-Round Contributions (%)

	(1)	(2)
Choice	0.0141	0.0219
	(0.0999)	(0.114)
Chat	0.366***	0.333***
	(0.0805)	(0.0992)
Choice*Chat	-0.0984	-0.0911
	(0.141)	(0.149)
Female		0.123
		(0.0734)
Experience		0.0797
		(0.0673)
Constant	0.406***	0.321***
	(0.0780)	(0.0943)
N	128	128

Cluster-robust standard errors in parentheses (clustered on group)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3

Linear Probability Model, Probability of Keeping Partner from Last Round

	(1)	**(2)**
Choice	-0.0241	-0.239***
	(0.0795)	(0.0449)
Chat	0.0173	-0.0232
	(0.0401)	(0.0451)
Choice*Chat	-0.0131	0.0866
	(0.131)	(0.145)
Round	0.000139	-0.000810
	(0.00103)	(0.00117)
Round*Choice	0.0195***	0.0198***
	(0.00296)	(0.00315)
Round*Chat	-0.00133	-0.00228
	(0.00227)	(0.00259)
Round*Choice*Chat	0.00332	0.000382
	(0.00654)	(0.00629)
Last partner's contribution ($y_{j,t-1}$)		-0.000463
		(0.000916)
Choice*$y_{j,t-1}$		0.0233***
		(0.00514)
Chat*$y_{j,t-1}$		0.00420***
		(0.000948)
Choice*Chat*$y_{j,t-1}$		-0.00835
		(0.00617)
Constant term	-0.873***	-0.853***
	(0.0262)	(0.0282)
Demographic controls	Yes	Yes
N	3840	3712

Cluster-robust standard errors in parentheses (Cluster id: Group)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$