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EIRIK STRØMLAND, SIGVE TJØTTA
AND GAUTE TORSVIK

RECIPROCITY EVOLVING: PARTNER CHOICE AND COMMUNICATION IN A REPEATED PRISONER'S DILEMMA

UNIVERSITAS BERGENSIS

Department of Economics
UNIVERSITY OF BERGEN

Reciprocity Evolving: Partner Choice and Communication in a Repeated Prisoner's Dilemma[1]

Eirik Strømland
Department of Economics, University of Bergen
Hermann Fossgate 6, 5007 Bergen, Norway

Sigve Tjøtta
Department of Economics, University of Bergen
Hermann Fossgate 6, 5007 Bergen, Norway

Gaute Torsvik
Department of Economics, University of Oslo
Moltke Moes vei 31, Eilert Sundts Hus, 0317 OSLO, Norway

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Abstract

Through what mechanisms do individuals enforce cooperation? In this paper, we show experimentally that partner choice by mutual consent improves cooperation compared to random matching of subjects. We find that partner choice is used to establish lasting reciprocal partnerships and thus that partner choice may be a force in the evolution of reciprocal cooperation. There is no additional impact on cooperation by allowing for both chat and partner choice. Our findings suggest that partner choice will improve cooperation in settings where ongoing group communication is infeasible, but not when there are opportunities to use large-scale communication to enforce cooperation.

Keywords: Cooperation, Partner Choice, Communication, Reciprocity, Prisoner's Dilemma
JEL Codes: C91, C92

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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

In most markets, trade is governed by incomplete contracts. Even though this creates a problem of cooperation, we often observe that firms maintain product quality when they could get away with cheating. In this paper, we show that a defining feature of markets – the freedom to choose partners – increases cooperation and ultimately leads to the evolution of reciprocity.[2] In a setting with repeated exchange, cooperators use partner choice to establish lasting reciprocal partnerships and avoid free riders. This disciplines people to cooperate even if the immediate material incentives point towards selfishness.

We use a repeated Prisoner’s Dilemma game to examine how the freedom to form partnerships by mutual consent affects cooperation. Each participant was randomly assigned to a fixed group of eight subjects. Within this group, players could freely choose their preferred partner and form a partnership through mutual consent. We compare the outcome of the partner choice treatment to a baseline in which pairs form randomly within the fixed group of eight.

We are not the first to address how voluntary group formation increases cooperation in social dilemmas but we are the first to study a game in which partnerships form dynamically by mutual consent. Our study therefore complements a growing literature showing that different forms of endogenous matching, such as moving around between groups (Ahn et al., 2009; Erhart & Keser, 1999), being matched into groups based on preference rankings for

[2] The term ‘reciprocity’ has different meanings in the literature. For instance, Fehr and Gächter (2000) define reciprocity as the act of responding to friendly actions. In this paper, we stick to the dictionary definition of reciprocity as mutual exchange of favours between the same two individuals. This closely follows the definition of direct reciprocity by Rand and Nowak (2013).

different partners (Page et al., 2005), making a pre-game choice of group (Brekke et al., 2012), voting on who gets to be a part of the group (Charness & Yang, 2014; Cinyabuguma et al., 2005), bidding for partners in a single-bid auction (Coricelli et al., 2004), matching through a stable marriage mechanism (Bayer, 2015), taking an outside option or entering a stage game (Hauk & Nagel, 2001) or making a one-sided choice of partner (Huck et al., 2012) serve to increase cooperative behaviour in social dilemma games. Our matching mechanism is an important addition to this literature; in real life, partnerships often form by mutual consent and one party seldom dictates partnership formation. Moreover, when two parties must agree to form a pair, cooperative types face the coordination problem of finding a similar type of partner. Studies that 'filter' preferences for partners through some optimisation algorithm (Bayer, 2015; Coricelli et al., 2004) may not fully capture this coordination problem inherent to many partner choice situations in real life.

The second novel feature of our experiment is its exploration of the way that partner choice interacts with chat room communication to shape cooperation. As communication facilitates coordination and verbal agreements, cooperators may use communication to find like-minded partners and match with them. Thus, communication may make it easier to establish and maintain a reciprocal partnership. Moreover, communication is often an integral part of forming a partnership in real life. A large literature suggests that communication robustly increases cooperation in social dilemmas (Balliet, 2009; Bochet et al., 2006; Isaac et al., 1988; Orbell et al., 1988; Sally, 1995). Our study adds to this literature by examining if communication can improve the efficiency of partner choice. We are not aware of any studies of this interaction.[3]

[3] Tullock (1999) conducted an experiment in which subjects could freely communicate and choose their game partners in a Prisoner's Dilemma game, and observed high cooperation levels. However, this study did not use control and treatment groups and therefore could not isolate the relative importance of partner choice and communication.

It has been demonstrated theoretically that in a repeated game in which players have incomplete information about the type of partners, the option to leave a partner and form a new partnership can facilitate cooperation (Ghosh & Ray, 1996).[4] Moreover, models in evolutionary game theory show that partner choice facilitates the evolution of cooperative strategies (Izquierdo et al., 2014; McNamara et al., 2008). From a theoretical point of view, we also expect communication to foster cooperation since conditional cooperators may use chat to influence other players' beliefs about the likelihood that their partner will contribute (Rabin, 1993, 1998). Furthermore, in our setting, it is possible that mutual partner choice involves a coordination problem for cooperative players and communication may make it easier for cooperators to form reciprocal partnerships and to avoid selfish types.[5]

We find that both partner choice and chat room communication increase cooperation compared to random matching. The increase is highest (67%) in the treatment with chat. However, there is no further increase in cooperation by combining partner choice and chat. Moreover, there is 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, which then declines slightly over time. In the chat treatment, cooperation is relatively low in the beginning but increases substantially over time. Finally, we find that subjects use the partner choice opportunity to establish lasting reciprocal partnerships, and that this seems to account for the increase in cooperation we observe when comparing random matching to partner choice.

The rest of the paper is structured as follows. First, we summarise the experimental design and procedures. Second, we present and analyse the results from the experiment. Finally, we discuss the main findings in relation to the literature and conclude the paper.

[4] In an earlier paper, Tullock (1985) informally discusses partner choice as a possible disciplining device to attain cooperation in the Prisoner's Dilemma.

[5] Even though our game has a finite number of rounds, the standard prediction of no cooperation in the finitely repeated Prisoner's Dilemma is highly sensitive to relaxing the assumption of common knowledge of player types (Kreps et al., 1982).

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 subjects were fully informed about the rules 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.[6] The experiment was computerised using z-Tree (Fischbacher, 2007).[7] Table 1 displays the different treatments employed, along with the number of subjects in each condition.

Table 1

Main Features of the Experimental Design

	CHAT	
MATCHING	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

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

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 who were not matched by mutual consent were randomly matched with either other 'unsuccessful' subjects or subjects choosing their own 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.

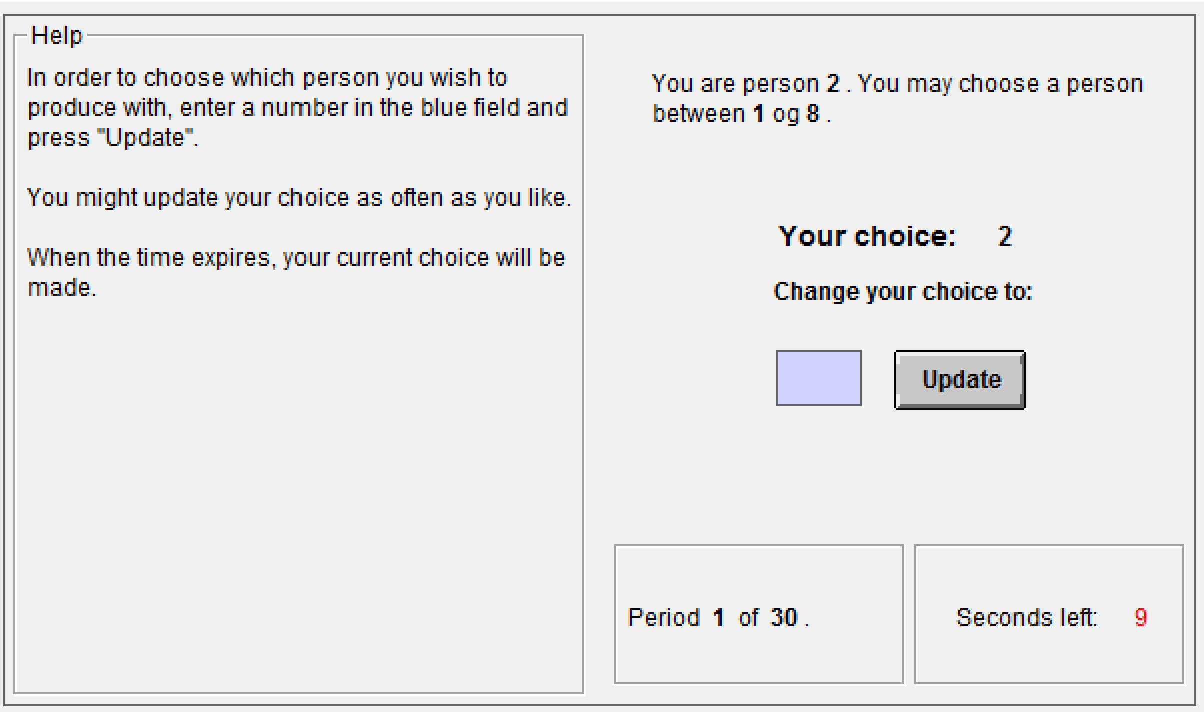

Figure 1. The partner choice stage.

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.

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

As the marginal cost of contributing exceeds the marginal private benefit, the equilibrium in dominant strategies is for each player to contribute zero of her endowment.

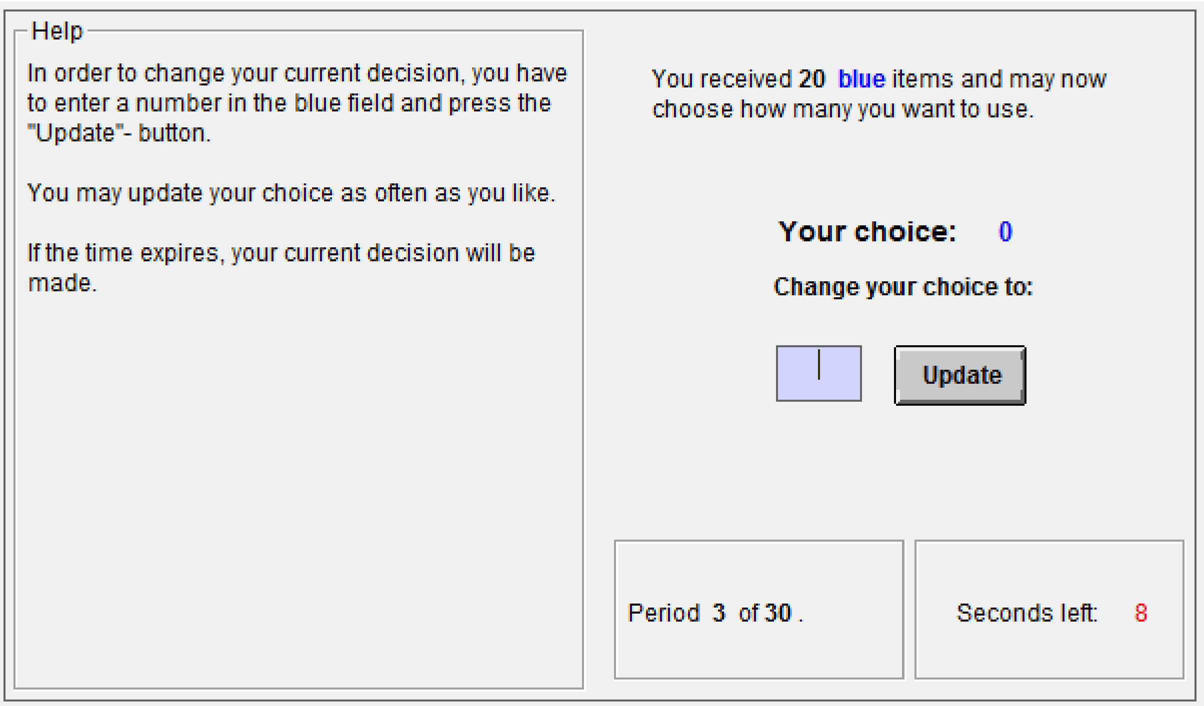

Figure 2. The contribution stage

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.

As a control, we used Random matching. This control was 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.[8] 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.

[8] 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.

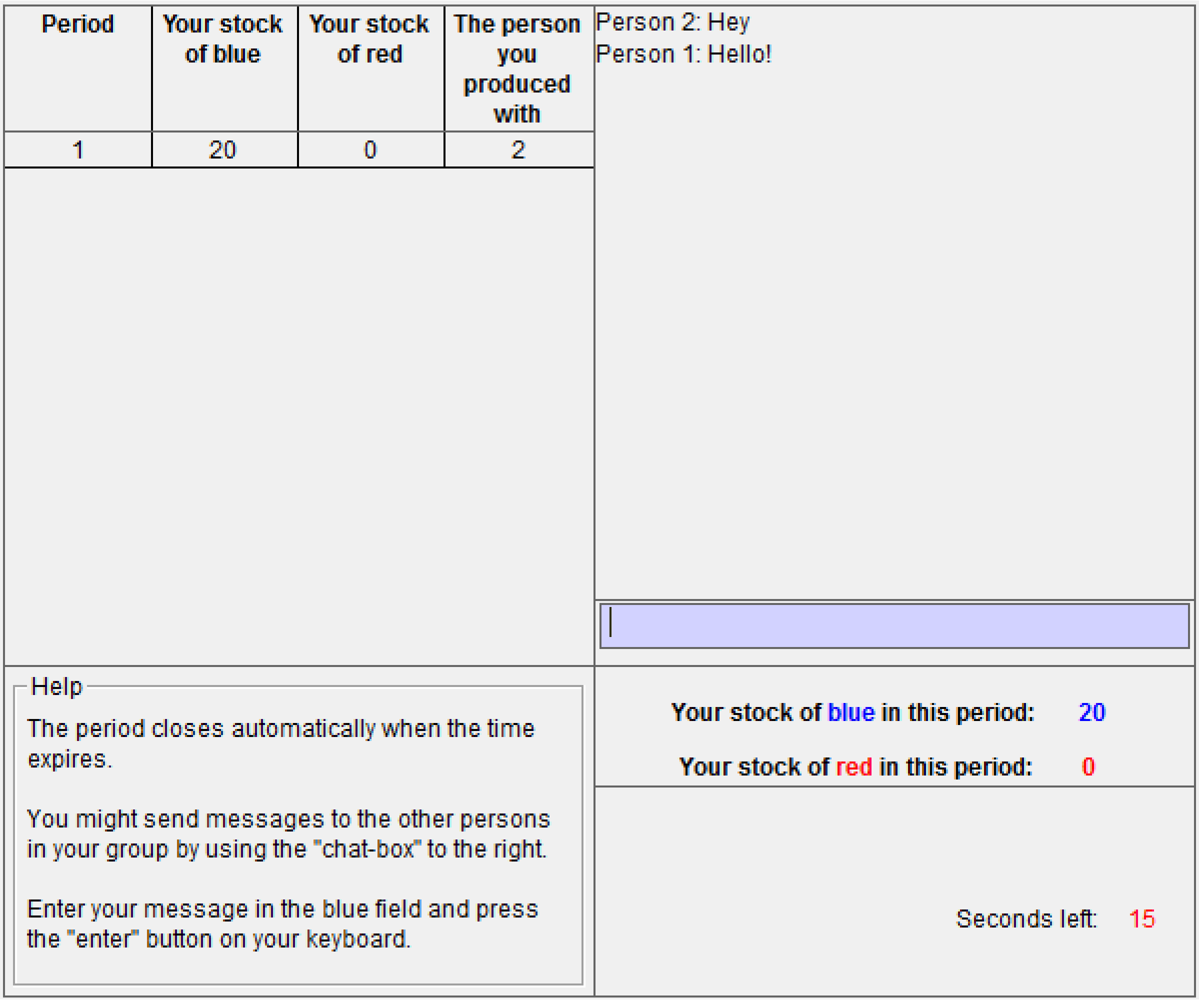

Figure 3. Information screen w/Chat. In the random matching condition, the northeast field was left blank.

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 may summarise the sequence of stages in the experimental 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 was left 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

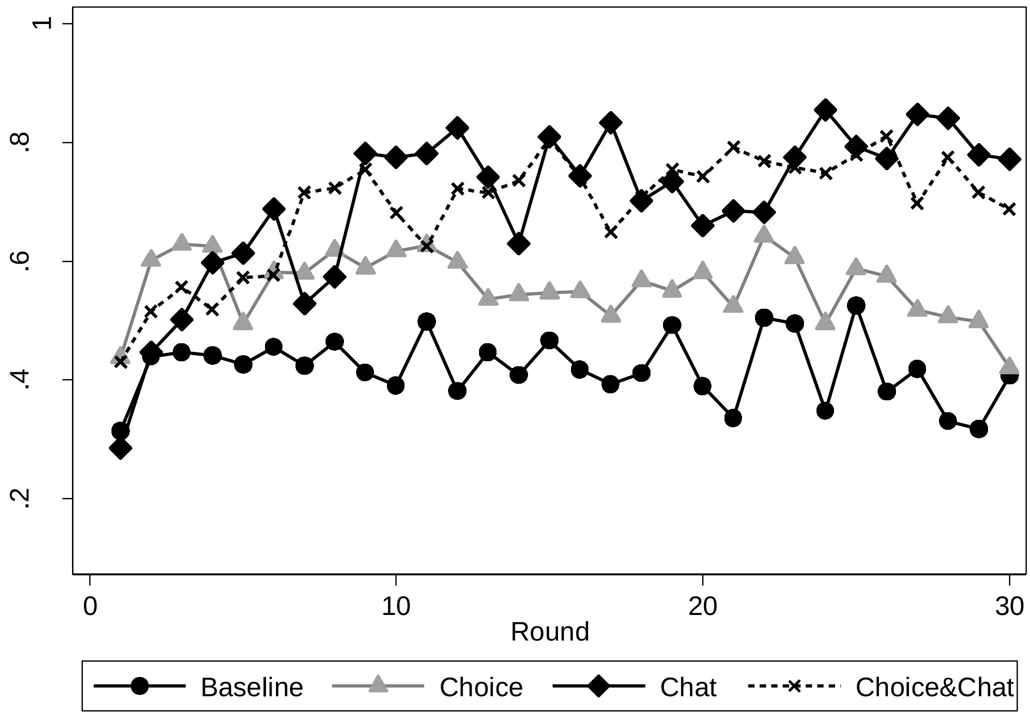

Figure 4. Average cross-sectional contributions over time (%), by treatment.

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).[9] 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,

[9] 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. Elsewhere, two-sided tests are used. All p-values for the non-parametric tests are from small-sample tables in Siegel and Castellan (1988).

2003). OLS regressions (Table A.1, Appendix A) also suggest a significant time-constant effect of partner choice on contribution ($p < 0.05$).[10]

Chat increases contributions considerably; on average, contributions are 28.2 percentage points higher than in the random matching condition (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 contributions (Bochet et al., 2006), and that communication in general increases cooperation (Sally, 1995).

However, there is no statistically significant interaction effect between the Choice and Chat treatment. Contributions in the Choice & Chat condition differs from the Chat condition by only one percentage point.

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

3.2. First- and Last-Round Cooperation

Figure 5 displays the distribution of contributions over conditions disaggregated into the first and last rounds of the experiment.

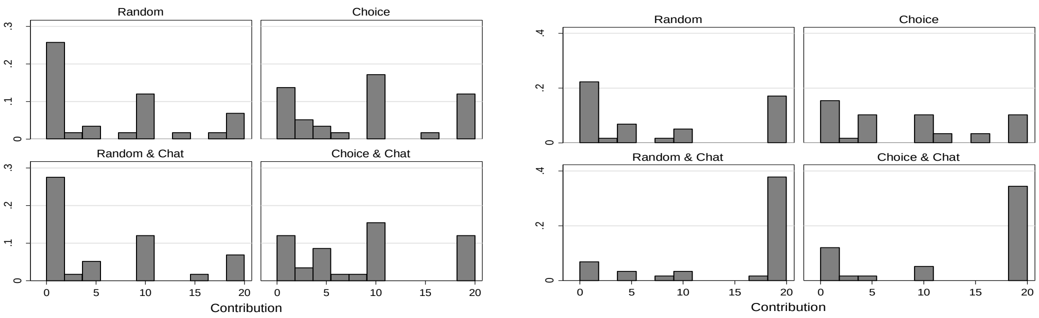

Figure 5. Distribution of contributions over conditions, first round and last round.

First round.

When the first round is compared with random matching, we expect more cooperation in the first round of the game, when partner choice is possible. By giving up current income, 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 partner choice and random matching conditions.

In the first round of play, subjects in the Choice treatment contribute, on average, 12.3 percentage points more than did subjects who played with random matching ($p = 0.064$, WMW, one-sided). Contributions in Chat & Choice are 14.5 percentage points higher than I Chat & Random ($p = 0.034$, WMW, one-sided).[11] This difference in first-round contributions is consistent with the idea that partner choice evokes investments in a reciprocal partnership.

A possible objection to this signalling interpretation is that a subject's contribution may reflect a reward for being chosen as a partner. Before the subjects enter the contribution stage, they are informed whether they have been chosen by their preferred partner or

[11] 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).

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, we may rule out reciprocity as an explanation.

As can clearly be seen from Figure 5, the conditions with and without chat have indistinguishable distributions in the first round. This suggests that even though players know they are identifiable by their fixed identity number, the expectation of a chat room does not lead to reputational signalling by contribution in the first round.

Last round.

In the last round, cooperation cannot be considered to be an investment because there is no future in which to invest. There is, however, a history of play that may affect last-round contributions. Since subjects are informed about their partner's identity number, contributions in the last round could be an expression of altruism or reciprocity. 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).

Comparing the Choice and Random treatments, there is no difference in the last round ($p = 0.89$, OLS regression, Table A.2 in Appendix A). Hence, the possibility of choosing a partner has no effect on contributions in the last round. In stark contrast to this, the Chat condition has a substantially higher level of contribution in the last round of the experiment than the Random treatments do. The difference is 36.6 percentage points and is statistically significant.[12]

A possible explanation for the last-round effect of the Chat treatment could be fear of verbal punishment or shaming (Ellingsen & Johannesson, 2008). Subjects are identifiable in

[12] $p = 0.014$ in a one-sided WMW on group averages in the last 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 ($p = 0.497$).

the chat room by their identity number. This means that chat may be used to express verbal punishment and warnings about free riders. Although we cannot fully rule out this mechanism, we do not find an initial (first-round) increase in cooperation when the opportunity to chat is announced in the instructions. We do not observe much verbal punishment in the chat room, but we cannot rule out that the few instances of verbal reprimand that are present have a large effect on the contribution level.

Another possible explanation for high contributions in the last round of the chat treatment is that communication fosters expectations of a cooperative atmosphere. Following McCloskey and Klamer (1995), communication is information plus 'persuasion and judgement'. This squares well with the interpretation in the literature of communication affecting cooperation either through group identity (Orbell et al., 1988) or promise making (Kerr & Kaufman-Gililan, 1994). Subjects in the Chat condition may have been persuaded to contribute to the public good, and they may continue to contribute in the last round even though there are no future interactions.

The chat transcripts seem to support the interpretation of 'persuasion' as essential for the effect of the chat.[13] An analysis of the chat transcripts shows that a very large fraction (24.7% of all 737 messages in the chat condition) comprises either attempts to get others to cooperate or commitments by oneself to cooperate. Other prominent message types include discussion of the payoff structure (14.2%) and comments on others' past behaviour; either expressions of discontent or rewards for good behaviour (5.7%). A large fraction of messages could be classified as 'small talk', unrelated to the payoff structure or other features of the game.

[13] We focus here on the language patterns in the Chat & Random condition. However, the Chat & Choice condition reveals the same patterns qualitatively. The main difference appears to be that promise making tends to shift from a group focus to a more personal form of communication between partners in a voluntarily formed partnership of the type 'Let us continue to choose 20, number 5'.

3.3. Reciprocity Evolving

To probe deeper into the mechanisms behind the effect of partner choice, we will now analyse the dynamics of the partner choice condition. We are especially interested in how the Choice treatment influences reciprocal cooperation.

From random to reciprocal partner choice.

When subjects can choose partners, they may form lasting partnerships. By construction, the observed frequency of partners kept in the conditions with random matching displays a binomial distribution with low partnership stability. 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).

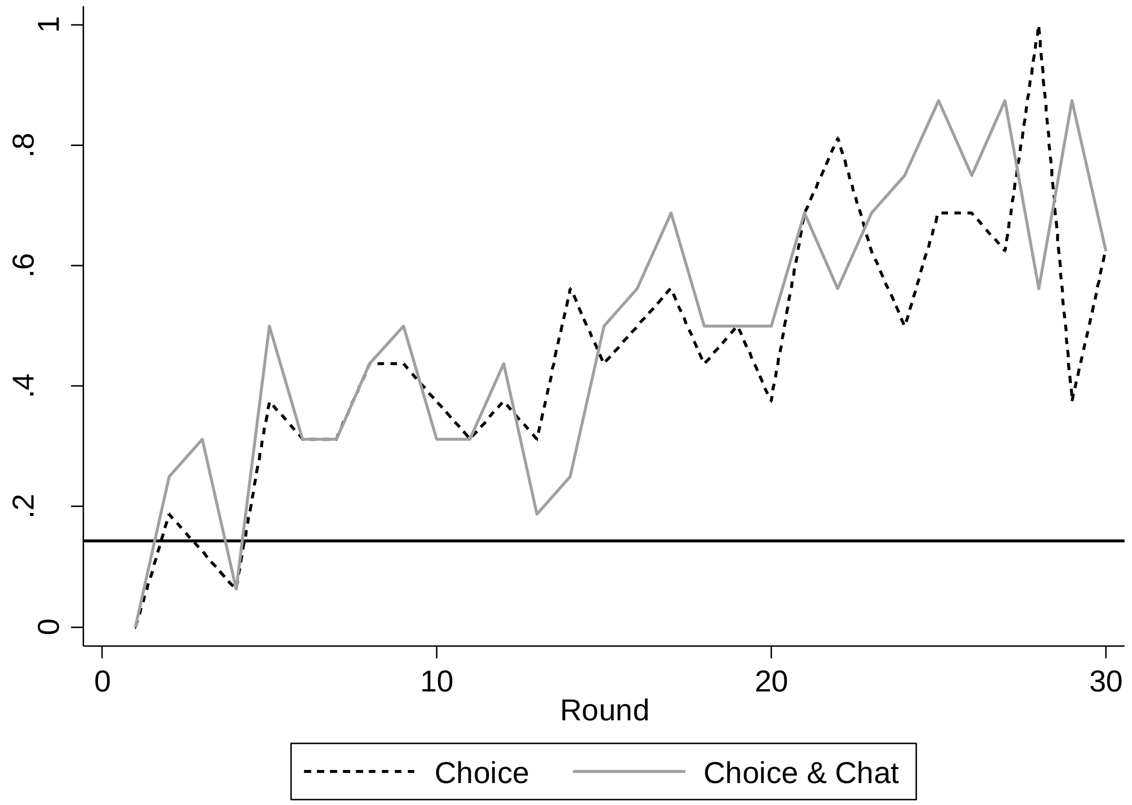

Figure 6. Frequency of kept partners in conditions with partner choice. The black line is the theoretical probability ($p = 1/7$) of keeping a partner assuming random pair formation.

Higher partnership stability reflects the fact that some players mutually agree to form a pair. In fact, 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. As selection into such stable partnerships reduces the number of partners left to randomly match with, a consequence of this is that remaining subjects who did not actively choose each other also keep their partner more frequently.

We expect that subjects self-select into reciprocal partnerships. If that is the case, their decision to hold on to their partner should depend on previous contributions; those who contribute generously to the common good should be chosen more often than low contributors. We should therefore expect a positive interaction effect of past contribution and the partner choice opportunity on the probability of keeping a partner. Obviously, in the random conditions, previous partners' contribution cannot influence this probability. As expected, the interaction is statistically significant in a linear regression ($p < 0.01$, two-sided, Table A.3 in Appendix A).

Partner choice strengthens reciprocal cooperation.

In stable partnerships, it is possible to immediately reciprocate previous actions, and to continue to do so. As partnerships are more stable in the Choice condition, we expect that previous partners' contribution has a stronger positive effect on contribution when participants can choose who they want to interact with. Hence we expect a positive interaction effect between partner choice and the previous partner's contribution. Moreover, the interaction term between the partner choice option and previous partner's contribution should at least partly account for the variation in contributions between the Random and Choice conditions. We use OLS regressions to test this hypothesis, reported in Table 2.[14] As shown in

[14] We use linear regressions instead of a two-limit Tobit model for two reasons. First, linear regressions will generally yield good approximations around mean values of the covariates (Wooldridge, 2010, p. 668). Second,

Table 2, the estimated 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 as a consequence of the possibility for partner choice. Moreover, 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.

for consistency, the Tobit model requires the strong distributional assumption that the error terms are normally distributed conditional on the covariates (Wooldridge, 2010, p. 670).

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

4. Discussion and Conclusion

We have shown that partner choice through mutual consent increases cooperation in a repeated continuous Prisoner's Dilemma and facilitates formation of lasting reciprocal partnerships. This finding points to the importance of partner choice in sustaining cooperation, and may contribute to our understanding of markets governed by incomplete contracts. For instance, internet traders on eBay honour agreements to a much greater rate than would be expected by selfish traders. What stops people from defecting in these situations is that buyers may rate sellers according to their past behaviour, and choose to interact with this seller again based on her reputation score (Tennie et al., 2010).

In most social dilemma experiments, the interaction structure (who plays with whom and for how long) is given by the experimenter. In a repeated game, the structure is either random matching or continuous interaction with the same partner throughout the game, with no opportunity to switch partner. A more natural – market-like – matching structure allows individuals to choose their partner. We have shown that allowing for partner choice changes the pattern of interactions from random matching to something that resembles fixed matching. How the rules of the game shape interaction patterns is an interesting topic for future research.

We have shown that both communication and the freedom to form partnerships improve cooperation in a social dilemma. There is, however, no positive interaction effect of these two conditions. This may be because we have a relatively small pool of individuals who can form pairs. If the pool of possible partners was large, the matching problem would potentially be more difficult. Moreover, large-scale coordination through communication might also be more difficult by itself. Then, communication would perhaps make it easier for conditional cooperators to find each other and to form lasting reciprocal partnerships.

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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)

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

Appendix B: Instructions

Screen 1:

This is an experiment on decisions. We pay in real money. You will receive 100 kroner as show-up payment. In addition, you will earn points that will be converted into money. The total amount in kroner you earn is paid out anonymously in a closed envelope at the end of the experiment.

The experiment consists of three parts: First, you read the instructions. Then, you go through the experiment. Finally, you will be asked to fill out a question form.

Screen 2:

In this experiment, you are person **i**. This number will be fixed the entire time. You have been randomly placed in a group of eight persons. This group is the same during the entire experiment. All the other persons have also received a random number between 1 and 8, which will be fixed the entire time.

The experiment consists of several periods. In each period, you and one other person may produce together two fictitious items, blue and red.

Screen 3:

The experiment consists of 30 periods in total.

{*Only Treatment II and IV*}:

In each period, you must first decide which of the seven other persons you wish to produce together with in this period. You may only choose one person. The other person also has to choose you. If you both choose each other, you produce together in this period. If you do not find another person, you will be randomly placed with one of the other available persons in your group. This also applies if you choose yourself.

{*Only Treatment I and III*}:

In each period, you will be randomly placed with one of the other persons in your group.

Screen 4:

The period continues with a production decision. You and the other person receive 20 blue items each. In order to produce red items, you must use blue items. The number of red items produced depends upon how many blue items you and the other person use.

The production stage lasts for 10 seconds. During these seconds, you must decide how many blue items you will use in the production of red items. This is done by writing a number in the blue field on the screen. You press the Update button to decide how many blue items you want to use in order to produce red.

The production stage automatically closes after 10 seconds, and the number of blue items of your choice will be made as your final decision.

Screen 5: {*only treatment III and IV*}

At the end of each period, you will have the opportunity to chat electronically with the other participants in your group of 8. This chat lasts for 25 seconds per period.

The rules for the chat are as follows:

You are not allowed to reveal your personal identity. Improper language is not permitted either. Violations of these rules will lead to exclusion from the experiment and you will lose your opportunity to receive payment.

Screen 6:

At the end of each period, you will see an overview of your stock of blue and red items, and who you produced with in this period. Only you can see this overview.

The monetary value of the production in a period is dependent upon the stock of blue and red items. You receive 15 øre for 1 blue item and 15 øre for 1 red item.

Screen 7:

As mentioned earlier, you and the other person will receive 20 blue items in each period. Your task is to decide how many of your 20 blue items you will use in order to produce red items and how many blue you want to keep for yourself. Correspondingly, the other person will decide how many of her items to use in order to produce red items or keep for herself.

The number of red items produced is determined as follows:

Number of red items = (The number of blue you use + The number of blue the other uses) x 0.7

Screen 8:

If, for instance, you use 20 blue and the other uses 20 blue, you and the other person will receive 40 x 0.7 = 28 red items each. If you use 10 blue, and the other uses 10 blue, both will receive 20 x 0.7 = 14 red items each.

Your total income in each period is the sum of your stock of blue and red items:

Total income = Income from the stock of blue (= 20 – your choice of blue for production of red items) + Income from the stock of red (= 0.7 x sum of blue items).

Appendix C: Control questions

We ask you to answer the following three questions. This will help you to understand how your income depends upon your stock of red and blue items.

Screen 9:

Question 1

You and the other person have 20 blue items each. Assume that both use 0 of their 20 blue items in order to produce red.

a) How large is your stock of blue items?

b) How large is your stock of red items?

c) How large is the stock of blue items for the other person?

d) How large is the stock of red items for the other person?

Screen 10:

Question 2

You and the other person have 20 blue items each. Assume that both use 20 of their 20 blue items in order to produce red.

a) How large is your stock of blue items?

b) How large is your stock of red items?

c) How large is the stock of blue items for the other person?

d) How large is the stock of red items for the other person?

Screen 11:

Question 3

You and the other person have 20 blue items each. The other person uses 20 of his 20 blue items in order to produce red. How many red items do you have if you use:

a) 0 blue in the production of red – in addition to the 20 blue the other person uses?

b) 10 blue in the production of red – in addition to the 20 blue the other person uses?

c) 20 blue in the production of red – in addition to the 20 blue the other person uses?

Screen 12:

You have answered all questions correctly and this is the end of the instructions. Please raise your hand if you have any questions. If you are ready to continue the experiment, press the Ready button. The experiment starts when everyone has pressed the Ready button.

Institutt for økonomi
Universitetet i Bergen
Postboks 7800
5020 Bergen
Besøksadresse: Fosswinckels gate 14
Telefon: +47 55 58 92 00
Fax: +47 55 58 92 10
www.uib.no/econ/