Synthese (2010) 176:125–147
DOI 10.1007/s11229-009-9487-y

# The medium or the message? Communication relevance and richness in trust games

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Received: 6 February 2009 / Accepted: 6 February 2009 / Published online: 18 March 2009


**Abstract** Subjects communicated prior to playing trust games; the richness of the communication media and the topics of conversation were manipulated. Communication richness failed to produce significant differences in first-mover investments. However, the topics of conversation made a significant difference: the amounts sent were considerably higher in the unrestricted communication conditions than in the restricted communication and no-communication conditions. Most importantly, we find that first-movers' expectations of second-movers' reciprocation are influenced by communication and strongly predict their levels of investment.

**Keywords** Trust · Laboratory experiments · Communication · Social norms · Cooperation · Computer-mediated communication

## 1 Introduction

In recent years there has been an upsurge in both the theoretical and the experimental study of trust. The traditional game-theoretic literature that examines one-shot Trust games predicts that nobody will trust, since it is common knowledge that no rational player will reciprocate. This prediction has been found to be false in a variety of experimental games (Camerer 2003), and many hypotheses have been advanced to explain the unexpected levels of trust and reciprocation. The culprit here is not rationality per se, but instead the common auxiliary hypothesis that players only care about their own

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material payoffs. In this paper we shall focus on the role of communication and mutual expectations in establishing trust and reciprocity. We assume players are rational, in the minimal sense of maximizing their expected utility, but drop the hypothesis that they only care about their material payoffs. In particular, we show how communication among players, when accompanied by promising, leads them to trust and reciprocate even in difficult circumstances.

There is by now a large body of research on the role of communication in fostering pro-social behavior (Bicchieri 2002). This research has mainly focused on face-to-face communication among the parties. Many interactions, however, are less direct. Internet communication, for example, has substituted many other forms of communication, and not just in the realm of commercial exchanges. We are especially interested in the possibility of trust and cooperation in computer-mediated environments. Online, trust can ground cooperation in a variety of contexts, such as decentralized multinational organizations and auction sites. Lacking trust, agents may be deterred from mutually beneficial exchanges with unfamiliar and possibly anonymous others. Furthermore, the emerging interest in deliberative democracy and the related use of computer-mediated communication among 'community' members requires a significant amount of trust, and the willingness to reciprocate the cooperative efforts and the investment in time and energy of community members. Hence the importance of understanding the mechanisms through which communication supports trust and cooperation.

## 2 The communication effect as an anomaly

A robust experimental finding in the study of social dilemmas is the positive effect of communication on cooperation, which Bicchieri (2002, 2006) denotes as the 'communication effect.' John Ledyard (1995), in an extensive survey of the experimental literature on public goods, singles out communication and the marginal per capita return as the two variables most conducive to cooperation. Likewise, David Sally (1995), in a meta-analysis of 35 years of social dilemma experiments, shows that the ability to communicate increases cooperation over base rates by 40%.

The communication effect has been mostly studied in face-to-face (FtF) settings. However, there is a growing body of research that looks at the influence of other forms of communication in social dilemma games, most notably computer-mediated communication (CMC). Bicchieri and Lev-On (2007) provide a summary of the main findings about the computer-mediated communication effect in Social dilemma experiments:

1. The communication effect is still present in computer-mediated environments: CMC produces higher cooperation rates than equivalent environments in which communication is not allowed.
2. The communication effect varies in degree according to the richness of the communication channel. Videoconferencing produces cooperation rates very close to FtF communication, whereas text-based communication produces substantially less cooperation. Generally, the CMC effect approximates the FtF communication effect the closer the communication channel comes to reproducing the features of face-to-face communication.

3. Compared to FtF communication, it takes more time to establish cooperation, especially when using 'poorer' CMC channels. As in FtF communication, cooperation deteriorates over time in the absence of continuing communication. After communication resumes, cooperation rates improve again.
4. Especially with asynchronous communication, it is more difficult to establish 'social contracts' in CMC, and even when such agreements are reached, they are violated more frequently than agreements reached using FtF communication.

## 3 The focus theory of norms

Such findings stand in sharp contrast to the predictions of traditional rational choice models, according to which the strategic structure of social dilemmas and trust games should be resilient to the influence of communication. Behaviors such as cooperation, trust and reciprocity should remain off the equilibrium path following communication. In Social Dilemma and Trust games all talk should be considered cheap, and communication is empty at best and deceptive at worst. A fortiori, the choice of a communication medium should not influence behavior in such games: if no 'communication effect' is expected, then the communication medium would obviously be inconsequential for cooperation, trust and reciprocity.

However, since the 'communication effect' is a robust phenomenon in experimental games, it is important to understand what makes communication so effective in promoting pro-social behavior. Bicchieri (2006) has argued that, when communication is successful in supporting cooperation, this happens because it focuses individuals on social norms, such as promise-keeping or reciprocity. Social norms are not universal, generic rules insensitive to context; rather, they are sensitive to the particular situation faced by the decision-maker. Norms should be understood in terms of expectations and conditional preferences, and are susceptible to threshold effects. The very existence and motivational force of a social norm depend upon there being a sufficiently large number of people who believe that it exists and pertains to a given type of situation, and prefer to conform to it as long as:

(a) They expect that enough others follow the norm in similar contexts [empirical expectations], and
(b) They believe that enough others believe that they ought to conform to the norm as well [normative expectations], and may even sanction transgressions [normative expectations with sanctions] (Bicchieri 2006, p. 16).

According to this theory, when a social norm becomes situationally salient, it causes a shift in the individual's focus, provides the individual with the right kind of expectations, and thus directs her actions towards norm compliance. Focusing people on a social norm means that they know that the situation is one to which the norm applies, expect a sufficiently large number of people to obey the norm, and also believe that they are expected to conform to the norm by a sizable number of other individuals, who may even be prepared to sanction violations.[1] Face-to-face (FtF) communication

[1] See Bicchieri 2006, p. 98.

with other agents involved in a social dilemma is a very effective mechanism to focus agents on pro-social norms (Bicchieri 2002). In particular, since successful communication always involves an exchange of promises, exchanging promises places agents in a familiar context associated with daily experiences where people who make promises tend to keep them. In such contexts, promises are not perceived as cheap talk, but have a clear binding force. Promises in dilemma settings focus agents on the norm of promise-keeping, even if the norm is not backed by an enforcement mechanism. Promises to cooperate are typically communicated through verbal utterances, and are supported by contextual cues such as tone of voice, gestures, eye contact and so on. When promises are perceived to be credible, they support judgments about the trustworthiness of others, and consequently elicit pro-social behavior.

## 4 Why communication relevance matters

In this paper we report our experimental results about two dimensions of the communication effect in Trust games: one is the influence of communication relevance (i.e., the situational relevance of what is communicated), the other is the influence of the richness of the communication medium. There are good reasons to expect that both communication relevance and richness of the medium would affect trust and reciprocation in Trust games.

Let us start with the hypothesized importance of relevant communication, by which we mean the possibility to talk about the strategic situation that the experimental subjects are facing, and their ability to make non-binding pledges about future actions. As argued in Bicchieri (2002, 2006), 'relevant communication' will usually produce more trust and cooperation than 'irrelevant communication', and when discussion lacks explicit promising, we may expect it to lose its effectiveness in supporting trust. Failing to establish the normative environment required for informed decisions about trust and reciprocity, risk-averse agents may fail to behave in a pro-social way.

Experimental work, mostly done with Social dilemma games, largely supports such hypotheses. Most notably, Bouas and Komorita (1996) enabled participants to interactively communicate in a Social dilemma game. While in one treatment subjects were allowed to talk about any topic, including the dilemma, in the other treatment they were explicitly forbidden to discuss the dilemma (and, by implication, to make promises about future actions) and were only permitted to discuss tuition levels.[2] When participants were allowed to discuss the dilemma and thus make promises, the cooperation rate was 81%. By contrast, when they were allowed to communicate but not discuss the dilemma, the cooperation rate was only 17%. Similar results were obtained in an earlier study by Dawes et al. (1977), in which the only permitted conversation topic was the percentage of people at different income levels in Eugene, Oregon, and also by Gächter and Fehr (1999), who let participants engage in 'personal conversations' about their studies and hobbies. In both studies, cooperation rates were very low.

[2] Note that tuition levels were a relevant issue for the participants, who were all university students. It was, however, irrelevant to the social dilemma they were facing. Bouas and Komorita (1996) interpret 'relevant' in a less stringent sense than we do, since for them a *relevant* conversation may not be related to the experimental game.

There are a few exceptions, though. In another experiment, high trust rates were recorded even when subjects were involved in conversation irrelevant to the game, especially when the topics of conversation were 'personal'. Buchan et al. (2006) report that in a Trust game with a 'personal' irrelevant communication condition (subjects introduced themselves and talked about birthdays), and an 'impersonal' irrelevant communication condition (subjects answered questions from the world almanac), trust in the first condition was significantly higher than in the second condition. The experiment, however, did not include a control no-communication condition. The authors hypothesize that even non-strategic communication can make a difference, but only if is 'personal'. They claim that "personal communication prompts greater 'other-regardingness' than does impersonal communication. The mere act of communicating more about themselves on a personal topic prompted participants to be significantly more concerned with others" (Buchan et al. 2006, p. 392).

Such conjectures are to some extent supported by other experimental work by Rocco (1998), where participants had a 45 minute social activity prior to playing a Social dilemma game. But recall that Gächter and Fehr (1999) found no increase in cooperation following a 'personal' communication prior to a Social dilemma game. Such mixed findings make the study of 'the kinds of non-strategic communication that make a difference' an even more critical pursuit.

## 5 Why media richness matters

A second factor that may influence the degree and characteristics of the 'communication effect' is the richness of the communication medium. Richness may matter because it affects the background conditions under which the act of promising occurs. As argued before, such conditions are crucial in conveying the credibility of mutual intentions.

When promises are made in face-to-face contexts, a variety of cues allow subjects to assess intentions and form expectations about each other, all of which can make their mutual promises credible. Such indicators include visual cues (i.e. body language, eye contact, facial expressions, etc.), verbal cues (tone of voice, phrasing, fluency, manner of expressing moral rhetoric, etc.) and social cues (status, group membership, gender, etc). Such cues are frequently correlated by agents with trustworthiness, and their presence or absence can have important motivational consequences via the formation (or impairment) of mutual expectations of promise-keeping behavior. When a norm of promise-keeping is activated, mutual expectations, beliefs and a conditional preference for following the norm will also be simultaneously activated in the vast majority of participants (Bicchieri 2006). However, when the environment and the means of communicating promises differ significantly from familiar settings in which promises are usually made, agents may become focused on the 'poverty' of the normative environment, fail to develop expectations about the future actions of promise-makers, and as a result they may refuse to cooperate or trust.

There are relatively few social dilemma experiments that study the effects of communication in computer-mediated contexts. When social dilemma experiments allow for unrestricted computer-mediated communication, including promising, cooperation

rates are significantly higher than in a control no-communication condition, although typically lower than in a face-to-face control condition (see Brosig et al. 2003; Frohlich and Oppenheimer 1998; Bos et al. 2001; Rocco 1998; Zheng et al. 2002).

It seems that, though promising matters, it also matters how the promises are communicated. Indeed, when the means of communicating promises are restricted, cooperation rates typically falter. For example, when non-binding promises were generated through a computerized text message or were written on a piece of paper (Palfrey and Rosenthal 1991; Chen and Komorita 1994), cooperation rates did not differ significantly from the no-communication condition.

For example, in a 10-round Public-good game, Bochet et al. (2006) found no significant differences in cooperation rates between a no-communication control condition and a 'numerical cheap talk' (NCT) condition where subjects could anonymously send via computer a non-binding message about how much money they intended to contribute before each period. To tease apart the effects of promising from those of interactive communication,[3] in a follow-up paper Bochet and Putterman (2007) added another condition (similar to NCT) in which anonymous participants, before making a contribution, could make a non-binding statement explicitly formulated as a promise after the initial round of cheap talk.[4] Again, there were no significant differences in actual contributions between the 'numerical cheap talk with promising' (NCTwP) condition and the no-communication condition.

These experimental data suggest that the further removed the act of promising is from daily contexts where promises are made, the less it can promote cooperation (or trust). It is realistic to assume that participants did not perceive others' promises as credible, and may have even been aware that their own promises might have been regarded with skepticism by the other parties. In this case, both empirical and normative expectations falter, and it is not surprising that one should not feel bound by a norm of promise-keeping that almost no one expects (or believe is expected) to follow.

## 6 What kind of promise?

In this paper we further explore the act of promise-making to clarify why and how it is conducive to trust. We focus specifically on computer-generated promises to further understand if and when pro-social behavior survives in computer-mediated environments.

Our paper gives two main contributions to the literature on communication and promising in mixed-motive games in computer-mediated settings. First, the effects of irrelevant communication have been mainly studied in face-to-face settings. We explore whether the differences between strategy-relevant and irrelevant communication occur when communication is computer-mediated as well.

[3] Interactive communication involves messages sent from 1st mover to 2nd mover and vice versa. Non-interactive communication means that only one side can send messages to the other; for example, in some experiments only second-movers could send messages to first-movers, but first-movers could not respond.

[4] Subjects were asked to choose one of the following statements: 'I do not wish to make a promise at this time,' or 'I promise to contribute—to the group account this period.' If they chose the second option, they had to type an integer between 0 and 10.

Second, the communication effect has been studied almost exclusively in Social dilemma games. Experimental work that directly tests the effects of interactive communication on behavior in Trust games is just emerging.[5] Our paper thus makes a significant contribution to the study of a 'communication effect'—i.e., a positive and significant influence of communication on trusting and reciprocating behavior—in Trust games as well.

Trust games are close cousins of Social dilemma games; in essence they are one-sided sequential dilemmas. In a typical Trust game experiment, participants are assigned one of two roles: first-mover or second-mover. Such games consist two decision periods.[6] In the first decision period, each first-mover receives an endowment and then decides to send some, all, or none of it to the second-mover. The amount the first-mover does not send is hers to keep. In the second decision period, the amount first-movers sent to second-movers is multiplied (by a given factor) by the experimenter. Then, the second-mover can send some, all, or none of this amount to the first-mover. The amount the second-mover does not send is hers to keep. The original amount given to first movers as well as the multiplication factor are common knowledge among the players.

A few studies demonstrate that the communication effect exists in Trust games as well. Among them, the only study we know of that allowed interactive communication is by Ben-Ner and Putterman (2006). Their Trust games involved four relevant pre-play communication conditions: 1. no-communication, 2. a one-stage computerized negotiation between first- and second-mover where participants could make choices out of a table of possible distributions and could enter into a contract; 3. a three-stage computerized negotiation along similar lines; and 4. a computerized pre-play chat. The authors found significant differences in terms of both trust and reciprocation between all communication conditions and the no-communication condition, and in particular they found significant differences between the non-binding chat and the negotiations conditions.

Other studies have allowed non-interactive communication prior to Trust games. For example, Charness and Dufwenberg (2006) allowed pre-play communication in the form of an unrestricted written message from second-movers to first-movers. They found significant differences between the communication and the no-communication conditions in terms of both trusting and reciprocating behaviors.[7] However, when first-movers sent an unrestricted written message to second-movers, there were no

[5] Bohnet and Baytelman (2007) conducted surveys in which senior executives were asked about their choices in simulated Trust games. Treatments included an anonymous one-shot Trust game scenario without communication, and a one-shot Trust game scenario with *face-to-face* communication before making a decision. The authors found significant differences between the communication and no-communication conditions in terms of amounts sent and received, and the expectations of both first- and second-movers. They also found that after face-to-face communication second-movers returned greater portions of the amounts sent to them by first-movers. The survey, however, did not include CMC treatments, and did not involve monetary incentives to subjects.

[6] By contrast, in one-shot social dilemma experiments there is only one decision period, and no role assignment to the players.

[7] Similar results were obtained by Ellingsen and Johannseeon (2004).

significant differences in trust or reciprocation between the communication and the no-communication conditions.

## 7 Experimental procedure

To further study the effects of communication (none, relevant and irrelevant) and medium richness (face-to-face or computer-mediated) in Trust games, we designed the following experiment.

### 7.1 Methods

*Participants* We recruited 64 participants using a web-based recruiting system at the University of Pennsylvania. Participants earned an average of $18.40 (including a show-up payment of $5.00, SD = $5.93).

### 7.2 Procedure

After seating participants, we distributed a set of written instructions and read them aloud (see Appendix). Immediately prior to playing each game, participants also read instructions specific to that game (see Appendix). After reading the instructions for each game, but prior to engaging in any communication (see below), all participants were required to complete a computerized quiz to ensure their understanding of the instructions. The instructions specified the following:

- Each experimental session consisted of three Trust games. For each game, the first-mover had 6 USD, any dollar amount of which he or she could send to the second-mover. The amount second-mover received from the first-mover was tripled by the experimenter. The second-mover could then send any dollar amount back to the first-mover.
- Participants made all decisions anonymously via a computer interface.
- Participants were paired randomly with a different partner for each game, and this was common knowledge.
- Prior to the first game, participants were not allowed to communicate, making it a control condition.
- Prior to the second game, pairs of participants communicated in real-time via computer-based text chat for 5 min. Messages entered by each participant appeared in a window visible only to the first- and second-movers comprising each pair. In addition to using generic identifiers, we both verbally and in the written instructions forbade participants from communicating their identities to their partners. Following the communication period, participants made their decisions in the game privately, and had no further opportunities to communicate with their partner. First-movers did not receive feedback on the amount that the second-mover returned until the end of the experimental sessions.
- Prior to the third game, pairs of participants communicated face-to-face for 2 min. Participants then returned to their computer stations and made their decisions in the game privately.

Furthermore, in roughly half of the experimental sessions, the instructions specified that participants were allowed to discuss any topic except those pertaining to their identities. However, in the remaining sessions, the instructions required instead that participants discussed only the following questions (adapted from Buchan et al. 2006) which were not relevant to the game: What are the three most populated cities in the world? What are the three most populated cities in the US? How many people live in Philadelphia and the surrounding suburbs? How many counties are there in Pennsylvania? The instructions explicitly stated that there was to be no discussion about what choices one might make, what the participant thought was the best approach to the experimenters, what the participant expected the other to do, or what the participant earned in earlier games. In addition, the experiments monitored all conversations to ensure adherence to the communication topics. Because we expected participants to discuss topics relevant to the game in the first condition and to discuss topic not relevant to the game in the second condition, we labeled these respectively as relevant and irrelevant communication conditions.

After making their decision, first-movers were asked about their expectations of second-movers reciprocation. We wanted to know whether expectations differ depending on the communication medium and condition, and if expectations predict the level of trust.

### 7.3 Design

We analyzed the effects of communication relevance and communication medium on three dependent variables: (1) trust—the amount in dollars sent by the first-mover ($0 through $6); (2) reciprocity—the amount returned by the second-mover, relative to the amount sent; and (3) expected reciprocity—the amount the first-mover expected to be returned by the second-mover, relative to the amount sent. Communication relevance was varied across participants, whereas medium (control, computer-mediated, or face-to-face) was varied within participants. This design led to five experimental conditions, No-communication (Control), CMC-Relevant, CMC-Irrelevant, FtF-Relevant, and FtF-Irrelevant. To analyze the effects of communication relevance and medium in a regression framework, we coded the conditions using three dichotomous variables: control (1 or 0), relevant communication (1 or 0), CMC (1 or 0). The ordering of media was fixed (computer-mediated in the second game, and face-to-face in the third); however, we did not anticipate an ordering effect as pairings for each game were unique and information following each game was minimal.

### 7.4 Statistical analysis

We modeled the three dependent variables as binomial responses using the generalized linear model (GLM) framework.[8] Using a binomial GLM instead of ordinary least squares was appropriate for two reasons: (1) the distributions of all three dependent

[8] Some regressions revealed evidence of overdispersion, making a quasi-binomial model necessary.

variables were non-normal, and (2) the amount returned by the second-mover should only be interpreted relative to the amount sent (and therefore would need to be converted to a proportion *of thrice the amount sent*). The binomial model allowed us to estimate the probability that the second-mover would return each dollar he or she had available, even though the amount available depended on the first-mover's decision. Finally, to assess the main effects and the interaction of communication relevance and medium, we sequentially tested pairs of nested models using likelihood ratio tests based on the $F$-statistic, where appropriate.

## 8 Results

*Overview* Because gender did not significantly predict trust ($F(1, 110) = 0.45$, $p = .50$), reciprocity ($F(1, 88) = 1.03$, $p = .31$), or expected reciprocity ($F(1, 88) = 0.56$, $p = .46$), we did not further analyze this variable.

Table 1 summarizes the responses across the five combinations of communication relevance and medium. Both relevance and medium had large, positive effects on trust, reciprocity, and expected reciprocity relative to the control condition. Relevant, face-to-face communication had the largest effects on all three variables, whereas relevant, computer mediated communication had the second largest effects. In addition to main effects of relevance and medium, there appeared to be interactions, which we tested for and reported on below, in the subsections corresponding to each dependent variable.

Figure 1 shows the distributions of the amount received and returned by the second-mover for all pairs of participants across conditions. Slightly fewer than half of second-movers received the maximum amount possible (indicated by the large block of the tallest light gray on the right side of the plot), corresponding to interactions in which the first-movers sent their entire endowment of 6 USD (which was tripled and became 18 USD). In these interactions, second-movers responded in a clear, bi-modal pattern: roughly two-thirds sent back exactly half (9 USD), and the remaining one-third sent nothing back. When first-movers sent less than their entire endowment, second-movers tended to send back little.

**Table 1** Mean (SEM) of trust, reciprocity, and first-mover expectations by communication relevance and medium ($N = 96$)

| | Control ($N = 32$) | FtF-Relevant ($N = 14$) | CMC-Relevant ($N = 14$) | FtF-Irrelevant ($N = 18$) | CMC-Irrelevant ($N = 18$) |
|---|---|---|---|---|---|
| Trust | 2.63 (0.36) | 5.57 (0.46) | 5.14 (0.57) | 4.17 (0.49) | 3.28 (0.61) |
| Reciprocity | 1.92 (.48) | 7.57 (0.96) | 5.14 (1.33) | 3.33 (1.05) | 1.94 (0.78) |
| Expected reciprocity | 3.54 (0.53) | 8.36 (0.69) | 7.43 (0.96) | 5.56 (0.91) | 4.28 (0.93) |

*FtF* Face-to-face; *CMC* Computer-mediated communication

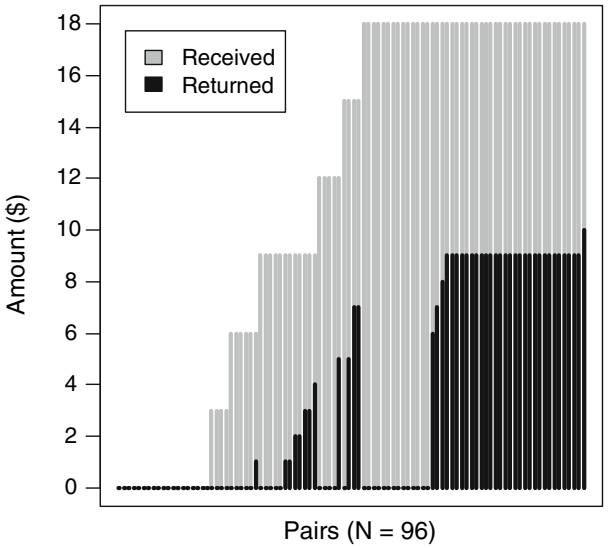


**Fig. 1** The amounts received and returned by the second-mover in each pair, sorted first by the amount received and then by the amount returned

### 8.1 Communication

We should briefly mention the qualitative findings from the logs of CMC and face-to-face relevant communication conditions. Especially in face-to-face conditions, when participants could discuss the game they always made promises. A typical exchange would be like the following:

[tr1 ]: *Hey, how much are you gonna send?*
[tr6 ]: *I'll send $3 if you promise to return $4.*
[tr1 ]: *Okay, I'll give you $4 if you send me $3.*

These results are in line with what has been observed about face-to-face communication in Social dilemma games: participants make promises and tend to keep them. Thus trusters tend to offer what they promised, and trustees consistently reciprocate much more than in the control condition.

### 8.2 Trust

Figure 2 shows the distribution of trust across the five conditions. First-movers were most trusting in the relevant communication conditions, in which the majority sent their entire endowment of 6 USD. We conducted a simultaneous regression of trust on control, communication relevance, and medium. $F$-tests revealed significant effects of control ($F(1,93) = 4.47$, $p = .037$) and relevance ($F(1,93) = 8.54$, $p = .004$), but not of medium ($F(1,93) = 1.56$, $p = .22$). Moreover, there was no interaction between communication medium and relevance ($F(1,92) = 0.01$, $p = .92$). Table 2

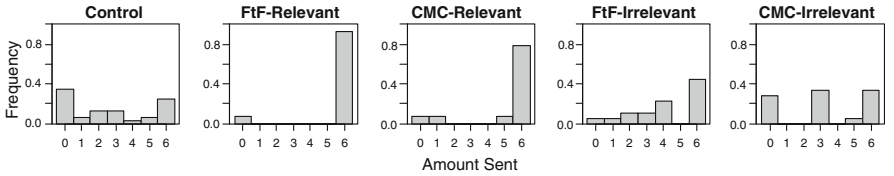


**Fig. 2** Distribution of trust by communication medium and relevance

**Table 2** Estimated log-odds of factors predicting trust ($N = 96$)

| Variable | Estimate | SE | $z$ |
|---|---|---|---|
| Intercept | −0.25 | 0.30 | −0.83 |
| Control | −1.09 | 0.51 | −2.14* |
| Relevant | 1.66 | 0.60 | 2.76** |
| CMC | −0.67 | 0.52 | −1.28 |

*Note* Residual deviance: 430.00 on 92 degrees of freedom. Estimated dispersion: 4.34
* $p < .05$; ** $p < .01$

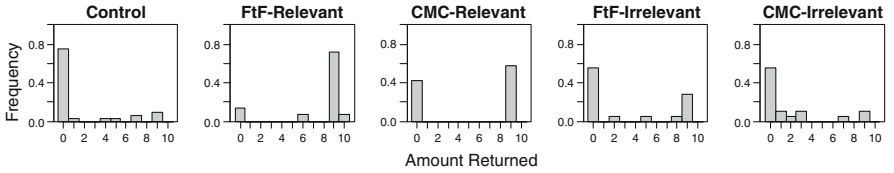


**Fig. 3** Distribution of reciprocity by communication medium and relevance

shows the estimated coefficients of the model on the log-odds scale. Controlling for the other variables, first-movers had over five times greater odds of sending each dollar when communication was relevant. Relative to the other conditions, participants had three times lowers odds of sending each dollar in the control condition.

## 8.3 Reciprocity

Figure 3 shows the distribution of reciprocity by communication medium and communication relevance. As noted in earlier discussion, the pattern of second-mover returns was highly bi-modal, with participants returning either nothing or exactly half of the maximum (i.e., returning 9 of 18 USD). This pattern depended on the condition—for example, almost all participants in the FtF-Relevant condition returned 9 USD, whereas almost all participants in the control conditions returned nothing. Although this pattern was due in part to the different levels of trust across conditions, a comparison of Figs. 2 and 3 reveals that second-movers behaved qualitatively differently across conditions, even after accounting for first-movers' levels of trust. Finally, for 19 data points, the amount trusted was zero; because reciprocity necessarily was zero for these data, we omitted them from the analyses in this section.

We conducted a simultaneous regression of reciprocity on trust, control, communication relevance, and medium. $F$-tests revealed significant effects of trust ($F(1,73) =$

**Table 3** Estimated log-odds of factors predicting reciprocity ($N = 77$)

| Variable | Estimate | SE | $z$ |
|---|---|---|---|
| Intercept | −4.04 | 0.61 | −7.42**** |
| Relevant communication | 0.60 | 0.15 | 4.43**** |
| Trust | 0.54 | 0.11 | 5.36**** |
| Computer-mediated chat (CMC) | 2.03 | 0.90 | 2.25* |
| Trust $x$ CMC | −0.42 | 0.16 | −2.67** |

*Note* The residual deviance is 311.32 on 72 degrees of freedom. We did not find evidence of overdispersion as the data are sparse
* $p < .05$; ** $p < .01$; **** $p < .0001$

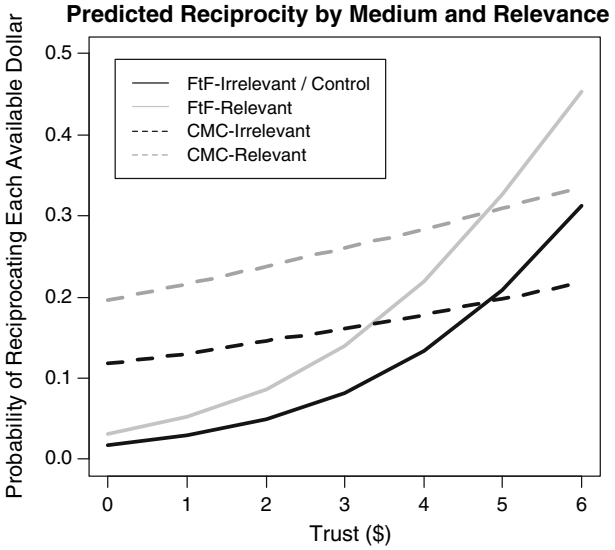


**Fig. 4** Predicted reciprocity by level of trust

28.49, $p < .0001$), communication relevance ($F(1,73) = 9.21$, $p = .002$), and medium ($F(1,73) = 8.02$, $p = .005$), but not of control. Moreover, controlling for trust, communication relevance, and medium, there was a significant interaction between medium and trust ($F(1,73) = 6.84$, $p = .009$). Table 3 shows the estimated coefficients of the interaction model on the log-odds scale. Reciprocity was higher in the CMC condition for lower amounts of trust, but became higher in the FtF condition for higher amounts of trust. For example, as the amount that the first-mover sent approached zero, the odds that the second-mover returned each available dollar was over seven times higher in CMC than in FtF. With each additional dollar that the first-mover sent, however, the odds that the second-mover reciprocated increased more rapidly for FtF interactions. Figure 4 shows these predictions graphically: The probability of returning each available dollar increased with the amount trusted, but increased more rapidly for the FtF and control conditions than for CMC.

### 8.4 Expectations

To determine whether expected reciprocity predicted the first-mover's level of trust, we converted expected reciprocity into the expected percentage reciprocity (the amount expected to be returned divided by the amount available), and then regressed trust on this variable using ordinary least squares.[9] This conversion was necessary to control for the dependency of the maximum amount that could be returned on the amount sent. The estimated coefficients in Table 4 show that trust increases with the expected percentage reciprocity. When the first-mover expected nothing to be returned, the predicted amount sent was only .36 dollars. For each percent of the amount sent that the first-mover expected to be returned, however, the first-mover sent an additional .10 dollars. Thus, the median expected reciprocity (proportion) of .5 resulted in a $5.5 increase in the amount returned. Moreover, the $R^2$ value of 0.78 indicates that a large percentage of the variance in trust is explained by the expected percentage reciprocity.

We also examined the relationship between expected reciprocity and actual reciprocity, and found that the amount the first-mover expected to be returned predicted reciprocity better than trust itself did ($F(1, 88) = 0.13$, $p = 0.72$). Table 5 shows the model estimates for expected reciprocity as a predictor of reciprocation. Figure 5 illustrates how the odds that the second-mover would return each dollar increased with the amount the first-mover expected to be returned.

**Table 4** Estimates for expected reciprocity (proportion) as a predictor of trust ($N = 94$)

| Variable | Estimate | SE | $T$ |
|---|---|---|---|
| Intercept | 0.37 | 0.22 | 1.69 |
| Expected percentage reciprocity | 10.08 | 0.55 | 18.284**** |

*Note* $R^2 = 0.78$
**** $p < .0001$

**Table 5** Estimated log-odds of expected reciprocity as a predictor of reciprocity ($N = 77$)

| Variable | Estimate | SE | $z$-value |
|---|---|---|---|
| Intercept | −2.86 | 0.56 | −5.10**** |
| Expected reciprocity | 0.25 | 0.07 | 3.79**** |

*Note* Residual deviance: 327.10 on 75 degrees of freedom. Estimated dispersion: 3.27
**** $p < .0001$

[9] Model diagnostics identified two observations as high leverage outliers, which we excluded from the analysis. Specifically, half-normal plots of the jackknife residual errors and Cooks' distance revealed extreme values for these points. Additionally, residual errors were over three standard deviations from the mean for these observations.

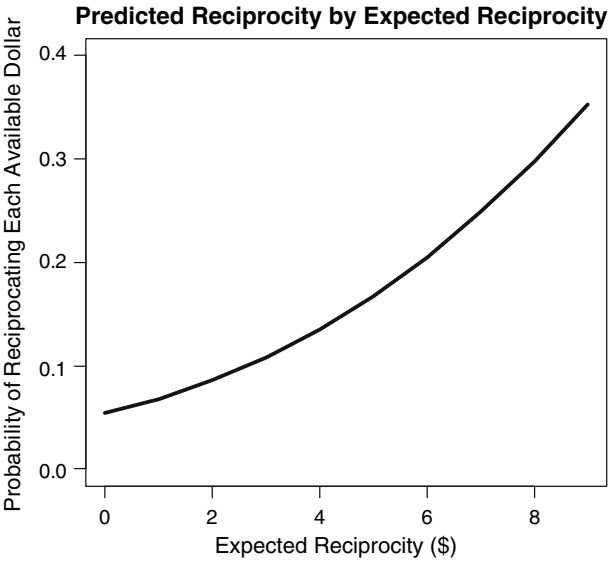


**Fig. 5** Predicted reciprocation as a function of expected reciprocity, based on the model estimates in Table 5

## 9 Discussion and conclusions

Our results suggest that, in Trust games, the behavior of first-movers is strongly determined by their expectations of second-movers' reciprocation. Note, however, that those expectations are rarely met, as expected reciprocation was significantly higher than the actual reciprocation, across all conditions.

We also found that the variable most conducive to creating such expectations is—paraphrasing McLuhan (McLuhan and Fiore 1967)—not the medium, but rather the message. In other words, first-movers' investments were significantly higher following unrestricted communication than restricted or no communication. Recall that unrestricted communication could include strategic discussion of the game and promise-making; according to our transcripts, all subjects who participated in the unrestricted communication were involved in both.

Media richness, instead, had no effect on trust. There were no significant differences between the amounts sent following chat communication, face-to-face communication, and the no-communication control *when communication was restricted*. Controlling for type of communication, the medium had no significant effect on trust. By contrast, earlier experimental results that were previously discussed found significant differences in cooperation rates across media types (FtF versus chat rooms or newsgroups). We believe this may have been due to the fact that those experiments allowed unrestricted communication (and thus promise-making, etc.) between subjects. As we already mentioned, we are the first to study the results of irrelevant (restricted) communication in Trust games, across media conditions. Our results are, however, in line with the experiments that allowed non-strategic-impersonal pre-play communication prior to Social dilemma games (Bouas and Komorita 1996 and Dawes et al. 1977).

Another possible explanation of the discrepancy between our and others' results is the presence of 'learning effects'. Since computer-mediated communication deeply penetrates the fabric of everyday lives, especially the lives of students who were the subjects in our experiments, it is possible that they got accustomed to computer-mediated communication and, furthermore, found ways to overcome media poverty by using symbols, special acronyms etc. that frequently appear in our transcripts. It may turn out that, as years go by and users get more experienced in computer-mediated conversations, computer-mediated communication will yield results similar to face-to-face communication, especially in experiments like ours that allow extended conversations between exchange partners, not just short numerical messages or one-line text messages. Though experiments that use numerical messages or one-line text messages permit more control over the influence of communication on trust and reciprocity, they move further away from everyday life conditions where people communicate with each other via computer interfaces. This, in turn, jeopardizes the external validity of experiments that involve such limited forms of communication.

As time goes by and computer-mediated communication becomes an important part of our lives, we would expect people to become better able to use it proficiently and to form expectations about future behaviors of exchange partners, at least when the content of communication is relevant to the situations they face.

While trust did not differ significantly by communication medium, reciprocity did. Indeed, reciprocity increased with the amount sent by the first-mover, and this effect was more pronounced in face-to-face communication. This result is consistent with earlier findings that individuals engage in positive reciprocation, especially following communication. It should also be noted that first-movers received no dividend on their investment in second-movers—with the exception of the face-to-face condition. This supports our hypothesis that communication, when accompanied by promising, focuses participants on social norms (in this case, promise-keeping and reciprocity), and motivates them to trust more and reciprocate. Interestingly, we find that first-movers seem to over-estimate the willingness of second-movers to send money back. This, again, might be due, when relevant communication is allowed, to the expectation that second-movers will abide by the social norms activated by communication about the game.

Our results have some institutional implications as well. Many online exchange sites allow some form of communication between future exchange partners. But these forms of communication vary widely; some allow individuals to send just a short numerical statement to each other or even just check a box (which is, of course, also a minimal form of communication). Others allow unlimited communication in terms of content, length etc. It is likely that the closer the sites come to the latter type of communication, the more conducive they will be to the trusting which is needed to trigger mutually-beneficial exchanges. On the other hand, when sites do not allow subjects to convey to each other much information relevant to their future exchanges, they may disable the formation of empirical and normative expectations, and thus jeopardize the success of computer-mediated exchanges.

## Appendix

### General instructions

This is an experiment about interpersonal decision-making. Specifically, it is concerned with how pairs of people make decisions that affect one another.

You have already earned $5 for coming in today, and can earn an additional amount of money (in the range of $0–37). The amount of money you make depends on your decisions and on the decisions of the persons with whom you are paired. You will be involved in three short and consecutive experiments. Because you will not be paired with the same person twice, the three experiments are independent of each other.

Immediately following the three experiments you will be paid your earnings in cash, in a sealed envelope. You will receive your total earnings for two of these experiments that will be randomly chosen. Since nobody knows in advance which experiments you will be paid for, each experiment has the potential to affect your earnings.

Unless otherwise specified, the decisions you make and the amount you earn are strictly anonymous. At no point will the experimenters make available any information about your decisions or earnings to other participants. Since you will be assigned a code ID, not even the experimenters will know your choices.

Please focus your attention on your computer screen and your screen only, and remain silent. At this time, please put away all reading materials, cell phones, headphones, and other electronic equipment. Please do not check your email, use instant messaging, or browse the web at any time during this experiment. Not following the instructions may disqualify you from further earnings.

You will be asked to enter a **login ID**. This will be handed out to you shortly.

For each experiment, you will read a set of instructions, followed by a short quiz to ensure that you understand them. In the case that you finish early with the quiz or experiment, please wait patiently while others are still completing them. If you have any questions, raise your hand and an experimenter will come by.

### Experiment 1 (no-communication)

In this experiment people are assigned to one of two roles: **first-movers** and **second-movers**. You will be assigned to one of these roles, and will be paired with another person in this room. You will not be able to tell who is the person you are paired with, either during or after the experiment, and likewise the person you are paired with will not know who you are.

The experiment contains two decision periods.

(1) In the first decision period, each **first-mover** receives an endowment of $6 and then decides to **send some, all, or none of this amount** to the second-mover. First-movers can only send a discrete amount of dollars; that is, they can send $0, $1, $2, $3, $4, $5, or $6. The amount the first-mover does not send is hers/his to keep.
(2) In the second decision period, the amount first-movers sent to second-movers is **tripled**. Then, the **second-mover** can **send some, all, or none of this amount** to

the first-mover. Second-movers can only send a discrete number of dollars. The amount the second-mover does not send is hers/his to keep.

Thus, the first-mover's payoff is the amount he/she keeps in the first decision period, plus the amount the second-mover sends in the second decision period. The second mover's payoff is the amount of money received from the first-mover (multiplied by 3) that he/she chose to keep.

*Example 1* The first-mover sends \$1 to the second-mover. This amount is tripled, so that the second-mover receives \$3. If the second-mover sends all \$3 to the first mover, then the final payoffs would be [**8**, **0**]: \$8 for the first-mover (\$5 he/she kept plus the \$3 sent from the second-mover), and \$0 for the second-mover. If instead the second-mover sends nothing to the first mover, then the final payoffs would be [**5**, **3**]: \$5 for the first-mover and \$3 for the second-mover.

*Example 2* The first-mover sends \$6 to the second-mover. This amount is tripled, so that the second-mover receives \$18 (\$6 $\times$ 3 $=$ \$18). If the second-mover sends all \$18 to the first mover, then the final payoffs would be [**18**, **0**]: \$18 for the first-mover and nothing for the second-mover. If instead the second-mover sends \$9 to the first mover, then the final payoffs would be [**9**, **9**]: \$9 for the first-mover and \$9 for the second-mover.

The most money that the first-mover can send to the second-mover is his/her entire endowment of \$6 (before it is multiplied). The second-mover can send back any amount between zero and the amount sent by the first-mover (multiplied by 3).

First-movers and second-movers will never know each other's identity.

Note that the decisions of second-movers are always anonymous. Since we pay only two out of three experiments, first-movers will not know, even after the end of all three experiments, the total amount of money sent back by any second-movers.

Once the decision phase of the experiment begins, you will be asked to remain at your seat and to refrain from any form of communication with other participants. After you received a computerized message informing you that you should make your selection, you will have **40 s** to do so.

**Experiment 2a (CMC irrelevant communication)**

In this experiment people are assigned to one of two roles: **first-movers** and **second-movers**. You have already been assigned to one of these roles in Experiment 1, and will keep this assignment. You will be paired with another person in this room with whom you were not paired before. You will not be told who is the person you are paired with, either during or after the experiment, and likewise the person you are paired with will not know who you are.

As in the previous experiment, each **first-mover** receives an endowment of \$6 and then decides to **send some, all, or none of this amount** to the second-mover. The amount first-movers sent to second-movers is **tripled**. Then, the **second-mover** can **send some, all, or none of this amount** to the first-mover. First- and second-movers

can only send a discrete number of dollars. The amount the first- and second-movers do not send is theirs to keep.

*Example* The first-mover sends \$3 to the second-mover. This amount is tripled, so that the second-mover receives \$9. If the second-mover sends \$3 to the first mover, then the final payoffs would be [**6**, **6**]: \$6 for the first-mover (\$3 he/she kept plus the \$3 sent from the second-mover), and \$6 for the second-mover. If instead the second-mover sends \$5 to the first mover, then the final payoffs would be [**8**, **4**]: \$8 for the first-mover and \$4 for the second-mover.

Right after we finish reading the instructions, you will have the opportunity to participate in a computerized text chat, and you can use your keyboard to send messages to the person you are paired with. You may chat for up to five (5) minutes.

During the communication period, you **may not** discuss the decision you will make, including what you think is the best approach to the experiment, what you plan to do, what you would like the other person to do, or **your decisions and earnings from earlier experiments**.

You may discuss only one or more of the following topics:

What are the three most populated cities in the world? What are the three most populated cities in the US? How many people live in Philadelphia and the surrounding suburbs? How many counties are there in Pennsylvania?

To make sure that these rules are adhered to, your conversation will be monitored by a member of the experiment team.

**You may not send a message that attempts to identify you to the person you are paired with**. For example, you **may not** use your real name, nicknames, or self-descriptions of any kind ("Tom Smith here," "I'm the guy in the red shirt sitting near the window," "It's me, Sandy, from French class," or even "As a woman [Latino, Asian-American, etc.], I think…").

When the communication period ends, you must cease all communication. You will then separately and individually make your decision. You will not have the opportunity to speak to the person you are paired with for the remaining duration of the experiment.

First-movers and second-movers will never know each other's identity. Note that the decisions of second-movers are always anonymous. Since we pay only two out of three experiments, first-movers will not know, even after the end of all three experiments, the total amount of money sent back by any second-movers.

Once the decision phase of the experiment begins, you will be asked to remain at your seat and to refrain from any form of communication with other participants. After you received a computerized message informing you that you should make your selection, you will have **40 s** to do so.

You will now be asked to take a short quiz to ensure your comprehension of the instructions.

### Experiment 3a (FtF irrelevant communication)

In this experiment people are assigned to one of two roles: **first-movers** and **second-movers**. You have already been assigned to one of these roles in Experiment 1, and

will keep this assignment. You will be paired with another person in this room with whom you were not paired before.

As in the previous experiment, each **first-mover** receives an endowment of $6 and then decides to **send some, all, or none of this amount** to the second-mover. The amount first-movers sent to second-movers is **tripled**. Then, the **second-mover** can **send some, all, or none of this amount** to the first-mover. First- and second-movers can only send a discrete number of dollars. The amount the first- and second-movers do not send is theirs to keep.

*Example* The first-mover sends $4 to the second-mover. This amount is tripled, so that the second-mover receives $12. If the second-mover sends $4 to the first mover, then the final payoffs would be [**6**, **8**]: $6 for the first-mover ($2 he/she kept plus the $4 sent from the second-mover), and $8 for the second-mover. If instead the second-mover sends $5 to the first mover, then the final payoffs would be [**7**, **7**]: $7 for the first-mover and $7 for the second-mover.

Right after we finish reading the instructions, you will have an opportunity to talk face-to-face with the person you are paired with. You may talk for up to two (2) minutes.

During the communication period, you **may not** discuss the decision you will make, including what you think is the best approach to the experiment, what you plan to do, what you would like the other person to do, or **your decisions and earnings from earlier experiments**.

You may discuss only one or more of the following topics:

What are the three most populated cities in the world? What are the three most populated cities in the US? How many people live in Philadelphia and the surrounding suburbs? How many counties are there in Pennsylvania?

To make sure that these rules are adhered to, your conversation will be monitored by a member of the experiment team.

When the communication period ends, you must cease all communication. You will then return to your computer terminal to separately and individually make your decision. You will not have the opportunity to speak to the person you are paired with for the remaining duration of the experiment.

Note that the decisions of second-movers are always anonymous. Since we pay only two out of three experiments, first-movers will not know, even after the end of all three experiments, the total amount of money sent back by any second-movers.

Once the decision phase of the experiment begins, you will be asked to remain at your seat and to refrain from any form of communication with other participants. After you received a computerized message informing you that you should make your selection, you will have **40 s** to do so.

You will now be asked to take a short quiz to ensure your comprehension of the instructions.

### Experiment 2b (CMC relevant communication)

In this experiment people are assigned to one of two roles: **first-movers** and **second-movers**. You have already been assigned to one of these roles in Experiment 1, and

will keep this assignment. You will be paired with another person in this room with whom you were not paired before. You will not be told who is the person you are paired with, either during or after the experiment, and likewise the person you are paired with will not know who you are.

As in the previous experiment, each **first-mover** receives an endowment of $6 and then decides to **send some, all, or none of this amount** to the second-mover. The amount first-movers sent to second-movers is **tripled**. Then, the **second-mover** can **send some, all, or none of this amount** to the first-mover. First- and second-movers can only send a discrete number of dollars. The amount the first- and second-movers do not send is theirs to keep.

*Example* The first-mover sends $3 to the second-mover. This amount is tripled, so that the second-mover receives $9. If the second-mover sends $3 to the first mover, then the final payoffs would be [**6**, **6**]: $6 for the first-mover ($3 he/she kept plus the $3 sent from the second-mover), and $6 for the second-mover. If instead the second-mover sends $5 to the first mover, then the final payoffs would be [**8**, **4**]: $8 for the first-mover and $4 for the second-mover.

Right after we finish reading the instructions, you will have the opportunity to participate in a computerized text chat, and you can use your keyboard to send messages to the person you are paired with. You may chat for up to five (5) minutes. During the communication period, you may discuss anything you like, including what you think is the best approach to the experiment, what you plan to do, or what you would like others to do.

When the communication period ends, you must cease all communication. You will then separately and individually make your decision. You will not have the opportunity to speak to the person you are paired with for the remaining duration of the experiment.

There are two restrictions on the types of messages that you may send.

First, you may not send a message that attempts to identify you to the person you are paired with. For example, you **may not** use your real name, nicknames, or self-descriptions of any kind ("Tom Smith here," "I'm the guy in the red shirt sitting near the window," "It's me, Sandy, from French class," or even "As a woman [Latino, Asian-American, etc.], I think…").

Second, **you may not discuss your decisions and earnings from earlier experiments**. A member of the experiment team will monitor the discussion, to insure that these rules are adhered to.

First-movers and second-movers will never know each other's identity.

Note that the decisions of second-movers are always anonymous. Since we pay only two out of three experiments, first-movers will not know, even after the end of all three experiments, the total amount of money sent back by any second-movers.

Once the decision phase of the experiment begins, you will be asked to remain at your seat and to refrain from any form of communication with other participants. After you receive a computerized message informing you that you should make your selection, you will have **40 s** to do so.

You will now be asked to take a short quiz to ensure your comprehension of the instructions.

**Experiment 3b (FtF relevant communication)**

In this experiment people are assigned to one of two roles: **first-movers** and **second-movers**. You have already been assigned to one of these roles in Experiment 1, and will keep this assignment. You will be paired with another person in this room with whom you were not paired before.

As in the previous experiment, each **first-mover** receives an endowment of $6 and then decides to **send some, all, or none of this amount** to the second-mover. The amount first-movers sent to second-movers is **tripled**. Then, the **second-mover** can **send some, all, or none of this amount** to the first-mover. First- and second-movers can only send a discrete number of dollars. The amount the first- and second-movers do not send is theirs to keep.

*Example* The first-mover sends $4 to the second-mover. This amount is tripled, so that the second-mover receives $12. If the second-mover sends $4 to the first mover, then the final payoffs would be [**6**, **8**]: $6 for the first-mover ($2 he/she kept plus the $4 sent from the second-mover), and $8 for the second-mover. If instead the second-mover sends $5 to the first mover, then the final payoffs would be [**7**, **7**]: $7 for the first-mover and $7 for the second-mover.

Right after we finish reading the instructions, you will have an opportunity to talk face-to-face with the person you are paired with. You may talk for up to two (2) minutes. During the communication period, you may discuss anything you like, including what you think is the best approach to the experiment, what you plan to do, or what you would like others to do. **You may not discuss your decisions and earnings from earlier experiments**. A member of the experiment team will monitor the discussion, to insure that this rule is adhered to.

When the communication period ends, you must cease all communication. You will then return to your computer terminal to separately and individually make your decision. You will not have the opportunity to speak to the person you are paired with for the remaining duration of the experiment.

Note that the decisions of second-movers are always anonymous. Since we pay only two out of three experiments, first-movers will not know, even after the end of all three experiments, the total amount of money sent back by any second-movers.

Once the decision phase of the experiment begins, you will be asked to remain at your seat and to refrain from any form of communication with other participants. After you received a computerized message informing you that you should make your selection, you will have **40 s** to do so.

You will now be asked to take a short quiz to ensure your comprehension of the instructions.

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