

Group and Dyadic Communication in Trust Games

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Abstract

We study the behavioral consequences of interpersonal communication prior to experimental Trust games. We manipulated the richness of the communication medium and the size of the communicating group. Communication richness failed to produce significant differences in first-mover investments, but the size of the communicating group did: The amounts sent were significantly higher in the dyadic communication conditions than in the group communication and no-communication conditions. We also find that first-movers' expectations of second-movers' reciprocation strongly predicted their levels of investment.

Introduction

There is a growing interest in the role of communication in mixed-motive interactions (for reviews see Dawes, Van de Kragt and Orbell 1990; Ostrom 1998; Shankar and Pavitt 2002; Bicchieri 2006). In this paper, we present new experimental results on the impact of the size of communicating groups and of media richness on behavior in Trust games.

The positive effect of *face-to-face* communication (FtF) on pro-social behavior, which Bicchieri (2006) dubs the 'communication effect,' has been a robust finding in the experimental study of mixed-motive games (Bicchieri, Lev-On and Chavez 2007). The 'communication effect' also occurs when communication is *computer-mediated*, but it is more fragile as it depends on the properties of the communication medium. In a survey of social dilemma studies that allowed inter-subject computer-mediated communication (CMC), Bicchieri and Lev-On (2007) show that the 'poorer' the communication medium, the longer it takes to reach agreements and establish cooperation, and even when such agreements are reached, they are violated more frequently than agreements reached by face-to-face communication. Most importantly, the communication effect varies in degree according to the richness of the communication medium. Generally, the CMC effect approximates the FtF communication effect the closer the communication channel reproduces the features of face-to-face interactions.

The 'communication effect' has been explained by Bicchieri (2006) in terms of her theory of social norms. According to the theory, the existence and motivational force of a social norm depend upon there being a sufficiently large number of people who believe that it exists and applies to a particular situation, and prefer to conform to it as long as:

- (a) They expect that enough others follow it in similar contexts [*empirical expectations*], and
- (b) They believe that enough others expect them to conform to the norm as well

[*normative expectations*], and may even sanction behaviors [*normative expectations with sanctions*] (Bicchieri 2006).

When a social norm becomes salient, it causes a shift in an agent's focus of attention and activates scripts related to the norm. Such scripts contain behavioral rules, beliefs and expectations, causal attributions and even emotions that are connected to the enactment/transgression of the scripted behavioral rules (Bicchieri, 2006, Ch. 3). Exchanging promises, for example, activates a script associated with a promise-keeping norm, and evokes familiar contexts associated with daily experiences where people who make promises tend to keep them. When agents perceive promises to be credible, they simultaneously make judgments about their partner's trustworthiness, and are induced to act on such judgments (Bicchieri 2006, Bicchieri and Lev-On 2007).

In what follows we explore two possible determinants of the communication effect in Trust games: the medium of communication, and size of the communicating group. Arguments about the importance of group size in collective action problems can be traced back to Olson's (1965) classic book *The Logic of Collective Action*. Here Olson argues that, as the number of participants in collective action becomes larger, problems of crowding effects and decreasing marginal returns become severe, the costs of communication and coordination among participants grow, and the monitoring of free-riders becomes exceedingly difficult. Olson's conclusion is that small groups are, in general, better suited to handle collective action problems than large groups. In contrast to Olson (1965), Hardin (1982) argues that the variable that

really matters for the success of collective action is the size of *efficacious* groups – the groups of entrepreneurs able to establish the organization for producing public goods. The larger the size of the efficacious group, the lower the possibility of organizing successful collective action. It should also be noted that experiments generally find no group-size effects in one-shot games (Franzen 1994, 1995).

Unlike Olson and Hardin, we are neither concerned with the number of participants in collective action, not with the number of entrepreneurs who organize it, but rather with the size of the group whose members communicate with each other about the Trust game before the game is played in pairs. We hypothesize that such pre-play discussions can generate normative and empirical expectations that later affect behavior, mainly due to the promises that occur during discussion.

We compare pre-play group and two-person (dyadic) communication. We hypothesize that dyadic communication may be more conducive to trust/reciprocation than group communication, since in dyadic communication the players directly communicate with the other they are paired with, and their actions have a clear consequence for these players - as agents' choices directly sanction or reward a single identifiable person. Also, a player's promise to invest or reciprocate refers directly to the person with whom they later play the game, thus triggering an additional motive-guilt aversion- for players not to break their promises, in spite of their cheap-talk status.

Note that group communication may be conducive to trust as well. A multi-player pre-play conversation may encourage subjects to focus on public reasons and channel

the discussion into a pro-social path, even though subjects are eventually paired with only a single person from the group, without knowing in advance who this person will be. The flip-side is the danger that a small number of subjects may choose to focus the conversation on the incentives to distrust and on their low expectations from other players, thus triggering a 'snowball effect' of mistrust and consequent lack of investment.

A second variable which may influence the 'communication effect' is medium richness. Richness may matter because it affects the background conditions under which the speech act of promising occurs. 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 may refuse to invest or cooperate themselves (Bicchieri and Lev-On 2007; Bicchieri, Lev-On and Chavez 2007).

Indeed, experimental work shows that while unrestricted CMC typically yields significantly lower trust and cooperation rates than unrestricted FtF communication, it also generates significantly higher cooperation rates than no-communication conditions, in both social dilemma and trust games (see Bochet, Page and Putterman 2006; Brosig, Ockenfels and Weimann 2003; Frohlich and Oppenheimer 1998; Bos et al. 2001; Rocco 1998; Zheng et al. 2002; Ben-Ner and Putterman 2006). These findings suggest that the further removed the speech act of promising is from daily contexts where promises are made, the less it can ground cooperation. It is realistic to

assume that when promises are conveyed through ‘poor’ media, players do not perceive others’ promises as credible, and may even be aware that their own promises might have been regarded with skepticism. In this case, both empirical and normative expectations falter, and agents may not feel bound by a norm of promise-keeping that almost no one expects or is expected to follow (Bicchieri and Lev-On 2007).

Procedure

In this paper, we further explore how the background conditions of communication influence behavior in Trust games. In particular, we offer the first experimental comparison thus far of dyadic and group pre-play communication.

The experiment involved 96 subjects, who were students at the University of Pennsylvania. The subjects participated in three short and consecutive sessions. Since the pairing differed across treatments and subjects were not paired with the same person twice (and knew that), the three experiments were independent of each other. First-movers did not learn about the amounts returned by second-movers before continuing to the next session. All 96 subjects first participated in the no-communication treatment, then in the CMC treatment, and finally in the FtF treatment. Across the three treatments, subjects communicated either in groups or in dyads, but not both.

The numbers of subjects who participated in each treatment appear in the table below. The sessions produced 108 ($= [96+32+32+28+28] / 2$) data points for analysis.

Table 1

Number of Subjects and Sessions per Condition

| | Subjects | Sessions |
|------------------|----------|----------|
| No Communication | 96 | 9 |
| Irrelevant CMC | 32 | 3 |
| Irrelevant FtF | 32 | 3 |
| Dyadic CMC | 28 | 3 |
| Dyadic FtF | 28 | 3 |

Subjects were paid their earnings for two out of the three conditions they participated in, and did not know in advance which condition they would not be paid for; the two paid sessions were chosen at random at the end of the experiment. Average earnings were \$18.83 (including a \$5 show-up fee, $sd=\$6.24$). Subjects were in the lab for about one hour.

Participants heard and received written general instructions about the trust game, and afterwards were engaged in communication (except for the no-communication control treatment). In the *dyadic face-to-face* communication condition, subjects were given two minutes to communicate with the person they were paired with. In the *dyadic CMC* condition subjects had five minutes to communicate with their partner via a computer chat program. In the *group CMC* condition subjects could use ten

minutes to communicate. In the *dyadic CMC* condition subjects could use five minutes to communicate. The difference in the length of the discussion periods across groups result from the disparities in the number of discussants and medium of communication. Copies of the communication instructions are available from the authors.

In the group-communication conditions, subjects participated in communication within a group of eight people. Subjects knew that they would eventually be paired with one of the other subjects in their group, but did not know who this person would be. Unlike in the dyadic conditions, where subjects knew that the person with whom they conversed would be their partner in the trust game, here subjects learned the ID number of the person with whom they were paired (a number which was assigned by the experimenters), but were unable to associate this identifier to the real-world identity of their partner.

At the end of the communication period, first-movers received an endowment of six dollars and made their computerized investment decisions privately. Then first-movers were asked about their expectations of second-mover reciprocation. The amounts sent by first-movers were tripled by the experimenters, and became available to the second-movers who then made their investment decisions. First-movers received no information about the amount of money sent over by second-movers.

Results

We were interested in the effects that communication medium (control, FtF, or CMC) and group size (dyadic or group) had on three variables: trust – the amount in

dollars sent by the first-mover (\$0 through \$6); reciprocation – the amount returned by the second-mover, controlling for the amount sent; and expected reciprocity – the amount the first-mover expected to be returned by the second-mover. We modeled these variables as binomial or quasibinomial responses using the generalized linear model (GLM) framework.¹ To assess the significance of communication medium and group size, we sequentially tested pairs of nested models using the F- or Chi-square statistic, as appropriate. In order to code all five experimental conditions, we treated communication medium as a dichotomous variable (CMC or non-CMC), and coded whether the condition was a non-control or a control condition, also as a dichotomous variable (hereafter, non-control). Together with group size, these variables yield the five experimental conditions: control, FtF-Dyadic, CMC-Dyadic, FtF-Group, and CMC-Group.

Table 2 summarizes the responses across conditions, whereas Figure 1 shows the distributions of the amount received and returned by the second-mover, separated by dyadic and group communication. There was a trend toward higher levels of trust, reciprocation, and expectations of reciprocity in the dyadic conditions compared to the non-dyadic conditions.

Finally, because gender did not significantly predict trust ($F(1,106) = 0.20, p =$

¹ Using ordinary least squares is inappropriate for all three variables, since analyses indicated that their distributions were non-normal. Furthermore, many of the regressions revealed evidence of overdispersion, making the quasi-binomial model necessary in several cases.

.65), reciprocation ($F(1,84) = 1.61, p = .21$), or expected reciprocity ($F(1,84) = 3.70, p = .06$), we did not further analyze this variable.

Table 2

Mean Trust, Reciprocation, and First-Mover Expectations by Communication Relevance and Group Size.

| Variable | Control | FtF-Dyadic | CMC- Dyadic | FtF-Group | CMC- Group |
|----------------------|---------------|---------------|----------------|----------------|----------------|
| Trust | 2.92 (.36) | 5.57 (.46) | 5.14 (.57) | 4.13 (.70) | 3.94 (.69) |
| Reciprocation | 1.92 (.48) | 7.57 (.96) | 5.14 (1.33) | 3.63 (1.11) | 2.13 (.95) |
| Expected Reciprocity | 3.54 (.53) | 8.36 (.69) | 7.43 (.96) | 4.31 (1.17) | 5.00 (1.14) |

Note. Parenthesized values are standard errors of the mean.

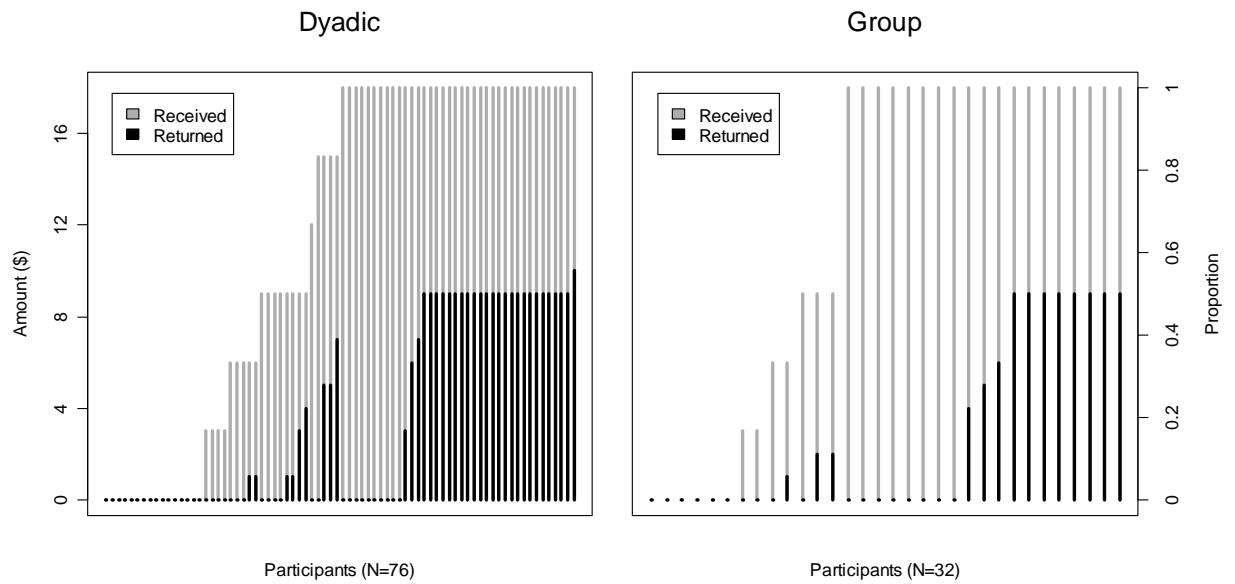


Figure 1. The amounts received and returned by the second-mover, sorted by the amount received and the amount returned.

Trust. Figure 2 shows the distribution of trust across the five conditions. Sequential regressions revealed that the interaction of communication medium and group size was not significant ($F(1,103) = 0.21, p = .65$), and that communication medium was not significant ($F(1,104) = .26, p = .61$). Group size, however, significantly predicted trust ($F(1,105) = 5.05, p = .03$), as did non-control ($F(1,105) = 16.15, p < .0001$).

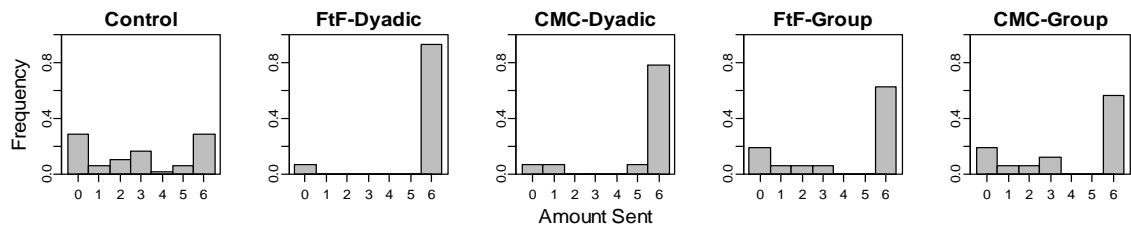


Figure 2. Distribution of trust by communication medium and group size.

Table 3 shows the resulting model of trust, which distinguishes between the control, non-control / group, and non-control / dyadic conditions. Table 4 shows the predicted probabilities of sending each dollar, by condition. The probability is not different from chance in the control condition, is significantly higher in the non-control / group conditions, and higher yet in the non-control / dyadic conditions.

Table 3

Summary of Quasi-Binomial GLM Estimates for Factors Predicting Trust ($N = 108$)

| Variable | Estimate | Std. Error | z -value |
|-------------|----------|------------|------------|
| Intercept | -0.06 | 0.26 | -0.22 |
| Non-Control | 2.18 | 0.60 | 3.65*** |
| Group | -1.40 | 0.63 | -2.21* |

Note. Residual deviance: 549.78 on 105 degrees of freedom. Estimated dispersion: 4.67.

* $p < .05$. *** $p < .001$.

Table 4

Predicted Bias in Favor of Sending Each Dollar, By Condition

| Condition | Log-odds | Odds | Probability |
|--------------------|----------|------|-------------|
| Control | -0.06 | 0.95 | 0.49 |
| Non-Control Dyadic | 2.12 | 8.33 | 0.89 |
| Non-Control Group | 0.72 | 2.05 | 0.67 |

Note. Odds of 1 represent an equal likelihood of sending versus keeping each dollar.

Reciprocation. Figure 3 shows the distribution of reciprocation by communication medium and group size. For 22 data points, the amount trusted was zero. Because reciprocation necessarily is zero for these data, we omitted them from the analysis in this section.

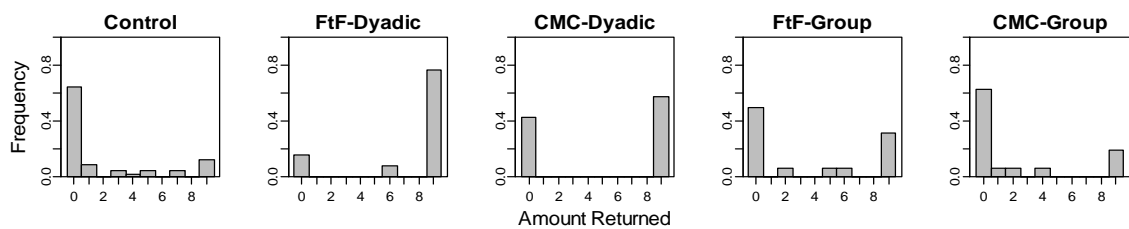


Figure 3. Distribution of reciprocation by communication medium and group size.

A simultaneous regression on reciprocation revealed significant effects of trust ($X^2(1) = 25.07, p < .0001$), non-control ($X^2(1) = 20.82, p < .0001$), group size ($X^2(1) = 18.59, p < .0001$), and communication medium ($X^2(1) = 11.54, p < .001$) – see Table 5. There were no significant interactions of trust with medium ($X^2(1) = .08, p = .77$), group size ($X^2(1) = .31, p = .58$), or non-control ($X^2(1) = .13, p = .72$).

Figure 4 graphs the model's predictions. The probability of returning versus not returning each dollar increased with the amount trusted, but was highest and increased most rapidly for the FtF-Dyadic condition.

Table 6

Summary of Binomial GLM Estimates for Factors Predicting Reciprocation ($N = 86$)

| Variable | Estimate | SE | z-value |
|-------------|----------|------|-----------|
| Intercept | -3.15 | 0.46 | -6.87**** |
| Trust | 0.37 | 0.08 | 4.42**** |
| Non-Control | 0.80 | 0.18 | 4.52**** |
| Group | -0.66 | 0.16 | -4.24**** |
| Medium | -0.52 | 0.15 | -3.37*** |

Note. The residual deviance is 351.33 on 81 degrees of freedom. We did not estimate the dispersion parameter, as the data are sparse.

**** $p < .0001$. *** $p < .001$.

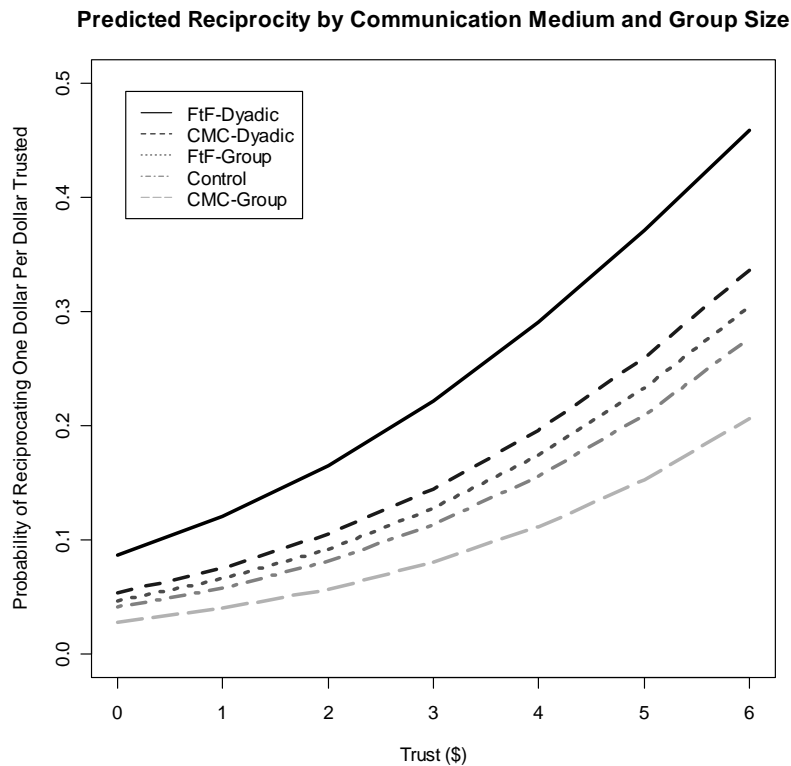


Figure 4. Predicted reciprocation as a function of trust, based on the model in Table 6.

Expectations. To determine whether expected reciprocity predicted the first-mover's level of trust, we converted expected reciprocity into the *expected reciprocity (proportion)* – the amount expected to returned divided by the amount available to be returned – and then regressed trust on this variable using ordinary least squares (OLS). This conversion was necessary to control for the fact that the maximum amount that could be returned was determined by the amount sent.

A simultaneous regression revealed that the expected reciprocity (proportion) and non-control were significant predictors of trust (respectively, $F(1,103) = 178.29$, p

< .0001; $F(1,103) = 7.68$, $p = .007$), while medium and group size were not (respectively, $F(1,103) = 0.71$, $p = .40$; $F(1,103) = 0.002$, $p = 0.96$). The estimated coefficients in Table 7 show that when the first-mover expected nothing to be returned, the predicted amount sent was only .80 dollars. For each percent of the amount sent that the first-mover expected to be returned, however, the first-mover sent an additional .08 dollars. Thus, the median expected reciprocity (proportion) of .44 resulted in a \$3.70 increase in the amount returned. Moreover, the R^2 value of 0.64 indicated that a substantial percentage of the variance in trust was explained by the expected percentage reciprocity.

Table 7

Summary of OLS Estimates for Expected Reciprocity as a Predictor of Trust ($N = 108$)

| Variable | Estimate | SE | t-value |
|--------------------------------------|----------|------|----------|
| Intercept | 0.80 | .288 | 2.89** |
| Non-control | 0.84 | .303 | 2.79** |
| Expected Reciprocity (Proportion) | 8.40 | .007 | 12.39*** |

Note. $R^2 = 0.64$.

*** $p < .001$. ** $p < .01$.

Conclusions

As mentioned earlier, we are the first to study the effects of group size in trust games. Our results show that the behavior of first-movers is determined strongly by their expectations of second-movers' reciprocation, even though those expectations are rarely met, as expected reciprocation has been significantly lower than the actual reciprocation, across all conditions.²

The variable most conducive to creating such expectations is not the medium of communication, but rather the number of communicators. Investments in the dyadic communication conditions were significantly higher than in the group communication conditions, which were in turn significantly higher than in the no-communication condition. As a general rule, higher levels of trust, reciprocation, and expectations of reciprocity were recorded in the dyadic conditions, compared to the non-dyadic conditions.

By contrast, the medium of communication did not significantly predict trust (note, for one, that the mean investment in the CMC-dyadic communication condition was significantly higher than the mean investment in the FtF-group condition.) This finding does not conform to other experimental results (see Bochet, Page and Putterman 2006; Brosig, Ockenfels and Weimann 2003; Frohlich and Oppenheimer 1998; Bos et al. 2001; Rocco 1998; Zheng et al. 2002) that found significant

² This was especially evident in the CMC-group condition, where mean reciprocation (2.13) was less than half the mean expected reciprocation (5.00).

differences in cooperation rates between ‘richer’ and ‘poorer’ communication conditions. In these studies, however, the number of communicators in a group remained constant. In another experiment (Bicchieri, Lev-On and Chavez 2007), we manipulated media richness and topics of conversation prior to Trust games. Analogous to our findings here, we found that communication *richness* failed to produce significant differences in first-mover investments, but the *topics of conversation* made a considerable difference: the amounts sent were significantly higher in the unrestricted communication conditions than in the restricted communication and no-communication conditions. This suggests that, in addition to the influence of communication media found in earlier experiments, there are additional variables (such as the content of conversation and the number of discussants) that mitigate the perception of the credibility of promises and generate expectations and behavioral consequences.

Results are more nuanced regarding second-mover reciprocation, where we found significant effects of trust, medium, and group size. Note, however, that first-movers seem to over-estimate the willingness to reciprocate of second-movers; first-movers expected higher returns than the actual returns they did receive, regardless of the condition. Note that first-movers received little benefit from their investment, with the exception of the FtF-dyadic condition and, to a lesser extent, the CMC-dyadic condition.

Our results demonstrate the advantages of dyadic over group communication for achieving trust and reciprocation, regardless of the richness of the communication

medium. Since dyadic, and not just group communication, seems crucial for accomplishing a group's goal, our results have interesting implications for managing global virtual teams or similar distributed ad-hoc workgroups where individuals have to cooperate with other team members to complete assignments.

References

Ben-Ner, A. and L. Putterman. 2006. 'Trust, Communication and Contracts: Experimental Evidence.' Working Papers 2006-23, Brown University, Department of Economics.

Bicchieri, C. 2006. *The Grammar of Society: The Nature and Dynamics of Social Norms*. New York: Cambridge University Press.

Bicchieri, C. and A. Lev-On. 2007. 'Computer-Mediated Communication and Cooperation in Social Dilemmas: An Experimental Analysis.' *Politics, Philosophy and Economics* 6: 139-68.

Bicchieri, C., A. Lev-On and A. Chavez. 2007. *The Medium or the Message? Communication Richness and Relevance in Trust Games.* Manuscript submitted for publication.

Bochet, O., T. Page and L. Putterman. 2006. 'Communication and Punishment in Voluntary Contribution Experiments.' *Journal of Economic Behavior and Organization* 60: 11-26.

Bos, N., D. Gergle, J.S. Olson and G.M. Olson. 2001. 'Being There versus Seeing

There: Trust via Video.’ *Proceedings of CHI 2001*: 291-2. New York: ACM Press.

Brosig, J., A. Ockenfels and J. Weimann. 2003. ‘The Effect of Communication Media on Cooperation.’ *German Economic Review* 4: 217-41.

Dawes, R.M., A.J.C. Van de Kragt and J.M. Orbell. 1990. ‘Cooperation for the Benefit of Us -- Not Me, or My Conscience.’ in *Beyond Self-Interest*, ed. J.J. Mansbridge, pp. 97-110. Chicago: The University of Chicago Press.

Franzen, A. 1994. ‘Group Size Effects in Social Dilemmas: A Review of the Experimental Literature and some New Results for One-Shot N-PD Games.’ In *Social Dilemmas and Cooperation*, eds. U. Schulz, W. Albers and U. Mueller, pp. 117-46. Berlin: Springer-Verlag.

Franzen, A. 1995. ‘Group Size and One-Shot Collective Action.’ *Rationality and Society* 7: 183-200.

Frohlich, N. and J. Oppenheimer. 1998. ‘Some Consequences of E-Mail vs. Face to Face Communication in experiments.’ *Journal of Economic Behavior and Organization* 35: 389-403.

Hardin, R. 1982. *Collective Action*. Baltimore: Johns Hopkins University Press.

Olson, M. 1965. *The Logic of Collective Action*. Cambridge, MA: Harvard University Press.

Ostrom, E. 1998. ‘A Behavioral Approach to the Rational Choice Theory of Collective Action- Presidential Address of the American Political Science Association

Rocco, E. 1998. 'Trust Breaks Down in Electronic Contexts but can be Repaired by some Initial Face-to-Face Contact.' *Proceedings of CHI 1998*: 496-502. New York: ACM Press.

Shankar, A. and C. Pavitt. 2002. 'Resource and Public Goods Dilemmas: A New Issue for Communication Research.' *Review of Communication* 2: 251-72.

Zheng, J, E. Veinott, N. Bos, J.S. Olson and G.M. Olson. 2002. 'Trust without Touch: Jumpstarting Trust with Initial Social Activities.' *Proceedings of CHI 2002*: 141-6. New York: ACM Press.