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Miscommunication in an investment game with one-way messages*

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Abstract. This paper aims to study the effects of free-form messages (cheap talk) in an investment game as Berg et al. (1995). We guess that messages matter, but they may not affect the outcomes on average because different outcomes of communication can be systematically misunderstood generating different effects that offset each other. Considering a non-binary choice game, where misunderstandings are more likely to be observed, we test our intuition in two steps. First, we classify messages by their contents and then we verify their impact on participants' behavior accordingly to their kind.

Keywords: Trust, reciprocity, promises, requests and empty talk.
JEL Codes D03, C91, D83.

1. Introduction

A number of experimental studies have found positive evidence that cheap talk is successful (to varying degrees) in achieving the Pareto-superior equilibrium in coordination games. Cooper et al. (1989, 1992) and Charness (2000), e.g., report that one-way communication increases play of the Pareto-dominant equilibrium relative to the no communication baseline in two-person coordination games.1 There is, however, less knowledge on its effects when risk dominance and payoff dominance conflict are present as in trust and investment games.

The effects of one-way messages have been investigated in many different reduced forms of trust games, leading to mixed evidence. Charness and Dufwenberg (2006, 2010, 2011) e.g. found that, in a binary choice game, promises may enhance trust, cooperation, and efficiency; by contrast, in a similar experiment, Bracht and Feltovich

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1 See also van Huyck et al. (1990), Blume and Ortmann (2007), Pogrebna and Blavatsky (2009) for similar results.
(2009) found that one-way message have no significant effect on the behavior of both investors and trustees.²

Our paper aims to study the effects of cheap talk on trust and cooperation in investment game a la Berg et al. (1995). Specifically, we investigate the effects of one way, free-form, non-binding messages on the average amounts sent by subjects who trust and cooperate. We guess that different results depend on misunderstandings rather than by the fact that the messages are ignored as they are not binding. In other words, we aim to verify that, despite the messages may have no effect on average, they are important factor that influence the choices of individuals. In large samples, for some pair of individuals messages support greater cooperation than in the case without communication. As the receiver understands the sender’s message, but for other pairs, messages reduce cooperative behavior related to misunderstandings. As a result, no effect is detected on average although messages are effective.

Our intuition seems to be in line with some empirical evidences which demonstrate that cooperation increases with communication, in our view this should reduce it, the case of misunderstandings. For instance, in an investment game a la Berg et al. (1995), Ben-Ner et al. (2011) found that trust, trustworthiness, and cooperation are greater when written numerical messages are used than when numerical communication only or no-communication is assumed. In the same context, Ben-Ner and Putterman (2009) found that cooperation also increases with the number of interactions (one-side vs. two-side messages). It was the highest when chat is used for communication. Similarly, Bochet et al. (2006) found higher public goods contributions under a “chat room” (no restriction on messages) treatment than when only numerical messages were possible.

We test our intuition by considering an investment game where decisions are not binary (i.e., choose to cooperate or not), and thus, misunderstandings are more likely to be observed. Moreover, following recent literature,³ we classify messages to verify their impact accordingly to their contents.

We find that cheap talk does not affect the outcomes on average, but looking closely at the different kinds of messages, we find that these generate different effects which offset each other. In fact, although promises enhance cooperation, other messages attempt to communicate intentions seem to be systematically misunderstood by receivers, who read them as promises when they are not. In other words, unilateral communication may have or not a positive effect on trust behavior depending on the outcome obtained during the communication.

The rest of the paper is structured as follows. Section 2 describes experiment design and procedures. Section 3 illustrates and discusses our main results. Section 4 concludes.

2. The experiment

2.1 Design

In our experiment we perform two treatments based on the investment game (Berg et al., 1995). The first treatment (TC) is a standard two stages investment game; the second (TM) is a variant where pre-play communication is allowed. By comparing TC (control) to TM, we investigate the effects of cheap talk.

The two treatments are based on the multiple stages defined below. For the sake of brevity, as the investment game involves two players (A and B), we refer to A as “she” and B as “he.” In both treatments, A and B are initially endowed with 10 tokens.

**Definition (TC).** Subjects interact in two stages during which they can increase or decrease their initial endowments depending on their choices. In the first stage, A can transfer part, all or none of his endowment (i.e., from 0 to 10 tokens) to B. Before being delivered to B, any amount transferred is multiplied by 3. In the second stage, B could transfer part, all or none of the tripled amount of tokens received from A. Payoffs are the initial endowments plus the tokens received minus those sent.

**Definition (TM).** In the first stage subject B can send a free message to A; the message is not binding. Stage two and three are the same as stage one and two of TC.

Referring to $a$ and $b$ as the amount respectively sent by A and B, we define trust and cooperation as follows.

**Definition (trust).** If A transfers to B some tokens ($a > 0$), she trusts him.

In both treatments, if all the agents are selfish, the sub-game perfect Nash equilibrium implies that nothing is sent, and the proof is trivial. However, experimental economics document different results in investment games due to the fact that people have other regarding preferences (they are not selfish). Therefore, we expect that subjects will transfer some tokens due to conditional or unconditional motivations. By comparing the outcomes of two treatments (TM vs. TC), we investigate the effects of cheap talk on trust. In particular, we analyze whether unilateral messages have an effect on the average amounts sent by A subjects (announcement effect).

Formally, we test the following hypothesis:

$$H_{1a}: \text{Announcement effect} \quad a_{TM} - a_{TC} > 0$$

where the subscript indicates the treatment. As $a_{TM} - a_{TC}$ is a measure of announcement effects, if $a_{TM} - a_{TC} = 0$, there is not announcement effect on average trusting behavior.

**Definition (reciprocity).** If B subjects send on average an amount ($b$) greater than what he received by A subjects ($b > a$); i.e., reciprocity, as defined by Berg et al. (1995).

$$H_{2a}: \text{Reciprocity} \quad b > a$$

However, Cox (2004) and Cox et al. (2008) pointed out that tests for reciprocity should use a regression approach that is conditional on the amounts sent (or received). In detail, we estimate following relation between amounts sent by A ($a$) and amounts returned by B ($b$), in treatments T1 and T3:

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4 We do not distinguish from conditional to unconditional other-regarding preferences. In order to disentangle conditional and unconditional motivations further treatments (appropriate dictator games) should be introduced (see Cox, 2004; Di Bartolomeo and Papa, 2015).
\[ b_i = \alpha + \beta D_ia_i + \gamma a_i + \varepsilon_i \]

where \( D \) is a dummy which assumes values equal to one, if the observation \( i \) refer to TM and zero to TC, otherwise.

The bounds for the Tobit estimation are those imposed by the experiment design 0 and 3\( a_i \). Following Cox (2004), we also take account for multiplicative heteroskedasticity. We estimate \( \theta \) from \( \sigma_i = \sigma e^{\theta a_i} \). The coefficient \( \beta \) measures reciprocity (\( \beta > 0 \)).

Following the methodology proposed by Charness and Dufwenberg (2006, 2010, 2011), we also distinguish messages according to their contents and investigate their effects on senders’ choices, i.e. on trust, reciprocity. Specifically, we consider three kinds of messages.\(^5\)

i) Promise (P). B subject promises to reciprocate if A subject trusts him.

ii) Request (R). B subject asks for something to be given by A subject as a favor or a courtesy.

iii) Empty (E). B subject sends a message that contains neither promises nor requests, the message simply attempts to achieve success or sympathy.

Therefore, we intend to analyze whether the average of amounts sent for trust and reciprocity is different, once we controlled for the kind of message received. In particular, we analyze whether the different kinds of messages induce A subjects to send larger amounts on average. We also test whether there some reciprocity effects emerge when types of messages are considered. Formally,

\[ H_3: \text{Announcement effect} \quad a_{ij} \neq a_{iTC} \quad i, j \in \{ P, R, E \} \]

As noted above, reciprocity should be detected by using individual data. Specifically, by using three Tobit regressions, we estimate following relation between amounts sent by A (\( a \)) and amounts returned by B (\( b \)):

\[ H_4: \text{Reciprocity} \quad x \in X \quad b(i) = \alpha + \beta D(i)a(i) + \gamma a(i) + \varepsilon(i) \]

where \( D \) is a dummy that takes value one if observation \( i \) refers to the type of message \( i = \{ P, R, E \} \) under scrutiny, zero if it refers to the associated control group. The bounds for the estimations are those imposed by the experiment design: 0 and 3\( a_i \). The coefficient \( \beta \) measures the effect of type of unilateral communication, i.e., promises, requests, or empty talk compared to the associated control group. The null hypothesis is that \( \beta \) is equal to zero.

### 2.2 Procedures

The experiment was conducted in 2012 at the Sapienza University of Rome and the University of Teramo. Participants were undergraduate students recruited by e-mail using lists of voluntary potential candidates.\(^6\) Subjects were randomly selected from the

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\(^5\) Classification is clearly subjective. Some messages were on boundary between promises and empty messages could arguably be placed in both categories; nevertheless, the overall pattern is quite clear and robust to alternative classifications. In the technical appendix we report all the messages, raw data about individual choices and our classification.

\(^6\) Lists were compiled in advance by advertisements placed on the universities notice boards and by using the universities mailing lists.
In each universities we ran two sessions for each treatment, for a total of 148 subjects and four sessions.

Regarding on incentive systems, all participants know that they will be randomly paid according to monetary payment or a between-subject random-lottery incentive systems.\(^7\) The incentive system used in the session was randomly drawn (50% probability for each) before the experiment and revealed at the end. In the case of monetary payment, the value of each token was equal to 0.50 euro; otherwise, the value of each token was equal to a ticket for a lottery that was rewarded with four electronic MP3 devices (35 euro each) for each session.\(^8\)

At the beginning of each session, subjects were required to provide identification cards. A database with name verified that there was no repeat participation. Then all the participants were divided in two groups (A and B) and placed two different rooms by a random sampling. Each subject A was matched to a subject B in a random and anonymous way.

All the decisions made during the experiment were anonymous. Anonymity was guaranteed by using identification codes; names remained unknown to all — including experimenter and controllers.\(^9\) During the experiment, two controllers checked that the instructions were correctly followed by participants. We used a standard double blind procedure.\(^10\)

### 3. Results

#### 3.1 Do non-binding messages affect people choices?

Our results from TM and TC are reported in Table 1. The table displays the average amounts sent in investment games. In the first row, we report the average amount sent by A subjects, which is 4.43 and 4.20 tokens in TM and TC, respectively. In the second row, we present that the average amount sent by B subjects is 4.66 and 4.59 tokens in TM and TC, respectively. Standard deviations are reported in square brackets. The last two columns report the mean and median (Wilcoxon) difference and one-tailed p-value (in parentheses) associated with a t-test and non-parametric test based on the independent sample assumption, respectively.

#### Table 1 – H1a: Parametric and nonparametric tests of announcement effect.

<table>
<thead>
<tr>
<th></th>
<th>Sent TM(_a)</th>
<th>Sent TC(_a)</th>
<th>mean tests</th>
<th>MW</th>
<th>Wilcoxon</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a TM vs. TC</td>
<td>4.43</td>
<td>4.20</td>
<td>0.47</td>
<td>-0.20</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>[3.31]</td>
<td>[2.57]</td>
<td>[0.32]</td>
<td>[0.42]</td>
<td>[0.35]</td>
</tr>
<tr>
<td>Average amount sent by B subjects</td>
<td>4.66</td>
<td>4.59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^7\) In dynamic-multi-task environments, between-subjects random lottery incentive system might induce some biases. However, in single task context, it performs well. For a detailed discussion, see Starmer and Sudgen (1991), Beattie and Loomes (1997), Cubitt \textit{et al.} (1998), Baltussen \textit{et al.} (2012).

\(^8\) Accordingly, participants who were not selected for the reward earned nothing.

\(^9\) Each subject does not know the subject s/he is paired with—neither during nor after the experiment.

\(^10\) In the case of random payment mechanism, using their codes, participants were paid by an administration office located in a separate building (the central administration of the university), which a payment summary from the examiners by email. Participants were aware that officers were unaware of the details for the reason for the payments or anything concerning the experiment. In the case of between-subject random-lottery incentive system, the lottery has been drawn by a controller at the end of experimenter.
Tobit analysis for second mover data (obs. 148)

<table>
<thead>
<tr>
<th></th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$\gamma$</th>
<th>$\theta$</th>
<th>LR test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-1.88</td>
<td>-0.04</td>
<td>1.39</td>
<td>4.71</td>
<td>24.18</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.67)</td>
<td>(0.00)</td>
<td>(0.29)</td>
<td>(0.00)</td>
</tr>
</tbody>
</table>

Notes: The column reports the means (and standard deviations between square brackets), and one-tail difference mean test based on a t-test assuming independent sample, non-parametric Wilcoxon sum-rank and signed-rank tests (p-values are reported between brace brackets).

The announcement effect is very small (0.47 tokens) and the amount sent in TM (4.43 tokens) is not significantly different on average from that in TC (4.20 tokens)—as indicated by the t-test on the mean, the non-parametric Mann-Whitney tests. As a result, H1a has to be rejected, and therefore, we observe no announcement effect on average. Pre play communication does not seem to play any role on the amount sent by investors on average; in fact, payoffs are not significantly different in TM and TC.

Regarding reciprocity as defined by Berg et al. (1995), subjects who trust gained more tokens on average than those who did not, as the return ratio is larger than one in TM. The same occurs in TC. Then, the null hypothesis in H2 can be rejected.

Furthermore, following Cox (2004) and Cox et al. (2008), we measure the effects of unilateral communication on reciprocity by using a Tobit regression approach. Looking at the Tobit estimates, we do not observe more reciprocity since $\beta$ is not significantly greater than zero. We do not find gender effects.12 Regarding reciprocity (H2), we have to accept the null hypothesis that reciprocity is not affected by unilateral communication.

Summarizing, we find that unilateral messages have no effect on the average amounts sent. A possible explanation of our results compared to other studies on trust formation, as e.g. Charness and Dufwemberg (2006, 2011) where the choice to trust is binary, could be related to the form of the game. Considering a non-binary trust game, where misunderstandings are more likely to be observed, in fact, in our case the number of strategies available is larger than in simple cooperate/non-cooperate trust games or similar. Therefore, one can infer that coordination is more difficult to achieve and miscommunication is more likely to be observed. Different kind of messages may have an impact on participants’ behavior; we will investigate this point in the next session by examining the messages by type.

3.2 Message types

As noted above, we distinguish the messages in three different types; i.e. promises, requests and empty messages. Then we analyze whether different types of messages affect trust and cooperation. Table 2 displays our results regarding the effects of types of messages comparing the average amounts sent by subjects A paired to control group (H3).

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11 Results on return ratios are mixed, as survived by Glaeser et al. (2000), Capra et al. (2008), Cardenas and Carpenter (2008), Johnson and Minslin (2011). In Cox (2004), the ratio is below one.

12 Results are available upon request.
We obtain mixed results on average. There is a significantly positive effect on trust on average in the subsample of unilateral promises compared to the paired control group, there is not effect of empty messages, whereas we find a significantly negative effect induced by the unilateral requests respect to the paired control group. The unilateral requests seem to reveal the kind of person the sender were, i.e., a subject who was not interested in cooperation. Similarly, unilateral promises characterize a more cooperative people. Thereafter, promises and empty messages induce cooperation more than requests do.

Looking closely at the distributions of unilateral promises compared to control group (see Figure 1), we do not find much difference between 0 and 4 tokens sent. By contrast, when people received promises seem to move toward the right side of the distribution, where it is more likely to observe an amount around 10 tokens sent respect to control group. The significant difference on the right side of the distribution is also confirmed by the Kolmogorov-Smirnov test. 

Results are available upon request.
Regarding reciprocity as defined by Berg et al. (1995), subjects which received a promise or an empty talk, and they trust gained more tokens on average than those who did not, as the return ratio is larger than one. Whereas this not occurs when subjects A received requests. Not all forms of communication are efficient in enhancing trust and cooperation.

Regarding reciprocity as defined by Cox (2004) and Cox et al. (2008), we controlled by the type of unilateral communication (H4), the results are illustrated by the following table 3.

<table>
<thead>
<tr>
<th>Censored Tobit analysis for second-mover data (obs. 74)</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$\gamma$</th>
<th>$\theta$</th>
<th>LR test</th>
</tr>
</thead>
<tbody>
<tr>
<td>P vs. C</td>
<td>-1.54</td>
<td>0.07</td>
<td>1.11</td>
<td>5.29</td>
<td>23.36</td>
</tr>
<tr>
<td></td>
<td>[0.20]</td>
<td>[0.76]</td>
<td>[0.00]</td>
<td>[0.49]</td>
<td>[0.00]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Censored Tobit analysis for second-mover data (obs. 32)</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$\gamma$</th>
<th>$\theta$</th>
<th>LR test</th>
</tr>
</thead>
<tbody>
<tr>
<td>R vs. C</td>
<td>-1.14</td>
<td>-0.50</td>
<td>1.19</td>
<td>2.84</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>[0.22]</td>
<td>[0.03]</td>
<td>[0.00]</td>
<td>[0.38]</td>
<td>[0.42]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Censored Tobit analysis for second-mover data (obs. 42)</th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$\gamma$</th>
<th>$\theta$</th>
<th>LR test</th>
</tr>
</thead>
<tbody>
<tr>
<td>E vs. C</td>
<td>-3.22</td>
<td>-0.13</td>
<td>2.11</td>
<td>3.88</td>
<td>11.16</td>
</tr>
<tr>
<td></td>
<td>[0.01]</td>
<td>[0.58]</td>
<td>[0.00]</td>
<td>[0.44]</td>
<td>[0.00]</td>
</tr>
</tbody>
</table>

Notes: In the Tobit models, we drop the observations associated to individuals that received zero from the investors, since they are both left- and right-censored.

Source: Author calculations.

We do not observe reciprocity in any types of message considered compared to the paired control group. Parameter $\beta$ is not significantly different from zero in none of three Tobit regressions, as consequence H4 must be rejected.\(^{14}\) Those results may derive from the different initial distributions endogenously generated by the experiment and a large sample should be used to better analyze reciprocity.\(^{15}\) Furthermore, we can observe only that larger paybacks sent by trustees are related by larger amount sent by investors, given that $\gamma$ is significantly different from zero. These results confirm that cooperation rises in each type of message.

Summarizing, we find that the kind of message matters. Promises and empty messages successfully trigger cooperation mechanism more than requests. Trustees which sent requests reveal that they were not interested in cooperation, whereas which sent promises enhance cooperation in term of proportion and in term of average amounts

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\(^{14}\) With the exception of requests, where the coefficient is significant different from zero, but it is negative.

\(^{15}\) Problems in testing reciprocity are due to not condition reciprocity for initial inequality that is endogenous when the first stage of investment game is played, as reported by Di Bartolomeo and Papa (2015).
sent. However, uncooperative trustees are usually unrecognizable by investors, which always trust them. A feasible explanation of our results is related to the misunderstanding of messages about A subjects who are unable to distinguish the underlying meaning of different kinds of messages, i.e., promises (empty messages) and requests.

4. Concluding remarks

In this paper we have investigated the effects of cheap-talk communication on trust and cooperation in investment games by a counterfactual experiment; i.e., comparing the outcomes of an investment game where pre-play communication is allowed to those of a canonical one (control group).

Different from other experiments on trust formation (e.g., cooperative/uncooperative trust games or similar) that find positive effects of cheap talk, at a first look, we do not find any effect of communication on the proportion of subjects who trust or cooperate nor on average amounts sent. The difference could due to the number of strategies available. In our game this difference is large, and therefore, on the one hand, coordination is more difficult to be achieved, whereas on the other hand, miscommunication is more likely to be observed.

Furthermore, by considering the content of the message, we observe that the different kinds of messages generate different effects, which offset each other on average (as we do not find effect in the full sample). In fact, after classifying the messages according to their contents as promises, requests, and empty messages, we find that promises increase the average amount sent for trust and cooperation compared to the control group. Whereas requests also affect in negative way the average amounts compared to the control group. Subjects receiving promises (requests) sent on average an amount greater (lower) than that sent by the control group.

Trustees which sent requests reveal that they were not interested in cooperation, whereas which sent promises enhance cooperation in term of average amounts sent. However, uncooperative trustees are usually unrecognizable by investors, which always trust them. A possible explanation is a problem in reading the message. Receivers are unable to distinguish the underlying meaning of different kinds of messages. They read requests as promises. A feasible explanation of our results is related to the misunderstanding of messages about A subjects who are unable to distinguish the underlying meaning of different kinds of messages, i.e., promises (empty messages) and requests.
References


