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A voluntary contribution experiment with one-way communication and income heterogeneity

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Abstract

One-way communication has been found to substantially increase contributions in linear voluntary contribution mechanisms. We confirm the robustness of this result in the presence of income heterogeneity.

JEL Classification: C72; C92; H41
Keywords: Public goods experiment; Cheap talk; Heterogeneous endowments

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1 Introduction

According to standard economic theory, markets underprovide public goods owing to the free-rider problem. Experimental and field evidence suggests otherwise, but the observed outcome is typically suboptimal (e.g., Ledyard 1995). Since the provision of public goods influences the functioning and well-being of our societies, social scientists and policy makers strive to find mechanisms that could propel individuals towards the social optimum.

In the context of any particular public goods production technology, the players' behavior depends on the choice of values for the various environmental and design variables. Koukoumelis et al. (2009) have recently shown that one-way communication, or more specifically a free-form text message sent by one group member to his co-players before contribution decisions are made, enhances efficiency in linear voluntary contribution mechanisms (VCMs). Thus, investigating the robustness of this communication method as a mechanism for facilitating cooperation is important in understanding how to alleviate the free-rider problem.

The experimental research on one-way communication has so far involved players that receive equal laboratory endowments. It is possible that the efficiency-enhancing properties of one-way communication hinge upon the endowments' homogeneity. In fact, the experimental literature on VCMs provides evidence that heterogeneity deters cooperation both when communication is not allowed (e.g., Cherry et al. 2005; Buckley and Croson 2006) and when group members can communicate face-to-face (Isaac and Walker 1988).[1]

In what follows we explore the effectiveness of one-way communication in fostering contributions in the presence of heterogeneously endowed players. Conditionally cooperative preferences (for a survey, see Gächter 2007) can transform the social dilemma game into a coordination game with multiple Pareto-ranked equilibria (e.g., Sen 1967). Insofar as the communicator is able to draw the group's attention to an equal payoffs (rather than an equal contributions) rule, the above kind of heterogeneity should not be relevant to the effects of one-way communication.[2]

[1] While in linear settings the effect of introducing heterogeneous endowments on average contributions is unequivocally negative, experiments conducted in non-linear environments suggest that the effect of heterogeneity on contributions could be neutral or even positive (e.g. Chan et al. 1996; 1999).

[2] The premise that the communicator's cheap talk increases the amount of efficient play

2 Experimental design

The experimental design builds on Koukoumelis et al. (2009) in order to facilitate comparisons. Groups of size 4 interact for 10 periods in a partners design. At the beginning of every period, each player i is endowed with an income of $e_{i,t}$ ECU (Experimental Currency Units) which he can either consume privately or contribute to a public good. Individual endowments are asymmetric: two "rich" members are endowed with 30 ECU and two "poor" members with 20 ECU (the total group endowment in each period is therefore 100 ECU, as in Koukoumelis et al.). The endowments remain constant throughout the game and are commonly known.

Let $c_{i,t}$ denote individual i's contribution to the public good in period t (with $0 \leq c_{i,t} \leq e_{i,t}$) and $C_t = \sum_{j=1}^{4} c_{j,t}$ be the total amount of public good provided. The monetary payoff per period of each i is given by

$$\pi_{i,t}(c_{i,t}, C_t) = (e_{i,t} - c_{i,t}) + 0.4\, C_t.$$

Since the marginal per capita return is less than unity, the dominant strategy for a monetary payoff maximizer is to contribute nothing. On the other hand, it is socially efficient to contribute everything.

We study two treatments that build on the basic game described above. In the baseline treatment (B_A), the group members cannot communicate with each other: in each period, they decide simultaneously and privately on the number of ECU that they wish to contribute to the public good. In the communication treatment (C_A), one member of each group is randomly appointed communicator at the beginning of the game, a role that he retains throughout the experiment. Prior to each period, the communicator has a maximum of four minutes to compose a message and send it to his co-players. In principle, the form of the message is free, the only restrictions to its content being that the communicator can neither identify himself, nor threaten the other group members, nor promise side-payments.[3]

The experiment was programmed in z-Tree (Fischbacher 2007) and conducted in the experimental laboratory of the Max Planck Institute of Economics (Jena, Germany). The subjects were undergraduate students from

in coordination games is consistent with theory and experimental evidence (Cooper et al. 1992; Farrell and Rabin 1996; Crawford 1998; Charness 2000).

[3]With the aim of enforcing compliance with these restrictions, all messages were screened before being sent.

the Friedrich-Schiller University of Jena. Upon entering the laboratory, they were randomly assigned to visually isolated computer terminals. The instructions (which are reproduced in the supplement) were distributed and then read aloud to establish public knowledge. Before starting the experiment, subjects had to answer a control questionnaire which tested their comprehension of the rules. In both treatments, at the end of each period the players received feedback on the number of ECU contributed by each group member, the income from the project, and their corresponding payoff. We implemented an exchange rate of 10 ECU = 50 euro cents. The average earnings per subject were €19.62 (inclusive of a €2.50 show-up fee).

We ran two sessions per treatment. Each session involved 32 participants. With group size equal to 4, we have 16 independent observations per treatment.

3 Experimental results

Table 1 reports summary statistics for the average group contributions. The series' measures of location increase in response to the introduction of one-way communication. On the other hand, its variation decreases, provided that we acknowledge the presence of outliers and consider a robust measure of spread (like the median absolute deviation).

[Table 1 about here.]

Figure 1 depicts the time paths of the means of the average group contributions. For the reader's convenience, we present as well the outcome of the symmetric-endowment treatments: B_S (C_S) corresponds to B_{10} (CC) in Koukoumelis et al. (2009). Treatment B_A replicates standard findings: the mean of average group contributions starts above the series' overall mean and follows a downward trend. In contrast, the C_A mean of average group contributions starts at a notably higher level and remains fairly stable in all periods but the last. A one-sided Wilcoxon rank sum test (W) with mean group contributions averaged over all 10 periods as independent observation units confirms that contributions in C_A are significantly higher than in B_A ($p = 0.00$). This result is consistent with our main hypothesis on the efficacy of one-way communication. Additionally, contributions are higher in C_S than in C_A, but the difference is not significant ($p = 0.36$; two-sided W).

[Figure 1 about here.]

Figure 2 graphs the average relative contribution (that is contribution divided by endowment) of poor and rich subjects in all periods. In line with the results of previous experiments (e.g., Cherry et al. 2005; Buckley and Croson 2006), poor subjects contribute in B_A a larger share of their endowment than rich subjects do. Conversely, in C_A the relative contributions of poor and rich are similar. Evidence to this is provided in Table 2 were we model the temporal pattern of $c_{i,t}/e_{i,t}$: the coefficient of the endowment dummy is significant in the B_A data regression but insignificant in the C_A data regression.[4] The communicator directs the players' attention away from an equal (in absolute terms) contributions rule, and successfully evokes a coordination rule prescribing contributions that equalize final payoffs.[5] In particular, 10 out of the 16 communicators suggest in their first period messages that all group members should contribute their whole endowment. Rich as well as poor subjects adhere to these suggestions in 80% of the cases.

[Figure 2 about here.]

[Table 2 about here.]

4 Conclusions

Past studies dealt with one-way communication as an institution that fosters contributions in symmetric VCMs. This paper demonstrates that the coordination role of the communicator is robust to situations where individuals are heterogeneously endowed. Our interpretation of this finding is that the communicator switches the people's attention away from an equal contributions rule. He promotes instead an equal payoffs rule, in particular the rule that is leading to the highest jointly attainable payoff.

[4]Table 2 presents parsimonious models that optimize the Bayesian information criterion. Yet, our claim that the coefficient of the endowment dummy becomes insignificant when we switch to the C_A dataset remains valid for alternative regression specifications.

[5]In B_A the median contribution of both poor and rich subjects equals 10, whereas in C_A it equals 20 for the poor and 30 for the rich. See Van Dijk and Wilke (1995) and Van Dijk et al. (1999) for studies showing that participants in resource dilemmas prefer an equal payoffs rule.

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Table 1: Summary statistics of average group contributions.

	Mean	Standard deviation	Median	Median absolute deviation
B_A	10.66	5.47	10.75	6.67
C_A	19.73	7.47	25.00	0.00

Note: 160 observations per treatment.

Table 2: Random-effects Tobit regression results for relative contributions to the public good.

	B_A	C_A
constant	0.282 (0.000)	0.056 (0.797)
t	−0.035 (0.000)	0.195 (0.000)
t^2		−0.032 (0.000)
$d_{endowment}$	−0.168 (0.001)	−0.111 (0.501)
$\frac{\sum_{j=1}^{4} c_{j,t-1}/e_{j,t-1}}{4}$	0.807 (0.000)	1.790 (0.000)
Wald test	199.89 (0.000)	99.94 (0.000)

Note: The dependent variable is $c_{i,t}/e_{i,t}$ (576 observations grouped by subject). t stands for trend; $d_{endowment}$ equals 0 for the poor and 1 for the rich. The last independent variable represents the average of the relative contributions of the group in the previous period. The B_A (C_A) regression involves 91 (53) left-censored and 74 (401) right-censored observations.

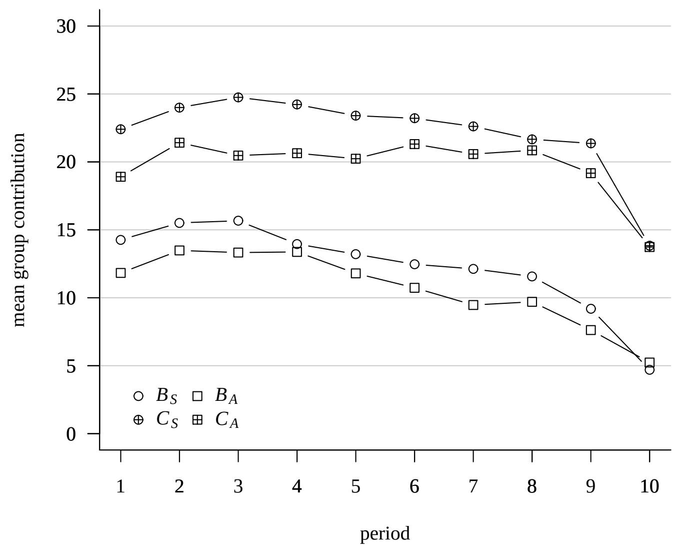

Figure 1: Mean of average group contributions over time.

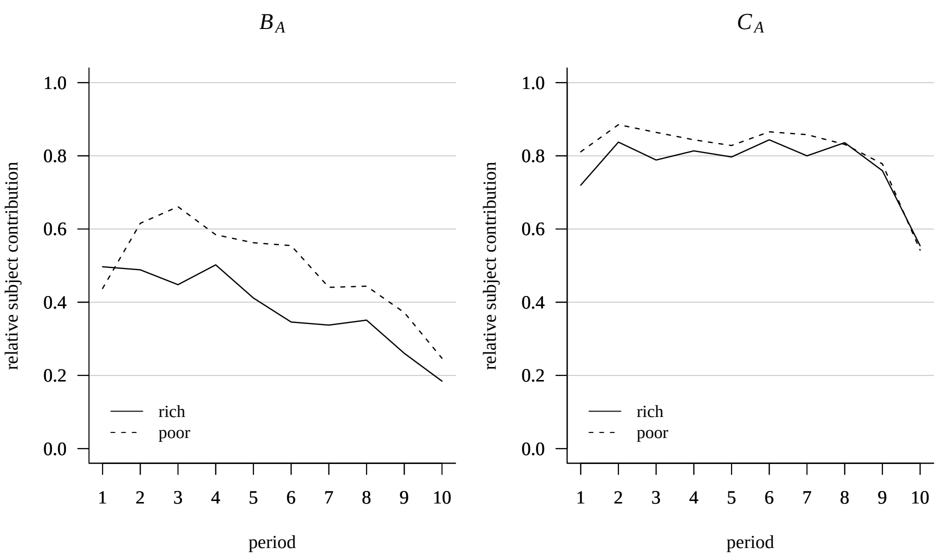

Figure 2: Average relative contributions of poor and rich subjects over time.