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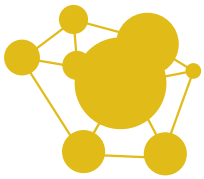

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Contributions and Beliefs in Liner Public Goods Experiment: Difference between Partners and Strangers Design

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Contributions and Beliefs in Liner Public Goods Experiment: Difference between Partners and Strangers Design

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Abstract

Our aim is to investigate why a difference in contributions was observed between Strangers and Partners design in linear public goods games. We focus on conditional cooperation and investigate how influential the difference of belief is in the contributions in Strangers and Partners design. Additionally, we try to clarify how much of the contribution is motivated by conditional cooperation. We found that 79.7% and 39.3% of the total contribution in the Partners design and the Strangers design, respectively, are motivated by conditional cooperation. Moreover, the difference in contributions between Strangers and Partners is not fully explained by only a difference of belief.

Keywords: conditional cooperation, public good, partners, strangers, experiment
JEL classification: C72, C91, H41

1. Introduction

Many previous studies of linear public goods experiments have compared two matching designs: the "Strangers design," which is a repeated single-shot design, and the "Partners design," which is a repeated game. Results have shown that the contributions in each design were significantly different (for a survey, see Andreoni and Croson, 2008). However, the differences in contributions that have been observed between Strangers and Partners remain poorly understood.

Croson (2007) conducted linear public goods experiments with a Partners design. In this experiment, subjects had to decide how much of their endowment to contribute to the public good and had to estimate the other group members' mean contributions (we called this *belief*). Croson found that there was a significant positive relationship between belief and contribution, using random-effects regression. Therefore, she mentioned that this result strongly supports the idea that contributions stem from conditional cooperation (reciprocity theory). Fischbacher and Gächter (2010) conducted a linear public goods experiment using a Strangers design. Their design also required subjects to estimate the belief, and they observed the same result as Croson (2007). Taken together, the results from both Croson (2007) and Fischbacher and Gächter (2010) show that conditional cooperation is one important explanation of the voluntary contributions, regardless of the matching design. Hence, one possible reason for the difference in contributions between Partners and Strangers is the difference in expectations concerning group members' contributions. Therefore, we focus on conditional cooperation and investigate if the differences in contributions between the Strangers and Partners designs could be explained by the differences in belief. Additionally, we try to clarify how much of the contribution is due to conditional cooperation.

We conducted a linear public goods experiment with the following three features:

(1) We asked the subjects to estimate other members' contributions. This method is almost same as the methods used by Croson (2007) and Fischbacher and Gächter (2010).
(2) A group member consisted of two subjects, because one subject could easily estimate the other subject's contribution.
(3) We provided subjects a payoff table that had complete payoff information, so that they could confirm all their strategies and payoffs easily and not make mistakes in calculating their payoff. Yamakawa et al. (2009) conducted the linear public goods experiment using a payoff table identical to our payoff table, and they observed that any resulting confusion and errors occurred for just 2.0% of all contributions.

These three features allowed us to analyze the relation between contributions and beliefs without confusion or other errors.

Three findings emerged from our data. First, the contribution and belief in the Partners design were higher than those in the Strangers design. Second, there was a positive correlation between contribution and belief in both the Strangers and Partners designs. Third, 79.7% of contributions in the Partners design were motivated by conditional cooperation. On the other hand, only 39.3% of contributions in the Strangers design were motivated by conditional cooperation. Furthermore, we found that the differences in contributions between the Strangers and Partners designs could not be fully explained merely by the differences in belief.

The current study proceeds as follows: Section 2 presents the experimental design. Section 3 presents the analysis and results, and section 4 discusses and draws conclusions about the results.

2. Experimental Design

We conducted the experiments in October 2010 at the Economics Department Computer Laboratory of Osaka University in Japan. Our subjects were 40 Osaka university students from various disciplines.

2.1 The Voluntary Contribution Mechanism and Treatment

There were two subjects, a and b, and subject $i\ (=a,b)$ had w_i points of initial endowment. Both subjects faced a decision of splitting w_i between their own consumption of the private good (x_i) and a contribution to the public good (y_i). The level of the public good each subject received from the contribution was $y=\sum_{j=1}^{2} y_j + w_y$, where w_y was the initial level of the public good. Therefore, each subject's decision problem was to maximize the payoff $\pi_i(x_i, y)$, subject to the constraint $x_i + y_i = w_i$. We set 0.7 as a marginal per capita return on the voluntary contribution. In addition, we set $w_i = 24$, $w_y = 3$. We assumed that all subjects had the same linear payoff function as follows:

$$\pi_i = 100\{24 - y_i + 0.7(\sum_{j=1}^{2} y_j + 3)\} \quad (1)$$

From (1) it is obvious that a rational and selfish individual would have an incentive to contribute nothing, whereas full contributions would be socially optimal. Our experiment included two experimental treatments: the Strangers treatment (Strangers), in which subjects met only once, and the Partners treatment (Partners), in which the group composition remained throughout the experiment.

2.2 Procedures

Twenty different subjects participated in each treatment. In both treatments, at the beginning of the experiment, subjects were provided with a record sheet, a payoff table for practice, a payoff table for the actual task, instructions, and a summary sheet of the experimental procedures[1]. After reading the instructions, subjects were given five minutes to ask questions. After that, subjects were tested to confirm that they understood the rules and the way they should read their payoff table[2]. Our subjects answered 11 control questions, and the number of mean correct answers was 10.65 (standard deviation is 0.6) in Strangers and 10.75 (standard deviation is 0.4) in Partners. After administering the control questions, we corrected the subjects' tests and then publicly explained the correct answers. We gave the subjects another five minutes to ask us about the instructions and to examine the payoff table for the actual task. On the basis of these procedures and the subjects' test scores, we are certain that all subjects completely understood the rules of the game and were able to readily calculate their payoffs.

After that, the subjects were randomly and anonymously allocated to groups of two, and these groups played a linear public goods game for 15 periods. Each subject had to decide how many of 24 points to contribute to the public good and estimate the other group member's contributions on their computer screen. All subjects simultaneously made these decisions. After each period, subjects were informed of the other member's actual contributions and own payoff in that period. After the experiment, we selected an integer number from one to 15 by lottery from a box, and we paid subjects additional money amounting to \$6.25 (\$1 = 80 yen) if the subjects had estimated correctly during the selected number period[3]. Thus, subjects' total earnings depended on the outcome from the public goods game for 15 periods and the additional money. After the lottery, all subjects answered the post-experiment questionnaire.

We used a z-Tree (Fischbacher, 2007) to conduct the experiment. Each treatment required approximately 1.6 hours to complete. The mean earnings per subject were \$27.50.

3. Results

3.1 Mean Contributions and Beliefs

[1] Experimental instructions and other materials are available upon request from the corresponding author.

[2] We provided with a payoff table for practice, and subjects used this payoff table in answering the control questions.

[3] This payment scheme followed proper scoring rules (Brier, 1950). Under this scheme, each subject has a single-peaked expected utility function and truthful revelation of her belief is the unique dominant strategy.

Fig. 1 shows the mean contributions to the public good and the mean belief about the other member's contributions in each of the two treatments over 15 periods. The mean contribution across 15 periods from Partners is significantly higher than that from Strangers, and similarly for mean belief (Wilcoxon rank sum test, $p < 0.01$). This result for contribution is consistent with those from a number of previous studies (e.g., Croson, 1996; Keser and van Winden, 2000; Sonnemans et al., 1999). However, we interpret this as the first piece of evidence that there is a difference between Strangers and Partners for belief.

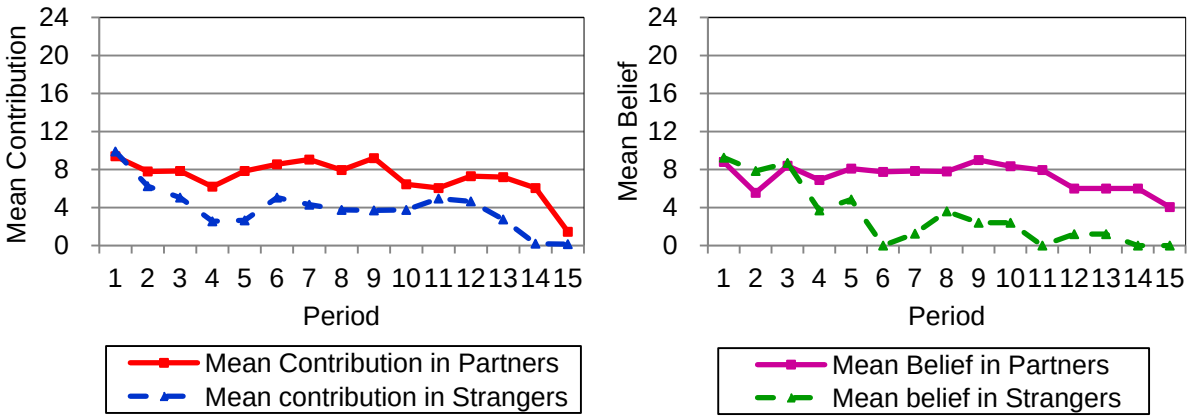

Fig. 1. Mean contribution and belief over time in both the Partners and the Strangers.

3.2 The Relation between Contribution and Belief

In this sub-section, we investigate the relation between contribution and belief using all the decision data. We use the random-effect regression as follows:

$$CONTRIBUTION_{it} = \beta_0 + \beta_1 PERIOD_t + \beta_2 BELIEF_{it} + \alpha_i$$

where $CONTRIBUTION_{it}$ is *i*'s contribution to the public good in period *t*, $BELIEF_{it}$ is the individual's belief of what the other member will contribute in this same period, and α_i is an individual indicator variable (i.e., a random effect). The results of the estimation are in Table 1. As can be seen in Table 1, the coefficients of $BELIEF$ are positive and significant in both treatments. This result suggests that conditional cooperation drives subjects to contribute to the public good in both treatments. These results are consistent with those of both Croson (2007) and Fischbacher and Gächter (2010). Since the coefficient of the Partners is bigger than that of the Strangers, conditional cooperation influence is stronger in the Partners than in the Strangers (*t*-test, $p < 0.05$).

Table 1. Random Effect Regression Results for Contributions

	Partners	Strangers
Period	-0.188	-0.1545
	(0.078)**	(0.095)
Belief	0.491	0.361
	(0.049)***	(0.006)***
Constant	5.174	4.098
	(1.253)***	(1.385)***
Observations	300	300

Notes: Standard errors in parentheses. ***Significant at the 1% level. **Significant at the 5% level.

3.3 The Amount of Conditional Cooperation

Finally, we analyze how much of the contribution is due to conditional cooperation in both treatments. Fig. 2 plots, separately for each treatment, per period total contribution and the contribution due to conditional cooperation (we called it the "CC contribution"). We defined that the CC contribution is the contributions which matched their beliefs about their partner's contributions (typically, contribution was 24 and belief was 24), and we aggregate per period the CC contributions.

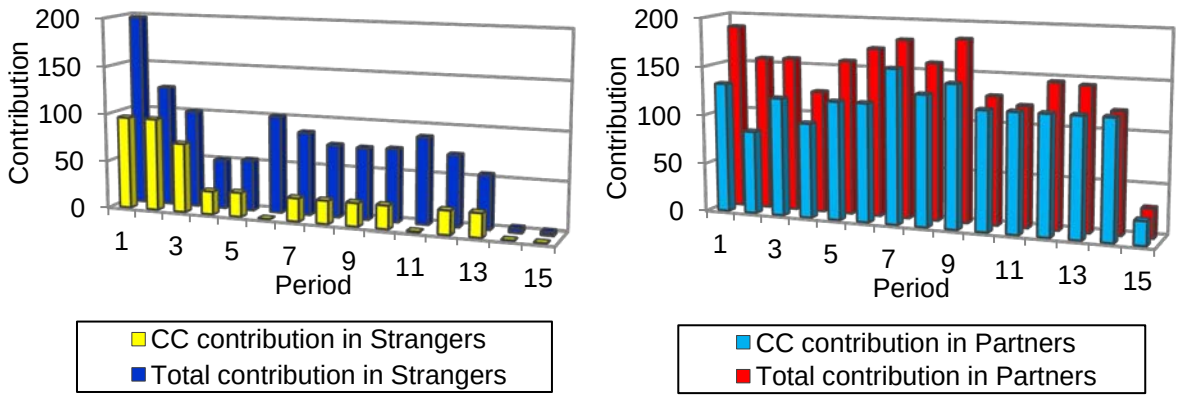

Fig. 2. Total contribution and CC contribution in both Partners and Strangers.

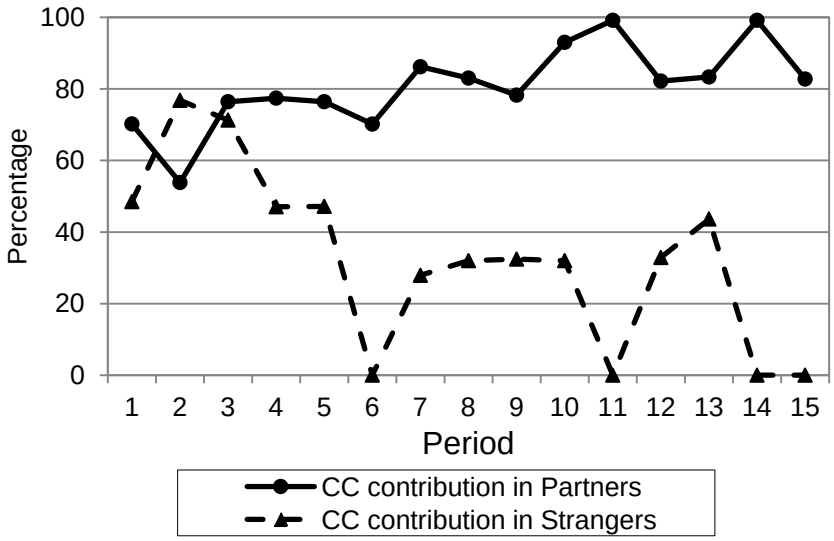

Fig.3. Percentage of CC contribution to the per period total contribution

Figures 2 and 3 convey two findings. First, the percentage of CC contribution to total contribution across 15 periods was significantly higher for Partners than for Strangers (*t*-test, $p < 0.01$). Specifically, these are 79.7% and 39.3% in Partners and Strangers, respectively. Second, in Fig. 3, the percentage of CC contribution to total contribution significantly increased over time, but that of Strangers significantly decreased over time (Spearman rank correlation test, $p < 0.01$).

4. Conclusion

We obtained three findings in this current experiment. First, the contribution and belief in the Partners design are higher than in the Strangers design. Second, there is a positive correlation between contribution and belief in both the Strangers and the Partners design. Third, 79.7% and 39.3% of contributions in the Partners and the Strangers, respectively, were motivated by conditional cooperation, and there is a significant difference between the two. Taken together, in the Partners design, subjects contributed to the public good mainly by motivation from conditional cooperation, whereas in the Strangers design, contribution was motivated by not only conditional cooperation but also another motive. Thus, the difference in contributions between Strangers and Partners cannot be fully explained by only difference in belief. Croson (1996) and Palfrey and Prisbrey (1996) mentioned that the Strangers design exhibited more variance in the contributions, and their suggestion is consistent with the current experimental result. The remaining puzzle is the motivation of contribution in the Strangers design, and it remains to be explored in future work.

Acknowledgments

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