Beliefs Matter in the Prisoners' Dilemma Game: Revisiting Economists' Free-Riding

Jung-Kyoo Choi[1] and Sulan Park[2]

[1] School of Economics and Trade, Kyungpook National University, jkchoi@knu.ac.kr

[2] School of Economics and Trade, Kyungpook National University,

Abstract

We revisit the well-known phenomenon of economists' higher propensity to free-ride, a result consistently reported in the laboratory experiment literature. We ran an experiment that allows us to examine whether economists' free-riding was attributed to their selfishness or their beliefs about the behavior of the other players. We found that their lower contributions were more likely to be due to the latter. Our experimental results shed light on the role of subjects' beliefs in sustaining cooperation, especially when they are conditionally cooperative.

1 Introduction

Economists' higher propensity to free-ride is a well-known phenomenon. Ever since Marwell and Ames (1981) reported the unusually low contribution rates among economics graduate students in their public goods game experiment, the economists' free-riding phenomenon has frequently been mentioned at conferences and workshops. This reported selfish behavior has been seen as an exception compared with the other-regarding behavior observed among "ordinary" people. In this vein, economics (or learning economics) has been sometimes accused of being the root whence many social problems spring, ranging from coordination failures to unethical behavior or sometimes even to economic crisis.

Economists' free-riding has also been confirmed in other experimental studies. Carter and Irons (1991) found in their ultimatum game experiments that subjects who major in economics tend to both make lower offers as proposers than non-economists ($3.85 vs. $4.56) and accept lower offers as responders than non-economists ($1.70 vs. $2.44). Frank et al. (1993) showed that the defection rate in a prisoners' dilemma game is higher among economists (60.4%) than among non-economists (38.8%). Some studies have attempted to test if the observed selfish behavior of economists is due to a self-selection or a training effect. The results are mixed. Some studies supporting the self-selection hypothesis showed that economists are already behaviorally different when they begin their study of economics and that this difference does not increase with economics training (Carter and Irons 1991; Frank and Schulze 2000). Other studies have reported that exposure to models based on the assumption of self-interest in economics may induce people to behave in self-interested ways (Frank et al. 1993). There is also a different line of explanation for the economists' free-riding phenomenon. For example, Yezer et al. (1996) argued that economists' free-riding only shows how they tend to play games, not their actual behavior in the real world, finding that economists appear to be more ethical than non-economists in a real-world situation (e.g., the lost envelope experiment).

In this study, we revisit the economists' free-riding problem with a different focus. We attempt to check whether economists' lower cooperativeness is due to their preferences (either selfish

from the very beginning of their studies or indoctrinated through their training) or due to their beliefs about the behavior of other people. We designed an experiment that allows us to examine the role of subjects' beliefs in their decision-making, and found that economists' lower contributions were largely due to their belief about others' behavior.

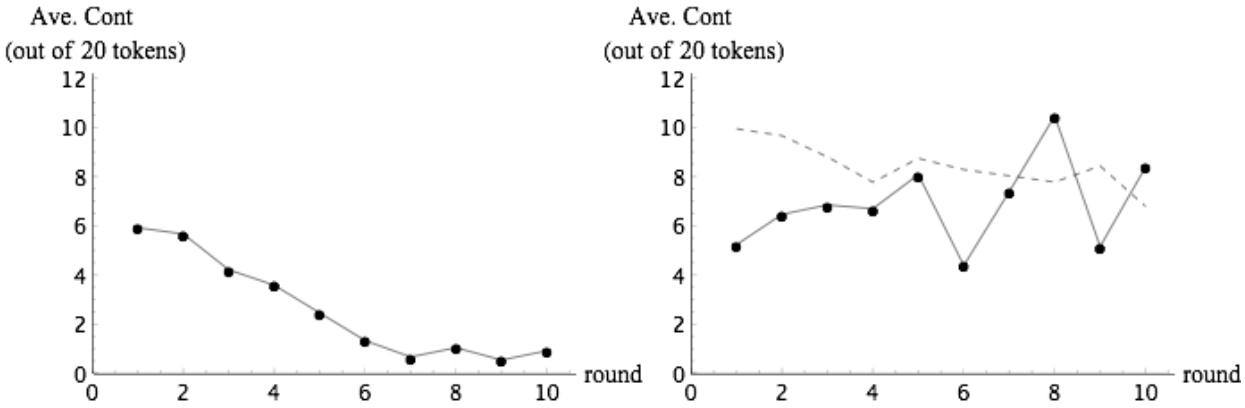
In line with previous studies, we show that when people are conditionally cooperative, other players' past behavior or the expectation of other players' future behavior affects their decision even when cooperation is the dominated strategy (Fischbacher and Gächter 2010; Fischbacher et al. 2001; Frey and Meier 2004; Gunnthorsdottir et al. 2007; Page et al. 2005; Kiyonari et al. 2000; Chaudhuri 2011). Fischbacher et al. (2001) showed that approximately half of the subjects appeared to be conditional cooperators. Fischbacher and Gächter (2010) showed that subjects' contributions in the public goods games were correlated with their beliefs of other subjects' contributions so that the subjects who believed that other players were cooperative (or reciprocal) would contribute more than those who have a lower level of beliefs. Gunnthorsdottir et al. (2007) and Page et al. (2005) provided experimental evidence that no decay of contributions were observed when subjects knew that they belonged to a group composed of highly cooperative members. Lastly, Kiyonari et al. (2000) ran a similar experiment to ours with a different focus and showed that subjects were more cooperative (in their terminology, the social exchange heuristics were more likely to be triggered among players) in sequential games than in simultaneous games.

2 Background: Preliminary Results and Motivation

In our preliminary research (Park and Choi 2014), we replicated the public goods game experiment and found economists' free-riding phenomenon (see Figure 1 for the details). 24 students exclusively recruited from the economics department showed substantially low contributions in the 10-round public goods games; the average contribution started from around 30% of the endowment and decreased to less than 5% (see Figure 1 (a)). The average

contributions reached a virtually complete free-riding level in the last round (among the 24 participants, 21 students contributed zero).

Figure 1. Economists' behavior in the economists' groups and mixed groups



(a) Economists' Behavior in the Economists-Only Groups (b) Economists' Behavior in the Mixed Groups

Note. (1) The data for Panels (a) and (b) are from our previous work (Park and Choi 2014). (2) Panel (a): 24 economics students under the stranger condition. (3) Panel (b): The solid line indicates the average contributions of 13 economics students in the mixed groups (n = 116). The dashed line indicates the average contributions of 103 non-economists in the mixed groups (n = 116). (3) Public goods games both in the economists-only group and in the mixed groups were conducted in an identical setting (i.e., both were played under the stranger condition; group size = 4 and MPCR = .5).

Interestingly, we found, however, that their unique behavioral pattern shown above was not observed when they played the games with non-economists. Figure 1 (b) shows economists' behavior in our earlier experiments, where 116 students including 13 economists were randomly grouped into mixed groups of four students and played 10-round public goods games under the stranger condition. We extracted economists' behavior in these mixed groups and compared it with other economists' behavior in the groups composed of only economics students. Two points are noteworthy. First, the first round average contribution was 5.9 (out of 20) for economists in the economists-only groups and 5.23 for economists in the mixed groups, both of which were significantly lower than the average contributions of non-economics major students (9.94).

Second, economists' average contributions consistently decreased toward zero in the economists' groups, while they tended to approach the other non-economists' contribution levels in the mixed groups.

The observed movement of economists' contributions in the mixed groups suggests that economists are also conditionally cooperative in the sense that their contributions are likely to be strongly affected by the other group members' behavior (Fischbacher and Gächter 2010; Fischbacher et al. 2001). Furthermore, the fact that economists' initial contributions, both in the economists' groups and in the mixed groups, were significantly lower than those of non-economists suggests that economists initially had lower beliefs about other players' contributions. In other words, the results from our preliminary work suggest that economists are also conditional cooperators and that their observed free-riding was due to their beliefs about the other players' behaviors.

These two features in our preliminary work motivated us to further examine the behavior of economists, focusing on the role of beliefs. In this study, we conducted a new experiment that allows us to explore if economists' lower contributions were due to their beliefs about other group members' cooperativeness or their own lower cooperativeness.

3 Experimental Design

In our experiment, subjects were paired and played a two-person prisoners' dilemma game in which each subject decides the number of tokens to be transferred to his or her partner and the partner receives three times the amount of the transfer. Subjects played the prisoners' dilemma game twice with different partners. Subjects were not aware in advance that they would play the game twice. In the first game, subjects were randomly paired and both subjects in each pair *simultaneously* decided how many tokens they would give to their partner. Without telling them the outcome of the first game, we reshuffled all the pairs and started the second one-shot prisoners' dilemma game (short instructions were given for the second game). In the second game, subjects made decisions *sequentially*, that is, the first player decided the number of tokens

he or she would give to the second player and then the second player, after observing the first player's decision, made his or her decision. Subjects were randomly assigned to be the first mover or the second mover.

All sessions were held in March 2015 at Kyungpook National University. A total of 122 subjects (54 students from the economics department and 68 from other departments) were recruited by online advertisements on the university's web bulletin board. The experiments were programmed and conducted by using z-Tree software (Fischbacher 2007).

We conducted seven sessions with 16 to 22 subjects in each. Altogether, 122 subjects were randomly assigned into these seven sessions, so that 30% to 59% of subjects in each session were economists. The subjects in each session were randomly paired without revealing their identities including their major. In the second game, of the 54 economics majors, 28 students became the first mover and the rest played the game as the second mover.

Each session began with the experimenter handing out instructions to participants and slowly reading them aloud line-by-line, which took about 10 minutes. After reading the instructions, participants were asked to answer a series of quizzes to make sure they clearly understood them. Between the two games, another set of short instructions for the second game were given, which took another 10 minutes. Each session lasted about 10 minutes on average. Based on the points subjects earned during the session, they were paid in cash immediately after the experiment. One token was worth 100 KRW. Average total earnings were 12,862 KRW, with a maximum of 22,000 KRW and a minimum of 6,000 KRW, including a 6,000 KRW participation fee[1].

4 Results

Table 1 summarizes the results. In the simultaneous move game, the average transfer of economists was lower than that of non-economists, but the difference was not significant

[1] Average earnings were approximately $11.30 (1,000 KRW was equivalent to 0.88 USD in 2015). The minimum hourly wage was 5,580 KRW in 2015.

(Wilcoxon rank sum $p = .12$). In the sequential move game, however, the first movers' behavior appeared to differ considerably depending on their major. Note that in the sequential move game, unlike the simultaneous move game, the first mover has a chance to reveal his or her intention before the second mover makes his or her decision. Thus, the first mover's behavior depends on his or her belief about how the second mover responds to his or her transfer. When the first mover believes that the second mover will reciprocate his or her transfer, the first mover can raise the transfer in the sequential move game, otherwise there will be no increase in the first mover's transfer.

Result 1. *For those who played the sequential move game as the first mover, economists' average transfer was significantly lower than non-economists'. Compared with their average transfers in the simultaneous move game, both economists and non-economists increased their transfers. However, the increase in non-economists' transfers was larger.*

When playing as the first mover in the sequential move game, economists on average transferred 7.32 tokens to the second mover, while non-economists transferred 10.42 tokens. This difference was significant (Wilcoxon rank sum $p = .04$). Economists who played the sequential game as the first mover increased their transfer by 2.46 tokens (from 4.86 in the simultaneous game to 7.32 in the sequential game); for non-economists, the increase was 4.39 (from 6.03 in the simultaneous game to 10.42 in the sequential game). The increase was significant at the 10% level for economists (Wilcoxon signed rank $p = .09$, $n = 28$) and at the .1% level for non-economists (Wilcoxon signed rank $p = .00$, $n = 33$). Lastly, for those assigned the role of the first mover in the sequential game, the average increase in the transfer of non-economists between two games was larger than that of economists (Wilcoxon rank sum $p = .05$).

Note that in the sequential move game, unlike in the simultaneous move game, the first mover has a chance to reveal his or her intention to the partner before the second mover makes his or her decision. If the first mover believes that his or her partner will reciprocate the transfer, the first

mover will raise the transfer in the second game compared with that in the simultaneous move game, otherwise there would be no increase in the first mover's transfer between the two games. Thus, the higher transfer among those assigned the role of the first player in the second game than their previous transfer in the simultaneous move game suggests that subjects expect their partner to reciprocate their transfer, that is, they believe a higher transfer would induce a higher return from their partner.

Table 1. Average transfers in the simultaneous and sequential move games

	Simultaneous move	Sequential move		
		First mover	Second mover	Response rate (of the second mover)
All	6.71	9.00	6.20	0.56
Econ	5.98	7.32	5.96	0.51
Non-Econ	7.29	10.42	6.37	0.59

Note: For the response rate, we excluded those who received zero from the first player. Among the 26 economists assigned the role of the second player, nine subjects received a zero transfer; among the 35 non-economists assigned as the second player, six received zero.

We found that both economists and non-economists on average raised their transfers in the second game; however, the average increase of non-economists was twice that of economists. This larger increase in non-economists' transfers between the simultaneous and sequential move games in our experiment suggests that non-economists are more likely to believe their partner's reciprocation than economists. Our OLS regression analysis also confirms both the role of beliefs and the lower beliefs among economists (see Table 2). Our regression shows that those assigned the first mover's role in the second game significantly raised their contribution compared with their transfer in the simultaneous move game (*Intercept* is positive and significant). It also shows that economists' increase in the transfer between the simultaneous and sequential move games was significantly lower than non-economist subjects' increase (*Econ* is negative and significant).

Table 2. First movers' transfers

Dependent variable: $Transfer_{II} - Transfer_{I}$ for first movers

Variable	Coef.
Intercept	6.95***
	(1.36)
$Transfer_{I}$	-0.42**
	(0.16)
Econ	-3.87**
	(1.88)
$Transfer_{I} \times Econ$	0.30
	(0.23)
R-Square	0.14

Note: N = 61. Standard errors in parentheses. (*** $p < .01$, ** $p < .05$, and * $p < .1$). Variables: $Transfer_{II}$ is the transfer in the sequential move game of the subjects assigned the first mover's role in the sequential move game; $Transfer_{I}$ is the transfer in the simultaneous move game of the subjects assigned the first mover's role in the sequential move game; and *Econ* is the dummy variable for economists.

Our setting also allows us to compare the reciprocity of economists and non-economists. For those who played the second mover role, we calculated their average back-transfer per token they received. We call this the response rate.

Result 2. *The response rates were not significantly different between economists and non-economists.*

Subjects from the economics department transferred on average .51 tokens for each token they received and this was not significantly different from non-economists' response rate of .59 (Wilcoxon rank sum $p = .65$; see Table 1). The reciprocal attitudes among economics and non-

economics majors were not significantly different. Although the economists in our experiment obviously had lower beliefs about their partner's cooperative attitude, they showed a similar level of reciprocity once they observed the first mover's transfer. The OLS regression we conducted for the second movers' behavior also confirmed this. The second movers' response to the first movers' transfer was positive and significant, and the difference in the response rates between economists and non-economists was not significant (see Table 3).

Table 3. Second movers' back-transfers (response rate)

Dependent variable: $Transfer_{II}^{Second}$

Variable	Coef.
Intercept	0.59 (2.17)
$Transfer_{I}^{Second}$	0.25** (0.11)
$Transfer_{II}^{First}$	0.38** (0.17)
Econ	1.03 (2.74)
$Transfer_{II}^{First} \times Econ$	-0.07 (0.24)
R-Square	0.21

Note: N = 61. Standard errors in parentheses. (*** $p < .01$, ** $p < .05$, and * $p < .1$). Variables: $Transfer_{I}^{Second}$ is the transfer in the simultaneous move game of those assigned the second mover's role in the sequential move game; $Transfer_{II}^{First}$ is the transfer in the sequential move game of the first mover; *Econ* is the dummy variable for economists; and $Transfer_{II}^{Second}$ is the transfer in the sequential move game of the second movers.

5 Conclusion

Based on our results, we draw the conclusion that the lower contributions of economics students are likely to be due to their lower beliefs about other subjects' cooperative attitude not to their lack of cooperativeness. Their lower beliefs about people's cooperativeness may lead them to cooperate less; however, they are also willing to cooperate as much as non-economists if they find other people have the same willingness. These results shed light on the role of subjects' beliefs in sustaining cooperation. As people are conditional cooperators, as many other studies have confirmed, cooperation can be encouraged simply by providing information that other people are also being cooperative.

Acknowledgement

to be added.

References

Carter, J. R., and Irons, M. D. (1991). Are economists different, and if so, why? *Journal of Economic Perspectives*, 5 (2), 171–177.

Chaudhuri, A. (2011). Sustaining cooperation in laboratory public goods experiments: a selective survey of the literature. *Experimental Economics*, 14, 47–83.

Fischbacher, U. (2007). Z-tree: Zurich toolbox for readymade economic experiments. *Experimental Economics*, 10 (2), 171–178.

Fischbacher, U., and Gächter, S. (2010). Social preferences, beliefs, and the dynamics of free riding in public goods experiments. *American Economic Review*, 100 (1), 541–556.

Fischbacher, U., Gächter, S., and Fehr, E. (2001). Are people conditionally cooperative? evidence from a public goods experiment. *Economics Letters*, 71 (3), 397–404.

Frank, B., and Schulze, G. (2000). Does economics make citizens corrupt? *Journal of Economic Behavior & Organization*, 43, 101–113.

Frank, R. H., Gilovich, T. D., and Regan, D. T. (1993). Does studying economics inhibit cooperation? *Journal of Economic Perspectives*, 7 (2), 159–171.

Frey, B. S., and Meier, S. (2004). Social comparisons and pro-social behavior: Testing "conditional cooperation" in a field experiment. *American Economic Review*, 94 (5), 1717–1722.

Gunnthorsdottir, A., Houser, D., and McCabe, K. (2007). Disposition, history and contributions in public goods experiments. *Journal of Economic Behavior & Organization*, 62, 304–315.

Kiyonari, T., Tanida, S. and Yamagishi, T. (2000). Social exchange and reciprocity: confusion or a heuristic? *Evolution and Human Behavior*, 21, 411-427.

Marwell, G., and Ames, R. E. (1981). Economists free ride, does anyone else? *Journal of Public Economics*, 15 (3), 295–310.

Page, T., Putterman, L. and Unel, B. (2005). Voluntary association in public goods experiments: reciprocity, mimicry and efficiency. *Economic Journal*, 115, 1032-1053.

Park, S., and Choi, J.-K. (2014). Economists' free-riding: Self-regarding preferences vs. belief. *Review of Social and Economic Studies*, 44, 45–69 (written in Korean).

Yezer, A. M., Goldfarb, R. S., and Poppen, P. J. (1996). does studying economics discourage cooperation? watch wat we do, not what we say or how we play. *Journal of Economic Perspectives*, 10 (1), 177–186.