SOCIAL PREFERENCES AND COOPERATION IN SIMPLE SOCIAL DILEMMA GAMES

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ABSTRACT. We use a laboratory experiment to examine the role of social preferences in simple one-shot social dilemma games by comparing play with and without a human counterpart. We find that cooperation rates are slightly lower without a human counterpart in all games we consider. However, the difference is small and statistically insignificant, suggesting that social preferences are not the primary driver of cooperation in one-shot social dilemma games.

Keywords: Cooperation, social preference, laboratory experiment, prisoner's dilemma, stag hunt
JEL Classification: C72, D03

1 INTRODUCTION

Cooperation in social dilemmas is a key topic of interest in experimental economics and related social sciences. A common explanation for such cooperative behavior is that individuals have social preferences such as altruism and warm glow (e.g. Andreoni, 1990; Goeree et al., 2002; Crumpler and Grossman, 2008). A number of previous experimental studies have tested this explanation in repeated linear public goods games by comparing the cooperative behavior of human subjects playing with and without a human counterpart (Houser and Kurzban, 2002; Shapiro, 2009; Ferraro and Vossler, 2010; Di Mauro and Castro, 2011; Yamakawa et al., 2016). In treatments without a human counterpart, the other players are automated, playing according to the distribution of choices of human players from previous sessions. Thus, while these automated players play like humans, no actual human participants receive their payoffs, so that a cooperative action by a human player has no external benefit. Without such external benefits to cooperative actions, the predictions of social preference models and self-interest are identical. In this study, we simplify the setting compared to previous related studies by using one-shot 2×2 matrix games, so that the potential for repeated game effects and confusion to influence behavior is reduced. This approach allows for a very straightforward examination of the role of social preferences in cooperation.

We examine three simple social dilemma games, varying the "temptation" payoff of the standard form of the Prisoner's Dilemma game within subject: the Strong Prisoner's Dilemma,

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STRONG PD		*Other's Choice*	
		C	*D*
Your	**C**	£5, £5	£0, £7
Choice	**D**	£7, £0	£1, £1

WEAK PD		*Other's Choice*	
		C	*D*
Your	**C**	£5, £5	£0, £5
Choice	**D**	£5, £0	£1, £1

STAG HUNT		*Other's Choice*	
		C	*D*
Your	**C**	£5, £5	£0, £3
Choice	**D**	£3, £0	£1, £1

Table 1. *Strong PD, Weak PD, and Stag Hunt matrix games.*

the Weak Prisoner's Dilemma (in which defecting is only weakly dominant), and the Stag Hunt. The potential importance of social preferences in driving cooperation is most clear in the Strong Prisoner's Dilemma, in which rational and self-interested players would never cooperate. However, social preferences may also play a role in coordination games such as the Weak Prisoner's Dilemma and the Stag Hunt, in which individual players must weigh the risk of cooperation against the potential group benefits.

If cooperation is motivated by social preferences, then subjects should be significantly less cooperative when playing without a human counterpart. Our results show slightly lower cooperation rates without a human counterpart in the Strong Prisoner's Dilemma, Weak Prisoner's Dilemma, and Stag Hunt. However, the treatment difference is very small and statistically insignificant, suggesting that social preferences are not a major driver of cooperation in these games. Moreover, the within-subject pattern of behavior across the three games is similar across treatments.

2 Experimental Design and Procedures

The experiment consists of two treatments, varied between subjects: the Human treatment and the Phantom treatment. In the Human treatment, we collected data on three one-shot social dilemma games, with the participants playing with each other. Participants were invited into a room, where they were given a seat that corresponded to their randomly-assigned participant number for the experiment. Participants were given a handout including all instructions, which were read aloud, with any questions being answered individually. Using pencil and paper, participants chose an action for each of the three games in Table 1, the Strong Prisoner's Dilemma, the Weak Prisoner's Dilemma, and the Stag Hunt. Participants were informed that their payoff would be based on the results of just one of the games, chosen randomly, played with one other randomly-matched player in the room. The three games were presented together on a single sheet of paper, always ordered left to right as shown in Table 1. Full experimental instructions are included in the appendix.

When all participants had made their three choices, the sheets containing their decisions were collected. While participants completed a demographic survey, participant pairs were randomly chosen from a hat and a fair die was rolled to select one of the three games. Decision sheets were checked, and the outcomes recorded. Participants were then paid and dismissed.

In the Phantom treatment, participants made the same three choices as in the Human treatment. However, they were informed that they were not playing with each other. Instead, they were matched randomly with a choice from the past data in the Human treatment.[1]

[1]This method of eliminating potential social preferences has been used previously in several experiments on linear public goods games (Houser and Kurzban, 2002; Shapiro, 2009; Ferraro and Vossler, 2010; Di Mauro and Castro, 2011; Yamakawa et al., 2016) and rent-seeking contests (Cox, 2017).

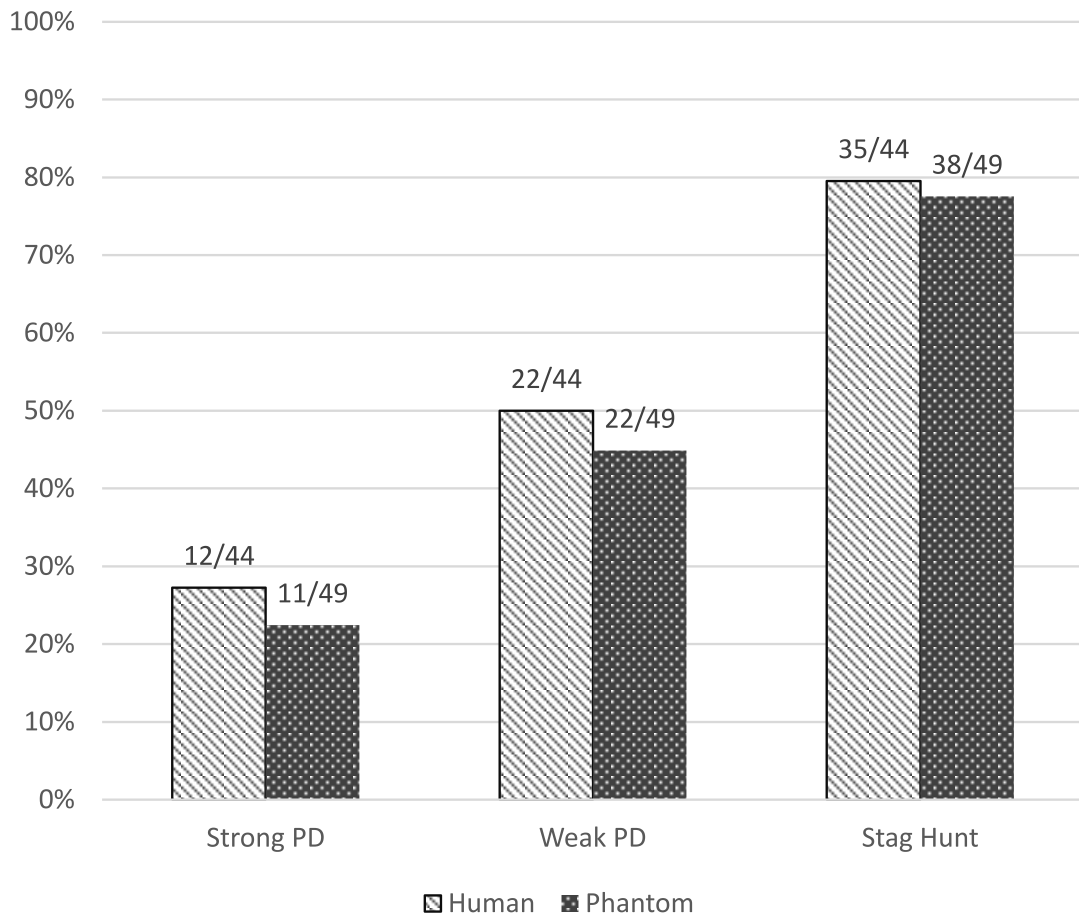

Figure 1. *Cooperation rates.*

Importantly, the other player from the previous Human treatment session whose choice was selected did not receive any monetary payoff from the outcome of the Phantom treatment session, and participants in the Phantom treatment were aware of this fact. Participants made their choices and filled out the demographic survey, after which they were matched to a data set of one participant from the Human treatment by selecting a random number from a hat. As in the Human treatment, one of the three games was chosen randomly by rolling a fair die. Participants were then paid and dismissed.

The experiment was conducted at Durham University Business School. A total of 93 students participated (44 in the Human treatment and 49 in the Phantom treatment), earning an average of £4.57 including a £1 show-up fee for participating in a session of approximately 30 minutes. Participants were recruited using ORSEE (Greiner, 2015).

3 Results

Figure 1 shows the rates of cooperation for each treatment. Cooperation rates are slightly lower in the Phantom treatment than in the Human treatment for all three games. However, the differences are small and statistically insignificant. For each game (Strong PD, Weak PD,

	Model 1	Model 2
Weak PD	2.74***	2.67***
	(0.67)	(0.94)
Stag Hunt	11.17***	10.37***
	(3.57)	(4.75)
Phantom	0.82	0.77
	(0.28)	(0.37)
× Weak PD		1.06
		(0.52)
× Stag Hunt		1.15
		(0.73)
constant	0.36***	0.38***
	(0.11)	(0.13)

Table 2. *Logistic regressions for cooperation. The omitted treatment categories are Strong PD and Human treatment. Odds ratios are shown with standard errors clustered by subject in parentheses. There are 279 observations with 93 subject-level clusters. ***, **, and * indicate 1%, 5%, and 10% level significance.*

	DDD	DDC	DCC	CCC	Other
Human	15.9%	29.5%	25.0%	22.7%	6.8%
Phantom	18.4%	32.7%	24.5%	16.3%	8.2%

Table 3. *Strategies across games for the Strong PD, Weak PD, and Stag Hunt, respectively.*

and Stag Hunt), non-parametric Pearson's χ^2 tests show no significant difference between the Human treatment and the Phantom treatment (p-values = 0.590 for Strong PD, 0.623 for Weak PD, and 0.815 for Stag Hunt).[2]

Table 2 shows logit regression results, reporting odds ratios with standard errors clustered by subject in parentheses. Similar to the non-parametric tests, the regression results show no significant difference in cooperation across treatments for any of the three games.[3] The results do indicate that cooperation increases as the "temptation" payoff decreases from the Strong PD to the Weak PD and the Stag Hunt. Table 3 shows the percentage of subjects choosing various combinations of strategies across the three games. In both treatments, for the vast majority of subjects, cooperation weakly increases as the temptation payoff decreases across games. The "Other" category combines the few subjects whose cooperation decreases or varies non-monotonically with the temptation payoff. There are no statistically significant differences in the frequencies of the various strategy combination types across treatments.

[2]It is possible that our tests may be underpowered. However, given the very small treatment differences in cooperation rates, finding a statistically significant difference may require an impractically large sample size. Given the effect sizes we observe, for our non-parametric Pearson's χ^2 tests to have 80% power with a 10% significance level would require approximately 1000-1200 subjects per treatment for the Strong PD and Weak PD games, and over 5000 subjects per treatment in the Stag Hunt game.

[3]Demographic variables were not significant and were omitted from the reported regression specifications.

4 Discussion

In this paper, we have presented a straightforward test of social preferences as an explanation for cooperation simple social dilemma games. The advantage of our approach is that using simple, one-shot games rather than more complicated repeated games reduces the potential for repeated game effects and confusion to influence the results. We find that human subjects cooperate only slightly less when playing without a human counterpart compared to playing with other humans. In each game we consider, the difference is small and statistically insignificant. This result suggests that social preferences are not the main driver of cooperation in simple one-shot social dilemma games. Furthermore, we find that the pattern of behavior across the three different games in the Phantom treatment is similar to the Human treatment. Thus, the effect of varying pecuniary incentives does not appear to interact with the presence of external benefits to cooperation.

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References

Andreoni, J., June 1990. Impure altruism and donations to public goods: A theory of warm-glow giving. *Economic Journal* 100 (401), 464–477.

Cox, C. A., 2017. Rent-seeking and competitive preferences. *Journal of Economic Psychology*, http://dx.doi.org/10.1016/j.joep.2017.02.002.

Crumpler, H., Grossman, P. J., June 2008. An experimental test of warm glow giving. *Journal of Public Economics* 92 (5-6), 1011–1021.

Di Mauro, C., Castro, M. F., 2011. Kindness, confusion, or . . . ambiguity? *Experimental Economics* 14, 611–633.

Ferraro, P., Vossler, C., 2010. The source and significance of confusion in public goods experiments. *B.E. Journal of Economic Analysis & Policy* 10 (1).

Goeree, J. K., Holt, C. A., Laury, S. K., 2002. Private costs and public benefits: unraveling the effects of altruism and noisy behavior. *Journal of Public Economics* 83, 255–276.

Greiner, B., 2015. Subject pool recruitment procedures: organizing experiments with ORSEE. *Journal of the Economic Science Association* 1 (1), 114–125.

Houser, D., Kurzban, R., 2002. Revisiting kindness and confusion in public goods experiments. *American Economic Review* 92, 1062–1069.

Shapiro, D., 2009. The role of utility interdependence in public good experiments. *International Journal of Game Theory* 38, 81–106.

Yamakawa, T., Okano, Y., Saijo, T., 2016. Detecting motives for cooperation in public goods experiments. *Experimental Economics* 19, 500–512.