Chapter 83

DIFFERENTIATING ALTRUISM AND RECIPROCITY

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1. Introduction

U.S. individuals made over 100 billion dollars of philanthropic contributions in 1997 (*Giving USA*, 1998).[1] This behavior is inconsistent with traditional utility theory in which individuals care only for their own consumption. A number of alternative theories have been invoked to explain such behavior in this and other settings, including altruism and reciprocity. This chapter describes a set of experiments which distinguish between these theories of altruism and reciprocity, by testing their comparative statics predictions in a linear public goods setting.

In altruism theories of public goods provision (either pure or impure), the consumption of others appears positively as an argument in an individual's utility function (e.g., Becker, 1974; Andreoni, 1989, 1990), causing individuals to contribute to the public good to ensure others' consumption. In contrast, Sugden (1984) proposes a theory in which the *principle of reciprocity* acts as a constraint on traditional individual utility maximization in public goods provision. The principle says (roughly) that an individual must contribute when others are contributing, thus no cheap or free riding is permitted.

Although both theories have been used in economic analysis, they generate some conflicting predictions. In particular, altruism theories predict a negative relationship between the contributions of others and the contributions of an individual; as others give more to the public good, the group's consumption from the public good increases and the individual substitutes away from providing it. In contrast, reciprocity theories predict a positive relationship between the contributions of others and the contributions of an individual; as others give more to the public good, an individual's contribution increases to avoid cheap-riding.

The paper on which this chapter is based (Croson, 2007) was the first to distinguish between these two theories. We use a traditional linear public goods game (finitely repeated, voluntary contribution mechanism with four person groups and an MPCR of .5) reviewed elsewhere in this book and in Davis and Holt (1994) and Ledyard (1995). Details about the experimental parameters, implementation and instructions can be found in Croson (2007).

[1] The actual amount contributed by individuals in 1997 was approximately $109,260,000,000. This number excludes charitable giving by corporations, foundations and bequests.

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2. Hypotheses

We differentiate between theories of altruism and reciprocity by distinguishing their comparative statics predictions. In addition to these, however, we would like to retain the traditional theory of pure self-interest as a benchmark. When individuals care only about their own payoffs, a pure public goods problem like the one our subjects face generates a unique equilibrium in which all players contribute zero (fully free ride). In this equilibrium, an individual's contribution is independent of what others in the group contribute. Thus our benchmark *self-interest hypothesis* is that subjects will always contribute zero to the public good and (the comparative static prediction) there will be no correlation between what an individual contributes and what others in his group contribute.[2]

In contrast, theories of altruism assume that individuals care directly about the consumption or utility of others. These theories then go on to generate behavior which involves positive levels of contributions to public goods, but also contributions which are *negatively* related to the contributions of others, when personal consumption and altruistic consumption are normal goods with decreasing returns (Sugden, 1984, p. 346, presents a proof in the case of altruism and Andreoni, 1989, p. 1451 in the case of warm-glow altruism). Thus our comparative static prediction from both of these types of theories of altruism (the *altruism hypothesis*) is that there will be a negative relationship between an individual's own contribution and (his beliefs about) the contributions of others in his group.

A final set of theories of giving behavior assume that individuals reciprocate or match the contributions of others. These theories then go on to generate behavior which involves positive levels of contributions to public goods, but also contributions which are positively related to the contributions of others (see Sugden, 1984, p. 780, for a proof).

The experiments reported in this chapter and in greater detail in Croson (2007) separate these theories by distinguishing their comparative statics predictions in two ways. First, we compare an individual's contributions with his beliefs of the contributions of others in his group. Next, we compare an individual's contributions with the actual contributions of others in his group.

3. The Experiments and Results

The first set of data compares an individual's contributions with his beliefs about the contributions of others in his group. Before making their contribution decision in each

[2] Other theories might also predict this comparative static prediction. For example, theories of *commitment* in which an individual contributes a fixed amount also predicts no relationship between an individual's contribution and the contribution of others in this setting (Sugden, 1984 provides a discussion of such theories). Similarly, pure warm-glow without altruism as discussed by Palfrey and Prisbrey (1997) predicts no relationship.

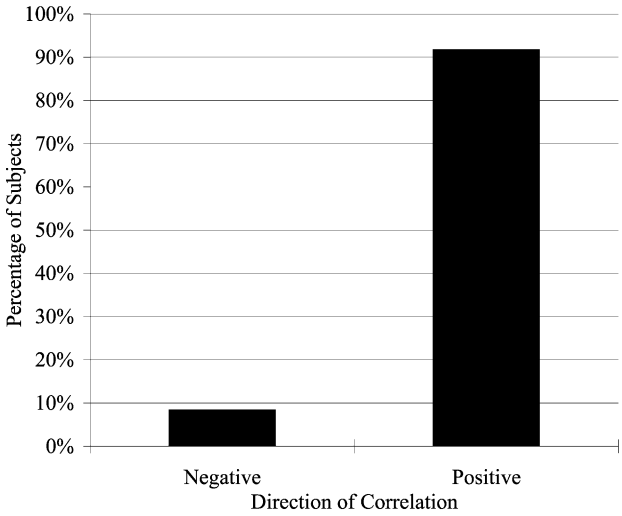

Figure 1. For each subject we find the correlation of own contribution and expectations of the contributions of others in the group of the 24 subjects in the Guess experiment, 22 had a positive correlation, consistent with models of reciprocity and only 2 a negative correlation, consistent with models of altruism. This distribution is significantly different than the null hypothesis of equal frequencies, $p < .01$

period, subjects are asked to estimate the contributions of the three other members of their group. They are paid for accurate estimates.

Twenty-four subjects arranged in six groups of four participated in this experiment. Subjects were undergraduate students at the University of Arizona summer session. They were paid a five dollar show-up fee along with their earnings in the experiment. Average earnings were $14.69, plus the $5 fee, for less than an hour of experimental time. The entire experiment was computerized; instructions were given through the computer screen, subjects entered their contributions via the keyboard and, at the end of each period, feedback about the outcome was displayed on the screen. Subjects could also access a "history" of past outcomes of their group at any time.

We characterize the behavior of individual subjects in the experiment. For each of the 24 subjects, we calculate the correlation between their contribution and their belief of the contribution of others in their group over time. In this way, we can identify individual subjects whose behavior is consistent with comparative statics of self-interest, altruism or reciprocity models. Figure 1 depicts the results from this analysis.

Twenty-two out of 24 subjects (almost 92%) exhibit a positive correlation between their own contribution and their estimates of the contributions of others, consistent with models of reciprocity. Only two subjects exhibit a negative correlation, consistent with models of altruism.

These results represent a statistically significant difference from random behavior. A chi-squared test comparing the actual categorization of subjects against a null hy-

pothesis of equal probability of positive and negative correlations, rejects the null at $p < .01$. Croson (2007) presents a more comprehensive statistical analysis with similar support for reciprocity.

Although these results appear encouraging for reciprocity models, a few questions remain. First, it may be that asking subjects for their estimates of others' actions leads them to think reciprocally where they would not otherwise (an elicitation explanation). Second, it may be that the repeated game nature of this experiment is yielding the positive correlation and not reciprocity *per se* (a reputation explanation).

To answer these questions and test the robustness of our results, three more experiments were run and the comparative static predictions of our models re-analyzed. None involved the elicitation of beliefs of others' actions. Instead, we compare an individual's contribution with the actual contribution of the other members of his group.

To test the first explanation, we ran a new experiment, identical to the first but excluding the estimation stage (No Guess). Twenty-four subjects, different from the previous subjects but from the same subject pool, participated in this experiment, arranged in six groups of four. To test the second explanation, we ran a new experiment, excluding the estimation stage in which subjects were re-randomized into groups after each round (a Strangers treatment as described in the Andreoni and Croson chapter of this volume). A different 24 subjects participated in the strangers experiment, run in two separate sessions of 12 subjects each. Finally, a further robustness check is presented in a new experiment where subjects remained in the same groups through time, but were given information at the end of each round on not only the total amount contributed by their group members, but the distribution of those contributions (full information as in Sell and Wilson, 1991; Croson, 2001). A different 24 subjects participated in this experiment from the same subject pool, again in six groups of four subjects.[3]

Figure 2 provides the correlations between subjects' contributions and the actual contributions of the others in their group for all four treatments (the original Guess, and the No Guess, Strangers and Full variations).

In all four treatments, subjects overwhelmingly exhibited positive correlations between their own contribution and the actual contributions of others in their group, consistent with reciprocity theories (remember that the previous comparison was between individual contributions and beliefs of the contributions of others; this is between individual contributions and the actual contributions of others).

These results represent a statistically significant difference from random behavior. A chi-squared test comparing the actual categorization of subjects against a null hypothesis of equal probability of positive and negative correlations rejects the null at $p < .01$ for each treatment (excluding the zero correlation subjects). More detailed analysis in Croson (2007) presents further support of models of reciprocity. We conclude that reciprocity in this setting is robust.

[3] Croson (1996, 1998, 2001) compares absolute contribution levels between these different treatments; for purposes of this chapter we focus on the comparative static predictions of the competing models of altruism and reciprocity in the four treatments.

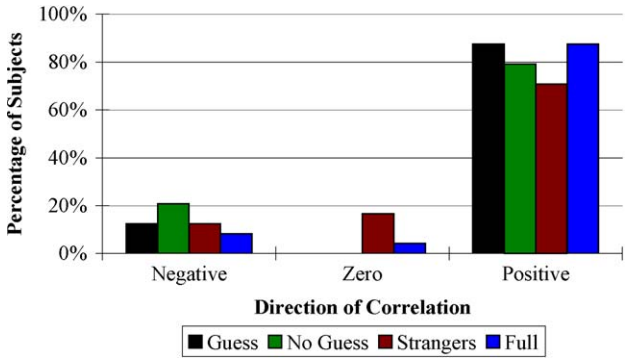

Figure 2. For each subject we find the correlation of own contribution and actual contributions of others in the group for the four experiments, Guess (where beliefs of others' contributions are elicited), No Guess (where they are not), Strangers (where subjects are randomly assigned to new groups after each period of the game) and Full (where subjects remain in the same group but are given feedback of the full distribution of individual contributions). In all four experiments, the overwhelming majority of subjects exhibit a positive relationship, consistent with models of reciprocity. Few subjects exhibit a negative correlation, consistent with models of altruism. In addition, a small number of subjects in the Strangers and Full conditions fully free-ride, leading to zero correlations between their contributions and the contributions of others. These distributions are significantly different than the null hypothesis of equal frequencies of the two types, $p < .01$ for each experiment, excluding free riders.

4. Types of Reciprocity

Additionally, we can use the data from the final experiment (Full) to characterize the *type* of reciprocity used by subjects. In Sugden's (1984) model of reciprocity, he suggests that actors will match the *minimum* contribution of others. In contrast, however, we can imagine different types of reciprocity in which subjects try to match the median or the maximum contribution of others. The full experiment allows us to distinguish between these different types of reciprocity.

In maximum reciprocity, subjects would attempt to match the maximum contribution of the other three members of their group. In minimum reciprocity, subjects would attempt to match the minimum contribution of the other three members of their group (this is essentially what Sugden proposed). Finally, in median reciprocity, subjects would attempt to match the contributions of the median contributor of the other three members of their group.

Our goal is to determine which of these three models of reciprocity best fits the data: whether the minimum, maximum or median contribution of an individual's partners better predicts an individual's own contribution.[4] We estimate four weighted fixed effects

[4] Notice it is quite possible for an individual's contribution to be above the maximum (or below the minimum) of the other three members of his group. In fact, the contributions of one person in each group in each period will have this characteristic.

regressions, correcting for both period and individual heteroscedasticity, as below

$$\text{CONT}_{it} = \alpha_0 + \alpha_1 \text{MINIMUM}_t + \sum_{t \neq 10} \beta_t \text{PERIOD} + \sum_{i \neq 1} \gamma_i \text{INDIVIDUAL} + \varepsilon, \quad (1)$$

$$\text{CONT}_{it} = \alpha_0 + \alpha_1 \text{MAXIMUM}_t + \sum_{t \neq 10} \beta_t \text{PERIOD} + \sum_{i \neq 1} \gamma_i \text{INDIVIDUAL} + \varepsilon, \quad (2)$$

$$\text{CONT}_{it} = \alpha_0 + \alpha_1 \text{MEDIAN}_t + \sum_{t \neq 10} \beta_t \text{PERIOD} + \sum_{i \neq 1} \gamma_i \text{INDIVIDUAL} + \varepsilon, \quad (3)$$

$$\text{CONT}_{it} = \alpha_0 + \alpha_1 \text{MINIMUM}_t + \alpha_2 \text{MAXIMUM}_t + \alpha_3 \text{MEDIAN}_t + \sum_{t \neq 10} \beta_t \text{PERIOD} + \sum_{i \neq 1} \gamma_i \text{INDIVIDUAL} + \varepsilon. \quad (4)$$

Results from these regressions are shown in Table 1.

Evidence from these regressions suggests that median reciprocity is a better predictor than either minimum or maximum reciprocity. First, in the individual regressions (1), (2) and (3), the t-statistic is higher for the median contribution than for either of the others. In addition, in the regression which includes all measures (4), only median is significantly different than zero ($p = .0134$). This suggests that the median contribution of the others in a subject's group is a better predictor of that subject's own contribution than either the maximum or the minimum.

This analysis sheds light on exactly what subjects in this experiment might be trying to reciprocate. We find significant evidence for median reciprocity, suggesting that subjects try to match the median contributions of others, rather than the minimum (as suggested by Sugden's theory of reciprocity) or the maximum.

5. Discussion and Conclusion

The experiments reported in this chapter test comparative statics predictions of models of reciprocity and altruism. The results support the reciprocity model in which individual contributions are positively related to the contributions of others, or to their beliefs about those contributions.

In the studies presented here, contributions decrease over time. However, when subjects are organized into groups based on their level of contributions, other authors have observed upward trends in linear public goods games with similar parameters. This phenomenon has also been attributed to reciprocity (Amden, Gunnthorsdottir, and McCabe, 1998). Reciprocity can also explain why communication increases contributions in similar games, by changing the expectations of what others will contribute (Isaac and Walker, 1991). Finally, one can imagine situations in which reciprocity is optimal, for

Table 1
Weighted regressions of individual contributions in full experiment on minimum, maximum and median contributions of others in group, including indicator variables for each individual (subject 1 is excluded) and each period (period 10 is excluded). The weights correct for heteroscedasticity of periods and individuals. The median contribution of others in the group is a better predictor of an individual's own contribution than either the minimum (as suggested by Sugden, 1984) or the maximum. In regressions (1) through (3), the coefficient on median is the largest and most significant. In regression (4), only the median remains a significant predictor of individual contributions. This result suggests that players try to match the contribution of the middle contributor, rather than the maximum or the minimum

Individual contributions	(1)	(2)	(3)	(4)
Intercept (α_0)	10.289[a]	8.182[a]	9.029[a]	8.320[a]
	(0.499)	(0.898)	(0.597)	(0.878)
MINIMUM (α_1)	0.115			0.019
	(0.070)			(0.079)
MAXIMUM (α_2)		0.156[b]		0.055
		(0.047)		(0.049)
MEDIAN (α_3)			0.180[a]	0.145[b]
			(0.048)	(0.048)
PERIOD ($\beta_t, t = 1, \ldots, 9$) (suppressed)				
INDIVIDUAL ($\gamma_i, i = 2, \ldots, 24$) (suppressed)				
Sum weights	74.854	79.666	74.325	75.885
R^2 adjusted	0.5981	0.5920	0.5676	0.5713

[a] $p < .001$.
[b] $p < .05$.

example, when the contributions of others provide valuable signals of the quality of the public good being funded, as in Vesterlund (2003).

This study examines the factors that motivate individuals to make voluntary contributions in social dilemma situations. In particular, it finds support for reciprocity theories over altruistic theories and traditional self-interest theories. We find a significant and positive relationship between an individual's contribution and his belief about the contributions of others in his group, as well as between an individual's contribution and the actual contributions of the others in his group. This result does not imply, however, that altruistic motives do not exist. In other settings altruism may indeed play a role in an individual's decision. However, in the public goods provision setting discussed here, comparative statics of individual's decisions are more consistent with theories of reciprocity than of altruism.

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