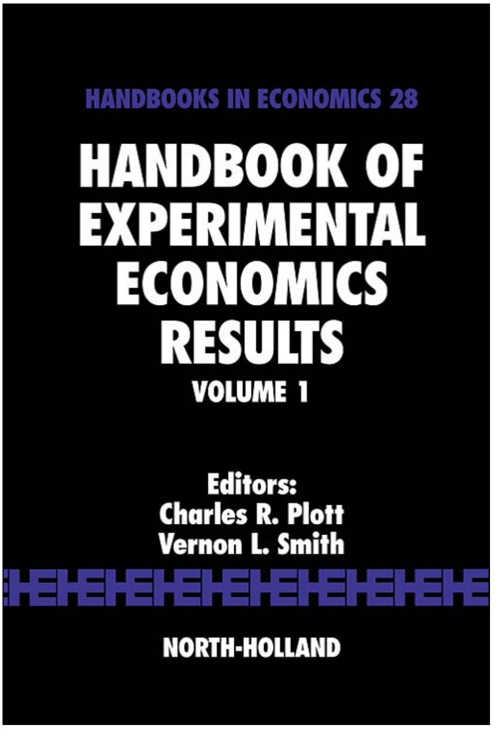

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Chapter 82

PARTNERS VERSUS STRANGERS: RANDOM REMATCHING IN PUBLIC GOODS EXPERIMENTS

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1. Introduction

How can an experimenter balance the desire to test a single-shot Nash equilibrium prediction with the need for repeated experience by subjects? Simply repeating the game with the same set of subjects may change the nature of equilibrium, since incomplete information about "types" can lead to reputation effects of the sort described by Kreps et al. (1982). A common way to deal with this has been to rematch subjects randomly into groups for each iteration of the game, hence forming a repeated single-shot design and avoiding the repeated-game effects. This raises the natural question: what is the effect of random rematching?

The rematching of subjects in linear public goods experiments was introduced by Andreoni (1988). The first linear public goods experiments, by Marwell and Ames (1981), were single-shot games and produced little of the dominant strategy Nash equilibrium free riding they predicted. Subjects, it was argued, needed experience to learn the dominant strategy. Isaac and Walker (1988) replicated these games, but used a 10-period, finitely repeated game. However, free riding was still not chosen, and repetition had only a small effect in increasing free riding. Was it reputation effects that kept subjects from adopting the single-shot dominant strategy?

Andreoni (1988) tested this question by comparing a set of subjects who played in finitely repeated games with another set who played in a repeated single-shot. Players in the repeated game were called "Partners," while those in the repeated single-shot game were called "Strangers." If reputations matter, then Partners should cooperate more than Strangers. Surprisingly, Andreoni found just the opposite – Strangers cooperated significantly more than Partners.

Since this time, many researchers have explored this anomalous result. This chapter will attempt to synthesize the various replications and studies that have addressed this puzzle.

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2. Partners versus Strangers

Linear public goods experiments can be described simply. Individuals are given a budget m of tokens which they can "invest" in a public good, g, or a private good, x, hence $x + g = m$. Payoffs to any subject i are determined by $P_i = x_i + \alpha \sum_j^n g_j$, where n is the number of group members. The parameter α is chosen such that $0 < \alpha < 1$, hence free riding, $g = 0$, is a single-shot dominant strategy, and such that $n\alpha > 1$, so that $g = m$ for all i is the symmetric Pareto efficient outcome.

Andreoni examined groups of five players, with $\alpha = 0.5$, in ten-period games. In each session of the Strangers treatment, 20 subjects were randomly rematched into groups of five after each play of the game, while a comparable set of Partners played in an adjacent room.[1] Andreoni also included another design twist intended to test learning effects. After ten periods subjects were told they would "restart" the experiment for another ten rounds – if no learning effects are present, the restart should have no effect. Due to budget constraints, the restart ended after three periods. Andreoni's results are plotted in Figure 1A.

The nearest replication to Andreoni's experiment was performed by Croson (1996). Again using $\alpha = 0.5$, ten periods, and a surprise ten-period restart, Croson considered four person groups.[2] A plot of the data by Croson is shown in Figure 1B.

We can see that Andreoni and Croson get different results for the first ten periods – Croson finds Partners are significantly more cooperative, while Andreoni finds it is Strangers. Looking at the restart, however, both find similar results. For Partners the effect of the restart is far more pronounced, indicating that for both experiments there is some effect of repeated play. Given the contradictory effects of the first ten periods, however, one must ask whether the effect of repeated play is on reputations or something else.

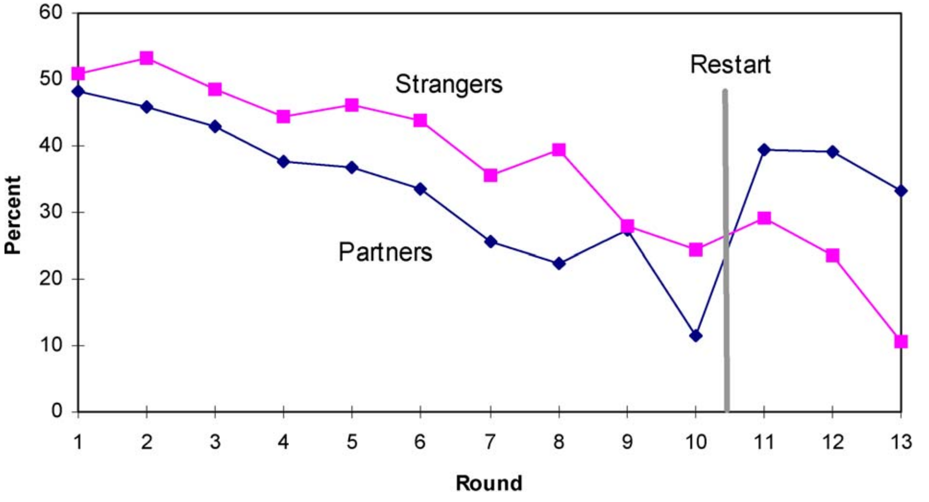
Several other authors have also compared Partners to Strangers in experiments. A summary of these results is given in Table 1. All of these experiments differ in sundry ways from either Andreoni or Croson's studies, so the comparisons to these results are not precise. Nonetheless, this summary of results does little to clear up the picture. In all, four studies find more cooperation among Strangers, five find more by Partners, and four fail to find any difference at all.

3. A Closer Look

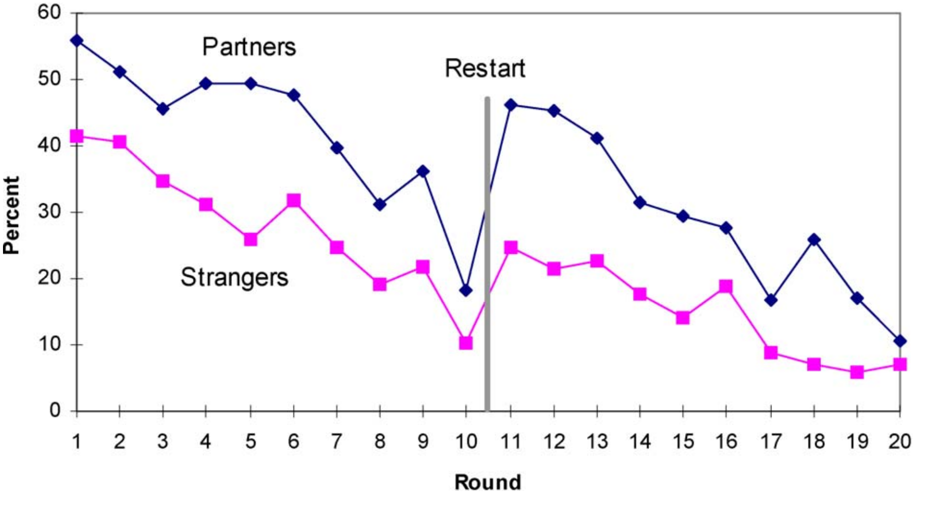
The discussion of Partners versus Strangers thus far has been predicated on the assumption that the incentives of individuals are consistent with money-maximization in the

[1] In each replication of the game there were 15 Partners and 20 Strangers. The experiment was run twice, hence the total experiment includes 70 subjects. The restart was only added in the second run.

[2] In the Partners session, Croson (1996) used 24 subjects, broken out into groups of four. For Strangers, she ran two separate sessions of 12 subjects each, randomly rematched into groups of four.



A. Andreoni (1988): Percent of endowment in the public good



B. Croson (1996): Percent of endowment in the public good

Figure 1. This illustrates the differing results of Andreoni and Croson in linear public goods experiments. Partners means subjects face the same opponents in a finitely repeated linear public goods game, and Strangers means groups are randomly rematched after each iteration. Both experiments are 10 periods, have a marginal return from the public good of 0.5, and both had a surprise "Restart" after the first 10 periods. Andreoni (panel A) had groups of 5 matched from a room of 20, while Croson (panel B) had groups of 4 matched from a room of 12. The two experiments differ on whether Partners or Strangers contribute more, but agree that the restart has a bigger effect on Partners.

Table 1
Below we summarize the studies that have compared Partners and Strangers. Many studies have made the comparison under a variety of conditions and parameter values, with is no consistent finding about which group contributes more. Plus, there is only slight evidence that random rematching controls for repeated-game effects, as intended. Palfrey and Prisbrey (1996) provide unifying evidence that Strangers are more variable, indicating that there is more unexplainable behavior among Strangers than Partners. Hence, random rematching simply appears to diminish the predictive power of a model of money-maximizing subjects

Study		Which group gives more?		
		Partners	Strangers	Neither
Andreoni (1988)			•	
Croson (1996)		•		
Palfrey and Prisbey (1996)			•	
Weiman (1994)				•
Keser and van Winden (2000)		•		
Burlando and Hey (1997),	UK:		•	
	Italy:	•		
Brandts and Schram (2001)				•
Brandts, Saijo and Schram (1997),	US:	•		
	Spain:		•	
	Japan:			•
	The Netherlands:			•
Sonnemans, Schram and Offerman (1999)		•		

experiment. What if there is some other model of preferences that captures the behavior of subjects better than money maximization? Could Partners and Strangers generate different predictions under an alternative model?

Three recent studies – by Andreoni (1995), Croson (1998) and Palfrey and Prisbrey (1997) – have attempted a closer look at preferences of subjects in public goods games. All have explored the hypothesis that subjects have some preferences other than money maximization. Andreoni suggests that subjects are altruistic toward other subjects or possibly that they get a warm-glow from giving to the public good (Andreoni, 1989, 1990). Croson (1998) suggests that a part of subjects' preferences may be to reciprocate or match the contributions of others in their groups.[3] Palfrey and Prisbrey (1997) suggest that subjects may be confused about the incentives of the game and/or make errors in their play.

Andreoni (1995), looking only at Strangers, compared a group in a standard public goods game, called the Regular condition, with subjects who played the same game but whose monetary earnings were determined on the basis of their rank in the standard

[3] Other researchers have proposed evolutionary reasons why reciprocity might be observed in experimental games in general. In particular, Amden, Gunnthorsdottir, and McCabe (1998) suggest that subjects in experiments are accustomed to (or have evolved to) playing infinitely repeated games. This suggests they may act as Partners even when matched as Strangers.

game – those with higher experimental earnings also got higher monetary earnings.[4] This rank condition was intended to remove much of the effect of tastes for cooperation while maintaining the money-maximizing equilibrium. This is because mutual cooperation, while increasing one's own experimental earnings, will only lower one's rank among other subjects. Hence, cooperation in the rank condition can only be consistent with the hypothesis of confusion.

The results of Andreoni's study indicate that indeed confusion is very important, accounting for at least a third of all cooperation. However, tastes for cooperation were even more important, accounting for at least 43 percent of giving. The data indicate, in fact, that many subjects learn the dominant strategy incentives well before they implement them; they try first to engender cooperation, and only after being frustrated at this do they adopt free riding.

Croson (1998) looks at the relationship among Partners between an individual's contribution and their belief of the contributions of others in their group. Subjects exhibit a significant and positive relationship, consistent with the idea that subjects try to match the contributions of others. In both Partners and Strangers designs, a similar positive relationship is observed between subjects' contributions and the contributions of others in their group. These results suggest that one motivation for the differences between the Partners and Strangers settings are the expectations subjects bring with them to the laboratory about the contributions of others, combined with their desire to match those contributions.

Palfrey and Prisbrey (1997) present an elaborate and ingenious experiment designed to identify altruism separately from warm-glow. All subjects in a group of partners face the same marginal return from investments in a public good, V, but have different privately known costs of giving, r_i, which change randomly each round. If $r_i > V$, then there is a dominant strategy to free ride, but if $r_i < V$ then there is a dominant strategy to give to the public good. The parameter V affects the social benefits of giving, hence affects altruism, while $r_i - V$ affects the private cost of giving, hence influences the warm-glow. By allowing independent variation between r_i and V, Palfrey and Prisbrey are able to identify the strength of altruism relative to warm-glow. Behavior that they are not able to capture, that is, the econometrician's error term, they attribute to some behavior other than warm-glow or altruism, such as subjects' confusion.

With their model, Palfrey and Prisbrey make the surprising observation that warm-glow is highly significant and that altruism, while present, is insignificant. Moreover, there is a great deal of heterogeneity among subjects. Warm-glow varied from slightly negative (i.e., spite) but insignificant, to highly positive and significant. There was also a large portion of the data (the error term) that could not be explained. As the experiment progressed, however, the magnitude of the errors decreased as did the level of cooperation. Hence, reduced confusion, rather than reputations, could explain patterns of giving in standard public goods experiments.

[4] The rank payoffs were determined by a predetermined table. The payoffs were designed to minimize differences in incentives and income effects across conditions.

4. Partners, Strangers, Warm-glow and Confusion

Palfrey and Prisbrey (1996) next applied their methodology to compare Partners to Strangers. In each session 12 subjects played four ten-period games as either Partners or Strangers.[5] The V was either 6 or 10, and the r_i varied from 1 to 20 randomly and independently for each subject each round. Half the subjects were Partners and half were Strangers. Palfrey and Prisbrey centered their analysis around the assumption that individual preferences are linear, and hence individuals will choose a "cut-point" decision rule like the following: Contribute everything if $V - r_i + W_i > 0$, and contribute 0 otherwise. W_i is interpreted as an individual "warm-glow parameter." For each subject they find the W_i that leads to the fewest violations of the decision rule.

As in Andreoni (1988), these authors find that the Strangers cooperate more than Partners. Moreover, both groups are characterized by the same optimal W_i, hence they exhibit equal amounts of warm-glow – this is true at either the aggregate or individual levels. Rather, the main finding of Palfrey and Prisbrey is that the Partners conformed to the cut-point decision rule much better than the Strangers. That is, the behavior of the Strangers was significantly less predictable by linear preferences.

Palfrey and Prisbrey (1997) thus provide the most compelling explanation for the differences between Partners and Strangers yet. They find that the estimated preferences of Partners and Strangers are the same, hence, there is no interaction affect between Partners/Strangers and warm-glow. However, that part of the data that does not fit the model, what we have been calling confusion, does interact with Partners/Strangers; the behavior of Strangers becomes more variable. This result, that Strangers exhibit more variance in their contributions, is also reported in Croson (1996).

Notice how this evidence can capture all of the disparate findings in Table 1. If Partners versus Strangers does not affect preferences but only makes Strangers more variable, then we might not be surprised the array of results listed in Table 1.

5. What is Next?

The evidence on Partners versus Strangers suggests that repeated play is quite different from repeated single-shot play, but it is unlikely that much of that difference is due to game-theoretic reputation effects.[6] What is the effect? Thus far the answer is rather

[5] Partners formed new groups every ten periods, while Strangers were rematched after every decision. A total of 48 subjects was used in this experiment.

[6] Note several other authors have examined reputation effects directly. These include Camerer and Weigelt (1988), McKelvey and Palfrey (1992), and Andreoni and Miller (1993). These experiments reveal that indeed reputation effects do matter, but it appears that these effects themselves must be learned. That is, with plenty of experience in a number of finitely repeated games, subjects will learn the benefits of reputation building. In a single finitely repeated game, such as these public goods experiments, these results indicate that subjects are unlikely to have learned the sophisticated strategy of reputation building.

unsatisfying: Putting subjects in a Strangers treatment increases the fraction of the data that we cannot explain. The next step in research should look to putting more substance into this statement.

One option is that the simple behavioral models of warm-glow, altruism, and linear utility cannot capture the important aspects of the choice. For instance, one could develop some behavioral theory of reciprocity, anonymity, or morality that would provide an explanation grounded in a neoclassical utility maximizing framework. Alternatively, perhaps preferences are strictly convex, rather than linear (Andreoni and Miller, 2002), and this may affect the variance of choices. A second approach may be to examine how Partners and Strangers conditions affect learning. Is there something about a Partners condition that makes learning easier? Third, it is possible that the current specifications of preferences and learning are adequate, but that the choice mechanism may be misunderstood. Hence, something could be gained from a decision-theoretic framework that examines how the Partners versus Strangers treatments affect the process of choosing an action.

Finally, can one conclude from this that random rematching of subjects in order to avoid reputation effects is unnecessary? People will, of course, read the data differently. Perhaps the evidence presented suggests that there may be less to fear than had been thought. However, without knowing more about what causes the difference between Partners and Strangers, it is impossible to say which condition is the most natural and which will give us the best insights into our models and into human behavior. Until that time, it seems only prudent that if a prediction is based on a single-shot equilibrium, then a Strangers condition will be most appropriate.

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