Cooperation across payoff equivalent public good and common pool resource experiments

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ABSTRACT

Subjects in public good experiments are often observed to be more cooperative than subjects in common pool resource experiments. This cooperation divergence may be explained by a behavioral asymmetry between the warm-glow of doing something good and the cold-prickle of doing something bad (Andreoni, 1995). However, recent research suggests that behavior is qualitatively similar across payoff equivalent public good and common pool resource experiments (Apesteguia & Maier-Rigaud, 2006). This paper reports on an experiment designed to test the robustness of the cooperation divergence. The analysis quantifies the cooperation across payoff equivalent public good and common pool resource experiments that explicitly inform subjects how their allocation decisions effect group earnings. Results suggest that the level of cooperation is equivalent across treatments. This research suggests that the observed cooperation divergence is caused, in part, by variation in the experimental parameters employed rather than from a behavioral regularity unexplained by standard theory.

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1. Introduction

Individuals within groups often have the opportunity to cooperate, to the benefit the group, or to pursue their self-interest, to the detriment of the group. Understanding the cooperative behavior of individuals is of practical importance, for example, to inform the design of institutions to solve market failures related to the provision of public goods or the management of common pool resources. Public goods are non-excludable and non-rival suggesting that it is not feasible to restrict anyone from using the good once it is provided and that one's use does not detract from another's use. Standard theory predicts that individuals will attempt to *free ride* and enjoy the benefits of the public good without contributing to its provision. Common pool resources are also non-excludable but, in contrast, are rival, suggesting that while it is not feasible to restrict one's use of the resource once the resource is used it is no longer available for another's use. Standard theory predicts that each individual's self-interest will lead them to over use the resource.

Despite the intuitive distinction between public goods and common pool resources individual incentives within each are

strategically equivalent.[1] It is therefore a puzzle for economists that a cooperation divergence is often observed suggesting that subjects are more cooperative within PG experiments than they are in CPR experiments. The public goods literature suggests that contributions decrease with repetition but remain above the level predicted by self-interest (Ledyard, 1995; Laury & Holt, 2008; Chaudhuri, 2011). On the other hand, the common pool resources literature suggests that the use of the resource increases with repetition and obtains or exceeds the level predicted by self-interest (Ostrom, Walker, & Gardner, 1992; Ostrom, Gardner, & Walker, 1994; Walker, Gardner, & Ostrom, 1990).

Andreoni (1995) offers an intuitive explanation suggesting that the cooperative behavior of individuals is affected by the externality generated by their decisions. Across strategically equivalent positive and negative frame public good experiments which differ only in the externality associated with one's allocation decision it is shown that cooperation is significantly higher in the positive frame public good (Andreoni, 1995; Park, 2000; Willinger & Ziegelmeyer, 1999). This suggests that subjects are more cooperative when their decisions generate positive externalities (the warm-glow of doing

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[1] It can be shown that PG and CPR experiments can be analyzed within a prisoner's dilemma framework and, as a result, has motivated some researchers to characterize them as strategically equivalent (Ledyard, 1995).

something good) than they are when their decisions generate negative externalities (the cold-prickle of doing something bad).

Alternatively, Casari and Plott (2003) suggest that the cooperation divergence, referred to as the spite/altruist paradox, may stem from specific experimental parameters. Specifically, they consider the location of the Nash equilibrium within the strategy set and the presence of spiteful individuals. In order to harm others, spiteful individuals will contribute less than the Nash prediction in PG experiments and will use the resource more than the Nash prediction in CPR experiments. The location of the Nash equilibrium will, therefore, systematically affect the capacity of spiteful individuals to harm others and alter the observed group behavior.

Recent research suggests that behavior is qualitatively similar across strategically symmetric, payoff equivalent, PG and CPR experiments (Apesteguia & Maier-Rigaud, 2006). In both experiments behavior trends toward but does not obtain the Nash equilibrium. This suggests that the cooperation divergence may be the result of variation in the experimental parameters employed. However, the design implemented by Apesteguia and Maier-Rigaud (2006) did not explicitly inform subjects how their allocation decisions affect the earnings of other group members. It remains an open empirical question whether the externality associated with individual behavior systematically effects the level of cooperation (Cox et al., 2013; Stoddard, 2013; Cherry et al., 2013).

Given the importance of understanding cooperative behavior within groups and the ubiquity of public goods and common pool resources this research investigates the robustness of the cooperation divergence. The experiment design presented here holds all aspects of the AMR (2006) design constant except it includes group payoff tables. Subjects in each treatment are explicitly informed how their decisions affect not only their own, but also their groups' earnings. The hypothesis of interest is whether including explicit instructions informing subjects how their individual decisions affect group earnings in an experiment designed similarly to AMR (2006) will reveal a cooperation divergence.

Consistent with the existing literature results suggest that behavior is qualitatively similar across symmetric, payoff equivalent, PG and CPR treatments. To test the hypothesis of interest the level of cooperation, across treatments, is quantified on a common metric to allow statistical analysis. The symmetry of the design allows us to develop an index that measures cooperation relative to the Pareto and Nash equilibriums. Importantly, identical levels of relative cooperation provide the same index value. Results suggest that while cooperation decays with repetition no significant difference across treatments is observed.

This suggests that the observed cooperation divergence is the result of variation in the experimental parameters and supports the intuition that the location of the Nash equilibrium within the strategy set influences observed group behavior. The results motivate additional research to investigate how experimental parameters systematically affect cooperative behavior.

2. Related literature

The intuitive distinction between public goods and common pool resources explains why much of the experimental literature treats them independently. The public goods literature often employs a linear Voluntary Contributions Mechanism (VCM) in which each subject in a group is given a fixed endowment of experimental currency (herein referred to as experimental dollars (EDs)) which can be allocated between a private and a group account. The return from the private account is independent and accrues only to the individual while the return from the group account depends on the group's aggregate allocation and is equally distributed across the group. Allocating EDs to the group account creates an external benefit for each member of one's group. Linear PG experiments yield straight forward theoretical results. Namely, a unique Nash equilibrium exists where each individual allocates nothing and a unique Pareto efficient equilibrium exists where each individual allocates their entire endowment to the group account.[2]

The literature on public goods has established that initial allocations to the group account are roughly half of one's endowment (below the Pareto efficient contribution) and that contributions decline with repetition. Yet, allocations consistently remain above the level predicted by self-interest (Ledyard, 1995; Chaudhuri, 2011). In interior solution public good experiments the incentive structure is similar except that it is in the self-interest of individuals to contribute some non-zero amount to the group account. Behavior in nonlinear public good experiments is consistent with the behavior observed in linear experiments (Laury & Holt, 2008; Cason & Gangadharan, in press). Allocations remain above the level predicted by Nash equilibrium whether the interior solution is a dominant or non-dominant equilibrium (Sefton & Steinberg, 1996). Providing detailed information about the declining marginal benefit of the group account and increasing the endowments decreases average allocations but they remain above the Nash prediction (Laury, Walker, & Williams, 1999). The result that group account allocations remain above the level predicted by Nash equilibrium is robust but not universal. When the Nash equilibrium is high relative to endowments average allocations are below the Nash equilibrium (Isaac & Walker, 1998).

A similar level of cooperative behavior is not generally observed in common pool resource experiments. Common pool resource experiments are similar to interior solution public good experiments. Subjects are given a fixed endowment of EDs and asked to allocate them between a private and a group account. Allocations to the group account create an external cost to each member of one's group. In this case the return from the group account is shared across the group in proportion to one's allocation such that individuals who allocate more into the group account obtain a larger share of the total return. This feature of CPR experiments, referred to as the *individual distributional factor*, captures the rivalry that distinguishes this social dilemma from public goods (Apesteguia & Maier-Rigaud, 2006).

Results from CPR experiments suggest that allocations tend to begin above the Pareto efficient allocation and increase toward the Nash equilibrium with repetition. In contrast to PG experiments allocations in CPR experiments obtain the level predicted by self-interest (Ostrom et al., 1992, 1994; Walker et al., 2000). In high endowment treatments allocations into the CPR have been shown to exceed the level predicted by self-interest (Walker et al., 1990).

Thus, across PG and CPR experiments a cooperation divergence is often observed. One explanation of these results is suggested by the positive and negative frame public good experiments reported by Andreoni (1995). In a positive frame experiment (a standard linear PG) subjects made allocations to the group account from their private account. Using a simple transformation of the individual's payoff function so that the endowment of each group member was initially in the group account Andreoni (1995) created a negative frame PG experiment. In this case subjects were able to allocate their endowment from the group account to their private account which negatively affects the group. Importantly, each experimental frame is strategically equivalent and differs only in the externality

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[2] A typical payoff function is as follows: $\pi_i = e - x_i + \alpha \sum x_j$ where e is the subject's endowment, x_i is the subject's allocation to the public good, α is the marginal per capita return (MPCR) from the public good ($\alpha < n\alpha$) and $\sum x_j$ is the sum of all group account allocations.