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Strategic behavior and learning in repeated voluntary contribution experiments

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Abstract

Voluntary contribution experiments systematically find that contributions decline over time. We use a two-stage voluntary contribution game to investigate whether this decrease is caused by learning or strategic behavior. Using a strategy method we find a robust pattern of declining contributions: contributions in stage 2 are 45 percent lower than in stage 1. Repeating the game five times we find that experience generates a smaller decline in contributions: stage 1 contributions decrease by around 7 percent per game. Finally we find no significant differences between the strategy and direct-response method, which suggests that our results help explain behavior in the latter.

JEL classification: C92; C72; H41

Keywords: Voluntary contributions; Cooperation; Experiment

1. Introduction

A robust finding in experimental studies of voluntary contribution games is that cooperation decreases with repeated interaction. Two explanations have been provided for this result. One is that strategies initially are well-defined, but that they depend on the history of play and therefore may cause players to change their actions over the course of the game. Another is that participants slowly begin to understand the game and refine their strategies accordingly. While both of these explanations are convincing, limited work has been done to determine directly the role played by each. The purpose of this study is to provide such an examination.

To determine the extent to which decreasing contributions arise as a result of history-dependent strategies we need to identify the participants' strategies in a multi-stage voluntary contribution game. To do so we apply the strategy method (Selten, 1967) to a two-stage voluntary contribution game. Participants submit a plan of action for the two-stage game, specifying a stage 1 contribution and a stage 2 response to any possible number of aggregate stage 1

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contributions by other group members. The plan is then matched with that of two other participants, and actions are taken in accordance with the participant's strategy. An advantage of the strategy method is that participants make a decision for every possible history of aggregate contributions, not just those reached in the course of actual play. Thus participants indicate how they would respond to different contributions, making it straightforward to identify strategies. We find that the pattern of contributions is comparable to the results from previous repeated voluntary contribution experiments in that the elicited strategies imply declining average contributions. The elicited strategies cause contributions to decline by an average of 45 percent within the two-stage games.

To examine the potential role played by learning we have participants play a sequence of 5 two-stage games, playing against a new set of people in each game. This allows us to examine whether experience with the game leads to a modification of strategies and whether such modifications decrease contributions. We find that individuals do modify their strategies across games, and as a result contributions in stage 1 sometimes increase and sometimes decrease across successive games. On average stage 1 contributions decrease by 7 percent per game. Stage 2 contributions decrease more reliably across games, but the average decrease is still only 14 percent per game. Thus experience with the game leads to an erratic and less pronounced deterioration in contributions, compared with the systematic and substantial deterioration generated by submitted strategies.

We observe, as in previous studies, considerable heterogeneity in submitted strategies. Following Fischbacher et al. (2001), we classify participants on the basis of the strategies they submit, and in any game most participants are classified as "free riders" (participants who contribute nothing in stage 2) or "conditional cooperators" (contributors whose stage 2 contribution increases with other group members' stage 1 contribution). Individual strategies are not stable across games, as many participants switch from one class to another across successive games. While a potential interpretation is that these participants do not have stable preferences, we cannot rule out that participants nonetheless have well-defined preferences over the outcome of the two-stage game. The reason is that experience may help participants better understand the game and may cause them to update their prior on the strategies others use when playing the game. Thus participants may be uncertain of what strategies best serve their interests and revise strategies as they learn how their own strategies influence outcomes. While participants often change their strategies from game to game, the *distribution* of strategies is quite stable: the proportions of different types do not change much from game to game.

A potential disadvantage of the strategy method is that it may elicit strategies that differ from those used by participants in a traditional experiment based on a 'direct-response' method. The direct-response method, applied to this game, would have participants make simultaneous stage 1 contributions, and then, after observing aggregate stage 1 contributions, participants would make simultaneous stage 2 contributions. For our strategy-method examination to shed light on the decrease in contributions observed in direct-response games it is necessary that the elicited behavior is similar across the two elicitations. Although the two methods are equivalent from a standard theoretical point of view, there are plausible behavioral reasons why differences may emerge (see the discussions in Roth, 1995 or Brandts and Charness, 2000). For example, eliciting a strategy for the two-stage game encourages subjects to consider stage 2 when making their stage 1 decision; if the two stages were played out in sequence a subject might make a stage 1 decision without giving any consideration to stage 2. If behavior under the direct-response method differs from that under the strategy method, then it is unreasonable to argue that we can use elicited strategies to shed light on the decrease in contributions observed in the direct-response interaction.

Previous research delivers mixed evidence on whether people behave differently according to whether the strategy or direct-response method is used. Brandts and Charness (2000) examined Sequential Prisoners' Dilemma and Sequential Chicken games and found no significant differences between outcomes elicited by direct-response and strategy-method approaches. They carefully conclude (p. 234): "in games of low complexity, the strategy method may be a valid technique for collecting a rich data set without affecting participants' decisions significantly." However, other studies provide evidence of significant differences between direct-response and strategy-method approaches. For example, Güth et al. (2001) compare alternative versions of a mini-ultimatum game and find significant differences when the direct-response method is used, but not when a strategy method is used, Brandts and Charness (2003) study a game with pre-play communication in which players can punish opponents who send misleading messages and find that under a direct-response method punishment rates are significantly higher than under a strategy method, and Burton et al. (2005) study coordination games with pre-play communication, finding that under a direct-response method coordination on the efficient equilibrium was significantly lower than under a strategy method.

Thus, since equivalence between the two elicitation procedures cannot be taken for granted, to test the validity of the strategy-method implementation of our game we also run a direct-response version of the game where participants