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Strategic behavior in repeated voluntary contribution experiments

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ABSTRACT

We conduct a repeated VCM (voluntary contribution mechanism) experiment using the strategy method and compare contribution behavior in a partner and a stranger matching in both a cold and a hot setting, where the latter differs from the former by allowing participants to revise their strategies in each round. Irrespective of whether the setting is hot or cold we find that partners provide higher initial contributions than strangers. In the cold setting (without revision possibility) partners contribute more on average but do not react differently to past contributions by others than strangers. In the hot setting the dynamic contribution plans of strangers are somewhat upward-shifted. Furthermore the contributions of partners decrease more strongly than those of strangers over time in a hot setting. The reason for this effect lies in the fact that partners react much more strongly to negative experiences than strangers. Our design and results contribute to explaining the mixed evidence in the literature on partner versus stranger comparisons and allow us to understand under which conditions commitment can be conducive or harmful to achieving and sustaining higher levels of contribution.

1. Introduction

An important and much studied question in the experimental literature on public good provision is whether and to what extent behavior differs between so-called "partner" matchings (participants are matched in groups which stay the same throughout the experiment) and under "stranger" matchings (group composition randomly changes from period to period). Andreoni and Croson (2008) survey the literature in this area and one conclusion that emerges is that differences between the two settings are typically not as strong as one might expect.[1] In order to understand the impact of path dependencies on possible treatment differences (or the lack thereof), one should retrieve information on behavior in subgames that may not be met during the actual course of play. Only then we know "what would have happened if …".

In order to unravel the role of path dependencies, we conduct VCM experiments using the strategy method (Selten, 1967). Participants are asked to provide a full description of their behavior in unit-recall strategies. That is, they have to provide (1) their initial contribution and (2) their dynamic response contribution conditioned on any possible average contribution by others in the previous period. In one of the sessions actual play is simulated using the given strategies as if the participants are exposed to a partner matching; in the other as if they are exposed to a stranger matching.

One question that naturally arises with the strategy method is whether the results from such a "cold" setting do easily transfer to a "hot" setting.[2] Hence, we also run two "hot" treatments (one in a partner and one in a stranger matching) in which participants have the possibility after each round to revise their strategy. This has the additional advantage that the class of strategies that participants can use is not restricted by design. Furthermore, using the data from these treatments, we can see how often participants revise, when they revise and how they revise. This will give us additional insights into where differences between partners and strangers come from and what their likely interpretation is.

Irrespective of whether the setting is hot or cold, we find that partners less often provide small initial contributions than strangers. In the cold setting (without revision possibility), partners also contribute more on average but do not react differently to past contributions by others than strangers. While for partners the dynamic response does not differ across the cold and hot settings, the (initial) dynamic response of strangers is upward-shifted and somewhat flatter in the hot setting. On balance, the difference between partners and strangers is smaller in the hot treatments.

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[1] Andreoni (1988) and Palfrey and Prisbrey (1996) find that strangers contribute more. Croson (1996), Sonnemans et al. (1999) and Keser and van Winden (2000), among others, find that partners contribute more. Weimann (1994) finds no significant difference. In an indefinitely repeated two-player prisoner's dilemma, Duffy and Ochs (2009) find that partners contribute more. We will discuss some of the literature in more detail at the end of this Introduction.

[2] The evidence is mixed. Brosig et al. (2003) find that whether the treatment is "hot" or "cold" makes a difference in a bargaining experiment, while Brandts and Charness (2000) do not find a difference for experiments with the prisoner's dilemma and the game of chicken.

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With regard to the evolution of strategies in the hot setting, we find that over time the average dynamic response of partners decreases more strongly than that of strangers. We run regressions to see when participants decide to revise their strategies. We find that both partners and strangers are more likely to revise their strategies after experiencing a bad payoff. Interestingly, this effect is much stronger for partners than for strangers. Hence, partners react more strongly to negative experiences than strangers.

Our design and results provide us with a number of interesting insights. First, the fact that partners provide higher initial contributions and dynamic contribution plans (dynamic responses), but in addition react much more strongly to bad news than strangers implies that there is a substantial amount of path dependence in the partner matching. This can explain why the existing literature provides mixed evidence on whether partners or strangers contribute more.

Moreover, observing strategies allows us to gain some insight into what drives the underlying differences between partner and stranger matchings. In particular, since our cold strategy method design rules out explicit reputation building, emotions or learning, any difference between partners and strangers that we observe in the cold setting must be due to other factors such as strategic reasoning or (anticipated) reciprocity. Furthermore, as we do not find differences in the slope of the dynamic responses in the cold treatments, reciprocity does not seem to cause the observed differences between partner and stranger matchings in the cold setting. This suggests that the differences observed in the cold settings are largely driven by strategic considerations. Since many of the behavioral patterns that we observe in the cold setting (such as higher initial contributions among partners than among strangers, increasing dynamic responses, the dynamic response of partners) do transfer to the hot setting, strategic considerations may explain a big part of the typically observed differences between partner and stranger matchings.

However, despite the behavioral patterns that are transferable from the cold to the hot setting, we do also observe some differences between these two settings. In particular, the (initial) dynamic responses of strangers are upward-shifted and somewhat flatter in the hot setting. Apparently, strangers are willing to start out on 'better terms' when they know that they will be able to revise their strategies later on. This may, but need not, be due to strategically anticipated reciprocity.

VCM mechanisms and the relation to the matching protocol have been studied extensively in the literature.[3] An early study is Andreoni (1988). He examines the role of learning and strategic behavior as explanations for the decay in contributions that is typically observed in (finitely) repeated VCM experiments. He introduces a stranger condition and a partner condition and implements a surprise restart in both conditions. The learning hypothesis states that behavior in the final period should not be different in both conditions. The strategic behavior hypothesis implies that partners should contribute more than strangers. Strikingly strangers are found to contribute more than partners over all periods (including the final one). Therefore, both the learning and the strategic behavior hypotheses had to be rejected.

Sonnemans et al. (1999) use an interesting design to investigate strategic behavior. Group compositions gradually change by switching two subjects after a certain amount of periods. Prior to any decision making, all subjects are informed when a switch takes place in their group and whether they are switched themselves or one of the group members. In either case, partners who are drifted apart will never meet again.[4] The authors find that contributions decline when a change is approaching, and that subjects that are about to leave a group temporarily decrease their contribution. This finding provides evidence for the important role of strategic (forward looking) behavior. They also find evidence for adaptive (backward looking) behavior as elicited beliefs are highly correlated with past observations.

Keser and van Winden (2000) focus on conditional cooperation and distinguish between future-oriented (strategic) behavior and simple reactive behavior. Future-oriented behavior includes aspects of subjects' behavior that are induced by their perception of future interaction and explains higher initial contributions and endgame effects in the partner setting. Simple reactive behavior assumes behavior to be oriented towards the observed average contribution of the other group members in the previous period and includes motives of reciprocity and inequity aversion. Both these latter motives are identified by adaptations of individual contributions towards the group average. They find evidence of both types of conditional cooperation playing a role. Moreover, they argue that the higher contributions in the partner treatment are largely due to higher initial contributions. This is consistent with our evidence from the partner treatment.

In the next section we present the experimental design. Afterwards, in Section 3, we report on our analysis of the data and present the results. We end with a short summary of our results in Section 4.

2. Experimental design and procedures

In our experiment, participants face a *voluntary contribution mechanism* (VCM) game. Each of four group members is endowed with 10 tokens and decides how many of these to contribute into a joint project. Every token that is not contributed to the project generates a private income of 2 ECU. In addition, each group member benefits from the joint project. Every token that is contributed to the joint project yields a return of 4 ECU that is equally divided among the group members (that is: 1 ECU each). Hence, the project has a marginal per capita return of 0.5.

Participants face the VCM repeatedly and a random ending rule is implemented to determine termination of the experiment. In each period there is a 90% chance that the experiment continues with another period. In the first period participants are randomly and anonymously assigned into groups of size 4. In the *partner* treatment the group composition remains fixed; in the *stranger* treatment groups are randomly determined each period anew. Participants are fully informed about all these treatment details.[5] For each treatment, we run one session with 24 participants.

Instead of making a choice in each period, participants are asked to specify their *initial contribution* and *dynamic response behavior*.[6] For the dynamic response, participants have to specify their contribution conditional on the average contribution by the (former) group members in the previous period.[7] Next the repeated VCM is simulated by the following iterative process. The initial contributions determine the contributions for the first period. For all remaining periods, the dynamic response behavior is applied. After making their decision participants observe the outcome of these simulations for each period until the end of the experiment.

Although this design allows participants already to adopt a number of standard strategies, such as tit-for-tat (by simply matching their dynamic response with average contributions from the last round) or constant strategies, it does not allow them to condition their

[3] See the papers listed in Footnote 1.

[4] An advantage of our design with respect to Sonnemans et al. (1999) is that strategic behavior is not triggered by awareness of alternative matching procedures, since we use a between-subjects design.

[5] Instructions are available on the second author's personal webpage.

[6] This is one of the reasons we decided for a random ending rule rather than a fixed ending, since with the fixed ending rule one should not expect strategies to be time independent.

[7] Not allowing participants to condition their contributions on more than just the last observation is restrictive. There are, however, several reasons to restrict to unit-recall strategies. It is the simplest kind of behavior that captures dynamics and does not require too much sophistication from participants. Moreover, it allows for a clean, unobstructed analysis of the influence of observed contributions in the past on future contributions and it substantially reduces the dimensionality to classify individuals. Finally, in Fischbacher and Gächter (2010) yesterday's realizations are found to be a highly significant ingredient for today's beliefs.