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Strategic thinking in public goods games with teams

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ABSTRACT

We experimentally investigate team behavior in repeated public goods games and use team chat logs to study motives for contribution. Subjects are matched into two-person teams, and each team makes a joint decision in each period. We compare teams with individuals and find similar overall contributions. However, initial contribution is higher and endgame effects are more pronounced for teams. We examine strategic discussions within teams and find strong evidence of concern for repeated game effects and limited backward induction. We also find evidence of confusion and explore its potential sources.

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1. Introduction

Team decision making is widespread in social dilemmas in the field. Families contribute to charities, churches, and neighborhood watch efforts. On a larger scale, firms, non-profit organizations, and governments contribute to disaster relief projects and pollution abatement. We study team behavior in repeated public goods games to address two primary questions. First, we examine whether individuals and teams differ in their contribution decision. Second, we use team chat logs to investigate team contribution motives. While recent studies by Kamei (2016) and Auerswald et al. (2016) have begun examining public goods games with teams, most experiments focus on individuals. Furthermore, studying teams allows us to examine strategic thinking through content analysis of discussions between team members making a joint contribution decision, which was not a focus of these related studies. Strategic discussions within teams provide a direct window into the decision making process. Examining teams can thus yield new insight into motives for contribution.

The method of examining team chat logs has recently been used to gain valuable insight into strategic thinking in other contexts such as the prisoner's dilemma (Kagel and McGee, 2016; Cason et al., 2017; Cason and Mui, 2017), signaling games (Cooper and Kagel, 2005), legislative bargaining (Bradfield and Kagel, 2015), ultimatum bargaining (Arkes et al., 2015), coordinated resistance games (Cason and Mui, 2015), and beauty contest games (Burchardi and Penczynski, 2014; Penczynski, 2016). In our setup, groups are composed of multiple decision makers, and each decision maker in a group is a team of two subjects who make a single joint decision in each period. Team members communicate with one another via text chat. Importantly, communication with other teams is *not* permitted, and team members have identical payoffs so their incentives are aligned, motivating them to work together to form a profitable strategy.[1] By examining chat logs among team members, it is possible to better understand how subjects reason about the public goods game, and what concerns motivate their contribution decisions.

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[1] There is no communication between different teams or incentive to free ride within a team. Thus, our study differs from experiments on cheap talk between rivals (e.g. Isaac and Walker, 1988a; Ostrom et al., 1992; Bochet et al., 2006) or inter-group competitions with intra-group free-riding incentives (e.g. Rapoport and Bornstein, 1987; Hargreaves-Heap et al., 2015; Bhattacharya, 2016).

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This "two heads" team chat method may be thought of as an elicitation procedure, similar in principle to various methods of eliciting beliefs, preferences, or strategies in economic experiments. However, the data being elicited are qualitative chat messages that reveal thought processes leading to contribution decisions. Chat messages are coded by research assistants into one or more of several categories such as discussing pro-social preferences, payoff maximization, and repeated game effects. These chat codes are used to learn about the underlying motives and strategic thinking of subjects in the experiment.

To examine the effect of playing in teams on contribution, we compare team behavior in public goods games to a baseline individual treatment. To investigate strategic thinking about repeated game effects and backward induction, we also compare the cases of random Strangers matching and fixed Partners matching of decision makers into groups. By comparing team chat logs in Partners and Strangers treatments, our experiment yields new insights on how motivations for contribution vary with repeated interaction in fixed groups. In this way, our experiment is related to the literature comparing Partners and Strangers in public goods games (Andreoni, 1988; Croson, 1996; Keser and van Winden, 2000; Andreoni and Croson, 2008) as well as the much broader literature on cooperation and free-riding in social dilemmas (Ledyard, 1995; Ostrom, 2000; Chaudhuri, 2011). To the best of our knowledge, this study is the first to use content analysis of team chat logs to compare strategic thinking with and without repeated interaction in fixed groups in any game.

We find that behavior is largely similar between individuals and teams. However, initial contribution is higher for teams. Furthermore, endgame effects are more pronounced for teams, as free-riding rates in the last period are greater for teams than individuals.

Aggregate contribution is similar for Partners and Strangers. However, we find differences in strategic thinking. Compared to Strangers, Partners more frequently discuss encouraging cooperation in future periods, as well as expectations of others' future choices. Nonetheless, concern for repeated game effects occurs with Strangers matching as well.

We find evidence of limited backward induction, with discussions of endgame effects mostly contained in the last few periods. Moreover, discussion of higher-order beliefs integral to the backward-induction process is very rare. Team discussions also reveal evidence of confusion, but relatively little direct evidence of pro-social preferences. Finally, we explore sources of possible confusion revealed in the chat logs, and discuss potential methodological implications for the design of future experiments.

2. Related literature

Many studies examine motivations for voluntary contribution to public goods and cooperation in social dilemmas more generally (Ledyard, 1995; Chaudhuri, 2011). Various forms of social preferences such as altruism and warm glow have been used to explain voluntary contribution (see, e.g. Andreoni, 1990; Goeree et al., 2002; Crumpler and Grossman, 2008). Several studies on repeated game effects compare fixed Partners matching with random Strangers matching, finding mixed results (Andreoni, 1988; Croson, 1996; Keser and van Winden, 2000; Andreoni and Croson, 2008; Cox and Stoddard, 2015).[2] Yamakawa et al. (2016) find repeated game effects to be the primary driver of contribution in a two-player game with a detailed payoff table, with confusion taking a smaller role. Several other experiments, including Andreoni (1995), Houser and Kurzban (2002), and Shapiro (2009) examine the extent to which confusion rather than social preferences drives contribution in public goods games, finding that half or more of all contribution may be explained by confusion. While social preferences, confusion, and repeated game effects may all drive contributions for some subjects, we use team chat logs as a window into subjects' strategic motivations to examine the relative prevalence of these motives.

Furthermore, most studies of contribution motives focus on individuals. Two recent studies, closely related to ours, compare team vs. individual decision making in public goods games (Kamei, 2016; Auerswald et al., 2016). Unlike these studies, we focus on the analysis of team chat logs to study strategic thinking and motives for contribution. Kamei (2016) compares individuals and two-person teams in public goods games with groups of two decision makers (i.e., two individuals or two teams of two persons each). He finds greater cooperation among teams when team members know each others' identities. In treatments where team members do not know each other's identities (as in our study), he finds teams are more cooperative than individuals with Partners matching, but not with Strangers matching. Kamei's results are consistent with our finding of more pronounced endgame effects among teams than individuals. However, we do not find a similar increase in overall cooperation among anonymous teams with Partners matching. This difference in results is interesting, and may be due to some key design differences between the two studies. Kamei's design uses groups of two decision makers (individuals or teams), and this group size necessitates individual-level feedback. In contrast, our design uses groups of three decision makers and aggregate-level feedback, where each decision maker is informed of the total contribution by all other decision makers, but not the individual contributions of each other decision maker. While results on the role of feedback in social dilemma experiments are mixed, a number of studies suggest that this design feature could be important (e.g. Sell and Wilson, 1991; Kreitmair, 2015; Van der Heijden and Moxnes, 1999; Carpenter, 2004; Cox and Stoddard, 2015).

Auerswald et al. (2016) examine three-person teams in Partners-matching public goods games with and without punishment. They find that teams contribute more and punish less than individuals. Unlike our experiment, team decisions in Auerswald et al. (2016) are made through voting with unanimity or majority rules rather than through free-form chat. While we do not find a significant difference in contribution overall between individuals and teams, our results share some features with theirs. In both our experiment and their no-punishment treatments, initial cooperation is higher and endgame effects stronger for teams than individuals.

Several studies in psychology compare individuals with teams in the prisoner's dilemma, including Insko et al. (1988), Insko and Schopler (1992), Bornstein and Ben-Yossef (1994), and Morgan and Tindale (2002). As summarized in Wildschut and Insko (2007), these studies tend to find teams are less cooperative than individuals. Kagel and McGee (2016) study teams in a series of finitely-repeated prisoner's dilemmas and also find that teams are less cooperative than individuals in early supergames, but find the opposite result in later supergames. As in our study, Kagel and McGee analyze team chats in depth, finding early cooperation is primarily motivated by a belief that it will encourage future cooperation, while early defection is motivated by concern that the other player will defect. They also find that subjects are aware, either initially or once mutual cooperation begins, that the opponent is likely to defect near the end of the game. However, a failure to realize that the opponent is thinking the same about them prevents complete unraveling of cooperation. While there are similarities between the finitely-repeated prisoner's dilemma and the public goods game, the public goods game can

[2] Public goods games with Partners matching typically involve a finitely-repeated game, which in the standard theoretical context should not create repeated game effects. However, related studies on the finitely-repeated prisoner's dilemma such as Selten and Stoecker (1986), Andreoni and Miller (1993), Cox et al. (2015), and Kagel and McGee (2016) suggest repeated game effects arise nonetheless due to a failure of backward induction.

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