How cheap talk enhances efficiency in threshold public goods games ☆

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ABSTRACT

This paper uses a Bayesian mechanism design approach to investigate the effects of communication in a threshold public goods game. Individuals have private information about contribution costs. Individuals can each make a discrete contribution. If the number of contributors is at least equal to the threshold, a public benefit accrues to all members of the group. We experimentally implement three different communication structures prior to the decision move: (a) simultaneous exchange of binary messages, (b) larger finite numerical message space and (c) unrestricted text chat. We obtain theoretical bounds on the efficiency gains that are obtainable under these different communication structures. In an experiment with three person groups and a threshold of two, we observe significant efficiency gains only with the richest of these communication structures, where participants engage in unrestricted text chatting. In that case, the efficiency bounds implied by mechanism design theory are achieved.

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1. Introduction

We investigate how communication influences public good provision in a threshold public goods game with private information about contribution costs. The provision of threshold public goods combines free riding incentives with a coordination problem, both of which are further complicated if there is private information. Pre-play communication between agents provides a potential path to overcoming these problems, but whether communication is effective in practice, and how its effectiveness depends on the structure of communication and private information, are questions that remain largely unanswered both theoretically or empirically. This paper makes three contributions to addressing these questions. First, by modeling the game with communication as a Bayesian mechanism design problem, we are able to develop some theoretical bounds on the gains that can be attained from different pre-play communication protocols. Second, we show how these bounds depend on the distribution of private information and on the communication structure – in particular the richness of the message space. Third, we design and conduct an experiment where we vary both the communication structure and the distribution of private information.

We present several results. First, in the experiment we find that communication has significant beneficial effects only when the group members communicate in natural language. Restricting subjects to coarser message spaces, such as a binary message space or to one-time reports of their private information partially solves the coordination problem, but not enough to produce a statistically significant improvement compared with groups that were not allowed to communicate. A second finding is that the effectiveness of pre-play communication depends on the distribution of private information. In half of our data, it was common knowledge that all subjects had contribution costs that were less than or equal to the benefit of the public good, implying that it was common knowledge that, for every subject, it is optimal to contribute if contribution is pivotal for the provision of the public good. In the other half of the data, the distribution of contribution costs was such that its support included costs that exceeded the benefit, and hence it was common knowledge that any group member with such a high cost has a dominant strategy to free ride. In this second variant, natural language communication was much less effective and helped only after substantial experience was gained. This sharp difference in the effect of communication is also reflected in the theoretical bounds implied by the optimal mechanism. A binding individual rationality constraint, which is present only in the high cost treatment, sharply reduces the amount of public good provision that can be supported. Thus, we establish both theoretically and behaviorally, that the effectiveness of private communication depends on both the richness of the message space and the distribution of private information.

To keep the analysis and experimental design simple, players in the threshold public goods game have only a binary choice – to contribute or not, and the public good is produced if and only if at least some threshold number of group members choose to contribute. This class of games includes the social dilemmas studied by Dawes et al. (1986), Offerman et al. (1998), and Palfrey and Rosenthal (1991), and shares similar strategic elements to the volunteer's dilemma, entry games, and participation games studied by Goeree and Holt (2005). Contributions are non-refundable, so that an efficient outcome requires that exactly the threshold number of contributions are made. Too many contributions or too few contributions reflect coordination failure. Because the group members have different contribution costs, (ex ante) efficient provision also requires that the contributions are made only by the lowest cost members of the group. Thus heterogeneity of contribution costs create a second kind of coordination problem, and private information exacerbates this latter coordination problem with an incentive compatibility problem. In all cases there is a free rider problem, in the sense that any contributor would prefer to switch roles with any non-contributor, regardless of their contribution costs.

The three forms of pre-play communication we consider were carefully chosen. The coarsest message space we consider is *binary*.[1] In the communication stage with binary messages, each group member announces an "intention" to either contribute or not, which is then followed by a simultaneous-move contribution stage with binding decisions, so the communication stage can be viewed as a direct signal about contribution in the final stage of the game or alternatively as a "practice game", where one's first round contribution decision has no direct payoff consequences. The second message space is somewhat richer, where group members simultaneously announce any number in the support of the distribution of contribution costs, thus mimicking a direct mechanism (but without a mediator), which is then followed by a contribution stage with binding decisions. The richest communication structure we consider is natural language communication where the communication stage consists of a fixed time period during which chat messages can be broadcast continuously among the group members. After the chat stage, binding contribution decisions are made simultaneously by all group members. In addition to varying the structure of communication, we varied the distribution of contribution costs. In the "$C = 1$" condition, it is always incentive compatible for the two lowest cost individuals to contribute and thus provide the public good. In the "$C = 1.5$" condition, incentive compatibility problems could result in the good not being provided even though provision was socially optimal.

The remainder of the paper is organized as follows. The related literature is reviewed in Section 2. Section 3 specifies the experimental design, theoretical framework and the central hypotheses. Section 4 presents the experimental results and analysis. The last section concludes.

2. Related literature

2.1. Theory

Selfish players may choose to reveal private information through costless and non-binding communication or cheap talk; such revelation can lead to efficiency gains, as shown by Crawford and Sobel (1982). The problem has been formulated in generality by Forges (1986) and Myerson (1986). Palfrey and Rosenthal (1991) were the first to investigate the effects of cheap talk in a model where players have private information about costs to contribute towards the provision of a public good. They considered a 'threshold public good game' where provision requires contributions from at least a minimum number of people. Using a binary communication setting, they showed that perfect coordination is not Bayesian-incentive compatible and that players have weak incentives to free-ride in these situations, but they show the existence of communication equilibria that lead to higher efficiency. Using a model of continuous contributions with two privately informed players, Agastya et al. (2007) show theoretically that individuals do not have an incentive to contribute to the public good without communication, but binary communication gives them incentives to provide the good with positive probability.

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[1] A binary message space was also explored in past work (Palfrey and Rosenthal, 1991).