European Economic Review 79 (2015) 263–280

Contents lists available at ScienceDirect

European Economic Review

journal homepage: www.elsevier.com/locate/eer

How does the effect of pre-play suggestions vary with group size? Experimental evidence from a threshold public-good game ☆

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ARTICLE INFO

Article history:
Received 12 November 2014
Accepted 4 August 2015
Available online 14 August 2015

Jel classifications:
C72
D80
C92

Keywords:
Pre-play communication
Suggestions
Group decision making
Equilibrium selection
Leadership

ABSTRACT

Numerous studies have examined factors influencing the likelihood of cooperative outcomes in nonzero-sum games, but there has been little study of the *interaction* between two of the most important: group size and pre-play cheap talk. We report results from an experiment in which groups of size between 2 and 15 play a one-shot multi-player threshold public-good game. In our *random leader* treatment, all group members select a suggestion (e.g., "Everyone should choose X"), with one randomly chosen to be broadcast to the group. In a *choice only* treatment, subjects choose suggestions but none is sent, and in a *baseline* treatment, there are no suggestions at all. We find a negative interaction between group size and this kind of communication: the beneficial effect of both suggestions overall and cooperative suggestions on cooperation, cooperative outcomes, and payoffs decreases sharply as the group size increases. We find a similar negative interaction in a follow-up treatment in which *all* group members' suggestions are broadcast to the group. Our results suggest that care should be taken in generalising conclusions from small-group experiments to large groups.

1. Introduction

Some of the most fundamental questions of economics involve the emergence of cooperative behaviour – actions that make others better off, usually with at least a chance of incurring a cost to oneself – in groups. Nearly all research into settings such as the Prisoners' Dilemma and linear public good games focuses on when and why people cooperate when standard theory predicts they will not. Studies involving a wide range of other environments (e.g., Stag Hunt, Chicken, minimum- and median-effort games, threshold public good games, or infinitely-repeated Prisoners' Dilemma games) are dominated by the question of why people cooperate in situations where standard theory may allow for cooperation, but allows equally for non-cooperative behaviour. A key component of all of this research consists of identifying factors that affect the likelihood and extent of cooperation. Two of the most important such factors are the size of the group and the presence of opportunities for communication among group members. A substantial body of experimental work, utilising a

☆ We gratefully acknowledge support from Monash University's economics department and from the Australian Research Council (DP130101695). We thank Brit Grosskopf, Mana Komai, participants at several conferences and seminars, and two anonymous referees for helpful suggestions and comments.
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http://dx.doi.org/10.1016/j.euroecorev.2015.08.001
0014-2921/

variety of strategic settings, has found that allowing communication tends to positively affect cooperation, while increasing group size tends to have a mixed effect. (See Section 2 for a review of this literature.)

While these two individual effects are well studied, there has been almost no systematic examination of the ***interaction*** between group size and communication. Understanding the nature of this interaction is manifestly important. Academic interest in this question was exemplified by John Ledyard in his chapter of the *Handbook of Experimental Economics*:

> "We see that communication increases contributions … with small ($N < 15$) groups. We do not know why. We also do not know what would happen in large groups." (Ledyard, 1995, p. 158)

Ledyard was speaking about public-good games, but his remark arguably holds true more generally. Beyond the academic interest, the relationship between group size and the effect of communication matters for reasons of external validity. The vast majority of experimental tests of communication involve small groups, with sizes typically between 2 and 6, and anything more than 10 quite unusual. In contrast, many of the real-life situations these experiments are meant to describe concern much larger groups; a collective-action problem like global climate change has at least 200 or so decision makers (if decisions are viewed as being made at the national level, more if not), coordination within a large firm can involve thousands of decision makers, and even a small group like an economics department will contain 20 or so. If the effect of communication turns out to vary substantially based on the size of the group, results from experiments with small groups may have little implication for real-world settings with larger groups.

The goal of this paper is to take a step toward understanding the interaction between group size and communication, utilising an experiment where we orthogonally vary both of these. The game we use is a multi-player threshold public-good game, where all players face a zero-one contribution decision, and the public good is provided if and only if everyone contributes. The threshold public-good game is useful to study as it models any situation where the group outcome depends on the effort of the least productive group member (Camerer and Knez, 1997; Weber et al., 2001). These "weak link" situations are most commonly found in organisations, but can also be seen in settings such as team sports, finance (e.g., bank runs), cyber-security, and international military alliances. The group-optimal outcome occurs when everyone contributes, but contribution is a best-response only when every other player contributes; otherwise, not contributing is optimal. (Thus, the game is also a multi-player Stag Hunt.) The close alignment of players' incentives in this game – and the likely difficulty of successful coordination when communication is not possible – mean that communication ought to be particularly effective here, relative to other frequently-studied games such as the Prisoners' Dilemma.

Following most but not all previous studies, the form of communication we examine is ***pre-play cheap talk***: costless, non-binding communication sent and received prior to the choice of actions.[1] Cheap talk communication generally takes one of three forms: unstructured communication (Isaac and Walker, 1988), a statement of the sender's (truthful or not) intended action choice (Cooper et al., 1992), or the sender's suggestion for the group members' action choices (Weber et al., 2001). Our experiment uses this last form of communication. Allowing communication to take the form of a suggested action for the group (a) may avoid the psychological or behavioural-economics implications of "lying", and (b) provides the sender an air of leadership, which might afford the received message greater authority than announcement of an intended action choice.[2] In many of the situations modelled by threshold public-good games (see previous paragraph), the group would typically be "managed" by a group leader suggesting how the group could improve performance.[3]

Groups of size 2, 3, 4, 5, 7 and 15 play this game a single time, under one of three message treatments. In our "random leader" treatment, each group member chooses a message to be sent to all group members, and exactly ***one*** group member's message is randomly chosen to be broadcast to the entire group prior to the choice of actions. (As noted above, messages are framed as suggestions to the group, and are cheap talk.) Two other treatments are controls. Our "choice only" treatment is designed to be as similar as possible to the random leader treatment, but without the communication itself. Specifically, subjects in this treatment still choose messages, but none is actually broadcast to the group, and actions are chosen based on no information beyond the game's strategic structure. A "baseline" treatment has no messages at all, so again, actions are chosen based only on the game's structure. In principle, our use of two control treatments should allow two distinct

[1] See Masclet et al. (2003) for an example of how ***post-play*** messages can improve outcomes.

[2] Weber et al. (2001) report that the leader's suggestion increases the number of both the least cooperative and the most cooperative responses. The leader's suggestion came after subjects had already played a number of rounds of the game.

[3] While our study contributes to the literature on communication, group size, and cooperation, it also speaks to the question of what constitutes a leader. Economics typically adopts a "minimal leader" paradigm, stripping leadership down to its most basic elements. Leadership style and personal and socioeconomic characteristics are assumed to be irrelevant. Leaders are typically assumed to be just average players whose authority arises merely by occupying the leadership position. Their legitimacy is derived from superior information about the group project (Hermalin, 1998; Vesterlund, 2003; Potters et al. 2005; Komai et al. 2007; and Komai and Stegeman, 2010). We have stripped down even further the definition of a leader; our leader has no superior information – only greater ability to make her voice heard by others. In our experiment, the "leader" is chosen randomly and does not differ from the other group members in terms of seniority, expertise, political skills, etc. This is admittedly a stylised notion of leadership, but is in the spirit of settings where leaders are chosen randomly (e.g., the ancient Athenian Boule), rotate through the eligible group members (e.g., the presidency of the Council of the European Union), or are chosen based on attributes unconnected to the issue at hand (perhaps, the non-permanent members of the United Nations Security Council). Subjects, when choosing their messages, do not know who will be chosen as their leader, or even whether anyone will, so that leaders' messages should not differ systematically from other group members' messages. The leader's authority comes from having her message chosen to be relayed to other members of the group.