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Communication in stag hunt games: When does it really help?

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ABSTRACT

This paper examines whether the effectiveness of cheap-talk communication in Stag-Hunt-like games is influenced by payoff asymmetry between players. We find that communication improves efficiency when both players benefit from the Pareto-dominant equilibrium. Otherwise, its impact is limited, regardless of whether one or both players communicate their intended actions.

1. Introduction

Communication, even when it is cheap talk, can significantly influence outcomes in strategic settings. A consistent finding in experimental literature is that communication affects coordination in games with multiple equilibria, particularly those that can be Pareto-ranked. The Stag Hunt game is the classical illustration of this case. It is a simultaneous-move game with two players and two pure strategy equilibria with symmetric payoffs. One equilibrium is more efficient than the other, featuring a higher total surplus. However, the main barrier to reaching this efficient equilibrium is the associated risk: it is riskier than the alternative when players have doubts about each other's actions. Numerous studies have shown that the introduction of cheap-talk communication can greatly enhance coordination on the efficient equilibrium (Charness, 2000; Duffy and Feltovich, 2002; Clark et al., 2001).

The Stag Hunt games explored in the literature so far share a common feature: symmetric payoffs, where both players receive equal payoffs in both equilibria. In this paper, we examine whether payoff symmetry is necessary for communication to be effective. We conduct two versions of the Stag Hunt game: one with symmetric payoffs, replicating previous studies, and a new version with asymmetric payoffs. The experiment manipulates the communication available to players across three treatments. In the no-communication treatment, players cannot communicate before making their decisions. In the one-way communication treatment, one randomly selected player sends a non-binding message to their partner, indicating their intended action. Lastly, in the two-way communication treatment, both players exchange non-binding messages about their intended actions before playing the game.

Our findings for the symmetric payoffs version of the game replicate the standard results in the literature. One-way communication proves highly effective in shifting behavior toward the efficient equilibrium, increasing its occurrence by 88% compared to the no-communication treatment. Two-way communication remains effective, though less so, with a more modest increase of 39%. In contrast, the results for the asymmetric payoffs version of the game are markedly different. While communication has a positive effect, it is much smaller, raising the likelihood of reaching the efficient outcome by about 25%, regardless of the communication structure.

We further investigate the relationship between messages and gameplay, finding that players generally respond sensibly to the messages they receive. The limited effectiveness of communication in the asymmetric payoffs game stems from players internalizing the inequality, leading to significantly fewer proposals to play the efficient outcome compared to the symmetric game. Overall, our results demonstrate that payoff asymmetry can severely undermine the effectiveness of cheap-talk communication in Stag Hunt-like games.

Beyond the literature on the Stag Hunt game, our paper connects to the growing body of experimental research that explores the diverse effects of communication in various strategic games (Agranov, 2024). The alignment of preferences between players appears to be a critical factor influencing the effectiveness of cheap-talk communication. For instance, studies show that communication in symmetric social dilemmas promotes efficient, non-equilibrium strategies (Sally, 1995; Ledyard, 1995; Balliet, 2010; Ostrom, 2006). However, Isaac and Walker (1988) and Chan et al. (1999) find that in public goods games with heterogeneous endowments, communication is less effective. Similarly, Agranov and Yariv (2018) show that communication alone has little impact on auction prices but becomes highly effective when combined with transfers, underscoring that communication's success depends on whether one or both players benefit.

The remainder of the paper is structured as follows. We present our experimental design and procedures in Section 2. Section 3 summarizes

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	Player B	
Player A	Left	Right
Top	7, 7	6, 0
Bottom	0, 6	9, 9

(A): Game 1: Symmetric payoffs

	Player B	
Player A	Left	Right
Top	7, 7	6, 0
Bottom	0, 6	7, 11

(B): Game 2: Asymmetric payoffs

Fig. 1. Payoff matrices.

results of our experiments. Finally, Section 4 offers a few final remarks and discusses potential future steps.

2. Experimental design

We conducted two versions of the Stag Hunt game depicted in Fig. 1: one with symmetric payoffs and another with asymmetric payoffs. The symmetric payoffs game is similar to the ones extensively studied in the literature (Cooper et al., 1992; Charness, 2000; Duffy and Feltovich, 2002; Clark et al., 2001). It features two equilibria, the efficient one (Bottom, Right) and the inefficient but less risky one (Top, Left). The asymmetric payoffs game has the exact same features except players' payoffs in the efficient equilibrium are unequal and only player B stands to gain from coordinating on playing it.

Treatments. For each game, we ran three communication treatments, resulting in six treatments in total. In the no-communication treatment (No Comm) players could not communicate before choosing their actions. In the one-way communication treatment (One-way), one randomly selected player sent a message to his partner indicating his intended action. In the two-way communication treatment (Two-way), both players sent a message to each other before playing the game. Following the literature, the messages were restricted to indicate an intended action. Player A could send one of the two messages: "I intend to play Top" or "I intend to play Bottom". Player B could send one of the two messages: "I intend to play Left" or "I intend to play Right". The participants played 15 repetitions of the same game with random re-matching and feedback at the end of each repetition.

Subject pool and payments. The experiments were conducted on the Prolific platform with 136 participants in total. Each subject participated in one treatment only, resulting in roughly 20 participants per treatment. We recruited participants between the ages of 21 and 65, who were living in the United States, were fluent in English, and had a high approval rating on Prolific (above 90%). The experiment was carried out in Spring 2024. All participants received the $3 show-up fee plus 20% of participants were selected to receive the bonus equal to the payoff they got in a randomly selected game (in $). The experiment lasted 15 min on average.

Implementation. The experiment was approved by Caltech IRB: protocol number IR24-1431. The experimental software was programmed in oTree (Chen et al., 2016). The screenshots of the interface are presented in Appendix.

Discussion of experimental design. The choice of parameters for the asymmetric payoffs game was dictated by the desire to equalize the total surplus appropriated by players in each equilibrium across the two games. This was done to ensure that any differences in behavior across two games cannot be driven by efficiency concerns. However, there are at least two alternative specifications of payoffs in Game 2, which we would like to mention.

The first alternative specification could set the payoffs in the (Bottom, Right) cell of Game 2 to (7, 9). This would keep Player A's payoffs the same across both equilibria in Game 2 while preserving Player B's incentive to coordinate on the (Bottom, Right) equilibrium.

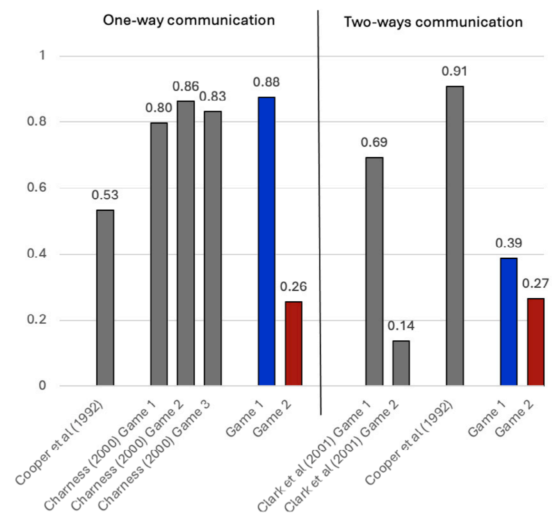

Fig. 2. Efficacy of communication and the role of payoffs' asymmetry.
Notes: We report the percentage increase in playing efficient outcomes at the group level due to the introduction of communication. Each parameterization of the game is depicted as a separate bar. This measure is computed as

$$\frac{\%\text{ eff outcomes in Comm} - \%\text{ eff outcomes in No Comm}}{1 - \%\text{ eff outcomes in No Comm}}.$$

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However, this adjustment alters the total surplus of the (Bottom, Right) equilibrium compared to Game 1. The second alternative specification could adjust the payoffs in the (Bottom, Right) cell of Game 2 to, for instance, (7.1, 10.9). This approach maintains the total surplus in the (Bottom, Right) equilibrium, consistent with Game 1, while allowing for a possibility that unequal benefits from coordinating on efficient outcome may interfere with the effectiveness of communication.

Both of the above specifications are reasonable and would contribute to a deeper understanding of the effects of communication in games with asymmetric payoffs. We leave these variations for future research.

3. Results

Approach to data analysis. We present the experiment results, focusing on the last 5 repetitions in each treatment, as this captures behavior after subjects have had time to stabilize. To compare outcomes across treatments, we use regression analysis, regressing the frequency of efficient outcomes on a constant and a treatment indicator, and clustering standard errors at the session level to account for interdependencies from random rematching.

How effective is communication? the aggregate outcomes. Fig. 2 summarizes the effectiveness of communication in shifting behavior toward efficient outcomes in our experiment and compares it to results obtained in the previous literature. Fig. 3 presents the distribution of

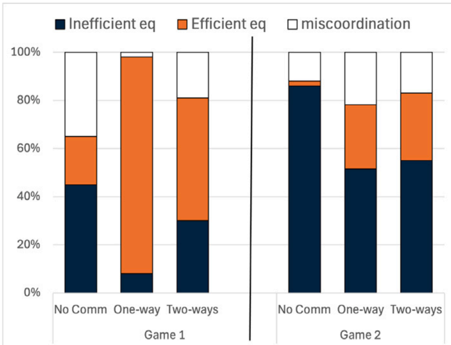


Fig. 3. Distribution of outcomes in all treatments.

outcomes in all our treatments separating between two equilibria outcomes (black for the inefficient one and red for the efficient one) and miscoordination (depicted in white).

Consistent with the literature, we find that one-way communication is highly effective in achieving efficient outcomes in Game 1, which features symmetric payoffs. The ability to send a cheap-talk message indicating one's intended action increases the likelihood of selecting the efficient strategy by 88%, closely aligning with the findings of Charness (2000) and surpassing those of Cooper et al. (1992). While two-way communication also improves efficiency, its impact is less pronounced, leading to a more modest increase in efficiency in Game 1. As shown in Fig. 2, the effects of two-way communication vary more significantly across games. Our results are somewhere in the middle of those reported in past literature: we document a 39% increase in the frequency of playing efficient outcome in Game 1 when two-way communication is introduced.

The situation changes dramatically when only one player stands to benefit from playing the efficient outcome as is the case in Game 2. In Game 2, regardless of the communication protocol, players coordinate on the efficient outcome less often compared to Game 1. The coordination rates in Game 2 are 2%, 27%, and 28% in no-communication, one-way communication, and two-way communication treatments, respectively. For comparison, the coordination rates in Game 1 are 20%, 90%, and 51%, respectively. Conditional on the communication protocol, all pairwise comparisons between frequencies of coordinating on the efficient outcome across Games 1 and 2 are statistically significant with $p = 0.029$, $p = 0.002$, and $p < 0.001$, respectively.

How did pairs reach these aggregate outcomes? Whether or not the pair reaches an efficient outcome depends on the messages players send. When only one player can send a pre-play message, both, the sender and the receiver, play the actions corresponding to the equilibrium indicated by the message. In Game 1, this happens in 98% or more cases, while in Game 2 it happens in 80% or more cases.

However, the distribution of messages is quite different across the two games: in Game 1, 92% of messages indicate playing the efficient equilibrium, while in Game 2, this happens 48% of the time when the sender is Player A and 38% of the time when the sender is Player B. Similarly, in the two-way communication treatments, most of the messages indicate an intention to play efficient equilibrium in Game 1, while this is not the case in Game 2. In Game 1, 62% of message pairs indicate playing the efficient equilibrium by both players. The same frequency is only 28% in Game 2. Players respond to the messages sensibly, by choosing to play efficient equilibrium only when both messages indicate that.

4. Discussion

This paper examines whether the effectiveness of cheap-talk communication in achieving efficient outcomes in Stag-Hunt-like games is influenced by payoff asymmetry between the players. Our findings show that communication is effective when both players have an incentive to choose the Pareto-dominant equilibrium. However, when this alignment is absent, the impact of communication becomes significantly limited, even when the total surplus of the efficient equilibrium remains constant. This holds true whether one or both players are able to communicate their intended actions before playing the game.

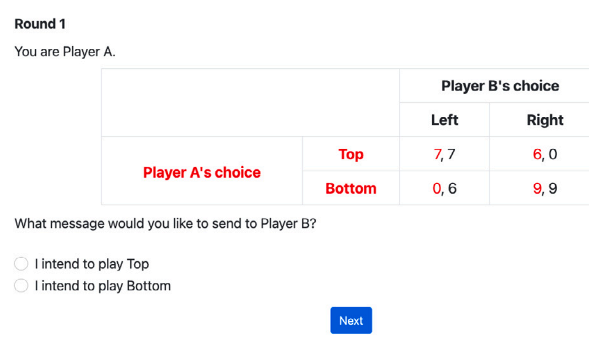
Our results open the door for future research into the necessary and sufficient conditions under which cheap-talk communication can meaningfully influence outcomes in games with multiple equilibria. We highlight the potential of exploring alternative payoff structures in asymmetric games, which could provide valuable insights into future studies. Additionally, our study, in line with existing literature, focused on restricted communication, where the messages were predetermined by the experimenter. An intriguing avenue for further investigation would be to examine whether more flexible and richer communication protocols, such as free-form messages in prose, could mitigate the effects of unequal payoffs and prove more effective than the restricted communication tool used in this paper.

Data availability

Data will be made available on request.

Appendix

Below we present the screenshots from the one-way communication treatment in Game 1.



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