Note

A note on pre-play communication ☆

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ABSTRACT

Consider a finite two-player game with one round of communication. Restrict players to a subset of "monotonic" strategies. The paper justifies this restriction. The paper provides sufficient conditions under which the strategies of the restricted game that survive iterative deletion of weakly dominated strategies favor the agent who can communicate.

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1. Introduction

This paper adds to the literature studying whether costless pre-play communication can influence outcomes. The setting is standard. Start with a finite, two-player (underlying) game. Create a new game in which one player (the Sender) has the opportunity to send a costless message to the other player (the Receiver) prior to playing the underlying game. The question is whether the opportunity to communicate changes outcomes.

Common sense and experimental evidence suggest that the ability to communicate can change outcomes. Intuitively, communication may help rational players coordinate when the underlying game has multiple, Pareto-ranked equilibria. If the Sender can credibly communicate her intentions, then communication may enable her to select her most preferred equilibrium.

The main result gives conditions under which the unique prediction of the game with pre-play communication is the equilibrium in the underlying game that gives the Sender her highest payoff. This conclusion is familiar, but this paper derives it as a consequence of novel and restrictive conditions.

It is difficult to guarantee that communication influences outcomes because adding communication inserts a new coordination problem into the original strategic setting. Whenever there is an equilibrium in which the speaker can communicate her intentions through the message she sends, there is another equilibrium that also communicates her intentions but in which the connection between message and action is different. In addition to these equilibria, there will be another in which messages are ignored.

This paper deals with the problem by imposing assumptions on the way that messages are interpreted. I assume that messages and actions are ordered. I construct the game with pre-play communication as usual, but assume that it is common knowledge that the Receiver will interpret messages in a systematic way. Specifically, the Sender believes that the

Receiver will play a strategy that is (weakly) monotonic in the Sender's message. That is, the Sender thinks that the Receiver will use only strategies that respond to higher messages with (weakly) higher actions. This restriction reduces the game with pre-play communication to a new game in which the Receiver can only use monotonic strategies. Finally, I solve the reduced game using iterative deletion of weakly dominated strategies. Both steps in this procedure are necessary for a selection result. It is straightforward to check that the restriction to monotonic strategies does not eliminate any pure-strategy Nash equilibrium predictions. Further, given an equilibrium of the underlying game that survives iterative deletion of weakly dominated strategies, one can construct an equilibrium for the game with pre-play communication in which the Sender randomizes uniformly over all messages and, after any message, the players use the equilibrium strategies of the underlying game. These strategies survive iterative deletion of weakly dominated strategies. Consequently, my results require the combination of a restriction on strategies (monotonicity) and an equilibrium refinement (deletion of weakly dominated strategies) to make a selection.

One stylized intuition for the result that communication influences behavior goes as follows. Consider a situation in which the Receiver ignores the Sender's message. Imagine the Sender deviates from the equilibrium by using a novel message. If the Sender can make a suggestion that is consistent with the incentives of both players, then the Receiver "should" believe it. For example, if the Sender and Receiver are playing the battle of the sexes, then the Receiver's favorite equilibrium would be destabilized if the Sender can credibly communicate her intention to play the strategy consistent with her favorite equilibrium. There are at least two things missing from this stylized intuition. First, there may not be any unused messages (for example, the Receiver may expect the Sender to randomize uniformly over all available messages). Second, even if there is an unused message, the formal description of the game does not provide any guidance about how to interpret the message. The monotonicity restriction imposes (a small amount) of structure on how the Receiver interprets unexpected messages. Iterative weak dominance formalizes the "forward-induction" intuition that a rational Receiver interprets unexpected messages in a systematic way. If the Receiver does so, then the Sender can use communication to her advantage.

Farrell (1988) allows the Sender to make a suggestion about which strategies to use prior to playing a game. He observes that the Sender can select her preferred outcome when the Receiver must follow suggestions that satisfy consistency restrictions.[1] Informally, a suggestion is consistent if the Receiver believes that the Sender would follow the suggestion, then it would be in the Sender's best interest to follow it. It is therefore consistent to suggest that agents should coordinate on a Nash equilibrium and if one player is given the opportunity to make a suggestion, she would suggest the equilibrium that she most prefers. Aumann (1990) argues that communication need not be credible when the Sender's preferences over the Receiver's actions do not depend on the action the Sender intends to take. These games arise, for example, when there are positive spillovers so that increasing the Receiver's action always benefits the Sender. My results are consistent with Aumann's discussion. I show in Section 4 that the monotonicity restriction and iterative weak dominance do not select the Sender's favorite outcome in Aumann's game. My central result requires that the underlying game satisfy a self-signaling property: conditional on playing a particular action in the underlying game, the Sender obtains the highest payoff when the Receiver best responds. The self-signaling condition explicitly guarantees that the action of the Receiver that the Sender prefers most depends non-trivially on the Sender's intended action and rules out Aumann's example.

Farrell (1988) mentions the possibility that the timing of announcements may influence the credibility of cheap talk and suggests that Aumann's concern is more relevant when the Sender communicates after moving. Furthermore, experimental evidence (for example, Charness, 2000) suggests that the credibility of pre-play communication depends on whether the Sender talks before or after making her choice of strategy. Motivated in part by these observations, Schlag and Vida (2013) demonstrate that in generic 2×2 games if the Sender can select the language and communicates prior to moving, then she obtains her favorite outcome, while this result fails if the Sender communicates after moving.[2] Schlag and Vida give one agent the power to select a partition of Player 1's strategy space (called the language). Messages are elements of the language. A language is credible if given any message ($M \subset S_1$), there exists a Nash Equilibrium of the underlying game in which the Sender selects a strategy with support contained in M.

Lo (2009) shows that if the underlying game is both self-committing[3] and self-signaling, then the Sender receives her favorite equilibrium payoff in the unique outcome surviving iterative deletion of weakly dominated strategies consistent with her notion of credible communication. Lo therefore reaches the same conclusion as I do. The assumptions used in obtaining the conclusion make the results non-comparable. Lo does not impose strong monotonicity conditions on the underlying game. In this way, her result applies to more situations. I do not require that the game be self committing, so my result covers some games not covered by her result. Although we both use iterative dominance, Lo's notion of credibility

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[1] Farrell and Rabin (1996) review literature on this topic and Rabin (1990) describes a related approach.

[2] Zultan (2013) presents a model of timing complementary to that of Schlag and Vida.

[3] Baliga and Morris (2002) define self-committing games to be those two-player games in which, every pure strategy of the Sender is a best response to the Receiver's best response to it. That is, in a self-committing game if the Sender promises to take an action and the Receiver believes the promise (and therefore best responds), it is in the Sender's best interest to behave as promised. The consistency condition in Farrell (1988) is an analogous property restricted to proposals (rather than games): the Sender's proposal to play a particular strategy in the underlying game is consistent if the strategy is a best response to the Receiver's best response to it.