Journal of Economic Behavior and Organization 154 (2018) 206–219

Contents lists available at ScienceDirect

Journal of Economic Behavior and Organization

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

Cooperation through coordination in two stages[☆]

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ARTICLE INFO

Article history:
Received 15 September 2015
Revised 2 April 2018
Accepted 7 August 2018

JEL classification nos:
C90
Z13

Keywords:
Experimental economics
Cooperation
Efficiency
Two-stage games
Turn-taking
Timing of moves

ABSTRACT

Efficient cooperation often requires coordination, such that exactly one of two players takes an available action. If the decisions whether to pursue the action are made simultaneously, then neither or both may acquiesce leading to an inefficient outcome. However, inefficiency may be reduced if players move sequentially. We test this experimentally by introducing repeated two-stage versions of such a game where the action is individually profitable. In one version, players may wait in the first stage to see what their partner did and then coordinate in the second stage. In another version, sequential decision-making is imposed by assigning one player to move in stage one and the other in stage two. Although there are fewer cooperative decisions in the two-stage treatments, we show that overall subjects coordinate better on efficient cooperation and on avoiding both acquiescing. Yet, only some pairs actually achieve higher profits, while the least cooperative pairs do worse in the two-stage games than their single-stage counterparts. For these, rather than facilitating coordination, the additional stage invites unsuccessful attempts to disguise uncooperative play, which are met with punishment.

1. Introduction

Sometimes cooperation can be achieved only through coordination. Yet, efficient coordination often requires that players rely on their private information. In any situation in which decisions must be made simultaneously, coordination cannot fully exploit such information. However, if decisions are made over time, then those attempting to coordinate have the ability to make use of their private information. In this paper, we ask whether this extra ability indeed results in increased payoffs.

Consider a quiz show for which a team must put forth a representative to answer a question. All team members have the same objective - success of the team. In this pristine situation, the players need only worry about coordination. For the highest chance of the team being correct, it would want the player with the highest degree of confidence to answer the question (confidence being private information). One selection method is to have players press a buzzer to indicate their willingness to answer. With only a second to buzz, a player can infer little about his teammates' confidence. With more

☆ We thank Sean D'Evelyn, Justin Smith, Ro'i Zultan, an anonymous referee and a co-editor of this journal, Dirk Engelmann, and numerous departmental seminar and conference participants for helpful comments. Tim Miller programmed the experiments. Kaplan thanks the Economic and Social Research Council (grant no. RES-000-22-0370) and Ruffle thanks the Israel Science Foundation (grant no. 776/03) for generous financial support.

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https://doi.org/10.1016/j.jebo.2018.08.008
0167-2681/

time permitted to buzz, a player can wait and infer that a teammate is less confident if he has not already responded. Thus, more time should increase the chance that a higher-ability player gets to answer the question.

Another way of selecting a player is to ask each sequentially. A player may decline if he thinks there is a better player to follow who would agree. In this case players do not need to infer about other players' information who preceded them. The mechanism itself takes advantage of the private information. A player asked second would effectively make the decision contingent on the first player's private information since that player should not volunteer with a low confidence level.

Both these cases point to the possibility that altering the timing of such decisions can improve coordination. This also applies when players' preferences are not aligned as in most real-world situations, that is, when they are playing a non-cooperative game. We seek to determine whether the increased capability to coordinate helps, using a two-player entry game with congestion first introduced in Kaplan and Ruffle (2012).[1] Here, a single entrant yields a higher social surplus than if both enter or, worse yet, neither does. The players have private information about their value of being an entrant. One interesting feature of this congestion game is that it sometimes requires cooperative players to act against their short-term interest; that is, they sometimes have to exit despite entry being the dominant strategy of the one-shot game. This tension, which does not exist in pure coordination games, poses a bigger challenge to obtaining cooperation.

We examine three timings of moves, each represented by an experimental treatment in a between-subjects design.[2] *Now:* simultaneous decisions. *Seq:* an exogenous ordering of sequential decisions whereby the first player decides to enter or exit and then, after observing the first player's move, the second player decides to enter or exit. *Wait:* the players endogenously time their decisions over two stages (similar to a two-period discrete version of the above quiz show example). In addition to entering or exiting in the first stage, each player may choose to wait; namely, he postpones his decision until the second stage giving him the opportunity to observe his partner's first-stage decision, which includes the possibility to wait.

Both the simultaneous game and its dynamic extensions have analogies to numerous real-world cooperation dilemmas. For example, bidders in an auction can actively compete with one another. In so doing, each reduces the other's expected surplus. Or bidders with a sufficiently low value for the good being auctioned can elect not to participate. Alternatively, consider two fast-food chains that each contemplates opening a franchise in a small town. They may possess different expected private values of being the local monopolist that stem from different expected costs or demand for its products. If these two chains wish to collude implicitly, then the chain with a low value would stay out, under the presumption that the favor will be returned in the future. Also, individuals may choose not to enter contests or competitions if their value for the prize or probability of winning is sufficiently low and they care about other more deserving or more capable participants. Junior employees backing down from an internal promotion contest is a common occurrence. Finally, cab drivers, bicycle messengers, golf caddies, waitstaff, sky caps and vendors in a marketplace often face the decision of whether to compete for a customer or acquiesce, with the consequences of their decisions similar to our game's payoff structure.

None of the above-mentioned dilemmas is inherently a simultaneous-move game. For example, a bidder in an English auction might hesitate before calling out a bid to gauge whether other auction participants intend to bid. A firm may postpone the decision whether to enter a market to determine whether a rival firm values the market more as indicated by its swift entry. A cab driver not in the immediate vicinity of the fare may choose to wait to see if other cabbies respond to the dispatcher's call.[3] In other examples the order of moves may be exogenously given. One bidder may be larger than the others. A chain store may be the market leader. A job, promotion or dating opportunity may be offered first to one candidate who can accept, or decline because he recognizes that the next candidate in line is better suited or more eager.

As suggested by all of these examples, the possibility that players commit at different times to their entry-exit decisions can facilitate a more efficient outcome according to which the player with the higher value for the action pursues it, while the lower-value player acquiesces. To illustrate, if a firm always enters for a certain range of high values, then the possibility of waiting permits the firm to refine its strategy to enter on only a subset of this range and wait otherwise. By waiting and subsequently not entering whenever the other enters, double entry is avoided and a higher social surplus attained.[4] Similarly, if there exists a natural sequential ordering to the firms' moves, then the second mover can enter whenever the first mover stays out and exit whenever the first mover enters, thereby altogether avoiding double entry and double exit.

In this paper, we show theoretically that permitting non-simultaneity of observable decisions in our game (*Wait* and *Seq*) can facilitate cooperation and higher profits compared to simultaneous moves (*Now*). We then explore this possibility in a repeated game over 60 rounds with fixed pairings.

[1] In that paper, the authors explore several single-stage variations of the above game with the goal of determining whether cooperative behavior takes the form of cutoff strategies (enter on high integers, exit on low ones) or alternating (players take turns entering and exiting).

[2] A different approach to reducing entry and improving cooperation would be to impose a limit on the total number of entries permitted by each player in the repeated game. In a similar vein, Engelmann and Grimm (2012) examine a two-player voting game where optimal cooperation requires one to vote for their preferred option only when one's private value is high. Interestingly, only when an exogenous budget constraint (in terms of number of votes) is imposed do they observe "cooperation" rather than players pursuing the dominant strategy of exaggerating their values and always voting for their preferred option.

[3] Gal-Or (1985) first made the point that the timing of moves (i.e., when to commit) may be a strategic choice variable. See also Dowrick (1986) for a model of quantity competition in which firms choose their roles as leader or follower.

[4] Consider for illustrative purposes the following simplified game parameterization: the set of values is 1, 2 and 3, each with an equal chance. If firms enter on a 2 or 3, then double entry occurs 4/9 of the time, no entry 1/9 of the time and single entry the remaining 4/9. By switching to entry on 3 and waiting on 2, double entry occurs only 2/9 of the time (1/9 in the first stage when both have 3s and another 1/9 in the second stage when both have 2s). Single entry increases to 2/3 of the time with no entry still at 1/9.