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Team versus individual behavior in the minimum effort coordination game

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ABSTRACT

We compare coordination success of individuals and teams in the minimum effort coordination game. The game is played by groups of either five individuals or five two-person teams with either fixed or random re-matching protocols. When groups are fixed, teams perform at least as well as individuals, if not better, in terms of coordinating to the payoff dominant outcome. But with random re-matching, teams experience pervasive coordination failures. A public recommendation to a strategy or a performance bonus exhorting players to coordinate to the payoff-dominant equilibrium has similar impact on coordination for both individuals and teams playing with fixed matching. However, coordination is far more difficult to achieve with teams playing under random re-matching. Our results have implications for the design of work-groups in organizations.

1. Introduction

Coordination problems are endemic to any organization engaged in team production. These situations are often characterized by strategic complementarities between worker efforts and take on a weak-link structure where the least performing worker exerts a large negative influence on overall productivity. Such games typically give rise to multiple payoff-ranked equilibria leading to questions about equilibrium selection. Successfully coordinating the actions of multiple agents is crucial to achieving optimal outcomes in such cases.

Knez and Simester (2001) provide a detailed account of how successful resolution of coordination failures in various operations led to the remarkable turn-around at Continental Airlines after 1995. Ichniowski, Shaw, and Prennushi (1997)

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describe how successful steel-mills adopt innovative human resource management practices that foster coordination along their production lines in an attempt to boost productivity. Field studies, like the ones noted above, are certainly instructive about how organizations can go about resolving coordination problems. But it is not always clear whether policies implemented in one organization will necessarily translate to others given that the successful resolution of such failures is tied up integrally with the corporate culture at particular organizations.

Consequently economists have often resorted to laboratory experiments to study the essence of the problem under the belief that generic lab environments enable us to hone in on crucial aspects of the coordination problem – where and why failures may happen – and the lessons learned will be applicable across a wide range of organizations. Cooper, De Jong, Forsythe, and Ross (1990, 1992) provide some of the earliest evidence of such failure to coordinate to the payoff dominant outcome in a number of 2×2 and 3×3 coordination games. Van Huyck, Battalio, and Beil (1990, 1991) document similar failure to coordinate to the payoff dominant outcome in a set of more elaborate "order-statistic" games where the payoff to individuals depends on one's own choice and either the minimum effort or the median effort chosen by a group member, giving rise in each case to multiple payoff ranked equilibria.

However, we also know that a number of interventions such as communication among group members, advice from one generation of players to the next, public announcements recommending a particular strategy choice, exhortative messages from a manager to workers and performance bonuses for achieving improved coordination can all be effective in resolving coordination failures. See for instance Bangun, Chaudhuri, Prak, and Zhou (2006), Brandts and Cooper (2006, 2007), Brandts and MacLeod (1995), Chaudhuri, Schotter, and Sopher (2009), Chaudhuri and Paichayontvijit (2010), Cooper et al. (1992), Hamman, Rick, and Weber (2007) and Van Huyck, Gillette, and Battalio (1992) for representative publications in this area. Devetag and Ortmann (2007) and Chaudhuri (2009, chap. 5) provide an overview of this line of work.

However, in studying problems of coordination failure the extant literature has focused on decisions made by individuals who are typically interacting with other individuals in work-groups. But the reality is that in most organizations increasingly workers operate in teams and have to coordinate their actions with other teams. Such is the case, for instance, every time a plane takes off where almost all the tasks such as pre-flight checks or loading fuel or luggage or food-carts, etc. are carried out by teams working in tandem. Indeed the Knez and Simester (2001) study of Continental Airlines is focused primarily on solving such team level coordination problems.

This raises at least two relevant questions: (1) *does resolving coordination failures become even more difficult when teams of workers need to coordinate their actions*? (2) *Do the policy interventions that improve coordination among individuals have similar efficacious impact for teams*?

Ex ante, it is not clear whether teams would be more or less successful in solving coordination problems. On the one hand, given that teams involve more players coordination may become more difficult since typically the larger the group size, the more difficult it is to coordinate the actions of many agents. On the other hand, given that team members can talk to one another, even if they are not able to communicate directly with other teams, this may help coordinate actions given the role of communication in resolving coordination failures.

A pioneering study by Feri, Irlenbusch, and Sutter (2010) addresses this gap in the literature by comparing the coordination success of individuals and three-person teams. Each group consists of either five individuals or five three-person teams who interact for twenty rounds and the group composition remains unchanged for the entire time. Feri et al. look at behavior in six different games. Two of these are weak-link games along the lines of Van Huyck, Battalio, and Beil (1990). Here each group member chooses one number from the set {1, 2, 3, 4, 5, 6, 7}. The efficient outcome is for everyone to choose 7 while choosing 1 is the secure action. Three of the games are "average opinion" games taken from Van Huyck, Battalio, and Beil (1991). Once again each group member chooses one number from the set {1, 2, 3, 4, 5, 6, 7}. The efficient outcome is for everyone to choose 7 while the minimum payoff is maximized by choosing 3. Finally, game 6 is the "continental divide game" taken from Van Huyck, Cook, and Battalio (1997). Here each player chooses a number from the set {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14} with two symmetric strict equilibria: everyone choosing 3 or 12.

Feri et al. report that teams are much better at coordinating to the payoff dominant outcome. Whether one looks at average effort choices or the appropriate order statistic (such as the minimum or the median effort choice depending on the specific game under consideration) teams in their study coordinate to a higher order statistic compared to individuals. This in turn also implies that teams on average earn more than individuals. Furthermore, not only do teams manage to coordinate to higher minimum/median effort choices, they are also better at coordinating their choices per se. The frequency of *mis-coordination*, in the sense of failing to coordinate choices to any of the available equilibria in the underlying stage-game, is much lower for teams compared to individuals.

The authors apply the *Experience Weighted Attraction* model of Camerer and Ho (1999) to study the dynamics of behavior and conclude that teams demonstrate "*a higher probability of playing more profitable strategies, leading ultimately to more efficient coordination when equilibria are Pareto ranked*" (Feri et al., 2010, p. 1904).

In this paper, we extend the Feri et al. study in two ways. First, in Feri et al. (2010) group composition – whether teams or individuals – is fixed. We compare behavior of teams and individuals under both fixed matching and random re-matching from one round to the next. It is quite likely that where teams are required to work in a coordinated manner, as in the Continental Airlines example discussed above, group composition tends to be fixed over extended periods. This is the matching protocol that Feri et al. study. However, as Chaudhuri and Paichayontvijit (2010) point out, one can think of situations involving short-lived interactions and frequent turn-over of personnel. Such may include (i) post-offices hiring additional temporary workers during Christmas; (ii) immigration authorities hiring temporary workers following a spike in visa applications