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Sorting and communication in weak-link group contests

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ABSTRACT

We experimentally study the effects of sorting and communication in contests between groups of heterogeneous players whose within-group efforts are perfect complements. Contrary to the common wisdom that competitive balance bolsters performance in contests, in this setting theory predicts that aggregate output increases in the variation in abilities between groups, i.e., it is maximized by the most unbalanced sorting of players. However, the data does not support this prediction. In the absence of communication, we find no effect of sorting on aggregate output, while in the presence of within-group communication aggregate output is 33% higher under the balanced sorting as compared to the unbalanced sorting. This reversal of the prediction is in line with the competitive balance heuristic. The results have implications for the design of optimal groups in organizations using relative performance pay.

1. Introduction

Many organizations use various forms of *contests* to incentivize high effort from workers. Under such pay schemes, workers exert costly effort to increase their chances of winning a fixed reward, e.g., a bonus or promotion. Production often takes place in teams where it is difficult to distinguish between individual inputs of team members; hence, contest incentives are applied to teams and the whole team is rewarded in the case of success.[1] For example, in an attempt to increase sales of U.S. beef, E-Mart Everyday, a chain of Korean grocery stores, awarded gift cards to the staff from the stores with the highest sales. As a result, the stores saw a six-fold long-term increase in the percentage of U.S. beef sales (from 4 to 25%).[2] Similarly, Adventist Health System, a healthcare organization based in Florida, held a contest between several hospitals' inpatient and emergency department units with the goal of improving patients' satisfaction. Staff members at top-performing hospitals received free registration to an upcoming conference with a monetary value of US$1300.[3]

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[1] Since the late 1980s, the number of organizations utilizing teamwork has increased substantially (Lazear and Shaw, 2007). From 1987 to 1999, the percentage of firms with at least 20% of personnel assigned to teams increased from 37 to 61% (Lawler et al., 2001; 1995), and so has the use of team contests (Chen and Lim, 2013).

[2] Source: http://www.agweb.com/article/sales_competition_boosts_us_beef_at_korean_grocery_chain_NAA_News_Release/.

[3] Source: http://www.adventisthealthsystem.com/page.php?section=news&page=article&id=1393.

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Within virtually any organization, workers differ in their ability to perform tasks. Hence, organizations using team production and contest incentives may be interested in the following question: How should workers be *sorted* by ability into competing groups? For example, should a firm use a *balanced* sorting, in which high-ability and low-ability workers are mixed together so that aggregate ability does not vary much across groups, or should an *unbalanced* sorting be used, where groups are stratified by ability? In theory, the answer to this question is not unique and depends on the degree of complementarity of individual efforts in team production.

In this paper, we focus on situations when group production follows the *perfect complements* (or *weak-link*) technology. Such technologies are widely applicable. For example, in a hospital emergency department, medical technicians, triage nurses, general physicians and surgeons each play a highly specialized, complementary role in the caring for patients, and the success of the organization is determined by the least productive worker. As we show in Section 3, when groups have the weak-link technology and the contest is modeled assuming an imperfectly discriminating lottery, the unbalanced sorting of workers into teams is optimal. This prediction is somewhat counterintuitive as it goes against the *competitive balance* heuristic whereby heterogeneity is viewed as detrimental to the effectiveness of contests. We conduct a laboratory experiment to put this prediction to an empirical test.

In the experiment, we assign subjects one of four types – A, B, C, or D – that differ in their cost of effort from lowest to highest cost (i.e., highest to lowest ability). Subjects compete in contests between two groups of two players each. The experiment follows a 2×2 between-subject design. Along the first dimension, we vary sorting between *balanced*, where types A and D compete against types B and C, and *unbalanced*, where types A and B compete against types C and D. Along the second dimension of the design, we either do or do not allow subjects to communicate with their group partners prior to making effort choices.

In a group contest with weak-link aggregation, equilibrium efforts within each group are equalized. There are multiple equilibria (Lee, 2012), but in this paper, for reasons that are explained in detail in Section 3, we focus on the unique coalition-proof equilibrium which is effectively the equilibrium in a contest between the lowest-ability individuals from each group. Thus, in the coalition-proof equilibrium, under the balanced sorting the group contest is effectively reduced to an individual contest between types C and D, while under the unbalanced sorting it is reduced to a contest between types B and D. Because total equilibrium effort is higher in the latter case, the unbalanced sorting yields higher predicted aggregate output than the balanced sorting. For the parameters of the experiment, total predicted output in the case of the unbalanced sorting exceeds the output under any other sorting by at least 25%. This suggests that managers and supervisors can benefit from the careful assignment of personnel into competing groups, especially considering the low-cost nature of making such a decision.

In addition to sorting, we explore the effects that within-group communication has on individuals' effort decisions. Communication is a natural occurrence in organizations, and it may improve coordination between group members and help them play more strategically. In group contests, a group's success not only depends on the coordination of efforts within a group, but also on the competition between groups, i.e., a group's coordination problem is embedded into another strategic environment. One important consequence of this is that, given the behavior of the other group, the Pareto ranking of equilibria in the reduced within-group game is no longer unidirectional, i.e., increasing group output does not necessarily lead to higher payoffs. The balanced sorting minimizes the variance in ability between groups; however, it leads to a large variance in ability within each group, which creates an interesting within-group dilemma: When players within a group have misaligned incentives, how will communication affect their effort decisions? Will the high-ability player be able to convince her teammate to choose higher effort which benefits the high-ability player but hurts the low-ability player? Or will the low-ability player convince her teammate to choose a lower effort which is more in line with the low-ability player's best response? Or will they arrive at some sort of compromise? At the same time, in the case of unbalanced sorting the difference between players within each group is smaller, and it may be easier for the players to coordinate, both with and without communication.

We find that in the absence of communication, total output under the balanced and unbalanced sortings is similar. This is achieved because (A,B) groups (i.e., the groups comprised of player types A and B) under the unbalanced sorting produce more than (A,D) groups under the balanced sorting, but (C,D) groups under the unbalanced sorting produce less than (B,C) groups under the balanced sorting, and the two differences nearly compensate each other. However, in the presence of communication we find that total output is significantly (33%) higher under the balanced sorting as compared to the unbalanced sorting, which is a reversal of the theoretical prediction. We find that (B,C) groups under balanced sorting increase their output in the presence of communication, while (C,D) groups under the unbalanced sorting have a surprisingly strong decrease in output when they can communicate.

Our results highlight important differences between the settings with symmetric and asymmetric groups competing in a group contest with weak-link aggregation. We show that it is not always the case that all group types increase their output in the presence of within-group communication. Furthermore, our results imply that the competitive balance heuristic is more robust than suggested by theory. While competitive balance does not appear to be beneficial without communication, in the more ecologically valid setting which allows for communication the positive role of competitive balance is restored.

The rest of the paper is organized as follows. We begin by briefly discussing the most relevant literature in Section 2. Section 3 presents the theoretical model and predictions that serve as the basis for the experimental design presented in Section 4. Section 5 presents the experimental results and Section 6 contains a discussion and concluding remarks.