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Adding Tournament to Tournament: Combining Between-Team and Within-Team Incentives

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Abstract

We examine theoretically and experimentally how combining between-team and within-team incentives affects behavior in team tournaments. Theory predicts that free-riding will occur when there are only between-team incentives, and offering within-team incentives may solve this problem. However, if individuals collude, then within-team incentives may not be as effective at reducing free-riding. Consistent with the theoretical predictions, the results of our experiment indicate that although between-team incentives are effective at increasing individual effort, there is substantial free-riding and declining effort over time. Importantly, a combination of between-team and within-team incentives is effective not only at generating effort but also at sustaining effort over time, mitigating free-riding problem, increasing cooperation and decreasing collusion within teams.

JEL Classifications: C70, D72, H41
Keywords: individual incentive, team incentive, tournament, free-riding, collusion

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1. Introduction

The use of teams in organizations has become increasingly popular in the U.S. workplace and elsewhere (Che and Yoo, 2001; Merchant and Van der Stede, 2007). Teams can increase the efficient application of specialized knowledge and skills to achieve greater collective performance (Cohen, 1993; Merchant and Van der Stede, 2007). Accordingly, how to design incentives in team settings is an interesting and important topic. Organizations consisting of teams can incentivize employees' effort based on (1) individual performance, (2) team performance, or (3) a combination of both. While the effects of individual and team incentives, in isolation, have been studied in the literature (e.g., Prendergast, 1999; Konrad, 2009; Connelly et al., 2014), less is known about the combined effects.

Mixed incentives are widely used in practice (Libby and Thorne, 2009). For example, Hwang et al. (2009) find that out of 1,780 U.S. manufacturing plants, 525 plants use a combination of group and individual-based performance measures. A survey conducted by the Center for Effective Organizations at the University of Southern California (Lawler and Mohrman, 2003) shows an increasing use of mixed incentives in *Fortune* 1,000 corporations. Sisk (2005) confirms that more firms now use a combination of incentives for compensating employees. For instance, Pfizer Pharmaceutical Group Canada ties all bonuses to the overall performance of Pfizer Canada, the performance of each person's team, and each individual's performance. Further, group members of audit teams in Ameritech's Internal Audit Services are compensated not only for their individual performance rankings within their team but also for their team performance ranking among other teams; and in the Wilson North Carolina pharmaceutical plant of Merck, employees can receive rewards based on individual performance, their team's performance, as well as the plant's overall performance (Parker et al., 2000).

One way to design incentives to motivate agents in both individual and team settings is to introduce a tournament. The use of tournaments to evaluate and reward performance has increased in the corporate world (Boyle, 2001; McGregor, 2006; Pfeffer and Sutton, 2006) and in the workplace (Merchant and Van der Stede, 2007; Sheremeta, 2016). In this study, we are particularly interested in a combination of between-team and within-team tournaments.[1] While it is well recognized in the literature that individual tournaments can be effective in eliciting high effort from contestants (Dechenaux et al., 2015), such tournaments are susceptible to collusion, especially when individuals are allowed to communicate (Harbring, 2006; Sutter and Strassmair, 2009; Cason et al., 2012, 2017). Similarly, within the literature team tournaments have been shown to effectively generate high effort (Abbink et al., 2010; Sheremeta, 2018), but such tournaments are susceptible to free-riding (Erev et al., 1993; Gunnthorsdottir and Rapoport, 2006). Therefore, the resulting effort from individuals under combined within-team and between-team tournaments is not clear as the problems of collusion and free-riding still exist. To study the effectiveness of the combination of between-team and within-team tournaments in light of these concerns, we provide a theoretical model and test its predictions in a controlled laboratory experiment.

Our model is built on the seminal nested contest model of Nitzan (1991). Whereas the original model only contains an individual reward (within-team incentive), to examine our research question we introduce a team reward (between-team incentive). The inclusion of the team reward also makes the model more generalizable in practice, because businesses increasingly require cooperation among employees from across the organization and the use of group rewards is believed to foster this cooperation (Cohen, 1993; Merchant and Van der Stede, 2007). The Nash

[1] Of course, the tournament manager has other ways of designing a tournament by changing the structure of the tournament (Cason et al., 2019), the number of prizes (Orrison et al., 2004; Lim et al., 2009; Müller and Schotter, 2010), the number of players (Orrison et al., 2004), and heterogeneity within the tournament (Weigelt et al., 1989; Cason et al., 2010).

equilibrium predicts that free-riding behavior will occur when there are only between-team incentives, and offering within-team incentives should solve this problem. However, if upon introduction of the within-team incentives individuals still choose to collude within a team, then the combined incentives may not be as effective at increasing effort and reducing free-riding.

We tested the predictions of our model using a controlled laboratory experiment in which a team of three participants competes against another team of three participants by exerting effort. We used a 2×2 design, by manipulating between-team and within-team incentives. Prior to competition, participants had an opportunity to communicate with their team members increasing the likelihood of collusion as well as cooperation. The results of our experiment indicate that although between-team incentives are effective at increasing individual effort, as predicted by the theory, there is substantial free-riding and declining effort over time. Within-team incentives are effective at increasing individual effort, albeit not as effective as between-team incentives in our experiment due to collusive behavior. Most importantly, a combination of between-team and within-team incentives is effective not only at generating effort but also at sustaining effort over time, mitigating free-riding problem, increasing cooperation and decreasing collusion within teams.

The rest of the paper is organized as follows. Section 2 presents the theoretical model. Section 3 describes the experimental design, procedures and testable hypotheses. Section 4 provides analysis and Section 5 concludes by discussing implications and suggesting directions for future research.

2. Theoretical Model

Our model is an extension to the seminal nested contest model of Nitzan (1991). Assume there are two teams competing to win a contest. For simplicity, assume that team A and team B each consist of N risk-neutral players. All players in both teams simultaneously and independently expend irreversible costly efforts x_{iA} and x_{jB}, where $i = 1, \dots, N$ and $j = 1, \dots, N$. The team performance X_A (similarly X_B) is the sum of all individual efforts within team A (Katz et al., 1990):

$$X_A = \sum_{i=1}^{N} x_{iA}. \tag{1}$$

After all players of team A and team B choose their efforts, X_A and X_B are compared. The probability of team A (similarly team B) winning is defined by a contest success function (CSF):

$$p_A = \begin{cases} \alpha \frac{X_A}{X_A + X_B} + (1-\alpha)\frac{1}{2} & \text{if } X_A + X_B > 0 \\ \frac{1}{2} & \text{if } X_A = X_B = 0 \end{cases}. \tag{2}$$

This CSF is different from a standard CSF defined by Skaperdas (1996) and Münster (2009). One interpretation of the CSF (2) is that winning depends on the "merit" of one team relative to the other team (between-team incentive) with a probability α, and on pure luck with the remaining probability $(1-\alpha)$ (Konrad, 2009).

All members of the winning team receive a team reward V_T and an individual reward V_I. When the team reward is present, receiving an individual reward V_I is contingent on receiving V_T. The team reward is equally shared by all team members, so that player i in team A receives $\frac{1}{N}V_T$. The individual reward is allocated according to the sharing rule proposed by Nitzan (1991), so that player i in team A receives $s_{iA}V_I$, where

$$s_{iA} = \begin{cases} \beta \frac{x_{iA}}{X_A} + (1-\beta)\frac{1}{N} & \text{if } X_A > 0 \\ \frac{1}{N} & \text{if } X_A = 0 \end{cases}. \tag{3}$$

Similar to the interpretation of the CSF (2), the sharing rule (3) shows that, with a probability β the individual reward V_I is allocated according to the "merit" of each individual within the team (within-team incentive), and with the remaining probability $(1-\beta)$ the individual reward is allocated randomly.

Given (2) and (3), the expected payoff of a risk-neutral player i in team A can be written as:

$$\pi_{iA} = p_A\left(\frac{1}{N}V_T + s_{iA}V_I\right) - x_{iA}, \tag{4}$$

where p_A is the between-team CSF defined by equation (2) and s_{iA} is an individual's share of the individual reward V_I defined by equation (3).

Differentiating (4) with respect to x_{iA} (see the derivations in Appendix A), and solving for the symmetric Nash equilibrium, we receive:

$$x_{iA}^* = x_{jB}^* = \frac{\alpha(V_T+V_I)+\beta(2N-2)V_I}{4N^2}. \tag{5}$$

A simple comparative static analysis shows that the equilibrium effort (5) is increasing in α (between-team incentive) and in β (within-team incentive).

If, as it is in this study, communication is allowed within each team, prior literature suggests that all individuals within each team may act cooperatively as one player (e.g., Sutter and Strassmair, 2009; Cason et al., 2012; Leibbrandt and Sääksvuori, 2012). In such a case, instead of an individual payoff (4), a risk-neutral player i in team A should maximize the joint team payoff:

$$\pi_{iA} = \sum_{i=1}^{N}\left(p_A\left(\frac{1}{N}V_T + s_{iA}V_I\right) - x_{iA}\right) = p_A(V_T+V_I) - X_A. \tag{6}$$

Differentiating (6) with respect to x_{iA} (see the derivations in Appendix A), and solving for the symmetric Nash equilibrium, we receive:

$$x_{iA}^* = x_{jB}^* = \frac{\alpha(V_T+V_I)}{4N}. \tag{7}$$

Intuitively, since each team member is maximizing the joint team payoff, the equilibrium effort (7) is only increasing in α (between-team incentive) and it does not depend on β (within-team incentive).

3. Experimental Design, Procedures and Predictions

3.1. Experimental Design

In order to examine how between-team and within-team incentives affect individual behavior, we collected data from a computerized experiment conducted with the zTree software (Fischbacher, 2007). We used a 2×2 design, as shown in Table 1, by manipulating between-team and within-team incentives. In all four conditions, a team of three participants (i.e., $N = 3$) competed against another team of three participants by contributing points to a team account. These points translated directly into the probabilities of receiving a team reward of 180 (i.e., $V_T = 180$) and an individual reward of 180 (i.e., $V_I = 180$).[2]

In the baseline NONE condition, all participants automatically split the team reward and the individual reward. Therefore, there were no between-team or within-team incentives (i.e., $\alpha = 0$ and $\beta = 0$). In WITHIN condition, all participants automatically split the team reward but the individual reward was allocated according to a lottery rule. For example, if a team member contributed 30 percent of his/her team's total output, his/her probability of winning the individual reward was 30 percent. Therefore, in this condition, there are only within-team incentives (i.e., $\alpha = 0$ and $\beta = 1$). In BETWEEN condition, the team and individual rewards were allocated according to a lottery rule between teams but all participants of the winning team automatically split the team and individual rewards. For example, if a team contributed 70 percent of the two

[2] The use of probability function in assigning rewards was designed to be consistent with the typical random noise added to an output function in labor economics literature (Lazear and Rosen, 1981).

team's total output, that team's probability of winning the team and individual rewards was 70 percent. Therefore, in this condition, there are only between-team incentives (i.e., $\alpha = 1$ and $\beta = 0$). Finally, in BOTH condition, the team rewards and individual rewards were allocated according to a lottery rule and only the winning team received both rewards. All participants of the winning team equally shared the team reward. However, the individual reward was allocated based on a lottery rule within the winning team. That is, only the winning individual in the winning team received the individual reward. Therefore, in this condition, there are both between-team and within-team incentives ($\alpha = 1$ and $\beta = 1$).

3.2. Experimental Procedures

A total of 144 students at a large university participated in 12 experimental sessions. Each session lasted about 70 minutes and had 12 participants. Each experimental session consisted of two parts, corresponding to two incentive conditions from Table 1.[3] The order of the general experimental procedures is shown in Figure 1. As participants arrived, each was assigned a computer with privacy dividers. Then participants read the instructions (see Appendix B), after which they answered several quiz questions to verify their understanding of the instructions. This quiz ensured that participants understood all relevant aspects of the task and their particular experimental incentive condition.

In Part 1 of the experiment, corresponding to one of the four experimental incentive conditions, participants were randomly assigned to a team (three members in each team) and two

[3] This design was chosen to minimize the number of participants necessary for the experiment, and to allow us to have direct within-subject comparisons while controlling for any between-subject differences. The design was completely counterbalanced. Each session contained 2 out of 4 conditions, yielding a total of 12 ordered combinations: NONE-WITHIN, WITHIN-NONE, NONE-BOTH, BOTH-NONE, NONE-BETWEEN, BETWEEN-NONE, WITHIN-BETWEEN, BETWEEN-WITHIN, WITHIN-BOTH, BOTH-WITHIN, BETWEEN-BOTH, BOTH-BETWEEN.

teams were randomly paired. Participants remained in the same team and competed against the same paired team for 10 periods.[4] In each period, every participant received 60 experimental points as an endowment and had an opportunity to communicate with their team members for 90 seconds (40 seconds in periods 3-10) prior to making their decisions.[5] After communication, each participant privately decided how many points (representing effort) to contribute to a team account.[6] After all participants made their decisions, they were notified whether they won the team reward, and if so, then whether they also won the individual reward. Each participant was privately notified of his or her current period payoff.

In Part 2, all participants were assigned to a new incentive condition. Each participant was also randomly assigned to a new team where their new teammates were not any of their teammates in Part 1. The new team was randomly paired with another new team and participants remained in the same team and competed against the same paired team for 10 periods under the new incentive condition. To control for an order effect, in each session participants were randomly assigned to one of 12 combinations of two conditions.[7]

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[4] We purposely did not announce the number of periods in the instructions because we wanted to avoid any end-of-session effects on participants' behavior. This technique is commonly used in market experiments (e.g., Rassenti et al., 2000; Davis et al., 2003; Huck et al., 2004). To the best of our knowledge, we are the first to implement this technique in the context of contests. It is important to emphasize, however, that not announcing the exact number of periods in a session does not seem to qualitatively change behavior (Normann and Wallace, 2012). In fact, when comparing our data from BETWEEN condition to a comparable REST condition in Leibbrandt and Sääksvuori (2012), we find that individual behavior in terms of the average effort is fairly similar (the rate of overbidding is 4.2 versus 5.6).

[5] The Nash equilibrium does not depend on the endowment, as long as the endowment is sufficiently large, which is the case in our experiment.

[6] According to standard agency theory (Baiman, 1982; Namazi, 1985), effort is any action that satisfies three conditions: (1) the agent controls the action, (2) an increase in the action results in a rightward shift of the distribution of (i.e. greater) output, and (3) the agent receives disutility from exerting effort. Physical exertion is not a requirement for an action to be regarded as effort.

[7] Picking any 2 out of 4 experimental incentive conditions yields a total of 12 ordered combinations (e.g., NONE-WITHIN and WITHIN-NONE). Each combination has 2 experimental conditions or parts. With 144 participants in total, this design results in 12 statistically independent observations (2 teams of 3 individuals each as one observation) in each condition. We tested our data to see whether there are any order effects. There are no significant differences between effort levels in BOTH condition, whether it is preceded by NONE, WITHIN, or BETWEEN condition. The same results hold for BETWEEN, WITHIN, and NONE conditions, except that effort in NONE condition is significantly higher when it is preceded by BOTH condition, compared to when it is preceded by WITHIN or

At the end of the experiment, participants completed a demographic questionnaire. Two periods (one from each part) were randomly selected for payments. Earnings were converted into US dollars at the rate of 20 points to $1, and participants received their payments in private and in cash, ranging from $5 to $23.75, with an average $13.98.

3.3. Predictions

The four experimental conditions test how between-team and within-team incentives affect individual behavior. If we assume that individuals are perfectly rational and maximize their own payoffs, then individuals should exert effort defined by equation (5). In such a case, effort in NONE condition ($\alpha = 0$ and $\beta = 0$) should be 0, in WITHIN ($\alpha = 0$ and $\beta = 1$) should be $\frac{(N-1)V_I}{2N^2} = 20$, in BETWEEN ($\alpha = 1$ and $\beta = 0$) should be $\frac{V_T+V_I}{4N^2} = 10$, and in BOTH ($\alpha = 1$ and $\beta = 1$) should be $\frac{V_T+(2N-1)V_I}{4N^2} = 30$.

Alternatively, if communication enhances group identity and causes individuals within each team to act cooperatively as one player, then individuals should exert effort defined by equation (7). In such a case, effort in NONE condition should be 0, in WITHIN should be 0, in BETWEEN should be $\frac{V_T+V_I}{4N} = 30$, and in BOTH should be $\frac{V_T+V_I}{4N} = 30$.

Finally, it could be the case that individuals have mixed motives, trying to maximize their individual payoff as well as their joint team payoff. In such a case, effort should be a convex combination of equations (5) and (7). Assuming a simple weighted average, see Table 2, effort in

BETWEEN condition. Also. there are no order effects for BOTH, BETWEEN, WITHIN, and NONE conditions. Finally, when needed, we check the robustness of our analysis, by examining the data only from the first part of the experiment (see Tables 4C and 6C in Appendix C).

NONE condition should be 0, in WITHIN should be 10, in BETWEEN should be 20, and in BOTH should be 30.

Based on these predictions, we can state testable hypotheses. First, it is clear that both between-team and within-team incentives should increase individual effort.

Hypothesis 1: Between-team and within-team incentives increase individual effort relative to no incentives.

Second, combining between-team and within-team incentives should have the greatest effect at increasing individual effort.

Hypothesis 2: Combining between-team and within-team incentives has the greatest effect at increasing individual effort.

4. Results

4.1. Descriptive Statistics

Table 3 provides an overview of the average effort and payoff within each experimental condition. Also, a graphical summary of results is presented in Figure 2. We use the average effort over all 10 periods by 6 participants (2 teams) as one independent observation. The Wilcoxon signed-rank test shows that the average effort in all conditions is higher than the Nash equilibrium predictions: the average effort is 47.15 in BOTH condition, 42.61 in BETWEEN, 25.07 in WITHIN, and 9.47 in NONE.[8] This is not surprising, given that the main observation, emerging from most experimental studies on group contests is that "the actual effort of subjects is

[8] We compare the average effort to the predictions stated in Table 2, and find that in only 1 out of 9 cases the average effort is not significantly different from the predicted value. Specifically, the average effort in NONE is significantly different from 0 (Wilcoxon signed-rank; p-value < 0.01). The average effort in WITHIN is significantly different from 0 (p-value < 0.01), 10 (p-value < 0.01), but not 20 (p-value = 0.11). The average effort in BETWEEN is significantly different from 10 (p-value < 0.01), 20 (p-value < 0.01), and 30 (p-value = 0.11). Finally, the average effort in BOTH is significantly different from 30 (p-value < 0.01).

significantly higher than the Nash equilibrium prediction" (Sheremeta, 2018, p. 2).[9] As a result, the average earnings is the highest in NONE, followed by WITHIN, then BETWEEN, and finally BOTH condition. This is due to the game structure. The average earnings in a group contest is always the highest when the average effort is the lowest.[10]

4.2. Differences between Conditions

The main purpose of our experiment was to examine how between-team and within-team incentives affect individual behavior. Therefore, we first examine whether between-team incentives (BOTH and BETWEEN conditions) motivate individuals to exert greater effort than when no between-team incentives are present (WITHIN and NONE conditions). On average, individual effort under between-team incentives is 27.61 greater than without between-team incentives (Wilcoxon rank-sum; p-value < 0.01), as shown in Table 4. We also examine whether within-team incentives (BOTH and WITHIN conditions) have a positive impact on individual effort. Table 4 shows that, on average, individuals exert 10.07 greater effort under within-team incentives compared to no within-team incentives (Wilcoxon rank-sum; p-value = 0.07).[11]

Result 1: Consistent with Hypothesis 1, both between-team and within-team incentives increase individual effort.

Next, we examine whether individuals exert the greatest effort when between-team and within-team incentives are combined (as in BOTH condition). Table 4 shows that the average

[9] The most common explanations for significant over-expenditure in group contests are overly competitive behavior of individuals in contests (Sheremeta, 2013, 2017), overly cooperative behavior in social dilemmas and collective action games (Ledyard et al, 1995; Chaudhuri, 2011), parochial altruism (Bernhard et al., 2006; Choi and Bowles, 2007), and group identity (Tajfel and Turner, 1979; Chowdhury et al., 2016).

[10] Effort plays only a redistributive role (i.e., which group and which group member receives the reward), but it is always costly.

[11] We obtain similar results, when examining the data only from the first part of the experiment (see Table 4C in Appendix C).

effort in BOTH condition is 37.68 greater than in NONE condition (Wilcoxon rank-sum; p-value < 0.01), 22.07 greater than in WITHIN condition (Wilcoxon rank-sum; p-value < 0.01), and 4.53 greater than in BETWEEN condition (Wilcoxon rank-sum; p-value = 0.46).

Since each individual participated in two conditions, we can also analyze the data using a within-subject comparison. This is a more powerful non-parametric test as it gives us direct results as to how a participant behaves in two different incentive conditions. As shown in Table 5, individuals in BOTH condition exert the greatest effort, compared to other conditions (Wilcoxon signed-rank; all p-values < 0.03). This brings us to our next result:

Result 2: Consistent with Hypothesis 2, combining between-team and within-team incentives has the greatest effect at increasing individual effort.

4.3. Effort over Time

Figure 3 shows the average effort across 10 periods for each condition. There are two immediate observations. First, there are clear differences between conditions. Second, effort decreases over time, most notably in NONE and BETWEEN conditions. This is likely due to the free-riding behavior in these conditions, which tends to increase with the repetition of the experiment (Chaudhuri, 2011; Sheremeta, 2018). In order to examine how repetition influences behavior, we conduct a time series cross-sectional regression analysis. In Table 6, we report the estimated results of linear cross-sectional time-series models with random effects on the participant level.[12] We use the individual effort in a given period as the dependent variable, and the period number and constant as independent variables. Estimation results show that effort in

[12] Taking the average effort in a group of six participants (i.e., both teams) as the unit of observation yields similar qualitative results.

NONE and BETWEEN conditions decreases with repetition of the experiment, which is demonstrated by a significantly negative period coefficient (p-value < 0.01).[13]

Result 3: Effort decreases over time when there are no incentives or only between-team incentives, while it remains stable when there are within-team incentives or combination of between-team and within-team incentives.

In addition, the regression analysis confirms our previous results. Specifically, the last column of Table 6 shows that, compared to no incentives (the omitted NONE condition), within-team incentives (WITHIN condition) increase effort by 15.60 (Wald Chi-Square test; p-value < 0.01), between-team incentives (BETWEEN condition) increase effort by 33.14 (Wald Chi-Square test; p-value < 0.01), and combined between-team and within-team incentives (BOTH condition) increase effort by 37.68 (Wald Chi-Square test; p-value < 0.01). Moreover, effort in BOTH condition is significantly higher than in WITHIN condition (Wald Chi-Square test; p-value < 0.01) and BETWEEN condition (Wald Chi-Square test; p-value = 0.05), suggesting that combining between-team and within-team incentives has the greatest effect at increasing individual effort.[14]

4.4. Free-riding

In this section, we examine how between-team and within-team incentives affect free-riding. Similar to Gunnthorsdottir and Rapoport (2006) and Sheremeta (2011), we define free-riding in a team contest when an individual exerts an effort of 0. Figure 4 shows the frequency of zero effort in each condition by period. It is important to emphasize that an effort of 0 can be interpreted as a free-riding only in BETWEEN and BOTH conditions. There are a total of 103

[13] It is important to emphasize, however, that after five periods of play, effort stabilizes in all conditions. We have re-estimated Table 6 using only the last five periods of data, and found no significant time trend.

[14] We obtain similar results, when examining the data only from the first part of the experiment (see Table 6C in Appendix C).

instances where individuals free-ride in BETWEEN condition, and only 31 in BOTH condition. Directly comparing BOTH condition with BETWEEN condition, we find about 69.9 percent less free-riding in BOTH condition. This difference is significant (Wilcoxon rank-sum; p-value = 0.03), confirming that a combination of between-team and within-team incentives is effective at mitigating free-riding problem.

Result 4: There is substantial free-riding when there are only between-team incentives, but free-riding behavior is reduced when between-team incentives are combined with within-team incentives.

Although the frequency of free-riding does not necessarily reflect the average effort, it is interesting to note that the pattern of free-riding in Figure 4 mirrors the pattern of the average effort in Figure 3. Similar to Table 6, we have estimated linear cross-sectional time-series models with random effects on the participant level and found that free-riding increases significantly with repetition of the experiment only in NONE and BETWEEN conditions (p-value < 0.01). Also, similar to the average effort, free-riding behavior in these conditions stabilizes after five periods of play.

4.5. Cooperation and Collusion

In our experiment, participants could communicate with each other by sending messages via chat windows. To analyze these messages, we first read the messages and established a set of four categories for cooperation and four for collusion.[15] The details of these categories are shown in Table 7. There are a total of 7,671 communication messages recorded, with an average of 80

[15] Collusion is a form of cooperation. However, in this study, "cooperation" refers to working hard and/or effort increasing cooperation. "Collusion" in this study only refers to minimizing effort because collusion within a team would lead to zero effort due to the fixed reward and costly effort.

chat messages within a single team in each experimental session. On average, in each experimental session there are 289 messages in NONE condition, 288 messages in WITHIN, 350 messages in BETWEEN, and 353 messages in BOTH. Next, two graduate students, trained separately, independently read and coded the communication messages for each team in each period, assigning the value of 1 if a message belongs to a given category and 0 otherwise.[16] The coders were not informed about any of the hypotheses in the study. All messages within each team in each period are taken as one observation for coding, resulting in 960 coding observations. Within each observation, each category for cooperation or collusion is coded either 0 or 1. Therefore, the same observation may belong to more than one category in each period. We also established two summary categories label overall cooperation (Panel A of Table 7) and overall collusion (Panel B of Table 7), which are coded as 1 if any of the specific four categories about cooperation (collusion) appears, and 0 otherwise.

Table 8 presents pairwise comparisons between conditions using logistic regressions. There are several general patterns that we see. First, we find that between-team incentives (BETWEEN and BOTH conditions) increase cooperation within teams ("overall cooperation" category, all p-values < 0.01). Specifically, compared to NONE and WITHIN conditions, in BETWEEN and BOTH conditions, individuals are significantly more likely to cooperate with their team members by proposing to choose high effort within their team or stating their own choices of high effort (category C2), by agreeing on their team members' high effort proposals (category C3) and by giving reasons why they need to choose high efforts (category C4). Second, we find that between-team incentives (BETWEEN and BOTH conditions) decrease collusion within teams ("overall collusion" category, all p-values < 0.01). Specifically, individuals are significantly less

[16] Taking each single team and period as one unit for coding is consistent with Sutter and Strassmair (2009).

likely to propose low effort within a team (category C5), to agree on team members' suggestions of contributing low effort (category C6), and to give reasons why they need to choose low effort (category C8). Further, we find that BOTH condition is the most effective in mitigating the collusion problem ("overall collusion" category, all p-values < 0.05). These findings can be summarized as follows:

Result 5: Between-team incentives increase cooperation and decrease collusion within teams, and the collusion problem is mostly mitigated when between-team incentives are combined with within-team incentives.

5. Discussions and Conclusion

We examine theoretically and experimentally how combining between-team and within-team incentives affects behavior in team tournaments. The Nash equilibrium predicts that free-riding behavior will occur when there are only between-team incentives, but offering within-team incentives may solve this problem. However, if individuals collude within a team, then within-team incentives may not be as effective at reducing free-riding.

The results of our experiment indicate that although between-team incentives are effective at increasing individual effort, as predicted by the theory, there is substantial free-riding and declining effort over time. Within-team incentives are also effective at increasing individual effort, albeit not as effective as between-team incentives in our experiment and not without collusion. Most importantly, a combination of between-team and within-team incentives is very effective not only at generating effort but also at sustaining effort over time, mitigating the free-riding problem, increasing cooperation and decreasing collusion within teams.

What are the implications of our findings? First, our study provides evidence that individuals exert the greatest effort when organizations use a combination of between-team and within-team incentives. Using both incentives simultaneously is important for mitigating the free-riding problem within teams and sustaining effort over time. Not surprisingly, therefore, tournament-like incentives have been gaining more popularity in the workplace (Che and Yoo, 2001; Merchant and Van der Stede, 2007; Connelly et al., 2014).

Second, our findings show that when individuals are allowed to communicate they appear to not only maximize their individual payoff, but also their joint team payoff. This finding contributes to the literature studying how communication enhances social identity within teams (Sutter and Strassmair, 2009; Cason et al., 2012, 2017). Specifically, social identity theory suggests that one of the most distinctive features of group identity and intergroup relations is positive distinctiveness – a belief that "we" are better than "them" (Tajfel and Turner, 1979; Turner, 1984; Hogg, 2006). Communication may help individuals to enhance their group identity causing team members to go to great lengths to protect and promote positive distinctiveness from other teams and thus contribute more effort to help their teams win reward (Hogg, 2006). Allowing communication also generalizes to the workplace as between-team tournaments are unlikely in environments were communication or direct contact between participants is not possible.

Although we only used tournaments in our experiment, we believe that our results are also applicable to other relative performance incentive settings (Cason et al., 2010, 2019; Agranov and Tergiman, 2013; Güth et al., 2016). The tournament winner is determined by calculating the team/individual's performance (output) relative to other teams/individuals. Although individuals' absolute effort levels may change when using other relative performance incentives, the direction of the effort differences across the incentive settings should hold. Future research could explore how effective between-team and within-team incentives are in other relative performance incentive settings, how individuals change their behavior in response to asymmetric valuations of a reward or individuals' heterogeneity in costs/abilities, and how results change when communication is costly.

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Figure 1: Experimental procedures.

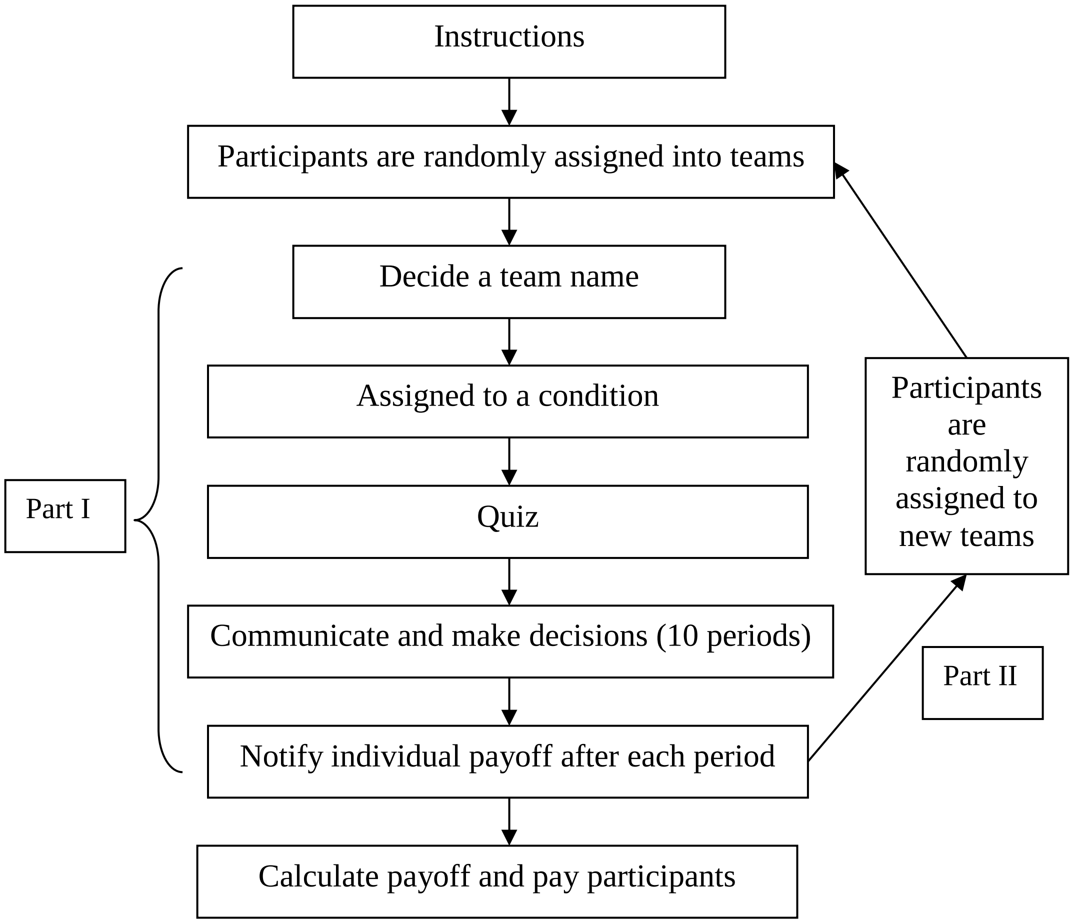

Figure 2: Average effort.

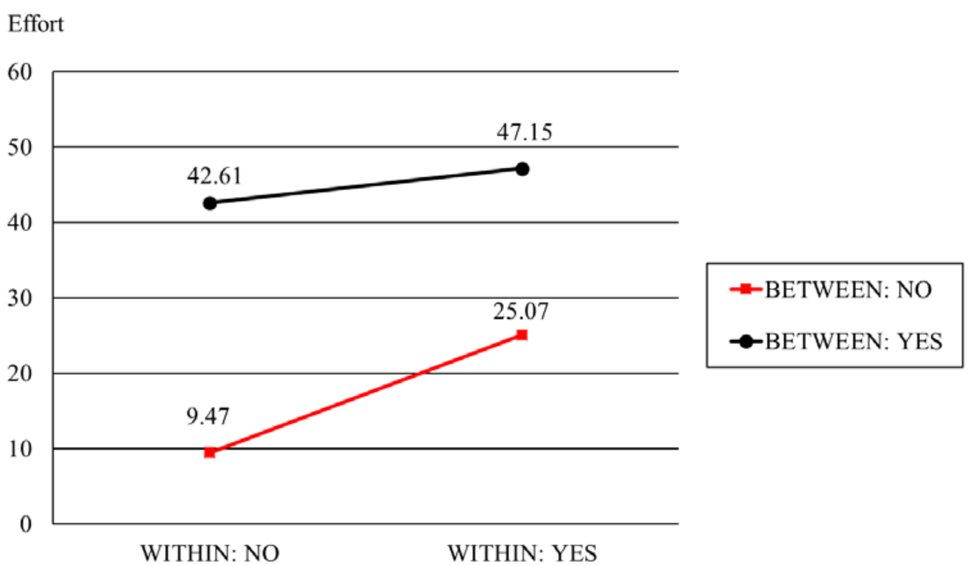

Figure 3: Average effort across 10 periods.

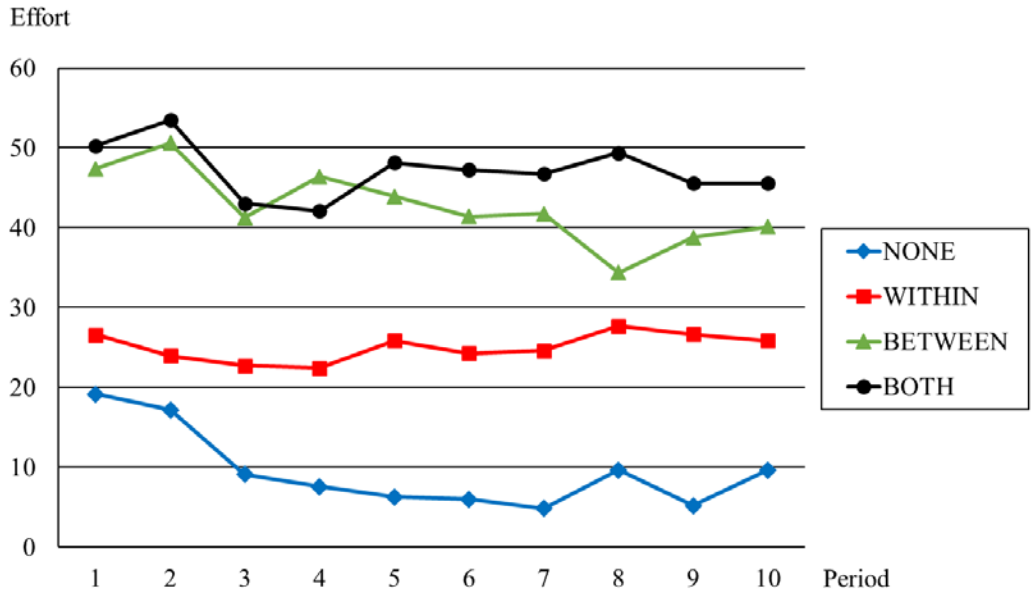

Figure 4: Frequency of free-riding (effort of 0) across 10 periods.

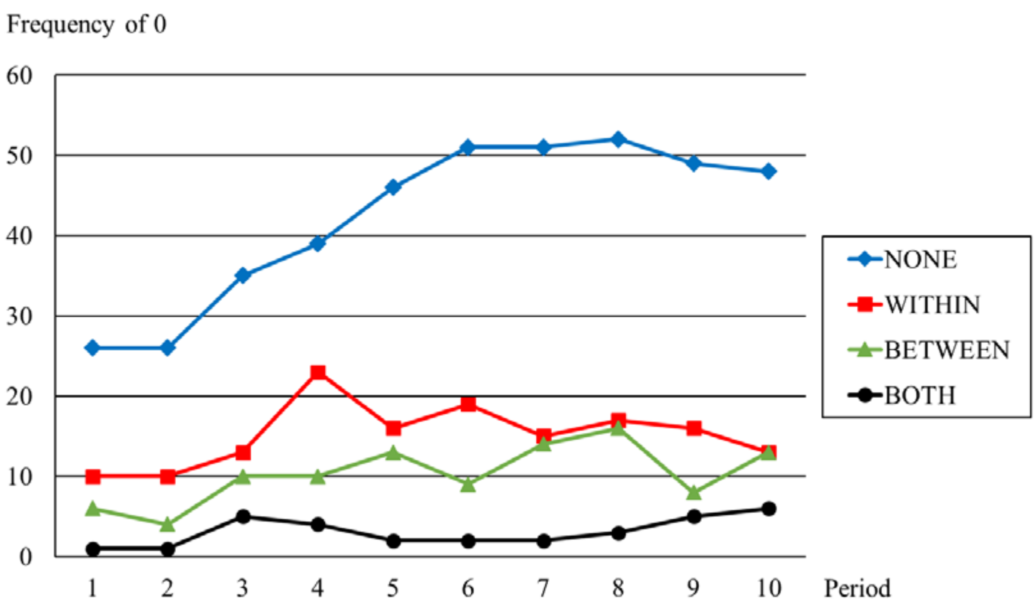

Table 1: Summary of experimental conditions.

		Within-team incentive	
		No	Yes
Between-team incentive	No	NONE	WITHIN
	Yes	BETWEEN	BOTH

Table 2: Theoretical predictions.

Condition	Effort prediction					
	Individual		Joint		Mixed = (Individual + Joint) / 2	
NONE	0	= 0	0	= 0	0	= 0
WITHIN	$\frac{(N-1)V_I}{2N^2}$	= 20	0	= 0	$\frac{(N-1)V_I}{4N^2}$	= 10
BETWEEN	$\frac{V_T+V_I}{4N^2}$	= 10	$\frac{V_T+V_I}{4N}$	= 30	$\frac{(N+1)}{2}\frac{(V_T+V_I)}{4N^2}$	= 20
BOTH	$\frac{V_T+(2N-1)V_I}{4N^2}$	= 30	$\frac{V_T+V_I}{4N}$	= 30	$\frac{(N-1)V_I}{4N^2}+\frac{(N+1)}{2}\frac{(V_T+V_I)}{4N^2}$	= 30

Table 3: Average effort and payoff.

Condition	Participants	Independent observations	Average effort	Standard deviation	Average payoff	Standard deviation
NONE	36	12	9.47	7.75	110.53	7.75
WITHIN	36	12	25.07	7.84	94.93	8.10
BETWEEN	36	12	42.61	11.31	77.38	11.31
BOTH	36	12	47.15	4.16	72.35	3.87

Table 4: Average effort difference between conditions.

Conditions			Independent observations	Average difference	Wilcoxon rank-sum	p-value
BOTH + BETWEEN	vs.	WITHIN + NONE	48	27.61	5.62	< 0.01
BOTH + WITHIN	vs.	BETWEEN + NONE	48	10.07	1.77	= 0.07
BOTH	vs.	NONE	24	37.68	4.15	< 0.01
BOTH	vs.	WITHIN	24	22.07	4.15	< 0.01
BOTH	vs.	BETWEEN	24	4.53	0.46	= 0.64
BETWEEN	vs.	WITHIN	24	17.54	3.34	< 0.01
BETWEEN	vs.	NONE	24	33.14	4.09	< 0.01
WITHIN	vs.	NONE	24	15.61	3.69	< 0.01

Table 5: Average effort difference between conditions (within-subject comparison).

Conditions			Independent observations	Average difference	Wilcoxon signed-rank	p-value
BOTH	vs.	NONE	8	33.60	2.52	= 0.01
BOTH	vs.	WITHIN	8	25.85	2.52	= 0.01
BOTH	vs.	BETWEEN	8	13.53	2.24	= 0.02
BETWEEN	vs.	WITHIN	8	19.74	2.52	= 0.01
BETWEEN	vs.	NONE	8	36.23	2.52	= 0.01
WITHIN	vs.	NONE	8	20.94	2.52	= 0.01

Table 6: Time series cross-sectional regression analysis.

Independent variables	Condition				
	NONE	WITHIN	BETWEEN	BOTH	All conditions
Period	-1.06*** (0.47)	0.25 (0.37)	-1.20*** (0.41)	-0.32 (0.42)	-0.58*** (0.22)
Constant	15.30*** (3.82)	23.67*** (2.45)	49.24*** (2.74)	48.91*** (2.37)	12.67*** (2.61)
WITHIN					15.60*** (3.08)
BETWEEN					33.14*** (3.83)
BOTH					37.68*** (2.45)

Note: * p-value < 0.10, ** p-value < 0.05, *** p-value < 0.01
Standard errors clustered at the individual group level are in parenthesis.

Table 7: Frequency of communication messages.

Category	Description	NONE	WITHIN	BETWEEN	BOTH
Panel A: Cooperation within teams					
C1	Ask for the opinions of other team members	0.188	0.333	0.379	0.396
C2	Proposal to choose *high* efforts within team or state own choice of *high* efforts	0.129	0.167	0.654	0.692
C3	Agree on team members' proposals of *high* effort	0.058	0.075	0.554	0.571
C4	Give reasons why need to choose *high* efforts	0.025	0.008	0.104	0.146
	Overall cooperation	0.263	0.413	0.725	0.750
Panel B: Collusion within teams					
C5	Proposal to choose *low* efforts within team or state own choice of *low* efforts	0.529	0.558	0.221	0.129
C6	Agree on team members' proposals of *low* effort	0.371	0.392	0.146	0.063
C7	Proposal to take turns in winning the tournament	0.000	0.142	0.000	0.021
C8	Give reasons why need to choose *low* efforts	0.233	0.167	0.050	0.038
	Overall collusion	0.567	0.600	0.221	0.146

Note: Each cell represents the likelihood of a particular message being used in a given period within a team.

Table 8: Comparison of communication messages.

Category	BOTH vs. NONE	BOTH vs. WITHIN	BOTH vs. BETWEEN	BETWEEN vs. WITHIN	BETWEEN vs. NONE	WITHIN vs. NONE
Panel A: Cooperation within teams						
C1	***	0.131	0.690	***	0.266	**
C2	***	***	0.371	***	***	0.242
C3	***	***	0.637	***	***	0.463
C4	***	***	0.157	**	**	0.173
Overall	***	***	0.519	***	***	**
Panel B: Collusion within teams						
C5	***	***	*	***	***	0.517
C6	***	***	*	***	***	0.636
C7	NA	***	N/A	N/A	N/A	N/A
C8	***	***	0.504	***	***	0.067
Overall	***	***	*	***	***	0.456

Note: Each cell represents a p-value based on Wald Chi-Square statistics.
* p-value < 0.05, ** p-value < 0.001, *** p-value < 0.0001

Appendix A (For Online Publication) – Theoretical Derivations

We can rewrite the expected payoff (4) as:

$$\pi_{iA} = \left(\alpha \frac{X_A}{X_A+X_B} + (1-\alpha)\frac{1}{2}\right)\left(\frac{1}{N}V_T + \left(\beta \frac{x_{iA}}{X_A} + (1-\beta)\frac{1}{N}\right)V_I\right) - x_{iA}. \tag{A1}$$

Further expanding the expression, we get:

$$\begin{aligned}\pi_{iA} = &\left(\alpha \frac{X_A}{X_A+X_B} + (1-\alpha)\frac{1}{2}\right)\left(\frac{1}{N}(V_T + (1-\beta)V_I) + \beta \frac{x_{iA}}{X_A}V_I\right) - x_{iA} = \\ &\frac{X_A}{X_A+X_B}\alpha\frac{1}{N}(V_T + (1-\beta)V_I) + \frac{x_{iA}}{X_A+X_B}\alpha\beta V_I + \\ &+(1-\alpha)\frac{1}{2}\frac{1}{N}(V_T + (1-\beta)V_I) + (1-\alpha)\frac{1}{2}\beta\frac{x_{iA}}{X_A}V_I - x_{iA}\end{aligned}. \tag{A2}$$

Differentiating (A2) with respect to x_{iA}, we receive the following FOC:

$$\frac{X_B}{(X_A+X_B)^2}\alpha\frac{1}{N}(V_T + (1-\beta)V_I) + \frac{X_A+X_B-x_{iA}}{(X_A+X_B)^2}\alpha\beta V_I + (1-\alpha)\frac{1}{2}\beta\frac{X_A-x_{iA}}{(X_A)^2}V_I = 1. \tag{A3}$$

Solving for the symmetric Nash equilibrium, we receive:

$$x_{iA}^* = x_{jB}^* = \frac{\alpha(V_T+V_I)+\beta(2N-2)V_I}{4N^2}. \tag{A4}$$

If the expected payoff is given by (6), then the maximization problem is the following:

$$\pi_{iA} = \left(\alpha \frac{X_A}{X_A+X_B} + (1-\alpha)\frac{1}{2}\right)(V_T + V_I) - X_A. \tag{A5}$$

Further expanding the expression, we get:

$$\pi_{iA} = \alpha \frac{X_A}{X_A+X_B}(V_T + V_I) + (1-\alpha)\frac{1}{2}(V_T + V_I) - X_A\ . \tag{A6}$$

Differentiating (A6) with respect to x_{iA}, we receive the following FOC:

$$\frac{X_B}{(X_A+X_B)^2}\alpha(V_T + V_I) = 1. \tag{A7}$$

Solving for the symmetric Nash equilibrium, we receive:

$$x_{iA}^* = x_{jB}^* = \frac{\alpha(V_T+V_I)}{4N}. \tag{A8}$$

Appendix B (For Online Publication) – Experimental Instructions

General Instructions

Welcome! You are participating in a decision-making study. The study will proceed in two parts. Each part requires you to make a series of choices which will determine your total compensation for the study.

Your decisions as well as the decisions of other participants will remain anonymous. The decision problems are not designed to test you; there is no right or wrong answer. I am simply interested in the choices you make. You will be paid privately in cash at the end of the study. The points you earn in the study will be converted to U.S. Dollars at a rate of **20** to **1**. The amount you earn will depend on your decisions, so please follow the instructions carefully.

Please turn off your cell phone, laptop computer, or any other device you may have brought with you. To maintain anonymity, please do not communicate, unless directed otherwise, with any other participants until the study is completely over. If at any point you have a question, or need assistance of any kind, please raise your hand and I will come to your desk. Thank you for your cooperation.

Instructions for Part 1

Part 1 of the study consists of several decision-making periods. At the beginning of the first period, you will be randomly and anonymously placed into a team of 3 people. You will remain in the same team for all periods in Part 1 of the study.

At the beginning of the first period, your **team** will be randomly paired with another **team** to **share** bonuses. Your team will be paired with the **same** team for all periods in Part 1 of the study.

TEAM NAME

After you are assigned to a team, you will be asked to communicate with your team members via a chat window to decide on a team name. However, to maintain anonymity, it is very important that you do not reveal your name, seat number or anything that might disclose your identity to your teammates.

YOUR DECISION

Assume you are an employee of **ABC** Company. Your compensation package consists of the following:
(1) a base salary (your participation fee today),
(2) any endowed points you keep (unallocated points), and
(3) two bonuses to be awarded at the end of each period: Group Bonus and Individual Bonus.

In each period your company will award two bonuses:

Group Bonus = **180** points;
Individual Bonus = **180** points.

In each period you will be given an endowment of **60** points and asked to decide how much to contribute. You may contribute any **whole** number of points between **0** and **60**, inclusively. Any leftover or unallocated points are yours to keep (60 – Points Contributed).

For each **one** point you contribute, you will generate **one** unit of individual output. A team's total output is the sum of all members' individual outputs within the team.

A hypothetical example is:

		Individual Output = Points Contributed	**Team Output** (Sum of Individual Outputs)
Team 1	Member 1	60	Team 1 Output = 60+ 30 + 10 = 100
	Member 2	30	
	Member 3	10	
Team 2	Member 1	50	Team 2 Output = 50 + 35 + 20 = 105
	Member 2	35	
	Member 3	20	

The Individual Bonus and Group Bonus will be awarded as described below.

COMMUNICATION

Each period, before you decide how many points to contribute, you will have the opportunity to chat electronically with the members of your OWN team via an anonymous chat window. You will have 90 seconds to chat with each other at the beginning of Period **1** and **2**, and 40 seconds in the following periods.

Again, to remain anonymity, it is very important that you do not make threats or reveal your name, seat number or anything that might disclose your identity. While the content of your discussion has no direct binding impact on the output or bonuses, you can use the chat window to discuss strategy with your teammates.

(NONE Condition) YOUR EARNINGS

After all participants have made their decisions, your earnings for the period are calculated as follows:

(1) Your period earnings are the sum of the earnings from the endowed points you keep AND any bonuses you receive from the company.

(2) You may keep or contribute all or some of your 60 points endowment.
The points you contribute will generate individual and team outputs.

(3) No matter what each team's total output is, **each** TEAM will receive 90 points for **Group Bonus** AND 90 points for **Individual Bonus**.

For example, if the outputs of both teams are as in the table below, both TEAMS will receive the same amount for Group and Individual Bonus.

	Team Output	**Individual** & **Group** bonuses Received
Team 1	160	50% = 90 points
Team 2	40	50% = 90 points
Total	200	100%

(4) Every TEAM MEMBER within each team will equally share the **Group** AND **Individual** bonuses.

PAYMENT

At the end of the study ONE period will be randomly chosen from Part 1 of the study for cash payment. Each period has an equal chance of being chosen. Hence each period is independent and you should make your decisions carefully in every period. The earnings for the period chosen will be converted to a U.S. dollar payment at the end of the study.

Are there any questions?

<u>(BETWEEN Condition)</u> YOUR EARNINGS

After all participants have made their decisions, your earnings for the period are calculated as follows:

(1) Your period earnings are the sum of the earnings from the endowed points you keep AND any bonuses you receive from the company.

(2) You may keep or contribute all or some of your 60 points endowment.
The points you <u>contribute</u> will generate individual and team outputs which may help your team earn Group and/or Individual bonuses as described below.

(3) Only **<u>one</u>** TEAM will receive the **Group** AND **Individual** Bonuses. The Group and Individual Bonuses will be awarded to your TEAM based on your team's output relative to the two teams' total output. For example, if your TEAM contributes 70% of the two teams' total output, your TEAM's likelihood of winning the **Group** AND **Individual** Bonuses is 70%.

<u>That is, the greater your **TEAM** output, the more likely your **TEAM** will receive **both** bonuses.</u>

For example, if the outputs of both teams are as in the table below, Team 1 has a 80% (=160/200) chance of winning the Group and Individual Bonus.

	Team Output	Chance (Probability) of Winning **Individual** & **Group** Bonuses
Team 1	160	160/200 = 80%
Team 2	40	40/200 = 20%
Total	200	100%

(4) If awarded, every <u>team member</u> within the <u>winning</u> team will <u>equally</u> share the **Group** AND **Individual** Bonuses.

PAYMENT

At the end of the study ONE period will be <u>randomly</u> chosen from Part 1 of the study for cash payment. Each period has an <u>equal</u> chance of being chosen. Hence each period is independent and you should make your decisions carefully in <u>every</u> period. The earnings for the period chosen will be converted to a U.S. dollar payment at the end of the study.

Are there any questions?

Instructions for Part 2

The Part 2 of the study also consists of several decision-making periods.

PLEASE NOTE:

All teams formed in Part 1 of the study are **NOW DISBANDED**.

You will be randomly and anonymously placed into a **NEW** team of 3 people. Your new teammates will **NOT** be any of the same people you were previously paired with. You will remain in the same (new) team for all periods in Part 2 of the study.

At the beginning of the first period, your **team** will be randomly paired with another **team** to **share** bonuses. Your team will be paired with the **same** team for all periods in Part 2 of the study.

NEW TEAM NAME

After you are assigned to a NEW team, you will be asked to communicate with your **NEW** team members via a chat window to decide on a **NEW** team name. Again, to maintain anonymity, it is very important that you do not reveal your name, seat number or anything that might disclose your identity to your teammates.

YOUR DECISION (Same as in Part 1)

Suppose you have changed companies and your new employer is **XYZ** Company. You will make the same decision as in Part 1.

In each period your **new** company will also award two bonuses:
Group Bonus = **180** points; **Individual** Bonus = **180** points.

However, the method for determining who gets what is **DIFFERENT**.

<u>(WITHIN Condition in "NONE&WITHIN combination")</u> YOUR EARNINGS

After all participants have made their decisions, your earnings for the period are calculated as follows:

Same as Part 1

(1) Your period earnings are the sum of the earnings from the endowed points you keep AND any bonuses you receive from the company.

(2) You may keep or contribute all or some of your 60 points endowment. The points you <u>contribute</u> will generate individual and team outputs which may help your team earn Group and/or Individual bonuses as described below.

(3) <u>No matter what each team's total output is</u>, **each** TEAM will receive 90 points for **Group Bonus** AND 90 points for **Individual Bonus**.

For example, if the outputs of both teams are as in the table below, both teams will receive the same amount for Group and Individual Bonus.

	Team Output	**Individual** & **Group** bonuses Received
Team 1	160	50% = 90 points
Team 2	40	50% = 90 points
Total	200	100%

(4) Every TEAM MEMBER within each team will equally share the **Group Bonus**, i.e. 30 points per team member.

Different from Part 1

(5) However, only **<u>one</u>** member within each team will receive the **Individual Bonus**. The Individual Bonus will be awarded to you based on your individual output relative to the total output within your team. For example, if you contribute 70% of your team's total output, your likelihood of winning the **Individual Bonus** is 70%.

<u>That is, the greater your **individual** output, the more likely you will receive the **Individual** bonus.</u>

For example, if the outputs of all members within a team are as in the table below, Member 2 has a 30% (=30/100) chance of winning the Individual Bonus.

Team 1 or 2	Individual Output	Chance (Probability) of Winning **Individual** Bonus
Member 1	60	60/100 = 60%
Member 2	30	30/100 = 30%
Member 3	10	10/100 = 10%
Total	100	100%

<u>(BOTH Condition in “WITHIN&BOTH combination”)</u> YOUR EARNINGS

After all participants have made their decisions, your earnings for the period are calculated as follows:

Same as Part 1

(1) Your period earnings are the sum of the earnings from the endowed points you keep AND any bonuses you receive from the company.

(2) You may keep or contribute all or some of your 60 points endowment. The points you <u>contribute</u> will generate individual and team outputs which may help your team earn Group and/or Individual bonuses as described below.

Different from Part 1

(3) Only <u>**one**</u> **TEAM** will receive the **Group** AND **Individual** Bonuses. The Group and Individual Bonuses will be awarded to your **TEAM** based on your team’s output relative to the two teams’ total output. For example, if your TEAM contributes 70% of the two teams’ total output, your **TEAM**’s likelihood of winning <u>**both**</u> bonuses (**Group** AND **Individual** Bonuses) is 70%.

<u>That is, the greater the output your **TEAM** contributes, the more likely your **TEAM** will receive **both** bonuses.</u>

For example, if the outputs of both teams are as in the table below, Team 1 has a 80% (=160/200) chance of winning the Group and Individual Bonus.

	Team Output	Chance (Probability) of Winning **Individual** & **Group** Bonuses
Team 1	160	160/200 = 80%
Team 2	40	40/200 = 20%
Total	200	100%

(4) If awarded, every <u>team member</u> within the <u>winning</u> team will equally share the **Group Bonus**.

(5) However, if awarded the **Individual Bonus**, only <u>**one**</u> member within the <u>winning</u> team will receive the Individual Bonus. The Individual Bonus will be awarded to you based on your individual output relative to the total output within your team. For example, if you contribute 70% of your team’s total output, your likelihood of winning the **Individual Bonus** is 70%.

<u>That is, the greater your **individual** output, the more likely you will receive the **Individual** bonus.</u>

For example, if the outputs of all members within a team are as in the table below, Member 2 has a 30% (=30/100) chance of winning the Individual Bonus.

Team 1 or 2	Individual Output	Chance (Probability) of Winning **Individual** Bonus
Member 1	60	60/100 = 60%
Member 2	30	30/100 = 30%
Member 3	10	10/100 = 10%
Total	100	100%

PAYMENT

At the end of the study ONE period will also be randomly chosen from Part 2 of the study for cash payment. Each period has an equal chance of being chosen. Hence each period is independent and you should make your decisions carefully in every period. The earnings for the period chosen will be converted to a U.S. dollar payment at the end of the study.

Are there any questions?

Manipulation Check (Part 1: ABC company; Part 2: XYZ company)

Part 1: Please answer the following questions (choose only **ONE** option for each question):

1. At the end of each period in the study, the ABC (XYZ) company will award its employees:

    A. Group Bonus
    B. Individual Bonus
    C. Group and Individual bonuses

2. The ABC (XYZ) company will award the Group and Individual bonuses to a **<u>TEAM</u>** based on:

    A. a team's output relative to the two teams' total output. That is, the greater of a team's output is, the more likely the **<u>team</u>** will receive the Group Bonus.
    B. Each **<u>team</u>** equally shares the Group and Individual bonuses.

3. When a team receives the **<u>Group</u>** Bonus:

    A. The team <u>member</u> with greater output will be more likely to receive the Group Bonus.
    B. Every <u>member</u> within the team equally shares the Group Bonus.

4. When a team receives the **<u>Individual</u>** Bonus:

    A. The team <u>member</u> with greater output will be more likely to receive the Individual Bonus.
    B. Every <u>member</u> within the team equally shares the Individual Bonus.

****

Please do NOT turn to the next page BEFORE you answer the questions above.

The correct answers to the questions on previous page are (the given answers depend on the condition the participant is assigned to):

Question	NONE	WITHIN	BETWEEN	BOTH
1	C	C	C	C
2	B	B	A	A
3	B	B	B	B
4	B	A	B	A

Please check your answers and re-evaluate any <u>wrong</u> answers.

Appendix C (For Online Publication) – Additional Analysis

Table 4C: Average effort difference between conditions (only Part 1 of the experiment).

Conditions			Independent observations	Average difference	Wilcoxon rank-sum	p-value
BOTH + BETWEEN	vs.	WITHIN + NONE	24	28.02	3.98	< 0.01
BOTH + WITHIN	vs.	BETWEEN + NONE	24	7.93	1.15	= 0.24
BOTH	vs.	NONE	12	35.96	2.88	< 0.01
BOTH	vs.	WITHIN	12	27.50	2.88	< 0.01
BOTH	vs.	BETWEEN	12	7.42	0.80	= 0.42
BETWEEN	vs.	WITHIN	12	20.08	2.56	< 0.01
BETWEEN	vs.	NONE	12	28.53	2.72	< 0.01
WITHIN	vs.	NONE	12	8.45	3.69	= 0.03

Table 6C: Time series cross-sectional regression analysis (only Part 1 of the experiment).

Independent variables	Condition				
	NONE	WITHIN	BETWEEN	BOTH	All conditions
Period	-0.58* (0.33)	0.39 (0.55)	-1.11*** (0.74)	-0.23 (0.77)	-0. 38** (0.31)
Constant	17.01*** (3.39)	20.05*** (2.91)	48.45*** (2.49)	51.03*** (3.62)	15.90*** (3.18)
WITHIN					8.45** (3.80)
BETWEEN					28.53*** (5.43)
BOTH					35.96*** (3.05)

Note: * p-value < 0.10, ** p-value < 0.05, *** p-value < 0.01
Standard errors clustered at the individual group level are in parenthesis.