The Effects of Disseminating Relative Performance Feedback in Tournament versus Individual Performance Compensation Plans

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ABSTRACT

We investigate the effects of incentive compensation method and relative performance feedback on performance. Our experimental results show that, in the absence of relative performance feedback, participants compensated under a tournament incentive scheme perform better, and their performance improves to a greater extent over time, compared to participants compensated under an individual incentive scheme. This finding is consistent with economic theory related to tournaments. Further, we investigate whether the presence and the content of relative performance feedback has different effects on performance when participants are compensated via a tournament compared to an individual incentive scheme. We find a disordinal interaction between incentive scheme and feedback. Specifically, providing relative performance feedback *improves* the mean performance of participants compensated under an individual incentive scheme regardless of the specific content of the feedback. In contrast, providing relative performance feedback *deteriorates* the mean performance of participants compensated under a tournament incentive scheme, but only if the content of the feedback is sufficiently precise. Supplement analysis indicates that this deterioration in performance is due to ineffective task strategies rather than reduced effort. These results have implications for the design of accounting, control, and reporting systems in firms.

I. INTRODUCTION

This study examines the effect of relative performance feedback on participants' performance when they are evaluated and compensated based on a tournament incentive scheme compared to an individual incentive scheme. Specifically, we investigate whether a tournament incentive scheme results in higher performance compared to an individual incentive scheme in the absence of relative performance feedback during the evaluation period. Further, we investigate whether the presence and the content of relative performance feedback has different effects on performance when participants are compensated via a tournament incentive scheme compared to an individual incentive scheme.

Although accountants have extensively studied performance measurement and incentive compensation, the focus of extant literature has been on examining how the properties of performance measures influence incentive contracting (see Bushman and Smith 2001; Gibbons 1998; Murphy 1999; Prendergast 1999 for reviews). These properties include, for example, how informative a measure is about agents' actions (Holmstrom 1979), the sensitivity of the measure to the manager's actions, the precision with which it is measured (Banker and Datar 1989), and its relation to other performance measures (Feltham and Xie 1994). The effect of tournament-based incentive schemes on performance has been under-explored by existing literature.[1]

A tournament can be defined as a compensation scheme where employees or managers are ranked on an ordinal scale based on their output and compensated according to their rank. In a tournament incentive scheme, the individual's compensation is a function only of his

[1] The focus of our study is on a specific form of relative performance contract, i.e., a tournament incentive scheme, where the incentive compensation is solely a function of rank. Archival studies have explored a related area, i.e., whether relative performance affects managers' compensation awards. For example, a firm's ROA standard (or other performance measure) may be evaluated relative to the industry average (e.g., Antle and Smith 1986; Gibbons

performance relative to the other individuals in the incentive system. The winner of the tournament receives the highest prize (such as bonus or promotion). The prize is not required to be a function of either the performance differential or actual performance.

Tournament schemes of evaluating and rewarding performance are pervasive in the corporate world. For example, contests are often held in which top performance sales persons are rewarded with valuable prizes. According to a recent *Business Week* survey, one-third of U.S. corporations use tournament systems to promote or fire employees (McGregor 2006). Under the leadership of Jack Welsh, the former CEO of General Electric Company, managers were divided into three groups – top 20%, middle 70% and bottom 10%. The top group received the highest rewards and the latter were often forced to quit. Similarly, *Yahoo* asks unit managers to rank employees and distribute bonuses based on each employee's rank.

Economists have examined the circumstances under which tournaments produce superior outcomes to other forms of compensation such as fixed pay, or piece-rate (i.e., individual incentive) schemes. The general conclusion from this area of literature is that when some risks are common to all managers, tournaments reduce the total risk that is imposed on the manager by filtering out the effects of the common uncertainty.[2] Therefore, the optimal effort levels are higher in tournaments compared to individual performance systems (i.e., piece rate systems).[3] There is empirical support for this notion, albeit limited. For example, Bull, Schotter, and Weiglt (1987) find that participants in their experiments select effort levels that are consistent with economic predictions about tournaments as well as individual incentive contracts. However,

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and Murphy 1990; Jensen and Murphy 1990). However, these studies focus on the *prevalence* of relative standards and not the *impact* of such standards on managerial actions.

[2] For ease of exposition, we will use the term "manager" in the remainder of this paper to encompass all levels of employees as well as agents.

[3] When the common error term is sufficiently large, or when the number of managers is large, tournaments can often approach the first-best optimum (Lazear and Rosen 1981; Nalebuff and Stiglitz 1983).

Bull et al. (1987) do not investigate the relative effectiveness of these two incentive schemes on performance. Frederickson (1992) finds that participants receiving a bonus based on their performance relative to a group average exert more effort compared to those compensated based on individual performance only. Finally, using archival data, Matsumura and Shin (2006) find that performance increases following implementation of a relative performance incentive plan for Korean postal stores and that performance is positively associated with the degree of common uncertainty.

Accounting literature on how the characteristics of the information system influence choices and performance under various incentive schemes is sparse (Sprinkle 2003). Research on how incentive schemes and feedback, individually or in conjunction, may affect performance is important because accountants play a major role in designing compensation plans (Atkinson et al 2001; Indjejikian 1999) as well as in providing information and feedback to decision makers (Bonner and Sprinkle 2002). In order to design effective compensation and information systems, it is important to understand which incentive schemes are more efficient at motivating performance and the role of feedback in improving performance. This understanding can help in structuring incentive schemes and information systems that best align employees' interests with that of the firm. Our study contributes to this body of knowledge.

We investigate how incentive schemes and feedback affect performance using an experiment. We manipulate incentive compensation scheme (tournament or individual) and relative performance feedback (none, coarse, fine). Although hybrid compensation schemes exist in practice, for experimental control purposes, we use only pure tournament or individual schemes. Feedback is provided at specified times throughout the experiment and can be thought of as three types of accounting systems: one where no benchmarking data are disseminated to

competing managers during the evaluation cycle, the second where coarse or noisy data are disseminated throughout the evaluation cycle, and the third where more precise data are disseminated throughout the evaluation cycle.

Our experimental results show the following.[4] First, in the absence of relative performance feedback, participants compensated under a tournament incentive scheme perform better, and their performance improves to a greater extent over time, compared to participants compensated under an individual incentive scheme. This finding is consistent with economic theory related to tournaments. Second, we find a disordinal interaction between feedback and incentive scheme. Specifically, providing relative performance feedback *improves* the mean performance of participants compensated under an individual incentive scheme, however the specific content of that feedback has no effect. That is, the performance of participants in the individual condition improved regardless of what the content of the feedback revealed about their relative performance. In contrast, providing relative performance feedback *deteriorates* the mean performance of participants compensated under a tournament incentive scheme, but only if the content of the feedback is sufficiently precise. Supplementary analysis reveals that the deterioration in mean performance caused by providing relative performance feedback in the tournament condition results from a decline in performance by participants whose performance in the first half of the tournament was below the 80^{th} percentile. The analysis indicates that the decline in performance is not because these participants reduced their effort but rather because they adopted ineffective task strategies.

Our study has several implications for the design of compensation and information systems. Our results suggest that as long as the environmental error is common across managers, a tournament incentive scheme elicits better performance compared to an individual incentive

scheme. However, the effectiveness of a tournament scheme decreases to the extent an information system provides relative performance feedback that allows managers to infer that their ranking makes it unlikely they will win the tournament. This finding is interesting because it is generally believed in the accounting community that more refined accounting systems are helpful in decision making (Cooper et al. 1992; Cooper and Kaplan 1998). However, if providing information on peers reduces the mean performance of managers and consequently reduces firm performance, as our study suggests, disseminating accounting information may have negative consequences.

Our study also implies that the effect of relative performance feedback depends on the type of incentive scheme. Whereas providing relative performance feedback may have negative consequences when managers are compensated via a tournament incentive scheme, such feedback is likely to have positive consequences when managers are compensated via an individual incentive scheme.

The remainder of this paper is organized as follows. The following section summarizes the theory of tournaments and individual incentive schemes and develops hypotheses. Section 3 describes the experiment. Section 4 reports the results. Conclusions and implications are discussed in Section 5.

II. THEORY AND HYPOTHESES

Tournament versus Individual Incentive Schemes

Although tournament-based reward schemes have been prevalent for a long time, the first formal theoretical model of tournaments is generally attributed to Lazear and Rosen (1981) who model rank-order tournaments, where an agent's payment depends only on the rank of his or her

[4] Our results and implications relate to the pure tournament or pure individual schemes investigated in our study.

performance.[5] Their model consists of a risk-neutral principal and two agents. The output of each agent is a function of his own effort, and a common shock that affects both agents. Lazear and Rosen (1981) compare three incentive schemes: first, a linear piece-rate based on output, second, compensation based on comparison against a fixed standard, and third, a tournament where each agent receives a prize based on their ordinal rank. Their results show that if agents are risk neutral, all three incentive schemes work optimally. However, if the agents are risk averse and the variance of the common shock is relatively large, the tournament outperforms the other two incentive schemes.

Analytically, the mechanism by which the tournament scheme outperforms the other incentive schemes is as follows. Suppose there are two managers in a tournament. The winner receives a fixed prize of W_1 and the loser W_2, where $W_1 > W_2$. The managers would like to win, and their incentive to win increases as the spread between W_1 and W_2 increases. Each manager's effort is a linear function of his effort μ_i and a random error term. Nalebuff and Stiglitz (1983) decompose this random error term into two components, ε_i and θ. While ε_i represents an individualistic or idiosyncratic error term that is specific to a particular manager, θ is a common or systematic error that is shared by all the managers. For example, ε_i could represent the individual manager's comparative advantage at the task, and θ the general level of difficulty of a task (Nalebuff and Stiglitz 1983). Alternatively, the accounting system could measure performance with noise, and this noise would be common to all managers (θ). Both the Lazear and Rosen (1981) and Nalebuff and Stiglitz (1983) models assume that the contract is signed

[5] Consistent with these models, we investigate a setting where the winner takes the entire bonus. Although other types of tournament schemes exist in practice, such as where the size of the bonus is contingent on performance rank, where piece rates and tournaments are used jointly, or where the loser is penalized, we use the simpler version analyzed in these models for our study.

before ε and θ are known. Subsequently, the manager observes θ and determines how much effort to expend.

If the manager is risk averse, the random error increases the manager's risk and therefore, the firm would need to compensate the manager for bearing this risk. When the manager is compensated on an individual piece rate system, the total error is $\varepsilon_i + \theta$. However, when the manager is compensated based on a tournament, the common error term θ is eliminated because it influences both contestants. Lazear and Rosen (1981) show that if this common error is large and/or the manager is sufficiently risk averse, the tournament model produces superior outcomes compared to the individual piece rate model.

We explore a setting where common environmental error is present and equal across all participants and where the expected value of compensation is the same for tournament and individual incentive schemes. Our first hypothesis tests the predictions of the economic models (Lazear and Rosen 1981; Nalebuff and Stiglitz 1983). Because these models ignore any potential effect of relative performance feedback received during the evaluation cycle, we initially examine a setting where participants do not receive any relative performance feedback until the end of the cycle. However, they do receive feedback about their individual performance. This is analogous to an organization where an individual's performance and bonus information is kept confidential from other individuals.

Based on the theoretical predictions of tournament models, we predict that performance will be higher when participants are compensated based on a tournament compared to an individual incentive scheme. We also predict that this performance differential will increase over time because the higher effort expended by participants compensated via a tournament incentive scheme will facilitate learning.

H1a: In the absence of relative performance feedback, performance will be higher when compensation is based on a tournament incentive scheme compared to an individual incentive scheme.

H1b: In the absence of relative performance feedback, performance will improve more when compensation is based on tournament incentive scheme compared to an individual incentive scheme.

Effects of Relative Performance Feedback

In this section, we draw on economic and psychological theories to develop hypotheses related to the effects of relative performance feedback *within* each type of incentive scheme. Because performance feedback systems can differ in terms of the quality of relative performance information that is provided, we explore two levels of feedback by varying the precision of the feedback's content. We vary the precision of the content by varying the number of partitions into which we divide the relative performance feedback (halves and deciles), and call these two levels of feedback "coarse" and "fine." Accordingly, a participant provided with coarse feedback can assess whether he is above or below the mean, but not the specific percentile of his relative performance. Fine feedback provides a more precise assessment of the participant's rank, to the actual performance decile.

Individual Incentive Scheme

From an economic theory perspective, relative performance feedback should not affect performance under an individual incentive scheme because compensation is based solely on individual performance. However, psychology theories predict that providing relative performance feedback will affect performance even in the absence of pecuniary considerations. Social comparison theory (Festinger 1954) posits that individuals have a drive to continually compare themselves with others in order to evaluate their own abilities. Individuals want to do well relative to others, and when they perform worse than others, their sense of self identity

suffers (Tesser and Campbell 1980). Thus, managers are likely to be motivated to avoid this loss of self identity when subjected to relative performance feedback. As a result of this boost in motivation, performance will improve.[6] In addition, relative feedback helps an individual assess the range of potential performance levels, and thereby facilitates learning and appropriate effort allocation. Hence, we predict that the increased motivation created by this feedback will result in improved performance over time compared to when no feedback is provided. We predict that the increase in performance will occur in both the coarse and the fine feedback conditions.

> *H2a: When participants are compensated based on an individual incentive scheme, performance will improve to a greater extent when they are provided with coarse relative performance feedback compared to no feedback about relative performance.*
>
> *H2b: When participants are compensated based on an individual incentive scheme, performance will improve to a greater extent when they are provided with fine relative performance feedback compared to no feedback about relative performance.*

We do not expect that the increase in performance will be different across the two feedback conditions because our hypotheses predict a motivating effect from the *presence* of feedback, rather than the *content* of feedback.

Tournament Incentive Scheme

The analytical models of Lazear and Rosen (1981) and Nalebuff and Stiglitz (1983), do not address the effects of providing relative performance information before the end of the evaluation period. These models assume that relative performance information does not have any intrinsic value to the manager and its only role is to reduce the extent of risk imposed on a risk-

[6] Frederickson (1992) provided feedback at the *end of the evaluation cycle* and investigated whether changing the degree of common uncertainty affected effort. From a psychological perspective, increased saliency of comparison others motivates higher effort, and therefore, to the extent that increases in common uncertainty increases saliency, effort increases. In contrast, Frederickson found that increases in common uncertainty increased effort in the tournament condition, but not in the individual condition. Our experiment provides relative performance feedback *throughout the evaluation cycle*. Our design is likely to have a stronger saliency effect because feedback is more frequent and its form is more direct compared to changes in common uncertainty.

averse manager, when included in a compensation contract.[7] However, both economic and psychology theories predict that feedback which increases the perception the bonus is attainable should increase performance. Specifically, from an economic theory perspective, as the probability of winning the tournament increases, the marginal effect of effort increases, thereby motivating increased effort (ignoring any non-linearities in disutility for effort). To the extent relative performance feedback can facilitate managers' probabilistic assessments, relative performance feedback should increase effort for higher performing participants. Psychology theories predict that feedback can increase effort, as long as the feedback indicates that the goal (i.e., the bonus) is attainable, because such feedback has cognitive effects such as increasing goal commitment (Locke and Latham 1990) or perceptions of self efficacy (Bandura 1991).

Similarly, both economic and psychology theories predict feedback that decreases the perception the bonus is attainable should decrease performance. Economic theory predicts that as the probably of winning the bonus decreases, the marginal effect of effort decreases, which in turn reduces effort. Likewise, from a psychology theory perspective, when goals are perceived to be unattainable, individuals give up (Locke and Latham 1990), resulting in lower performance. Consistent with this notion, prior research has shown that participants in a tournament incentive scheme who think that they will not be able to catch up, tend to reduce their effort (Cases-Arce and Martinez-Jerez 2005; Muller and Schotter 2003; Young et al. 1993). In addition, the performance of those who are falling behind but have not given up may still deteriorate because they exert cognitive effort on non-task related activities such as designing a competitive strategy

[7] If the differences in performance are due to differences in ability, and the firm can sort managers based on ability, then handicapping systems can be used. In handicapping systems, the prizes and probability of reward are tailored to each participant. For example, marathon organizers provide incentives to champion runners to induce people to participate (O'Keefe, Viscusi, and Zeckhauser 1984). When participants are of similar ability however, handicap systems are not required.

or worrying about their performance, thereby reducing the effort available for task-related strategy (Kanfer and Ackerman 1989) or they try risky strategies since they believe they have nothing to lose (Camerer and Hogarth 1999).

In our experimental setting, participants whose performance is in the top 10% compared to other participants receive a bonus. Coarse feedback, which provides an assessment of whether a participant's performance is above or below the mean, is likely to have offsetting effects on performance. Although some participants (whose performance is below the mean) will interpret the feedback as indicating that the bonus is unattainable and decrease effort, others (whose performance is above the mean) will interpret the feedback as indicating that the bonus is attainable and increase effort. Thus, the performance of some participants will increase, while that of others will decrease, resulting in no overall effect on mean performance. As a result, we predict that the performance improvement will be the same when coarse feedback is provided as when no feedback about relative performance is provided. We acknowledge that our prediction is for a null hypothesis, which accordingly should be interpreted with caution.

> *H3a: When participants are compensated based on a tournament incentive scheme, change in performance will not differ when they are provided with coarse relative performance feedback compared to no feedback about relative performance.*

We predict that fine feedback will have a different effect on performance. Participants who are not in the top one or two deciles of performance, will likely perceive the relative feedback as indicating that they have a very low or zero probability of attaining the bonus. Thus, a majority of participants will become demotivated and decrease effort. Alternatively, these participants may devote more effort to competitive rather than task strategies, or try risky strategies that are unlikely to work out. As a result, performance will worsen when participants

are provided with fine feedback, whereas we expect it to improve when they are provided coarse or no feedback. Therefore, we present the following hypotheses:

> *H3b: When participants are compensated based on a tournament incentive scheme, performance will increase to a lesser extent when they are provided with fine relative performance feedback compared to no feedback about relative performance.*
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> *H3c: When participants are compensated based on a tournament incentive scheme, performance will increase to a lesser extent when they are provided with fine relative performance feedback compared to coarse relative performance feedback.*

Summary of Hypotheses

To summarize, we expect an interaction between incentive scheme and relative performance feedback. Specifically, in the absence of relative performance feedback, performance (change in performance) will be higher when individuals are compensated via a tournament compared to an individual incentive scheme. However, relative performance feedback will have opposite effects for participants in the individual compared to the tournament incentive scheme. Under the individual scheme, we expect change in performance to *be higher* for both the coarse and fine feedback conditions compared to the no feedback condition. In contrast, under the tournament scheme, we expect change in performance to *be lower* in the fine feedback condition compared to the coarse and none conditions.

III. METHOD

We use an experiment to test our hypotheses because this allows us to control the manipulation of the incentive scheme and the relative performance feedback system.

Participants

One hundred and thirty four business students at a large, public university participated in the experiment. Participants were recruited from upper-level undergraduate accounting classes. Of the participants, 26% were juniors, 66% were seniors and 8% were post-baccalaureate

students. Participation was voluntary. Participants received $5.00 plus any additional money earned during the experiment.

Experimental Procedures and Task Description

The procedures and task described in this section are the same for all conditions. Variations for incentive scheme and feedback manipulations are described in the next section.

Experimental sessions were conducted in a computer lab and lasted approximately one hour. Separate sessions were conducted for each incentive scheme and feedback condition. Instructions were read aloud to the participants by one of the authors. To ensure that participants understood the task and the computation of their pay, participants were required to take a computerized pre-experiment quiz. Each participant was required to score 100% on the quiz before beginning the actual experiment.[8]

The experimental task was adapted from Sprinkle (2000). Participants acted as managers and made output quantity decisions for a single product. The output decision in conjunction with a randomly-determined state of nature determined the amount of profit points earned by the participant. Participants were not informed of the state of nature. Profit points for all potential combinations of output choices and states of nature are shown in Table 1. Participants received a similar table and they were provided with several examples to help them understand it. For example, suppose a participant chose an output of 11. If the random state of nature was a number from 1 to 10, the participant would earn 0 profit points. If the random state of nature was a number from 11 to 20, the participant would earn 60 profit points.[9]

[8] 83% of participants scored at least 90%, and all but one participant scored at least 70% on their initial quiz attempt. The high initial scores together with the requirement that the final score must be 100% indicates that participants understood the task and how they would be compensated.

[9] Eleven of the 20 options are dominated choices. For example, option 13 is dominated by options 11 and 12 because for all possible states of nature, options 11 and 12 produce a profit that is equal to that of option 13, and in addition, these options also produce a profit for states of nature where option 13 does not produce a profit (states 11

Participants made output decisions for 60 periods, which were divided into 12 trials of 5 periods each. The state of nature remained constant for each of the 5 periods within a trial. We used the same states of nature for the 12 trials as Sprinkle (2000). By using the same set of states of nature for each participant, the potential total profit point earnings were the same for all the participants. Thus, the common error, θ, was the same for all participants.

Because the state of nature remained constant within each trial, participants had the ability to update their beliefs about the expected profit of future alternative output choices by reviewing the profit points earned in each prior period of that trial. Participants were given the option to do so. Specifically, after making their output choice each period, participants were queried whether they wanted to see their trial history, which would display their output choice and profit points for the current as well as all prior periods of the trial. However, viewing this trial history screen was costly. If a participant opted to view his trial history, it would display for a minimum of ten seconds, thereby reducing the number of time points (described next) that a participant could earn.

To proxy for a disutility for effort, participants were awarded time points for completing a trial early. Specifically, for each trial they earned one time point for every second that they finished before the 180 second time limit had expired. They received cash payment of $0.25 for each 400 time points earned during the experiment. To help participants keep track of time, a clock that counted down from 180 seconds was displayed on all screens during the trial. The payment for time points was in addition to any earnings they received from earning profit points (individual condition) or the bonus (tournament condition).

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and 12 for option 11 and state 12 for option 12). Dominated choices are included to obtain a measure of task strategy effectiveness and are discussed as part of the supplemental analysis.

At the end of each trial, a screen displayed a summary of the participant's quantity choices, profit points earned, and time points earned for the current trial. It also displayed a cumulative total of profit points and time points earned. Thus, each participant was provided with complete individual performance feedback.

At the end of the experiment, each participant completed a questionnaire, after which a screen displayed the participant's total earnings. The participant was paid in private and dismissed.

Experimental Design and Variables

The complete experimental design is a 2x3x12x3 mixed factorial design. The primary independent variables of interest are incentive scheme, which has two levels (individual and tournament), and relative performance feedback, which has three levels (none, coarse, and fine). These factors are manipulated between-subjects. The third factor, manipulated within-subjects, is trial, which has 12 levels. The fourth factor is order, manipulated between-subjects. We divided the twelve trials into four quarters, and then used three orders within each quarter. Because order has no effect ($F=0.29$, $p=0.75$), we exclude it from further discussion.

We use two primary dependent variables: 1) Performance, which is cumulative profit earned over the entire 60 periods (12 trials), and 2) Change in performance, which is fourth quarter profit (trials 10, 11, 12) less first quarter profit (trials 1, 2, 3).[10] These dependent measures use one observation per participant, and so are independent observations for purposes of our statistical tests. By experimental design, the set of states of nature is the same in the first and fourth quarters (although the order is randomized within quarter). Therefore, the total profit potential is the same in the first and fourth quarters.

Incentive Scheme

The two levels of incentive scheme were manipulated as follows: Participants in the *individual* incentive scheme were paid $1.00 for each 400 profit points they earned during the experiment. Participants in the *tournament* incentive scheme were paid a bonus of $46 if their total profit point performance for the 12 trials was in the top 10%, otherwise they received no compensation for their profit point performance.[11] The benchmark for determining the top 10% was based on performance in the individual sessions. The amount of the bonus equaled the average profit points compensation earned by participants in the individual condition, multiplied by 10. Thus, the expected value of the bonus in the tournament condition was the same as the average profit point compensation received by participants in the individual condition.

Relative Performance Feedback

The three levels of relative performance feedback were manipulated as follows: Participants in the *none* condition were not provided any information about their relative performance ranking during the decision-making portion of the experiment. Participants in the *coarse* condition were provided relative performance feedback at the end of each quarter, which specified whether their profit point performance was above or below the 50th percentile compared to previous participants. For example, if a participant's profit point performance placed him in the 82nd percentile, he received a message that said, "The total profit points you have earned so far in the experiment places you above the 50th percentile." Participants in the *fine* condition were also provided relative performance feedback at the end of each quarter. However, their feedback was more precise compared to the coarse condition because it reported

[10] We use performance rather than time as our dependent measure because the latter measures only the duration of effort whereas the former captures both the duration and the effectiveness of effort, which can be influenced by factors such as attention, strategy formation and intensity (Bonner and Sprinkle 2002).

[11] Thus their only earnings would be the $5 show-up fee plus payment for any time points earned.

the deciles of the participant's profit point rank. For example, if an individual's profit point performance placed him in the 82nd percentile, he received a message that said, "The total profit points you have earned so far in the experiment places you in the 80-90 percentile."

At the end of the experiment, all participants received relative performance feedback in 10-percentile intervals, i.e., the same format as the fine condition.[12] Thus, participants in the tournament condition could determine whether they earned the bonus regardless of their feedback condition.

Recall that within each quarter all participants had the same set of states of nature. Participants were informed that their feedback would be based on a comparison of previous participants who had received the same states, and who thus had identical profit point potential. In other words, participants were told that the common error, θ, was the same for all participants to whom they were being compared.[13]

IV. RESULTS

Descriptive Statistics

Table 2 reports descriptive statistics and Figure 1 provides a graphical summary of these data. Panel A of Table 2 reports mean performance (cumulative profit points for the 12 trials) for each condition. These data suggest that participants in the individual condition performed better when they had coarse feedback relative to none, and their performance improved further with

[12] Obviously, it is impossible to provide relative performance feedback based on all observations until all data have been collected. We ran the individual/no feedback condition first and, at the end of the session, provided these participants with feedback based on the performance of all participants in this condition. We next ran the individual/coarse feedback and individual/precise feedback conditions and based their feedback on performance in the individual/no feedback condition. Finally, we ran the tournament condition and based their feedback on the pooled data from the three individual conditions.

[13] On the initial quiz attempt, 87% of participants responded correctly to the pre-experiment question assessing knowledge of the common profit point potential for their reference group. The following message was displayed if the initial answer was incorrect: "Your overall profit points performance will be compared to other participants who have completed the same set of conditions as you. This means that the potential total profit points that could be earned is the same for you as for your reference group." The high percentage of correct initial responses together

fine feedback. However, for participants in the tournament condition, feedback caused deterioration in performance. Performance was highest when there was no feedback provided, and lowest when fine feedback was provided.

Table 2, Panel B reports mean change in performance, defined as profit points earned in the fourth quarter minus profit points earned in the first quarter. Recall that the states of nature were the same for the first and fourth quarters, and so this comparison is unaffected by noise in the common error. These data suggest that in the individual condition, feedback substantially increased performance for both coarse and fine feedback. However, in the tournament condition, relative performance feedback decreased performance for participants receiving fine feedback.

Hypotheses Tests

Taken together, our hypotheses predict an interaction between incentive scheme and feedback. Therefore, before reporting the planned comparisons to test the hypotheses, we report ANOVAs that test the full 2x3 model, using both performance and change in performance as the dependent variables. As reported in Table 3, Panel A, the interaction between feedback and incentive scheme is significant ($F=3.62$, $p<0.03$), when performance is the dependent variable. Likewise, as reported in Panel B, the feedback x incentive interaction is significant ($F=10.98$, $p<0.01$), when change in performance is the dependent variable. Figure 1 shows that these interactions are disordinal.

Formal tests of hypotheses are reported in Table 4. H1a(b) predicts that in the absence of relative performance feedback, performance (change in performance) will be higher (improve more) in a tournament compared to an individual incentive scheme. Mean performance in the tournament condition is 2,230 compared to 1,766 in the individual condition, and this difference

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with the reinforcement provided to those participants who initially responded incorrectly indicates that participates were aware that the error term resulting from the state of nature was the same for all participants.

is statistically significant (t=3.12, p<0.01, one-tailed). Mean change in performance in the tournament condition is 115.23 compared to 15.42 in the individual condition. This difference is also statistically significant (t=3.09, p<0.01, one-tailed). Thus, both H1a and H1b are supported, indicating that participants who received compensation based on a tournament incentive scheme not only performed better overall, but also improved their performance to a greater extent over time compared to participants who received compensation based on an individual incentive scheme.

Next, we report tests of hypotheses related to the effects of relative performance feedback on performance within the individual incentive scheme condition. H2a predicts that performance will improve more when participants are provided with coarse feedback compared to no feedback about relative performance. Similarly, H2b predicts that performance will improve more when participants are provided with fine feedback compared to no feedback about relative performance. As shown in Table 4, Panel B, mean change in performance differs significantly across conditions, providing support for H2a and H2b. Specifically, while performance increased by 15.42 in the no feedback condition, it increased by 84.35 in the coarse condition (t=2.13, p<0.02, one-tailed) and 77.14 in the fine condition (t=2.08, p<0.02, one-tailed). These results suggest that providing relative performance feedback increased performance over time.

Although we made no prediction regarding the change in performance when participants received fine compared to coarse relative performance feedback, we test this comparison for the sake of completeness. There is no difference between means in the two conditions (t=0.28, p=0.78). Therefore, it appears that although the existence of relative performance feedback improved performance, the specific content of the feedback in terms of its precision had no additional effect.

The remaining hypotheses relate to comparisons within the tournament incentive scheme condition. H3a predicts that change in performance will not differ when coarse feedback is provided compared to providing no relative performance feedback. As reported in Table 4, Panel B, mean performance increased by 92.27 in the coarse and 115.23 in the none condition. These means are not significantly different (t=0.64, p=0.53, two-tailed), supporting H3a. H3b predicts that performance will improve to a lesser extent when fine feedback is provided compared to providing no relative performance feedback. This hypothesis is supported. Although mean performance increased by 115.23 in the no feedback condition, it decreased by 41.59 in the fine condition (t=4.77, p<0.01, one-tailed). Finally, H3c predicts that performance will improve less when fine feedback is provided compared to coarse feedback. This hypothesis is also supported. Specifically, mean performance increased in the coarse condition by 92.27, while it decreased in the fine condition by 41.59 (t=3.39, p<0.01, one-tailed).

The overall pattern of results suggests the following. When no relative performance feedback is provided during the evaluation period, performance is higher in a tournament compared to an individual incentive scheme. Providing relative performance feedback to participants compensated under an individual incentive scheme *increases* performance regardless of the precision of the feedback. In contrast, providing relative performance feedback to participants compensated under a tournament incentive scheme *decreases* performance if the content is sufficiently precise for participants to assess their chances of winning the tournament. Otherwise relative performance feedback has no effect on performance.

As a result of the disordinal interaction between incentive scheme and feedback, the tournament scheme loses its advantage when participants are provided with fine relative performance feedback. That is, as reported above, both performance and change in performance

are greater in the tournament compared to individual condition when no feedback is provided. However, when fine feedback is provided, performance is no longer greater in the tournament condition (1,773 vs. 1,925, for tournament and individual respectively, t=0.91, p=0.37, two-tailed). Moreover, the trend in performance is much worse in the tournament condition (-41.59 vs. 77.14, t=3.95, p<0.01, two tailed), suggesting that had the experiment lasted for more periods, overall performance may have been significantly worse in the tournament compared to the individual condition.

Supplemental Analysis

We conducted separate analysis for each quarter via a 2 (incentive scheme) x 3 (feedback) ANOVA. This analysis shows that the tournament incentive scheme had significantly higher performance in the first quarter, consistent with the incentive effects predicted by economic theory. The incentive scheme x feedback interaction was not significant in the first quarter, which is expected given that relative performance feedback was first received after the first quarter. However, a significant interaction emerges in the second quarter and remains in the third and fourth quarters. Thus, the effects of relative performance feedback on performance did not fade out as participants obtained more experience on the task. In fact, the differential effects of relative performance feedback for the tournament versus individual incentive scheme became more pronounced.

Results reported above suggest that feedback improves performance regardless of its content in the individual condition, however the effect of feedback depends on its content in the tournament condition. To further explore this relation, we examined change in performance conditional on the content of the feedback received by participants at the end of the second quarter (i.e., mid-way through the experiment). We restricted our analysis to participants

receiving fine feedback because that is when the content is potentially informative. Figure 2 presents a histogram of mean change in performance conditional on second quarter feedback. As shown in Figure 2, mean performance increased for all feedback deciles in the individual condition. Moreover, the mean increase in the top two deciles (79.0) is the same as the bottom five deciles (78.6, $t = 0.01$, $p = 0.98$, two tailed). A different picture emerges when the tournament condition is examined, however. Although mean performance increased for participants receiving second quarter feedback indicating they were in the top two deciles, mean performance decreased for the remaining deciles. In this condition, the differences between the highest two (83.8) and lowest five (-66.9) deciles are statistically significant ($t = 2.49$ $p<0.04$, two tailed). These results indicate that although the content of the feedback had little impact on future performance in the individual condition, the content made a dramatic impact in the tournament condition.

Our analysis indicates that participants in the tournament/fine condition whose performance deteriorated did not reduce effort but rather that their effort was less effective compared to participants whose performance improved. Specifically, a comparison of time spent (a proxy for effort) between participants whose performance deteriorated and those whose performance improved shows no difference in overall time ($p = 0.67$) or in fourth quarter time ($p =0.26$). Further, participants with improved performance, decreased the time spent in the fourth quarter compared to the first quarter by a much greater amount (49.6 seconds) on average compared to participants with deteriorated performance (7.7 second, p. <.05, two tailed). Another proxy for effort is the number of times participants viewed feedback within each trial. Comparisons of number of views overall, number of fourth quarter views and the change in views across the first and fourth quarters find no difference between participants whose

performance improved and whose performance deteriorated. Taken together, these data indicate that the deteriorated performance was not due to a lower effort level.

Two pieces of evidence are consistent with reduced task strategy effectiveness. First, recall that the table provided to the participants contained eleven dominated choices. Because the expected value of a dominated choice is clearly lower than an alternative choice, selection of a dominated choice is evidence of an ineffective task strategy. Compared to participants with improved performance, participants with deteriorated performance made more dominated choices overall (23.0 vs. 36.2, p. <0.03 two tailed), and in the fourth quarter (4.7 vs. 10.4, p. < .01, two tailed), and their learning to avoid making dominated choices lagged (comparing the fourth to first quarters, -3.0 compared to +2.1, p. <.01, two tailed). Second, if participants settle on a strategy, they are likely to make the same choice for the first period within each trial. A comparison of the standard deviation of first period choices shows more variation for participants whose performance deteriorated (standard deviation 2.2 for improved, 3.9 for deteriorated, p. <.02, two tailed), suggesting a continued search for a strategy throughout the experiment. Taken together, these results suggest that participants' deteriorating performance is not the result of reduced effort but rather because of factors such as devoting cognitive effort to activities unrelated to task strategy (e.g., interpreting the meaning of the relative performance feedback, evaluating their chances of obtaining the bonus, or worrying about their performance) which hampered their performance (Kanfer and Ackerman 1989) or adopting a risky strategy in the hope of catching up (Camerer and Hogarth 1999).

V. CONCLUSIONS

Firms routinely use tournament-based compensation schemes where the compensation of the manager is based on performance relative to others. At the same time, compensation plans

where a manager's pay depends only on his own performance are also prevalent in practice. In this paper we examine the effect of providing relative performance feedback when participants are compensated under one of these types of compensation schemes.

Our experimental results show that, when participants are not provided with relative performance feedback, performance is higher when they are compensated under a tournament compared to individual incentive scheme. However, there is an interaction between incentive scheme and feedback. As a result, the tournament scheme loses its advantage when feedback allows participants to asses their chances of winning.

We find that providing relative performance feedback increases the performance of participants who are compensated based on an individual incentive scheme. That is, feedback results in increased performance over time compared to providing no relative performance feedback. Moreover, the specific content of the feedback has no impact on performance: participants increase performance to the same extent when receiving coarse or fine feedback, and this increase in performance is not affected by whether the feedback indicates relative performance lags or excels.

Providing relative performance feedback has the opposite effect for participants compensated under a tournament incentive scheme. Providing coarse feedback has no effect on future performance. However, providing fine feedback causes mean performance to deteriorate. This deterioration is caused by participants' response to the content of the feedback. Performance deteriorates for those participants whose feedback indicates their performance lags, which represents most participants. Although performance increases for those participants whose feedback indicates their performance excels, this increase is not sufficient to overcome the deterioration in performance of the other participants, resulting in a net decrease overall.

Interestingly, supplemental analysis suggests that the deteriorating performance is not due to reduced effort but rather to reduced effectiveness of the participants' task strategy as they devote cognitive resources to activities unrelated to the task and/or adopt more high risk strategies.

Our study has several implications for the design of compensation schemes, performance measurement and reporting systems in firms. It suggests that as long as the environmental error is common across managers, a tournament incentive scheme is more efficient at eliciting performance compared to an individual incentive scheme. However, the effectiveness of a tournament scheme is lessened to the extent an information system informs managers that their ranking makes it unlikely they will win the tournament. Our study also implies that the usefulness of relative performance feedback depends on the type of incentive scheme. Whereas providing relative performance feedback may have negative consequences when managers are compensated via a tournament incentive scheme, such feedback is likely to have positive consequences when managers are compensated via an individual incentive scheme.

Our study shows one mechanism, i.e., providing relative performance feedback, through which the effectiveness of tournament incentive schemes may be reduced. Other potential costs and benefits need to be considered when evaluating whether to adopt and the specific design of a tournament compensation scheme. For example, tournaments may motivate managers to make more risky decisions, which may or may not be beneficial to the firm (Chow and Haddad 1991; Sayre, Rankin and Fargher 1998). The effectiveness of tournaments may be undermined by motivating collusion (Bandiera, Barankay, and Rasul 2005), discouraging innovation, hindering cooperation, or, as our study finds, reducing performance of lagging managers. The choice of an improper reference group (Gibbons and Murphy 1990) may also decrease the effectiveness of tournaments. On the other hand, tournaments may provide additional benefits such as sorting on

attributes the firm finds desirable (Sprinkle 2003), less need for costly monitoring (Henderson and Fredrickson. 2001), and increased flexibility, especially in the presence of environmental uncertainty (Nalebuff and Stiglitz 1983). Further, our study limited its examination to a setting where pure tournament or individual schemes are used. Future research could examine the effectiveness of providing relative performance feedback using a hybrid incentive scheme which contains both tournament and individual components.

While a *Business Week* survey reveals that one-third of US corporations use tournament-based incentive schemes, it also reports that companies are re-evaluating these schemes (McGregor, Jan 9, 2006). Even General Electric, which used tournament-based models and pitted managers against each other, is re-evaluating this practice. Our study demonstrates that designing an incentive compensation plan that is effective and efficient in motivating performance that benefits the firm is no easy task. Numerous variables may impact its effectiveness and even interact with each other. Thus, constant re-evaluation of the effectiveness of incentive compensation schemes is warranted.

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TABLE 1

Profit for Each Combination of Output Quantity and State of Nature

	Output Quantity Choice																			
State of Nature	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	5	5	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	5	5	10	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	5	5	10	20	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	5	5	10	20	20	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	5	5	10	20	20	30	30	0	0	0	0	0	0	0	0	0	0	0	0	0
8	5	5	10	20	20	30	30	30	0	0	0	0	0	0	0	0	0	0	0	0
9	5	5	10	20	20	30	30	30	45	0	0	0	0	0	0	0	0	0	0	0
10	5	5	10	20	20	30	30	30	45	45	0	0	0	0	0	0	0	0	0	0
11	5	5	10	20	20	30	30	30	45	45	60	0	0	0	0	0	0	0	0	0
12	5	5	10	20	20	30	30	30	45	45	60	60	0	0	0	0	0	0	0	0
13	5	5	10	20	20	30	30	30	45	45	60	60	60	0	0	0	0	0	0	0
14	5	5	10	20	20	30	30	30	45	45	60	60	60	80	0	0	0	0	0	0
15	5	5	10	20	20	30	30	30	45	45	60	60	60	80	80	0	0	0	0	0
16	5	5	10	20	20	30	30	30	45	45	60	60	60	80	80	95	0	0	0	0
17	5	5	10	20	20	30	30	30	45	45	60	60	60	80	80	95	95	0	0	0
18	5	5	10	20	20	30	30	30	45	45	60	60	60	80	80	95	95	95	0	0
19	5	5	10	20	20	30	30	30	45	45	60	60	60	80	80	95	95	95	100	0
20	5	5	10	20	20	30	30	30	45	45	60	60	60	80	80	95	95	95	100	100

TABLE 2
Descriptive Statistics (Mean, {Standard deviation}, N)

Panel A: Performance (Cumulative Profit Points)

		Incentive Scheme	
		a. Individual	b. Tournament
Type of Relative Performance Feedback	1. No Relative Performance Feedback	1,766 {599} N=24	2,230 {374} N=22
	2. Coarse Relative Performance Feedback	1,863 {566} N=23	2,050 {571} N=22
	3. Fine Relative Performance Feedback	1,925 {479} N=21	1,773 {602} N=22

Panel B: Change in Performance (Q4 Profit Points – Q1 Profit Points)

		Incentive System	
		a. Individual	b. Tournament
Type of Relative Performance Feedback	1. No Relative Performance Feedback	15.42 {121.08} N=24	115.23 {95.17} N=22
	2. Coarse Relative Performance Feedback	84.35 {99.06} N=23	92.27 {140.13} N=22
	3. Fine Relative Performance Feedback	77.14 {66.53} N=21	-41.59 {121.22} N=22

TABLE 3
ANOVA Results

Panel A: Dependent Variable = Performance (Total profit points) (n=134)

Source	df	Mean Square	F-Value	p-value
Incentive Scheme (Individual, Tournament)	1	927,003	3.18	0.08
Feedback (none, coarse, precise)	2	257,111	0.883	0.42
Incentive Scheme x Feedback	2	1,053,762	3.62	0.03

Panel B: Dependent Variable = Change in Performance (Q4 profit points – Q1 profit points) (n=134)

Source	df	Mean Square	F-Value	p-value
Incentive Scheme (Individual, Tournament)	1	449	0.037	0.85
Feedback (none, coarse, precise)	2	56,656	4.67	0.01
Incentive Scheme x Feedback	2	133,236	10.98	<0.01

TABLE 4
Test of Hypotheses

Panel A
Tests Comparing Incentive Scheme in the Absence of Relative Performance Feedback

Hypothesis	Mean Performance or Change in Performance		Prediction	t and *p* values*	Conclusion
	Individual Incentive Scheme	Tournament Incentive Scheme			
H1a	1,766	2,230	Tournament>Individual	t=3.12, $p<0.01$	supported
H1b	15.42	115.23	Tournament>Individual	t=3.09, $p<0.01$	supported

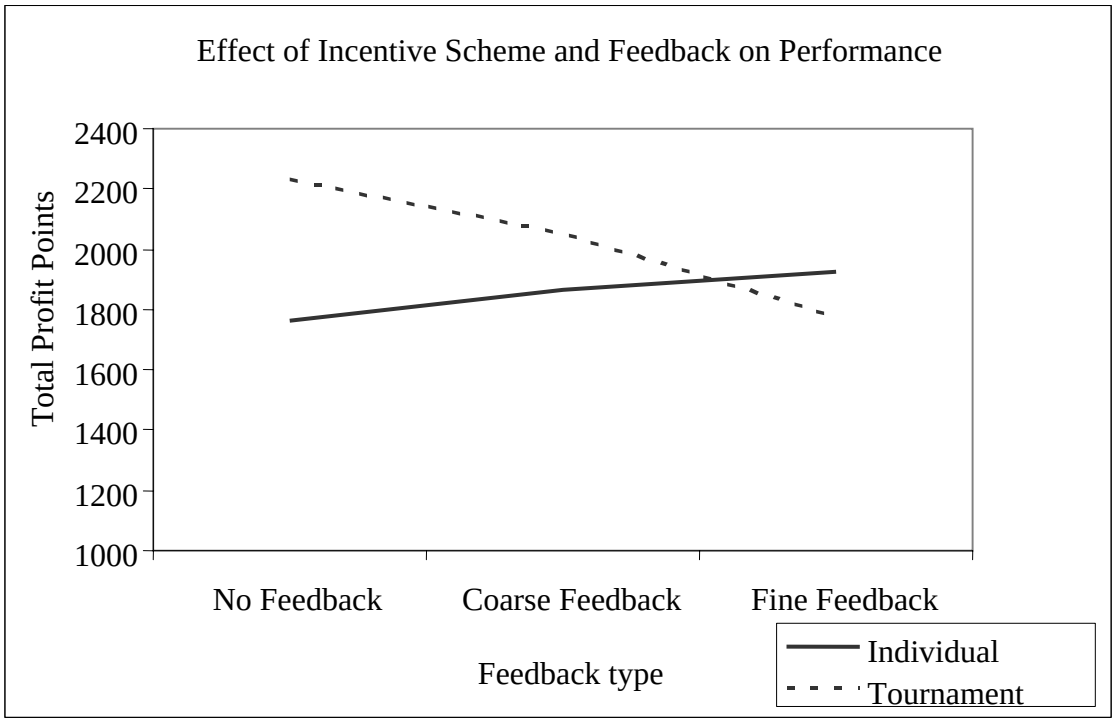
Panel B
Tests Comparing Relative Performance Feedback within Incentive Condition

Hypothesis	Mean Change in Performance			Prediction	t and *p* values*	Conclusion
	None	Coarse	Fine			
Individual Incentive Scheme						
H2a	15.42	84.35		Coarse>None	t=2.13, $p<0.02$	supported
H2b	15.42		77.14	Fine>None	t=2.08, $p<0.02$	supported
none		84.35	77.14	no prediction	t=0.28, $p=0.78$	
Tournament Incentive Scheme						
H3a	115.23	92.27		Coarse=None	t=0.64, $p=0.53$	supported
H3b	115.23		-41.59	Fine<None	t=4.77, $p<0.01$	supported
H3c		92.27	-41.59	Fine<Coarse	t=3.39, $p<0.01$	supported

* *p*-values are one-tailed for directional, and two-tailed for non-directional predictions. Tests reported are two-sample t-tests; standard deviations and number of observations are reported in Table 2.

FIGURE 1
Summary of Results

Panel A



Panel B

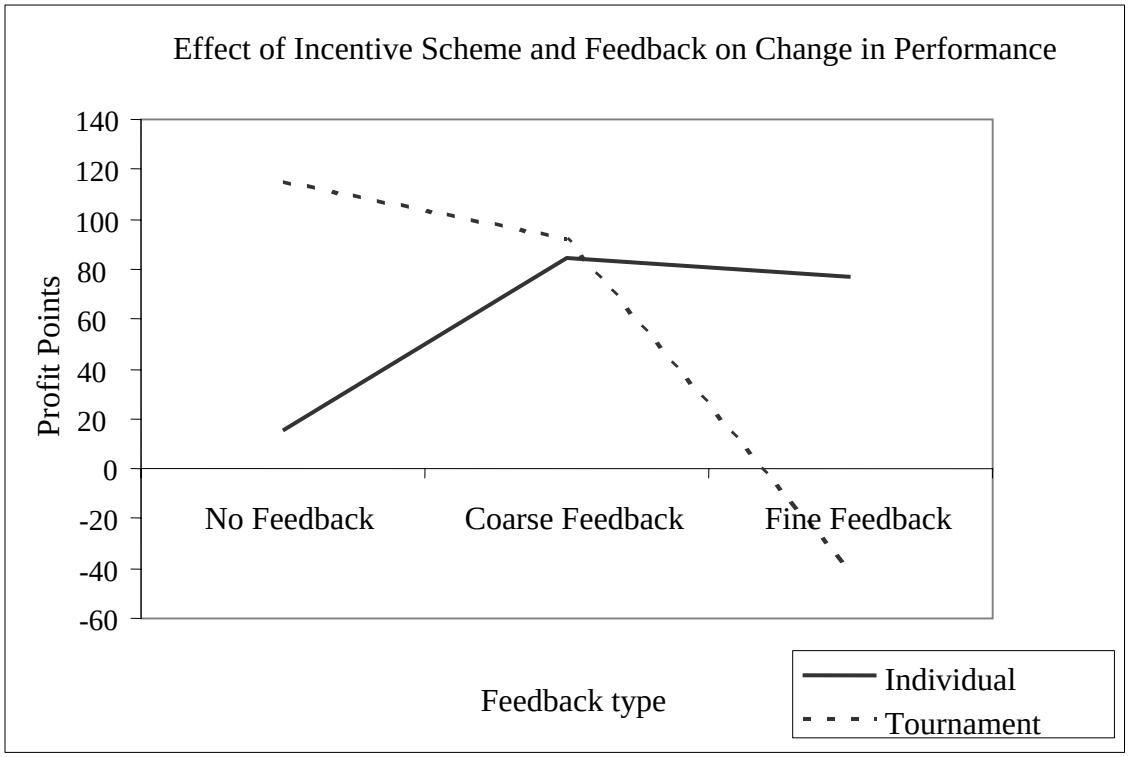


FIGURE 2
Change in Performance Conditional on Feedback Received