Reactions to Discrimination in an Incentive Pay Compensation Scheme: A Game-Theoretic Approach

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In a series of experiments with undergraduate business students, some behavioral consequences of discrimination in an incentive compensation scheme were investigated. A game-theoretic approach was used to predict the choices subjects should make if they attempted to maximize monetary outcomes. Subjects, who were assigned to either an advantaged or disadvantaged condition, participated in an experiment in which they earned money based on their chosen decisions. The decision choices of the advantaged and disadvantaged groups were then compared to the predicted choices from the game-theory model. The results supported the predictions from the theory of tournaments only in the symmetric tournament, where there was no discrimination. When discrimination was introduced into the experiment, the observed choices of both advantaged and disadvantaged subjects were significantly greater than that predicted by the theory. © 1989 Academic Press, Inc.

INTRODUCTION

In incentive compensation schemes, organizations often compare the performance of one person to another, in order to decide which one will receive a bonus, promotion, etc. In some situations, organizations might want to favor one group of employees over another when making such comparisons. For example, summer research proposals for junior faculty are often looked upon more favorably relative to proposals from senior faculty. Or, an organization evaluating one group of employees might want to take into account previous incidences where that group was underrepresented in terms of receiving promotions or raises. In such situations, the rules favor one group over another. Although the organization

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may have the best intentions, the behavioral consequences of setting up a system (explicitly or implicitly) in which one group is advantaged are unclear. The purpose of this research is to begin to explore some of the consequences of an incentive compensation scheme in which the rules favor one group over another in the comparison process.

While research in equity theory has focused on the outcomes of distributive decisions and how these outcomes affect behavior (see Greenberg, 1982, for a review), there is a growing realization that the process of how rewards are distributed is equally important (Folger & Greenberg, 1985). Much of this work on procedural justice has examined people's perceptions of unfair or arbitrary procedures (Greenberg, 1987). More research is needed, however, to determine how such unfair procedures may affect people's behavior.

The Theory of Games

One model frequently used in the behavioral sciences to study behavior in interdependent situations is game theory (Colman, 1982). Game theory seems well-suited for the present research, since one individual's performance is judged relative to the performance of another. The theory of games provides a formal framework for analyzing the decisions of individuals in interactive social situations (cf. Luce & Raiffa, 1957). Individuals are assumed rational; that is, they have a set of preferences, and attempt to maximize those preferences. Selection between possible actions is based on expectations of another's action choice, since payoffs are dependent on the actions of both players—although each individual only controls his or her own actions. A basic tenet of game theory is that a satisfactory solution is one that jointly satisfies the preferences of both individuals. That is, the theory identifies which action set (the combination of actions by both individuals) should be selected. Since an optimal response can be identified, it is possible to compare these predictions to what actually occurs.

The remainder of the paper is as follows. The following section provides a brief overview of the game-theory model used in the research—the theory of tournaments. The study methodology is then described, followed by a presentation of results. Finally, conclusions and implications of the research are discussed.

The Theory of Tournaments

The theory of tournaments attempts to predict behavior when an individual's payment depends only on his or her performance relative to other individuals in the tournament (cf. Green & Stokey, 1983; Lazear & Rosen, 1981; Nalebuff & Stiglitz, 1983). In the simplest possible case, the
rank-order tournament, the person's payment depends only on the *rank* of his or her performance relative to others in the tournament.

The hierarchical structure of firms contains characteristics of a rank-order tournament: as the organizational pyramid narrows only the top ranked workers move to the next, and smaller, set of promotions. For example, five vice-presidents compete to be promoted to president. Other forms of tournaments also exist in firms: sales managers are paid bonuses based on their percentage of sales above quota, relative to the sales of others, and employees receive merit pay increases based on relative performance.

Tournaments can be symmetric or asymmetric. Symmetric tournaments occur when individuals are relatively identical (e.g., natural talent, education, experience), and are treated equally (i.e., each person has an equal chance of winning the tournament). Tournaments can be asymmetric in two basic ways. Using the terminology of O'Keefe, Viscusi, and Zeckhauser (1984), tournaments are "uneven" if individuals are not identical. For example, one person may have more experience and thus has to expend less effort to achieve the same output. Tournaments are "unfair" if the individuals are identical, but the rules favor one of them. For example, to be promoted, person i must not only achieve an output greater than person j's, i's output must exceed j's by some specified amount. In other words, person i is discriminated against. This research investigates behavior in unfair tournaments.

In a two-person rank-order tournament, the performance of one person is compared to the performance of another, and on the basis of the comparison the low performance person receives a low payment, and the high performance person receives a high payment. Two assumptions are inherent in such tournament compensation schemes. First, individuals prefer the high payment to the low payment and are willing to expend effort to increase their chances of receiving the high payment. Second, there is a cost associated with this effort; the greater the expended effort the greater the cost.

We expect the rules of any given compensation scheme may affect the behavior of individuals. The difference in rules between absolute compensation schemes (in which payment is based on performance relative to an absolute standard) and tournament compensation schemes are strategically important because they affect a person's behavior. Consider an absolute compensation scheme. By examining the compensation plan, and estimating how difficult the task is, individuals select an optimal effort level which maximizes their preference between effort expended and compensation. Tournaments, on the other hand, are much more complicated in a strategic sense, because no such independent "best" answer exists. Individuals have less control over the compensation amount be-
cause obtainment of the compensation depends on their actions and the actions of another person. Individuals, in choosing actions, must form beliefs about the action choices of others. An individual cannot determine optimal effort level in isolation since such levels depend on the chosen effort level of others.

Since tournaments involve payments based on relative performance, they contain elements of noncooperative games. The predicted solution concept derived from the theory of tournaments is the Nash equilibrium solution (Nash, 1951). Nash predicts the strategies that each person should follow. The strategies in a Nash equilibrium are stable "mutual best responses": a person's choice is optimal given that another person selects his or her equilibrium choice. A Nash solution is stable (i.e., an individual will not deviate given they believe the other person is choosing the Nash solution) because individuals cannot improve their payoffs by unilaterally changing a strategy choice.

**Determining an Optimal Strategy**

Consider a two-person symmetric tournament: both individuals are identical and are treated equally. Both individuals prefer (have greater utility for) the high payment. If one individual receives the high payment, the net reward is not simply the amount of the payment, but the amount minus the costs associated with the effort expended. It is assumed therefore, that two identical individuals i and j have the following utility (preference) function:

\[
U_i(p,e) = U_j(p,e) = u(p) - c(e),
\]

where

- \(U_i\) = utility function for person i
- \(U_j\) = utility function for person j
- \(p\) = a nonnegative payment to the person
- \(e\) = a scalar representing a person's nonnegative effort level
- \(u(p)\) = a person's utility for receiving payment \(p\)
- \(c(e)\) = the cost to the person of expending effort \(e\).

A general tenet in the compensation literature is that the effort levels of workers are not observable but generate an output that is observable (Carroll & Schneier, 1982). In the absence of perfect monitoring devices, the observed output depends upon the amount of effort expended, plus a random component which is a function of the precision of the monitoring device (O'Keefe et al., 1984). This random component could be considered an extraneous uncontrolled situational factor which affects observed individual performance. For example, firm A obtains the hourly effort of workers by monitoring their output on an hourly basis, while firm B mon-
itors output for 1 hr, and then estimates effort per day by multiplying that amount by hours worked. Firm A's estimate of a worker's true per hour effort is better because its monitoring device gives a more reliable estimate. Thus, in measuring output, it is necessary to take into account random fluctuations in measurement.

Worker i's output could be considered as,

\[ y_i = f(e_i) + \epsilon_i, \quad (2) \]

where

\[ y_i = \text{observed output of worker i} \]
\[ f(e_i) = \text{a production function with production conditional on the effort expended by worker i} \]
\[ \epsilon_i = \text{a random component.} \]

As explained before, in a tournament scheme, the person with the higher observed output (y) receives a high payment (M), while the person with the lower observed output receives a small payment (m). Given any pair of effort choices by two individuals (i and j), person i's probability of winning M is just equal to the probability that the difference between his or her random component and person j's random component is greater than the difference between person j's effort level and his or her effort level,

\[ (\epsilon_i - \epsilon_j) > f(e_j) - f(e_i). \quad (3) \]

Using the three equations, the following equilibrium solution is derived:

\[ \frac{c[M - m]}{4a} = e^*, \quad (4) \]

where

\[ M = \text{the high payment monetary amount} \]
\[ m = \text{the low payment monetary amount} \]
\[ c = \text{the costs associated with expended effort} \]
\[ a = \text{the range of the random component} \]
\[ e^* = \text{the predicted effort levels.} \]

The mathematical representation of the Nash solution provides the following testable behavioral implications. One, the effort levels chosen by individuals increase proportionately with any increase in the spread between the high and low payments. This result is expected because the greater the spread, the greater the incentive to produce the higher output and receive the high payment. Two, effort levels will move inversely with increases in the cost of effort, and with increases in the effect of the random component on observed output. The more weight the random
component has—i.e., the less precise the monitoring device—on the observed output, the less effort an individual will expend.

Equation (4) predicts that in symmetric tournaments individuals will choose the same effort levels, with levels specified by the parameters in Eq. (4). Earlier experiments tested this prediction (Bull, Schotter, & Weigelt, 1987b), and found that, on average, individuals did choose the same effort levels. Behavioral reactions (i.e., the effort level chosen) to changes in parameters were also as predicted: Subjects chose lower effort levels as the prize spread narrowed, as the cost of effort increased, and as the effect of the random component on observed output increased.

The Nash solution for unfair tournaments is derived in a similar fashion (see the Appendix for a formal derivation). Recall that an unfair tournament is one where individuals are identical but the rules favor one of them. For example, person i's output must exceed person j's by some specified amount \( k \), if i is to receive the high payment. Individuals discriminated against are labeled as disadvantaged, while all other persons are labeled as advantaged. The equilibrium of unfair tournaments is defined as

\[
e_i^* = e_j^* = \left[ (\sqrt{2}a) - (k/4a^2) \right] \left( c(M - m)/2 \right),
\]

where:
- \( M \) = the high payment monetary amount
- \( m \) = the low payment monetary amount
- \( c \) = the costs associated with expended effort
- \( a \) = the range of the random component
- \( k \) = the level of discrimination.

Intuitively, Eq. (5) states that while individuals still consider the same parameters as in equitable tournaments, they also consider the effect of the discriminatory policy in selecting their effort levels. Note that both advantaged and disadvantaged persons are still expected to choose the same effort level in order to maximize their monetary gains.

The result that both advantaged and disadvantaged individuals are predicted to choose the same effort level is somewhat counterintuitive. The logic underlying the result is as follows. The equilibrium condition basically equates the marginal benefit of effort with the marginal cost of effort. The marginal benefit is the gain in benefits realized by providing one additional unit of effort. Since both individuals have the same cost of effort function, both their marginal benefit functions will intersect their marginal cost functions at the same point. Thus, the marginal probability of winning functions is identical for both individuals.

One might consider the \( k \) factor as a lump sum payment with which the advantaged person is endowed. While \( k \) does increase the advantaged person's probability of winning (given any chosen effort level) relative to
the probability of the disadvantaged person, it doesn't affect the marginal probability of winning. By increasing the probability of winning, \( k \) increases the expected earnings of the advantaged person and decreases the expected earnings of the disadvantaged person. The larger \( k \) is, the greater its effect on the expected earnings of individuals. Regardless of this effect on earnings, according to the theory, disadvantaged individuals are expected to expend as much effort as their advantaged counterparts.

**Overview of the Task and Operationalization of the Parameters**

A series of experiments was conducted to test the predictions of the two-person unfair tournament. Subjects were asked to participate in a decision-making experiment in which they would earn money based on their chosen decisions. Subjects entered a room and were randomly assigned subject numbers. Their task was relatively simple—given a table of decision numbers and associated costs, choose a decision number. After selecting a decision number (always a positive integer) subjects drew a random number from a specified range (either a positive or negative integer), and totaled the two. This total represented their performance (output) for a particular trial. The outputs of two randomly chosen subjects (pair members) were then compared, with the high output subject receiving the high payment. Unfair tournaments were operationalized by requiring the disadvantaged pair member (even-numbered subjects) to exceed the performance of the advantaged pair member by a specified amount, \( k \), in order to receive the high payment. Thus, in the present research the parameters were operationalized as follows: effort by the chosen decision number, cost of effort by the associated cost of the decision number, the extraneous uncontrolled situational factor by the random number, performance (output) by the total of the chosen decision number and selected random number, and the level of discrimination by the factor \( k \).

**METHOD**

Four separate experiments were conducted to test the predictive power of the theory. All experiments followed the same basic procedure; different unfair conditions were induced across experiments by changing parameters. The following section describes the basic experimental design and procedure, noting the relevant differences across experiments.

**Subjects**

A total of 53 male and 45 female (Experiment 1, \( n = 24 \); Experiment 2, \( n = 22 \); Experiment 3, \( n = 32 \); Experiment 4, \( n = 20 \)) undergraduate students recruited from management and economic courses at New York
University were paid for their participation. Each subject participated in only one experiment. Subjects were explicitly told when recruited, and again before the experiment began, that the amount they earned depended on the decisions they made. Subjects within each experiment were run as a group. Subjects were randomly assigned seats and subject numbers and given written instructions. All of the tournament’s parameters were explained in the instructions, and thus were common knowledge.

Procedure

Subjects were informed that another subject was randomly assigned as their “pair member” and that the amount of money they would earn in the experiment was a function of their decisions, their pair member’s decisions, and the effects of a random variable. Half the subjects received odd subject numbers, while the other half received even numbers. A pair always consisted of one odd-numbered subject and one even-numbered subject. The physical identity of each pair member was never revealed, and the pairing of odd- and even-numbered subjects was randomly determined for each round in the experiment. Thus, subjects were not necessarily competing against the same (unknown) opponent throughout the experiment. The experiment then began.

Upon entering the room, subjects selected a set of envelopes (equal in number to the number of rounds in the experiment) from a box containing hundreds of envelopes. Within each envelope was a random number ranging between $-a$ and $+a$. Each subject was then asked to select an integer between 0 and 100 (inclusive), called their “decision number,” and to enter their choice on their worksheet. Corresponding to each decision number was a cost listed in a table in the instructions. These costs took the form of $e^2/c$, $c > 0$, where $e$ represented the decision number and $c$ was a scaling factor used to make sure payoffs were of a reasonable size. After all subjects had chosen and recorded their decision numbers they were told to open one of their envelopes, enter the random number on their worksheets, and then add it to their selected decision number. The

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1 A colleague suggested that subjects who were placed in the advantaged position in asymmetric tournaments might not fully exploit this advantage because they did not “earn” it. To test this proposition an experiment was conducted where subjects played a preliminary game in which the winner earned the right to be the advantaged person. The results indicated that the actions of subjects in this type of tournament did not differ significantly from those reported in the text.

2 This was done so that over-arching reputations would not develop. If two players knew they were always playing against the same person, then some collusion between the two was possible. In fact, both players could have reaped maximum earnings from the experiment by tacitly agreeing to choose zero as their decision number.
sum was called their "total number" for that round. This information was recorded on a slip of paper and collected by the experimenters.

Following the collection of subjects' slips, an experimenter randomly drew an odd-numbered subject's slip and compared its total number to that on a randomly drawn slip from an even-numbered subject. This continued until all subject slips were drawn. The experimenter then announced which pair member from each comparison had the higher total number. Experiment 1 was a symmetric tournament and provided a baseline. In this experiment, subjects were instructed that the pair member with the higher total number would receive "fixed payment" $M$, while the other would receive "fixed payment" $m$, where $M > m$. Thus, there were no advantaged or disadvantaged members; an equal likelihood existed for all subjects to receive the high fixed payment. Experiments 2, 3, and 4 examined the effects of discrimination by varying the magnitude of the discrimination factor ($k$). Subjects in these experiments were told that the even-numbered pair member would only receive the fixed payment $M$ if their total number was 5 or greater (Experiment 2), 25 or greater (Experiment 3), or 45 or greater (Experiment 4), than their odd-numbered pair member. Therefore, all subjects were made aware that the odd-numbered subjects could have a lower total number than their even-numbered pair member and still receive the fixed payment $M$.

Following the announcement of subjects receiving fixed payment $M$, subjects calculated their payoff for the round by subtracting the cost of their decision number from the fixed payment. When round 1 was completed and the payoffs recorded, the next round began. All the rounds were identical. Each group of subjects repeated this procedure for 20 rounds. After completing the last round, subjects calculated their payoff for the entire experiment by adding up their payoffs for the 20 rounds and subtracting a fixed cost. Following this calculation in Experiments 3 and 4, subjects were asked to fill out a short questionnaire concerning their perceptions of the experiment. The experiments lasted approximately 75 min and subjects earned between $8.72 and $24.71 (mean = $14.99).

The experimenter made great efforts never to use value-laden terms in the instructions. For instance, instead of calling subjects with high total numbers "winners" they were simply called "high number subjects". Similarly, $M$ and $m$ were never called "prizes" but simply fixed payments. This was done to remove any possible emphasis on the game nature of the experiment and reduce the possibility that winning might affect subjects' decisions independent of payoffs.

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3 If both members of a pair had the same total number then a coin was tossed to decide which pair member was to be designated as having the higher total number. The subjects were informed of this tie-breaking procedure before the experiment began.
TABLE 1
EXPERIMENTAL PARAMETERS

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Decision number range</th>
<th>Cost function</th>
<th>Random number range</th>
<th>Fixed payments with spread</th>
<th>Predicted equilibrium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>[0,100]</td>
<td>$e^2/15000$</td>
<td>[-60, +60]</td>
<td>$2.14$ $0.86$ $1.18$ 0 $73.75$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>[0,100]</td>
<td>$e^2/10000$</td>
<td>[-40, +40]</td>
<td>$1.45$ $0.86$ $0.59$ 5 $34.57$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>[0,100]</td>
<td>$e^2/15000$</td>
<td>[-60, +60]</td>
<td>$1.45$ $0.86$ $0.59$ 25 $29.19$</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>[0,100]</td>
<td>$e^2/15000$</td>
<td>[-120, +120]</td>
<td>$2.04$ $0.86$ $1.18$ 45 $29.96$</td>
<td></td>
</tr>
</tbody>
</table>

Choosing Parameters

Table 1 describes the parameter values used in the experiments. In Experiment 1, the fixed payments were $2.14 and $0.86, the range of the random numbers -60 to +60, and the cost of effort (decision number) function was $e^2/15,000. Given these parameter values, the pure strategy Nash equilibrium derived from (4) is 73.75. The parameters were chosen to yield a Nash equilibrium of 73.75 because that number did not seem to be any natural focal point in the way that, for instance, 50 might be.

Unfair tournaments were investigated by giving one group of subjects (the odd-numbered ones) an advantage which increased their likelihood of obtaining the high fixed payment, M. In Experiment 2, in order to receive M the even-numbered subjects (i.e., disadvantaged subjects) were required to have a total number that exceeded the total number of odd-numbered subjects by at least 5 ($k = 5$). The random number range was -40 to +40, the cost of effort function was $e^2/10,000$, and the fixed payments were $1.45 and $0.86. Given these parameters the predicted equilibrium choice for both advantaged and disadvantaged subjects was 34.57.

The degree of discrimination was increased in Experiment 3 by requiring even-numbered subjects to exceed the total number of their odd-numbered pair member by at least 25 ($k = 25$) if they were to receive M.

4 Although we would have preferred to keep all parameters the same (except for $k$), the presence of "corner solutions" made this impossible. Simply put, a corner solution exists when it becomes optimal for disadvantaged subjects not to exert any effort (i.e., choose zero as their decision number). For example, subjects could have guaranteed themselves a per round payoff of m (always $0.86) by choosing a decision number of zero in every round. Subjects are predicted to do this when their expected payoff for choosing a number with a positive cost is less than m. Corner solutions can be avoided by changing the parameters, for example, increasing the spread between the high and low payments. Since this increases a subject's expected payoff from choosing decision numbers greater than zero, the probability of corner solutions is reduced.
The corner solution problem required some parameter changes. While the random number range and cost of effort function remained the same as in Experiment 1, the fixed payments changed to $1.45 and $0.86. The predicted equilibrium choice for advantaged and disadvantaged subjects was 29.19.

In Experiment 4, \( k \) was increased to 45. Again, the presence of corner solutions mandated parameter changes. While the cost function was held equal to that of Experiment 3, the random number range was increased to \(-120\) to \(+120\), and the fixed payments were set at \$2.04\) and \$0.86\). The predicted equilibrium choice for advantaged and disadvantaged subjects was 29.96.

**RESULTS**

*Observed vs Predicted Mean Decision Number Choice*

Experiment 1 provided a baseline point of comparison for subjects' behavior in a symmetric tournament versus the three unfair tournaments. As noted earlier, in Experiment 1, each subject within a pair had an equal likelihood of receiving the high payment, therefore the appropriate comparison was the observed mean decision number choice to that predicted by the theory. Figure 1 presents the pattern of per round mean decision number choices across subjects relative to predicted behavior. The figure shows that as subjects became experienced with the task, their mean decision choice numbers approximated that predicted by the theory. A

![Figure 1](image-url)
1 × 20 repeated measures analysis of variance (ANOVA) was used to compare the mean decision choices across the 20 trials to the predicted equilibrium solution and is reported in Table 2. The results indicated that the subjects’ mean observed choice across the 20 rounds was not significantly different from the equilibrium. There was not a significant effect due to trials, nor an interaction between trials and the comparison between the observed decision choices and the predicted equilibrium. Thus, subjects’ behavior in this symmetric tournament tended toward that predicted by the theory of tournaments.

Experiments 2, 3, and 4 examined subjects’ behavior under conditions of increasing unfairness. Figures 2, 3, and 4 present the pattern of per round mean decision number choices across subjects for both the advantaged and disadvantaged groups relative to the predicted choices. The results of separate 1 × 20 repeated measures ANOVA tests compared subjects’ choices to predicted and are presented in Table 2. As can be seen from the table, observed mean decision choice numbers deviated from that predicted by the theory when a discrimination factor was added to the experiments. In Experiment 2, the mean observed choice across both advantaged and disadvantaged subjects was significantly different from predicted. There were no significant trial effects nor any interactions with the trial factor.

In Experiment 3, the mean observed choice across both subject groups was significantly different from the predicted equilibrium. This difference was relatively constant over trials; no trial effects or interactions with the trial factor were found. Separate comparisons of both groups with the equilibrium also were significant. Mean decision choices of both the advantaged group and the disadvantaged group were significantly greater than the equilibrium across the 20 trials, $F(1,15) = 42.79, p < .001$, and $F(1,15) = 19.68, p < .001$, respectively.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Observed</th>
<th>Predicted</th>
<th>$F$</th>
<th>$p$</th>
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</thead>
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<tr>
<td>symmetric</td>
<td>75.57</td>
<td>73.75</td>
<td>0.45</td>
<td>.50</td>
</tr>
<tr>
<td>2</td>
<td>(25.31)$a$</td>
<td>(26.14)</td>
<td>(1,23)$b$</td>
<td>.05</td>
</tr>
<tr>
<td>3</td>
<td>43.52</td>
<td>34.57</td>
<td>4.56</td>
<td>.05</td>
</tr>
<tr>
<td>$k = 5$</td>
<td>(1,20)</td>
<td>(25.31)$a$</td>
<td>(1,20)</td>
<td>.05</td>
</tr>
<tr>
<td>4</td>
<td>49.21</td>
<td>29.96</td>
<td>51.77</td>
<td>.000</td>
</tr>
<tr>
<td>$k = 25$</td>
<td>(26.08)</td>
<td>(25.31)$a$</td>
<td>(1,30)</td>
<td>.000</td>
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<tr>
<td>4</td>
<td>54.44</td>
<td>29.96</td>
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<tr>
<td>$k = 45$</td>
<td>(28.56)</td>
<td>(25.31)$a$</td>
<td>(1,18)</td>
<td>.000</td>
</tr>
</tbody>
</table>

$^a$ Standard deviation.

$^b$ Degrees of freedom.
In Experiment 4, mean decision choices were again significantly greater than the predicted equilibrium for both subject groups. Individual comparisons for each group were also significant, with the mean decision choices of the advantaged group and the disadvantaged group signifi-

**Fig. 2.** Pattern of per round mean decision number choices across subjects relative to the predicted equilibrium in Experiment 2 \((k = 5)\).
Fig. 4. Pattern of per round mean decision number choices across subjects relative to the predicted equilibrium in Experiment 4 ($k = 45$).

significantly greater than the equilibrium across the 20 trials, $F(1,9) = 9.65, p < .01$, and $F(1,9) = 19.92, p < .005$, respectively. Again, there were no trial effects or interactions with the trial factor.

**Advantaged vs Disadvantaged Mean Decision Number Choice**

Observed decision choices for both subject groups were compared to determine if these two groups chose significantly different decision numbers. Separate $2 \times 20$ repeated ANOVAs were conducted and are reported in Table 3. Although disadvantaged subjects tended to choose higher decision numbers than advantaged subjects, this difference was

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Advantaged</th>
<th>Disadvantaged</th>
<th>$F$</th>
<th>$p$</th>
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<tbody>
<tr>
<td>2</td>
<td>43.29</td>
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<td>(30.04)</td>
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<td>.70</td>
</tr>
<tr>
<td>3</td>
<td>48.16</td>
<td>50.26</td>
<td>0.14</td>
<td>.70</td>
</tr>
<tr>
<td>$k = 25$</td>
<td>(19.75)</td>
<td>(31.11)</td>
<td>(1,30)</td>
<td>.13</td>
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<tr>
<td>4</td>
<td>47.30</td>
<td>61.58</td>
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</tr>
<tr>
<td>$k = 45$</td>
<td>(23.97)</td>
<td>(30.93)</td>
<td>(1,18)</td>
<td>.13</td>
</tr>
</tbody>
</table>

$^a$ Standard deviation.

$^b$ Degrees of freedom.
not significant in any experiment, nor were there any significant trial effects, or any significant interactions with the trial factor.

**Manipulation Check**

In Experiments 3 and 4, subjects completed a postexperiment questionnaire to determine the effect of the discrimination manipulation on subjects’ perceptions. Subjects were asked whether they felt at an advantage or disadvantage compared to their pair member using a 7-point scale. In Experiment 3, even-numbered subjects felt significantly more disadvantaged than their odd-numbered counterparts ($t(1,30) = 5.20, p < .01$). This difference was also significant in Experiment 4 ($t(1,18) = 3.80, p < .01$). These results indicate that subjects accurately perceived their advantaged or disadvantaged status.

**DISCUSSION**

The intent of the research was to examine some behavioral consequences of discrimination in a comparative incentive compensation scheme. By using a game-theoretic approach, we attempted to determine if systematic behavior was present in unfair tournaments, and if the theory of tournaments could accurately predict this behavior. The results indicate that in symmetric tournaments, observed choices of subjects did approximate that predicted. In unfair tournaments, while the behavior was systematic, it significantly differed from that predicted. Across the three unfair tournaments, both the advantaged and disadvantaged groups’ mean decision number was significantly higher than predicted, although the two groups were not significantly different from each other. Thus, the theory underestimated the choices of subjects in unfair tournaments.

This observed oversupply of effort could have been caused by non-monetary motivational factors. Previous experiments on noncooperative games (cf. Colman, 1982) have shown that while economic considerations are important, they do not solely determine subjects’ behavior. For example, in noncooperative escalation games, although most subjects drop out at the point where their investments equal the value of the prize, the ones that remain appear to be motivated by interpersonal considerations, such as “saving face” by not being the loser (Teger, 1980). Like escalation games, tournaments have “winners” and “losers.” The theory of tournaments only considers the economic consequences of winning and losing. That is, the theory does not account for any nonmonetary utility of winning. If subjects do receive nonmonetary utility from winning (i.e., gaining pleasure or avoiding embarrassment), then they might sacrifice some monetary earnings to increase their expected probability of winning. They could do this by increasing their effort level above that predicted by the theory.
Using a simple measure and a similar experimental design, Bull, Schotter, and Weigelt (1987a) found evidence that subjects in symmetric tournaments had a positive utility for winning. This motivational effect could have been exacerbated by the discrimination factor. Specifically, disadvantaged subjects may have increased their effort levels in an attempt to overcome their disadvantaged state, and their oversupply of effort could have stimulated the advantaged subjects to do the same. While the fact that subjects do have nonmonetary attributes in their preference function is not surprising, what is surprising is the apparent myopic behavior of subjects. If subjects were slightly increasing their effort levels in order to increase their probability of winning, they should have considered what their pair member was doing. Because of the interactive conditions, consequences are a function of the actions of both persons. If pair members were also slightly increasing their effort levels, then neither person would increase his or her probability of winning, both would realize lower monetary payoffs, and the tournament organizer (i.e., the firm) would realize higher payoffs. This type of behavior might mimic what occurs to employees who get caught up in “rat races” with each other. Such behavior is prevalent in situations where the spread between prizes is high. For example, in law firms or investment consulting firms where the winners become partners, while the losers must find employment elsewhere, candidates are often observed to expend tremendous amounts of effort.

An additional explanation for the apparently myopic behavior of subjects concerns the experimental parameters. Subjects were asked to perform a task which required them to understand the interrelationships between their chosen decision number, their pair member’s chosen decision number, the random number range, and the level of discrimination. Subjects may not have been able to adequately judge the point at which they were expending too much effort (i.e., choosing too high of decision numbers) in order to receive the high payment. The random range in particular may have been a significant factor because it created a noisy environment, thus making it more difficult for subjects to determine what their pair member was doing. For example, in Experiment 4 the observed mean decision choice was substantially higher than the equilibrium. It may be recalled that the random number range in Experiment 4 was relatively large (-120, +120) so as to prevent corner solutions. According to the theory of tournaments, since one of the other parameters was adjusted as well (i.e., the fixed payment spread), subjects should have considered both changes, equally, and adjusted their behavior. However, subjects may not have been able to adequately cope with the high degree of randomness, and since the cost of effort (i.e., the cost associated with the decision number choice) was relatively low, subjects in both conditions may have been deliberately choosing high numbers in an attempt to
offset the random number. Future research needs to explore these and other possible reasons for the oversupply of effort.

The present research is obviously exploratory, and several limitations should be mentioned. First, although the three experiments which examined increasing levels of discrimination followed an identical procedure, parameter changes other than just the discrimination factor \((k)\) were made. Thus, the experiments are not completely comparable. In future research a within-subjects design with levels of \(k\) varying in the same experiment should be used in order to determine if subjects' behavior can be manipulated depending on the discrimination factor. Second, the tournaments used in the present research were two-person games, comparing one individual to another. Comparison processes in organizations, however, are often based on more than two individuals. The theory of tournaments therefore needs to be expanded to include multiperson, multi-prize games, comparing the behavior of a number of individuals, or groups of individuals. Third, more experimental work is needed to test the robustness of the reported results, especially insofar as the operationalization of the major parameters, such as effort and output, is concerned.

As a result of the mathematical predictions that can be made using a game-theoretic approach, future research on equity theory and procedural justice might gain from incorporating such an approach into their models. One criticism of equity theory involves the ambiguity of the other comparison (Goodman & Friedman, 1971). The use of a game-theoretic approach avoids this problem since one subject's performance is directly compared to another's. Additionally, game theory may be enriched by integrating behavioral explanations for behavior found in equity theory and research on procedural justice. For example, a more generalized theory of tournaments that included nonmonetary motivational factors, like utility of winning, might be more useful.

**APPENDIX**

Consider the following two-person tournament. Two identical agents \(i\) and \(j\) have the following utility functions that are separable in the payment received and the effort exerted.

\[
\begin{align*}
    u_i(p, e) &= u(p) - c(e) \\
    u_j(p, e) &= u(p) - c(e),
\end{align*}
\]

where \(p\) denotes a nonnegative payment to the agent, and \(e\), a scalar, is the agent's nonnegative effort. The positive and increasing functions \(u(\cdot)\) and \(c(\cdot)\) are, respectively, concave and convex. Agent \(i\) provides a level of effort that is not observable and which generates an output \(y_i\), according to
where the production function $f(\cdot)$ is concave and $\epsilon_i$ is a random shock. Agent $j$ has a similar technology and simultaneously makes a similar decision. The payment to agent $i$ is $M > 0$, if $y_i > y_j + k$, and $M < M$ if $y_i < y_j + k$, where $k$ is a constant. A positive $k$ indicates that $j$ is favored in the tournament, while a negative $k$ indicates that $i$ is favored. Agent $j$ faces the same payment scheme.

Testing the theory of tournaments requires the specification of the utility function, the production function, the distribution of $(\epsilon_i - \epsilon_j)$ and the prizes $M$ and $m$. One simple specification is

$$U_i(p_i, \epsilon_i) = p_i - \frac{\epsilon_i^2}{c}$$
$$U_j(p_j, \epsilon_j) = p_j - \frac{\epsilon_j^2}{c},$$

where $c > 0$ and $\epsilon$ is distributed uniformly over the interval $[-a, a]$, $a > 0$, and independently across the agents. $\epsilon_i$ and $\epsilon_j$ are restricted to lie in $[0, 100]$. If a pure strategy Nash equilibrium exists and is in the interior of $[0, 100]$, each agent's first-order condition must be fulfilled,

$$\frac{\partial E_i}{\partial \epsilon_i} (\epsilon_i^*, \epsilon_j^*, k) \frac{\partial E_i}{\partial \epsilon_j} = \epsilon_i \frac{\partial E_i}{\partial \epsilon_i} (\epsilon_i^* - \epsilon_j^*) = 0$$

The concavity of the agent’s payoff function ensures that (A3) is sufficient for a maximum.

Given the distributional assumptions on $\epsilon_i$ and $\epsilon_j$, the probability of winning functions with $k > 0$ can be shown to be

$$\pi^i(\epsilon_i, \epsilon_j, k) = \frac{1}{2} + \frac{(\epsilon_j - \epsilon_i + k)}{2a} - \frac{(\epsilon_j - \epsilon_i + k)^2}{8a^2}$$
$$\pi^j(\epsilon_i, \epsilon_j, k) = \frac{1}{2} + \frac{(\epsilon_i - \epsilon_j - k)}{2a} - \frac{(\epsilon_i - \epsilon_j - k)^2}{8a^2},$$

with

$$\frac{\partial \pi^i(\cdot)}{\partial \epsilon_j} = \frac{1}{2a} - \frac{(\epsilon_j - \epsilon_i + k)}{4a^2}$$
$$\frac{\partial \pi^i(\cdot)}{\partial \epsilon_i} = \frac{1}{2a} - \frac{(\epsilon_i - \epsilon_j - k)}{4a^2}.$$

Plugging (A5) and (A6) into (A3) and solving for $\epsilon_i^*$ and $\epsilon_j^*$, we find that when $k = 0$ the equilibrium of a symmetric tournament is

$$\epsilon_i^* = \epsilon_j^* = \frac{c(M - m)}{4a}. (A7)$$
When $k > 0$, the equilibrium of an unfair tournament is defined as

$$e_i^* = e_j^* = [\frac{1}{2}a - (k/4a^2)](c(M - m)/2).$$  \hspace{1cm} (A8)

Note that despite $j$'s advantage, at equilibrium both agents choose the same effort levels.

REFERENCES


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