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ABSTRACT

The relative effectiveness of alternative reward structures in strengthening group performance on a cooperative math task was investigated by operationalizing four reward structure treatments--one non-contingent pay treatment and three differential pay allocation treatments including two levels of inter-group competition and a group piece-rate pay contingency. In each of the four treatments eight male and eight female dyads worked on cooperative math tasks for 10 performance-pay trials. Although male dyads outperformed female dyads, group performance did not vary by pay allocation treatment, even though subjects in the non-contingent pay treatment indicated the pay system was less motivating than did subjects in the three differential pay allocation treatments. Although no main effects of treatment were indicated on various satisfaction measures, members of higher performing dyads reported higher satisfaction than members of lower performing dyads on several measures, particularly when higher performance was associated with higher pay. Feasible interpretations for why performance and differential rewarding were unrelated included uncontrolled or extraneous sources of motivation in the experimental setting and the brief duration of the work session. (Author)

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Introductory Statement

The Center for Social Organization of Schools has two primary objectives: to develop a scientific knowledge of how schools affect their students, and to use this knowledge to develop better school practices and organization.

The Center works through three programs to achieve its objectives. The Schools and Maturity program is studying the effects of school, family, and peer group experiences on the development of attitudes consistent with psychosocial maturity. The objectives are to formulate, assess, and research important educational goals other than traditional academic achievement. The program has developed the Psychosocial Maturity (PSM) Inventory for the assessment of adolescent social, individual, and interpersonal adequacy. The School Organization program is currently concerned with authority-control structures, task structures, reward systems, and peer group processes in schools. It has produced a large-scale study of the effects of open schools, has developed the Teams-Games-Tournament (TGT) instructional process for teaching various subjects in elementary and secondary schools, and has produced a computerized system for school-wide attendance monitoring. The School Process and Career Development program is studying transitions from high school to postsecondary institutions and the role of schooling in the development of career plans and the actualization of labor market outcomes.

This report, prepared by the School Organization program, investigates the effects of alternative reward structures on group performance on a cooperative task.

Abstract

The relative effectiveness of alternative reward structures in strengthening group performance on a cooperative math task was investigated by operationalizing four reward structure treatments--one non-contingent pay treatment and three differential pay allocation treatments including two levels of inter-group competition and a group piece-rate pay contingency. In each of the four treatments eight male and eight female dyads worked on cooperative math tasks for 10 performance-pay trials. Although male dyads outperformed female dyads, group performance did not vary by pay allocation treatment, even though subjects in the non-contingent pay treatment indicated the pay system was less motivating than did subjects in the three differential pay allocation treatments. Although no main effects of treatment were indicated on various satisfaction measures, members of higher performing dyads reported higher satisfaction than members of lower performing dyads on several measures, particularly when higher performance was associated with higher pay. Feasible interpretations for why performance and differential rewarding were unrelated included uncontrolled or extraneous sources of motivation in the experimental setting and the brief duration of the work session.

Introduction

Miller and Hamblin (1963), after reviewing ten studies completed prior to 1960, concluded that the task performance of individuals working independently generally varies directly with intra-group differential rewarding or competition. More recent evidence tends to support their conclusion (e.g., Weinstein and Holzbach, 1972; Michaels, 1974; Michaels, 1975). However, few studies have systematically examined the effects of inter-group differential rewarding (i.e., competition between groups) on group performance on cooperative tasks. Johnson and Johnson (1974) noted that numerous studies have demonstrated that groups become more cooperative and cohesive when confronted with the external threat of a competing group, but the evidence that group competition leads to superior group performance is both meager and mixed. For example, Julian and Perry (1967) found group performance on psychology laboratory exercises to be greater under group competition than under a group reward contingency (i.e., "pure cooperation"), but Hammond and Goldman (1961) found the two group reward structures equally effective in producing adequate recommendations in group problem solving sessions. The present research extends previous differential rewarding formulations by examining the effects of differentially rewarding groups on group performance on a cooperative task.

Recent Empirical Background

The effects of differentially rewarding individuals within groups on individual math performance was investigated in a recent study (Michaels, 1975). In that study differential rewarding of individuals within groups was varied by allocating the total group pay between two dyad members in three ways: (a) equally regardless of individual performance (b) proportionately according to relative performance, or (c) disproportionately,

with the higher performer on each performance-pay trial receiving three-fourths of the total group pay. Dyads were randomly assigned to the three pay allocation conditions and each dyad member worked individually on sets of three-step math problems for 11 performance-pay trials. Performances were measured and subjects were paid after each trial according to the condition assigned. Separate analyses for males and females indicated that the math performances of females varied directly with intra-group differential rewarding, whereas performances of males did not, although the results for males were also in the predicted direction. One interpretation for the absence of significant effects for males is that the performance feedback following each performance trial encouraged males more than females to compete regardless of the pay allocation condition assigned. This interpretation is consistent with the review findings of Maccoby and Jacklin (1974) that males are generally more spontaneously competitive than females in such feedback situations, particularly on male sex-typed tasks, such as mathematics.

The Present Investigation

The present study extends the previous differential rewarding formulation by investigating the effects of differentially rewarding groups (i.e dyads) on cooperative math performance by allocating a fixed amount of pay between two dyads equally, proportionately, or disproportionally after each of 10 performance-pay trials. Thus, the levels of differential reward correspond to increasing degrees of competition between groups. A group reward contingency treatment in which the amount of pay each dyad received varied directly with group performance (i.e., a piece-rate pay system) is also included in the investigation. As in the previous study (Michaels, 1975), performance is expected to vary directly with differential rewarding,

being lowest in the equal pay allocation and highest in the disproportionate pay allocation. Group performance in the piece-rate pay allocation treatment is expected to be intermediate between that in the equal pay allocation and that in the disproportionate pay allocation.

Method

Subjects

One hundred forty-four students enrolled in summer session courses at The University of Maryland Baltimore County served as subjects. Volunteers were recruited from classrooms on the basis of the opportunity to earn a variable amount of money (from $3.00 to $10.00) for one hour's participation in a pay systems experiment and were guaranteed no deception and no aversive stimulation. Subjects assigned to dyads and experimental sessions were of the same race and sex, and each experimental session was randomly assigned to one of the four pay-allocation treatments. Thus two dyads, each made up of persons of the same race and sex, were run in each experimental session.

The data from four experimental sessions consisting of black females and one consisting of black males were deleted because the number of black male volunteers was insufficient to complete an experimental design balanced by race and sex. Thus, the completed design contained data on 64 white male and female dyads, 16 in each of the four pay-allocation conditions.

Procedures

Upon arrival subjects were seated at a long table, the two dyads being separated by a partition at the center of the table. At each subject's position were typed instructions and writing pens. In addition, the members of each dyad shared a set of math problems and answer sheets. The experimenter

was positioned at a second table approximately six feet in front of the subjects' table. At her position were a tape recorder with recorded instructions, problem answer keys, a performance-pay matrix, results sheets, a stopwatch, and money for paying subjects.

Subjects were asked to read their copies of the instructions as the taped version was being played. The instructions stated that the purpose of the experiment was to find out how groups performed on math problems under different pay systems. The pay system the subjects would be operating under was then described. Subjects assigned to the equal pay allocation treatment were told that $2.00 would be divided equally between the two dyads after each trial regardless of performance. Subjects assigned to the proportionate pay allocation treatment were told that $2.00 would be divided proportionately between the two dyads after each trial. Thus, if one dyad contributed 60 percent of the total performance, that dyad would receive 60 percent of the $2.00, or $1.20. Subjects assigned to the disproportionate pay allocation treatment were told that $2.00 would be divided disproportionately between the two dyads after each trial, the higher performing dyad receiving 75 percent, or $1.50. Finally, subjects in the piece-rate pay allocation treatment were told that their dyad would earn five cents for each problem worked correctly on each performance trial. In each case, dyad earnings were to be split evenly between dyad members. The instructions stated how the math problems were to be worked and how dyad members would share the work. Subjects were informed that there would be 10 separate performance-pay trials. At the end of the instructions the experimenter offered to answer any questions the subjects might have regarding the pay system, the math problems, or the procedures to be followed. The work

session began after all subjects expressed complete understanding of the instructions and procedures.

On each of 10 performance-pay trials dyads worked for two minutes on a different set of 24 three-step math problems similar to those used in previous research on motivation by Raynor and Rubin (1971) and Entin and Raynor (1973). The task was made cooperative by requiring dyad members to work alternate math problems, passing a single problems sheet back and forth between them on each trial.. The experimenter called time at the end of two minutes, collected and scored the answer sheets, and provided subjects with a results sheet. The results sheets for dyads assigned to the equal and piece-rate pay allocation treatments (in which the dyad's pay could not be affected by the other dyad's performance) informed dyad members of their own performance and pay on that trial. In contrast, the results sheets for dyads assigned to the proportionate and disproportionate pay allocation treatments (in which the dyad's pay could be affected by the other dyad's performance) informed dyad members of the other dyad's performance and pay as well as their own. The reason for not informing equal and piece-rate pay system dyads of the other dyad's performance and pay was to preclude the possibility of spontaneous competition between dyads even though a competitive reward structure was absent. Dyads were then paid the amounts indicated on the results sheets. Total pay was allocated equally between dyads when performance ties occurred in the disproportionate pay allocation treatment. After the dyad pay had been split evenly between dyad members, the next performance trial began.

At the end of the work session, subjects were asked to report their feelings about various aspects of the experiment by completing a questionnaire (see Appendix A) consisting of 12 Likert-type items. Subjects were

asked to report how important they considered their performance and pay; how satisfied they were with their performance and pay; how satisfied they were with the pay system, their work partner, and the task; how fair and how motivating the pay system was; and finally, how satisfied they were with their participation in the study in general.

Results

Performance

Group performance was analyzed by means of a 2 x 4 analysis of variance for effects due to sex and pay allocation treatment. Although a main effect of sex was indicated, in which male dyads scored higher than female dyads ($F = 6.91$, $p < .01$), no main effect of pay allocation treatment was indicated ($F = 1.14$, $p < .33$), and no Sex X Treatment interaction effect was indicated ($F = .64$, $p < .59$). Table 1 shows the group performance means and standard deviations by sex and pay allocation treatment.

Self-Report Measures

Self-report measures were analyzed by means of a 2 x 4 x 2 analysis of variance for effects due to sex, pay allocation treatment, and performance rank (i.e., whether the dyad was the higher or lower performing dyad during the session).

Treatment effects. Subjects in the equal pay allocation treatment reported the pay system to be less motivating (item 11, Appendix A) than did subjects in the differential pay allocation treatments ($F = 27.85$, $p < .001$), but no treatment differences were indicated on item 1 ($F = .83$) which asked subjects to report how important they considered performing well on the task to be. There were also no treatment differences indicated on satisfaction

Table 1

Group Performance Means and Standard Deviations by Sex and Treatment

	Pay Allocation Treatment			
	Equal	Proportionate	Disproportionate	Piece-Rate
Males				
M	111.38	116.88	110.38	127.00
SD	24.02	38.13	29.02	30.91
Females				
M	106.88	107.25	96.13	104.13
SD	21.27	27.32	26.81	18.32

with the pay allocation between groups (item 5, $F = 1.11$, $p < .35$), or within groups (item 6, $F = .16$), fairness of the pay allocation system between groups (item 10, $F = 2.59$, $p < .056$), or overall satisfaction (item 12, $F = 1.60$, $p < .19$).

Rank effects. Performance rank (i.e., whether the subject was a member of the higher or lower performing dyad during the work session) apparently affected several self-report measures. However, performance rank and pay rank are confounded in three of the four pay allocation treatments (i.e., the higher performers also received higher pay). Thus, there is no way to determine whether the effects were due to performance differences, pay differences, or both. Members of higher performing dyads reported being more satisfied with their group's performance (item 3, $F = 49.64$, $p < .001$) and their group's pay (item 4, $F = 28.32$, $p < .001$) than did members of lower performing dyads. However, both main effects were accompanied by similar Treatment X Rank interaction effects, indicating that members of higher performing dyads were more satisfied with their group's performance ($F = 3.61$, $p < .016$) and pay ($F = 8.80$, $p < .001$) only in the three differential pay allocation treatments. Thus, differential performance apparently affected satisfaction with performance and pay only when it was accompanied by differential pay. Members of higher performing dyads also reported greater liking for the task (item 7, $F = 6.61$, $p < .011$), greater liking for their partners (item 8, $F = 9.46$, $p < .003$), greater preference for the same partner again (item 9, $F = 26.30$, $p < .001$), and greater overall satisfaction from participating (item 12, $F = 11.59$, $p < .001$) than did members of lower performing dyads. The main effect of performance rank on overall satisfaction was accompanied by a Sex X Treatment interaction effect ($F = 3.79$, $p < .012$) suggesting that the

positive association between performance rank and overall satisfaction held for males only if they were in the disproportionate or piece-rate pay allocation treatments, whereas the relation held for females across all four pay allocation treatments.

Discussion

In contrast to the previous study (Michaels, 1975), and contrary to predictions, group performance on cooperative math tasks was not associated with differential rewarding for either sex--dyads of both sexes performed similarly regardless of pay allocation treatment. The expected performance differences did not occur even though subjects in the differential pay allocation treatments reported the pay system to be more motivating than subjects in the equal pay allocation treatment. Assuming we can take subjects at their word, it appears that either performance on the task was not responsive to varying levels of motivation, or there were other uncontrolled or extraneous sources of motivation in the task environment. The former interpretation, that performance on the task was not responsive to varying levels of motivation, contradicts the previous findings of Raynor and Rubin (1971) and Entin and Raynor (1973), who used the same task in their research, but not as a cooperative task. The latter interpretation, that there were uncontrolled or extraneous sources of motivation in the task environment, appears more likely. Specifically, regardless of the pay allocation treatment, the cooperative nature of the task appeared to motivate subjects to work quickly when they received the problems sheet from their partners. The problems sheets were typically passed back and forth between partners with vigor. Thus, a norm of responsibility to the partnership may have operated as an

additional motivating factor--that is, the individual working the problem may have felt real peer pressure to get the problem done quickly and return the sheet to his or her partner.

The question that arises is whether or not this source of motivation, if operative, would continue to operate over longer duration if it were not accompanied by differential pay. Thus, one could argue that the short duration of the work session (about 30 minutes) did not provide a fair test of the differential rewarding hypothesis. Perhaps if subjects performed daily on the task over an extended period of time the novelty of the task and the norm of responsibility in the absence of differential pay would wear thin, causing a gradual decline in performance. Such extended work sessions would, of course, be a closer approximation to working in natural classroom or industrial settings.

One other finding with potential relevance to classroom and other work settings may be worthy of further investigation. This was the finding that members of higher performing dyads reported greater satisfaction with their group's performance than members of lower performing dyads only when higher performance was associated with higher pay. This brings to mind the question of the degree to which satisfaction with performance depends on external recognition of the performance, one source of recognition being formal rewards such as pay.

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Appendix A

POST EXPERIMENTAL QUESTIONNAIRE

1. How important to you was whether your group did poorly or well on the task?

not at all important	slightly important	moderately important	extremely important

2. How important to you was whether your group earned little money or much money?

not at all important	slightly important	moderately important	extremely important

3. How satisfied are you with your group's performance on the task?

not at all satisfied	slightly satisfied	moderately satisfied	extremely satisfied

4. How satisfied are you with the amount of money your group earned?

not at all satisfied	slightly satisfied	moderately satisfied	extremely satisfied

5. How satisfied are you with the system by which the two groups were paid?

not at all satisfied	slightly satisfied	moderately satisfied	extremely satisfied

6. How satisfied are you with the system by which your group's pay was divided equally between you and your partner?

not at all satisfied	slightly satisfied	moderately satisfied	extremely satisfied

7. How much did you like working on the task?

liked not at all	liked slightly	liked moderately	liked extremely

8. How much did you <u>like</u> working with your partner?

liked not at all	liked slightly	liked moderately	liked extremely

9. If you had a choice, how much would you <u>like</u> to work with the <u>same partner</u> again?

would not like at all	would like slightly	would like moderately	would like extremely

10. How <u>fair</u> was the system by which the two groups were paid?

not at all fair	slightly fair	moderately fair	extremely fair

11. How much did the system by which the two groups were paid <u>motivate</u> you to do your best on the task?

motivated not at all	motivated slightly	motivated moderately	motivated extremely

12. All things considered, how <u>satisfied</u> are you with your participation in the study?

not at all satisfied	slightly satisfied	moderately satisfied	extremely satisfied