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ABSTRACT

The general shortcomings of the traditional classroom reward structure are discussed in light of performance-reward principles of demonstrable effectiveness. Four alternative general reward structures are analyzed, and studies comparing their effectiveness are reviewed. Although none of the reward structures was found to be consistently superior in terms of strengthening academic performance, group reward structures were consistently superior to individual reward structures in strengthening several intragroup processes. Although the appropriateness of a particular general reward structure may vary from one case to another according to resources and goals, effectiveness is apparently strongly affected by the particular operationalization of the general reward structure. (Author)

CLASSROOM REWARD STRUCTURES AND ACADEMIC PERFORMANCE

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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 School Organization program is currently concerned with authority-control structures, task structures, reward systems, and peer group processes in schools. The Careers program (formerly Careers and Curricula) bases its work upon a theory of career development. It has developed a self-administered vocational guidance device and a self-directed career program to promote vocational development and to foster satisfying curricular decisions for high school, college, and adult populations.

This report, prepared by the School Organization Program, reviews and analyzes the research comparing the effects of alternative reward structures on the academic behavior of students.

Abstract

The general shortcomings of the traditional classroom reward structure are discussed in light of performance-reward principles of demonstrable effectiveness. Four alternative general reward structures are analyzed and studies comparing their effectiveness are reviewed. Although none of the reward structures was found to be consistently superior in terms of strengthening academic performance, group reward structures were consistently superior to individual reward structures in strengthening several intra-group processes. Although the appropriateness of a particular general reward structure may vary from one case to another according to resources and goals, effectiveness is apparently strongly affected by the particular operationalization of the general reward structure.

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Introduction

Classroom reward structures refer to the performance criteria, contingencies, or standards students must satisfy in order to receive presumably valued or reinforcing consequences. The most traditional classroom reward structure is a form of individual competition under which students are graded according to their performances relative to those of their classmates. This reward structure has been increasingly criticized as being less effective than alternative reward structures in strengthening and maintaining the academic performances of most students (e.g., Deutsch, 1949; Coleman, 1959; Spilerman, 1971; and Johnson & Johnson, 1974).

Because the performances of at least some students <u>are</u> effectively strengthened under the traditional structure, it is tempting to dismiss the criticism by arguing that performance differences are simply a function of differences in ability and effort. This argument ignores the possibility that both ability and effort may be more effectively strengthened under alternative classroom reward structures. Even if the most effective classroom reward structure would not fully overcome initial differences in the abilities of students, it is reasonable to assume that the vast majority of students have sufficient ability to master the basic skills necessary for satisfactory academic performance. Yet many students are apparently not doing so under the traditional reward structure.

<u>Effective Reward Structures vs. Traditional Classroom Reward Structure</u>.

Reinforcement (e.g., Skinner, 1968), utility (e.g., Ofshe & Ofshe, 1970), and expectancy (e.g., Kukla, 1972) formulations suggest that

effective classroom reward structures, regardless of how they might otherwise differ, would satisfy at least three general criteria. First, the rewards for, or consequences of, satisfactory performance must have significant value or utility to students. In other words, the consequences of satisfactory performance must be reinforcing. Second, the probability of reaching a satisfactory level of performance must be substantially above zero. In other words, given reasonable effort, there must be a reasonable chance of receiving the rewards. Third, because the satisfactory performance of all students is desired, the above criteria must hold for all students in the class. In other words, the reward structure must be responsive to the performances of all students.

Responsiveness to the performances of all students is not characteristic of the traditional classroom reward structure. First, the value or reinforcing effectiveness of high grades varies considerably across students. Presumably the value or reinforcing effectiveness of high grades is greater for students who plan to enter college than for those who do not, and greater for students whose parents reinforce high grades than for those whose parents do not. Several procedures described in the following review demonstrate the reinforcing effectiveness of rewards other than high grades; rewards which are readily available in classroom settings and which may have greater immediate utility for a wider range of students.

Second, the probability of receiving high grades also varies considerably under the traditional classroom reward structure. The probability is extremely high for high ability students who try and extremely low for

low ability students who try. The students who need to try hardest are given the least incentive to do so; for the probability of the low ability studsnt receiving a high grade is approximately zero regardless of effort, and the utility of receiving a barely passing grade may hardly be worth the additional effort required.[1] Several procedures described in the following review provide average and low performers with a more reasonable chance of success.

Third, the traditional classroom reward structure is not equally responsive to gradual changes in performance across all performance levels. A high performer may receive a still higher grade for a five percent increase in performance, whereas a low performer may still receive a failing grade for a 30 percent increase. Consequently the behavior associated with the 30 percent increase is not reinforced. Several procedures described in the following review render the classroom reward structure more responsive to performance changes by low performers.

In summary, several characteristics of the traditional classroom reward structure appear to render eventual success by initially low performers unlikely. In fact, the effectiveness of this reward structure may be largely restricted to students in the top third of the class, for these are apparently the students to whom the reward structure is most responsive. The problem is to implement classroom reward structures which are likely to more effectively strengthen and maintain the academic

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[1] It should be noted that a stimulus cannot become a reinforcer unless it is at least occasionally received by a performer.

performances of a wider range of students. The purpose of the present paper is to review and analyze the research comparing the effects of alternative classroom reward structures on the academic behavior of students.

General Approaches

Two distinct general approaches to structuring rewards in classroom settings can be identified. These are the reinforcement approach (e.g., Packard, 1970; Bushell, et al., 1968; Hamblin, et al., 1972) and the competition approach (e.g., Deutsch, 1949; Coleman, 1959; Edwards, et al., 1972). Collaboration across the two general approaches has been minimal and for the most part each approach has maintained its own distinct concepts, methodology, and literature. Because potentially effective general classroom reward structures are associated with each approach, joint consideration of both approaches should provide a more complete analysis of potentially effective reward structures than would consideration of either approach alone. Although each reward structure will be considered in detail, it may be helpful to briefly compare their general characteristics.

Reinforcement and competition approaches. It is necessary to distinguish two major differences between the reinforcement and competition approaches. The first difference concerns the relationship of rewards across recipient units, be they individuals or groups. Reinforcement reward structures involve reward independence across units. In other words, the magnitude or probability of rewards for one unit is unrelated to the magnitude or probability of rewards for other units.

In contrast, competition reward structures involve negative reward interdependence across units. In other words, the magnitude or probability of rewards for one unit is an inverse function of the magnitude or probability of rewards for other units.

The second major difference concerns who sets the standards to which each unit's performance is compared in order to determine reward allocation. Under reinforcement reward structures these standards are set by external agents; i.e., persons operating outside of the current reward structure. Under competition reward structures, these standards are set by the performances of all units concurrently in negative reward interdependence. Thus units receive rewards according to how their performances compare to those of other units.

Individual and group reward types. Two general reward structures are associated with each type, depending on whether individuals or groups represent the performing and recipient units. Under an individual reward contingency, each individual's performance is independently compared to an external standard in order to determine reward allocation; whereas under individual competition, individual performances are compared across all individuals in concurrent negative reward interdependence in order to determine reward allocation. Under a group reward contingency, group performances are independently compared to an external standard to determine reward allocation across groups, and typically all members of a particular group receive the same consequence. Under group competition, group performances are compared across groups in order to determine reward allocation across groups, and typically all members of a particular group receive the same consequence. Thus, group reward contingencies and

group competition both involve positive reward interdependence within groups, but group competition also involves negative reward interdependence across groups. It should be made clear that the within group allocation of group rewards is not part of the definitions of group reward types. Although equal allocation of group rewards among group members is typical of both group reward contingencies and intergroup competition, group rewards may also be allocated differentially among group members. Of course, if the differential allocation is in accordance with the relative performance of group members, the intragroup reward structure is by definition competitive regardless of the intergroup reward structure. The major distinguishing characteristics of the two approaches and four reward structure types are summarized in Table 1 on the following page.

Several cautions regarding the four reward structures are in order. First, these reward structures represent general types. The specific rewards used, performance conditions, reward criteria, and reward procedures may vary considerably across specific applications of the same general type. For example, the traditional classroom reward structure is only one of many possible ways of operationalizing individual competition, and the different operationalizations may vary widely in their effectiveness. This means within-cell variations should be attended to as well as between-cell variations. It also means that drawing conclusions about the superiority of a general reward structure type from the findings of a single study operationalizing only one example of each type would be extremely risky.

Table 1 BEST COPY AVAILABLE

Summary of General Reward Structure Approaches and Types

Description	General Approach: Reinforcement	General Approach: Competition
General Characteristics	Standards set by external agents. Reward interdependence across units.	Standards set by other competitors. Negative rewar inter-dependence across units.
Applied to Individuals	Individual reward contingencies. Reward independence across individuals.	Individual (intra-group) competition. Negative reward interdependence across individuals.
Applied to Groups	Group reward contingencies. (Pure cooperation) Reward independence across group and positive reward interdependence within groups.	Group competition (Inter-group competition and intra-group cooperation) Negative reward interdependence across groups and positive reward interdependence within groups.

Second, the four general reward structures represent pure types, but more than one type may be implemented concurrently in a single setting. For example, concurrent individual and group competition may be implemented by using the outcomes of direct competition among individuals representing different groups to determine the outcomes of competition among groups.

Third, the present typology is derived from the research traditions for the sole purpose of classifying the studies reviewed and making between-cell comparisons of effects. The present reward structure types, like the studies themselves, do not exhaust the full range of possible reward structures.

Finally, the performance-reward standards for any reward structure may be binary, incremental, or some combination of both. Under binary performance-reward standards, a particular performance either meets or does not meet the criteria for rewards and the unit is either rewarded or not rewarded accordingly. Thus, the unit may succeed or fail, win or lose, and is not rewarded differentially by the degree to which its performance exceeds the criteria. Under incremental standards, performance is judged on a continuum, and magnitude or probability of rewards is a direct function of magnitude or quality of performance. Traditional grading practices represent a combination of binary and incremental standards under which performances up to some artibrary point are judged as failing, but thereafter letter grade is determined by the ordinal category within which the performance falls.

The Reinforcement Approach

Individual Reward Contingencies[1]

Most operant conditioning studies in schools (as well as other natural settings) have used individual reward contingencies to modify the behavior of students in the class. Thorough reviews of applications of individual reward contingencies in classroom settings are available (e.g., Altman & Linton, 1971; O'Leary & Drabman, 1971). Only a few examples are given here in order to facilitate comparison with group reward contingencies and competition reward structures.

Individually tailored reward contingencies. One category of individual reward contingency applications includes individualized approaches in which a particular behavior by a specific student is considered undesirable, or desirable but infrequent, and procedures are designed to modify (weaken or strengthen) the behavior. The procedures usually involve presenting rewards contingent on the desired behavior. Zimmerman and Zimmerman (1962), for example, treated the different behavior problems of two students in the same class by rewarding appropriate behaviors incompatible with the inappropriate behaviors. In one case persistent and bizarre misspellings of words were ignored (extinguished), whereas correct spellings of words were rewarded by teacher attention and praise, in addition to earlier release as a consequence of completing word lists sooner. The frequency of bizarre spellings approached zero after four weeks of treatment. The temper tantrums, baby talk, and irrelevant comments and questions of

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[1]The term "reward" is used to refer to the presumed valued or attractive consequences students receive contingent on specified behaviors. In contrast, a reinforcer is a consequence which actually strengthens the behavior on which it is contingent. Thus, it is acknowledged that rewards used in academic settings may have differential reinforcing effects across students.

another student in the same class were similarly ignored, whereas incompatible appropriate behaviors were intermittently followed by teacher attention and praise. The frequency of inappropriate behaviors gradually approached zero and appropriate behaviors increased in frequency. At the termination of the treatment, the student's speech was described as being relevant and mature.

Such individualized treatments in classroom settings can produce undesirable modeling effects if the relationship between becoming a reformed sinner and receiving rewards becomes obvious. The student with a history of temper tantrums received special attention and praise not received by other students without a history of temper tantrums. Thus, any student deprived of special attention and praise might establish a history of temper tantrums in order to receive the rewards which accrue to reformed sinners.

Identical contingencies for a set of individuals. The above-mentioned problem is avoided in a second category of individual contingency applications in which identical individual reward contingencies apply to all students in the class. The use of a token economy (or exchange) system in institutional settings is perhaps the clearest example of this type of application. Under a token economy, individuals receive tokens or credits for emitting any of several previously specified behaviors. Tokens or credits earned can later be exchanged for a variety of goods and special privileges. In an early and extensive application, Ayllon and Azrin (1965) found that a token economy effectively altered a wide range of behaviors of psychotics in a mental institution. In an early

application in a preschool setting, Bushell, et al. (1968) used a token exchange system to extinguish aggressive behaviors in hyperaggressive boys and bizarre and disruptive behaviors of autistic children, and to strengthen reading by two-year-olds, functional speech by autistic children, and the frequency of verbal communication by shy and withdrawn ghetto children.

In summary, individual reward contingencies have been used to modify a wide range of behaviors of students in classroom settings. Under individual reward contingencies any student emitting the specified behavior receives rewards, and the rewarding of one student is contingent only on that student's behavior. Thus, at least operationally, the behaviors and consequences of one student are independent of those of others.[1]

Group Reward Contingencies

In contrast to individual reward contingencies, group reward contingencies produce interdependence among the individuals in the group. There are typically two sources of operational interdependence--behavior interdependence and reward interdependence. Behavior interdependence is a result of group rewards being made contingent on the behaviors of more than one group member. Typically most or all group members must emit similar or dissimilar behaviors, simultaneously or in sequence. Reward interdependence is a result of more than one group member receiving rewards. Typically all group members receive identical rewards. Thus, under group reward contingencies there is typically both behavior and consequence interdependence.

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[1]This does not rule out the possibility of behavior modeling effects or cognitive effects such as feelings of inequity or relative deprivation. Thus, the behaviors of individuals sharing a common environment may not be completely independent in an empirical sense.

Group contingencies for simple behaviors. Behavior interdependence and reward interdependence were present in the group reward contingency application by Schmidt and Ulrich (1969). In the first application, students in a fourth grade class received additional gym period time and a short break contingent on maintaining an unbroken ten minute quiet period during their free study period. Behavior interdependence in this case was based on the requirement that all students had to remain quiet simultaneously. An outburst by any student would terminate the current quiet period. Classroom noise level dropped from a baseline average of 52.5 decibels to an average of 39 decibels during the group reward contingency (maximum allowable noise level for group reward was 42 decibels). The authors reported the exertion of peer pressure on noisier members of the class during the time the contingency was in effect. In a second application the group noise contingency was combined with an individual negative punishment contingency for being out of seat without permission. Under the individual punishment contingency, students who were inappropriately out of their seats when observations were taken lost five minutes of gym period. Noise levels, being out of seat, and teacher reprimands decreased sharply under the dual contingency, thus demonstrating the potential effectiveness of concurrent individual and group reward contingencies.

Barrish, et al. (1969) used a group reward contingency procedure to reduce talking and being out of seat without permission in a fourth grade class. The group reward contingency was described as a game in which the two teams constituting the class could earn special privileges

(including going to lunch early and a 30-minute free period) by following the rules concerning talking and being out of seat. When a student was observed breaking the rules, one mark went against his team. When the total marks against the team were fewer than a specified allowable number (varying from 10 to 5 during the course of the experiment) at the end of the period, the team received the privileges. The two teams were in competition against one another only if the marks against both teams exceeded the allowable number. In this case the team with the fewer marks received the privileges. Apparently team competition did not become an important factor as both teams earned privileges on 14 out of a possible 17 trials. Compared to baseline levels, inappropriate behavior was reduced by approximately three-fourths under the group reward contingency, but returned to baseline levels when the reward contingency was removed. Fourteen of the 21 students reported liking the game, several requesting that it be extended to other class periods.

The effects of individual and group reward contingencies were compared in a study by Herman and Gramontana (1971) in which appropriate rest period behavior was strengthened in two groups of Head Start children. Appropriate rest period behavior was defined as remaining still and quiet, body resting on the mat. During baseline, inappropriate behavior occurred in almost all time intervals sampled. Baseline conditions were followed by several experimental treatments in which tokens (which could be exchanged for 10-cent toys) were presented contingent on appropriate behavior. Inappropriate behavior decreased only slightly under contingent rewarding without instructions, but approached zero under contingent rewarding

paired with instructions regarding the behavior to be rewarded. Instructions without individual or group reward contingencies were relatively ineffective in reducing inappropriate behavior. Individual and group reward contingencies were equally effective, but because inappropriate behavior approached zero under both contingencies, this may not be a very powerful test of relative effectiveness.

Group contingencies for complex behaviors. Apparently there is still some suspicion that, although contingent rewarding may be effective in modifying simple motor behaviors such as being quiet and remaining seated, similar procedures are unlikely to be effective in substantially altering the more important and complex motor and cognitive activities associated with attending to academic tasks and academic performance. The effectiveness of individual reward contingencies in increasing task and achievement behavior has been demonstrated in studies reviewed by O'Leary and Drabman (1971). The following studies demonstrate the potential effectiveness of group reward contingencies in increasing academic task behavior and performance.

Packard (1970) used a group reward contingency to increase attention to academic tasks. Kindergarten, third, fifth, and sixth grade students received access to play activities and special privileges contingent on all students in the class simultaneously attending to academic tasks. The three components of attending were: (1) silence (2) appropriate eye and body positions and (3) following instructions. Instructions and descriptions of desired behaviors paired with teacher praise or admonitions had no effect on the attending of kindergarten children and third graders,

and only a slight short-term effect on the attending of fifth and sixth graders. Instructions paired with the group reward contingency substantially increased attending in all classes. Attending increased from a baseline average of less than 15 percent of total class time to an average of over 75 percent under the group contingency. Attending increases were no doubt facilitated by a shaping procedure which required the class to exceed previous attending time by 5 percent in order to receive rewards. Although the peer support and peer pressure factors were not included in the analysis, the author reported instances of peer scolding of nonattending students and peer praising of reformed sinners.

Bushell, et al. (1968) used both individual and group (dyadic) reward contingencies to increase study behavior in a preschool class. The group contingency applied during team study sessions in which student tutors were assigned to help other students. During these team study sessions, tokens were presented to both members of study teams which appeared to be actively working on the assigned task. Both team members could earn additional tokens at the end of the session contingent on the quiz performance of the tutee only. Tokens could be accumulated from day to day and exchanged for the opportunity to attend special events. When attending special events was contingent on payment of tokens earned for task behavior, study time for the class as a whole represented 67 percent of total class time. When attending special events was made non-contingent, study time dropped to 42 percent, but immediately jumped 22 percent when the contingency was reapplied. After four days, study behavior for the class as a whole represented 80 percent of total class time. Because

students could also earn tokens under an individual reward contingency, the separate effects for individual and group reward contingencies are not recoverable from the data.

Hamblin, et al. (1971) compared the academic achievement gains in spelling, mathematics, and reading for groups of fourth graders operating sequentially under two individual reward contingencies and three somewhat different group reward contingencies. The three group contingency treatments differed only in the way "group performance" was computed. Under the average performance group contingency, group members were rewarded proportionate to the average performance of all group members. Under the high performance group contingency, group members were rewarded proportionate to the average performance of only the three highest performers. Under the low performance group contingency, group members were rewarded proportionate to the average performance of only the three lowest performers. In each case, however, all members of a group showing satisfactory progress received an equal share of tokens which could be exchanged for food, toys, and sundries. Under the individual performance contingency, individuals received tokens for making satisfactory academic progress, and under the individual attendance contingency, individuals received tokens for attendance only.

Several interesting findings were reported. First, the individual attendance contingency was relatively ineffective in affecting academic performance. Second, the individual performance contingency and the average performance group contingency were about equally effective in producing gains in academic achievement. Third, the average gain for all students was greatest under the low and high performance group contingencies.

Although these two group contingencies produced similar average gains, they produced different effects across academic ability levels. Specifically, the low performance group contingency produced the greatest gains by low ability students, whereas the high performance group contingency produced the greatest gains by high ability students. Thus, in both cases those students whose academic performances were most likely to contribute to the group performance showed the greatest gains in academic performance. These findings suggest that a group reward contingency which enhances the contribution that low performers make to the group performance is likely to be effective in increasing the performances of all group members, and the performances of low performers in particular.

The authors suspected that the increased achievement gains by low performers under the low performance group contingency was partially due to a greater frequency of spontaneous peer tutoring under this contingency. In a second experiment, only the low performance group contingency and the individual performance contingency were used, and the proportion of total individual rewards deriving from these sources was systematically varied. Specifically, the proportion of total individual rewards deriving from the low performance group contingency was either zero, 33, 67, or 100 percent, while those deriving from the individual contingency were 100, 67, 33, or zero percent respectively.

Findings indicated that the frequency of spontaneous peer tutoring varied directly with the proportion of individual group members' rewards deriving from the low performance group contingency. When rewards were based totally on individual performance (100 percent individual contin-

gency--zero percent group contingency) an average of approximately 15 percent of available time was spent tutoring. When rewards were based totally on the group contingency, 80 percent of the available time was spent tutoring. The intermediate levels of the group contingency (33 and 67 percent group contingency) produced intermediate and proportionate levels of peer tutoring, indicating an approximately linear relationship between strength of the group contingency and the frequency of spontaneous peer tutoring.

Summary. The group reward contingencies reviewed parallel earlier individual reward contingency applications. Individual and group reward contingencies are similar in that all individuals or groups which satisfy the contingency are rewarded. Rewards received by one individual or group do not affect the magnitude or probability of other's rewards. Thus, the only operational competition is against the previously established standard or criterion to which actual behavior is compared in order to determine whether or not rewards are to be presented.

In all cases every member of a group which satisfied the group contingency received identical rewards. Thus, in all cases there was positive reward interdependence among group members. With two exceptions (Bushell, et al., 1968; Hamblin, et al., 1971) group members were rewarded only if all members emitted the specified behavior. In the first exception both members of a tutoring group could receive additional tokens contingent on the quiz performance of the tutee only. In the second exception only the performances of the high or low performers in the group contributed to the group performance. Thus, both behavior and reward interdependence are typically operational under group contingencies.

In all applications reviewed, group reward contingencies were effective in altering the behavior of individuals in groups. The comparison of individual and group contingencies in terms of relative effectiveness was attempted in only two cases. In both cases (Herman & Tramontana, 1971; Hamblin, et al., 1971) individual and group contingencies were found to be equally effective if the average performance group contingency in the latter study is used as the comparative group contingency.

Two characteristics of operant conditioning in schools sometimes make it difficult to judge the relative effectiveness of the reward structures involved. First, researchers frequently do not describe baseline reward structure, if any. Under baseline conditions the rewards and the contingencies may have been meager or nonexistant for the behavior of interest. Second, reward and contingency effects are frequently confounded. Operant researchers frequently make novel and more immediately valuable rewards available under experimental treatments than existed under baseline conditions. In these cases it is impossible to separate reward change effects from contingency effects. As a consequence of these two shortcomings, when the experimental reward contingency is reported to effectively strengthen the behavior of interest, we must frequently ask, "compared to what?"

The Competition Approach

In academic settings, competition usually refers to reward structures in which limited or fixed rewards are differentially allocated to individuals or groups according to their respective performances. The standards

by which level of performance is measured are typically the performances of all individuals or groups concurrently in negative reward interdependence. The magnitude or probability of rewards is a direct function of relative performance, with individual (intragroup) competition referring to differential rewarding across individuals within a group, and group (intergroup) competition referring to differential rewarding across groups paired with equal rewarding within groups. The equal rewarding within groups under group competition constitutes the positive reward interdependence among group members so frequently labeled "cooperation." For the sake of clarity, however, the term cooperation will be used to refer to behavior interdependence (e.g., coordination and collaboration) rather than positive reward interdependence.

For many decades, schools have adopted individual competition as a matter of course. Several investigators (e.g., Deutsch, 1949; Coleman, 1959; Spilerman, 1971; and Johnson & Johnson, 1974) have urged the more widespread adoption of group competition. The studies reviewed below are representative of the research in which the effects of individual and group competition are compared. A more extensive review of the literature is provided by Johnson and Johnson (1974).

Individual versus Group Competition

Using higher course grades and term paper exemptions as rewards, Deutsch (1949) tested the relative effectiveness of individual and group competition on group problem solving tasks. Under individual competition (differential rewarding within groups), students received high grades

and exemptions by being the top performer in their group. Under group competition (differential rewarding among groups--equal rewarding within groups), students received high grades and exemptions by being a member of the top five groups. Most productivity measures (e.g., productivity per unit time and product quality) and all group process measures (e.g., helping, coordinating, intragroup liking, and peer pressure and influence) were greater under group than individual competition. No differences were found on individual learning or interest and involvement.

Hammond and Goldman (1961), however, failed to replicate Deutsch's findings. Students worked on group problem solving tasks under one of four reward structures: an individual reward contingency, a group reward contingency, individual competition, or group competition. Although most differences across the four treatments were not statistically significant, individual and group reward contingencies were ranked as being slightly more effective than individual and group competition. Individual and group competition did not produce significant differences in performance on group problem solving tasks. Differences across treatments might have been greater had the magnitude or utility of rewards (credits toward final grade) been as great as those in the Deutsch study.

Julian and Perry (1967) also compared the effects of individual and group competition with those of a group reward contingency, but in this case the group reward contingency came in a poor third. College psychology students working on laboratory tasks were told they would

have their laboratory exercises graded under one of three systems. Students in the individual competition treatment were told that the best papers in the class would receive A's, the next best papers B's, etc. Students in the group competition treatment were told that each member of the group which turned in the best exercise would receive an A, each member of the group which turned in the next best exercise a B, etc. Students in the group contingency treatment (called "pure cooperation" by the authors) were told that each member of any group which got 90 percent of the possible points would receive an A, 80 percent a B, etc. Thus, the competition in this case was against a previously established percent criterion. Both quantity and quality of performance were highest under individual competition and lowest under the group contingency based on the percent criterion. Specifically, performance quantity scores were 534 under individual competition, 410 under group competition, and 264 under the group contingency. Performance quality scores were 6.3, 5.5, and 4.3 respectively.

Behavior interdependence and differential rewarding. The three studies reviewed above used tasks requiring a fairly high degree of task or behavior interdependence (i.e., coordination and collaboration). Miller and Hamblin (1963) investigated the effects of degree of task interdependence and degree of differential rewarding on the performance of individuals in groups. Two levels of task interdependence and three levels of differential rewarding were used. Task interdependence was generally defined as the extent to which group members needed to exchange information in order to solve a problem, and operationalized as whether

or not guessing wrong was penalized. Degree of differential rewarding was operationalized as the difference between the rewards of group members adjacently ranked on performance.

Three-member groups worked 10 trials on a number-guessing task in which they tried to determine which of 13 numbers had been chosen by the experimenter on each trial. Each of the three group members was given a different list of four numbers not chosen by the experimenter which could be communicated to other members. In the high task interdependence condition, group members were penalized for wrong guesses. Under equal rewarding this penalty would likely encourage collaboration, but under differential rewarding according to which member guessed the number first, this might not be the case. In the low task interdependence condition, group members were not penalized for wrong guesses, and because the magnitudes and probability of rewards varied inversely with time to correct guess, the no penalty condition encouraged trial-and-error responding; i.e., guessing. In the low differential rewarding condition, group members received an equal share of the group rewards regardless of which member solved the problem first. In the intermediate differential rewarding condition, the first member to guess correctly received one-half, the second member one-third, and the last member one-sixth of the group rewards. In the high differential rewarding condition, the first member to guess correctly received two-thirds, the second member one-third and the last member none of the group rewards. In all cases the magnitude of the group rewards (unexchangable points) was determined by how quickly the number was first guessed.

Under high task interdependence, performance varied inversely with degree of differential rewarding.[1] The effect was approximately linear and rather strong. However, performance was not systematically related to degree of differential rewarding under low task interdependence. In a post hoc analysis of previous studies the authors found that studies using tasks requiring high task interdependence generally found an inverse relationship between differential rewarding and performance, whereas studies using tasks requiring low task interdependence generally found a direct relationship between differential rewarding and performance.

Using monetary rewards for performance and a different operationalization of task interdependence, Weinstein and Holzbach (1972) were unable to replicate Miller and Hamblin's findings. College students coded questionnaires under low or high task interdependence (based on degree of task specialization and degree of behavior sequencing across group members) and under equal or differential rewarding of group members. More problems were coded under differential than under equal rewarding under both low and high task interdependence. Again the utility of rewards appears to differ in the two studies, with rewards appraently being greater in the Weinstein and Holzbach study than in the Miller and Hamblin study.

Summary. Occasional inconsistent findings across studies have sometimes been difficult to explain theoretically. Explanations have frequently been based on apparent or presumed differences in task types, reward utilities, and specific reward procedures used.

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[1]Task interdependence alone accounted for such a large portion of the variance in performance that its independent effect was ignored in the analysis of variance by setting its sums of squares equal to zero.

Under high task interdependence, differential rewarding across groups (group competition) is likely to be more effective than differential rewarding within groups (individual competition) in increasing group performance. In other words, under high task interdependence the magnitude or probability of group rewards should vary directly with group performance. This is what usually happens when groups compete for fixed rewards. The appropriate reinforcement proposition would then be that group performance varies directly with group reward contingency.

The findings are consistent in showing certain group process variables such as peer influence, cooperation, and favorable attitudes towards tasks and peers to be stronger under group than individual competition. If individual and group competition facilitate performance when used separately, why not use both concurrently to increase individual and group performance while at the same time producing more favorable group processes as well? It can be shown that concurrent differential rewarding across groups and within groups approximates pure individual competition. Thus, one should not expect levels of peer influence and helping to be as high under concurrent differential rewarding as when there is differential rewarding across groups only. However, there is a way to structure concurrent individual and group competition without destroying the positive reward interdependence among group members. The reward structure described in the following section used the outcomes of direct competition between individuals representing different groups to determine the outcomes of group competition.

Concurrent Individual and Group Competition

Individual competition across teams was paired with inter-group competition in a series of studies by DeVries and Edwards. In the first study (Edwards, et al., 1972) the math achievement gains of seventh grade students operating under a procedure called Teams-Games-Tournament (TGT) were compared to those of students in a control group. Students in the control group operated under the usual math class procedures involving lectures, practice sessions, and individual testing for grades. Students in TGT also received lectures and practice sessions, but grades were determined by relative team standings based on the outcomes of individual game competition. The TGT procedure can be briefly described as follows. (See DeVries, et al., 1973, for a full description.) Students were assigned to four-member teams on the basis of past performance in math. Each team consisted on one high, two average, and one low performer. Team members competed within ability levels as representatives of their respective teams in groups of three playing the math game EQUATIONS (Allen, 1969). Because the three students competing at a particular game table were comparable in math ability, the probability of any student winning was approximately .33 on each trial. Winners accumulated points for their respective teams. The twice-weekly game competition replaced grading by test scores and a twice-weekly newsletter was distributed showing cumulative team standings as well as results of the previous game session. Successful teams were congratulated in the newsletter and individual performances (i.e., points earned in individual game competition) were listed on the second

page. Thus, grades were determined by relative team standings, but team points were accumulated by winning in individual competition. Because team members always competed against others of equal ability from other teams, high and low ability students had an equal chance to contribute points to their team.

Performance gains on a divergent solutions test and on relevant items from the computations subtest of the Standard Achievement Test in Mathematics were substantially greater for students in TGT than for students in the control group. Furthermore, most of the difference in achievement gains between treatments was accounted for by the very impressive gains of low ability students in TGT.

Because numerous independent variables were manipulated simultaneously in the TGT procedure, the relative contributions of the various components were not recoverable from the data. A second study (DeVries and Edwards, 1973) examined the effects of teams alone, games alone, and the teams-games combination (TGT) on classroom process variables. Using team competition alone produced greater peer tutoring, greater reported mutual concern, and greater reported competitiveness than did individual test competition. Using the game EQUATIONS alone produced greater peer tutoring, less perceived difficulty, and greater reported satisfaction than did individual testing. The teams-games combination (TGT) produced greater peer tutoring than did either teams or games alone.

Another study (Edwards and DeVries, 1972) found the components of TGT relatively ineffective in increasing performance on a standardized

math achievement test when used separately. On the whole students in team competition reported greater satisfaction than did students in individual competition, but there was also a significant ability-by-treatment interaction effect, with low ability students reporting the greatest increase in satisfaction, average ability students a moderate increase, and high ability students reporting a slight decrease in satisfaction. This suggests that team as opposed to individual competition is most attractive to low ability students and least attractive to high ability students. This may reflect the fact that low ability students probably have the most to gain and the least to lose under team competition, whereas the converse probably holds for high ability students.

In still another study (DeVries, et al., 1974) the effects of a modified version of TGT on achievement in American History classes were examined. The three treatments were: (a) individual test competition, (b) TGT as previously described with team scores based on team averages (TGT-A), and (c) TGT which gave greater weight to the lower performers' scores in determining team scores (TGT-W). Specifically, under TGT-W a student's raw score in individual game competition was multiplied by his performance rank in the team, and the sum of these score-by-rank products constituted the team score. Thus, the team's lower performers contributed more to the team score than did the team's higher performers. As in the Hamblin, et al., (1971) study, a good team strategy would be to get the team's lower performers to outperform other teams' lower performers. Thus, it was predicted that peer tutoring and achievement gains by low performers would be greater under TGT-W than TGT-A.

In fact, practically no differences were found between the two TGT treatments on numerous achievement, group process, and student attitude measures. However, a number of rather substantial differences were found between the two TGT treatments and the individual test competition treatment. Significant treatment effects were detected for 11 of 13 dependent variable measures. Among other things, TGT produced greater peer tutoring, interest and involvement, and satisfaction. TGT produced slightly greater achievement gains on a treatment specific test, but not on a more general achievement test. This difference was also accompanied by a significant teacher-by-treatment interaction indicating that much of the achievement gain under TGT could be attributed to only one of the two teachers.[1]

In summary, the TGT procedure combined individual academic game competition with inter-team competition for grades based on aggregate scores from individual competition. In comparison to traditional individual test competition, TGT typically produced higher academic achievement on tests designed to test skills specific to the game, but not necessarily on more general standardized academic tests. Achievement gains under TGT were typically greatest for low ability students, intermediate for average ability students, and least for high ability students. TGT also produced greater peer tutoring, greater cross-race and cross-sex interaction (DeVries and Edwards, 1974), greater reported satisfaction, greater importance of doing well, and greater task behavior.

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[1]Teacher and class size effects were totally confounded in this study. Although both teachers taught one class under each of the three treatments, the classes of one teacher were about twice the size of the classes of the other. TGT effects were greater for the teacher having the smaller classes. This suggests that TGT effects may vary inversely with the number of teams in competition. The fewer the teams competing, the greater the probability of a particular team winning.

It should be noted that the reward structure and matching procedure of TGT are very similar to those of interteam competition in sports such as tennis, fencing, and wrestling in which team points are determined by the outcome of a series of individual matches and individual competitors are matched on the basis of some performance related variable such as ability (e.g., intrateam ranking) or body weight.

Summary and Conclusions

Summary of Comparisons

The present review and analysis compares the effects of four general classroom reward structures on academic performance, group process, and student attitudes. The four reward structures are individual reward contingencies, group reward contingencies, individual competition, and group competition. Specific comparisons are summarized below.

Individual versus group reward contingencies. Four studies (Hammond and Goldman, 1961; Bushell, et al., 1968; Hamblin, et al., 1971; and Herman and Gramontana, 1971) found individual and group reward contingencies equally effective in modifying simple and complex behaviors in the classroom. Three other studies (Barrish, et al., 1969; Packard, 1970; and Schmidt and Ulrich, 1969), although not using individual reward contingencies for purposes of comparison, found group reward contingencies effective in modifying classroom behavior.

Group reward contingencies typically involve behavior interdependence or cooperation as well as positive reward interdependence, thus making certain presumably desirable group processes more likely. Group reward contingencies may be less costly to implement and monitor in many cases,

and may also bring peer influences more into line with the desires of teachers and parents. Thus, in many cases the choice between individual and group reward contingencies might be made on the basis of monitoring and reward costs and the desirability of creating behavior interdependence.

Individual competition versus group reward contingencies. Three studies compared the effects of individual competition (based on differential rewarding within groups) and group reward contingencies (based on rewarding groups proportionate to performance and equal rewarding within groups). Miller and Hamblin (1963) found a negative relationship between degree of differential rewarding (competition) and performance under high task interdependence and no relationship under low task interdependence. Weinstein and Holzbach (1972), however, found a direct relationship between degree of differential rewarding and performance under both high and low task interdependence. Using a high interdependence task, Hammond and Goldman (1961) found individual competition and the group reward contingency to have similar effects on group performance, although the group reward contingency consistently ranked higher in strengthening several group process variables, such as coordination and communication.

Individual versus group competition. Three studies compared the effects of individual competition with those of group competition. Again the findings are mixed. Deutsch (1949) found group competition to be somewhat more effective, especially for bringing certain group processes into play. Julian and Perry (1967), however, found greater performance under individual competition than group competition, but

performance under group competition was greater than under a group reward contingency based on a percent criterion. The only study to implement examples of all four reward structures (Hammond & Goldman, 1961) found individual and group competition about equally effective on both performance and group process measures, but both forms of competition were ranked as less effective than individual and group reward contingencies.

Proposition Summary

The following propositions can be induced from the findings of studies reviewed.

1. Individual and group reward contingencies can be equally effective in modifying a wide range of simple and complex behaviors in academic settings (Hammond & Goldman, 1961; Bushell, et al., 1968; Hamblin, et al., 1971; Herman & Framontana, 1971).
2. Reward contingencies accompanied by instructions are more effective than reward contingencies or instructions alone (Herman & Framontana, 1971).
3. Individual and group reward contingencies may be used concurrently to modify behavior (Schmidt & Ulrich, 1969; Bushell, et al., 1968).
4. When group achievement under a group contingency is totally or disproportionately determined by the achievements of a subset of individuals in the group, the achievement gains of individuals in that subset will be greater than those of individuals not in the subset (Hamblin, et al., 1971).

5. Individual and group competition can be used to increase individual and group performance (Deutsch, 1949; Julian & Perry, 1967; Weinstein & Holzbach, 1972; Edwards, et al., 1972; DeVries & Edwards, 1973).
6. Group performance is higher under group than individual competition when the group task requires a high degree of behavior interdependence across group members (Miller & Hamblin, 1963).
7. Individual performance is higher under individual than group competition when the task requires a low degree of behavior interdependence (Weinstein & Holzbach, 1972).
8. Most group process measures, including peer helping, are greater under group than individual competition (Deutsch, 1949; DeVries & Edwards, 1973; DeVries, et al., 1974).
9. Attitudes toward task and fellow group members are more positive under group than individual competition (Deutsch, 1949; DeVries & Edwards, 1973; DeVries, et al., 1974).
10. Individual performance is greater under concurrent individual and group competition than under individual competition alone if the individual competition component of concurrent competition is across groups (Edwards, et al., 1972; DeVries, et al., 1974).

Discussion

A particular reward structure treatment frequently has been found to be more effective in a particular study but not consistently across

studies. Much of the variation in effectiveness may be accounted for by the specific implementations of reward structure treatments within studies. Most studies implement only one of many possibilities to represent a particular general reward structure. For example, the traditional classroom reward structure is typically used to represent individual competition in spite of the fact that there are apparently more effective ways of implementing individual competition. Thus, effectiveness in strengthening academic performance may be less a function of which general reward structure one chooses than a function of what one does afterwards. This is not to say that particular characteristics of the setting, the students, the behaviors to be modified, and the resources at one's disposal will not render one general reward structure more desirable than others. Rather, once a general reward structure is selected, rewards must still be carefully selected and reward contingencies carefully and clearly specified and operationalized. More specifically, the rewards selected should have significant value or utility for all students and should be made contingent on performance. The reward contingency should be responsive to the performance changes of all students and should be sensitive enough so that even small gains in performance are reinforced.

The conclusion that none of the four general reward structures maintains a position of clear superiority across various studies differs somewhat from that of Johnson and Johnson (1974) who conclude that under most conditions higher academic performance occurs under "cooperative goal structures" than under "competitive goal structures." Although

much of their review suggests that competition never be used, Johnson and Johnson also conclude that competition may be effective if restricted to simple drill activities and speed related tasks. The findings of the DeVries and Edwards studies, however, suggest that competition may be used to strengthen more complex academic performances as well, especially when competitors are of approximately equal ability.

Group reward structures (group reward contingencies and competition) have been generally found to be more effective than individual reward structures (individual reward contingencies and competition) in strengthening such group process variables as cooperation, peer tutoring, peer rewards and punishments, and mutual concern as well as individual interest, involvement, and satisfaction. Some educators are apparently reluctant to adopt group reward structures because they fear a loss of individual responsibility for performance; i.e., they fear that certain students may "hide" in the group and be carried along through the efforts of others. Although this is certainly a legitimate concern, the specific procedures used by Hamblin, et al., (1971) and DeVries, et al., (1974) should demonstrate that combinations of individual and group reward structures can provide cooperation and group support without sacrificing individual responsibility for performance. In both cases the combined reward structures apparently offered both greater rewards for success (by bringing peer helping and peer rewards into play) and a better chance of success for initially low performers. Thus, the combined reward structures may be more effective than using any of the pure types alone in strengthening the academic performance of a wider range of students.

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