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Cooperative Learning: Effects of Task, Reward, and Group Size on Individual Achievement

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Research Institute for the Behavioral and Social Sciences

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This research sought to (a) determine whether cooperative learning can effectively promote individual achievement, and if so, (b) identify specific conditions under which a benefit can be expected. In each of two experiments, trainee Equipment Records and Part Specialists, Military Occupational Specialty (MOS) 76C, received 15 blocks of instruction on how to perform specific supply-related tasks as part of Advanced Individual Training (AIT). Blocks 1-7 and 9-14 consisted of lecture-based instruction followed by a practical exercise after each block. Blocks 8 and 15 were devoted to testing. (Continued)

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20. (Continued)

Experiment 1 compared the test performance of 280 trainees after they had completed practical exercises (PEs) under either cooperative or individual learning. Under cooperative learning, trainees worked together in groups of two or four and helped each other learn. Under individual learning, they worked alone and obtained help from an instructor rather than from each other. In addition, group members were rewarded (i.e., allowed to proceed through the course without attending remedial study halls) either independently or as a group for their subsequent individual test performance. Results revealed that (a) cooperative learning improved individual trainee test scores but only when coupled with a group rewa d contingency, and (b) significant benefits occurred once group size reached four members.

Experiment 2 employed 80 additional trainees to determine why group reward was necessary for obtaining enhanced individual achievement under cooperative learning. Two potential hypotheses were tested: that group reward effects were caused by increased individual trainee motivation to learn resulting from group pressure to perform, or that group reward encouraged groupmates to share information and that this "peer tutoring" facilitated individual learning. Test performance results supported the peer tutoring hypothesis.

The significance of these findings for Army training is that individual achievement gains can be obtained through cooperative learning in four-member groups without modifying training materials and without increasing the demand for training resources.

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Education and Training

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FOREWORD

This report examines whether cooperative learning can be used to promote individual achievement and identifies conditions under which a benefit can be expected. The research was conducted by the Training and Simulation Technical Area of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) within the context of the Training Technology Field Activity (TTFA) established at the Quartermaster School, Fort Lee, Virginia. The mission of this TTFA site and others located at Fort Knox, Kentucky, Fort Rucker, Alabama, and Gowen Field, Idaho, is to improve Army training by facilitating the transfer of instructional technology and research findings from the laboratory to the schoolhouse. These sites serve as test beds for the application and demonstration of the latest in training technology and the conduct of research to identify promising new methods for improving training effectiveness. The results of the research reported herein suggest that cooperative learning is just such a method.

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COOPERATIVE LEARNING: EFFECTS OF TASK, REWARD, AND GROUP SIZE ON INDIVIDUAL ACHIEVEMENT

EXECUTIVE SUMMARY

Requirement:

The research sought to determine whether cooperative learning can effectively promote individual achievement and, if so, identify specific conditions under which achievement gains can be expected.

Procedure:

In each of two experiments, trainee Equipment Records and Parts Specialists, Military Occupational Specialty (MOS) 76C, received 15 blocks of instruction on how to perform specific supply-related tasks as part of Advanced Individual Training (AIT). Blocks 1-7 and 9-14 consisted of lecture-based instruction followed by a practical exercise (PE) after each block. Blocks 8 and 15 were devoted to testing.

Experiment 1 compared test performance of 280 trainees after they had completed PEs under either cooperative or individual learning. Under cooperative learning, trainees worked together in groups containing two or four members and were expected to help each other learn. Under individual learning, they worked alone and were expected to obtain help from an instructor rather than from one another. Group members were then rewarded (i.e., allowed to proceed through the course without attending remedial study halls) either independently or as a group for their subsequent individual test performance.

Experiment 2 employed 80 additional trainees to determine why group reward was necessary for obtaining individual achievement benefits under cooperative learning in Experiment 1. Two hypotheses were examined: that group reward effects were caused by increased individual trainee motivation to learn as a result of group pressure to perform, or that group reward encouraged groupmates to share information while working the PEs and that this "peer tutoring" facilitated individual learning.

Findings:

Experiment 1 revealed that (a) cooperative learning only promoted individual achievement when coupled with group reward, (b) individual achievement varied directly with group size under group reward, but inversely with group size under independent reward, (c) differential effects of reward were substantial when group size reached four members, and (d) trainees preferred to work cooperatively regardless of group size, provided a group reward contingency was enforced. The results of Experiment 2 revealed that information exchange among group members is essential for obtaining individual achievement

gains under cooperative learning, and thereby supported the peer tutoring hypothesis.

Utilization of Findings:

These findings indicate that cooperative learning, when coupled with group reward, can be an effective way to promote substantial gains in individual achievement without having to either modify training materials or increase training resources.

COOPERATIVE LEARNING: EFFECTS OF TASK, REWARD, AND GROUP SIZE ON INDIVIDUAL ACHIEVEMENT

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Cooperative Learning: Effects of Task, Reward, and Group Size on Individual Achievement

BACKGROUND

In 1983, the Commanding General, U.S. Army Training and Doctrine Command (TRADOC), established the Training Technology Activity (TTA) and charged it with the mission to improve Army training by facilitating the transfer of instructional technology and research findings from the laboratory to the schoolhouse. In response, TTA joined efforts with the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and established Training Technology Field Activities (TTFAs) at the Armor (Ft. Knox, Kentucky), Aviation (Ft. Rucker, Alabama), and Quartermaster (Ft. Lee, Virginia) Schools to serve as test-bed sites for (a) application and demonstration of the latest in training technology and (b) the conduct of research to identify promising new methods for improving training effectiveness. The following report describes ARI's initial TTFA research effort conducted at the Quartermaster School in the area of cooperative learning.

EXPERIMENT 1

Over the past 15 years, there has been growing interest in the potential use of cooperative learning methods for improving training effectiveness (see Sharan, 1980; Slavin, 1983; for recent reviews). Under cooperative learning, trainees spend some portion of their class time working in small groups where they are expected to help one another learn. This is in contrast to individualistic learning where trainees are supposed to learn on their own with help from an instructor rather than from one another.

Considerable evidence indicates that working cooperatively is more effective than working individualistically on a wide variety of tasks (Dossett & Hulvershorn, 1983; Humphreys, Johnson, & Johnson, 1982; Hungerland, Taylor, & Brennan, 1977; Yager, Johnson, & Johnson, 1985). Group productivity, however, does not necessarily result in enhanced individual achievement. Sometimes individuals perform better after having learned in a group (Humphreys, et al., 1982; Slavin & Karweit, 1981); other times they perform better after having learned on their own (Beane & Lemke, 1971). For both theoretical and practical reasons, it is important to (a) determine whether cooperative learning can be used to promote individual achievement and, if so, (b) identify specific conditions under which achievement gains can be expected.

Slavin (1983) suggests that two conditions must be met before cooperative learning will be effective. First, each group member must be held accountable for his or her individual performance. And second, group members must be rewarded (e.g., recognized, praised) as a group. In this case, group reward is contingent upon demonstration of successful performance by each group member and differs from independent reward where group members are rewarded individually on the basis of their own performance regardless of that of others.

Experiment 1 provides a direct test of the notion that group reward is a prerequisite for obtaining gains in individual achievement through cooperative learning. The general approach was to compare the test performance of individual trainees following cooperative learning under either an independent or group reward contingency.

The effect of group size on individual achievement was also examined under each reward contingency. According to Steiner's (1966) complementary task model, performance should vary directly with group size because each group member possesses knowledge not possessed by others. The probability of a correct response, therefore, should increase as this knowledge pool expands provided that group members are willing to communicate and share information with one another.

Generally speaking, overall group performance does improve as group size increases (Anderson, 1961; Hill, 1982; Klausmeier, Wiersma, & Harris, 1963; Taylor & Faust, 1952). The present question of interest, however, is whether gains in individual achievement track the overall gains in group performance brought about by increases in group size. The answer to date has been no for groups containing at least four members (Laughlin & Sweeney, 1977; Lemke, Randle, & Robertshaw, 1969). These studies, however, have not adopted a group reward contingency. Group reward should encourage meaningful within-group communication and as a result promote individual achievement gains that parallel those found for overall group performance.

The present experiment examined whether effects of group size on individual achievement are influenced by the kind of reward provided (i.e., independent vs group). If group reward is effective in promoting within-group communication, then individual achievement should vary directly with group size. Conversely, individual achievement should not improve, and perhaps even decline, as group size increases under independent reward given the hypothesized lack of incentive for group members to communicate.

Method

Subjects. Two hundred and eighty male trainees from the Quartermaster School at Fort Lee, Virginia, participated in the experiment. All had completed basic training and were undergoing advanced individual training to receive the 76C (Equipment Records and Parts Specialist) Military Occupational Specialty.

Design. Upon arrival at the School, trainees were assigned to one of seven classes. Each class was assigned randomly to one of six treatment conditions formed by the between-subjects, factorial combination of two kinds of reward (independent vs group) and three group sizes (1, 2, and 4 members). Hereafter, group size will be referred to by number, and reward will be abbreviated "I" for independent and "G" for group. Condition 2I, for example, would refer to pairs learning under independent reward.

Table 1 shows the six treatment conditions along with the number of classes and trainees assigned to each. To obtain at least 20 groups per condition, two classes were assigned to Conditions 4I and 4G while for Conditions 1I and 1G a single class was divided in two with one half assigned to each condition. Such a division was possible because no difference existed between group and independent reward when group size equaled one. Scores for two quads from Condition 4G and one pair from Condition 2I were discarded randomly to permit equal-n analysis of group data across conditions. Each class was taught by a different three-member team of instructors, with both instructor-to-team and team-to-class assignments made on a random basis.

The experiment was conducted during the Prescribed Load List (PLL) Annex of the 76C course. This annex extended for 11 days (79 course hrs) and contained 15 blocks of highly-structured instruction covering tasks necessary for maintaining a PLL in support of unit operational requirements. Example tasks included: identification of repair parts, preparation of requests for issue and turn-in of parts, receipt and storage of parts, updating of due-in records, and taking parts inventory. Blocks 1-7 and 9-14 consisted of task-specific, lecture-based instruction followed by a practical exercise (PE) after each block. Each PE was scored and knowledge of results provided before trainees entered the next block. Blocks 8 and 15 were dedicated to testing. Test performance was evaluated on a criterion-referenced basis. Trainees had to score at least 85% correct on each test to progress through the course without interruption. Those not attaining criterion on their first attempt were allowed to take each test a second time, provided that they attended an intervening remedial study hall.

Procedure. Before starting the PLL Annex, separate classes were divided into groups containing either 1, 2, or 4 randomly assigned members. Cooperative learning took place during each PE of an instructional block. Group members worked together to arrive at agreed-upon answers which they recorded in their own individual PE booklets. These booklets then were scored and knowledge of results regarding both the speed and accuracy of responding was provided. Each trainee was tested individually at Blocks 8 and 15. Both tests required performance of tasks similar but not identical to those covered in preceding PEs. Prior to the start of the PLL Annex, trainees were told they would be working in groups of various sizes during the PEs, tested later individually, and rewarded either independently or as a group

Table 1. Class and trainee assignments for each condition.

Condition	Assignments	
	n	Classes
1I	20	1/2
1G	20	1/2
2I	40	1
2G	40	1
4I	80	2
4G	80	2

depending on the condition they were in. Trainees were not allowed to remove training materials from the classroom, and were asked not to discuss course content after class.

Under independent reward, trainees received either a "GO" or "NOGO" based on their individual test scores and were rewarded (i.e., allowed to proceed to the next instructional block without mandatory attendance of a remedial study hall) independently of one another. Trainees not attaining criterion had to attend a remedial study hall before making a second attempt at the test. If successful on the second attempt, the trainee rejoined his fellow groupmates for the next instructional block. If unsuccessful, the trainee was either recycled to a later nonexperimental class or dropped from the course entirely.

Under group reward, groupmates received either a GO or NOGO based on whether or not all attained criterion. If each member was successful, then all were rewarded (i.e., allowed to proceed as a group without having to attend the study hall). If one or more members failed to reach criterion, then all, including those that did reach criterion, returned to study hall to help the failing member(s) restudy for a second attempt at the test. For all conditions, only first-attempt test scores were analyzed.

After completing the PLL Annex, trainees who had worked cooperatively on the PEs indicated via questionnaire whether they preferred to work alone or in a group. All had worked individualistically on PEs during a prior 36-hour annex covering use of the Army Master Data File (AMDF), and therefore, had experienced both individualistic and cooperative learning procedures.

Results and Discussion

To determine whether performance differed among conditions at the start of the PLL Annex, a one-way analysis of variance (ANOVA) was performed on individual trainee error scores obtained at completion of the preceding AMDF annex. This ANOVA revealed no significant differences, $F < 1$, with the rejection region for this and all other analyses set at .05. Thus, subsequent performance differences among conditions to be reported were not the result of any differences present before the PLL Annex began.

Practical Exercises. To evaluate PE performance prior to each test, total error and time scores were calculated separately for PE Subsets 1-7 and 9-14. Then separate 2 (Reward) X 3 (Size) between-subjects analyses of variance (ANOVAs) were performed on error and time scores added for each group within each subset. Mean total error scores for each subset are shown in Figure 1 while associated mean completion time scores are shown in Figure 2.

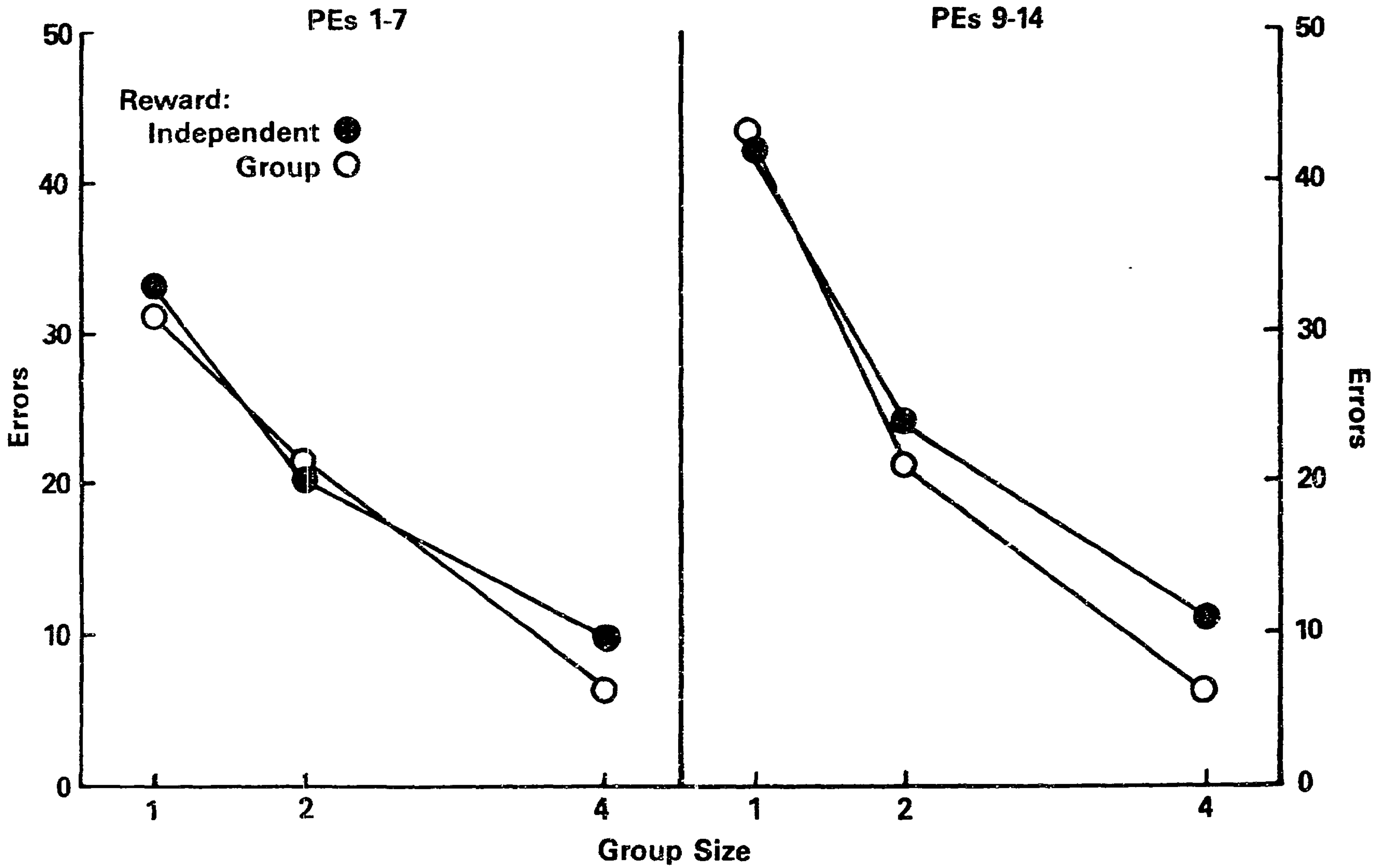

Figure 1. Mean number of total errors committed on PE subsets.

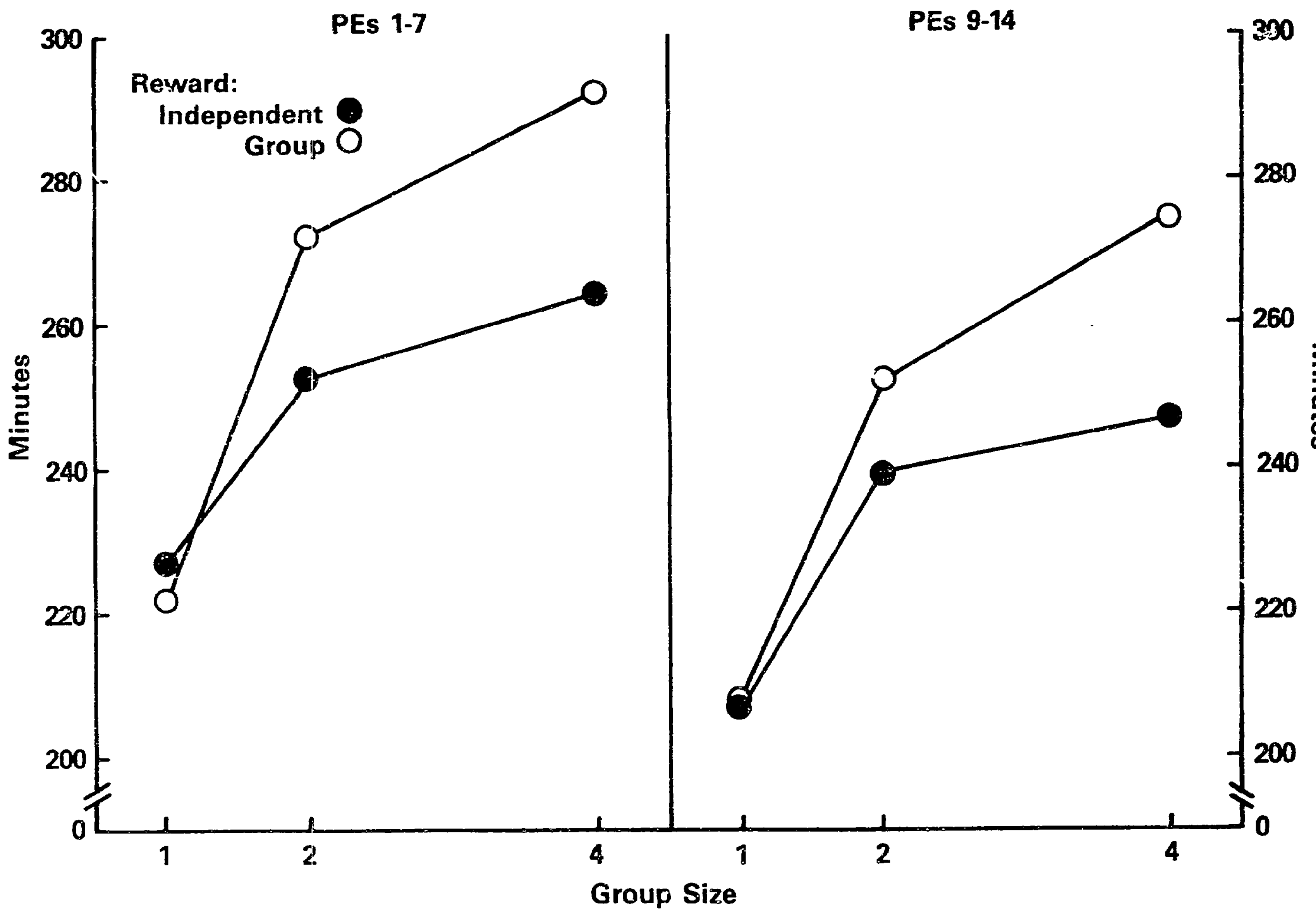

Figure 2. Mean total completion times for each PE subset.

Analysis of errors revealed significant main effects of group size for PEs 1-7, $F(2, 114) = 16.89$, and 9-14, $F(2, 114) = 34.09$. Performance of subsequent individual comparisons via the least significant difference method (Carmer & Swanson, 1973) revealed that errors were inversely related to group size for both subsets. This relationship is consistent with that reported elsewhere for other kinds of tasks (Hill, 1982; Laughlin & Jaccard, 1975; Taylor & Faust, 1952).

Analysis of time scores for PEs 1-7 revealed significant main effects of size, $F(2, 114) = 32.09$, and reward, $F(1, 114) = 5.68$, along with a Size X Reward interaction, $F(2, 114) = 3.09$. Simple effect comparisons revealed that times increased with each increment in group size under group reward (1G < 2G < 4G), but flattened out once group size reached two members under independent reward (1I < 2I = 4I). In addition, pairs and quads took more time under group reward than their counterparts under independent reward (2G > 2I; 4G > 4I). Analysis of time scores for PEs 9-14 revealed significant main effects of size, $F(2, 114) = 30.55$, and reward $F(1, 114) = 5.89$, but no significant Size X Reward interaction. Although the interaction failed to reach significance, Figure 2 shows that the effect of reward occurred primarily because pairs and quads took longer to complete the PEs under group reward than under independent reward. Presumably, larger groups took longer to coordinate their answers (Fox & Lorge, 1962) under both reward conditions. The additional increment in time taken under group reward probably was necessary to provide explanations required to ensure that all group members understood the underlying rationale for the answers selected.

In summary, analyses of the PE data revealed that (a) groups were more accurate than individuals, (b) errors were inversely related to group size, but unrelated to reward, and (c) PEs took longer to complete under group reward than under independent reward for both pairs and quads.

Tests. Test performance of individual trainees was analyzed to determine individual achievement under each condition. Mean error and time scores were computed for each pair and quad. These within-group means were then compared with the scores from individual trainees in the single-member groups. This procedure yielded 20 scores for each of the six conditions. The means of the 20 error scores for Tests 1 and 2 are depicted in Figure 3 while the time score means for the two tests are depicted in Figure 4.

To determine whether overall group performance on the PEs affected later test scores of individual group members, each dependent variable was analyzed separately using 2 (Reward) X 3 (Size) factorial ANOVAs identical to those performed earlier. Analysis of Test 1 errors revealed a significant main effect of reward, $F(1, 114) = 7.57$, and a Reward X Size interaction, $F(2, 1\ 4) = 4.31$. Analysis of simple effects associated with the interaction revealed that errors decreased as group size increased under group reward, but were unrelated to group size under independent

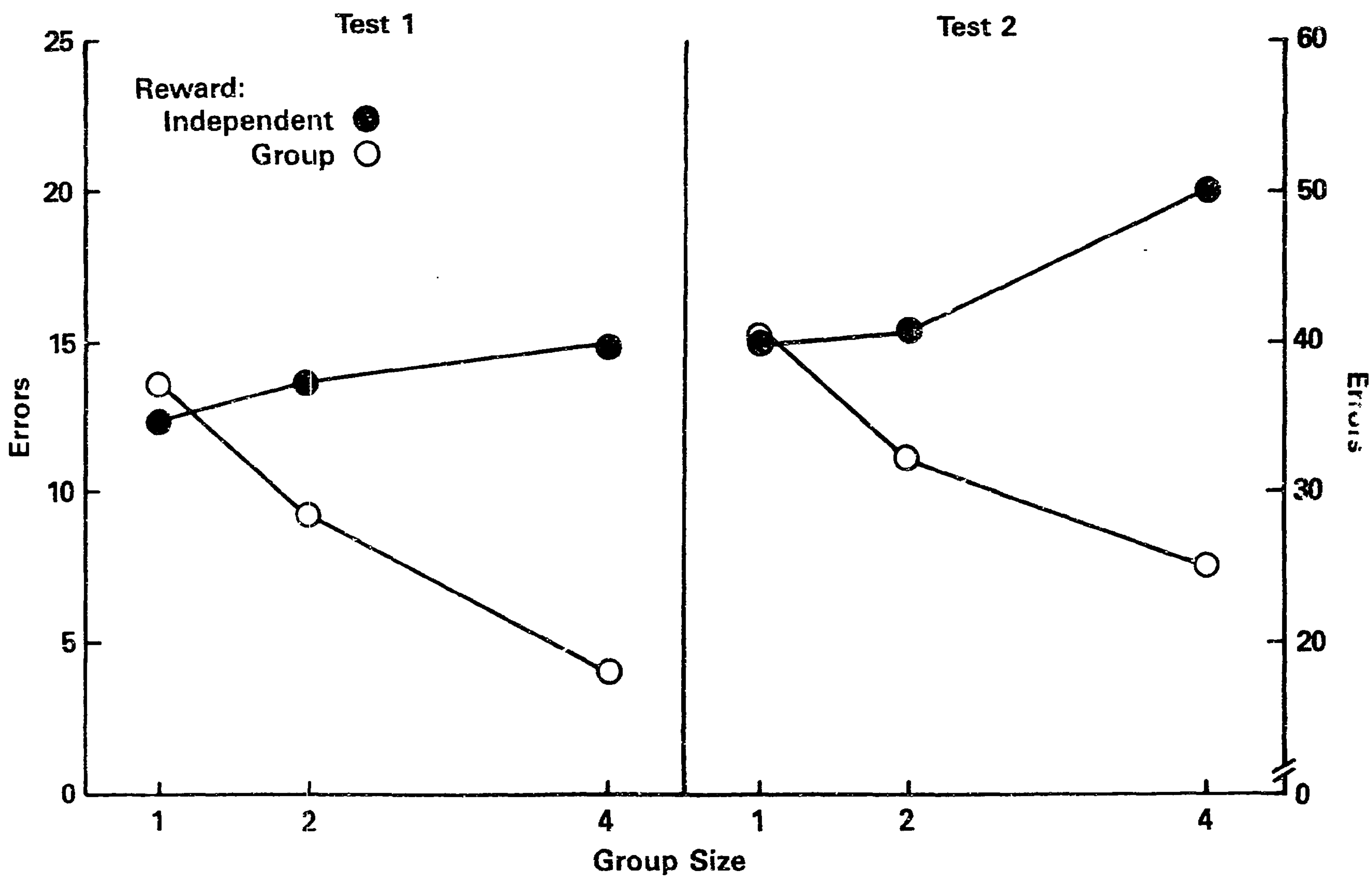

Figure 3. Mean number of errors committed on each test.

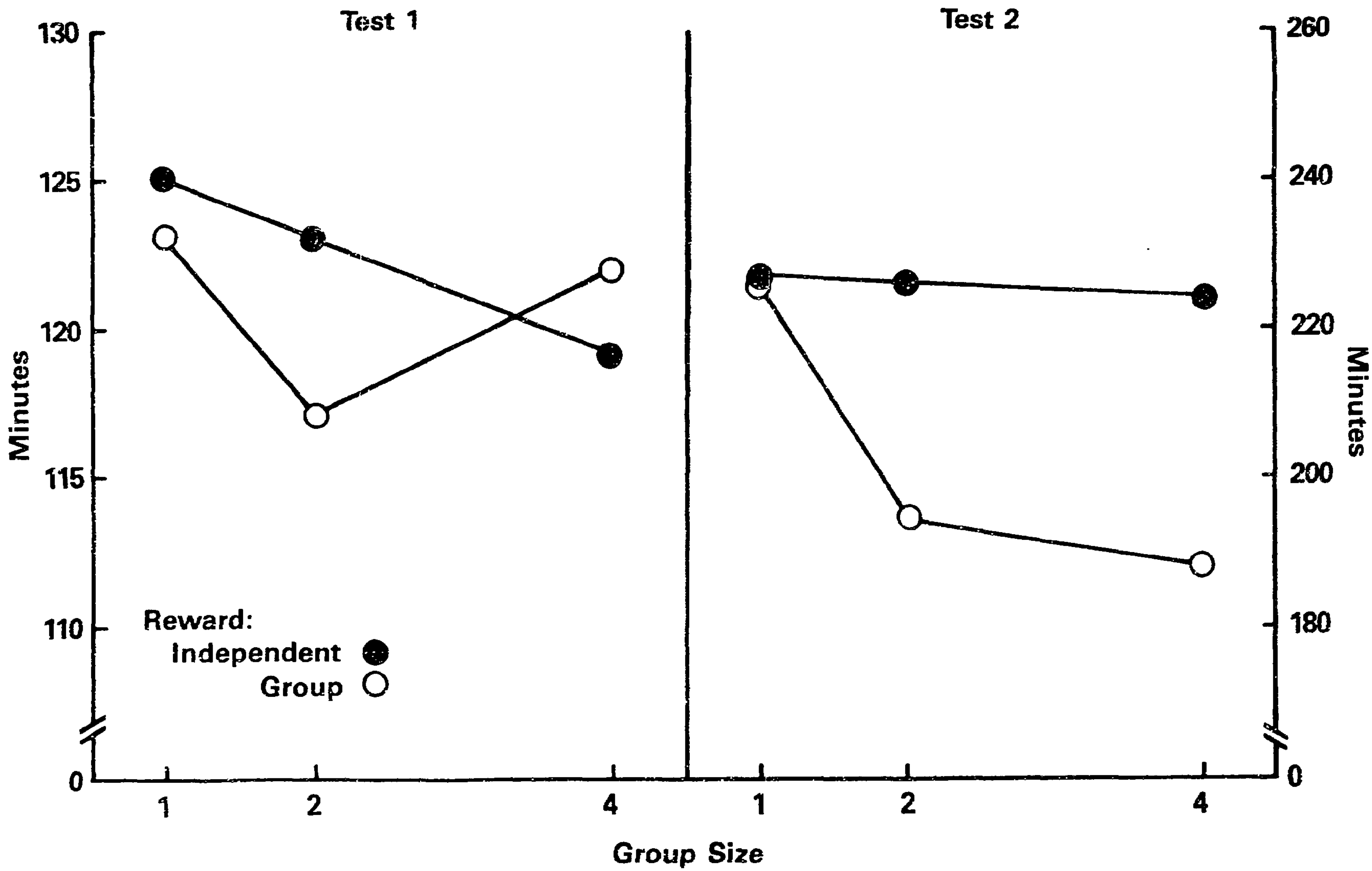

Figure 4. Mean test completion times.

reward. Differences, however, were not reliable until group size reached four members (1I = 1G; 2I = 2G; 4I > 4G). Analysis of time scores revealed no significant effects.

Analysis of Test 2 errors also revealed a significant main effect of reward, $F(1, 114) = 9.53$, and a Reward X Size interaction, $F(2, 114) = 4.82$. Analysis of simple effects revealed that errors decreased under group reward, but increased under independent reward as group size increased. The mean numbers of errors committed under group reward by the pair and single-member groups did not differ, but were greater than those committed by the quad groups (4G < 1G = 2G). The pair and single-member groups under independent reward displayed comparable accuracy, but committed fewer errors than the quad groups (4I > 2I = 1I). Once again, only when group size reached four members were reliable performance differences found between the two kinds of reward.

Analysis of Test 2 times revealed significant main effects of reward, $F(1, 114) = 33.71$, and size, $F(2, 114) = 10.10$, along with a Reward X Size interaction, $F(2, 114) = 7.96$. Analyses of the interaction's simple effects revealed that test completion times decreased as group size increased under group reward, but remained stable across group sizes under independent reward. Most of the additional time taken under group reward occurred as groups increased from singles to pairs, with no further demand for time occurring as groups increased in size from two to four members (1G > 2G = 4G). Time differences were also found between reward conditions for pairs and quads (2I > 2G and 4I > 4G).

Questionnaire Responses. Questionnaire data obtained from individual trainees revealed that 72% of those who had worked in pairs and 70% of those who had worked in quads preferred a cooperative task with no difference in preference found on the basis of group size, $X(1, n = 240) < 1$. Percentages almost identical to these have been reported elsewhere (Dossett & Hulvershorn, 1983; Morrison, in press). There was, however, a significant relationship found between preference and reward. Ninety-one percent of the trainees who had worked under group reward preferred to work cooperatively compared with only 51% of those who had worked under independent reward, $X(1, n = 240) = 46.47$.

In summary, analyses of the test and questionnaire data revealed that (a) cooperative learning only promoted individual achievement when coupled with group reward, (b) individual achievement varied directly with group size under group reward, but inversely with group size under independent reward, (c) differential effects of reward were most evident with quads, although pairs did show some time advantage at Test 2, and (d) trainees preferred to work cooperatively on the PEs regardless of group size, provided that a group reward contingency was enforced.

These results reveal the importance of group reward for obtaining individual achievement gains under cooperative learning. It is unclear, however, why group reward was so effective. On the one hand, it may have encouraged effective communication among group members, as suggested earlier. Results of past research (Slavin, 1980a), having shown that trainees in cooperative groups help each other substantially more when they are rewarded as a group than when they were not, support this argument. On the other hand, group reward may simply motivate individual group members to learn more on their own because the rest of the group depends on them to do so. Hulten & DeVries (1976) have found that greater peer pressure exists for members to do well under group reward than under independent reward, and along with Slavin (1980a), have shown that group reward can increase trainee achievement even without an opportunity for within-group communication. Thus, enhanced individual motivation to learn rather than effective within-group communication could have been responsible for individual achievement gains found under group reward. If true, then group reward should promote comparable individual achievement under both a cooperative task where group members help one another, and an individualistic task where group members work alone and are not allowed to intercommunicate. If within-group communication is necessary for group reward to be effective, then greater individual performance gains should be found with a cooperative task than with an individualistic task because the latter does not allow within-group communication.

EXPERIMENT 2

Experiment 2 was designed to differentiate between the motivation and communication hypotheses offered above as possible explanations for the beneficial effects of group reward on individual achievement under cooperative learning. Task structure was varied to include both cooperative and individualistic learning tasks under both group and independent reward contingencies. Under the individualistic task, trainees learned on their own without input from fellow groupmates; under the cooperative task, within-group communication was allowed. If increased motivation is the key to enhanced individual achievement, then no performance differences should be found as a function of task because motivation to learn should be the same under both individualistic and cooperative procedures. If within-group communication is the key, then individual achievement should be greater when trainees work cooperatively because only a cooperative task provides the opportunity for communication.

The present experiment also varied reward to include independent and group contingencies under both individualistic and cooperative task conditions. Manipulation of both reward and task within the same experiment provided an opportunity to examine their relative importance in promoting individual achievement.

Method

Design, subjects, and procedure. Four treatment conditions were formed by the factorial combination of two kinds of reward, i.e., independent (I) vs group (G), and two kinds of task, i.e., individualistic

(I) vs cooperative (C). These four conditions are designated CG, IG, CI, and II, with the first letter referring to the kind of task and the second letter to the kind of reward. Groups contained four members in all conditions except II where formal grouping was unnecessary. Data from Conditions 4G, 4I, and 1I of Experiment 1 were used for Conditions CG, CI, and II of Experiment 2, because these three conditions were slated to be treated the same in Experiment 2 as they were in Experiment 1. Eighty male trainees from two additional 76C classes were divided into quads to provide the data necessary for Condition IG. Group members in this condition worked alone on the PEs, but were rewarded as a group for their individual test performance. Because trainees in Condition IG worked individualistically on the PEs, their performance scores were averaged within groups and compared with PE scores achieved through mutual agreement in the cooperative learning conditions. Tests scores for all groups were analyzed the same as in Experiment 1. Instructor-to-team and team-to-class assignments were made on a random basis except for Conditions CG and IG which were taught by the same team of instructors.

Results

Practical Exercises. A one-way ANOVA performed on individual trainee error scores obtained at completion of the preceding AMDF Annex revealed no differences among conditions prior to the start of the PLL Annex, $F < 1$. To determine PE performance prior to each test, total error and time scores were calculated separately for PE Subsets 1-7 and 9-14. Separate 2 (Task) X (Reward) between-subjects ANOVAs then were performed on within-group error and time scores added separately for each condition across each subset. Figure 5 shows the resulting mean error scores while Figure 6 shows the mean time scores.

Analysis of errors revealed significant main effect of task for PEs 1-7, $F(1, 76) = 35.13$, and 9-14, $F(1, 76) = 37.78$, with fewer errors committed when trainees worked cooperatively. A significant main effect of reward was also found for PEs 9-14, $F(1, 76) = 7.42$, revealing that accuracy was greater under group reward than under independent reward. Thus, enforcement of a group reward contingency improved the accuracy of PE performance for both kinds of task, at least for PEs 9-14, but working cooperatively produced superior response accuracy regardless of the reward contingency enforced.

Analysis of completion times revealed significant main effects of task, $F(1, 76) = 40.53$, and reward, $F(1, 76) = 9.38$, for PEs 1-7 along with similar task, $F(1, 76) = 35.6$, and reward, $F(1, 76) = 11.93$, effects for PEs 9-14. For both subsets, completion times were faster when trainees worked alone and when reward was given on an independent basis.

Tests. Test scores were examined to reveal individual trainee achievement under the four treatment conditions. Mean error and time scores for Conditions CI, CG, and IG were derived by computing the mean within-group scores for each quad. These within-group mean scores were

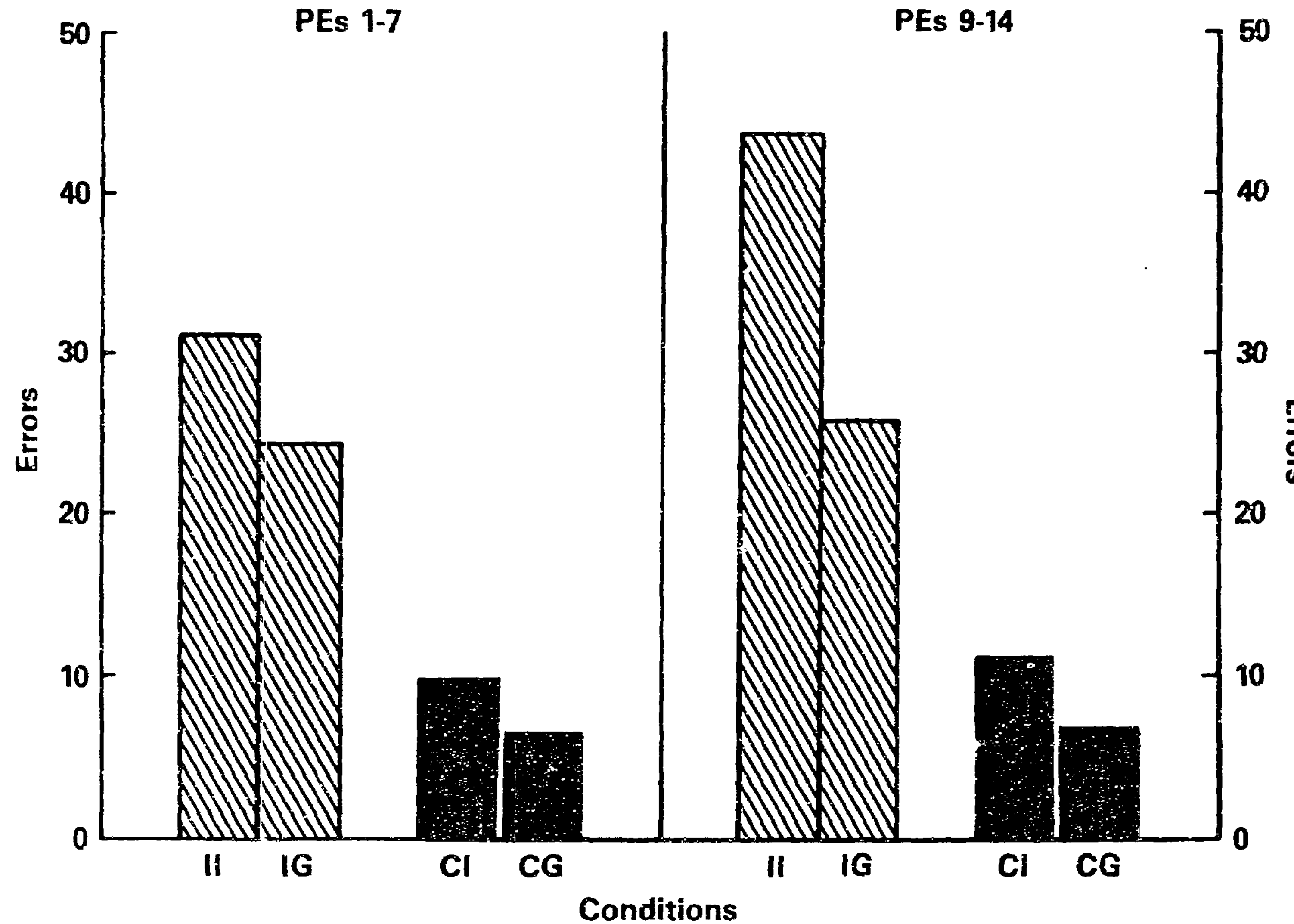

Figure 5. Mean number of total errors committed on *PE* subsets under each condition (II=individualistic task/independent reward; IG=individualistic task/group reward; CI=cooperative task/independent reward; CG=cooperative task/group reward).

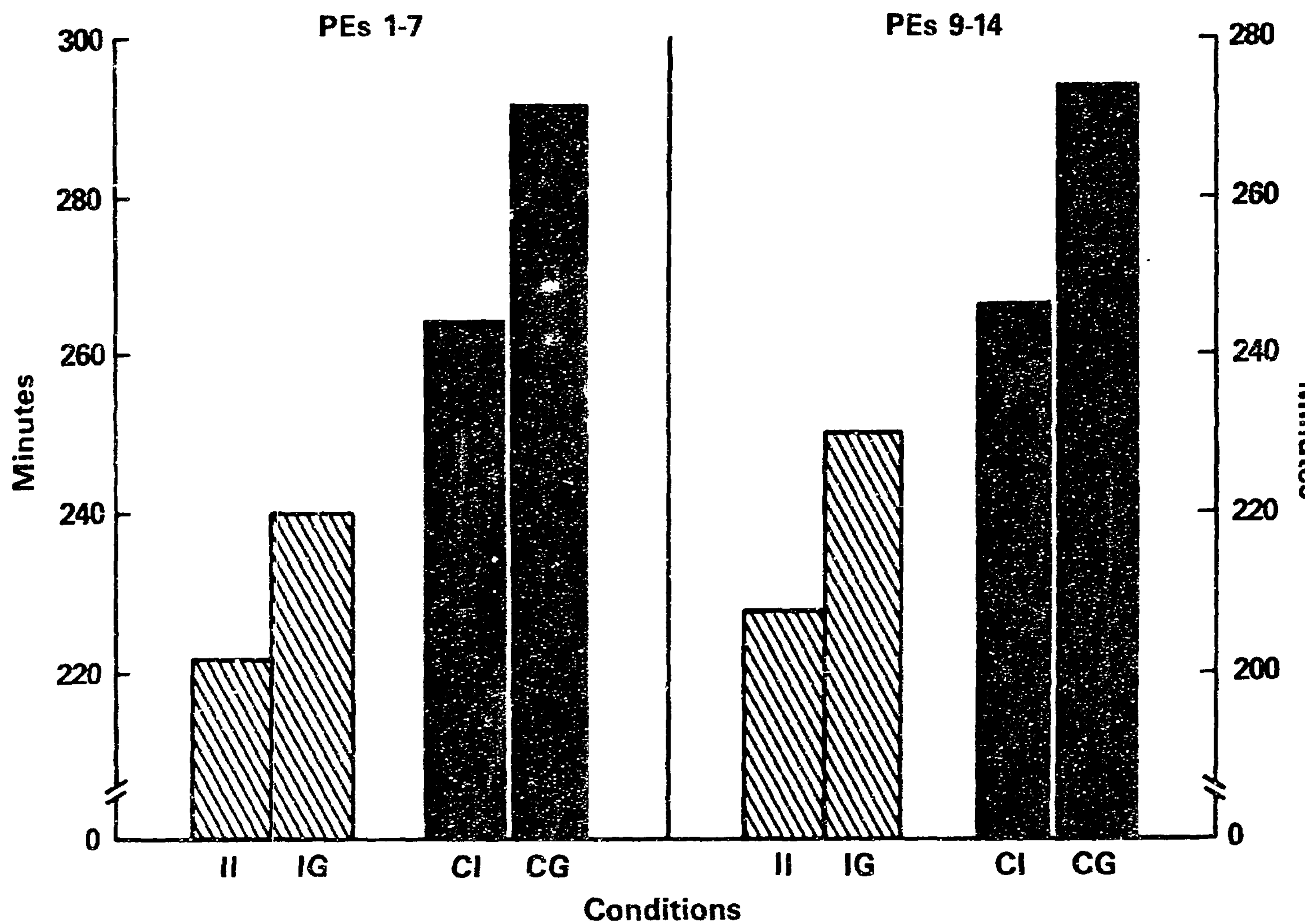

Figure 6. Mean total completion times for PE subsets under each condition (II=individualistic task/independent reward; IG=individualistic task/group reward; CI=cooperative task/independent reward; CG=cooperative task/group reward).

then included along with the raw scores for individual trainees in Condition II to yield 20 scores for each condition. Error score means for Tests 1 and 2 are shown in Figure 7 while time score means for the two tests are shown in Figure 8.

Both dependent measures were analyzed via separate 2 (Reward) X 2 (Task) between-subjects ANOVAs identical to those used earlier. Analysis of Test 1 errors revealed a significant main effect of reward, $F(1, 76) = 16.65$, and a significant Reward X Task interaction, $F(1, 76) = 3.95$. Analysis of simple effects associated with the interaction revealed that trainees in Condition CG performed best, followed by those in Conditions IG and II, which did not differ from one another, with trainees in Condition CI performing the worst of all (CG < IG = II < CI). Thus group reward effectiveness was dependent upon task, in that group reward was only beneficial when trainees learned cooperatively.

Analysis of Test 2 errors also revealed a significant Reward X Task interaction, $F(1, 76) = 5.45$, and an ordering of simple effects almost identical to that found on Test 1. The performance differences favoring Condition CG over IG on both tests suggest that a cooperative task is necessary for promoting individual achievement under group reward, and thus provide support for the communication hypothesis. Because motivation to learn should have been the same under both reward conditions, the obtained performance differences must have been caused by information exchange among group members while they learned cooperatively on the PEs. The lack of a difference between Conditions II and IG indicates that differential achievement should not be expected under either kind of reward when trainees must learn on their own.

Analysis of time scores revealed no significant effects for Test 1, but significant main effects of reward, $F(1, 76) = 24.60$, and task, $F(1, 76) = 10.01$, in addition to a Reward X Task interaction, $F(1, 76) = 7.2$, for Test 2. Analysis of simple effects from the interaction provided additional support for the communication hypothesis in that faster completion times were found for Condition CG than for the other three conditions which did not differ from one another. Thus, trainees in Condition CG did not only respond more accurately during testing but also showed faster test completion times than trainees in the other three conditions.

GENERAL DISCUSSION

This research sought to (a) determine whether cooperative learning can be used to promote individual achievement, and if so, (b) identify specific conditions under which a benefit can be expected. The test results of Experiment 1 indicate that cooperative learning is no better, and sometimes worse, than individualistic learning unless a group reward contingency is enforced for individual performance. This supports Slavin's (1983) claim that group reward is necessary for cooperative

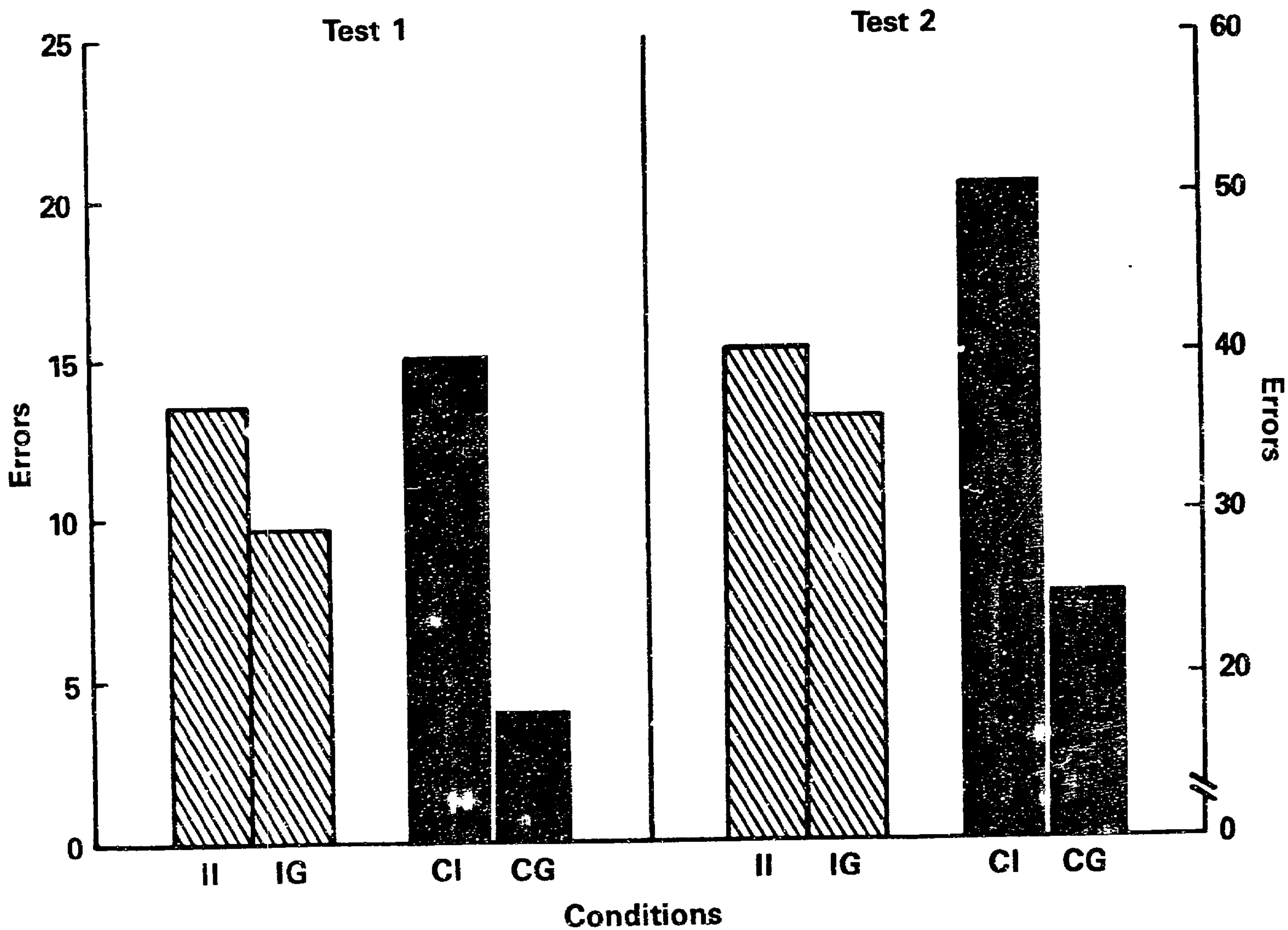

Figure 7. Mean number of errors committed on each test under the four conditions (II=individualistic task/independent reward; IG=individualistic task/group reward; CI=cooperative task/independent reward; CG=cooperative task/group reward).

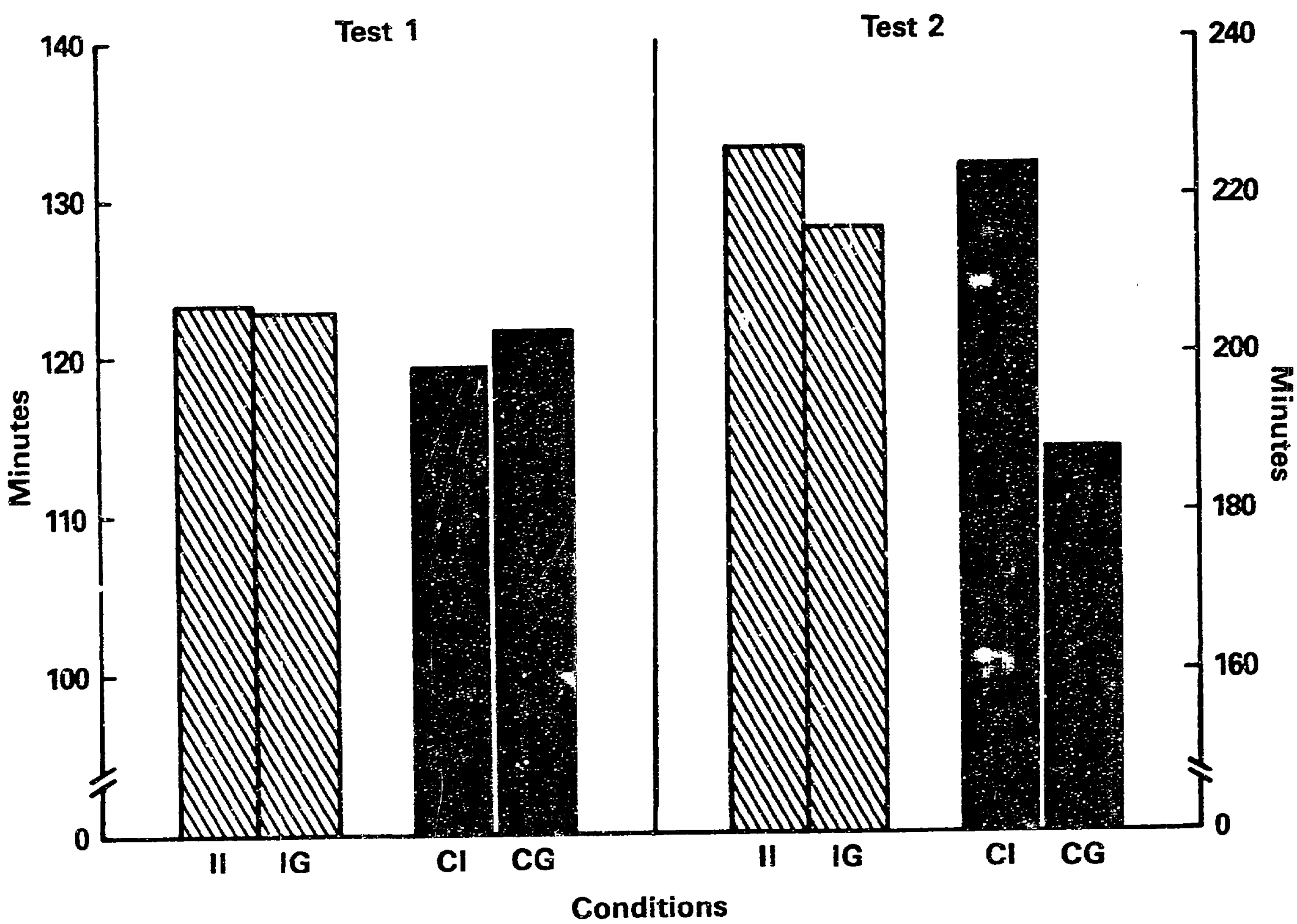

Figure 8. Mean test completion times under each condition (II=individualistic task/independent reward; IG=individualistic task/group reward; CI=cooperative task/independent reward; CG=cooperative task/group reward).

learning to be effective. The test results also indicate that individual achievement varies directly with group size under group reward, with maximum benefits to be expected with groups containing four members. Under independent reward, increases in group size have either no effect or a detrimental effect on individual trainee test scores. Additional research is needed to determine if the group-size effects found here apply to groups containing more than four members.

Performance on the PEs suggests that an inverse relationship exists between errors and group size irrespective of reward. This was expected for two reasons. First, groups generally outperform individuals when a group product is considered (e.g., Hill, 1982). And second, answer sharing was ensured to some extent by requiring pairs and quads to provide agreed-upon answers on the PEs regardless of the reward contingency applied later for individual test performance.

Completion time scores varied directly with group size and to a greater extent under group reward than under independent reward. Presumably, the extra time taken by cooperative groups was necessary to coordinate answers (Fox & Lorge, 1962) and larger groups required longer to effect this coordination. This would account for the extra time required by pairs and quads under independent reward.

Why, however, was even more time taken under group reward? Presumably, this extra time was used for explaining or elaborating upon the underlying rationale for selected answers. This added time for explanation could account for the superior individual achievement found under group reward. Cognitive processes, such as elaboration and retrieval, are necessary for deeper understanding and effective storage of information into memory. These processes occur through dialogue and interaction with others (Baker, 1979). Although it is tempting to interpret the superior achievement found under group reward as merely the result of added time taken on the PEs, this interpretation does not hold for the finding that independently rewarded pairs and quads also took more time than single-member groups, and yet failed to display any additional improvements in individual test performance.

The results of Experiment 2 indicate that group reward benefits are the result of within-group communication that occurs during cooperative learning rather than the result of increased motivation to learn on the part of individual group members as a function of group pressure. Although it was not possible to record the nature of group interactions within the operational military classroom, they probably took the form of peer tutoring. Although peer tutoring is not always beneficial (Slavin, 1983), most of the time its effect on individual learning is positive. Devin-Sheehan (1976) has reported that tutoring, in general, effectively improves the academic performance of tutees, and in some instances, of tutors as well. Buckholdt and Wodarski (1978), have argued that receiving trainee-generated explanations is particularly effective for learning, because trainees tend to use language that other trainees understand and tend to correctly interpret each other's nonverbal cues about whether or not a concept is understood. Sharan (1980) has shown that cooperative learning methods that allow peer tutoring are especially effective in promoting performance of low-level cognitive tasks. The kind of supply-related tasks taught to entry-level soldiers in the present research would fall into this category. And lastly, others (Webb, 1982; 1984) have found that the giving and receiving of answers (with explanations) are the best predictors of individual achievement in cooperative learning tasks, whereas receiving no answer or merely a terminal answer with no explanation is negatively associated with achievement gains (Lockhead, 1983).

Although the present experiments used group reward to encourage within-group communication, any cooperative procedure that ensures meaningful communication among group members should also promote individual achievement. Thus, group reward may not be necessary when communication is brought about by other means. Recent research supports this notion (Dansereau, 1983; Yager, et al., 1985). Dansereau (1983), for example, has shown that structuring interaction within cooperative groups by giving members specific assignments to orally summarize and elaborate upon to-be-learned materials can effectively promote individual achievement in the absence of group reward. The present research suggests that if group interaction is left unstructured, then group reward can be used to encourage the interaction among group members necessary for promoting individual achievement gains when trainees work cooperatively.

In conclusion, what should be especially encouraging to the instructor or trainer about the results of this research is that individual achievement gains can be obtained through unstructured cooperative learning without modifying existing training materials, compromising the basic goals of criterion-referenced evaluation, or increasing the demand for training resources. Of course, one important factor affecting the successful implementation of changes in any instructional or operational training program is trainee acceptance. In this regard, preference responses obtained in Experiment 1 suggest that cooperative learning will be well received provided it is coupled with group reward for individual test performance.

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