

THE EFFECTS OF RECIPROCAL PEER TUTORING AND GROUP CONTINGENCIES ON THE ACADEMIC PERFORMANCE OF ELEMENTARY SCHOOL CHILDREN

H. EDMUND PIGOTT, JOHN W. FANTUZZO, AND PAUL W. CLEMENT

FULLER THEOLOGICAL SEMINARY AND CALIFORNIA STATE UNIVERSITY, FULLERTON

We evaluated the effects of reciprocal peer tutoring combined with group reinforcement contingencies on the arithmetic performance of 12 underachieving fifth-grade students. Results indicated that the intervention increased the students' arithmetic performance to a level indistinguishable from their classmates during treatment and 12-week follow-up phases. Pre-, post-, and follow-up sociometric data indicated that the students who participated in the treatment groups increased their amount of peer affiliation with other treatment group members.

DESCRIPTORS: peer tutoring, group contingencies, academic behavior, arithmetic performance, classroom interventions

Peer tutoring and group contingencies are two effective and economical classroom strategies for improving academic performance. There is a growing body of literature indicating that these strategies may be particularly beneficial for underachieving children (Gerber & Kauffman, 1981; Greenwood & Hops, 1981). Group contingencies that foster interdependence have the added advantage of promoting cooperative behavior among students (e.g., McCarty, Griffin, Apolloni, & Shores, 1977).

In an attempt to develop an intervention that combines the benefits of peer tutoring, interdependent group reward contingencies, and individual accountability procedures (see Slavin [1983] for a discussion of the advantages of interdependency and accountability), we designed a peer-mediated group contingency intervention. Pilot studies of this strategy found that this reciprocal peer-tutoring in-

tervention was effective in increasing arithmetic performance and decreasing disruptive behaviors of underachieving male students in an experimental (Wolfe, Fantuzzo, & Wolter, 1984; Wolter, Pigott, Fantuzzo, & Clement, 1984) and natural classroom setting (Piggott, Fantuzzo, Heggie, & Clement, 1984).

The purpose of this investigation was to replicate the study conducted by Pigott et al. (1984) across three natural classroom settings with both male and female underachieving students. This study also involved a more thorough assessment of the efficacy of this intervention by including assessments of (a) response maintenance, (b) the social validity of treatment gains, and (c) the social impact of using this intervention within a natural classroom setting.

METHOD

Subjects and Setting

Ninety-three children participated in this study. Each child attended one of three regular fifth-grade classes in the same elementary school of the Pasadena Unified School District. The classes ranged in size from 30 to 33 students per class. Twelve 10- and 11-year-old children (8 girls and 4 boys) were selected to participate in the reciprocal peer tutoring treatment groups. There was one treatment group in each classroom. Each group con-

This study is based on a dissertation submitted by the first author, who is currently at the Klingberg Family Center, New Britain, Connecticut. We express our gratitude to Toni Dunbar and Peter Hagan of the Pasadena Unified School District for their support of this investigation, to Deborah Heggie and Stacy Schantz for their assistance in conducting the study, and to Linda Mans-Wagener and Douglas Greer for their valuable assistance in the preparation of this manuscript.

Reprints may be obtained from John W. Fantuzzo, Department of Psychology, California State University, Fullerton, California 92634.

tained four children of the same sex and an ethnic mixture of either black and hispanic or hispanic and white children. The selection criteria for the treatment group included (a) teacher report card evaluations of unsatisfactory performance in arithmetic and (b) performance within the lower quartile on arithmetic drills during the initial baseline phase. Although these children were able to perform basic arithmetic operations correctly, their arithmetic proficiency or rate of correct arithmetic computations was below grade level (cf. Lovitt, 1978). Additionally, data were collected across all the remaining nontreated class members for comparison purposes.

The research was conducted in the students' classrooms during their regularly scheduled arithmetic period.

Design

An ABAB reversal design was used to evaluate the effectiveness of the treatment package across three classes. Following the second treatment phase, a 12-week partial-withdrawal phase (C) was instituted to assess response maintenance (Rusch & Kazdin, 1983).

General Procedure

Arithmetic drill sessions occurred at the same time each school day and the procedures were identical for each class. A teacher's aide distributed specially prepared arithmetic sheets to each student in the class. These sheets were standardized (i.e., same number of operations and equivalent level of difficulty); however, the number combinations on each sheet were randomly determined so that no two sheets were identical. After the arithmetic sheets were distributed, the aide instructed the students to work on each problem in sequence, and to try to complete accurately as many as possible. At the end of the 7-min drill period, the teacher's aide collected the arithmetic sheets and provided students with an opportunity to get feedback on their arithmetic performance.

Treatment Conditions

Baseline. The teacher's aide collected data on the number of accurately completed arithmetic

problems for all participants. No contingent reinforcers were provided to any of the participants for arithmetic performance.

Reciprocal peer tutoring. The reciprocal peer tutoring and group contingency intervention was designed to incorporate peer-tutoring procedures into a group format. Peer tutoring operations (i.e., peer instruction, peer observation, peer evaluation, and peer reinforcement) were converted into four roles ("coach," "scorekeeper," "referee," and "manager"), and each role was assigned to a member of the treatment group.

The coach (peer-instruction) informed the group of their goal for the day, reminded them of their strategies for increasing their arithmetic performance, and told them if they applied their strategies they would "WIN." The scorekeeper (peer-observation) counted the number of arithmetic problems completed correctly by each team member and wrote the number down on each individual's arithmetic sheet. The referee independently counted the number of correctly completed arithmetic problems and recorded the number by each individual's name on the team scorecard. This provided a built-in reliability check for the group. The manager (peer-evaluation and peer-reinforcement) determined the team's total score and compared it with the team's goal for the day. If the goal was met, the manager declared that the team had "WON." After four wins, the group was eligible to obtain group-determined backup reinforcers (e.g., video game tokens).

Prior to the first day of treatment, the four students selected for each treatment group were trained to use this technique by the principal investigator. This training included (a) teaching the group members, via modeling and instruction, the tasks required for each role, (b) practicing the coordination of the roles during simulated arithmetic drill sessions, and (c) assessing competency (i.e., the team members' ability to perform each role at a 95% or higher level of accuracy on a behavioral checklist of the discrete tasks germane to each role). It took one 1-hr training session to achieve competency for each group. After the training was completed the group members (a) selected a team name; (b) devised a "pep talk" for the coach, which included

their own strategies for increasing arithmetic performance (e.g., "work hard," "work fast," "work carefully," "don't talk") and (c) selected backup reinforcers from a reinforcement menu.

At the beginning of each week of treatment, the students selected the roles each would be performing. They also selected their goal for the number of arithmetic problems they needed to answer correctly in order for them to count the day as a win from a list of three possible goals. These goal choices represented a narrow range of numbers close to the total of the individual treatment goals for each group member.

Just prior to the beginning of the arithmetic drill, the teacher's aide set out on a table cue cards that specified the tasks for each role. The aide gave no instructions and issued no further prompts throughout the session. Next, the coach oriented the group to their task, recorded the team's daily goal on the team scorecard, and encouraged each group member to use the group strategies for increasing arithmetic performance. The teacher's aide then performed the same arithmetic drill procedures that she had during the baseline phase. At the end of the arithmetic drill, the scorekeeper and referee counted the number of correctly completed problems on each sheet and recorded the number correct on the top of each sheet. If the referee's totals differed from that of the scorekeeper's, the referee carefully recounted and recorded this number on the team scorecard. The referee then gave the team scorecard to the manager who compared the score with the goal. This entire process took approximately 3 min. To conduct the intervention it was necessary to have at least three group members present. If one group member was absent, the roles of scorekeeper and referee were combined.

While this intervention was in effect, data continued to be collected on the number of accurately completed arithmetic problems by the untreated students. These students received no contingent reinforcers for their arithmetic performance outside of the regular teacher-student interaction and feedback, which was consistent throughout the study.

Maintenance. During this phase the teacher's aide set out on a table the team's cards just prior to the arithmetic drill just as she had done during

treatment conditions. If a group member asked if he or she should run the group, the student was told to do so if he or she wanted to. However, no reinforcement contingencies were delivered during this condition for arithmetic performance. This condition was in effect for 12 weeks, during which there was a 4-week break for spring vacation and standardized testing.

Definition of Behaviors and Data Collection

Arithmetic performance. Arithmetic performance was evaluated through the number and percentage of arithmetic problems completed accurately. An independent evaluator checked the arithmetic sheets for at least 35% of the sessions for each phase. The smaller number was divided by the larger number and multiplied by 100 to determine the reliability which averaged 98% (range: 96% to 100%).

Accuracy of reciprocal peer tutoring procedures. During each day of treatment, the teacher's aide used a checklist, which defined the discrete tasks germane to each role, to assess the accuracy with which each group member performed. Reliability checks on the accuracy of the aide's observations were made twice during each treatment phase by a research assistant; these checks yielded 100% agreement. The mean accuracies of the reciprocal peer tutoring procedures across classes during the treatment conditions were: coach = 87.9% (70%–100%); scorekeeper = 100%; referee = 100%; and manager = 96.2% (86.4%–100%). Mean accuracies during maintenance were: coach = 37.9% (23.1%–46.2%); scorekeeper = 99% (96.9%–100%); referee = 89% (84.6%–93.8%); and manager = 82.3% (79.1%–84.5%). During the maintenance condition, the coach was more inconsistent in delivering the "pep talk."

Accuracy of peer-administered reinforcement. During the treatment condition, the groups' arithmetic sheets were collected, and the number of correct problems were compared to the number of points awarded by the manager on the team scorecard. Reliability was calculated by dividing the smaller number of the comparison by the larger

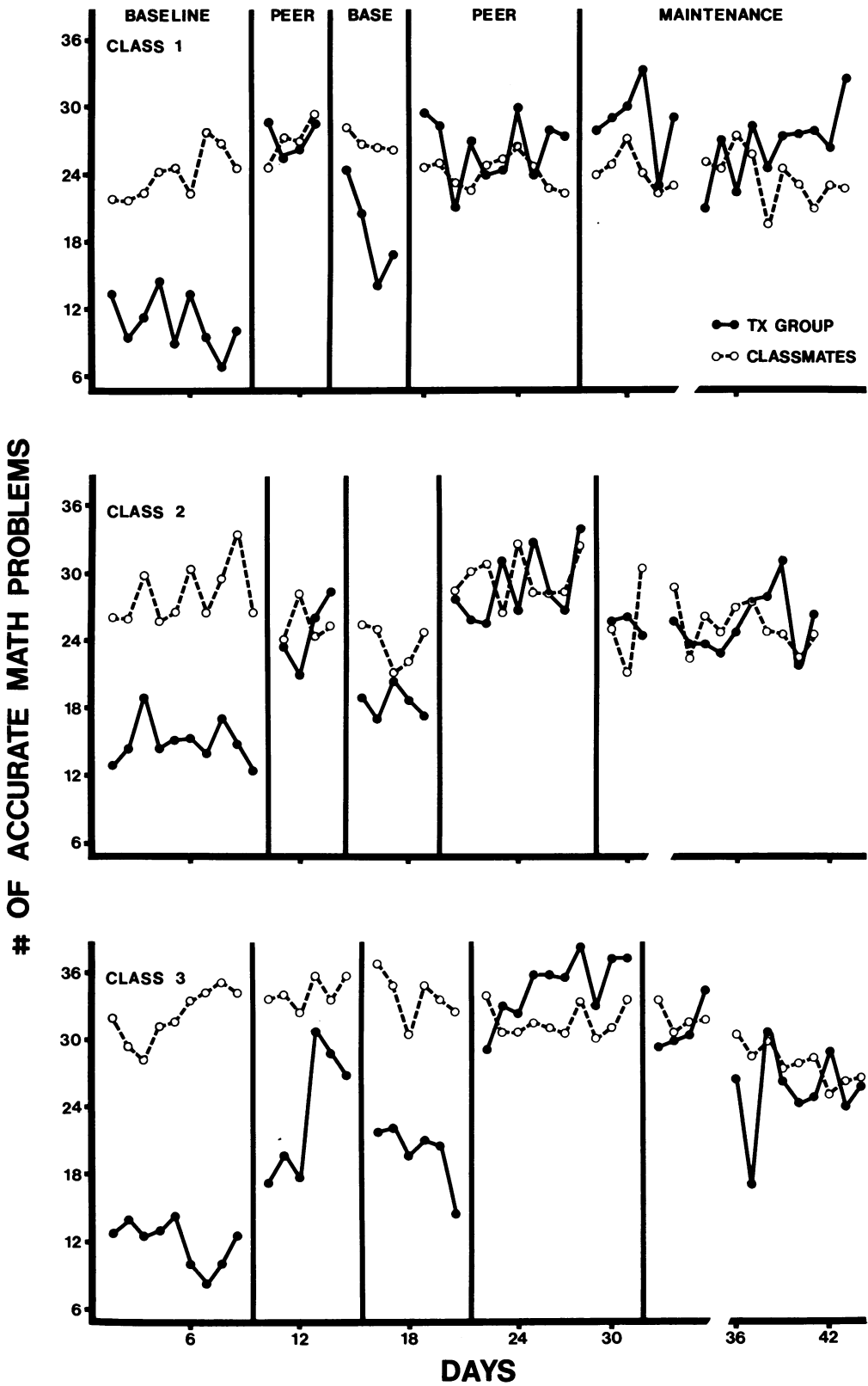


Figure 1. Average number of accurately completed arithmetic problems during the 7-min arithmetic drill for each class of treated and randomly selected nontreated students across experimental phases.

and multiplying by 100; mean reliability classes was 99.7% (range: 99% to 100%).

Peer affiliation. The students' preferences for affiliation with their classmates were assessed in each class during the initial baseline phase, at the end of the second treatment phase, and at the end of the follow-up phase. The teachers passed out sheets with spaces marked 1–5 and asked the students to rank in order the five classmates that they would most like to sit with during "group sharing time." In each class, four students of the same gender as the treatment group were randomly selected to form a comparison group. We compared the social attractiveness of the children in the treatment and comparison groups in terms of (a) number of selections within each group and (b) number of selections of the four children in each group by the entire class.

RESULTS

Reciprocal Peer Tutoring Intervention

Figure 1 shows the average number of arithmetic problems completed accurately by the treatment group members in classes 1, 2, and 3, and by seven randomly selected nontreated students in each class. During baseline, the students in the treatment groups performed consistently below the average performance of their nontreated classmates. During the treatment conditions, the treatment groups improved their performance to a level equivalent to the average performance of their classmates. During the 12-week maintenance phase, the treated students continued to perform at a level indistinguishable from their peers.

Table 1 presents both the average number of problems completed accurately and the mean accuracy percentage for each treatment group. These group data are very representative of the individual student data. Instituting the reciprocal peer tutoring intervention resulted in the following average gains in arithmetic problems solved for each treatment group member: Class #1: 18.2, 14.5, 14.8, and 15.8; Class #2: 10.5, 16.3, 16.0, and 8.0; Class #3: 20.0, 23.3, 25.8, and 5.1. In addition to showing increases in the number of correctly

Table 1
The Average Number of Accurately Completed Arithmetic Problems and Percent Correct Across Experimental Phases

Classes	Experimental phases				
	A	B	A	B	C
Class #1					
Number	10.8	27.3	19.0	26.4	27.4
% Correct	73.9	90.1	80.5	89.2	91.8
Class #2					
Number	15.0	24.8	18.6	28.8	25.5
% Correct	68.8	82.6	73.5	87.3	84.5
Class #3					
Number	11.9	23.6	19.9	34.9	27.1
% Correct	32.5	70.1	60.6	77.6	78.2
Average					
Number	12.6	25.2	19.2	30.0	26.7
% Correct	58.4	80.9	71.5	84.7	84.8

completed problems, the treated students consistently demonstrated increases in their accuracy percentage during treatment and maintenance phases.

Peer Affiliation

The treated students were mentioned 40 times in their classmates' rankings in the baseline assessment, whereas the control students had 53 inclusions. In the postranking the treated students had 46 inclusions compared to 54 for the control students and in the follow-up rankings the number of inclusions were 44 and 54, respectively. Changes in intragroup peer affiliation were assessed by comparing the number of within-group selections by the treatment and control students. In the baseline assessment, the 12 treated students included members of their treatment group 14 times in their rankings, whereas the 12 control students had 18 inclusions. In the postranking the treated students had 24 inclusions compared to 13 for the control students and in the follow-up rankings the number of inclusions were 22 and 12, respectively.

DISCUSSION

The results of this study indicate the effectiveness of the reciprocal peer-tutoring intervention in increasing the arithmetic performance of mixed

ethnic groups of male and female underachieving fifth-grade students. Introducing this intervention resulted in an increase in arithmetic proficiency for the treated students. During treatment these students increased both their rate and accuracy of arithmetic computations.

This investigation also provided an assessment of the social validity, the maintenance, and the social impact of treatment gains. A comparison of the arithmetic performance of the treated and non-treated classmates validated the social significance of the amount of improvement made by the treated students. During the treatment and maintenance phases, the arithmetic performance of the treated students was indistinguishable from the average performance of their classmates (Walker & Hops, 1976). Twelve weeks of follow-up data revealed that the average arithmetic performance of the treated students during the maintenance condition was either at or above treatment levels. Only one of the 12 children dropped slightly below her treatment level (the 4th child in Class #2 went from a treatment average of 22.6 to a follow-up average of 20). These data are superior to the 6 weeks of follow-up data obtained by Pigott *et al.* (1984). In that investigation, the treatment gains of only one out of four treated students were maintained. In contrast with that investigation, the study reported here used a partial-withdrawal procedure (Rusch & Kazdin, 1983) to promote response maintenance. The pre-, post-, and follow-up sociometric data indicated that the students who participated in the treatment groups increased in their amount of peer affiliation with other treatment group members. Additionally, the social status of the treated students relative to the nontreated students remained stable, evidencing no deleterious side effects as a function of their involvement in the treatment group.

Future research efforts are needed to determine the relative contribution of the active components of this reciprocal peer-tutoring treatment package. Additionally, research should be conducted com-

paring the relative efficacy and cost efficiency of this intervention with both teacher-administered group contingencies and individualized peer-tutoring strategies.

REFERENCES

- Gerber, M., & Kauffman, J. M. (1981). Peer tutoring in academic settings. In P. Strain (Ed.), *The utilization of classroom peers as behavior change agents* (pp. 155-188). New York: Plenum Press.
- Greenwood, C. R., & Hops, H. (1981). Group-oriented contingencies and peer behavior change. In P. Strain (Ed.), *The utilization of classroom peers as behavior change agents* (pp. 189-259). New York: Plenum Press.
- Lovitt, T. C. (1978). Arithmetic. In N. Haring, T. Lovitt, M. Eaton, & C. Hansen (Eds.), *The fourth R research in the classroom* (pp. 127-166). Columbus, OH: Charles E. Merrill.
- McCarty, T., Griffin, S., Apolloni, T., & Shores, R. E. (1977). Increased peer-teaching with group-oriented contingencies for arithmetic performance in behavior-disordered adolescents. *Journal of Applied Behavior Analysis*, *10*, 313.
- Pigott, H. E., Fantuzzo, J. W., Heggie, D. L., & Clement, P. W. (1984). A student-administered group-oriented contingency intervention: Its efficacy in a regular classroom. *Child and Family Behavior Therapy*, *6*, 41-55.
- Rusch, F. R., & Kazdin, A. E. (1983). Toward a methodology of withdrawal designs for the assessment of response maintenance. *Journal of Applied Behavior Analysis*, *14*, 131-140.
- Slavin, R. E. (1983). When does cooperative learning increase student achievement? *Psychological Bulletin*, *94*, 429-445.
- Walker, H. M., & Hops, H. (1976). Use of normative peer data as a standard for evaluating classroom treatment effects. *Journal of Applied Behavior Analysis*, *9*, 159-168.
- Wolfe, J. A., Fantuzzo, J. W., & Wolter, C. F. (1984). Student-administered group-oriented contingencies: A method of combining group-oriented contingencies and self-directed behavior to increase academic productivity. *Child and Family Behavior Therapy*, *6*, 45-60.
- Wolter, C. F., Pigott, H. E., Fantuzzo, J. W., & Clement, P. W. (1984). Student-administered group-oriented contingencies: The application of self-regulation techniques in the context of a group to increase academic productivity. *Techniques: A Journal for Counseling and Remedial Education*, *1*, 14-22.

Received April 11, 1985

Final acceptance October 24, 1985