April 1994

Using Student-Managed Interventions to Increase Homework Completion and Accuracy

Daniel E. Olympia
University of Utah

Susan M. Sheridan
University of Nebraska - Lincoln, ssheridan2@unl.edu

William R. Jenson
University of Utah

Debra Andrews
University of Utah

Published in *Journal of Applied Behavior Analysis* 27:1 (Spring 1994), pp. 85–99.

Submitted March 29, 1993; revised September–December 1993; accepted December 7, 1993. Action editor for journal edition: Brian K. Martens.

Using Student-Managed Interventions to Increase Homework Completion and Accuracy

Daniel E. Olympia, Susan M. Sheridan, William R. Jenson, and Debra Andrews

University of Utah

Abstract: We examined the effectiveness of self-managed individual and group contingency procedures in improving the completion and accuracy rates of daily mathematics homework assignments. A group of sixth-grade students having homework difficulties in mathematics were selected for the study. There was substantial improvement in the amount of homework completed over baseline for a majority of the students, whereas the results for accuracy were mixed. Students who participated in the self-management training made significant gains on standardized measures of academic achievement and curriculum-based measures of classroom performance. Parents also reported significantly fewer problems associated with homework completion following the intervention. Students who were allowed to select their own performance goals made superior improvements in the number of homework assignments returned compared to students who were given a specified goal by the classroom teacher. Parents, subjects, and the classroom teacher responded positively on consumer satisfaction measures following termination of the study.

Keywords: homework, interventions, self-management, academic skills, education

Recent research investigating the relationship of homework to achievement indicates that time spent on homework has important and positive effects on learning, whether measured by grades or by test scores (Anderson, 1986; Frederick & Walberg, 1980; Keith, 1986; Rutter, Maughn, Mortimore, Ouston, & Smith, 1979; Walberg, Paschal, & Weinstein, 1985). These effects are clear even when controlling for background factors such as ability and socioeconomic status (Paschal, Weinstein, & Walberg, 1984). In fact, homework has been identified as one of the most important practices for establishing a successful academic environment (Coleman, Hoffer, & Kilgore, 1981; Epstein, 1983). According to Cooper (1989), two important variables affecting the relationship of homework to achievement are time spent on homework and grade level. That is, the average student spending more time on homework scored 0.39 standard deviations higher on academic outcomes than did the average student reporting less time spent on homework. Upper-level elementary students showed the smallest effect for homework, and high school students showed the largest effect. According to Cooper, the "average student doing homework over a 10-week period would be expected to outscore 52% of no-homework students if the class is in the upper elementary grades, about 60% in the junior high grades and 69% in the high school grades" (p. 164).

Considering that existing research generally supports the relationship of homework to school achievement, homework completion and accuracy have been continuing sources of concern for parents and educators alike (Lieberman, 1983; Maertens & Johnson, 1972). Because homework will not fulfill any purposes if students do not complete assignments, homework completion and accuracy are logical targets for behavior change (Anesko & O'Leary, 1982; Miller & Kelley, 1991). Children may avoid academic tasks at home, producing conflict in many families (Anesko & O'Leary, 1982; Anesko, Schoiock, Ramirez, & Levine, 1987). Difficulties often begin during the elementary school years when homework assignments are first required by teachers (Keith, 1986).

Few studies have been directed at improving methods by which children approach or complete homework (Miller & Kelley, 1991). Strategies to increase homework compliance fall into one of three areas: parent training, school-

based management, and self-management (Olympia, Sheridan, & Jenson, in press). Although the literature generally supports the effectiveness of using external agents (e.g., parents, teachers) to carry out behavior-change programs, drawbacks include loss of teaching time to time spent managing behaviors, difficulties in observing and providing consistent consequences for behaviors, and the association of parents and teachers with the administration of negative contingencies (Kazdin, 1975).

Behavioral techniques that assign greater control of contingencies to individuals and groups of students offer a means of overcoming the disadvantages associated with externally based programs (Kazdin, 1975). Two approaches that offer these advantages are cooperative learning and self-management. Cooperative learning (Nastasi & Clements, 1991; Slavin, 1980) uses small groups of students of mixed abilities who learn or complete a task together. Cooperative learning structures the learning environment by providing mutual goals, division of labor, role interdependence, and group rewards. Applications of cooperative learning all share the basic concept of a cooperative goal structure but vary in the degree of task specialization and incentives provided.

Although the rationale for cooperative learning emphasizes social and emotional growth, significant effects on academic achievement and cognitive growth have also been apparent. Several reviews have concluded that favorable academic effects are evident across settings and students at all grade levels (Nastasi & Clements, 1991; Sharan, 1980; Slavin, 1983). Cooperative learning has produced significant gains across a wide range of content areas, including mathematics and other core subjects (Johnson & Johnson, 1985; Slavin, 1983). The most successful cooperative learning methods for increasing student achievement (a) use group scores (composed of individual achievement scores) to provide feedback to students and (b) provide each member with a unique task for which he or she is held accountable (Slavin, 1983).

The combination of self-management with group-oriented contingencies (Pigott, Fantuzzo, Heggie, & Clement, 1984; Wolfe, Fantuzzo, & Wolter, 1984) has been particularly effective in academic settings at improving on-task behavior. This approach requires children to prompt, monitor, evaluate, and reinforce their own academic behavior. Group-oriented contingencies are used to take advantage of peer influences by involving more than one student in a contingency management program. Wolfe et al. (1984) used a student-controlled group contingency to increase arithmetic performance of grade-school children in a clinic setting. Using a single-subject design, increases in performance for all 4 subjects were found. Roles of "coach," "scorekeeper," "manager," and "referee" were assigned to students. Each role corresponded to a specific self-management function. Students performed these roles in the context of regular math drill sessions. Interestingly, nontreated disruptive behavior also decreased substantially.

The effectiveness of classroom-based strategies using peer-mediated cooperative self-management procedures to support homework assignment completion has not been researched. Developments in the use of peer tutors and cooperative learning show considerable promise for remedying many academic problems, including homework compliance (Cooper, 1989). This study was conducted to evaluate the effectiveness of a package of intervention techniques to improve homework completion and accuracy. A student-administered intervention that combined aspects of cooperative learning, self-management, and interdependent group-oriented contingencies was implemented within a regular classroom setting. We also evaluated the relative contribution of self-selected goals versus teacher-selected goals to the self-management model. Additional areas of inquiry included student motivation to complete extra work, consumer satisfaction, and treatment integrity.

METHOD

Subjects

Subjects in the study were 10 male and 6 female sixth-grade mathematics students who met the following criteria: (a) completion of

less than 50% of assigned homework in mathematics, or accuracy on returned homework averaging 50% or less for the previous marking period (at least 6 weeks duration); (b) receipt of an unsatisfactory grade in arithmetic during the previous marking period; and (c) performance within the lower 50th percentile on a criterion-referenced group-administered competency test of mathematics achievement. For comparative purposes, data were also recorded for 37 sixth-grade students who were enrolled in the same section of mathematics instruction, but who did not participate in the study.

Measures

Completion of arithmetic homework assignments. Homework completion was assessed by counting the number of days per condition that an arithmetic worksheet was returned by each subject to the teacher and expressing this number as a percentage. Homework completion was also calculated daily for the remaining class members in a similar fashion.

Accuracy of arithmetic homework problems. Homework accuracy was assessed by counting the number of correct arithmetic problems completed by subjects each day a sheet was returned divided by 20 (the number of arithmetic problems as-signed) and multiplying this number by 100%. Accuracy was also calculated daily for the entire class in a similar fashion.

Achievement and generalization of math skills. The Woodcock-Johnson Psychoeducational Test Battery (Revised)-Calculations subtest was administered to subjects before and after the homework intervention to assess changes on standardized achievement measures. Likewise, curriculum-based probes were used to assess maintenance of computational math skills in the classroom. Probes were obtained for participating students and remaining class members twice during each baseline and experimental condition. Probes were randomly selected from seat work assignments and were based on current curriculum goals. Each probe provided opportunities for practice and review of a specific concept taught in the class on that same or preceding day. Data for each subject participating in the study and the class as a whole were compiled by calculating the number of problems completed correctly on each probe and dividing by the total number of problems in each probe.

Motivation to complete homework. To assess subjects' motivation to complete homework, the number of extra practice problems attempted was recorded for each student.

Consumer satisfaction. The classroom teacher completed a 24-item questionnaire designed to evaluate the appropriateness and acceptability of the classroom treatment strategy. The questionnaire was adapted from the Behavior Intervention Rating Scale (BIRS; Elliott & Von Brock Treuting, 1990) and assessed several dimensions of treatment acceptability using a 6-point Likert scale. Parents of subjects evaluated the level of homework difficulty that their child experienced by completing the Homework Problems Checklist (HPC; Anesko et al., 1987) before the intervention and at the conclusion of the study. They also completed a brief 24-item consumer questionnaire adapted from the BIRS at the end of the study. Finally, students completed two consumer questionnaires regarding their participation in the study. The first consisted of a 7-item checklist adapted from the Children's Intervention Rating Profile (CIRP; Witt & Elliott, 1985); the second was adapted from the 15-item Treatment Evaluation Inventory (TEI; Kazdin, French, & Sherick, 1981).

Procedure

During each treatment condition, four self-management operations (self-monitoring, self-instruction, self-evaluation, and self-reinforcement) were incorporated into three distinct team roles (coach, scorekeeper, and manager) adapted from research on self-management (Wolfe et al., 1984). For this study, a fourth team member was designated as a pinch hitter. He or she participated in all aspects of training, met with team members, and filled in for other team members when they were absent or otherwise unavailable for the study. Random assignment of team roles to each participant was initially made by the investigator. Each subject performed his or her assigned role for 3 days, at

which time roles were reassigned, giving each subject an opportunity to perform another team function. Roles were reassigned every 3 days thereafter. Duties for each role were posted in the training room for quick reference.

Team members were trained to follow a four-step structured meeting procedure daily. In Step 1, the coach (a) made verbal statements to the group to prompt and direct various team functions, (b) assembled the team and verbally reviewed the daily team goal, and (c) reviewed homework production strategies as needed. In Step 2, the scorekeeper (a) counted the number of assignments turned in and graded each assignment, (b) determined each team member's accuracy rating, and (c) completed a team scorecard. In Step 3, the manager (a) totaled the daily team score and declared a win or loss depending on whether the team matched or exceeded its daily goal, (b) posted a win sticker publicly on a league scoreboard when appropriate, and (c) provided individual reinforcement to team members if they met or exceeded their daily individual goals. Individual raffle tickets were distributed by the manager to team members earning reinforcement. Tickets were placed in a raffle drum for mice weekly drawings. Finally, Step 4 involved the coach verbally prompting team members to select a goal or reading the teacher-selected goal for the next homework assignment.

Baseline (Phase A)

During baseline, no intervention was administered. Daily, standardized math homework assignments were distributed to two math sections of the sixth-grade class. The assignments were compiled using a computer program that generated a random assortment of practice and review problems related to a specific teaching goal (Science Research Associates, 1988).

Math instruction consisted of the classroom teacher presenting math concepts and functions in a large-group format. Worksheets were provided to students for practice purposes. Homework assignments were distributed at the end of the period and consisted of 20 problems and 10 "extra practice" problems. Homework was scored the following morning, and correct answers were reviewed. No specific behavioral contingencies were in effect to increase homework completion or accuracy.

Training

Training of subjects occurred during the 2 days subsequent to baseline and before the treatment phase. All team members were trained by the investigator in groups of 8 students. A seven-page handbook of procedures and activities essential to implementation of the intervention was provided to each student. Students reviewed the first half of the manual during the first meeting and the last half during the second meeting.

Training included teaching group members the tasks required for each role and their coordination via modeling and direct instruction. Competency was assessed by establishing each team member's ability to perform each role at a 95% or higher level of accuracy on a behavioral checklist of discrete tasks specific to each role.

File folders were assembled that corresponded to each team member role, with a list of specific responsibilities attached to the exterior of the folder. Inside the folder were various materials necessary for each team member to complete his or her responsibilities. After training was completed, group members were assigned to teams based on a random draw. Organized teams then selected a team name and devised or discussed several strategies for increasing homework completion and accuracy. Finally, team members completed a reinforcement survey to assist the investigator in selecting back-up reinforcers.

Team meetings were scheduled daily and occurred at the beginning of each math period. They lasted 10 to 15 min, after which students returned to class and handed in their corrected homework to the teacher. The completed homework assignments were rescored and checked for accuracy by a classroom aide. If scores were incorrectly calculated, only corrected scores were recorded for analysis. No feedback was given to students after the training period.

Interventions (Conditions B and B')

Two teams within the same grade and curriculum level were randomly assigned to one of two conditions (i.e., Condition B: student-selected goal group; and Condition B': teacher-selected goal group). For the first 3 days of intervention, students on all teams were told that they were required to return homework and obtain at least 80% correct to receive individual reinforcement. Teams were required to average at least 80% correct to receive team reinforcement. This maximized the probability of each ream experiencing reinforcement and earning a win.

Self-selection of performance criteria (Condition B). In Condition B, two teams of students monitored, recorded, and self-reinforced homework completion and accuracy. Scoring templates were developed by the examiner and made available to the teams for self-scoring. They earned daily points in the form of runs for each homework assignment returned by a team member. Additional runs were earned for accuracy levels of 80%, 90%, and 100%. A team scorecard (including identifying information, individual team member scores, goal options, a daily score, and a goal completion rating) was completed daily by the scorekeeper to track daily performance.

After the first 3 days, students were allowed to select their own performance levels from low, medium, and high performance criteria identified by the researcher and classroom teacher. The number of possible individual and team points to be earned was determined by the team members, depending upon the criterion level selected by each individual and team. No additional points were awarded for completion of extra practice problems.

Teacher selection of performance criteria (Condition B'). In Condition B', two different teams followed the same general procedures with one exception. Students were provided with a single target goal of 90%; that is, they were required to average at least 90% on returned homework assignments to earn team reinforcement. Daily team scores at or above the fixed criterion were exchanged by the manager for a win sticker that was posted on a league scorecard. Reinforcement was provided in a manner identical to that experienced by teams operating under the self-selection criteria.

Research Design

A single-subject reversal (ABAB) design yoked across two parallel conditions (Conditions B and B') was used. This permitted within- and between- subject comparisons of mathematics homework performance across baseline, intervention, reversal, and intervention conditions (Kazdin, 1982).

Baseline data were collected for 13 days by the investigator and a research assistant. This was followed by a 2-day training period, during which time the homework teams program was introduced to four participating teams. The treatment phases for both conditions (B and B') were initiated simultaneously and lasted 17 days.

Following 5 weeks of intervention, a return to baseline was in effect for approximately 3 weeks. Team members were informed that the investigator would be out of town and that the teams would not be meeting. Homework assignments were routinely collected but subjects were not allowed to earn team win stickers or spin for reinforcers. A return to treatment was instituted after approximately 3 weeks and continued for approximately 4 weeks.

Reliability and Treatment Integrity

Measures of reliability were obtained in several areas to assess treatment integrity and accuracy of self-grading procedures. Trained observers used structured checklists with operational definitions to observe discrete tasks specific to subjects' roles during team meetings and record team compliance with the self-management protocol. Observations were conducted four times during each treatment phase by classroom aides, the primary researcher, and volunteers during team meetings. Two reliability observations were obtained for each team during each of the two research conditions. Calculations of agreement were made using a formula for weighted agreement (Harris & La-

Table 1
Percentage of Homework Assignments Returned (and Mean Accuracy in Parentheses) for Subjects Assigned to Condition B′ Across Experimental Phases

Subject	Baseline 1	Treatment 1	Baseline 2	Treatment 2
1	0 (DNA)[a]	35 (93)	27 (77)	20 (62)
2	15 (23)	59 (69)	30 (72)	27 (73)
3	54 (57)	56 (80)	45 (83)	47 (68)
4	0 (DNA)[a]	82 (66)	27 (25)	67 (90)
5	69 (70)	65 (83)	91 (84)	93 (81)
6	77 (35)	81 (59)	45 (44)	73 (82)
7	8 (70)	69 (76)	20 (83)	80 (83)
8	31 (24)	69 (70)	18 (90)	46 (83)
M	31.8 (34.9)	64.6 (74.5)	37.9 (69.8)	56.6 (77.8)
SD	31.1 (28.4)	15.2 (10.8)	23.7 (23.0)	25.8 (9.3)

[a]DNA = Data not available.

hey, 1978). The formula combines agreement for occurrence and agreement for nonoccurrence, and weights each according to the frequency with which it appears.

Interrater reliabilities for each of the 12 steps of the homework self-management procedure ranged from 56% to 100%, with a mean of 86%. In general, observers agreed that students completed essential collection, scoring, and reinforcement functions 100% of the time. Other steps that occurred at least 85% of the time included "asks classmates to get into student teams and collects homework"; "gives scorecard to manager"; "adds team score, compares with daily goal, and declares win or loss to other team members." Observers agreed that certain behaviors occurred less than 60% of the time, including "reviews at least one team strategy for meeting homework goal," and "announces team goal for the day."

Reliability of self-scoring was also assessed throughout each experimental phase. An independent observer checked the number of problems marked correct on the homework assignments using a computer-generated scoring key. These observations were compared to the number of problems scored correct by the scorekeeper on each homework assignment and the team scorecard. Overall accuracy was calculated as percentage of agreements between the observer's scoring key and each student's reported score.

During Baseline 1, Teams 1 and 2 averaged 28% accuracy when allowed to grade their own homework independently, and Teams 3 and 4 averaged 42% accuracy. Nontargeted class members overestimated their grades 54% of the time. During both treatment phases, target subjects substantially increased their reporting accuracy when using self-management procedures. The teacher-selected goal teams averaged 85.5% accuracy across both treatment phases, and the student-selected goal teams averaged 92% accuracy in reporting correct homework scores across both treatment phases. The remaining class members continued to underreport their errors for the duration of the study, averaging 70% over the remaining three experimental phases.

RESULTS

Individual data on homework completion (i.e., the percentage of days homework sheets were returned) and mean accuracy rates for subjects assigned to Conditions B' and B are presented in Tables 1 and 2, respectively. Individual data paths for homework accuracy for subjects in Conditions B' and Condition B are provided in Figures 1 and 2, respectively. Results for each variable and condition are discussed separately below.

Homework Completion Condition B' (teacher-selected goal). As evident in Table l, 6 of 8 subjects (all subjects except Subjects 3 and 5) demonstrated a gain in homework completion from Baseline 1 to Treatment 1, suggesting an initial treatment effect. Seven of the 8 sub-

Table 2
Percentage of Homework Assignments Returned (and Mean Accuracy in Parentheses) for Subjects Assigned to Condition B Across Experimental Phases

Subject	Baseline 1	Treatment 1	Baseline 2	Treatment 2
9	54 (54)	62 (76)	36 (66)	70 (85)
10	38 (57)	94 (81)	82 (93)	100 (89)
11	8 (50)	60 (69)	27 (47)	60 (88)
12	54 (46)	67 (74)	45 (94)	73 (74)
13	23 (37)	67 (91)	9 (100)	55 (73)
14	46 (58)	71 (73)	91 (97)	87 (98)
15	38 (75)	86 (72)	0 (DNA)[a]	73 (72)
16	54 (71)	88 (76)	45 (82)	73 (84)
M	39.4 (47.3)	74.4 (76.5)	41.9 (72.4)	73.9 (82.9)
SD	16.7 (12.5)	13.0 (6.8)	31.9 (34.4)	14.3 (9.2)

[a]DNA = Data not available.

jects demonstrated a return to baseline, and 4 of the 8 showed a positive response to the second treatment implementation. In sum, the homework teams intervention exerted clear experimental control over homework completion by Subjects 4, 6, 7, and 8.

Across all subjects in Condition B', return rates averaged 34.8% during baseline and increased to 60.5% during treatment (an increase of 25.7%). This is slightly lower than the average return rate of 7 1.5% for the remaining class members across all phases of the intervention.

Condition B (student-selected goal). As depicted in Table 2, all 8 subjects in Condition B demonstrated a gain in homework completion from Baseline 1 to Treatment 1, suggesting an initial treatment effect. Seven of the 8 subjects (excluding Subject 14) showed a return to baseline when treatment was postponed. Seven of the 8 subjects demonstrated a second gain with the reinstatement of the intervention. In sum, the homework teams intervention exerted clear experimental control over 7 of the 8 subjects' homework completion in Condition B.

Across both teams in Condition B, subjects averaged a return rate of 40.6% during baseline conditions and a return rate of 74.1% during treatment phases (an increase of 33.5%). This compares favorably to an average return rate of 72% for the remaining class members across all phases of the intervention.

Homework Accuracy

Condition B' (teacher-elected goal). As depicted in Table 1 and Figure 1, 5 of 6 subjects in Condition B' for whom baseline data are available demonstrated a gain in homework accuracy from Baseline 1 to Treatment 1, suggesting an initial treatment effect. Two of the 8 subjects (Subjects 4 and 6) showed a return to baseline when treatment was postponed, whereas the remaining subjects maintained treatment gains into Baseline 2. These same 2 subjects exhibited a second gain with the reinstatement of the intervention, suggesting that the homework teams intervention exerted clear experimental control over 2 of the 8 subjects in Condition B' for homework accuracy. With the exception of Subjects 1, 2, and 3, subjects who failed to return to baseline demonstrated maintenance of treatment effects following the initial phase change.

Across both teams in Condition B', subjects attained an average accuracy rate of 52.3% over baseline conditions and an accuracy rate of 76.1% across treatment phases (an increase of 23.8%). This is slightly higher than the average accuracy rate of 71% for the remaining class members across all phases of the intervention.

As can be seen in Figure 1, no common patterns were evident across subjects. Data for only 3 subjects (Subjects 1, 4, and 8) are considered stable and high during one or both treatment phases; however, relatively few data points are available in these cases. Some subjects demon-

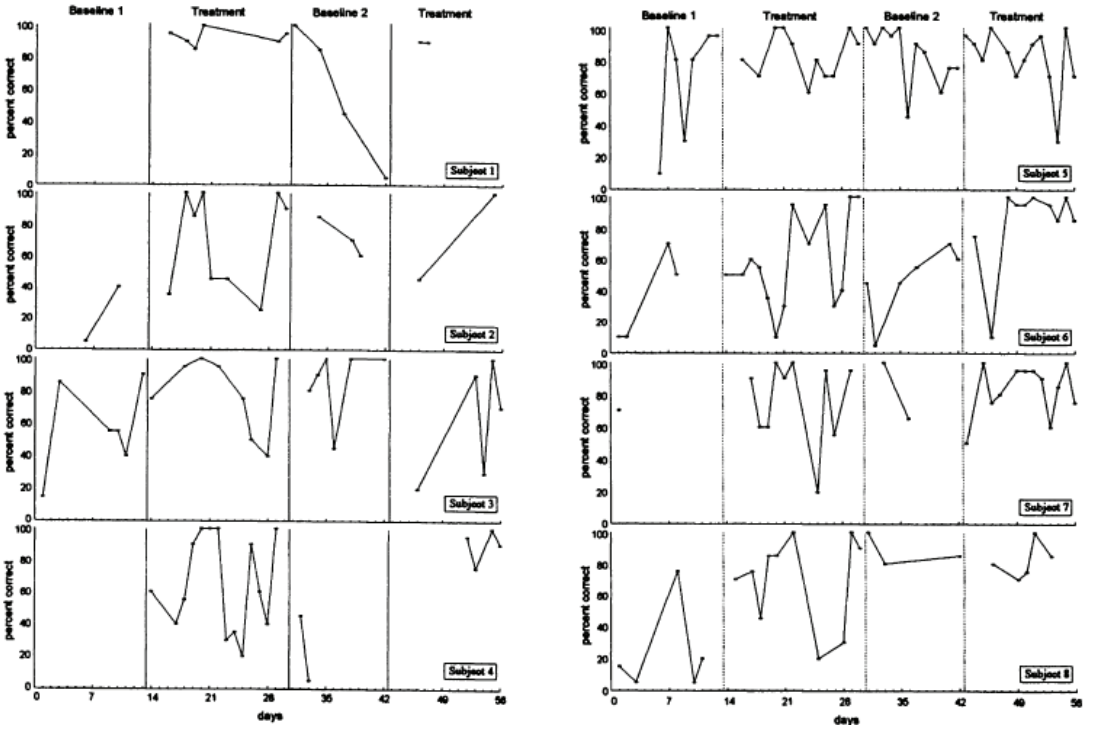

Figure 1. Mean accuracy level of completed homework assignments returned for subjects in Condition B' (teacher-selected goal).

strated increased accuracy in Treatment 1 largely due to an increased number of assignments completed (i.e., Subjects 1, 2, 4, and 7). Specifically, although increases in accuracy were immediate for Subjects 1 and 4, this may be due to the fact that no homework assignments were completed during baseline and hence, no accuracy rates were available. For Subjects 2 and 7, only 2 and 1 baseline data points are available, respectively. Several subjects demonstrated decreasing trend lines in accuracy during the second baseline phase, suggesting that initial maintenance effects were extinguished with the withdrawal of reinforcers.

Condition B *(student-selected goal).* As depicted in Table 2 and Figure 2, 6 of the 8 subjects in Condition B (excluding Subjects 15 and 16) demonstrated a gain in homework accuracy from Baseline 1 to Treatment 1, suggesting an initial treatment effect. Two of the 8 subjects (Subjects 11 and 15) returned to baseline when the treatment was postponed, whereas the remaining subjects maintained treatment gains into Baseline 2. Subjects 9, 10, 11, and 15 exhibited gains with the reinstatement of the intervention. One subject in this condition (Subject 11) demonstrated a pattern across phases indicative of clear functional control of the intervention. Those subjects who failed to return to baseline after the initial phase change tended to maintain high levels of accuracy.

Across both teams in Condition B, subjects averaged an accuracy rate of 57.8% during baseline conditions and an accuracy rate of 79.7% during treatment (an increase of 17.9%). This compares favorably with an average accuracy rate of 79% for the remaining class members across all phases of the intervention.

Similar to subjects in Condition B', data for several subjects in Condition B appeared to be variable. Analysis of Figure 2 reveals that subjects in this condition maintained treatment effects into the second baseline more readily than did subjects in Condition B'. In fact, data for one half of subjects in Condition B were high and stable during Baseline 2, indicating

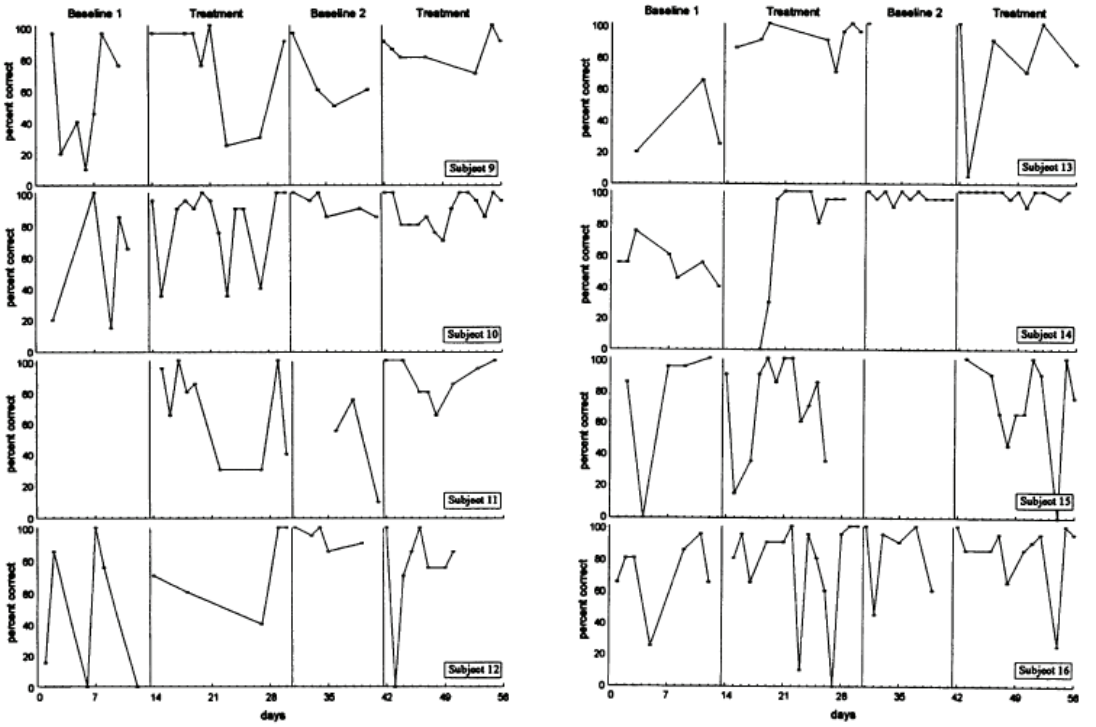

Figure 2. Mean accuracy level of completed homework assignments returned for subjects in Condition B (student-selected goal).

some resistance to extinction. Generally high accuracy rates were observed into Treatment 2, with some infrequent occurrences of low outlying data points (e.g., Subjects 12, 13, and 15).

Access to Reinforcement

Interestingly, students who were allowed to select their own target goals tended to receive more reinforcement in the form of team wins than did students who were provided with a performance goal by the classroom teacher. Across both treatment phases, the student-selected goal teams achieved group reinforcement 53.9% of the time. Students who were provided with a team goal by the classroom teacher achieved a group reinforcement rate of 26.6% across both treatment phases. The student-selected goal teams' performance produced a higher rate of reinforcement than the teams receiving their goal from the classroom teacher for 6 of 7 weeks.

Although students who were allowed to select their own performance goals and reinforcement contingencies experienced more reinforcement, they also tended to select lower performance goals. Across both treatment conditions, the student-selected goal teams chose the lowest performance criteria (corresponding to an 80% accuracy level) 69.6% of the time, the medium performance criteria (corresponding to the 90% accuracy level) 2 1.4% of the time, and the highest goal (corresponding to the 100% accuracy level) only 9% of the time.

Student motivation was assessed by evaluating the number of extra problems completed across each experimental condition for Teams 1 and 2 (teacher-selected goal), Teams 3 and 4 (student- selected goal), and the remainder of students in each classroom. Averaged across baseline and treatment phases, neither group exceeded the average of the remainder of the class. Specifically, subjects in Condition B

completed an average of 8% of extra problems during treatment phases, compared to 11.8% completed by their classmates. Subjects in Condition B' completed an average of 6% of extra problems during treatment phases, compared to 12.8% completed by their peers. Although subjects in both treatment groups demonstrated increases in number of extra math problems completed from Baseline 1 to Treatment 1, no patterns across subjects or within groups were evident. Initial gains returned to baseline levels for subjects in Condition B only, and completion of extra problems failed to be maintained into Treatment 2 for any subject.

Standardized Achievement and Curriculum-Based Measures

Using a *t* test for independent groups, no significant differences were found on the pretest between students who were assigned performance goals by the teacher and those students allowed to select their own performance standard, $t(14) = -1.13$, $p > .278$. Similarly, no significant differences between teacher- and student-selected goal groups were found on the posttest measure, $t(14) = -0.70$, $p > .49$.

Collapsing data across both conditions, a comparison was made of pretest and posttest performances on the calculations subtest for all target students. A t test for paired groups indicated that students who completed the self-management intervention made significant gains over pretest scores on a standardized measure of mathematics achievement, $t(15) = -3.67$, $p < .01$. Overall, participating students gained an average of 5 standard score points ($M = 95.813$, $SD = 8.75$) over their mean pretest performance ($M = 90.81$, $SD = 8.27$).

During Baseline 1, all teams failed to average more than 45% correct on any curriculum-based probe. In contrast, the remainder of the class achieved at least 60% and 70% correct on these same probes. Treatment 1 was associated with increased accuracy on daily probes for all teams, with mean percentage correct scores of 68.1 % and 79.9%, respectively. Comparable accuracy was recorded for the remaining class members, with mean percentage correct scores of 68.2% and 83%, respectively. Conversely, when all teams returned to Baseline 2, accuracy on curriculum probes declined to 50.2% on the last probe. Class members maintained their overall level of accuracy during this same period, and received mean percentage correct scores of 82% and 76% on this same probe. When all teams returned to the last treatment phase, mean percentage correct scores returned to levels comparable to the remainder of the class. Mean percentage correct scores for all teams ranged from 71.3% to 79.6%, whereas the remainder of the class achieved mean percentage correct scores ranging from 70% to 82%.

Consumer Satisfaction

Parent reports. Difference scores on an adaptation of the HPC (Anesko et al., 1987) were calculated for each student using pretest and post-test scores provided by parents. Across 20 items assessing a variety of homework-related behaviors, students who were provided with a performance goal by the teacher achieved a mean difference score of 8.875 ($SD = 6.99$). Students who selected their own performance criteria achieved a mean difference score of 13.87 ($SD = 8.37$). A *t* test for independent groups revealed no significant differences between treatment groups on parent ratings of homework problems, $t(14) = -1.30$, $p > .215$. Results of a paired samples t test indicated a significant difference between target and nontarget students' pretest scores ($M = 26.06$, $SD = 9.33$) and post-test scores ($M = 14.69$, $SD = 8.94$), $t(15) = 5.77$, $p < .001$. Parents of children who participated in the study reported fewer problems with children over homework completion and increased motivation to complete homework.

Parents also completed an adaptation of the TEI (Kazdin et al., 1981), rating treatment acceptability on a 6-point Likert scale (1 = strongly disagree; 6 = strongly agree). Mean ratings across TEI items ranged from 3.31 (homework teams intervention is similar to other things we have used to help with homework) to 5.23 (homework teams intervention is

a good way to handle my child's motivation to complete homework).

Teacher reports. The classroom teacher completed a brief questionnaire based on an adaptation of the TEI. The total acceptability score (based on a sum across all items of the TEI) was 104 *(M* = 4.3; slightly agree). The teacher gave her highest rating to an item indicating that the identified students had problems with homework completion that were severe enough to warrant intervention. The teacher gave her lowest rating to an item that reflected the inconsistency of homework teams with other types of interventions she had used. She also reported that the procedures used were very acceptable, that the subjects made noticeable improvements in homework completion and accuracy soon after the intervention commenced, and that students' homework remained at an improved level even after the intervention was discontinued. However, she doubted that the intervention would improve behavior in other settings, such as the home.

Student satisfaction. Each subject completed two brief treatment acceptability questionnaires (i.e., adaptations of the CIRP; Turco & Elliott, 1986; and the BIRS). Students agreed most strongly with statements indicating that the homework teams intervention was a fair means of dealing with homework assignments and that the procedures would help other children. They also felt that homework teams would cause few problems with their peers as a result of their participation and that the procedures were not harsh. Students indicated that they were more undecided about the existence of other ways of helping students complete homework.

On the adaptation of the BIRS, students gave their highest rating to items reflecting satisfaction with the procedures and the acceptability or fairness of the intervention. Students also reported that they found homework teams moderately good for getting homework done and expressed a willingness to participate again if given the opportunity.

DISCUSSION

This investigation examined the effectiveness of self-managed individual- and group-contingency procedures in improving the completion and accuracy rates of sixth-grade students' daily mathematics homework assignments. The major findings of the study can be summarized as follows:

1. There were improvements in homework completion over baseline performance for a majority of the students participating in the homework teams procedures. Students who were allowed to select their own performance goals made slightly greater improvements in the number of homework assignments returned over students who were given a specified goal by the classroom teacher (7.8%).

2. Data on homework accuracy were variable and mixed. There was a negligible (3%) difference in accuracy rates across the two groups. Some subjects in the self-selected goal group appeared to demonstrate greater levels of resistance to extinction during the second baseline than did subjects in the teacher-selected goal group.

3. Students who participated in the self-management training demonstrated significant gains on standardized measures of academic achievement and curriculum-based measures of classroom performance. Parents also reported significantly fewer problems in the home associated with homework completion at the conclusion of the intervention.

4. Students were able to implement the self-management procedures reliably for 9 of 12 specified steps in the self-management procedure.

5. Students who participated in homework teams completed fewer extra practice problems than their classmates did.

6. Parents, subjects, and the classroom teacher responded positively to consumer satisfaction measures following termination of the study.

Completion and Accuracy

Results of this study indicate that student participation in homework teams generally resulted in gains across both completion and accuracy variables, although some inconsistencies are evident. Comparisons of rates of returned homework assignments suggest increases over baseline performance for the majority of students using the self- management program. Twelve of 16 students who partici-

pated in the study produced at least 20% more homework assignments during treatment compared to baseline phases, and completion rates were comparable to those obtained by nonparticipating students. Students who were allowed to select their own performance goals made superior improvements in the number of homework assignments returned compared to students who were given a specified goal by the classroom teacher. Data on homework accuracy were variable and mixed across both conditions. Six of 14 subjects for whom initial baseline data are available produced increases of at least 20% in homework ac-curacy over baseline, placing them at a level comparable to nonparticipating peers.

The maintenance of homework completion and accuracy across no-treatment conditions is worthy of discussion. Only 4 of 16 subjects failed to return to baseline completion levels, suggesting that the self-management intervention was effective in controlling the majority of subjects' work-completion behaviors. On the other hand, 12 of 16 subjects failed to return to baseline accuracy levels, suggesting that subjects' math skills were positively affected by the intervention. These findings may also be related to a supportive environment that reinforced accurate performance through peer, parental, and teacher verbal approval and/or through achievement measures such as improved grades.

Although mean levels of homework accuracy increased for several subjects, individual data suggest equivocal results. Specifically, for most subjects accuracy data were variable, with a considerable amount of overlap between baseline and treatment phases. Four subjects failed to demonstrate an increase in homework completion of at least 2057, and half the subjects failed to show an increase in accuracy of at least 2057. Experimental control over subjects' behaviors (i.e., accuracy) was evident for only 3 subjects.

An important limitation of the study is in its subject selection. Although it was presumed (based on teacher report and class grouping) that subjects had an academic performance deficit rather than a skill deficit, this was not tested directly. In fact, in retrospect it is possible that some subjects exhibited skill deficits, given the low accuracy levels during treatment phases in some cases. Likewise, the criteria allowed participation of subjects who achieved an average of 50% or less completion or accuracy. This resulted in some subjects having high levels of completion or accuracy at baseline, limiting the size of treatment effects.

The intervention's effectiveness was limited by an inability to extend data collection beyond the final treatment phase. Follow-up maintenance data were not collected due to the conclusion of the school year and academic program for these students.

Goal Selection

Although measurement of differences between groups was not a major objective of this study, it was observed that student teams who self-selected target performance goals for daily mathematics homework appeared to perform somewhat differently from student teams who were provided with teacher-selected performance goals. Students who were allowed to select their own performance goals tended to show slightly greater gains in the number of assignments returned when compared to students who were provided with a goal by the classroom teacher. No differences in levels of accuracy were noted, but performances of subjects in the self-selected goal condition appeared to be more resistant to extinction during the return to baseline. Subjects in the teacher-selected goal condition tended to maintain high levels of accuracy initially into Baseline 2; however their performance quickly extinguished as treatment was withdrawn. This may be related to the differences in reinforcement rates between the two groups; students who selected their own performance goals received reinforcement for homework completion or accuracy twice as often as students who were provided a goal by the classroom teacher. They also tended to select lower performance criteria more frequently. Thus, the control of contingencies and reinforcement schedule for students in the student-selected goal condition may have altered their performance.

It has been suggested that selecting one's own goals functions as a response facilitator (Kelley & Stokes, 1984; Rosenbaum & Drab-

man, 1979). Previous reviews indicate that moderate effects are possible, but students often have a tendency to choose lenient performance standards. The degree of external prompting provided by the investigator in this study was minimal. Students responded to prompting by occasionally selecting a higher goal, but this occurred primarily during the second treatment phase. A lack of experience with risk taking and reinforcement for academic success may make students reluctant to go out on a limb when access to contingencies has been tied to group performance.

Achievement Measures

Taken as a whole, much of the research on homework indicates that homework has a positive effect on academic outcomes. Analysis of data collected in this study confirms that achievement gains found in previous studies are possible. Results also reaffirm the utility of homework as a means of improving basic skills and increasing school achievement for elementary students. Students who completed the self-management intervention made statistically significant gains over pretest scores on a standardized measure of mathematics achievement. Given the somewhat equivocal results on repeated measures of accuracy through daily homework assignments, subjects' performance on standardized achievement measures may reflect in part the stimulus value of "test-taking" situations. Students may place less emphasis on practice activities that have less of an impact on grades than a quiz or test.

Results of curriculum-based probes administered during prebaseline, baseline, and treatment phases also demonstrated a consistent trend in math skill acquisition and proficiency for the treatment group, and for the remaining class members as a whole. Gradual increases are expected for students with no academic or homework difficulties, whereas the response of the experimental groups appears to be functionally related to the intervention. Consequently, the practice and review of skills presented in class and reinforced by additional practice through homework likely resulted in increased performance on the average for all students.

Results of this study also add to the body of evidence establishing the effectiveness of homework with elementary students. The literature has been somewhat equivocal in its support for homework with younger students (Cooper, 1989; Keith, 1986). Homework is becoming more prevalent in elementary schools, and the current data indicate that such practices can have a decidedly positive impact on basic skill acquisition for these students.

Nonacademic measures

Reviews of past research suggest that many potential nonacademic outcome measures of the effectiveness of homework have yet to be assessed. Many of these nonacademic effects, including student motivation, the effect of homework on parents, and cheating, have remained unmeasured. In this study, students in both treatment and regular class settings were found to overreport their actual daily grades substantially when allowed to correct their own papers. Cheating in this fashion was minimized in the treatment groups by using a scorekeeper and manager to grade and record individual as well as team performance and produced increased accuracy. Practically speaking, the scorekeeper and manager served as reliability or accuracy checks for self-scoring.

Students failed to show evidence of any meaningful increase in motivation, as defined by a willingness to complete nonreinforced extra assignments. This is not surprising in view of the fact that completion of these problems was not tied to any contingencies. In fact, given that this variable was not related to the treatment, it can be conceptualized as a type of intervention control. No discernible pattern of motivation was evident, except that students assigned to the intervention failed to complete more extra math problems than peers under any of the intervention phases. It is more likely that a student's willingness to complete additional practice work is related to other factors.

Design Limitations

The most frequently used designs in self-management studies in the classroom have been within- subject reversal and between-sub-

jects comparison designs (Rosenbaum & Drabman, 1979). The design used in the study does not control for any presumed order effects. There was no attempt to isolate public posting of team performance, group contingency, or individual contingency components from the total treatment package. Single-case experimental designs that account for order effects could be used in future research to assess the relative efficacy of teaming, individual and group rewards, self-selection of performance criteria, peer-tutoring components, and other procedures that are naturally suited for this type of intervention. In addition, multiple baseline between-subjects designs could be used to study the temporal control provided by self- and peer-managed interventions.

Although the reversal design used in this study permits an analysis of behavior change in relation to the introduction and withdrawal of treatment, alternative hypotheses for the observed results can be raised. It is possible that simply allocating more time to homework (i.e., time on task) produced desirable changes in completion and accuracy. Likewise, increased attention to homework and the requirement of accountability may have caused improvements in subjects' performances even without the treatment components. Given that no control group was included, it is impossible to determine whether the effects were due exclusively to the homework teams intervention.

Conclusions

Classroom-based strategies such as homework teams are promising interventions. They are practical, and the cost of implementing the training and monitoring the program appears to be reasonable. Homework can certainly be regarded as a low-cost treatment. Major costs associated with giving homework assignments involve a minor loss in instructional time required by homework management and additional preparation time for teachers. It is likely that a classroom teacher would have low- or no-cost reinforcers available, so that these costs can be reduced.

The effectiveness and potential of self-management interventions with children have been limited by a training technology that itself is still in its early infancy (Fantuzzo, Rohrbeck, & Azar, 1986). To assess more fully the practical benefits of cooperatively based peer-intervention strategies, future studies need to be more comprehensive and extensive. Studies need to be replicated across students, classrooms, and teachers. An environmental management component, possibly including student-determined rule statements, could provide more home-oriented benefits valued by parents. Assessment of treatment fidelity and collateral effects also needs to be extended. Because this intervention involves cooperative interactions, future research should also assess the impact of procedures like homework teams on social interactions and social skills development.

REFERENCES

Anderson, B. (1986). *Homework: What do national assessment results tell us.* Princeton, NJ: National Assessment of Educational Progress, Educational Testing Service. (ERIC Document Reproduction Service No. 276 980)

Anesko, K. M., & O'Leary, S. G. (1982). Effectiveness of brief parent training for the management of children's homework problems. *Child and Family Behavior Therapy, 4,* 112-122.

Anesko, K. M., Schoiock, G., Ramirez, R., & Levine, F. (1987). Homework problems checklist: Assessing children's homework difficulties. *Journal of Applied Behavioral Assessment, 9,* 179-185.

Coleman, J. S., Hoffer, T., & Kilgore, S. (1981). *Public and private schools.* Washington, DC: U.S. Department of Education.

Cooper, H. (1989). *Homework.* White Plains, NY: Longman.

Elliott, S. N., & Von Brock Treuting, M. (1990). The behavior intervention rating scale: Development and validation of a pretreatment acceptability and effectiveness measure. *Journal of School Psychology, 28,* 43-51.

Epstein, J. L. (1983). *Homework practices, achievements, and behaviors of elementary school students.* Baltimore, *MD:* Johns Hopkins University, Center for the Social Organization of Schools. (ERIC Document Reproduction Service No. 250351)

Fantuzzo, J. W., Rohrbeck, C. A., & Azar, S. T. (1986). A component analysis of behavioral self management interventions with elementary school students. *Child and Family Behavior Therapy, 9,* 33-43.

Frederick, W. C., & Walberg, F. (1980). Learning as a function of time. *Journal* of *Educational Research, 73*, 183-204.

Harris, F. C., & Lahey, B. B. (1978). A method for combining occurrence and nonoccurrence interobserver agreement scores. *Journal of Applied Behavior Analysis, 11,* 523-527.

Johnson, D. W., & Johnson, R. T. (1985). The internal dynamics of cooperative learning groups. In R. Slavin, S. Sharan, S. Kagan, R. H. Lazarowitz, C. Webb, & R. Schmuck (Eds.), *Learning to cooperate, cooperating to learn* (pp. 103-124). New York: Plenum.

Kazdin, A. E. (1975). *Behavior modification in applied settings.* Homewood, IL: Dorsey Press.

Kazdin, A. E. (1982). *Single case research designs: Methods for clinical and applied settings.* New York: Oxford University Press.

Kazdin, A. E., French, N. H., & Sherick, R. B. (1981). Acceptability of alternative treatments for children: Evaluations by inpatient children, parents and staff. *Journal of Consulting and Clinical Psychology, 49,* 900-907.

Keith, T. Z. (1986). *Homework.* West Lafayette, IN: Kappa Delta Phi.

Kelley, M. L., & Stokes, T. F. (1984). Student-teacher contracting with goal setting for maintenance. *Behavior Modification, 9,* 223-244.

Lieberman, L. M. (1983). The homework solution. *Journal of Learning Disabilities, 16,* 435.

Maertens, D., & Johnson, K. (1972). Effects of arithmetic homework upon the attitudes and achievement of 5th and 6th grade pupils. *School Science and Mathematics, 72*, 117-126.

Miller, D. L., & Kelley, M. L. (1991). Interventions for improving homework performance: A critical review. *School Psychology Quarterly, 6,* 174- 185.

Nastasi, B. K., & Clements, B. K. (1991). Research on cooperative learning: Implications for practice. *School Psychology Review, 20,* 110- 131.

Olympia, D. E., Sheridan, S. M., & Jenson, W. R. (in press). Homework: A natural means of home-school collaboration. *School Psychology Quarterly.*

Paschal, A,, Weinstein, R., & Walberg, H. (1984). The effects of homework on learning: A quantitative synthesis. *Journal of Educational Research, 78,* 97-104.

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.

Rosenbaum, M. S., & Drabman, R. S. (1979). Self-control training in the classroom: A review and critique. *Journal of Applied Behavioral Analysis, 12,* 467-485.

Rutter, M., Maughn, B., Mortimore, P., Ouston, J., & Smith, A. (1979). *Fifteen thousand hours: Secondary schools and their effects on children.* Cambridge, MA: Harvard University Press.

Science Research Associates. (1988). *SRA computer drill and instruction: Mathematics*. Chicago, IL: Pergamon.

Sharan, S. (1980). Cooperative learning in small groups: Recent methods and effects on achievement, attitudes and ethnic relations. *Review of Educational Research, 50,* 241-271.

Slavin, R. E. (1980). Cooperative learning. *Review of Educational Research, 50,* 315-342. Slavin, R. E. (1983). *Cooperative learning.* New York: Longman.

Turco, T. L., & Elliott, S. N. (1986). Assessment of students' acceptability of teacher-initiated interventions for classroom misbehaviors. *Journal of School Psychology, 24*, 307-313.

Walberg, H. J., Paschal, R. A., & Weinstein, T. (1985). Homework's powerful effects on learning. *Educational Leadership, 42,* 76-79.

Witt, J. C., & Elliott, S. N. (1985). Acceptability of classroom intervention strategies. In T. R. Kratochwill (Ed.), *Advances in school psychology* (Vol. 6, pp. 252-288). Hillsdale, NJ: Erlbaum.

Wolfe, J. A., Fantuzzo, J., & Wolter, C. (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.