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A SELF-MONITORING PACKAGE FOR TEACHING SUBTRACTION WITH REGROUPING TO STUDENTS WITH LEARNING DISABILITIES

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In this investigation, we evaluated the effectiveness of a self-monitoring package with 3 learning disabled students whose responding to subtraction problems had been highly inconsistent and unsuccessful. Following a two-phase baseline of didactic instruction and special incentives, an error analysis was used to develop individualized self-monitoring checklists that the students then responded to as they completed their subtraction assignments. In the context of a multiple baseline design, the self-monitoring procedures produced immediate gains in correct responding, with more stable levels of successful performance occurring across sessions. In a subsequent maintenance phase, the checklists were removed and the previous incentives condition was reinstated, resulting in continued levels of successful responding. The results are compared to the literature on self-monitoring and learning disabilities and discussed in terms of the continuing need for effective and efficient instructional strategies.

DESCRIPTORS: academic behavior, learning disabled, self-monitoring

Research has shown that although students with learning disabilities may demonstrate proficiency with the specific behaviors necessary for successful task completion, they do not always use these skills spontaneously or in the context of complex response chains (Torgesen, 1980). As a result, their performance is often variable, with mastery levels being difficult to interpret and maintain. Thus, a major emphasis of behavioral and educational research has been to identify instructional techniques that serve to increase these students' abilities to learn and perform academic problems in a consistent manner. One set of procedures that has attracted considerable attention is referred to as self-monitoring.

Self-monitoring approaches are derived from the broad area of research on self-control strategies (Rosenbaum & Drabman, 1979). Such strategies have been used with many populations, ranging from normally achieving students (e.g., Ballard & Glynn, 1975) to students with mental retardation (Johnston, Whitman, & Johnson, 1980; Whitman & Johnston, 1983). Studies focusing on self-monitoring processes have shown that these procedures can increase accuracy in many curricular areas, including speech training (Koegel, Koegel, & Ingham, 1986) and writing composition (Ballard & Glynn, 1975). Self-monitoring procedures appear to be particularly promising with learning disabled students (Harris, 1986b) because these procedures provide students with continuously available instructional cues that may produce specific response strategies and self-initiated responding (Kneedler & Hallahan, 1981).

The purpose of the present investigation was to extend the literature on self-monitoring with learning disabled students by evaluating a self-monitoring package that was applied to subtraction (with regrouping) problems within a multiple baseline format. Prior to implementing the self-monitoring approach, a two-phase baseline was conducted in which each student was instructed with a traditional didactic strategy (baseline) and with a special incentive system (points). An error analysis was then conducted to develop individualized self-monitoring checklists that the students used to guide their completion of the subtraction problems.

The data reported in this study were collected while the first author was with Cabell County Schools and the second author was affiliated with Marshall University in Huntington, West Virginia. A version of this paper was presented at the 14th annual convention of the Association for Behavior Analysis, Philadelphia, Pennsylvania, May 1988.

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METHOD

Subjects

Three students participated in this study. Although each of the students functioned with some success in many academic areas (e.g., reading), each had been diagnosed as having a learning disability and was enrolled in a public school resource program serving learning disabled students. In the resource room, they received daily instruction in mathematics. Casey was a 10-year-old fifth-grade student who was functioning approximately 1 year below grade level in math. On the Wechsler Intelligence Scale for Children—Revised (WISC-R), his scores reflected a full scale IQ of 79, with a verbal scaled score of 95 and a performance scaled score of 67. Billy was a 12-year-old sixth-grade student who was functioning at approximately a fourth-grade level in math. His WISC-R scores showed a full scale IQ of 94 (verbal, 103; performance, 86). Carrie, a 13-year-old sixth grader, was functioning at approximately a fourth-grade level in math. Her WISC-R scores were: full, 77; verbal, 86; performance, 77. All 3 students had mastered basic operations involving addition, subtraction, and multiplication; however, none of the children were successful consistently with subtraction problems that involved regrouping.

Task

This study addressed the students' performance in completing subtraction problems. During each daily session, each student was presented with a worksheet containing subtraction problems that he or she was expected to complete independently. Casey's worksheets consisted of 10 to 20 problems with the exact number varying randomly over the duration of the study. The worksheets for Billy always contained 12 problems, and Carrie's worksheets always had 10 problems. The students were provided sufficient time (e.g., 15 min) to complete all of the problems on their worksheets and, in fact, they did complete all of the problems on each day of the study. Each problem on the worksheets contained two to four digits and required up to three instances of regrouping. For example, a typical problem was to subtract the number "257" from the number "314."

Procedure

Design. A multiple baseline across students design was used, with a two-phase baseline included for each student. The first phase was traditional baseline instruction consisting of didactic explanation and verbal feedback. The second phase for each student added an incentive of two points per correct response. Together, these phases were implemented for 8 days for Casey, 10 days for Billy, and 25 days for Carrie. Following these two phases, the self-monitoring package was implemented sequentially according to the multiple baseline format. When stability of performance was achieved, the self-monitoring procedures were removed, and the students continued their work under the previous incentive conditions.

Baseline—didactic. During the first baseline phase, the students were given verbal instructions on how to perform the subtraction problems and were then given their worksheets. Upon completion of the problems, the teacher provided praise for correct responses and specific verbal feedback and explanations about each error. All feedback was provided on an individual basis.

Baseline—didactic plus points. During this phase, the same conditions were in effect, except that each correct response was reinforced with two points that were part of a classroom incentive system. The system was a part of the regular classroom routine in which points served as reinforcers for desirable social behavior and successful academic performance. The points were exchanged later in the day for an assortment of prizes, such as attractive pencils, notebooks, and other items.

Self-monitoring package. Before the self-monitoring procedures were implemented, each student's previous errors were analyzed and, based on the analyses, individualized self-monitoring checklists were developed. The checklists were developed by reviewing each of the student's previous responses and compiling lists of every error for each

Table 1
Entries on the Individual Self-Monitoring Checklists for Each of the Students

Casey
1) I copied the problem correctly.
2) I regrouped when I needed to (top number is bigger than bottom).
3) I borrowed correctly (number crossed out is one bigger).
4) I subtracted all the numbers.
5) I subtracted correctly.

Billy
1) I underlined all the top numbers that were smaller than the bottom.
2) I crossed out only the number next to the underlined number and made it one less.
3) I put a "1" beside the underlined number.
4) All the numbers on the top are bigger than the numbers on the bottom.

Carrie

Regrouping
1) I underlined all the top numbers that are smaller than the bottom.
2) I started in the one's place and crossed out the number to the left of the underlined number and made it one less. I put a "1" in front of the underlined number.

Regrouping over zero
1) I underlined all the top numbers that are smaller than the bottom.
2) I passed the 0, crossed out the first number to the left of the 0 and made it one less.
3) I put a "1" in front of the 0.
4) I crossed out the "10" and made it a "9."
5) I put a "1" in front of the underlined number.

student. The individualized checklists were then constructed in such a way that each error was represented on the student's list. The types of errors ranged from a failure to copy integers accurately to specific mechanical errors in the regrouping procedure. Thus, the checklists contained specific "reminders," written in a first-person format (Harris, 1986a), that the students would refer to and check off after each problem (e.g., "I regrouped when I needed to"; "I crossed out only the number next to the underlined number and made it one less"). The entries for each student's checklist are shown in Table 1.

As in the previous phases, the students were given worksheets, but in this condition they were also expected to monitor their work on each problem by recording a plus or a minus for each entry on their checklists. If a minus was recorded (acknowledging that the student had failed to perform the specified step), the student was expected to rework the problem without erasing the original attempt. At the end of the session, when the problems were completed, the work was reviewed by the teacher, and the students were awarded one point for each correct response and one additional point for each problem in which all of the steps on the checklist were self-monitored correctly. As in the two previous conditions, the students were also provided with praise for correct responses and verbal feedback regarding their errors.

Maintenance. When the students achieved high levels of stable responding under the self-monitoring condition, the checklists were removed and the students worked for additional days under the preexisting points condition in which two points were given for each correct response. This phase was included to make the procedures more normalized and to assess the students' ability to perform the calculations without the continuing assistance of the checklists.

Measurement and Interobserver Agreement

The dependent variable throughout the investigation was the percentage of correct responses to the assigned subtraction problems. Because the stu-

dents' responses were in the form of written answers, all data were collected by the teacher and kept in the form of a permanent record. Interobserver agreement was assessed for all responses by having a second observer count the correct and incorrect answers on the completed worksheets, independently of the teacher, and calculate daily percentages. Agreement was 100% across all phases of the study.

A measure of procedural reliability during the implementation of the self-monitoring package was obtained by reviewing the checklists after they were collected. Two observers independently recorded that each student's checklists were completed for each day of the intervention.

RESULTS

The results are presented in Figure 1. The data reveal inconsistent and generally low levels of correct responding during the baseline condition for each student. The subsequent points condition produced no change for Casey or Billy. Carrie's data under the points phase show an increasing trend for 11 days followed by a subsequent decline during the final 4 days, with correct responding at the end of this phase being as low as 30%.

Introduction of the self-monitoring package produced immediate and dramatic gains for each student. Although some variability was evident for Casey and Carrie, the results under this instructional strategy were clearly superior to the preceding baseline phases, with each student succeeding on the majority of the problems. When the self-monitoring checklists were withdrawn, the students continued to perform more successfully than they had previously and maintained their improved performance throughout the maintenance condition.

DISCUSSION

The results of this investigation provide support to a considerable amount of previous research on learning disabled students (e.g., O'Leary & Dubey, 1979). A consistent finding has been that the use of self-monitoring checklists helps children to respond correctly and consistently (Kneedler & Hallahan, 1981; Rosenbaum & Drabman, 1979). The present study suggests further that these procedures can be more successful than the use of incentives alone. These findings support Torgesen's (1980) position that students who are learning disabled tend to fail because they do not consistently employ useful task strategies. Thus, the cues for self-checking provided by self-monitoring may enable the students to keep responding in accordance with the successful task strategies. Although the incentives (points) may have been rewarding, they were not sufficient to increase correct responding, perhaps because they did not offer the stimulus control provided by the checklists.

An important aspect of this investigation is that it demonstrates the effectiveness and efficiency of an instructional package that was relatively easy to implement and to fade. Such packages are vital to instructional practice, especially when standard interventions are not successful. The present package included self-monitoring, reinforcement, feedback, and an individualized error analysis of baseline responding. Although the functional impact of the separate components was not delineated in the present design, it is possible that the detailed analysis of baseline responding might be especially important because of the specific, individual task analysis it produced. It is likely that the error analyses enhanced the effects of the self-monitoring checklists by emphasizing the most relevant stimuli in the regrouping process.

A limitation of the present study pertains to the absence of direct observations and procedural reliability on the process of self-monitoring. Future research that includes direct observations of student responding might contribute to an improved understanding of the manner in which self-monitoring approaches facilitate success with various student populations.

From a practical perspective, this study and the results of numerous other articles (Rosenbaum & Drabman, 1979) indicate that self-monitoring procedures have wide applicability in classrooms and

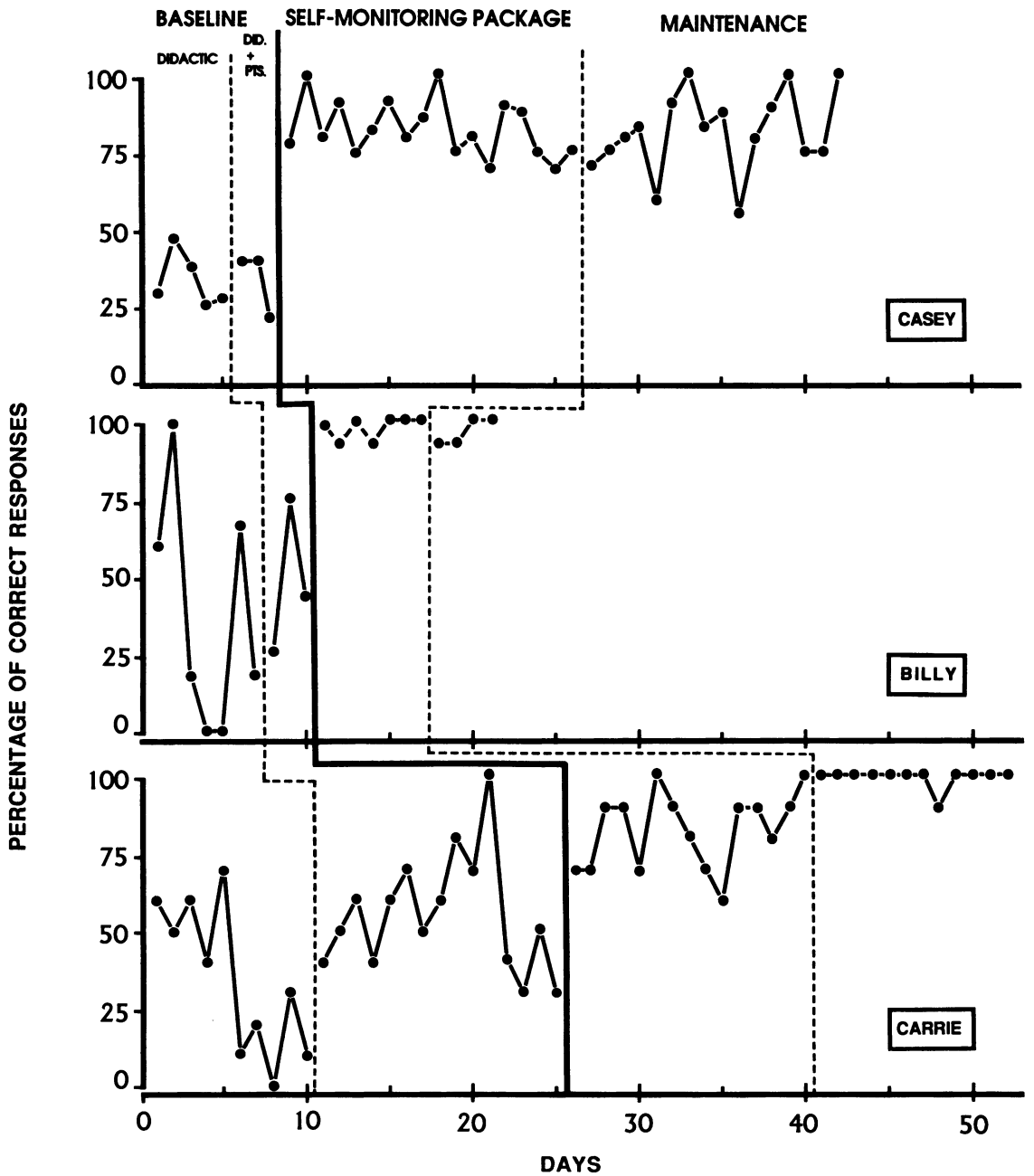

Figure 1. Results of the multiple baseline analysis for the 3 students. Percentage of correct responses to the subtraction problems is shown on the ordinate and consecutive school days are plotted on the abscissa.

other settings. It is apparent that further work in refining and expanding self-monitoring techniques can contribute significantly to improved technologies of instruction for students with learning problems.

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