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INCREASING ON-TASK BEHAVIOR DURING MATHEMATICS INDEPENDENT SEAT-WORK IN STUDENTS WITH EMOTIONAL DISTURBANCE BY INTERSPERSING ADDITIONAL BRIEF PROBLEMS

CHRISTOPHER H. SKINNER, KRISTAL L. HURST, DONNA F. TEEPLE,
AND SADONYA O. MEADOWS

The University of Tennessee

Alternating treatments designs were used to compare on-task levels in 4 students diagnosed as emotionally disturbed while working on control and experimental independent seat-work mathematics assignments. Control and experimental assignments were similar except experimental assignments contained additional briefer mathematics problems interspersed following every third problem. Results showed greater on-task levels while working on experimental assignments across 3 of the 4 students. Discussion focuses on problem completion being a conditioned reinforcer and applying this theory to prevent and remedy academic and social-behavior problems in students with behavior disorders. © 2002 John Wiley & Sons, Inc.

In some instances, students with behavior disorders may engage in inappropriate behavior in order to gain access to reinforcing stimuli. In other instances, inappropriate behavior may be negatively reinforced when students are allowed to escape or avoid specific stimuli or demands (e.g., Carr, Newsome, & Binkoff, 1980; Dunlap, Kern, Clarke, & Robbins, 1991). Perhaps the most salient and pervasive demands within educational settings are demands to perform academic behaviors (Dunlap & Kern, 1996). Thus, inappropriate behavior may be negatively reinforced by removal of academic demands (Sprague, Sugai, & Walker, 1998). This learning history can cause both behavior and learning problems. With respect to behavior problems, the effect is direct, as negatively reinforcing inappropriate behaviors will increase the probability of students engaging in these behaviors when they are faced with similar demands or tasks (Carr, 1977). Additionally, as students avoid activities designed to enhance their academic skills they are more likely to experience achievement problems (Skinner, 1998). This process may explain why many students with behavior disorders also have academic skills deficits (Walker, Colvin, & Ramsey, 1995).

Choice in the Classroom

Myerson and Hale (1984) conceptualized student classroom behavior as choice and indicated how Herrnstein's (1961) Matching Law could predict and control students' behavior. Within educational environments, students can choose between two competing behaviors; engaging in assigned academic activities or engaging in other, sometimes disruptive behaviors. In order to increase the probability of students choosing to engage in assigned academic activities, educators can increase rates of reinforcement for academic behavior and/or weaken reinforcement rates for engaging in competing behaviors. The key to predicting and altering student behavior is to alter *relative* rates of reinforcement for competing behaviors.

Myerson and Hale's (1984) conceptual work has been empirically validated. Using reinforcers such as nickels, tokens, edibles, and praise, researchers have altered relative rates of reinforcement and investigated the effects on student choice behaviors. In some studies, students were given the choice of two academic assignments. Results showed that students were more likely to choose to engage in academic assignments that yield higher rates of reinforcement (e.g., Mace, McCurdy, & Quigley, 1990; Neef, Mace, & Shade, 1993; Neef, Mace, Shea, & Shade, 1992; Neef,

Correspondence to: Christopher H. Skinner, The University of Tennessee, College of Education, Claxton Complex A-518, Knoxville, TN 37996–3400. Email: cskinne1@utk.edu

Shade, & Miller, 1994). In others studies, researchers altered relative rates of reinforcement for engaging in assigned behaviors versus off-task or disruptive behaviors. Results showed that increasing rates of reinforcement for doing assigned tasks can increase the probability that students will choose to engage in assigned work as opposed to engaging in competing inappropriate behaviors (Horner, Day, Sprague, O'Brien, & Heathfield, 1991; Martens & Houk, 1989; Martens, Lochner, & Kelly, 1992). Furthermore, the amount of time students allocated toward assigned versus off-task behavior was based on relative rates of reinforcement for assigned and off-task behaviors.

Previous researchers have studied the Matching Law by carefully monitoring each student's behavior and delivered reinforcement based on competing behavior levels. However, educators charged with working with large numbers of students (e.g., a class of 25 students) may find it difficult to monitor each student's behavior, both academic and off-task, and deliver immediate reinforcement to students contingent upon these behaviors (Hall, 1991). Recent experiments suggest an alternative procedure for increasing rates of reinforcement for working on academic assignments.

Discrete Task Completion as a Conditioned Reinforcer

Researchers have proposed that when given an assignment with multiple discrete tasks, completing each task is a conditioned reinforcer (Cates & Skinner, 2000; Cates, Skinner, Watkins, & Rhymer, 1999; Logan & Skinner, 1998; McCurdy, Skinner, Grantham, Watson, & Hindman, 2001; Skinner, Fletcher, Wildmon, & Belfiore, 1996; Skinner et al., 1999; Skinner, Robinson, Johns, Logan, & Belfiore, 1996; Wildmon, Skinner, McCurdy, & Sims, 1999; Wildmon, Skinner, & McDade, 1998). This theory is based on the assumption that students have a learning history where assignment completion has been reinforced. Reinforcement may be positive (e.g., delivery of praise, the opportunity to engage in a preferred activity). Additionally, reinforcement may be negative as students who complete assignments often avoid aversive consequences that may be delivered contingent upon them not completing their assigned work (e.g., having to stay after school).

If completing assignments has been reinforced, then stimuli that consistently precede assignment completion should become conditioned reinforcers through the process of classical conditioning (e.g., Malone, 1990; Skinner et al., 1999). When given assignments with multiple discrete tasks (e.g., each mathematics problem contained in an assignment that contains 20 problems), completing a discrete task or problem can be considered an event or stimulus that should become a conditioned reinforcer (e.g., Cates & Skinner, 2000; Martin, Skinner, & Neddenriep, 2001).

If discrete task completion is a reinforcing event, when students are given assignments that contain many discrete tasks (e.g., mathematics problems), one way to increase rates of reinforcement is to increase discrete task completion rates. Additionally, *relative* rates of discrete task completion should predict student choice behavior in accordance with Herrnstein's (1961) Matching Law. In one study, students were given four opportunities to choose between control and experimental assignments (Skinner et al., 1999). Control assignments contained one of four types of target problems: 4-digit by 1-digit problems, 4-digit by 2-digit problems, 4-digit by 3-digit problems, or 4-digit by 4-digit problems. Matched experimental assignments contained equivalent target problems and additional interspersed 1-digit by 1-digit problems. Results showed that as the difference between problem completion rates on experimental and control assignments increased across assignment pairs, the proportion of students choosing the experimental assignments also increased. This study showed a clear linear relationship between relative problem completion rates and the proportion of students choosing experimental and control assignments. Thus, relative discrete task completion rates predicted student choice behavior in a precise manner that corresponds to Herrnstein's (1961) Matching Law.

If discrete task completion is a reinforcing event, then it may be possible to increase rates of reinforcement and the probability of students choosing to engage in assigned work, without having an agent (e.g., teacher, peers, computer) immediately deliver these reinforcers. Several experiments have demonstrated the applied value of this theory. Previous researchers have shown that if given a choice, students would prefer or choose assignments that require less time and effort to complete (Cooke, Guzaukas, Pressley & Kerr, 1993; Horner & Day, 1991; Kern, Childs, Dunlap, Clarke, & Falk, 1994). If problem completion is a reinforcing event, then interspersing brief problems should be an effective procedure for increasing the probability of students choosing or preferring assignments with even more target (longer, more time consuming) problems. Cates and Skinner (2000) and Cates et al., (1999) showed that interspersing briefer problems caused students to choose homework assignments that contained 20% and 40% more target problems.

If rates of reinforcement are increased for engaging in academic behaviors, then students are more likely to engage in assigned tasks and less likely to allocate their time towards engaging in alternative, perhaps disruptive behaviors (Horner et al., 1991; Martens et al., 1992; Myerson & Hale, 1984). In another study, a general education, second-grade student was referred to a consultant for high rates of off-task behavior during mathematics independent seat-work time (McCurdy et al., 2001). The consultant altered some of the mathematics assignments by adding and interspersing briefer problems and collected data on the student's on-task behavior. Results showed higher levels of on-task behavior while working on the interspersal assignments relative to the unaltered assignments.

Students with emotional and behavioral disorders may engage in off-task behaviors in order to escape or avoid demands to complete assigned academic work (Sprague et al., 1998). One way to increase the probability of these students choosing to engage in assigned activities is to increase rates of reinforcement for those behaviors (Myerson & Hale, 1984). Previous research suggests that one way to increase rates of reinforcement during independent seat-work is to increase problem completion rates by interspersing additional, less time-consuming problems (e.g., McCurdy et al., 2001; Skinner et al., 1999). In the current study, alternating treatments designs were used to determine if the interspersal procedure could be used to increase on-task behavior across 4 students diagnosed as emotionally disturbed.

METHOD

Participants and Setting

This study took place at a self-contained school that served students with emotional and behavioral disorders in the southeastern United States. After support from teachers and administrators of the school was obtained, internal review boards of both the school system where the study was conducted and the university that supported this research provided formal approval for this study. Parental consent and student assent were granted so that all 6 students enrolled in an intact classroom in an extended school year program could participate in this study. The students ranged in age from 9 to 11 years old and were placed in this program by their Individual Education Program (IEP) teams because of concerns over possible academic skill regression during the summer months. Although initial assent was obtained for all 6 students, after the program began, one student withdrew his assent during the second day of experimental procedures and was dropped from the study. For a second student, only limited data (i.e., 3 data points under the experimental condition) could be collected due to excessive absenteeism. This student's data were excluded from analysis. Thus, data from 4 students, 3 females (Jill, Cindy, and Susan) and 1 male (Bob) were analyzed in the current study.

Researchers were allowed access to the students' summer IEPs, but were denied access to other psycho-educational and medical records (e.g., psychological evaluations). Participants' IEPs indicated that all were diagnosed as emotionally disturbed. In accordance with State Department of Education guidelines (Tennessee State Department of Education, 1993), emotional disturbance was defined as a child who exhibited one or more of the following characteristics: a) inability to learn which cannot be explained by intellectual, sensory, or health factors; b) inability to build or maintain satisfactory interpersonal relationships with peers and teachers; c) inappropriate types of behavior or feelings under normal circumstances not due to socioeconomic or cultural differences; d) general pervasive mood of unhappiness or depression; e) a tendency to develop physical symptoms or fears associated with personal or school problems; and f) demonstration of adverse effects on educational performance in the classroom or learning environment. One or more of these characteristics had to be present over a long period of time and to a marked degree and had to adversely affect the student's educational performance.

Summer IEPs indicated that Bob had a secondary diagnosis of attention-deficit hyperactivity disorder. It is likely that other participants carried secondary diagnoses that were not included in their summer IEPs. Although all students were receiving medication, researchers were denied access to medical records due to administrators' concerns with confidentiality.

Three school psychology graduate students and a school psychology professor served as primary researchers for this project. A licensed special education teacher and an assistant teacher also participated in this research.

Materials

Using the students' IEPs, experimenters constructed and administered a pre-test consisting of 20 mathematics problems ranging from simple addition (e.g., 1-digit plus 1-digit) to complex or long division problems (e.g., 3-digits divided by 2-digits). Pre-test results, summer IEPs, and teacher recommendations were used to develop assignments for the study. The goal was to include target problems that the students could complete accurately (i.e., they had acquired the skill), but might need some opportunities to respond in order to master the skills (see Skinner, 1998, for a review).

Researchers constructed four sets of control assignments that contained the following target problems: a) simple addition set, b) addition with carrying set, c) simple subtraction set, and d) subtraction with borrowing set. For each assignment set, two control assignments and two experimental assignments were constructed. Both experimental and control assignments contained four assignment sheets.

Each control assignment sheet contained 30 target problems on one side of 8.5 × 11 inch white paper. The simple addition control assignments contained 4-digit plus 4-digit problems that did not require re-grouping or carrying (e.g., 3425 + 6372 = ____). The addition with carrying control assignments contained 4-digit plus 4-digit problems that did require re-grouping at each place value (e.g., 6985 + 7329 = ____). The simple subtraction problems contained 4-digit minus 4-digit problems that did not require re-grouping or borrowing at any place value (e.g., 8975 − 2841 = ____). Subtraction with borrowing problems contained 4-digit minus 4-digit problems that did require re-grouping at three place values (e.g., 7231 − 4978 = ____). Problems were not numbered and were presented in an unbalanced order with a different number of problems on each line and different spacing between problems.

Experimental assignments were constructed for each control assignment. These assignments contained the same number and type of target problems as each control assignment. However, for the simple addition and addition with re-grouping assignments, an additional 1-digit plus 1-digit problem (e.g., 2 + 4 = ___) was interspersed following every third target problem. For the simple

subtraction and subtraction with re-grouping assignments, an additional 1-digit minus 1-digit problem (e.g., 7 − 5 = ___) was interspersed following every third target problem. Thus, experimental assignments contained 10 additional brief problems. For all problems, digits were selected in a random fashion.

An audiotape player with headphones was used to prompt observers to record direct observation data. Researchers constructed a 15-minute audiotape that signaled intervals every 5 seconds. Two sets of headphones that could be attached to the audiotape player allowed researchers to hear the 5-second interval cues. Researchers also constructed data recording sheets that allowed them to record the presence of off-task behavior for each student at each 5-second interval.

General Procedures and Design

Over the 6 weeks of the summer program, students were scheduled to be in class 3 or 4 days a week, for a total of 20 days. Experimenters needed the first 4 days to review IEPs, construct, administer, and score pre-tests, construct assignments, and obtain written informed parental consent and student assent for participation in this research. The experiment was then scheduled to run for 16 days on Monday, Tuesday, Thursday and every third Friday. Because this was a summer program, there was frequent absenteeism due to family activities (e.g., summer vacations). Thus, no student completed all assignments.

Alternating treatments designs were used to make within-student comparisons of on-task behavior across experimental or interspersal assignments and control assignments (Kazdin, 1982). The study was scheduled so that during the first 4 days students worked on simple addition assignments. During the second 4 days, students worked on addition with carrying assignments. The next 4 days, students were given the four simple subtraction assignments. Although experimenters scheduled the final 4 days to work on subtraction with borrowing assignments, students had only 2 days to work on these assignments due to scheduling conflicts (i.e., two field trips that were planned after this experiment was designed). This schedule was maintained even when students were absent from school and missed sessions.

For the first three sets of problems (i.e., simple addition, addition with carrying, and simple subtraction) interspersal assignments were randomly selected as the first assignment. The experimenters then altered the sequence of control and experimental assignments each school day. For the last set of problems, (i.e., subtraction with borrowing) experimenters randomly selected a control assignment as the initial assignment. Because students were sporadically absent, students may have completed several control or several experimental assignments sequentially. Thus, in addition to randomly selecting initial assignments for each set, these naturally occurring absences also helped to control for sequence effects (e.g., practice effects, carryover effects).

Experimental Procedures

Each day, one or two experimenters entered the classroom at 9:00 AM. The primary experimenter and the teachers seated the students at their individual desks. The primary experimenter spent between 2 and 5 minutes reviewing (e.g., demonstration and description on the blackboard) the mathematics skills that they would need to follow to complete target problems on the assigned worksheets (e.g., simple addition, addition with carrying, simple subtraction, and subtraction with borrowing). After this review, students were given the opportunity to ask questions related to these mathematics problems. However, questions were rare as pre-testing showed that all participants could complete these problems accurately. Next, the primary experimenter passed out assignments, face down, and instructed the students not to turn the assignment over until instructed to begin. After all students had their assignments and a sharpened pencil or pen, the experimenter

moved to the front of the room next to a seat where direct observation materials were placed (e.g., tape-recorder, recording sheets). Students were instructed that when told to begin they should turn their assignments over, work from left to right without skipping any problems, and raise their hand if they had questions. Also, students were instructed to put their pencil down and their head on their desk if they finished the assignment before time ran out. After answering any questions, the experimenter sat down, put on the headphones, and instructed the students to turn their assignments over and begin working as she started the tape player and began collecting direct observation data. When this tape reached the final interval, the 15-minute session ended and the experimenter instructed students to stop working and put their pencils on their desks. When typical learning routines were altered for such activities as medication administration, data were not collected for that individual student. However, the observer(s) resumed taking data when students returned to their assigned seats and began working.

During sessions, the assistant teacher and the teacher helped children who raised their hand. During the second session, one student put his head down before completing his work and informed the teacher that he no longer wanted to participate in the experiment. In accordance with the assent agreement, this student was given other independent seat-work for the remainder of the experiment and no direct observation data were collected or reported for this student.

Dependent variables. Direct observation was used to measure students' on-task behavior while working on assignments. On-task was operationally defined as the student having his/her head oriented toward the worksheet. On-task was measured using momentary time sampling. An audio-cue delivered every 5 seconds via a cassette player signaled experimenters to look at all participating students simultaneously and then recorded (i.e., a slash in a box for each student's data) if they were not on-task at that moment.

The primary dependent variable was the percentage of intervals each student was on-task during time allotted to work independently on mathematics assignments. This was calculated by dividing the number of intervals each student was scored as on-task by the number of intervals each student was on-task plus off-task and multiplying by 100. Intervals were excluded if the student had finished the assignments (i.e., raised their hand and put their head down), and when students were interacting with a teacher or engaged in other activities such as taking medication or leaving the room for other activities. Data were also collected on problem completion rates across experimental and control assignments by experimenters who collected the assignment sheets and calculated the number of problems completed.

Interobserver Agreement

In addition to the primary experimenter, another school psychology graduate student collected direct observation data across six sessions (i.e., sessions 2, 5, 6, 10, 12, and 13). This observer sat next to the primary experimenter and two sets of headphones were connected to the same audiocassette player so that observers could record momentary data simultaneously. Interobserver agreement was calculated for each student during these sessions by dividing the number of intervals the two observers agreed that the student was on-task by the number of intervals they agreed plus the number of intervals they disagreed and multiplying by 100. Average interobserver agreement across the six sessions was 95% (range of 92%–99%). In addition to the primary experimenter, another experimenter independently scored assignment sheets from six sessions. Interscorer agreement for problems completed was calculated in the same manner as interobserver agreement. When instructed to stop, often students had started a problem but not yet completed the problem. These problems were not included in calculations of mathematics performance. Interscorer agreement for number of problems completed was 100%.

RESULTS

Table 1 displays the average number of total problems (i.e., target problems and interspersed problems on experimental assignment) each student completed for experimental and control sessions for each assignment type. When data are averaged across all assignments, these data show that all 4 students completed more total problems while working on experimental assignments. Within-subject data show that the interspersal procedure resulted in high problem completion rates for Cindy and Jill across problem types. However, Table 1 also shows that the interspersal procedure was not effective in increasing problem completion rates across all types of problems for Bob and Susan. For Bob, the interspersal procedure resulted in greater problem completion rates for the first three problem types (i.e., simple addition, addition with carrying, and simple subtraction), but yielded lower relative problem completion rates for subtraction with borrowing. For Susan, the interspersal procedure initially resulted in lower problem completion rates (i.e., simple addition and addition with carrying), but yielded higher relative problem completion rates for simple subtraction.

Figures 1–4 display the on-task data for Cindy, Jill, Bob, and Susan, respectively. Over the first four sessions, there were no clear differences between Cindy's on-task levels across experimental and control assignments. After these four sessions, Cindy's on-task levels were consistently higher while working on experimental assignments. On-task levels while working on control assignments initially were high (over 80%), followed by a decreasing, and then an increasing trend in Cindy's on-task levels. While working on experimental assignments, Cindy's on-task levels were more stable with only one session dropping below 84.4%. Across sessions, mean on-task levels for Cindy were 88.0% while working on experimental assignments and 69.6% while working on control assignments.

Figure 2 shows Jill's on-task levels were generally higher while working on experimental assignments. This pattern was somewhat consistent with one exception; between sessions 7 and 9 Jill's on-task levels were higher while working on control assignments. Jill began the experiment with high levels of on-task behavior across both control and interspersal assignments. Jill's on-task behavior while working on control assignments decreased as the experiment progressed. While working on experimental assignments, Jill's on-task behavior initially decreased and then began to gradually increase over the last two sessions. Across sessions, mean on-task levels for Jill were 88.0% while working on interspersal assignments and 76.4% while working on control assignments.

Table 1
Average Total Problems (i.e., Target Problems and Interspersed Problems) Completed for Experimental and Control Assignments for Each Assignment Type

	Cindy		Jill		Bob		Susan	
	Exp.	Con.	Exp.	Con.	Exp.	Con.	Exp.	Con.
Simple addition	22.0	21.5	60.0	48.0	59.0	54.0	22.0	30.5
Addition with carrying	9.5	8.5	42.5	22.5	39.0	27.5	14.0	15.0
Simple subtraction	8.0	4.0	51.0	39.0	40.0	28.0	20.0	12.5
Subtraction with borrowing	22.0	12.0	ND*	33.0	46.0	58.0	22.0	ND*
Means	13.0	11.4	51.8	33.0	48.6	41.5	20.0	18.2

*ND—No data were collected for these specific students while working on these specific assignments because the students were absent on days when these assignments were administered.

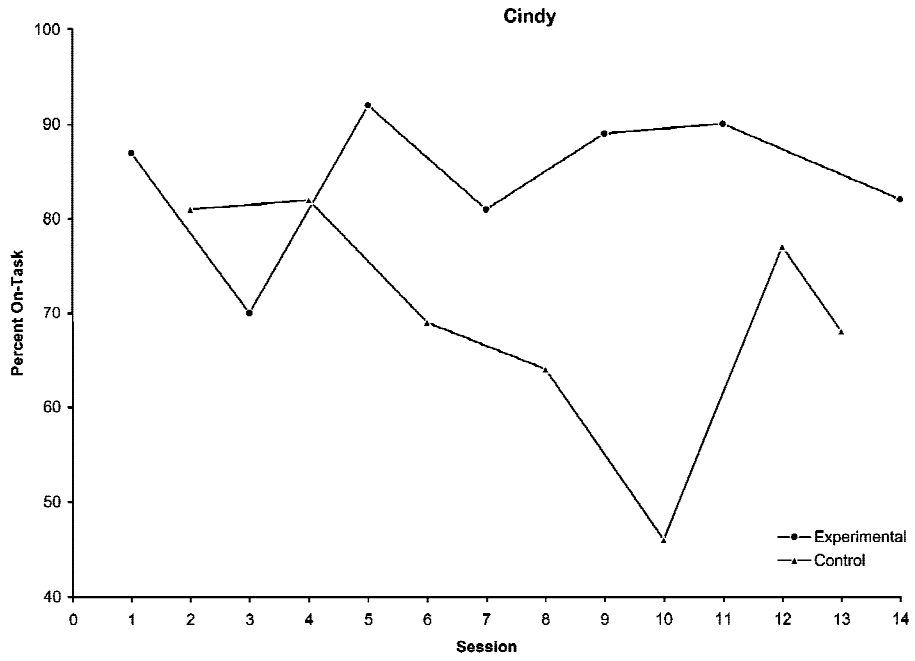

FIGURE 1. Percentage of intervals scored as on-task for experimental (interspersal assignments) and control sessions for Cindy.

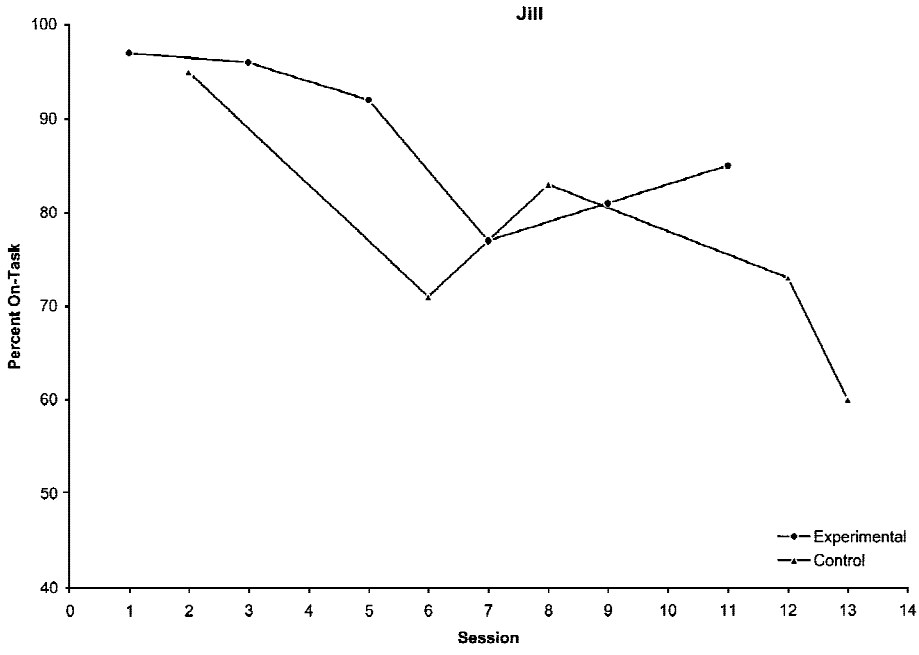

FIGURE 2. Percentage of intervals scored as on-task for experimental (interspersal assignments) and control sessions for Jill.

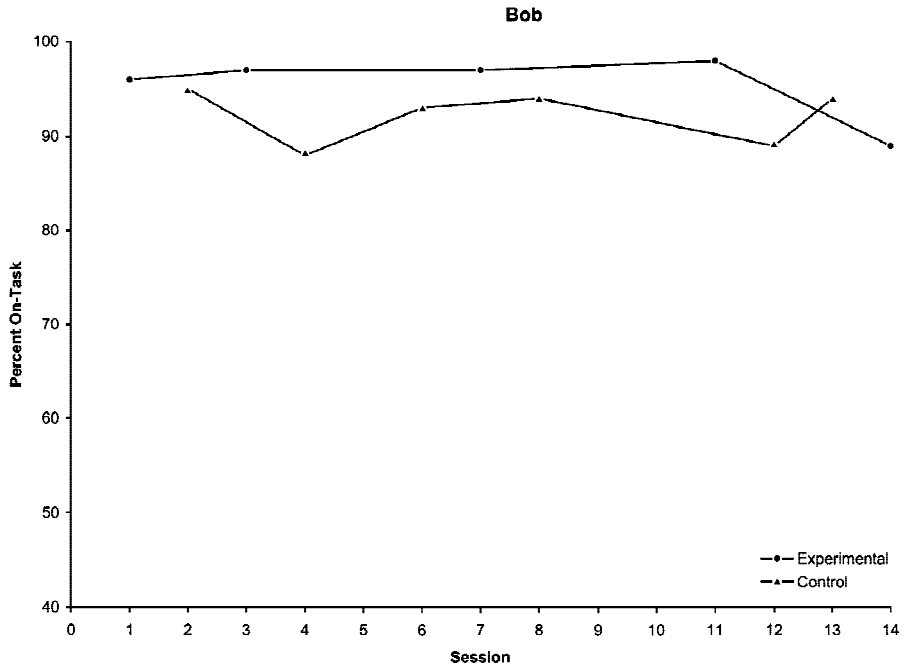

FIGURE 3. Percentage of intervals scored as on-task for experimental (interspersal assignments) and control sessions for Bob.

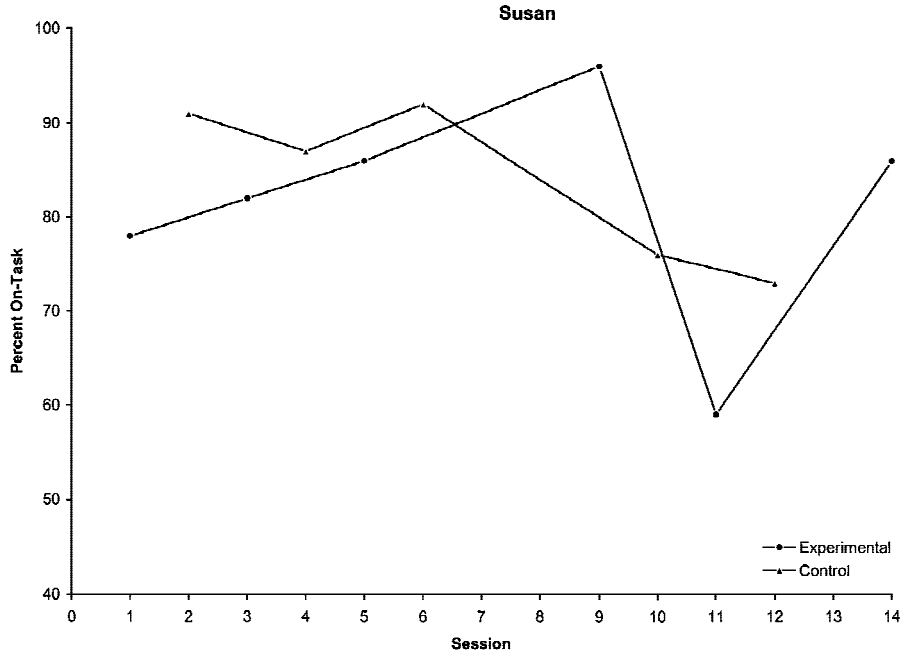

FIGURE 4. Percentage of intervals scored as on-task for experimental (interspersal assignments) and control sessions for Susan.

Although the differences were slight, Figure 3 shows that Bob's on-task levels were higher while working on experimental assignments. Again, there is one overlapping data point where Bob's on-task levels were higher on the control assignment. This overlap was the result of a decrease in Bob's otherwise stable on-task levels that occurred during session 14. Across sessions, mean on-task levels for Bob were 95.4% while working on experimental assignments and 92.2% while working on control assignments.

Figure 4 shows that initially, (i.e., sessions 1–6) Susan engaged in higher levels of on-task behavior while working on control assignments. As the experiment progressed, Susan's on-task levels were more variable and there were no clear differences in on-task levels across experimental and control assignments over the final five sessions. Trend data suggest a decreasing trend in on-task levels on control assignments over the last two sessions. On-task levels were steadily increasing on experimental assignments for the first four sessions, but decreased on the last two sessions. Across sessions, mean on-task levels for Susan were 81.2% while working on experimental assignments and 83.8% while working on control assignments.

DISCUSSION

Previous researchers found that interspersing additional briefer problems increased problem completion rates (e.g., Wildmon et al., 1999) and on-task levels (McCurdy et al., 2001) in general education students while working on independent seat-work assignments. The current study was designed to replicate and extend this research by evaluating the effects of the interspersal procedures in students diagnosed with emotional disturbance. Total problem completion data support previous research that showed that the interspersal procedure can increase problem completion rates (e.g., Logan & Skinner, 1998). However, in the current study, repeated measures designs showed that interspersing briefer items did not consistently result in higher within-subject problem completion rates.

The current results showed that the interspersal procedure enhanced on-task levels in 3 of the 4 students (i.e., Jill, Bob, and Cindy). Although the 4th student, Susan, initially engaged in lower levels of on-task behavior while working on experimental or interspersal assignments, as the study progressed the differences in on-task levels while working on control and interspersal assignments was decreasing. As with relative problem completion rates, the data on relative levels of on-task behavior showed within-subject fluctuations across sessions and problem types.

The data from the current study suggest that the interspersal procedure can increase on-task levels and relative problem completion rates in students diagnosed as emotionally disturbed. However, data analysis showed small and inconsistent differences in on-task behavior levels across the experimental and control assignments. Future researchers should address several limitations of the current study in order to better evaluate the effectiveness of the interspersal procedure.

Although the students who participated in the current study were diagnosed as emotionally disturbed, data from the control assignments showed that throughout this study the students' rates of on-task behavior were high. Thus, the current study was limited by ceiling effects. Several variables may account for this, including a) medication(s) students were taking to reduce symptoms associated with their disabilities, b) the small class size in this summer program, c) a higher than typical teacher-to-student ratio, and d) students working on tasks that they had previously been taught. Regardless, within classroom settings, many variables may influence students' academic performance across independent seat-work sessions (e.g., setting event and/or establish operations such as how much sleep students got the night before, how they performed on previous tasks, the quality of recent teacher-parent-student meetings or counseling-therapy sessions). While it may be difficult to experimentally control these variables, in the current study their impact may have been exacerbated by ceiling effects (i.e., high levels of on-task behavior during the control

condition). Specifically, because the students were engaging in high levels of on-task behavior during the control assignments, there was little room for improvement. Future researchers should conduct similar studies with students who engage in higher levels of off-task behavior in order to reduce the influence of ceiling effects.

When given an assignment, students can chose to engage in assigned academic activities, or they can chose to engage in other behaviors (Myerson & Hale, 1984). Students with behavior disorders may be more likely to choose to engage in other behaviors that are disruptive (Sprague, Sugai, & Walker, 1998). Although the current study suggests that interspersing additional problems may increase appropriate academic behavior in students with behavior disorders, only on-task behavior was measured as students engaged in low rates of disruptive behavior. Thus, future researchers should conduct similar studies with students who engage in higher levels of active, off-task behavior to determine if this procedure could prevent or reduce disruptive classroom behaviors.

In the current study, on-task was measured over 15-minute periods. High levels of on-task behavior across these intervals may reflect persistent responding. Future researchers should determine if this procedure could be used to increase the duration of time students spend on-task with students who have problems remaining on-task (e.g., students with attention deficit disorder who are not being treated with medication) over longer intervals. Students who choose to engage in assigned academic tasks and persist in that responding are likely to have more opportunities to respond than students who engage in high rates of off-task behavior. Consequently, these students should experience fewer academic problems because they acquire, master, and maintain more academic skills (Greenwood, Delquadri, & Hall, 1984; Greenwood et al, 1987; Skinner, Belfiore, Mace, Williams, & Johns, 1997; Skinner, Fletcher, & Henington, 1996). Although this study was conducted over several weeks, future researchers should conduct similar studies over longer periods of time (e.g., a school year) to determine if this procedure increases academic achievement.

In the current study, students were practicing previously acquired skills rather than newly acquired skills. This may have also contributed to ceiling effects and high levels of on-task behavior. Future researchers should determine if the interspersal procedure would be as effective under more typical mathematics classroom conditions where teachers demonstrate a new skill and students practice that new skill during independent seat-work. The current study and much of the previous research has involved mathematics assignments. Future researchers should determine if the interspersal procedure is effective when working on other assignments that include many discrete tasks (e.g., grammar assignments).

The current study provides support for the theory that when people are given assignments or demands that require them to complete many discrete problems or tasks, the completion of each task may serve as a conditioned reinforcer (see Skinner et al., 1999). If this theory is correct, then other procedures that increase problem or task completion rates should also increase students' on-task levels and persistence, and cause students to prefer those assignments to assignments that yield lower problem completion rates. Future researchers should determine if this theory might explain why other procedures, such as reducing intervals during teacher-paced instruction (e.g., Carnine, 1976: Darch & Gersten, 1985) increase on-task levels. Additionally, researchers should determine if this theory may explain why breaking large continuous tasks down to smaller tasks increases the probability of people engaging in specific behaviors and responding in a more persistent manner (Malott, 2000; Martin et al., 2001).

Increasing discrete problem completion rates may prove to be an efficient procedure for increasing rates of reinforcement while students are working on independent seat-work assignments. However, it is possible that discrete task completion rates merely operate like rates of reinforcement (Logan & Skinner, 1998). Given the applied implications of this hypothesis that

have been discussed above, future researchers should attempt to conduct basic research that clearly identifies the causal mechanisms responsible for these results. Such research may allow educators to make time- and resource-efficient alterations to assignments that enhance student persistence, learning rates, and attitudes toward school work, while decreasing student inappropriate and disruptive behavior levels across large groups of students (Martin et al., 2001).

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