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THE EFFECTS OF FLASHCARDS AND STUDENT SELECTED REINFORCERS WITH GOALS AND ADDITIONAL PRACTICE WITH MULTIPLICATION FACTS FOR TWO INTERMEDIATE ELEMENTARY STUDENTS WITH BEHAVIOR DISORDERS*

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ABSTRACT

The purpose of this study was to increase the fluency and accuracy on seem to write multiplication facts for two elementary school students with behavior impairments. One was an 11-year-old male and the other was a 13-year-old male. The study was conducted in a self-contained behavior impaired classroom in a large urban school district in the Pacific Northwest. The three behaviors measured were corrects, errors, and skips per minute. These data were gathered from a multiplication probe sheet. The behavioral results showed a clear increase of corrects per minute and decrease in both skips and errors when the three interventions (flashcards + student selected rewards, flashcards + student selected rewards + goals, and flashcards + student selected rewards + goals + extra timings). The outcomes one participant was larger than for the other. The benefits of employing data-based evaluation procedures with intermediate children with behavior impairments are outlined.

Keywords: flashcards, behavior disorders, goals, extra practice, single case research design, self-contained classroom, multiplication facts, probe sheets

INTRODUCTION

Math skills are important in the classroom as well as after students leave school and enter the labor market (Stein, Kinder, Silbert, & Carnine, 2006). Math is extremely important in our culture, and understanding the concepts and strategies of it is highly important in order to be a contributing member of society (Cipani, 1988; McClosky & Macaruso, 1995). The comprehension of mathematics demands practice of the subject and realizing the patterns and relationships amongst numbers (Cruikshank, 1992). For those who do not understand math it would be even more difficult to obtain a decent paying job when they join the workforce. Even minimum wage jobs such as janitorial work,

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positions in fast food restaurants, and lawn care, use math. Without mastery of basic multiplication facts, students are likely to struggle in their entire educational career and have an increased chance on dropping out of school and being incapable of functioning productively in today's global economy (Lerner & Johns, 2009, 2011). Furthermore, it has become increasingly harder in today's society to be able to survive off of a minimum wage paycheck due to the increase in the cost of living and unstable economy (Thompson, Bourget, & Brown, 2010). An increased knowledge in math should provide better job opportunities, thus allowing individuals to live a more comfortable lifestyle as an adult (Greenwood, 1991).

The number of students being diagnosed with behavior disorders continues to grow (Kauffman, in press; Kauffman & Hallahan, 2011; Trout, Epstein, Nelson, Synhorst, & Hurley, 2006). Students with a behavior disorder have an underlying behavior issue that often makes academic learning in the classroom difficult (Heward, 2008; Kauffman & Landrum, 2009; Nelson, Benner, Lane, & Smith, 2004). Another common characteristic of students with behavior disorders is below grade level achievement (Kauffman & Landrum 2009; Nelson et al., 2004). Students with behavior disorders also have the lowest grade point average and the highest school drop out rate (Heward, 2008). Of those students, most have major issues in academics with math deficiencies being somewhat common (Kauffman & Landrum, 2009; Lerner & Johns, 2011).

Several behavioral procedures have been developed and implemented in classrooms to assist students with behavior disorders. These procedures have ranged from classroom token program (Kauffman & Landrum, 2009; McLaughlin & Williams, 1988) to daily report card systems (Fabiano, Pelham, Gnagy, Wymbs, Chacko, Coles et al. 2007; Mash & Barkley, 2006). Typically, flashcards each printed with the academic problem with its answer or solution on the back (Van Houten & Rolider, 1989). For example, numbers, letters, sight words, or math facts can be taught with DI flashcards (Brasch, Williams, & McLaughlin, 2008). The student goes through the deck of flashcards with an adult who utilizes the model, lead test procedure for errors (Becker, McLaughlin, Weber, & Gower, 2008; Glover, McLaughlin, Derby, & Gower, 2010). If a student makes an error, the teacher employs the model lead and test procedure and that flashcard is placed two to three cards from the top of the stack (Glover et al., 2010). First, the teacher says the correct answer, the student and teacher say the correct answer together, finally, the student is presented with the error card again and has to the say the correct answer (Brasch et al., 2008). This card is again placed back a few cards and is presented again after two or three other flashcards have been presented (Kaufman et al., 2011; Ruwe et al., 2011). After the student makes the correct response three times in a row, the card is then moved to the bottom of the stack (Becker et al., 2009; Glover et al., 2010).

The use of flashcards to teach math skills in students with behavior disorders has recently been documented. Hopewell, McLaughlin, and Derby, (2011) implemented a Direct Instruction (DI) flashcard procedures along with a reading racetrack to teach two primary students with severe beahvior disorders sight words. Using a multiple baseline design, they found that using both a DI flashcard procedure combined with reading racetracks were effective. However, we still do not know of effects of employing reading racetracks on their outcomes. Finally, most the previous research has employed students diagnosed with learning or intellectual disabilities, we wanted to complete another study using children older and who attended a different school.

The purpose of this study was to increase the fluency and accuracy on see to write multiplication facts for two male elementary school students with behavior disorders. A second purpose was to replicate the findings of Hopewell et al. (2011) with older students in a different classroom and school district. This would allow one to gain further confidence regarding the efficay of employing both flashcards and individual behavior management practices. Finally, we wanted to compare adding additional levels of our intervention by adding goals and later additional timings (Fabiano et al., 2007).

METHOD

Participant and Setting

There were two participants in this study. Student 1 was an 11-year-old male in the fifth grade enrolled in a Behaviorally Impaired classroom for fourth through sixth graders with severe behavior

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Vol. 2, No. 1, January 2012

problems. Student 2 was 13-year-old male in the sixth grade that was enrolled in the same setting. All three demonstrated deficits in fluency, accuracy or both for see to write multiplication facts. The classroom teacher felt these two children would be outstanding subjects for the study, and after baseline observations, the researcher concurred.

Subject 1 had IEP goals for reading, writing, math, and behavior/social skills. One of his current goals is to memorize multiplication facts 0-9 at the grade four level with 100% accuracy over three trials. Student 1 self-identified himself for this study and asked the researcher if she could work with him to achieve better fluency and accuracy in multiplication facts to help with his mainstreaming into a regular 5th grade classroom. Student 2 has a 504 plan, but none of his goals include math. He asked to be a part of the study shortly after it began, and the researcher thought his success with the study might help with his behavior goals. One of these goals is for Student 2 to demonstrate the ability to handle failure, frustration, or teacher direction without an angry outburst or crying with no more than two redirects per day. Student 2 has high accuracy but low fluency with see to write multiplication facts.

The setting for this study was a self contained behaviorally impaired intermediate classroom located in a large urban elementary school in the Pacific Northwest. There were 10 students, one teacher, two aides, and the researcher present at one time in the class. The study took place during a short period of time during the afternoon in the quiet room of the classroom. None of the data collection or teaching required the students to leave the room, with the exception of when they earned a reward. Students completed the intervention during read aloud or math during the school day. The first author completing her student teaching assignment in the classroom. Each session was conducted with at least the first author present.

Materials

This study required flash cards for all multiplication facts from 0-12, probe sheets reproduced from a packet of multiplication worksheets, timer, calculator, and student selected reinforcers. Student 1 chose italian sodas or smoothies from a nearby coffee shop as their reinforcer, Student 2 chose extra computer time during read aloud as his reinforcer.

Dependent Variables and Measurement Procedure

The dependent variable was the student's students performance writing the solutions for multiplication facts taken from a multiplication worksheet. The correct answer had to match that on an answer key developed by the first author. The second measure was the number of errors per sheet. An error was any solution that did not match that found on the answer key. The final measure was the number of problems that students did not answer was labelled a skip. The number of corrects, errors and skips was then divided by the amount of time to complete the sheet took to complete the worksheet in minutes. This was measured by the scoring the number of corrects, errors, and skips on each probe sheet for each student.

Data Collection and Interobserver Agreement

Permanent product recording was used (Alberto & Troutman, 2008; McLaughlin, 1993). The students would complete the probe sheet, and it was then scored in three different areas: problems correct, incorrect, and skipped. Each participant in the study had a different goal for the number of problems to answer correctly in order to achieve reinforcement. Once this goal was achieved, the student received a new goal.

Interobserver agreement was carried by having the classroom teacher or aid correct a photocopied version of the probe sheet immediately following the student completing their work.

Experimental Design and Donditions

An ABCD non-concurrent multiple baseline design (Barlow, Nock, & Hersen, 2008; Kazdin, 2010) was used for this study. A description of each phase follows.

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Vol. 2, No. 1, January 2012

Baseline. During baseline, students were asked to complete a multiplication probe sheet. Each student was timed on the probe sheet, and the researcher determined the number of problems the student completed per minute.

Flashcards and student selected reinforcers. Flashcards from all multiplication problems from 0-12 were presented. Students had three seconds to correctly identify the card. If student responded correctly within 3 seconds, the card was placed on the ground and finished for the day. If the student took more than 3 seconds to respond or responded incorrectly, the therapist told the student the correct response, the student repeated the entire problem (i.e., for 6x8, the student would say six times eight is forty-eight). The card was then placed 3 cards down in the stack. This procedure was repeated until the student completed all cards accurately. Students were given a selected reinforcer weekly for participating in the study, and completing extra math each day. Student 1 chose an italian soda, which he received each Friday, student 2 chose to receive $5.00 for the school store daily, which added up to approximately the purchase price of an italian soda in the school store.

Flashcards, student selected reinforcers, and increasing goals. The first two independent variables remained constant throughout the intervention. A goal was made for the student taking their highest achieved rate of corrects per minute, and moved to the next interval of 5. Both students had a first goal of 25 corrects per minute. For each goal achieved student 1 chose a smoothie as his reinforcer, student 2 chose 20 minutes of computer time during read aloud. Each time students reached their goal, the researcher added 5 more corrects for their new goal.

Flashcards, student selected reinforcers, increasing goals, and repeated timings. With the first three independent variables were still in effect, if a student, if decreased for their corrects per minute or increased in errors per minute, the student was required to have a second timing for that day.

Interobserver Agreement.

For Student 1, interobserver agreement was taken for thirteen out of the thirty-nine sessions of the study, with the agreement being 98.8% (range: 96-100%). For Student 2, interobserver agreement was taken for seven out of the seventeen sessions of the study, with the agreement being 99.6% (range: of 99-100%). The total agreement for both of the students combined for the entire study was 99.1% (range: 96-100%).

RESULTS

Inferential Statistical Outcomes

Student 1. A repeated analysis of variance (Siegel, 1956) for each measure for Student 1 was carried out. For this student a significant difference was found for skips ($F = 8.857$; $df = 3$; $p = .0137$) across conditions. Follow up tests indicated a significant difference between baseline and all of the other conditions. All follow-up comparisons using a paired t-test were significant compared to baseline.

Student 2. A repeated analysis of variance for each measure for Student 2 was also carried out. For this student a significant difference was found for corrects ($F = 152.596$; $df = 3$; $p = .0001$), and skips ($F = 410.905$; $df = 3$; $p = .0001$). For errors outcomes approached significance ($F = 3.961$; $df = 3$; $p = .0714$). Follow up tests for both corrects and errors indicated that significant differences between baseline and all three interventions for both corrects and skips.

Descriptive Outcomes

Student 1. For baseline with Student 1, the median rate of corrects was 15.1 per minute with a range of 12.6 to 23.6 corrects per minute. The median rate of errors was 1.2 errors per minute with a range of .2 to 1.3 errors per minute. The median rate of skips per minute 14.6 skips per minute with a range of 7.1 to 16.5 skips per minute.

During flashcards and student selected reinforcers, the median rate of corrects was 12.1 per minute with a range of 10.4 to 13.1 corrects per minute. The median rate of errors was .5 errors per minute with a range of .4 to .6 errors per minute. The median rate of skips per minute was 4 skips per minute

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Vol. 2, No. 1, January 2012

with a range of 1.6 to 5.1 skips per minute. During the first intervention corrects, errors, and skips all decreased.

In the addition of increasing goals, the median rate of corrects was 17.2 per minute with a range of 8.4 to 19.6 corrects per minute. The median rate of errors was .75 errors per minute with a range of .4 to 1.5 errors per minute. The median rate of skips per minute was 3.2 skips per minute with a range of 1.8 to 7.1 skips per minute. Corrects increased during the second intervention, while errors and skips also increased.

For the final intervention, the median rate of corrects was 17.2 per minute with a range of 8.4 to 19.6 corrects per minute. The median rate of errors was .75 errors per minute with a range of .4 to 1.5 errors per minute. The median rate of skips per minute was 3.2 skips per minute with a range of 1.8 to 7.1 skips per minute. Corrects increased during the second intervention, while errors and skips also increased.

Student 2. For Student 2 in baseline, the median rate of corrects was 14.1 per minute with a range of 11.3 to 14.7 corrects per minute. The median rate of errors was .6 errors per minute with a range of .5 to 1.4 errors per minute. The median rate of skips per minute .1 skips per minute with a range of .1 to .5 skips per minute.

During flashcards and student selected reinforcers, the median rate of corrects was 23.8 per minute with a range of 19.7 to 27.8 corrects per minute. The median rate of errors was .2 errors per minute with a range of 0 to .4 errors per minute. The median rate of skips per minute was 0 skips per minute with a range of 0 to 0 skips per minute. During the first intervention corrects increased, while errors, and skips decreased.

When increasing goals were added, the median rate of corrects was 26.7 per minute with a range of 23 to 27.4 corrects per minute. The median rate of errors was .2 errors per minute with a range of 0 to .5 errors per minute. The median rate of skips per minute was 0 skips per minute with a range of 0 to .9 skips per minute. Corrects greatly increased during the second intervention, while errors and skips continued to decrease.

When additional timings were added to the intervention package, the median rate of corrects was 28.9 per minute with a range of 28.1 to 29.6 corrects per minute. The median rate of errors was .35 errors per minute with a range of .3 to .4 errors per minute. The median rate of skips per minute was .15 skips per minute with a range of 0 to .3 skips. Corrects increased during the final intervention, while errors slightly increased and skips decreased.

DISCUSSION

The overall results of this study indicated that a combination of flashcard drills and student selected reinforcers improved the rate for corrects per minute on multiplication problems. The only significant differences between conditions was found for both students was skips. However, it should be noted that these results do not necessarily reflect all progress made by students. When Student 1 began baseline he had a median of 96 corrects out of 168 problems with a range of 85 to 101 problems correct. He accomplished this in a median time of 5 minutes and 38 seconds with a range of 4 minutes and 4 seconds to 8 minutes and 1 second. Throughout the beginning of intervention he decreased his rate of answering problems in order to answer more problems, and to work toward increasing his accuracy. This made it appear that he was decreasing in his skills rather than increasing. As his confidence in may appeared to increase, so did the speed at which he could complete the work. Student 2 began with a high accuracy on his problems, but with low fluency. He had a median of 158 problems correct out of 168 with a range of 152 to 158. However, this too a median of 10 minutes and 49 seconds, with a range of 10 minutes and 45 seconds to 13 minutes and 57 seconds.

It should also be noted that at the beginning of this study, only one student (Student 2) was to be employed. However, Student 1 volunteered to help with this project, and asked if the researcher

would help him to learn his multiplication facts. Enthusiasm and excitement around this project built in the classroom and two more students also asked to participate.

The present outcomes provide evidence as to the efficacy employing flashcards and student selected consequences. These outcomes varied by student as well as measure. Reducing the number of problem the students skipped was signficant for both students. Student 2 who had the lowest initial performance increased the most. Something that one would expect since there was greater room for improvement. (Kazdin, 2010). Employing a rate measure (Lindsley, 1990) allowed for Student 1 to increase his fluency even though is accuracy was high in baseline, but he took several minutes to complete his work in math. Due to the non-current multiple baseline, statistical tests were computed. These data revealed the differential effects of each phase for each student.

The present outcomes provide a partial replication of our work with DI flashcards (Glover et al., 2010; Herberg, McLaughlin, Derby, & Gilbert, in press; Kaufman et al., 2011; Erbey et al., 2011) employing students with learning disabilities. However, as we have reported elsewhere, students with behavior disorders may need addition interventions such as cover, copy, and compare (Becker et al., 2010; Carter, McLaughlin, Derby, Schuler, & Everman, 2011) or a math racetrack with consequences and/or goals. Maybe providing feedback as to student outcomes (McLaughlin, 1991) and self-graphing may have also improved our outcomes; especially with Student 1. Also adding almost any evidence-based practice listed by Pelham and Fabiano (2008) for students with ADHD to what was employed in this research, may have been appropriate for Student 1's corrects and errors.

The cost of this study was minimal; however, it may vary with each child due to the fact that they chose the reinforcers. If the reinforcers were more expensive it was possible to discuss alternative ideas such as free time on the computer, extra recess, game time, items from the classroom store, classroom money, etc.

There were limitations in the present paper. First, as each additional procedure was employed student performance improved for all three measures. A return to the original intervention of flash cared and student selected rewards would have allowed a better measure as to the effects of these later procedures. However, due to the improvements in our students' performance, we choose not to carry this out. A second limitation was the time that it took away from regular class time during math. There were many days with time limitations when students completed math from this study in lieu of their math assignments. While this study helped to increase their multiplication skills, it took time away from other math concepts. Another limitation was the lack of follow up data collection to determine if out students were able to maintain the same level of skill over time. Due to the ending of student teaching for the first author, this could occur.

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