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Using Direct Instruction Error Correction and a Match to Sample Procedure to Teach Three Kindergarten Students with Developmental Delays Number Identification

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Abstract: *The purpose of this study was to determine the efficacy of match to sample with error correction training procedure with three kindergarten students with developmental delays in an elementary resource room. The procedure was implemented to teach visual and verbal identification of randomly presented numbers from 1 to 30. The effects of the match to sample and direct instruction error correction procedure were evaluated within a multiple baseline design across participants. During baseline, all of the participants had difficulty with number identification. The results indicated an increase in corrects and a decrease in errors for each of the participants when error correction and match to sample was employed. In addition, when the match to sample with error correction exercise was faded, no decrease in student performance occurred.The benefits of using match to sample with error correction to teach number identification are discussed.*

Key Words: *match to sample, primary students, developmental delays, multiple baseline design, resource room*

Introduction

Number recognition and identification is an important pre academic skill in math. Number recognition has been suggested as an important skill for students to acquire by the end of kindergarten (Stein, Kinder, Silbert, & Carnine, 2006). Similarly, mathematic skills are critical for everyday living such as grocery shopping, balancing a checkbook, etc. (Lerner & Johns, 2009, 2011; Stein et al., 2006). Jordan and Montani (1997) found that children identified as having a weakness in mathematics, also experienced difficulty with rapid fact retrieval and efficient problem solving. Having adequate skills in math has been linked to employability and success in adult life (Livingstone, 1998). It has been reported that children who exhibit difficulties in mathematics in elementary school continued to exhibit those same difficulties in mathematics throughout their academic careers (Rivera-Batiz, 1992). Therefore, having a weakness in the area of mathematics can hinder both current and long-term educational opportunities (Rivera-Batiz, 1992). A major goal for schools is to prepare young people for the competitive job market and students without skills in math are more likely to drop out of school (Chambers, Dunn, & Rabren, 2004; Lloyd, 1978).

Match to sample have been a suggested as a teaching procedure in special and remedial education (Haring, Lovitt, Eaton, & Hansen, 1978; Smith, 1981). At its most elementary level, matching to sample requires that the student be provided with a sample followed by the opportunity to choose from an array of stimuli to match to the stimulus that corresponds to the sample provided. Most classroom teachers provide such instruction using match to sample across a wide range of subjects ranging from math to spelling (Haring et al., 1978; Smith, 1981). Unfortunately, there is not a great deal of data regarding the effectiveness of match to sample with young children.

Error correction is a procedure often employed within direct instruction curricula (Marchand-Martella, Slocum, & Martella, 2004; Watkins & Slocum, 2004), and as a method to reduce errors made by students with disabilities (Peterson, McLaughlin, Derby, & Andersen 2008). Error correction requires three steps: (1) the instructor presents the problem with the correct solution (model), (2) the student practices the correct solution with the teacher (lead), and (3) the teacher asks the student to perform the skill independently (test). Error correction is employed until the student can provide the correct response. Error correction has been shown to be effective, not only within Direct Instruction curricula, but in teaching both academic and social skills (Greenwood, 1998; Lignugaris/Kraft, 2004; Marchand-Martella et al., 2004; Peterson et al., 2008).

Direct instruction has been shown to provide the motivation and teaching procedures that allows for individualized instruction that meets student needs (Marchand-Martella et al., 2004). Number identification is often the first step in the development of mathematical skills, and it is important that children can correctly identify numbers and the earlier they are successful with this task the better (Polya, 2002; Stein et al., 2006).

The purpose of this study was to determine the effectiveness of match to sample with error correction in a Direct Instruction context with three kindergarten students with developmentally delays. Another purpose was to provide additional data regarding the efficacy of error correction strategies when combined with match to sample procedures. A final purpose was to briefly assess how fading of the match to sample procedure effects student performance.

Methodology

Participant and Setting

Three kindergarten students enrolled in a special education resource room served as participants. The participants included two female students ages 5 and 6, and one male student age 6. All students were served under a developmental delay category within a pullout model. All participants had IEP goals in reading, writing, and math. In addition, one of the female participants had behavior goals.

Battelle Developmentally Inventory Test (Newborg, Stock, & Wnek, 1984) results for Participant 1 indicated skills at 28 months with a chronological age of 41 months. These test results suggested a significant delay in her pre-academic/social skills. Her evaluation also suggested significant delays in pre-academic/social skills. Achievement data for Participant 2 using *Woodcock Johnson III Tests of Achievement* (Woodcock, McGrew, & Mather, 2001) suggested significant delays in reading, math, and written language skills, indicated a need for her to receive individual instruction. Her full scale IQ on the *WISC-III* (Weschler, 1992) placed her within a borderline range of intellectual functioning. Achievement data for Participant 3 using the *Battelle Developmentally Inventory Test* (Newborg et al., 1984) indicated his age equivalent was 24 months with his chronological age being 52 months suggesting significant delays in pre-academic/cognitive skills.

The study took place in a special education resource room located in a large urban school district in the Pacific Northwest. Two participants attended the same afternoon session, and the other participant attended a later afternoon session. All of the students in the resource room had specific academic delays and several different behavioral goals. Sessions lasted anywhere between 10 to 15 minutes.

The classroom employed an ongoing token reinforcement system (McLaughlin & Williams, 1988). It was in place during baseline and intervention phases. Formally termed the BINGO Board System, it was made up of these elements: (a) verbal praise for appropriate behavior; (b) a token system for on-task and work completion; and (c) a reinforcement menu that allowed the students to acquire tangible back up reinforcers such as model cars, trinkets, etc.

Dependent Measures, Materials, and Data Collection

The dependent variable was the frequency of corrects and errors for number identification responses. A correct answer was defined as a match between the number prompted and the sample stimulus that took place within 3 to 5s after the verbal prompt. An error was defined as

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the participant not matching the number prompted, failing to respond, or taking longer than 3s to 5s to respond. The mathematical numbers that the participants had to identify were presented in random order to minimize memorization and guessing. Each of the 30 flashcards contained a picture which represented each number. Pictures were presented in two different formats. The first employed a domino representation of the number, while the second employed various shapes representing the number (i.e., 6 hearts, 6 chairs, and 6 cans).

Experimental Design and Conditions

A multiple baseline across participants (Kazdin, 2011; McLaughlin, 1983) was implemented to assess the efficacy of employing match to sample and error correction procedures. A description of the various conditions follows.

Baseline.

Baseline data were gathered over a period of 7 to 8 school days. In baseline, each student was asked to identify all 30 numbers on a number line. The number line which contained the numbers 1 to 30. The order of the numbers prompted was determined at random for each participant. Each student was verbally prompted to "Show me number __." Each participant was required to point to that number within 3 to 5s. Baseline errors data were used to develop a set of intervention stimulus cards. This condition was in effect for 2 to 3 sessions.

Match to sample + error correction.

The match to sample sets were created. Each set consisted of 10 numbers (three numbers the participant did not know and 7 numbers identified in baseline). If the participant matched the number sample incorrectly with the picture representation, the first author would engage in an error correction procedure. For error correction, the teacher modeled the correct response by physically showing correct match between the number to the correct picture representation. For example, if the participant matched the number 15 to the picture representation of 19, the teacher would match the correct 15 correctly to the correct number match. With the verbal prompt, "The number 15 matches this picture with 15 hearts." The participants were then required to repeat the match to sample number phrase correctly. When the participant correctly matched the number to the picture sample, verbal praise was delivered. Statements such as "good job," great," "excellent" were employed. This condition was in effect for 12 to 16 sessions (27 school days). Just as in baseline, the number line was available to the students.

Reliability of Measurement and Procedural Integrity

Reliability was taken for 50% of each participant's sessions by an independent observer. One of the two classroom instructional assistants served as the reliability observers. The reliability data collector was trained using the same scoring criteria and metric as the first author. Reliability data were taken while the first author worked with the participants. Correct responses were recorded with a positive (+), and incorrect responses were recorded with a negative (-). An agreement was defined as both scorers scoring the item in the same manner. Any deviation in scoring was tallied as a disagreement. The number of agreements was divided by the total amount of possible agreements and then divided by 100. The reliability measurement for all participants was 100%.

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Procedural fidelity of the independent variable was assessed on separate three occasions. Specifically, the second author came unannounced to the classroom and observed the first author working with the participants. Procedural integrity for using match to sample and error correction procedures was 100%.

Findings

The number of corrects (closed boxes) and errors (closed diamonds) for each participant during baseline and match to sample and error correction phases are displayed in Figure 1. In baseline, Participant 1's corrects declined (*M* =18; range 16-19) while her errors increased (*M* =12; range 11-14). When the match to sample and error correction procedures were employed, her number identification skills increased (*M* =27; range 20-30) and her errors declined (*M* = 3; range 0-10). In baseline, participant 2's performance was stable (*M* =17; range 15-18) as were her errors (*M* =14; range 12-15). When the match to sample and error procedures were in effect, her corrects increased (*M* =24; range 16-30), while her errors declined (*M* =8; range 0-14). In baseline, participant 3's corrects declined over time (*M* =20; range 19-22), while his errors increased (*M* =10; range 8-11). When the match to sample and error correction procedure was employed his frequency of corrects improved (*M =26*; range 22-30), and his errors declined (*M* =4; range 0-8).

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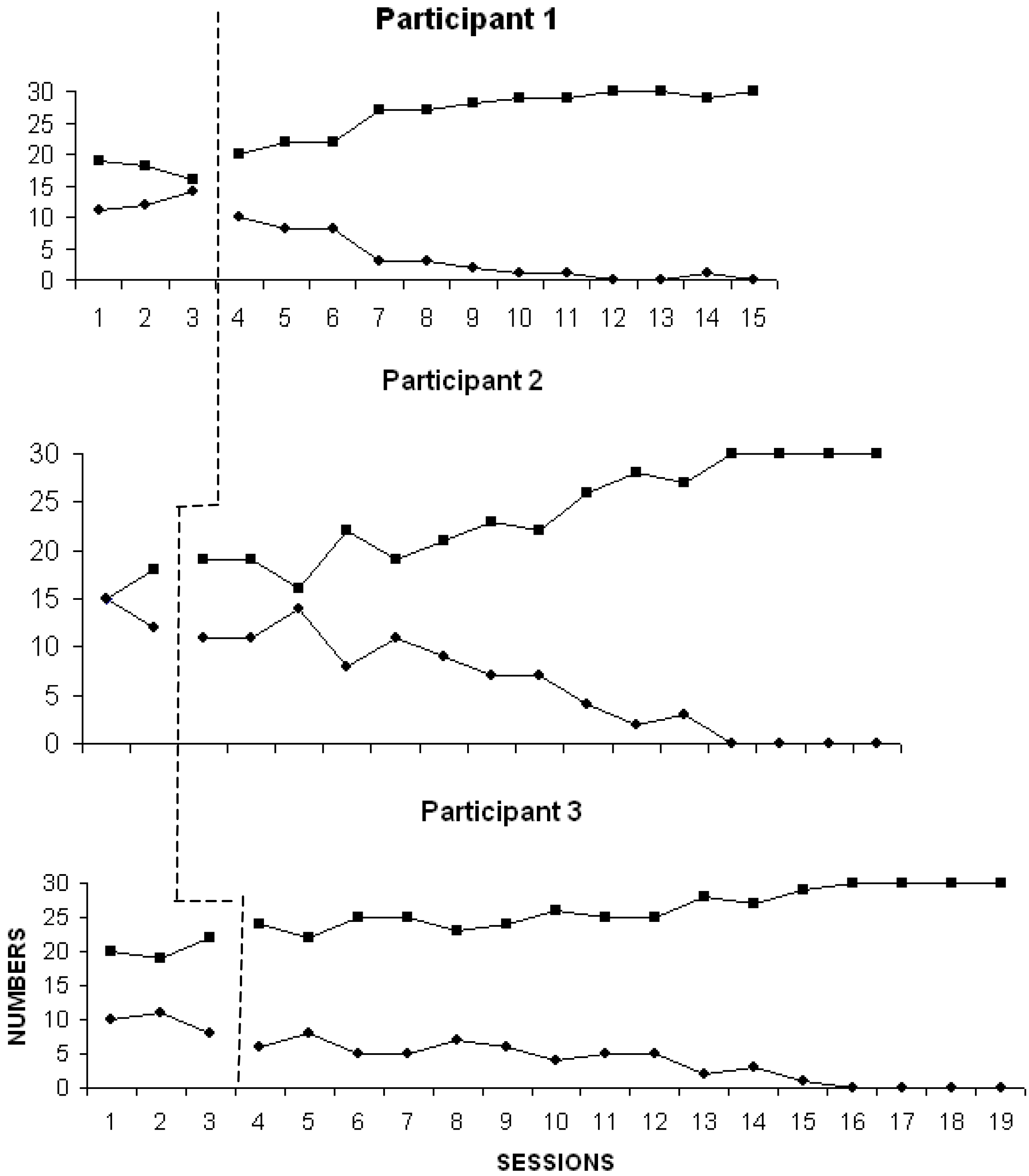

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Figure 1. The number of correct (closed boxes) and error (closed diamonds) numbers for Participants 1-3 in baseline and match to sample + error correction.

Conclusions

Our results demonstrate that through a combination of match to sample, direct instruction error correction, and praise, we were able to increase the number identification skills of three kindergarten students with academic delays. Thus, the match to sample system and error correction appears to be an effective procedure. Specifically each participant showed a substantial increase in mastery and retention of their targeted number identification skills. With each week of intervention, the students improved their performance. Over time, they were able to identify numbers 1 through 30, with not only greater speed, but with more accuracy.

Once the number identification routine had been established, the participants completed their assigned tasks in a timely manner. On many occasions, the students continued working on their math worksheet or math game after formal data collection ceased. In addition to matching with error correction, the participants were taught to graph their performance. Thus, they kept track and took their graphs home after formal data collection was formally terminated. Anecdotally, charting at the end session became a fun activity that allowed them to color their graphs and monitor their progress. It appeared that each student was excited to complete his or her bar graph with a score of 100%.

There were limitations in the present research that should be noted. First, data collection had to be terminated due to the completion of the first author's student teaching. This did not allow for long-term maintenance or follow-data to be gathered. Also data collection did not occur due to spring break and other school holidays. Therefore, the intervention period spanned only five weeks. Since acquisition of number identification skills was slow, each of our participants should have remained in baseline longer. The use of such short baselines reduces the experimental control in the present study (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005). However, it was the wish of the classroom teacher and first author to begin instruction as soon as possible.

Suggestions and Recommendations

These procedures were time efficient. Each participant spent about 15 to 20 minutes per session and improved their number identification skills. The procedure was practical in method. The researchers did not have to spend much time doing actual data collection. This procedure could easily be implemented in a classroom setting, or done at home.

Adult attention and the reward of earning tickets for their BINGO boards may have also helped make the procedure enjoyable for the students. Bingo boards and tickets were already part of the ongoing classroom routine and according to the master teacher, were highly motivating for her students. During the study, the first author noted that the use of verbal praise was quite effective for each of the participants. The first author did not have to spend any money on extra rewards at any time during the study. Cost to the researchers was minimal; money was spent on 3 x 5 index cards and a permanent marker. The cost was well under $5.00. The effort involved was also minimal, since the instructional time frame was only 15 to 20 minutes each school day. The researcher estimated that she spent about 8-10 total hours with the participants during the evaluation.

The outcomes replicate our prior work with error correction (Brasch, Williams, & McLaughlin, 2008; Peterson et al., 2008) and provided some additional confirmation of employing both error drill and match to sample. As suggested by Lignugaris/Kraft, 2004) and Watkins and Slocum (2004), the instructional procedures of Direct Instruction can be employed with other content or in other contexts (Peterson et al., 2008). Finally, the present outcomes provide some additional data regarding the use of match to sample in an applied classroom setting and a partial replication of the work by Smith (1981).

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