COMPARING ERROR CORRECTION PROCEDURES: INCORPORATING EFFECTIVE AND EFFICIENT TEACHING WITH LEARNER PREFERENCE

A Thesis

Submitted to

the Temple University Graduate Board

In Partial Fulfillment

of the Requirements for the Degree

Masters of Education in Applied Behavior Analysis

by

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July 2016

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ABSTRACT

Previous research has evaluated error correction procedures to assess their effectiveness, yet few studies have evaluated preferences for these procedures. An alternating treatments design was used to compare the effects of four error correction procedures: model, single response repetition (SRR), multiple response repetition (MRR), and single response repetition with an embedded distracter trial (SRR-D), on the acquisition of sight words for three adolescent males. Preference for the procedures was assessed by using a concurrent chains procedure consisting of forced choice and free choice presentations. Results demonstrated that all participants performed best with a specific error correction procedure. Participant 1 showed a moderate preference for his most effective error correction procedure. Participant 2 demonstrated a slight preference for the SRR procedure which did not correlate with his most effective error correction procedure, SRR-D, and participant 3 did not demonstrate preference for any of the procedures. These findings suggest that error correction procedures should be evaluated and individualized for each learner. Although a moderate preference for a procedure was demonstrated with only one participant, future research should continue to use and refine these procedures to incorporate learner preference in all teaching strategies.

DEDICATION

This paper is dedicated to my students.

You've changed my life in more ways

than I could have imagined, you truly inspire me.

ACKNOWLEDGMENTS

I would like to thank my advisor, Shana Hornstein, Ph.D., BCBA-D, for aiding in the development and analysis of this paper. I would also like to recognize Jennifer Croner, MS. Ed., BCBA, and Marianna Maggiore for their assistance in data collection.

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CHAPTER 1

COMPARING ERROR CORRECTION PROCEDURES

The goal of a teaching intervention is to increase correct responding and decrease errors to near zero levels. Discrete trial instruction provides a specific set of teaching strategies; however, the choice of error correction procedures tends to vary widely across settings. For many practitioners the decision to use a particular error correction procedure may be based on the standard procedure used in their clinical setting or, alternatively, based on practitioner preference rather than the needs of the learner. On the other hand, various types of antecedent manipulation strategies, such as prompting and prompt fading, video modeling, and priming, have been studied to evaluate their effectiveness; however, learners with autism spectrum disorder (ASD) have a tendency to become dependent on these antecedent prompts (Green, 2001). Therefore, a more thorough evaluation of error correction procedures may aid in achieving stimulus control with the discriminative stimuli (S^D) instead of teacher's prompts (Smith, 2006). A number of studies have used an alternating treatments research design to compare general types of error correction procedures. These procedures include delivering feedback statements (McGhan & Lerman, 2013; Rodgers & Iwata, 1991), modeling (Barbetta, Heron, & Heward, 1993; McGhan & Lerman, 2013), active student responding (Carroll, Joachim, St. Peter, & Robinson, 2015; McGhan & Lerman, 2013; Waugh, Alberto, & Fredrick, 2011), delayed error correction (Carroll et al, 2015; Worsdell, Iwata, Dozier, Johnson, Neidert, & Thomason, 2005), and using error correction with distraction trials (Belfiore, Skinner, & Ferkis, 1995; Turan, Moroz, & Paquet Croteau, 1995; Worsdell et al., 2005).

Feedback and Model Statements

The error correction procedures that require the least response effort from the learner and therapist are the feedback statement and model procedures (McGhan & Lerman, 2013). Many researchers have incorporated the feedback and model procedures into their evaluation of error correction procedures. The feedback statement procedure requires the instructor to state, "No that is not (learner's response)". The instructor then moves on to the next teaching trial. The modeling procedure requires the instructor to respond by stating, "This is (correct response)" contingent on a learner's incorrect or no response (see Figure 1). The instructor then moves on to the next teaching trial. Barbetta, Heron, and Heward (1993) used a combination of the feedback statement and model procedures; when a student emitted an error, the therapist stated, "No, this word is ____. Look at it." Then, after two to three sec, praised the student for attending to and moving on to the next word. All of the participants in this study were unable to learn, maintain, and generalize as well they did in the active student responding condition. McGhan and Lerman (2013) evaluated a feedback statement and a modeling procedure against two other error correction procedures. They found that none of the participants acquired new target behaviors with the feedback statement error correction procedure. However, four of the five participants met mastery criteria in the model procedure. Rodgers and Iwata (1991) reported similar results in which all the participants showed improved responding in the baseline condition in which correct and incorrect responding was differentially reinforced when a feedback statement followed an error. However, the participants performed best in one of the error correction procedure conditions that required a response following an instructor's correction.

Immediate Active Student Responding

Participants tend to perform better when they are required to respond immediately following a correction made from the instructor (Barbetta, Heron & Heward, 1993; McGhan & Lerman, 2013; Rodgers & Iwata, 1991). The immediate active student responding error correction procedure requires the learner to emit a response immediately following a correction from the instructor. This general procedure has been incorporated into many studies in various ways. A single response repetition procedure requires the learner to emit one correct response after the instructor's model prompt and the representation of the S^D (see Figure 2) (Barbetta, Heron, and Heward, 1993; Carroll et al., 2015; McGhan & Lerman, 2013; Waugh, Alberto, & Fredrick, 2011; Worsdell et al., 2005). A variation of this procedure, the single response repetition procedure that McGhan and Lerman (2013) used, was similar to the model procedure with an added gestural prompt to the correct target sight word. Then the instructor immediately re - presented the S^D and waited for a correct response. They found that only one participant needed this error correction procedure to produce future correct responding. Waugh, Alberto, and Fredrick (2011) found that all participants had lower error rates when the single response repetition type of error correction procedure was implemented. The re-present until independent procedure implemented by Carroll et al. (2015) required the instructor to provide a vocal model, have the learner repeat the modeled stimulus, and re - present the trial to allow for independent responding. However, if the participant did not emit the correct response after the first error correction, the instructor repeated this sequence until the learner emitted an independent response or if there had been 20 error correction trials. Three participants were able to master targets at a faster rate under this condition. Carroll et al. (2015) failed to include a less intrusive procedure, such as the modeling procedure, which demonstrated more efficient acquisition than the active student response condition for the majority of participants (McGhan & Lerman, 2013). Rodgers and Iwata (1991) explored the effects of a practice condition in which the procedures mirrored those of Carroll and colleagues (2015) in which they repeated the error correction trial until the student reached independent responding for that target.

Another version of the single response repetition procedure is the multiple response repetition procedure (see Figure 3). The multiple response repetition procedure requires the participant to emit a varying amount of correct responses following the model (Carroll et al., 2015; Marvin, Rapp, Stneske, Rojas, Swanson, and Bartlett, 2010; McGhan & Lerman, 2013; Worsdell et al., 2005). Carroll et al. (2015) required participants to correctly respond five times, or, if there had been 20 error correction trials the error correction would cease, which is unlike Marvin et al. (2010), which required participants to repeat the correct response four times after the model prompt was delivered. Belfiore, Skinner, and Ferkis (1995) utilized the multiple response repetition procedure; however, the instructor gave the S^D “Please repeat the word four more times” rather than delivering the original S^D. The authors hypothesized that the four repetitions required in the response repetition condition could have acted as a punisher for correct responding since the repetitions followed the correct prompted response. Worsdell et al. (2005) focused their research on the number of repeated responses the learner is required to emit. The single response repetition and multiple response repetition procedures used were similar to the procedures used in other studies (Carroll et al., 2015) in which the participant was required to repeat the model prompt either once or five times. Worsdell et al. (2005) reported that, unlike other findings (Carroll et al, 2015; McGhan and Lerman, 2013), the multiple response repetition procedure was more effective across multiple variables than the single response repetition procedure including more cumulative words mastered, more words read correctly per session, and more words retained both short term and long term.

Delayed Error Correction

An alternative type of error correction procedure used in multiple studies is the delayed error correction procedure wherein the instructor implements a range of brief to extended periods of time delays before correcting a learner's error response. Carroll et al. (2015) employed a remove and re - present procedure which required the instructor to provide a vocal model if the learner did not emit a response; if the learner did emit an incorrect response, the instructor removed the stimulus for two sec and re - presented the S^D with an immediate correction. One participant mastered targets in this condition in the fewest number of sessions, suggesting a delayed error correction procedure may be effective for select learners. A variation of the delayed error correction procedure was evaluated by Worsdell and colleagues (2005) who used an intermittent schedule of error correction. The error correction procedure determined to be the most effective in the first study, multiple response repetition, was delivered on a variable ratio schedule in a follow up study, in which the participants received a correction for an average of every third error emitted. Results illustrated that none of the participants mastered targets in the intermittent error correction condition. Similar results were shown by Barbetta, Heward, Bradley, and Miller (1994) on same day, next day, and maintenance tests. Barbetta and colleagues (1994) used a delayed error correction procedure in which the instructor provided a feedback statement, “No, we’ll try this one later”, then shuffled the incorrectly responded to words after all words had been presented. The S^D was represented with a correction from the instructor; results illustrated that the delay error correction procedure allowed for more incorrect responses to be emitted during the delay. Turan, Moroz, and Croteau (2012) used a delay procedure in which the instructor allowed five sec between the learner’s response and the re - presentation of the S^D with a correction. This variation of the delay error correction procedure allowed for two of the three participants to master targets faster. Overall, the delay error correction procedures that promoted the most efficient learning are when the delay is no longer than five seconds from the incorrect response given by the learner. This conclusion supports the use of an immediate error correction with an extremely brief use of a delay. Due to a lack of evidence for the effectiveness of a delayed error correction procedure, the focus of this research will include the other general error correction procedures.

Distracter Trials

Another type of error correction that incorporates both the immediate active student responding and the delayed error correction procedures is single response repetition with distracter trials (see Figure 4). Error correction with distracter trials entails correcting errors after an incorrect response has been emitted, then using unrelated trials to distract the student, and finally re - presenting the S^D as a way to test for learning within a trial. Worsdell et al. (2005) used an error correction with distracter trials, which they labeled as an irrelevant error correction procedure, with multiple response repetition, which involves presenting a sight word not related to the target sight word and a non-training word contingent on an incorrect response. The authors concluded that one participant mastered more target sight words in the irrelevant condition than in any other condition. Belfiore, Skinner, and Ferkis (1995) investigated a trial repetition procedure in which the instructor provided a model statement and allowed for correct responding; this sequence was repeated until five error correction trials were interspersed with mastered targets. The authors found that the trial repetition procedure was more effective in producing faster rates of learning. The authors suggest that, based on their results, educators should focus on increasing the number of learning opportunities rather than increasing correct responding. Turan, Moroz, and Paquet Croteau (1995) utilized a distracter trial following a correction of an error. Then the original S^D was presented to test for learning. The participants that acquired more discrimination targets in study one demonstrated similar acquisition of tact targets in study two; these results suggest that error correction procedures may require individualization for each type of learner. Rodgers and Iwata (1991), while testing for acquisition of match to sample tasks, used a color matching task as the distracter trials. The number of color matching trials was yoked from the average number of repetitions for the practice condition in the previous session. This condition was designed to target the maintenance of correct responding by negative reinforcement alone as was seen in Worsdell et al (2005). The possible maintaining consequence of negative reinforcement in this type of error correction procedure is similar to the maintaining consequence seen in the multiple response repetition procedure. These procedures require multiple responses from the learner which could act as an aversive stimulus; therefore, the learner will avoid being required to emit these additional responses by emitting a correct answer in the future to receive positive reinforcement.

With the introduction of Individualized Education Plans (IEP) under the Individuals with Disabilities Education Act (IDEA), the U.S. Department of Education (2005) requires educators to individualize student's teaching strategies and specific goals. However, error correction procedures have not been a required area specifically reported in this document. Although, the Behavior Analyst Certification Board (2016) states under item 4.03a, "Behavior analysts must tailor behavior-change programs to the unique behaviors, environmental variables, assessment results, and goals of each client" (p. 12). Thus, choosing an error correction procedure should not deviate from this standard. The varying results of these studies show that there is not a universal error correction procedure that is best for all learners. Therefore, developing a method to assess specific error correction procedures for individual learners could aid in the learning process which could allow for students to reach their benchmarks and goals more quickly.

CHAPTER 2

PREFERENCE

The studies examined in this review have demonstrated that error correction procedures should be individualized to each learner. However, not many studies have incorporated individual choice when evaluating these procedures. Bannerman, Sheldon, Sherman, and Harchik (1990) discuss the potential for client resistance to be interpreted as a failure in teaching procedures, but it may be an expression of preference. Therefore, by incorporating preference, individuals may respond more accurately to certain teaching procedures. Waugh, Alberto, and Fredrick (2011) incorporated some form of learner and instructor preference by using a social validity questionnaire at the conclusion of their study. The results of this questionnaire showed that all instructors and students agreed that there should be an error correction procedure; students, for example, reported that they "did not like when the teachers didn't correct their mistakes." Although a social validity questionnaire is a valuable way to determine preference, students with communication impairments may not be able to complete a paper and pencil survey. More importantly, statements of preference do not reliably predict behavior. Therefore, Hanley (2010) discusses the concerns that practitioners have with obtaining a reliable preference from individuals with language impairments, since historically preference was determined by a questionnaire or interview with the recipient of services. However, an appropriate alternative is a concurrent chains procedure. This procedure includes pairing an unrelated stimulus with a certain teaching procedure which allows the learner to choose a single stimulus to express preference rather than multiple questions included in a survey. This procedure provides a way to objectively obtain a learner's preference without requiring advanced language skills (Hanley, 2010). Few researchers have attempted to assess learner's preference for teaching strategies and even less has assessed preference for error correction procedures. All studies that have utilized a concurrent chains procedure to pair an ambiguous stimulus with a specific teaching procedure have used forced choice or pairing followed by free choice. Examples of ambiguous stimuli include small colored cards (Brower-Breitwieser, Miltenberger, Gross, Fuqua, & Breitwieser, 2008; Heal, Hanley, & Layer, 2009; Luczynski & Hanley, 2009; Slocum & Tiger, 2011) and larger colored table mats (Leaf, Sheldon, & Sherman, 2010). The forced choice procedure entails physically prompting the learner to choose a specific stimuli to signal the corresponding condition will commence (Brower-Breitwieser et al., 2008; Heal, Hanley, & Layer, 2009; Slocum & Tiger, 2011). Free choice sessions have followed forced choice sessions in which data were collected to determine preference. Leaf, Sheldon, and Sherman (2010) and Luczynski and Hanley (2009) utilized a concurrent chain procedure in which the ambiguous stimuli is paired the teaching procedure during the training phases then free choice sessions are completed to measure preference. A majority of participants across these studies showed a preference for a particular teaching strategy. However, some learners showed mixed or no preference. A limitation to using a concurrent chains procedure to evaluate learner preference is the number of sessions needed to adequately pair the ambiguous stimulus in order to accurately measure preference. This limitation is derived from the participants who showed mixed or no preference for a particular strategy. Nevertheless, using a concurrent chains procedure is a reasonably reliable way to consider the learner's choice and preference.

The purpose of this study is to determine the most efficient and effective error correction procedure. This study will also assess the participant's preference for tested error correction procedures.

CHAPTER 3

METHODS

Participants

Participants were recruited from various classrooms at an approved private school for children and adults with disabilities. The inclusion requirements for the study were that the participants were within the age range of 3 to 18 years, attended the school-based program at the approved private school in which the study took place, had a diagnosis of a developmental disability, and had an IEP that included a reading goal. Participants were excluded from this study if they failed to meet any of the inclusion requirements or their parents or guardians were unable to read an English consent form.

There were three participants included in this study. Bret was a 15-year-old male diagnosed with ASD. At four years of age, Bret was evaluated using the Childhood Autism Rating Scale (CARS) in which he received an overall score of 42 which is consistent with a diagnosis of ASD. The participant attended the approved private school and resided in a residential community home on the same campus. Toby was a 13-year-old male diagnosed with ASD, using the Gilliam Autism Rating Scale-Second Edition (GARS-2), and scoring an autism index of 79. Toby was also assessed using the Stanford-Binet Intelligence Scales, Fifth Edition (SB5), scoring an overall intelligence quotient of 41 which classifies him as moderately delayed. Will was a 16-year-old male diagnosed with an intellectual disability, hypertonia, chromosomal translocation, macroencephaly, and chronic static encephalopathy by a neurologist at age 4. Toby and Will attended the approved private school and resided at home with their parents. All of the participants were able to emit single words or short phrases vocally and were able to imitate words and short phrases as assessed by the individual's speech and language pathologists.

Consent was obtained from the participants' parents, who were their legal guardians, per the University's Institutional Review Board. The researcher met with the participants' team (i.e. Behavior Analyst and classroom teacher) to gather information and concerns about current programming for their reading curriculum. The researcher then spoke with the participants' parents, via phone call or e-mail, to review their concerns and to provide an overview of the study. An outline of procedures was sent to each of the parents included in the consent form. The parents then provided consent for their children to participate in this study as well as video consent giving permission to record the sessions. Will's parents did not provide video consent. Assent was assumed by the participant's willingness to begin each session.

Materials

Target stimuli were selected, based on the individual learner's upcoming targets in their school-based curriculum, Edmark© reading program. This curriculum focuses on word recognition, specifically for individuals with developmental disabilities. The curriculum is broken down by lessons, and there is a corresponding target word for each lesson. All target words were selected from level one, which includes 150 sight words of a kindergarten and first grade reading level, to ensure that the target words were comparable across all error correction procedures. The target words for the next four lessons for each participant were selected as the target words for the study and an error correction procedure was assigned to each word (see Table 1). All words were printed on various colored, 3x5 inch index cards in 18 point Times New Roman font then laminated. A video camera and tripod were used to record all sessions for Bret and Toby; Will's sessions were not recorded. A standard timer was used to calculate the duration of each session. During sessions, participants gained access to edible and tangible reinforcers for correct responding. Each participant was asked what they would like to work for before each session began; Bret received cheese ball or chips; Toby received chips and Will received popcorn or Michael Jackson videos on an iPad©. Reinforcers were selected based on preference assessment surveys given to the parents of these individuals.

Table 1.

Error Correction Procedures with Corresponding Target Words

Participant	Bret	Toby	Will
Model	Boy	See	In
Single Response Repetition	And	Ball	The
Multiple Response Repetition	Fish	And	Girl
Distracter Trial	Ball	Fish	Little

Setting

All sessions were conducted in the school - based program of the approved private school the participants attended. All participants received their instruction in their assigned classroom. Sessions were conducted in the participants' wooden school desks and chairs.

Dependent Measures

Data were collected on the number of correct and incorrect responses following the initial S^D for each trial, reported as a percentage of correct responses divided by ten (i.e., the total number of trials for each session), excluding error correction trials. Post error responses (See the asterisks in Figures 1-4 for the post error response in each error correction procedure) were also recorded separately, by calculating the number of correct post error responses divided by the total post error trials. Post error responses within the model procedure consisted of the participant echoing the word after the therapist had emitted the target word, which was not required as per the procedure; however, all of the participants engaged in this behavior. Post error responses within the single response repetition procedure consisted of the participant correctly emitting the target word after the therapist had stated the correct target word and re - presenting the S^D. Post error responses within the multiple response repetition procedure consisted of each response emitted by the participant after the therapist had stated the correct target word and re - presented the S^D. Post error responses within the single response repetition with an embedded distracter trial procedure consisted of the response emitted after the therapist had stated the correct target word, presented a mastered skill, and re - presented the original S^D. The duration of sessions was also calculated. The timer to record duration was started when the therapist delivered the prompt to choose a colored card. The timer stopped when the therapist provided verbal praise and/or a tangible reinforcer after the tenth trial. All sessions consisted of 10 trials but the length of time required for the different errors correction procedures varied, which altered the length of sessions. The mastery criterion set for the participants was 90% or more correct responding across three consecutive sessions. Preference data were collected during the free choice condition on cumulative initial link selections.

Inter-observer Agreement and Procedural Integrity

Interobserver Agreement data were collected for at least 25% of total sessions across baseline, intervention, and preference. Employees of the private school were trained prior to the start of the study. Training entailed collecting data during baseline sessions until the therapist and the student investigator reached 100% inter-observer agreement for at least 3 sessions. The trained employees aided in all data collection, either in-vivo or through video recordings. IOA data were collected using the total method in which the total number of agreements was divided by the total number of agreements and disagreements. IOA data were collected on correct responding, session duration, and choices made during the preference assessment; the mean agreement scores were 99.6% (range, 98% - 100%) for Bret, 97.8% (range, 78% – 100%) for Toby, and 99.4% (range, 89% - 100%) for Will.

A procedural integrity form was created to monitor and measure whether the procedures were being implemented as intended. Employees of the approved private school were trained prior to the start of the study through role play training with the student investigator until they reached 100% procedural integrity before data - collection began. The trained employees aided in all data collection, either in-vivo or through video recordings. Procedural integrity data were collected for 25% of total sessions. The mean integrity scores were 100% for Bret and Will and 99.8% (range 95% - 100%) for Toby.

CHAPTER 4

EXPERIMENTAL DESIGN

An alternating treatments' design with an initial baseline was used to evaluate the effectiveness and efficiency of error correction procedures. An additional condition was added using the concurrent chains procedure to assess preference for error correction procedures. At the beginning of each session, the therapist physically prompted the student to select the pre-determined colored card to initiate the forced choice procedure. Once the participant reached mastery criteria for all targets, the therapist then allowed the participant to choose among all the colored cards to initiate the free choice procedure.

Procedures

Prior to beginning the assessment phase, a multiple stimulus without replacement (MSWO) preference assessment was conducted for color. The moderately preferred colors for each participant were selected as the paired colors for each condition. Sessions consisted of ten trials for each target. One target word was assigned to each error correction procedure. A single error correction procedure was run during each session. Sessions consisted of ten consecutive trials of the same target word and corresponding error correction procedure. At the beginning of each session the instructor physically prompted the student to choose the corresponding colored card for the specified condition to initiate the initial link in the chain. The instructor then held up a card with the target stimulus on it and asked the participant, “What word is it?” A correct response following the initial S^D resulted in an edible or tangible reinforcer and social praise. An incorrect response following the initial S^D resulted in the therapist correcting the error using one of the following error correction procedures: modeling, single - response repetition, multiple - response repetition, and single - response repetition with an embedded distracter trial. These procedures were alternated in a randomized order until the participant reached mastery criteria of 90% or better correct responding for three consecutive sessions (Rogers and Iwata, 1991). If the participant were unable to reach three consecutive days following at least one session reaching 90% or better responding, the target and corresponding error correction procedure were terminated.

During baseline, the S^D was presented, a correct response resulted in brief verbal praise and access to a specified reinforcer. An incorrect response or no response from the learner resulted in no consequence from the instructor, and the next trial was presented. During the model condition (See Figure 1) the consequence for correct responding will remain the same as baseline. An incorrect or no response will result in the instructor stating, “This is ____.” Then the instructor will present the next trial. During the single response condition (SRR) (see Figure 2), the consequence for correct responding will remain the same as baseline. An incorrect or no response will result in the instructor stating, “This is ___. What word?” The instructor will wait 5-10 seconds for the learner to repeat the model prompt and then present the next trial. During the multiple response repetition condition (MRR) (see Figure 3), the consequence for correct responding will remain the same as baseline. An incorrect or no response will result in the instructor stating, “This is ___. What word?” Following the correction, the instructor will repeat the original S^D an additional three times. Then the instructor will present the next trial. During the single response repetition with an embedded distracter trial condition (SRR-D) (see Figure 4), the consequence for correct responding will remain the same as baseline. An incorrect or no response will result in the instructor implementing the same procedures as the single response repetition procedure. The instructor will then present a distracter trial (i.e. a previously mastered target that is unrelated to the target stimulus). Following a distracter trial, the instructor will present the original S^D.

Model Procedure

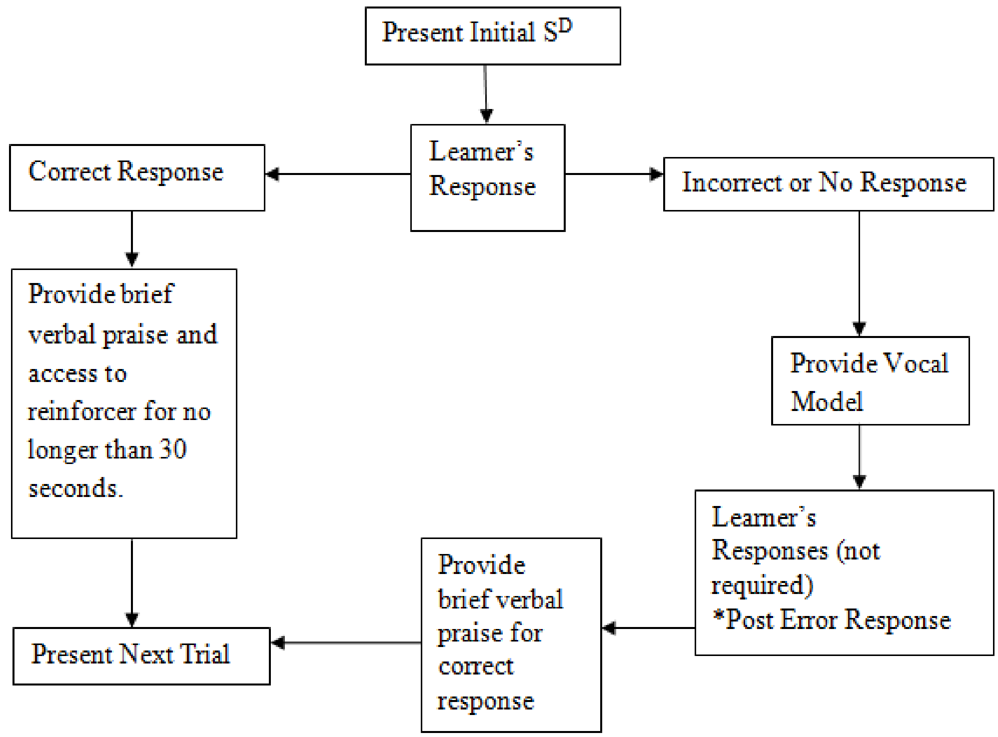

Figure 1. Flow chart describing the components a model error correction procedure. Adapted from Carroll et al. (2015).

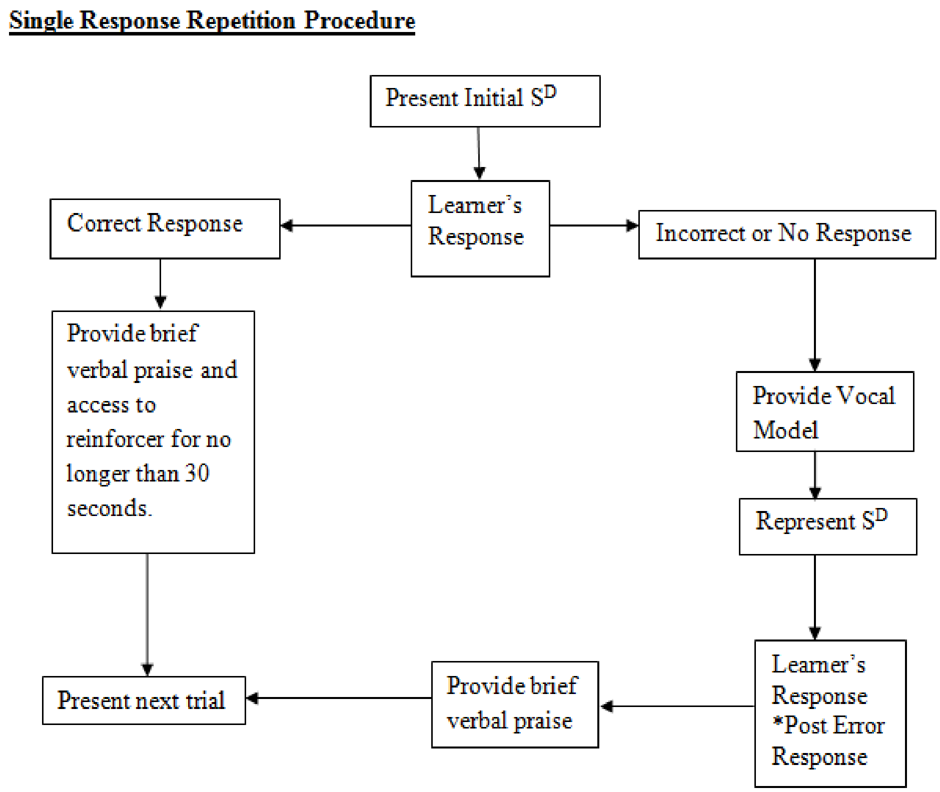

Figure 2. Flow chart describing the components of single response repetition procedure. Adapted from Carroll et al. (2015).

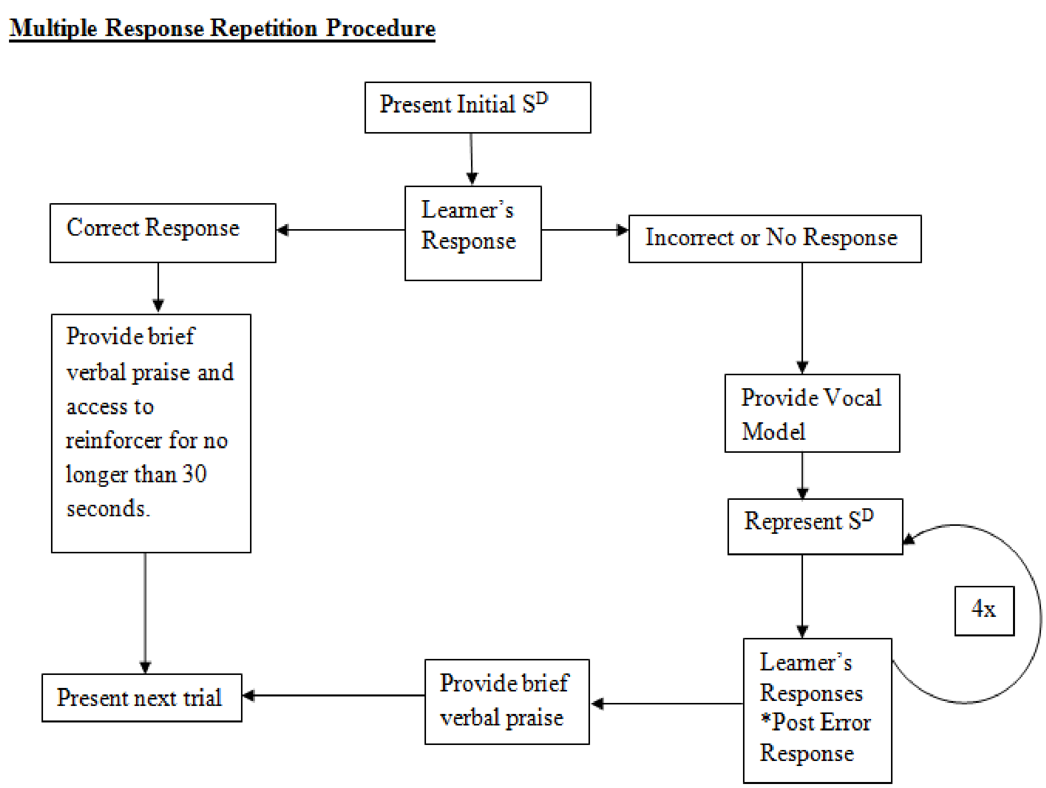

Figure 3. Flow chart describing the components of multiple repetition error correction procedure. Adapted from Carroll et al. (2015).

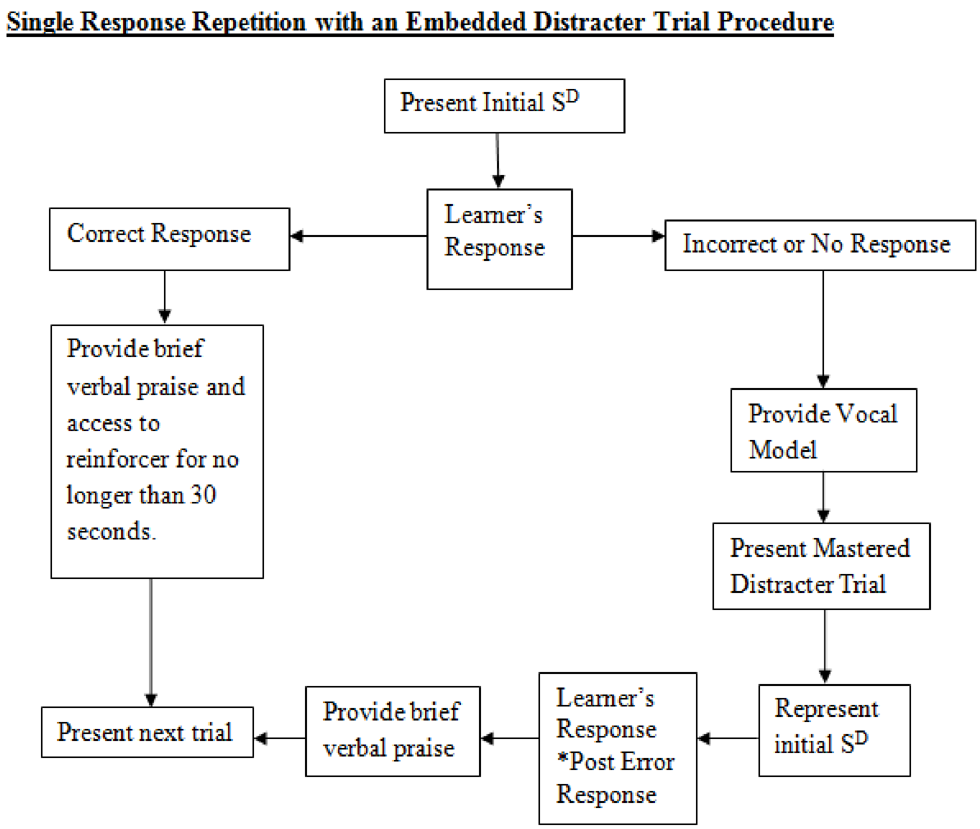

Figure 4. Flow chart describing the components of single response repetition with a distracter trial procedure. Adapted from Carroll et al. (2015).

Modifications were made to the procedures. Following session 16, Bret required an initial "ready response" prompt (i.e. "Show me ready" or a model prompt of hands folded on table and obtaining eye contact) to improve his attending skills. During the initial sessions, Bret would direct his eye gaze away from the target stimulus card and emit mands for other items in the environment. Therefore, to ensure Bret was attending to the correct stimulus, the therapist implemented a "ready response" prompt, which is a typical prompt delivered to this student by classroom staff members. Toby and Will were also prompted to show ready behavior at the onset of the study. Modifications were made to Will's reinforcement delivery due to the variability of responding with the multiple response repetition procedure. Will was originally receiving an edible on an FR 1 schedule and was able to consume the edible after each correct response. However, this participant had difficulty chewing and swallowing at a typical pace which contributed to his poor attending behavior; as he was chewing, he would seek out attention from other staff members or students in the classroom. The modification that was made consisted of the therapist stating to Will prior to the session, "You will earn a piece of popcorn for every correct answer but they will go into a cup and you can have all of the popcorn in the cup when we are finished."

Choice Evaluation

Free choice sessions were run after the participants reached the mastery criteria for their respective targets. All predetermined colored cards were presented to the participant, and he was asked to choose a color. The error correction procedure associated with that color card was used during the following session. The target word from the next lesson was chosen for the preference assessment. The same target word was used with each error correction procedure during the preference assessment.

CHAPTER 5

RESULTS

Figures 5, 6, and 11 display the results for Bret. Bret required 39 sessions to master, or terminate, all targets. Baseline responding for Bret was low and stable. Bret met mastery criterion (i.e., three consecutive sessions with 90% correct responding) in 6 sessions with the model procedure and the SRR procedure (see Figure 5). Percent of non-overlapping data (PND) resulted in 100% for the model, SRR, and SRR-D procedure from baseline to treatment and PND resulted in 13% for the MRR procedure. There was an immediacy effect for the model, SRR, and SRR-D procedures as well; rising from 0% correct responding in baseline to 70% and 80% respectively. There was not an immediacy effect demonstrated with the MRR procedure; however, there was an increasing trend with these data during the initial sessions. Due to the variability in responding, the therapist implemented a "ready hands" prompt. Once this prompt was implemented there was less variability in the data. However, the MRR procedure remained variable across the treatment phase. A level change was also demonstrated with the model, SRR, and SRR-D from both baseline to treatment and from prior to prompting the ready response to after prompting the ready response. The model procedure (14.17 minutes) and the SRR procedure (16.52 minutes) also required the least amount of training time (see Figure 11). Post error responses were also evaluated to determine effectiveness of each procedure. Bret was unable to emit the correct response after the correction was given from the therapist with the MRR procedure Data were collected during free choice sessions to determine preference (see Figure 6). Bret initially showed a preference for the single response repetition with an embedded distracter trial choosing this procedure approximately 50% of sessions. Bret seldom chose the model procedure during the last few sessions of the assessment, with responding between 0-33% of sessions. However, the single response repetition procedure resulted in an increasing trend towards the end of the assessment.

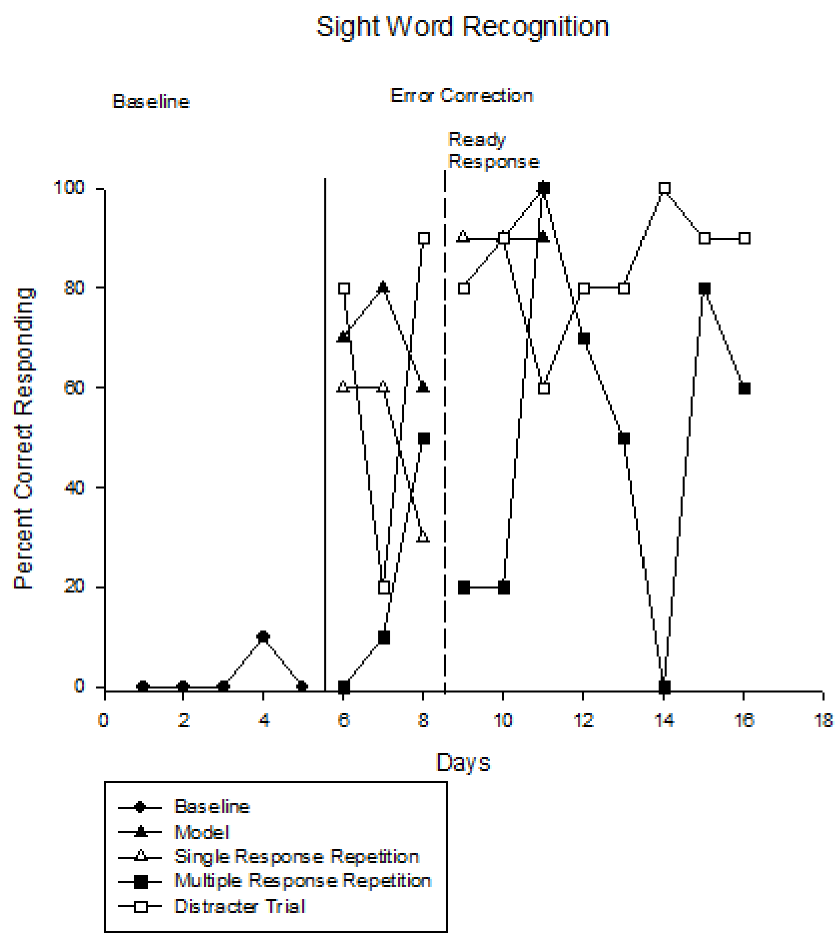

Figure 5. Alternating treatments graph depicting performance for Bret.

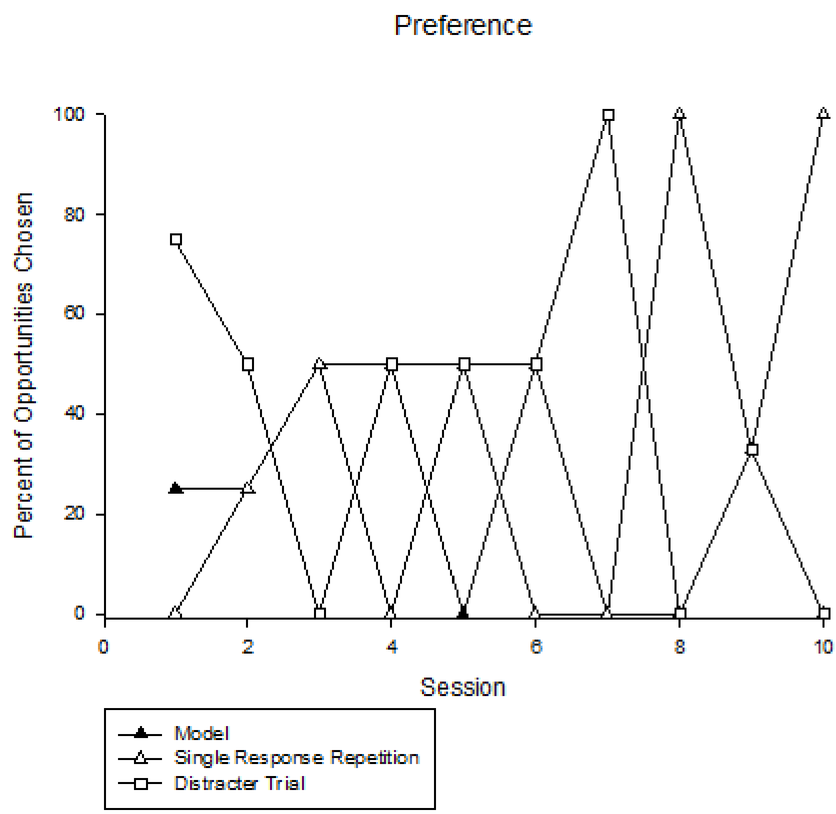

Figure 6. Preference data for Bret (which excludes the MRR procedure due to Bret's inability to master a target with this procedure.)

Figures 7, 8, and 11 display the results for Toby. Toby required 62 sessions to reach mastery, or terminate, all targets. Baseline responding was low and stable for Toby. Toby met mastery criterion with the SRR-D procedure in 9 sessions (see Figure 7). PND resulted in 100% for all procedures from baseline to treatment. There was an immediacy effect for the model procedure, MRR, and SRR-D procedure. The model procedure showed an increasing trend but remained variable throughout the treatment sessions. The SRR procedure showed a steep increasing trend initially then remained stable until mastery criterion was reached. The MRR procedure initially showed a level change from 0% correct responding to 75% correct responding then responding resulted in a decreasing trend after the fifth session. The SRR-D procedure demonstrated the fastest rate of acquisition and an increasing trend until mastery criterion was reached. The SRR-D procedure (6.59 minutes) also required the least amount of training time (see Figure 11). Toby was unable to master a target with the multiple response repetition procedure. Post error responses resulted in 100% accurate for 50 of 54 sessions in which he was required to emit the correct response following a correction from the therapist. Toby showed a slight preference for the single response repetition procedure. Initial preference data were variable, however beginning with session five the model and the SRR procedure were on an increasing trend and the SRR-D procedure was on a decreasing trend (see Figure 8).

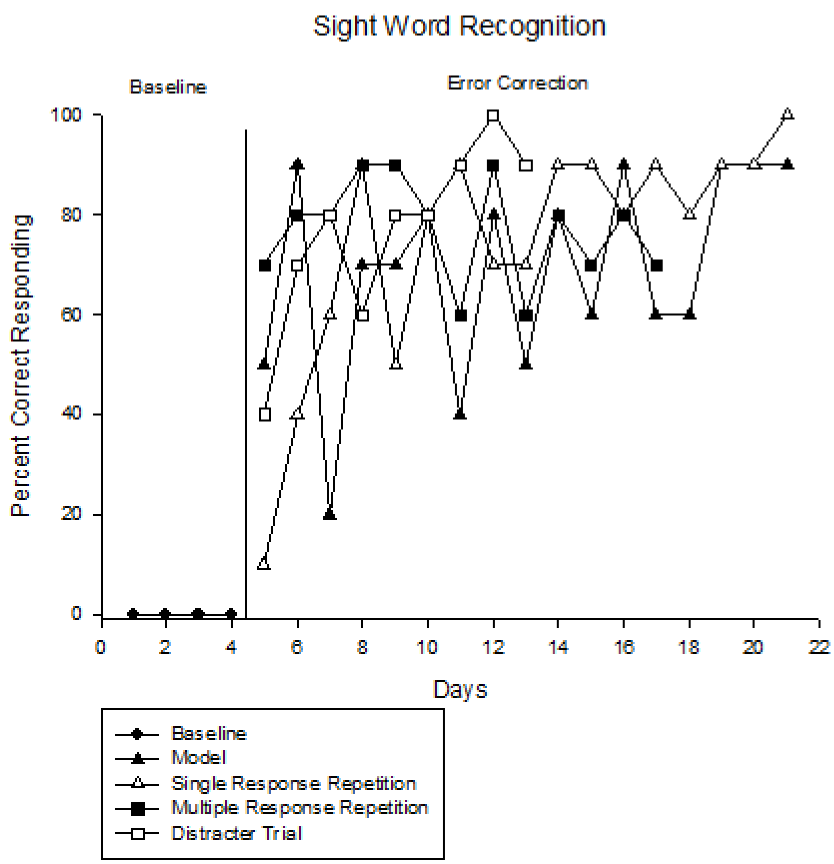

Figure 7. Alternating treatments graph for Toby.

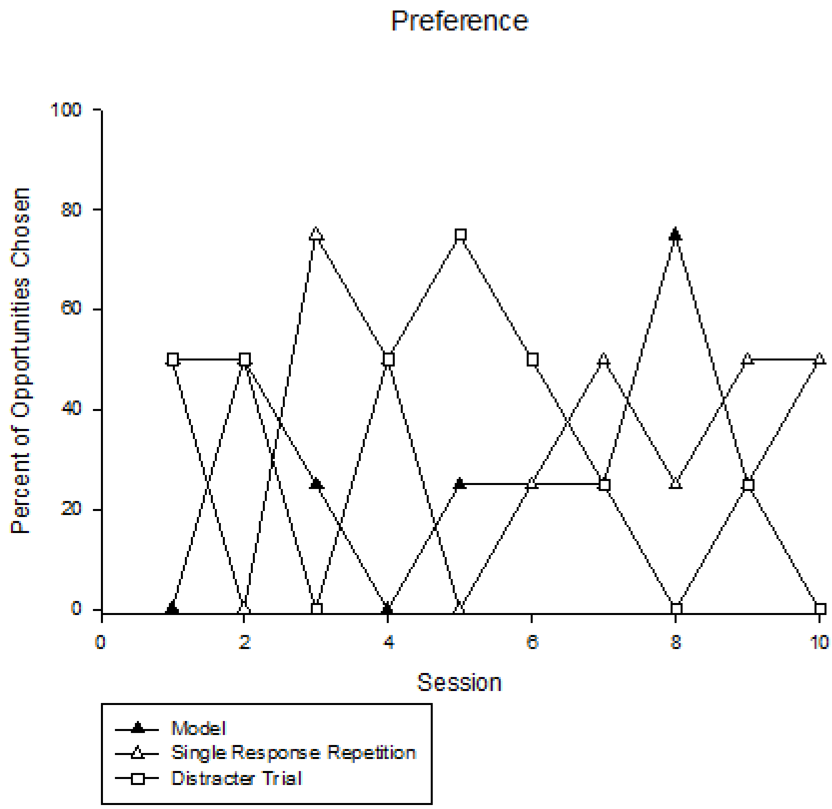

Figure 8. Preference data for Toby (which excludes the MRR procedure due to Toby's inability to master a target with this procedure.)

Figures 9, 10, and 11 display results for Will. Will required 42 sessions to reach mastery criterion for all targets. Baseline responding for Will remained low and stable. Will reached mastery criterion with the SRR-D procedure in 5 sessions (see Figure 9). The single response repetition with an embedded distracter trial (18.78 minutes) also required the least amount of training time (see Figure 11). Will generally required longer sessions due to the individual's diagnosis of hypertonia; this muscle disorder causes the muscles of the mouth to tense when attempting to produce speech, chew, etc. PND resulted in 100% for all procedures. All procedures demonstrated an increasing trend. After session seven, responding within the MRR procedure became variable. Although, once the delivery of reinforcement was modified responding became stable at 100%. Post error responses resulted in 100% accurate for 22 of 27 sessions. Preference data for Will were variable throughout the assessment (see Figure 10). Therefore preference for an error correction procedure cannot be determined.

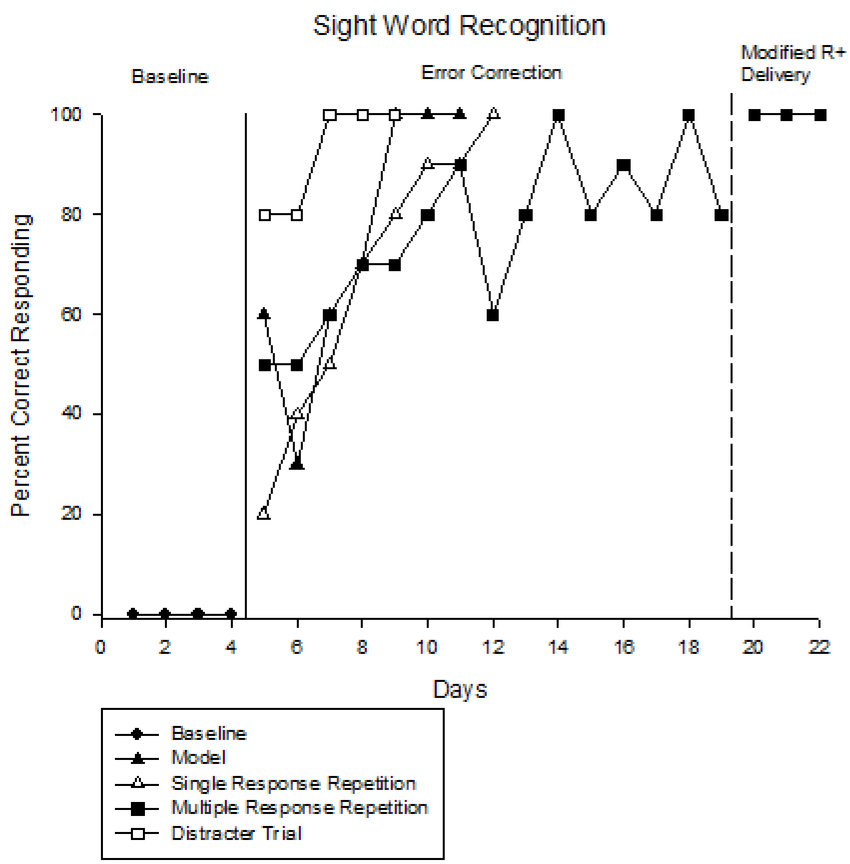

Figure 9. Alternating treatments graph for Will.

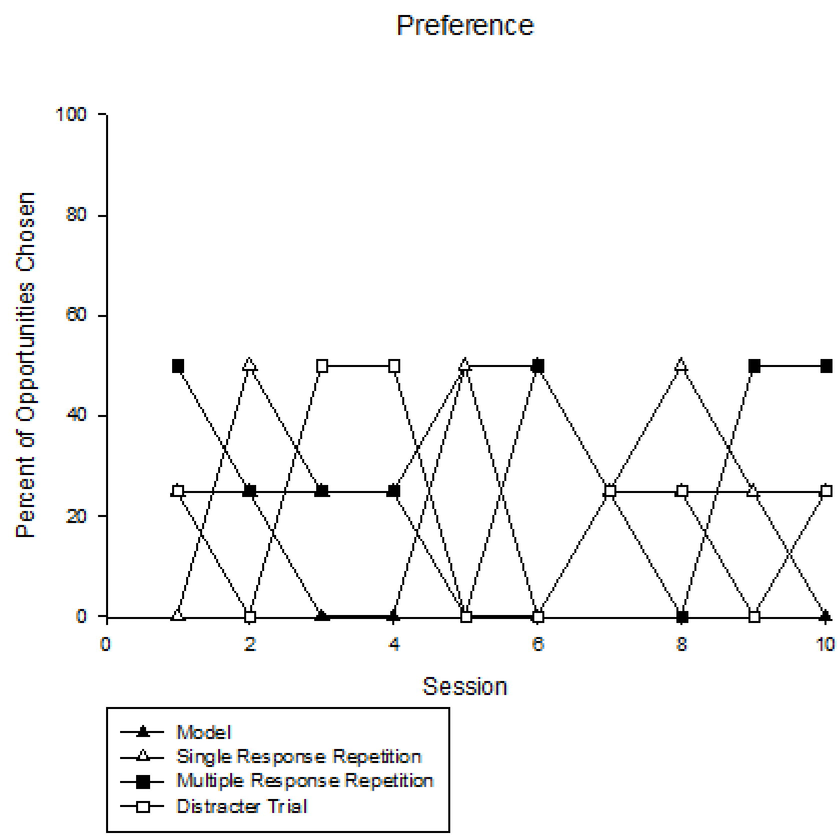

Figure 10. Preference data for Will.

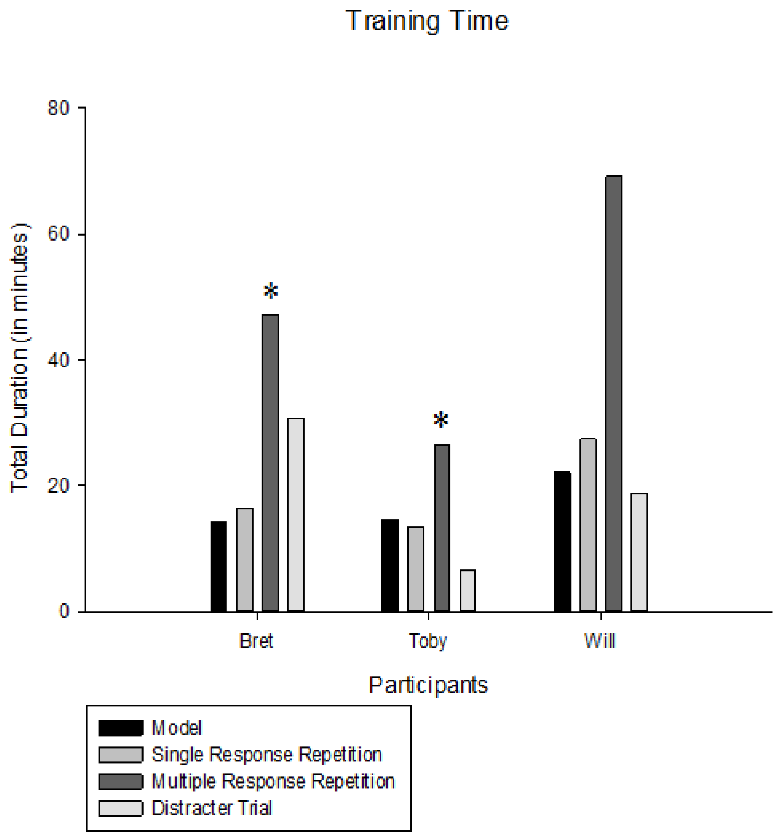

Figure 11. Bar graph depicting total training time required to reach mastery criterion within each error correction procedure for Bret, Toby, and Will.

*Total training time for the MRR condition for Bret and Toby displays total training time to termination, due to their inability to master a target with this type of error correction.

CHAPTER 6

DISCUSSION

The purpose of this research was to evaluate error correction procedures to determine the most successful and preferred procedure for individuals diagnosed with developmental disabilities. The procedures evaluated in this study have been identified as commonly effective procedures for correcting errors (Carroll et al., 2015; McGhan & Lerman, 2013). The results of this study are similar to those of previous research in that error correction procedures should be individualized for each learner. The most effective error correction procedures for all participants also re-established stimulus control of the teacher's S^D and not a teacher prompt, with the exception of Bret who learned the target stimuli with the model procedure in the same number of sessions as the SRR procedure. By re - presenting the S^D after a correction was provided by the therapist, the immediate antecedent to the correct response was the S^D. Few researchers have focused on the functionality of these procedures, specifically from a stimulus control perspective (Smith, 2006). Stimulus control is defined by Cooper, Heron, and Heward (2007) as "a situation in which the frequency, latency, duration, or amplitude of a behavior is altered by the presence or absence of an antecedent stimulus" (p. 705). The SRR, MRR, and the SRR-D procedures re-established stimulus control of the S^D by requiring the learner to receive the correction from the therapist, as per each procedure defines, and then respond to the original S^D for the final step in the correction. These procedures allowed the learners to become independent of antecedent prompts, which are commonly used when teaching new skills.

Smith (2006) also reported that there have not been many studies that compared procedures intended to have a stimulus control function to a procedure that has a mildly aversive function. This study showed that the procedure with a mildly aversive function, the MRR procedure, was not an effective punisher for incorrect responding as previous research has stated (Marvin et al., 2010). The MRR procedure is intended to have a mildly aversive function due to the increased demand of the repetitive responding, which in turn should show an increase in correct responding in order for the participants to avoid this repetitive procedure. However, these data show that the MRR procedure did not serve as an effective punisher for incorrect responding. This was shown by Bret and Toby's inability to master a target and Will required the most sessions to master a target with this error correction procedure.

Another consideration to take into account is the mastery criterion used. The mastery criterion may have been too stringent for this population. The participants would have acquired targets more quickly if the criterion had been lowered to either 80% for three consecutive sessions or 90% for three out of five sessions. Should this research be replicated, a modification to the mastery criterion may be beneficial.

There is adequate research to support the use of these and other error correction procedures; however, unlike previous research this study took measures to include the learners' preference for the procedures. Although only one participant showed a moderate preference for a specific procedure, the procedure used to evaluate preference is noteworthy. The concurrent chains procedure has been a valuable way to assess preference for other procedures, such as forward or backward chaining (Slocum & Tiger, 2011) and social reinforcement contingencies (Luczynski & Hanley, 2009). The concurrent chains procedure may have not yielded differentiated results due to a few reasons. First, the ambiguous stimuli chosen to pair with the error correction procedures may not have been adequately paired during the treatment sessions. All of the participants in this study quickly began responding correctly to the initial S^D, which diminished the frequency with which they experienced the error correction procedures. The diminished frequency of experiencing the error correction procedures could have made the colored card pairing not as salient to the learner within the forced - choice sessions. Future research to assess preference of error correction procedures, may consider using nonsense or abstract stimuli that would not be taught in a typical curriculum in order for the participant to encounter the procedures more often. Second, the MRR procedure was removed from the preference assessment due to Bret and Toby's inability to master a target. This could have skewed the preference data. Future research should include all procedures in order to appropriately test the procedures they encountered within the acquisition phase. On the other hand, Will's preference assessment included all procedures, and his data were more variable throughout all sessions. This could have been due to the number of error correction procedures tested at once. Future research may consider assessing fewer error correction procedures at a time and evaluating preference on fewer than four procedures. Thirdly, the order in which the concurrent chains procedure was run could have affected the results. Preference was only tested after all targets had reached mastery, which meant that some error correction procedures were not experienced for a few days, up to a week, after the target was mastered. The amount of time between the forced choice sessions and the preference assessment could have weakened the pairing that occurred during the forced choice sessions. Future studies may consider running a free choice session following each group of forced choice sessions to maintain the pairing of the ambiguous stimuli to the error correction procedure.

In conclusion the error correction procedures evaluated in this study were shown to be effective and the continuation of research surrounding preference of these procedures should be conducted. Preference can be a valuable way to determine which procedure to use, especially if more than one procedure has found to be effective, as was the case with Bret. Future research should also assess additional tasks, other than sight word recognition, to determine if error correction procedures generalize across tasks.

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