

Identification of Printed Nonsense Words for an Individual with Autism:

A Comparison of Constant Time Delay and Stimulus Fading

by

Emily Redhair

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Graduate Supervisory Committee:

Kathleen McCoy, Chair
Sarup Mathur
Stanley Zucker
Linda Caterino

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ABSTRACT

This study compared a stimulus fading (SF) procedure with a constant time delay (CTD) procedure for identification of consonant-vowel-consonant (CVC) nonsense words for a participant with autism. An alternating treatments design was utilized through a computer-based format. Receptive identification of target words was evaluated using a computer format and the researcher conducted a generalization probe for expressive identification evaluation. Neither treatment condition resulted in consistent gains on the receptive identification measure. Both treatment conditions resulted in gains on the expressive identification assessment. The SF treatment condition was more efficient due to 1) accuracy in identifying all of the SF target words in fewer sessions than the CTD target words and 2) incidental learning that occurred as a result of exposure to additional SF words as distracter choices and in receptive identification assessments. Implications are discussed.

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Chapter 1

INTRODUCTION TO THE STUDY

This dissertation is a report of an alternating treatments designed study comparing a stimulus control shaping procedure (viz., stimulus fading) and a constant time delay procedure for teaching an individual with autism to identify single syllable C-V-C nonsense words. The study was conducted in a computer-based format. The first chapter of the dissertation introduces the background of the study, details the problem, indicates significance, and provides an overview of the methodology used. The chapter concludes by describing the delimitations of the study.

Background of the Study

Over the past decade, the number of individuals diagnosed with autism has increased (National Research Council, 2001). The Centers for Disease Control and Prevention (n.d.) recently indicated that 1 in 110 children are diagnosed with autism. As autism has shifted from a low-incidence to a high-incidence disability, a variety of therapies have emerged, many of which have limited support in the literature (Heflin & Simpson, 1998; Hess, Morrier, Heflin, & Ivey, 2008), necessitating more research-based instructional strategies (Hess et al.). In addition to the need for more empirically-based instructional strategies for individuals with autism, the paradigm in the field of education has shifted to emphasize empirical evidence overall, particularly in the area of reading.

In 2001, the No Child Left Behind Act (NCLB, 2001) took effect requiring that all children learn to read using research-based methodologies.

Although the NCLB and IDEA (Individuals with Disabilities Education Act) require research-based reading instruction for individuals with and without disabilities, a relatively small number of studies have addressed reading instruction for individuals with autism. Chiang and Lin (2007) conducted a literature review on teaching reading comprehension skills to individuals with autism. In their review, only 11 of 754 studies screened met their inclusion criteria of participants with autism, publication in a peer-reviewed journal, and use of an experimental design. Similarly, Whalon, Otaiba, and Delano (2009) conducted a literature review on reading instruction for individuals with autism that focused on the components of effective reading instruction identified by the National Reading Panel (National Institute of Child Health and Human Development, 2000) and also found only 11 studies to include in their review. Only four studies were reviewed by both literature review articles (Chiang & Lin; Whalon et al.).

Although available research indicates that individuals with autism can learn to read using various interventions, Whalon, Otaiba, and Delano (2009) purported that the available research is preliminary and lacks sufficient substance to guide practice. Chiang and Lin (2007) also noted that the studies they reviewed identified effective strategies for teaching reading to individuals with autism; however, those studies do not provide information on which of the effective strategies are best. The limited supply of reading research for individuals with autism inhibits practical application of educational mandates requiring researched based strategies.

The Problem Statement

Traditional reading instruction for beginning readers involves phonics-based methods so individuals can decode unfamiliar words (Ehri & McCormick, 1998; National Institute of Child Health and Human Development, 2000). After sufficient exposure and reading experience, individuals are able to read single words rapidly and automatically by sight (Ehri, 1995; Vaessen & Blomert, 2010). Individuals with autism vary in their ability to learn to read (Nation, Clarke, Wright, & Williams, 2006). Although some individuals with autism are able to use phonics to decode unfamiliar words (Frith & Snowling, 1983), individuals with autism who have more intensive needs may have more success with whole word recognition strategies (Broun, 2004). This study concentrated on the latter group, who may benefit from whole word recognition strategies.

Two instructional methodologies that have been documented as effective in teaching whole words to individuals with autism include constant time delay (Ledford, Gast, Luscre, & Ayres, 2008) and stimulus fading procedures (Birkan, McClannahan, & Krantz, 2007). The purpose of this study was to compare the effectiveness of constant time delay and stimulus fading procedures to determine which procedure was more efficient in teaching an individual with autism to identify a set of C-V-C target nonsense words.

The Professional Significance

The ability to read words by sight is an important life skill for individuals with more severe disabilities, including autism. Word identification skills allow individuals to identify and find items in a grocery store (Mechling & Gast, 2003)

and even develop communication skills (Eikeseth, & Jahr, 2001; Krantz & McClannahan, 1998; Marshall & Hegrenes, 1972). Although previous literature has identified effective strategies for teaching reading to individuals with autism, Chiang and Lin (2007) asserted that identifying the most effective strategies is difficult without a supply of comparison studies available in the literature. This study compared the effectiveness of stimulus fading with superimposed images to the effectiveness of a constant time delay procedure to teach an individual with autism to identify nonsense words.

An Overview of the Methodology

This study was conducted using an alternating treatments design variation consisting of a baseline phase and an alternation phase of the two treatment conditions. An alternating treatments design was selected due to its ability to compare a minimum of two different treatments simultaneously while minimizing the problem of irreversibility (Cooper, Heron, & Heward, 2007). Sequence effects were minimized with the alternating treatments design as treatments were alternated randomly and were in effect for a short period of time (Cooper et al.). The baseline phase ensured that participants were not able to recognize all of the target words prior to treatment and provided a comparison from the no treatment phase to the treatment phase. The alternating treatments phase allowed a quick comparison of the two target treatments (stimulus fading and constant time delay). Detailed explanations of the methodology used are discussed later in this dissertation.

The Delimitations of the Study

The delimitations of this study are the result of the nature and size of the sample of participants and the limitations that are inherent with an alternating treatments design.

Due to the small number of participants in this study, the results are not representative of all individuals with autism. The participation criteria described in the methods chapter of this dissertation assist the reader in evaluating appropriate generalization of results to other individuals with autism who would also meet the same participation criteria. Generalization to higher or lower functioning individuals with autism is limited.

Due to the nature of an alternating treatments design, the implementation of the two treatments (stimulus fading and constant time delay) resulted in an unnatural rapid switch between treatment types. This type of implementation of treatments—although beneficial for research purposes—is artificial from an instructional perspective. In addition, this study compares only two possible treatment conditions. The results do not indicate that other treatment conditions (e.g., progressive time delay) are more or less effective than stimulus fading or constant time delay procedures.

This first chapter describes the need for a comparison study evaluating teaching procedures for individuals with autism in the area of reading. Chapter 2 reviews empirical evidence of the two teaching procedures studied (constant time delay and stimulus fading) and computer-assisted instruction, which was the mode of implementation of the treatments in this study.

Chapter 2

REVIEW OF THE LITERATURE

Literature on reading instruction for individuals with autism—including the instructional arrangement of computer-assisted instruction and the teaching methodologies of constant-time delay (CTD) and stimulus (SF)—were used as the basis for the study described in this dissertation. This chapter describes the search process used for obtaining the reviewed articles and then examines the relevant literature.

Search Process

The following review was constructed through a systematic procedure to retrieve relevant articles. An electronic search of citations through Academic Search Premier (EBSCO Host), ERIC (via CSA Illumina), PsycINFO and Wilson Web was conducted using the keywords: *autism, ASD, autistic, reading, sight word, computer-assisted instruction, computer-based instruction, constant-time delay, CTD, and stimulus fading*. The electronic search was limited to peer-reviewed journals available in English encompassing the years 1985 to 2010. Non-data articles including literature reviews and commentaries were not included in analysis. An ancestral search based on the reference lists of obtained articles was conducted for relevant citations.

For computer-assisted instruction and the teaching strategy of CTD, resulting citations were limited to research studies that included at least 1 participant identified as having autism and used an experimental design. Only information regarding participants with autism was extrapolated. For example, if a

study included 2 participants, one with autism and one without autism, only data relevant to the participant with autism were included in analysis.

For SF, articles relating to reading were extrapolated and not limited to include at least 1 participant with autism due to the limited number of relevant articles extrapolated (three total, one with a participant with autism).

Computer Assisted Instruction

Computer assisted instruction (CAI) is an instructional arrangement that uses a computer to teach specific skills. CAI has been used to teach social skills (Mitchell, Parsons, & Leonard, 2007; Simpson, Langone, & Ayres, 2004), sentence construction (Basil & Reyes, 2003; Yamamoto & Miya, 1999) and reading skills (Coleman-Martin, Heller, Cihak, & Irvine, 2005; Heimann, Nelson, Tjus, & Gillberg, 1995; Tjus, Heimann, & Nelson, 1998) to individuals with autism. Computer-based formats have been found to improve task completion (Mechling, Gast, & Cronin, 2006) and to increase time on task (Williams, Wright, Callaghan, & Coughlan, 2002) for individuals with autism.

Coleman-Martin et al. (2005) compared the instructional arrangements of teacher only, teacher plus CAI, and CAI only using the Nonverbal Reading Approach (NRA) with their participants, one of which had autism (12 year old female). The NRA utilizes metacognitive strategies with internal speech for developing decoding skills, diagnosing errors using analysis of errors from an array of distracters, and utilizes modeling, practice, and feedback techniques. The CAI component was created using Power Point and modeled sounding out words as each corresponding letter was presented. Coleman-Martin et al. found that

there was no significant difference in student outcomes when comparing types of instructional arrangements including CAI and more traditional teacher-student methods.

Williams, Wright, Callaghan, and Coughlan (2002) compared the instructional arrangements of CAI with one-on-one instruction. Williams et al. split their 8 participants with autism into two groups who were matched as closely as possible by severity of autism, the number of spoken words, and age. Each group participated in both conditions (i.e., CAI or one-on-one book instruction) for 10 weeks, but in an opposite sequence (e.g., CAI, book or book, CAI). The book-based one-on-one condition consisted of a teacher-made reading book that the participants used to practice reading. The books were constructed with bells and horns for students to push on to increase interest. Additional flash cards were used with the 30 target words and corresponding pictures and activities with these cards were integrated into the participants' school day. Limited information was provided on how frequently the flash cards were used or the teaching procedures used during book instruction or the flash card activities. The book materials were used to create the CAI condition (e.g., scanning and using identical pictures, words, etc.). The CAI condition allowed for an automatic narration option, a manual page turning option, and included sounds for interactivity (e.g., a horn sound when a car image was clicked on with a mouse.). The flash card activities were simulated in the CAI condition through drag and drop interactivity for matching.

Williams et al. (2002) found that participants had higher levels of engagement in the CAI condition (an average of 9.9 minutes of a 15 minutes session) when compared to the book condition (an average of 2.8 minutes of a 15 minutes session). As noted by the authors, the difference in engagement would be substantial over the course of a full school year (30.5 hours versus 8.5 hours).

Williams et al. (2002) reported that 5 of their 8 participants learned between 3 and 5 new words from treatment, during a total of 20 weeks of instruction. The remaining 3 participants did not increase from their zero level baseline assessment. Two participants who had the book condition and then the CAI condition, showed gains in word reading after the CAI condition only. One participant who had the computer condition and then the book condition gained word reading skills after exposure to both conditions; a second participant who had the computer and then the book condition only gained after the book condition; a third participant who received the same intervention sequence could recognize 25 of the 30 target words at baseline and all of the target words after the 10-week assessment. The gains reported seem minimal after 20 weeks of instruction. This may be due to the lack of an empirically supported instructional methodology or to variability in participant readiness for learning to read (i.e., mastered pre-requisite skills), neither of which can be evaluated in this study due to limited information provided by the authors.

Findings that CAI improved participant engagement in reading tasks are promising and warrant implementation of CAI for individuals with autism; however, simply using CAI as an instructional arrangement is not enough.

Individuals should be evaluated for pre-requisite skills for learning to read, at minimum, for whole word instruction, such as attending to the stimuli, visual discrimination and memory of words (Broun, 2004; Cooper, Heron, & Heward, 2007; Heilman, 1998). In addition, empirically supported instructional methodologies should be paired with the CAI instructional arrangement to maximize learning potential through valid and reliable instruction.

CAI is a viable instructional arrangement for individuals with autism due to the potential for increased interest (e.g. as demonstrated by time on task) as well as consistent performance using CAI in comparison to more traditional teacher-based instructional arrangements. CAI should be combined with effective instructional procedures to enhance desired results. For the proposed study, CAI is used as an instructional arrangement to control the fidelity of implementation of the instructional procedures being compared (i.e., SF and CTD).

Constant Time Delay

Constant Time Delay (CTD) is an antecedent response prompt used to transfer stimulus control. CTD starts with a 0-second time delay for one to several trials and then shifts to a fixed-interval time delay in all subsequent trials (Cooper, Heron, & Heward, 2007). In the case of teaching an individual to read words, CTD would be applied by presenting the written word (this would be the natural stimulus) and then immediately giving the response prompt (e.g., saying the word in the case of expressive identification; pointing to the word or using physical prompts in the case of receptive identification). Subsequent trials would occur in the same manner, except the time between the natural stimulus (e.g., the

presentation of the written word) and the response prompt would be at a preset interval, such as 5 seconds. This interval allows the individual to respond to the stimulus. If there is no response within that preset interval, the trial ends with the response prompt. CTD has been used to teach numeral identification (Ault, Wolery, Gast, Doyle, & Eizenstat, 1988), self-help skills (Morse & Schuster, 2000), leisure skills (Wall & Gast, 1997; Wall, Gast, & Royston, 1999), language skills, such as labeling items (Kurt & Parsons, 2009), and reading skills (Ledford, Gast, Luscre, & Ayres, 2008) to individuals with autism.

Ledford et al. (2008) evaluated the effect of a 3-second CTD procedure on learning to expressively read functional sight words incidentally and through observational learning in a small group teaching arrangement (two students per teacher) with their 6 participants who had autism and a speech and language impairment (age ranged from 5 years 9 months to 8 years 4 months). All participants were able to verbally imitate all of the 40 target words, but were unable to read at least 12 of the 40 target words. The participants were split into pairs for the small group arrangement based on similar skills and prior reading instruction experience.

Each participant pair was assigned 12 target words. Half of the target words would be directly taught to one participant and the other six target words (which would be directly taught to the other participant in the pair) would be evaluated for observational learning. Materials included target words or phrases printed in lower case letters on unlined index cards in various colors and fonts. A

related visual stimulus for incidental information (e.g., a caution sign for the word “caution”) was presented on cardstock paper.

Participants were initially assessed on their ability to expressively read the 12 target words assigned to their groups and the 12 visual stimuli that corresponded to each target word. The 12 target words were split into 3 word sets. Teaching sessions were set up so that four words were covered (two per student) over the 20 trials in each teaching session (5 trials per target word). Visual attention was facilitated slowing the pace of instruction (to avoid impulsive responding) by instructing the student to “look” at the word and then “tell me the letters” as the instructor held a blank card over the target word card and uncovered one letter at a time. Incorrect letter-calling resulted in a correct model from the teacher. After the letters were correctly called, the trial continued on to the whole-word reading component. The teacher asked, “What word?” During initial sessions, a 0-second time delay was used and a correct model was provided immediately after the question. The student was expected to imitate this model. A 3-second time delay was used in subsequent sessions after participants had 100% accuracy in imitating the 0-second time delay model. The incidental information (i.e., the corresponding visual stimuli such as a caution sign) was presented by holding the stimulus card for 1 second in front of participants. After both participants mastered the word set (criterion reached after 3 consecutive days), then they both moved on to the next four words.

Five of six participants reached and maintained 100% accuracy for their target words and had 100% accuracy for the observational learning words (target

words of the other participant in their group) across at least two of the three word pairs. All 6 participants identified between 50 to 100% of incidentally presented corresponding visual stimuli of their target words and 100% for at least two of three word pairs for the observed incidentally presented corresponding visual stimuli (the incidental stimuli presented to the other participant in their assigned group). CTD procedures have been effectively used to teach individuals with autism to read whole words (Ledford et al., 2008).

Stimulus Fading

SF is a procedure used to transfer stimulus control by changing the task stimulus. With SF, a physical dimension (e.g., color, size) is highlighted to elicit a correct response and then faded in or out (Cooper et al., 2007). In this study, SF is applied by adding a photograph to the stimulus by superimposing the target word on the photograph, and then fading out the photograph by reducing visibility of the photograph. Similar SF procedures have been used to teach letter sounds (De Graff, Verhoeven, Bosman, & Hasselman, 2007) and whole words (Corey & Shamow, 1972) to typically developing children, and whole words to a child with autism (Birkan, McClannahan, & Krantz, 2007).

De Graff et al. (2007) evaluated a picture mnemonic with a fading procedure to teach letter sounds using CAI to 39 Kindergarten students. DeGraff et al. compared a picture supported mnemonic with fading, a picture supported mnemonic only (no fading), and a no picture condition. In the fading condition, the letter is superimposed on a corresponding picture (e.g., an “m” is on top of a drawing of a mouth; the drawing is sized to fit the shape of the “m”). In the fading

condition, the visibility (e.g., 100% visibility, 70% visibility, 50% visibility, etc.), is faded over the course of six phases until in the sixth phase, there is no drawing visible. De Graff et al. found that participants had more productive letter-sound knowledge in the fading condition in comparison to the two other conditions. In the other two conditions (no picture supports or pictures without fading) participants with first-sound isolation ability did better than those with poor-first sound isolation ability. The effectiveness of the SF condition was not dependent on participants' prior first-sound isolation ability, which is a good predictor of reading success. SF has the potential to help develop reading skills with individuals who have limited pre-reading skills.

Corey and Shamow (1972) compared a SF procedure with a no fading procedure with their 12 typically developing non-reading participants (4 to 5.8 years old). Participants were split into two groups and each group only received one treatment condition. In both conditions, a word was superimposed on top of a representative picture. In the SF procedure, the visibility of the representative picture was faded out through a series of steps (i.e., step 1 was full visibility of the picture, steps 2, 3, 4, and 5 had sequentially reduced visibility, and in step 6, the representative picture was not visible). Corey and Shamow found that participants in the SF group learned to read more whole words than participants in the no fading condition.

Birkan et al. (2007) evaluated a SF procedure where target words would be superimposed on photographs and then portions of the photograph would be faded out to teach a 6-year old boy with autism to read whole words by sight.

Prior to the start of the study, the boy with autism was able to follow a picture schedule, imitate a verbal model, label common objects, label letter names, and read 16 sight words. Prior to implementation of the SF procedure, the participant was taught to verbally label target photos that words would later be superimposed on and then faded out.

The 15 target words selected for this study were based on words the participant would use in an activity schedule for physical education (e.g., balance beam). Words were superimposed in white text as they were more visible on the photographs in comparison to black text. During fading, the portions of the photograph removed (viz., $\frac{1}{4}$ of the photograph) were replaced with a black background, so the white text was still visible. During generalization assessments, the background was white with black text.

The target words were split into three sets and the study used a multiple baseline across word sets design. During the baseline phases, the participant was asked to identify the target word without photographic support within 5 seconds of the request. During the teaching phase, after two consecutive sessions at 100% accuracy, the next fading step was introduced. In step 2, the photograph was faded by cutting off 1 centimeter from the top and bottom of the photograph. In step 3, the photograph was cut so that only the text and the portions of the photograph showing through the text were visible. In step 4, only the sight word was visible.

The participant was able to learn to read the new words using the SF procedure. After fading was complete, the participant could read 14 of the 15

target words, which was maintained after a 44-day follow-up probe and generalized to a different text size and color.

SF procedures using letters or words superimposed on corresponding representative images have effectively taught typically developing children to learn to read whole words and learn letter-sound correspondence skills (Corey & Shamow, 1972; De Graff et al., 2007). In both of these studies, the representative image that corresponded to the target (letter or word) was faded out by reducing the visibility of the image over a series of several steps. SF procedures seem to circumvent phonemic awareness skills, such as first-sound isolation in a word (De Graff et al.) which expands the possible effective application of SF to teaching reading of whole words to additional populations who may lack some reading prerequisite skills. Birkan et al. (2007) found that SF was effective with a boy who has autism. Corey and Shamow found that SF is more effective than providing the visual support and removing it without fading, which is consistent with evidence that presenting pictures with words may block learning to read (Didden, Prinsen, & Sigafos, 2000; Fossett & Miranda, 2006). This finding suggests the need for a fading procedure if picture supports are to be presented simultaneously with words in reading instruction.

SF and CTD procedures have both been demonstrated as effective practices in teaching children with autism to learn to read (Birkan et al., 2007; Ledford et al., 2008). Birkan et al. found that SF was effective with a boy who has autism; however, no studies have compared SF and CTD to determine which, if any, is more effective and/or efficient with individuals who have autism. This

study compared SF and CTD in teaching an individual with autism to identify single syllable C-V-C nonsense words through a CAI instructional arrangement.

Comparison studies in regards to reading instruction for individuals with autism are necessary for identifying the most effective strategies for teaching reading and are limited in the current literature base (Chiang & Lin, 2007). This study compared SF and CTD to determine which procedure is more effective in teaching an individual with autism to read whole words by evaluating:

- 1) changes in accuracy for receptive and expressive identification of target nonsense words
- 2) the number of trials completed with each nonsense word
- 3) the number of sessions required to meet the criteria to move on to a new word

Chapter 3

METHOD

Type of Research

A single-subject approach was used to compare the effectiveness of a SF approach using superimposed images with the effectiveness of a CTD procedure in teaching a child with autism to identify sight words. An alternating treatments design was used, with the two treatments implemented during a portion of every session, consisting of 1) baseline and 2) alternating the two treatment conditions. The alternating treatments design was implemented in this study due to the design's ability to 1) quickly compare treatments, 2) minimize irreversibility problems, and 3) minimize sequence effects (Cooper, Heron, & Heward, 2007).

Context

The study was conducted in a private school setting that exclusively served students with special needs located in the Western United States.

Treatment sessions were conducted in the workroom area of the building. A work table was placed in the room with a chair for the participant centered with the table and a chair for the facilitator next to the participant chair. A portable touch screen computer (Dell Inspiron Duo) was placed in front of the participant with the computer screen flipped around so that the participant had only the touch screen in front of him and not the keyboard. During each session, the participant sat on the chair in front of the computer and next to the facilitator. The research activities covered a one-month period, from April 20, 2011 to May 20, 2011.

Participants

Four potential participants were selected by the school director based on teacher reports that the participants had met the first four participation requirements. The participation requirements are as follows:

- 1) Participants had a diagnosis of autism based on a psychological evaluation within the past 3 years.
- 2) Participants were able to attend to stimuli and could respond to the direction “touch the _____” from a field of one choice.
- 3) Participants were able to match photo to identical photo.
- 4) Participants were able to match word to word up to 3 to 6 letters long in an array of three.
- 5) Participants were able to select choices on a touch screen computer.
- 6) Participants scored less than 70% for both CTD and SF target words during baseline.

The researcher verified that the first, fourth, fifth, and sixth participation requirements were met.

Three of the four potential participants were excluded. One participant was excluded as he had a diagnosis of at-risk for autism rather than of autism. Another potential participant was excluded as the researcher was not able to verify that the fourth participation requirement was met. The third potential participant was excluded due to high scores on his initial baseline assessment. The researcher was able to verify that the first, fourth, fifth, and sixth participation requirements were met for the remaining potential participant.

Greg (a pseudonym used to preserve confidentiality) is a Caucasian boy who was 4 years, 7 months old at the time of the study. He was diagnosed with autism and a coordination disorder by a developmental specialist (within the past 2 years). He did not have any previous experience with the researcher who conducted the study, nor did he have exposure to the computer program that was used to implement the study. He attended pre-school and received occupational therapy in the area of sensory integration, speech therapy, and habilitation services at the school where the study was conducted. Reading skills were not specifically addressed in Greg's individualized education plan (IEP) at the time the study was conducted. Information was reported in his file that he could recognize his name; however, the researcher observed that he pointed to words that began with the first letter of his name and said that it was his name.

Instrumentation

Materials

The instructional materials were presented on a touchscreen computer (Dell Inspiron Duo) and programmed using a Flash interface. Ten CVC (consonant-vowel-consonant) nonsense words were used as target words in order to prevent the potential confounder of familiarity with the word. Photographs of unrecognizable objects were presented with the target nonsense words to provide a concrete association with the target words. The words that corresponded to the photographs were printed in Times New Roman 90 point font. Two target words contained the same middle vowel, but all of the target words began and ended with different letters. Target words containing the same middle vowel were

assigned to different conditions (SF or CTD) so that no letters were duplicated within one particular condition (e.g., SF). The CTD target words were kax, sem, fip, loy, and jur. The SF target words were daw, zet, hin, vob, and cug.

In the SF condition, each word from the set was split into five levels. The first level (A) had a full photograph of the word with the target word superimposed on the photograph. For example, the photograph that corresponded to the nonsense word “daw” had the printed word “daw” superimposed on top of it. Filters were used to adjust the brightness of the photographs underneath the printed word. The photographs in the first level (A) had the brightness adjusted through a 1% alpha filter, so that the photograph was clear and the superimposed word was clearly visible. The photograph was faded to white in subsequent levels by adjusting the brightness of the photograph using the alpha transparency tools available in Flash. Three additional fading levels (B, which utilized a 50% alpha filter, C, which used a 70% alpha filter, and D, which used a 90% alpha filter) were used until the fifth level (E), where the photograph was completely faded so that there was no picture behind the word.

In the CTD procedure, photographs were used with the instruction, but target words were not superimposed on photographs during teaching trials. Photographs and words were the same size as the photographs and words presented in the SF condition. A 0-second time delay was used for initial presentation of words and a CTD of 5-seconds was employed during the instructional trials.

In all conditions, words were on “buttons” in the program. The “buttons” were a rectangular background shape to define the touch area of the word. When the button was touched on the touch screen, it appeared to depress as it was selected.

Dependent Variable

The dependent variable was the ability to receptively identify target words from a field of three dissimilar choices. Receptive identification measured the participant’s ability to select the correct target word independent of verbal skills. A response was recorded as correct if the participant independently (without prompts) touched only the target word on the touch screen from a field of three choices, of one correct choice and two distracter choices, within 5 seconds of the request, “Find _____” (target word). A generalization probe was also conducted prior to treatment sessions. In the generalization probe, a 2 × 4 printed card was presented and the student read the card to the facilitator. The generalization probe evaluated the participant’s expressive identification, through verbal articulation, of the target nonsense words.

Alternating Treatments Design

An alternating treatments design was implemented (Cooper, Heron, & Heward, 2007).

Phase 1: Baseline. Baseline data was established by conducting an assessment for all of the target words across a minimum of 3 sessions and continued until there were no new high and low scores.

Phase 2: Alternating Treatments. Both treatment conditions (i.e., CTD and SF) were presented in each session. The two treatment conditions were counterbalanced by randomly assigning (through computer programming) which treatment condition was presented first for each session. Each treatment condition continued for 5 minutes. This allowed for 10 minutes of instruction during each session and 3-4 minutes for the assessment. An assessment was conducted at the end of each session to measure participant progress. Phase 2 continued over the course of 1 month.

Procedure

Assessments

The assessment procedures were identical during each phase of the study (i.e., baseline and alternating treatments). Each of the 10 target words were presented 3 times for a total of 30 trials for each assessment. Each assessment took no more than 3.5 minutes to complete. The target word was presented in an array of 3 (the target word plus 2 different distracter words from the same word set). The location of the correct choice was randomized. A female voice (which was recorded by the researcher for all verbal instructions and feedback within the program) said, “Find ____” (the target word). A response was correct if the correct word was selected by touching the word on the touch screen within 5 seconds of the instruction. All other responses or a failure to respond were counted as incorrect. Correct and incorrect responses were not given feedback. Participants were reinforced for responding at the end of the entire assessment with a positive feedback screen containing an animation of balloons rising and

printed praise words (viz., “excellent”) as a female voice said, “excellent” to a background of clapping sounds.

Generalization probe

A generalization assessment was conducted at the beginning of a session starting with the sixth treatment session. Each target word was presented by the researcher in random order one at a time on a 2 × 4 piece of paper printed with the target word in 72 point Times New Roman font. Responses were counted as correct if the participant said (expressive identification) the target word within 5 seconds of presenting the target word card. Correct responses were reinforced with verbal praise, such as, “Good job!” All other responses or failure to respond were counted as incorrect and not given feedback.

Instructional trials

CTD and SF trials occurred automatically through the computer program as described in the CTD and SF specific steps below. An additional error correction of least-to-most prompting was implemented by the researcher if there was no response. The first level prompt was to repeat the direction “Find _____” given by the computer and then model the correct response by pointing to the correct word on the screen. The second level prompt was to repeat the direction “Find _____” and then use a partial physical prompt to move the participant’s hand toward the correct word on the screen.

During all instructional trials, a response was counted as correct if the target word button was selected on the touch screen within 5 seconds of the request. All other responses were incorrect. Correct responses were reinforced

with a positive feedback screen containing an animation of balloons rising and printed praise words (i.e., “great job,” “excellent,” or “amazing”) as a female voice said the corresponding praise words (e.g., “great job”). The praise “amazing” occurred only after meeting the criterion for moving on to the next word in a condition (e.g., 3 consecutive correct trials at step 5 for the CTD condition) and also included clapping sounds with the positive feedback screen.

CTD instructional trials. CTD trials occurred as described in the five steps below. Partial error correction was programmed into the teaching trials as part of the CTD procedure (a correct response was provided after an incorrect response or no response after 5 seconds).

Step 1) The target word was presented in an array of one and a voice said the target word. A photograph representing the target word was in place at the top of the screen. A voice said, “Find _____.” A 0-second time delay was implemented as the target word was initially presented in step 1. Immediately after the instruction, the target word button depressed on the screen and correct feedback was given.

Step 2) The target word was presented in an array of 3 (the target word plus 2 distracter words from the same word set) with a photograph assigned to correspond to the target word above the choices. A voice said, “Find _____” (the target word). If the response was correct, step 2 was repeated. If the response was incorrect, step 3 was implemented. After 3 consecutive correct trials at step 2, a new word from the word set was introduced in step 1.

Step 3) The target word was presented in an array of 1 with a photograph of the target word above the word button. A voice said, “Find ____” (the target word). If the response was correct, step 4 was implemented. If the response was incorrect, the target word button depressed on the screen while a voice said, “This is _____” (target word). Then step 3 was repeated with the location of the target word shuffled randomly in the array of 3. .

Step 4) The target word was presented in an array of 2 (target word plus 1 distracter word from the same word set) with a photograph of the target word above the word button. A voice said, “Find ____” (the target word). If the response was correct, step 5 was implemented. If the response was incorrect, the target word button depressed on the screen while a voice said, “This is _____” (target word). Then step 4 was repeated with the location of the target word shuffled randomly in the array of 2.

Step 5) The target word was presented in an array of 3 (the target word plus 2 distracter words from the same word set) with a photograph of the target word above the choices. A voice said, “Find ____” (the target word). If the response was correct, step 5 was repeated. If the response was incorrect, the target word button depressed on the screen while a voice said, “This is _____” (target word). Then step 5 was repeated with the location of the target word shuffled randomly in the array of 3. After 3 consecutive correct trials at step 5, a new word from the word set was introduced in step 1.

SF instructional trials. SF trials occurred as described in the seven steps below.

Step 1) The target word (Level E, with a white background in place of the photograph) was presented in an array of one and a voice said the target word. The photograph representing the target word (without the target word superimposed on it) was in place at the top of the screen. A voice said, “Find ____.” Immediately after the instruction, the target word button depressed on the screen and correct feedback was given.

Step 2) The target word (Level E) was presented in an array of 3 (the target word plus 2 distracter words from the same word set and same word level) with a photograph of the target word above the choices. A voice said, “Find ____” (the target word). If the response was correct, step 2 was repeated with the location of the target word shuffled randomly in the array of 3. If the response was incorrect, step 3 was implemented. After 3 consecutive correct trials at step 2, a new word from the word set was introduced in step 1.

Step 3) The photograph of the target word (initially at level A, with a fully visible photograph) was presented with the target word superimposed on it an array of one and a voice said the target word. The photograph representing the target word (without the target word superimposed on it) was placed at the top of the screen. A voice said, “Find ____.” Immediately after the instruction, the target word button depressed on the screen and correct feedback was given.

Step 4) The photograph of the target word with the word superimposed on it (Level A, with a fully visible photograph) was presented in an array of 3 (the target word plus 2 distracter words from the same word set and same word level) with a photograph of the target word above the choices. A voice said, “Find ____”

(the target word). If the response was correct, step 1 was implemented at the next word level (initially at level B). If the response was incorrect, step 5 was implemented.

Step 5) The photograph of the target word with the word superimposed on it (Level A, with a fully visible photograph) was presented in an array of 1 with a photograph of the target word above the choice. A voice said, “Find ____” (the target word). If the response was correct, step 6 was implemented. If the response was incorrect, step 5 was repeated.

Step 6) The photograph of the target word with the word superimposed on it (Level A, with a fully visible photograph) was presented in an array of 2 (the target word plus 1 distracter word from the same word set and same word level) with a photograph of the target word above the choices. A voice said, “Find ____” (the target word). If the response was correct, step 4 was implemented. If the response was incorrect, step 6 was repeated with the location of the target word shuffled randomly in the array of 2.

Steps 3 through 6 were repeated with the additional word levels (B, C, D, and E). After step 4 was answered correctly at word level E (photograph completely faded), step 7 was implemented.

Step 7) The target word (level E) was presented in an array of 3 (the target word plus 2 distracter words from the same word set and same word level) with a photograph of the target word above the choices. A voice said, “Find ____” (the target word). If the response was correct, step 7 was repeated with the location of the target word shuffled randomly in the array of 3. If the response was incorrect,

step 4 was implemented at word level E (photograph completely faded). After 3 consecutive correct trials at step 7, a new word from the word set was introduced in step 1.

Data Collection

Data on the ability to receptively identify target words from a field of three dissimilar choices was collected automatically through the computer program. Data on the generalization probe (the ability to expressively read the target words when presented with the printed word in isolation) was recorded by the researcher. Data was also collected automatically through the computer program during treatment portions of each session on the number of trials the participant completed on each target word for the CTD portion and the number of trials the participant completed on each level of each target word for the SF portion. Trial data was used to calculate the efficiency of treatment conditions (viz., number of trials completed with each word, average number of trials per session, and the sessions that met criteria for moving on to new target words).

Data Analysis

Data collected on accuracy during assessments (receptive identification assessments and the generalization probes that measured expressive identification) were converted to percent correct for each treatment. Assessment data was plotted on graphs and analyzed visually for each participant.

The efficiency of each treatment was measured by collecting data on the number of trials each participant completed with each word and through an examination of the raw data. The number of trials per word were plotted in a bar

graph and analyzed visually. Raw data was used to calculate the average number of trials per session for each treatment condition (CTD and SF). Analysis was also made based on a visual exam of the raw data. Each word in each condition was presented in the same order. For example, in the CTD condition, trials were always completed starting with the word kax, then sem, fip, loy, and jur (in that order). The participant had to pass off on the word kax during the treatment portion of the session prior to moving on to the word sem and so on. A visual analysis of the raw data allowed the researcher to observe how many sessions were required to move through each word for the participant.

This chapter has explained the methods used to compare the effectiveness of a SF approach with superimposed images with the effectiveness of a CTD procedure in teaching a child with autism to identify sight words. The next chapter presents the results obtained with those methods.

Chapter 4

RESULTS

As stated in Chapter 1, this study compared a SF procedure and a CTD procedure for teaching an individual with autism to identify single syllable CVC nonsense words. This chapter reports first on the participant's accuracy during receptive identification assessments, then on expressive identification through the generalization probes, and lastly on the efficiency teaching trials in the CTD and SF conditions.

Receptive Identification

There was no consistent change in performance when comparing percent of words correctly identified from a field of three choices from baseline to treatment (See Figure 1). During the receptive identification assessments, Greg would regularly select the same button location. Greg's performance in receptive identification assessments was inconsistent with his performance during treatment trials where he would consistently select the correct choice from up to a field of three choices.

Expressive Identification

Expressive Identification was measured through the generalization probe. The generalization probes indicated improvement in performance for both the CTD and SF treatment conditions (See Figure 2). In initial probes, SF words had higher levels of accuracy than CTD words. In subsequent sessions, CTD words surpassed SF words in accuracy and reached 100% accuracy in fewer sessions than did the SF words.

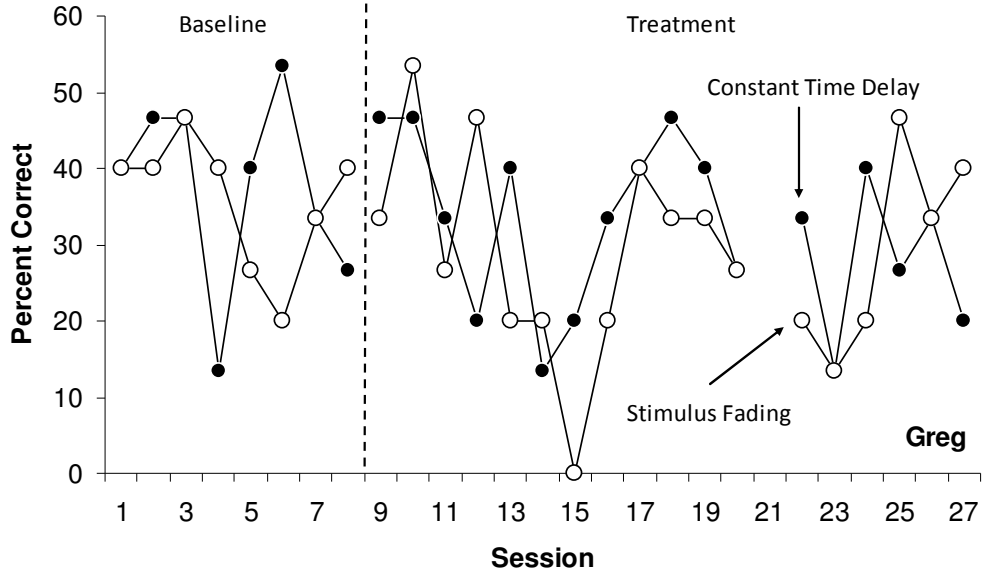


Figure 1. Receptive Identification. Open circle represents SF. Closed circle represents CTD. The break in data at session 21 is due to missing data.

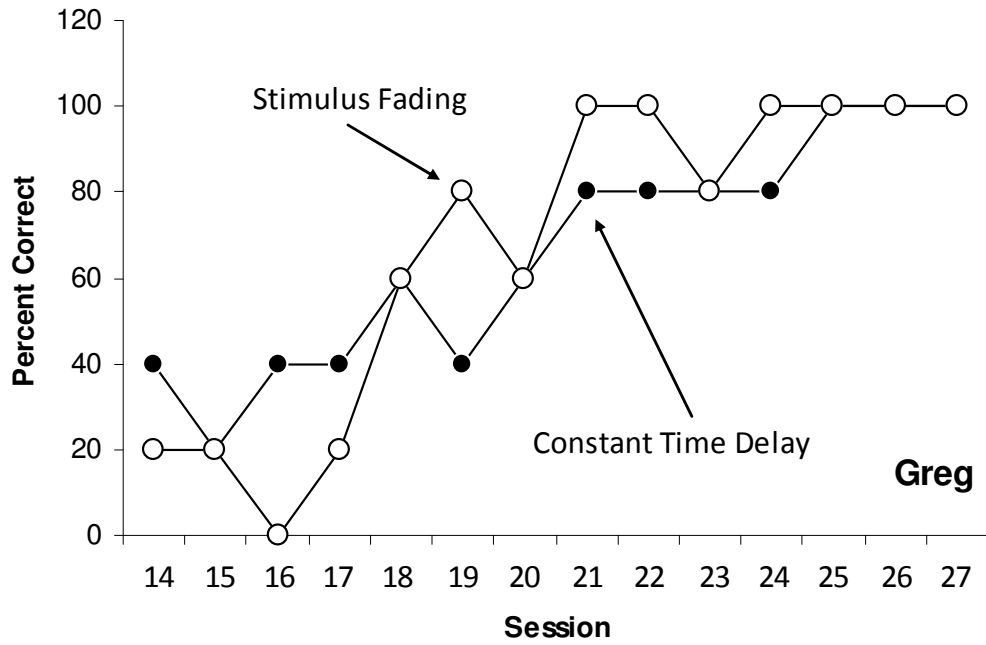


Figure 2. Expressive Identification. Open circle represents SF. Closed circle represents CTD.

Efficiency

Greg was exposed to more trials per word in the CTD treatment condition than in the SF treatment condition (See Figure 3). The additional trials per word in the CTD condition did not result in higher accuracy in the generalization probes when compared to the SF words. Greg correctly identified SF words that he had exposure to in the receptive assessments (picture paired with a voice saying “Find ____”) and in the distracter choices in other SF word trials prior to having exposure to the same word in teaching trials (correctly identified “vob” starting in session 17 generalization probe and did not complete a teaching trial with this nonsense word until session 18 and correctly identified “cug” starting in session 19 and did not complete a teaching trial with this word until session 20).

Greg averaged 54.31 trials per session with CTD nonsense words and 39.69 trials per session for SF nonsense words (See Tables 1 and 2). In his first treatment session (session 9), Greg completed trials with the CTD nonsense words “kax,” “sem,” and “fip.” In all subsequent treatment sessions, Greg completed trials with all of the target CTD nonsense words. For the SF target nonsense words, Greg only completed trials with the nonsense words “daw” and “zet” during his first two treatment sessions (9 and 10). Greg also completed trials with the nonsense word “hin” starting in session 11, the nonsense word “vob” starting in session 18, and the nonsense word “cug” in session 20.

The results presented above indicate that both CTD and SF strategies were effective in teaching Greg to expressively identify CVC nonsense words and that

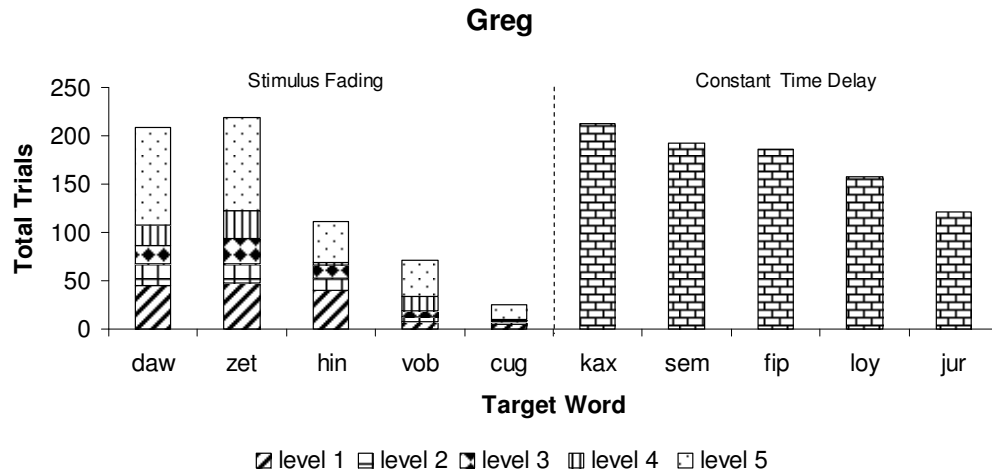


Figure 3. Number of Total Trials per Word for Greg.

SF strategies were more efficient as Greg was able to 1) correctly identify all of the SF target words in fewer sessions than the CTD words and 2) correctly identify words prior to teaching trial exposure. A detailed summary and a discussion of the findings are presented in the next chapter.

Chapter 5

DISCUSSION

The final chapter of this dissertation restates the research problem and reviews the methods used in this study. This chapter summarizes the results of this study and discusses their implications.

This study compared the effectiveness of a CTD procedure and a SF procedure to determine which procedure was more efficient in teaching an individual with autism to identify a set of CVC nonsense words. As explained in chapter 2, the study was conducted using an alternating treatments design consisting of a baseline phase and an alternation phase of the two treatment conditions (CTD and SF).

Summary of Results

Both CTD and SF treatment conditions were effective in teaching Greg to expressively identify target words. Neither treatment condition resulted in consistent gains as measured by the receptive identification assessment. When comparing progress between CTD and SF treatments, initially Greg had a higher accuracy with CTD treatment words during expressive identification assessments; however, by the twelfth treatment session, the SF treatment word accuracy was increasing and he was able to correctly identify SF target words prior to completing teaching trials with those words. He was exposed to the picture paired with the spoken word in receptive assessments and the printed word paired with the picture in distracter buttons for other target words within the same SF word group. The SF treatment condition was more efficient in the long term for

increasing word identification skills due to the incidental learning that occurred as a result of exposure to the words during trials with other words (as a distracter choice) and during receptive identification assessments (where photographs were presented with a voice saying, “Find _____.”)

Implications

This study found that CTD and SF were effective in teaching an individual with autism to read whole words. This finding is consistent with previous research that CTD procedures (Dagoe, Banda, Lock, & Feinstein, 2011; Ledford, Gast, Luscre, & Ayres, 2008) and SF procedures (Birkan, McClannahan, & Krantz, 2007) have been effective in teaching individuals with autism to recognize whole words.

As asserted by Chiang and Lin (2007), a supply of comparison studies is needed to identify the most effective strategies. This study compared the learning outcomes of CTD and SF in an attempt to add to the literature base in identifying the most effective strategies for teaching whole word reading skills to individuals with autism. The results of this study suggest that for some individuals with autism, a potential benefit of SF over CTD is incidental learning of new words without direct teaching trials. Ledford et al. (2008) found that CTD also resulted in positive gains through incidental learning; however, in the Ledford et al. study, the incidental learning targets were visual information, such as a caution sign for the word caution, rather than printed words in isolation. In probes to evaluate the incidental learning, Ledford et al. removed the target word from the visual stimulus (e.g., the word “caution” was removed from the caution sign during

assessments) so that the researchers could evaluate the participant's ability to recognize the visual information separate from the participant's ability to read a word. In this study, Greg learned to read words incidentally rather than recognize related pictures. Due to the small number of participants in this study, results are not representative of all individuals with autism. Future research is needed to specifically explore the incidental learning possibilities through SF treatment conditions.

The receptive identification assessment results did not accurately represent the participant's progress. During treatment sessions, Greg would select the correct response consistently and even verbally tell the facilitator the words on the distracter buttons. The generalization probes which assessed Greg's ability to expressively state the word when presented with a single flash card more accurately reflected progress that was evident by his performance within treatments sessions (i.e., responding correctly and labeling the words on the distracter word choice buttons). During receptive identification assessments, both correct and incorrect responses were not given feedback. During teaching trials, praise was provided (e.g., "Good job") for correct responses. Praise was also provided for correct responses during generalization probes. The discrepancy between Greg's ability to identify words and his performance during receptive identification assessments may be due to the lack of reinforcement for correct responses during receptive identification assessments.

During expressive assessments (viz., the generalization probes), Greg initially read the words he knew as "Find ____" (with the correct target choice) or

“This is ____” (with the correct target choice). These responses were counted as correct. During later sessions, Greg would only say the word presented (e.g., “daw”). For Greg and potentially for some other individuals with autism in a practical setting, the instructional prompt (e.g., “Find”) may need to be removed when teaching real words.

This study utilized nonsense CVC words as the target words to prevent the potential confounder of familiarity with the target word, that could occur with real words and words of interest to the individual, on acquisition of identifying the word. Broun (2004) suggests that selecting target words for instruction that are individually relevant and meaningful is a key to success in teaching reading to individuals with autism, who may have limited life experiences due to their disability.

Both CTD and SF treatments were effective in teaching Greg to expressively identify the target nonsense words. The SF treatment condition was more efficient as Greg could identify all of the SF target words in fewer sessions than the CTD target words and as Greg learned additional SF words incidentally through exposure in assessments and as distracter choices.

Generalization of these findings to other individuals with autism may be limited due to the sample size of 1 participant in this study. Future research should be conducted to evaluate the potential incidental learning benefits of SF with additional individuals with autism. Additional comparison studies should also be conducted comparing SF with other empirically based strategies, such as progressive time delay (PTD) which has been found to result in fewer errors when

compared to CTD procedures (Walker, 2008), to determine which strategies are most effective with individuals with autism.

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APPENDIX A
RAW DATA TABLES

Table 1

Number of Trials for Each SF Word per Session

Word	Level	Treatment Session																			
		9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Daw	1	1	1	4	4	7	4	4	4	1	4	1	1	x	0	x	0	4	0	5	
	2	1	1	1	4	1	1	4	1	1	1	1	1	x	0	x	0	4	0	0	
	3	4	1	1	1	1	1	1	1	1	1	1	4	x	0	x	0	1	0	0	
	4	1	1	4	1	1	1	1	1	1	3	1	1	1	x	0	x	0	4	0	0
	5	11	22	4	4	4	4	7	4	1	4	7	4	x	6	x	6	8	6	6	
Zet	1	1	1	1	6	4	6	11	9	4	1	1	0	x	1	x	1	0	0	1	
	2	1	1	1	1	4	1	4	1	1	1	1	0	x	1	x	1	0	0	1	
	3	4	1	4	1	4	1	1	1	1	1	1	0	x	1	x	1	0	0	4	
	4	7	1	1	1	1	1	1	1	7	1	1	0	x	0	x	1	0	0	4	
	5	18	10	4	4	4	7	4	6	4	4	4	3	x	4	x	10	6	6	5	
hin	1			1	4	14	1	4	2	2	2	0	0	x	0	x	0	0	0	0	
	2			1	1	0	4	0	1	4	1	0	0	x	0	x	0	0	0	0	

Word	Level	Treatment Session																		
		9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
hin	3			6	0	0	5	0	1	1	1	0	0	x	0	x	0	0	0	0
	4			0	0	0	0	0	1	1	1	0	0	x	0	x	0	0	0	
	5			2	1	2	1	1	4	4	4	3	3	x	3	x	6	5	4	3
vob	1										1	1	1	x	1	x	1	1	1	1
	2										0	1	1	x	1	x	1	1	1	1
	3										0	1	1	x	1	x	1	1	1	1
	4										0	4	1	x	4	x	4	1	1	1
	5										2	4	14	x	4	x	5	4	4	4
cug	1											4	x	1	x	0	0	0	0	
	2											1	x	1	x	0	0	0	0	
	3											1	x	1	x	0	0	0	0	
	4											0	x	1	x	0	0	0	0	
<i>N</i>	5											1	x	5	x	3	3	3	3	
<i>o</i>																				

te. Missing data for sessions 21 and 23 is represented by “x.”

Table 2.

Number of Trials per Session Completed for Each CTD Word

Word	Treatment Session																		
	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Kax	38	8	9	15	9	17	8	10	11	14	14	9	x	16	x	12	9	x	14
Sem	12	12	16	14	10	6	9	9	14	19	12	13	x	9	x	14	12	x	11
Fip	16	12	12	13	14	11	16	12	9	11	14	12	x	9	x	6	9	x	10
loy		15	9	9	11	11	15	6	11	6	6	16	x	14	x	9	12	x	7
jur		4	6	6	6	12	6	20	8	9	8	10	x	6	x	11	6	x	3

Note. Missing data for sessions 21, 23, and 26 is represented by “x.”