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The Effects of Constant Time Delay in Teaching Recognition of Braille Words

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THE EFFECTS OF CONSTANT TIME DELAY IN TEACHING RECOGNITION OF BRAILLE WORDS

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Education at the University of Kentucky

By

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River, Kentucky

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ABSTRACT OF THESIS

THE EFFECTS OF CONSTANT TIME DELAY IN TEACHING RECOGNITION OF BRAILLE WORDS

The purpose of the study was to evaluate the use of a constant time delay procedure to teach core content words in braille to a student with a visual impairment. A multiple probe (conditions) across behaviors design was used to evaluate the effectiveness of the training and follow-up sessions. The results showed the procedure was effective in teaching core content braille words within a resource setting and the student was able to generalize the information to an inclusive setting.

KEYWORDS: visual impairment, constant time delay, brailled words, near errorless learning, nontargeted information

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April 18, 2016

THE EFFECTS OF CONSTANT TIME DELAY IN TEACHING RECOGNITION OF BRAILLE WORDS

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Section 1: Introduction

Hua, Woods-Groves, Kaldenburg, and Scheidecker (2014) estimated that 27 million American adults with disabilities do not have the literacy skills to acquire information from educational materials. For this reason, it is important for investigators to utilize evidence based practices to teach reading. Hirsch (2003) stated that the basic task of reading is a three-stage process, from sight to sound to meaning. This process must happen quickly, because a human's short term memory is brief and the information may never be recovered. When discussing vocabulary for children with a visual impairment, Vervloed, Loijens, & Waller (2014) stated that "Although the breadth of the vocabulary of children who are blind or visually impaired is mostly comparable to that of sighted children, some children show problems with regard to the proper meaning of words" (p. 434). These difficulties can occur in words that describe something that is too large to touch at one time, therefore not allowing the person to receive information in its entirety or in words that are too dangerous to allow the person a tactile experience. There also are abstract words that do not have a concrete referent that often are used in mathematics instruction. The meaning of these words is completely dependent on language itself (Vervloed et al., 2014).

The National Reading Panel (NRP) was formed in 1997 in response to a request from Congress to research and report how children learn to read and what practices are most efficient. "The National Reading Panel analysis made it clear that the best approach to reading instruction is one that incorporates explicit instruction in phonemic awareness, systematic phonics instruction, methods to improve fluency, and ways to enhance comprehension," (National Reading Panel, 2000, p. 1-5) They also identified strategies to improve each area, such as comprehension. One of the categories or strategies of

improving comprehension instruction is vocabulary-comprehension relationship. Reading comprehension is largely dependent upon word knowledge and utilizing this strategy will improve upon the student's knowledge of word meaning. "These comprehension strategies yield increases in measures of near transfer such as recall, question answering and generation, and summarization of texts" (National Reading Panel, 2000, p.3). Therefore, having a comprehensive vocabulary with the understanding of word meanings will increase comprehension of text materials.

One area that has been researched extensively, in other populations other than visually impaired, is sight word reading and constant time delay. In fact, Browder, D.M., Ahlgrim-Delzell, L., Courtade, G., Gibbs, S.L., and Flowers (2008) identified CTD (CTD) as an evidence-based strategy to teach sight words to students with moderate and severe intellectual disabilities. CTD is a response-prompting strategy designed to transfer stimulus control by inserting an amount of time between a stimulus and a controlling prompt. The strategy minimizes the practice of errors, thus ensuring that students practice a high rate of correct responding (Pruitt & Cooper, 2008). In one example, Mechling, Gast, and Krupa (2007) used CTD and computer assisted instruction (CAI) to teach sight word reading. These researchers delivered instruction using SMART Board technology to three students with moderate intellectual disabilities to increase the accuracy of reading target grocery words and matching grocery item photos to grocery words. The controlling prompt for all students was the investigator's verbal model of the target word. All students increased correct reading and matching of all target word sets when using the CAI and 3s CTD.

CTD has been effective and efficient in teaching students with a variety of ages and disability categories. For example, it has been used to teach students who are in preschool (Aldemir & Gursel, 2014), elementary school (Koscinski & Gast, 1993), middle school (Seward, Schuster, Ault, Collins, & Hall, 2014), and secondary school (Doyle, Gast, Wolery, Ault, & Farmer, 1990). It terms of disability categories, the procedure has been successfully used across a variety of disabilities including those with moderate to severe disability (Morrison, 2013), learning disabilities (Hughes & Fredrick, 2006), autism (Dogoe, Banda, Lock, & Feinstein, 2011), and those without disabilities (Wall & Gast, 1997).

In addition to effective strategies, investigators need ways to make their instruction more efficient. One way to do this is to present nontargeted information during instructional trials. Nontarget information can be delivered during the antecedent, task direction, prompt delivery, or consequence. Nontarget information is described as information that is presented to the learner within the instructional trial on the targeted behavior. (Collins, 2012) It is not considered part of the learning objective and direct instruction is not provided on the nontargeted information. Several examples from the literature show researchers using the delivery of nontarget information. Smith, Schuster, Collins, and Kleinert (2011) studied the effectiveness of simultaneous prompting (SP) when teaching four participants with moderate and severe disabilities to read 12 sight words from community restaurants and the generalization of the nontarget information provided in the discriminative stimulus. The results indicated that SP was effective in teaching the participants the targeted sight words and participants acquired the nontarget information knowledge of the food classification embedded in the discriminative

stimulus. Daugherty, Grisham-Brown, and Hemmeter (2001) studied the use of CTD to teach counting to preschoolers with disabilities while embedding nontarget information in the task direction. The target behavior was counting and the CTD procedure was embedded in ongoing activities and routines in the classroom. The data indicated that CTD was effective in teaching counting and the participants acquired the nontarget information of colors (ex. “Count the blue blocks.”).

However, the research is limited on the use of both CTD and nontarget information to teach word reading and meanings to students with visual impairments. In fact, no studies were located that evaluated the use of CTD paired with nontarget information in students with a visual impairment. Currently there are no evidence-based practices that meet standards set by either the Institute for Educational Science or the Division for Research of the Council for Exceptional Children regarding literacy instruction for students with visual impairments (Savaiano & Hatton, 2013). However, there have been studies conducted in which literacy was taught to students with visual impairments. Savaiano and Hatton (2013) conducted a study with 3 participants who attended a state school for the blind. The authors attempted to demonstrate a functional relation between a repeated reading intervention and oral reading rate as measured in standard words per minute (WPM) using a changing criterion design. Data were collected on oral reading rates, error rates, and comprehension while reading Dolch Classic Books (Dolch & Dolch, 1961). The authors conducted a visual analysis of the data and concluded that a functional relation between repeated readings and oral reading rate was demonstrated with Participants 1 and 2 and between repeated readings and comprehension for all students. They did not find a direct relation between repeated readings and error rate with

any participant. Recently, Savaiano, Compton, Hatton, and Lloyd (2016) released the results of a study using an adapted alternating treatments design with three students with visual impairments whose primary learning medium was braille. All three students attended a specialized school for the blind and had a visual disability with an additional impairment. The purpose of this study was to determine if the presence of a target word in braille facilitates vocabulary acquisition by comparing the following conditions: a flashcard instructional condition was more effective than an auditory-only instructional condition. (Savaiano, et. al., 2016). The results of the study indicate that all three participants met mastery criteria for all 18 words in all conditions. Efficiency data indicated that participants were able to recall the information two to six sessions faster in the auditory-only condition compared to the flashcard condition. "Therefore, the data indicate that both instructional strategies are effective for teaching the meanings of vocabulary words to students who read Braille, and patterns consistent across participants suggest fewer sessions to mastery when instruction is auditory-only, rather than having a flashcard present during instruction." (Savaiano, et. al., 2016, p.350)

Ferrell (2006) authored a review of the literature in the area of literacy for students with visual impairments. She researched 30 intervention studies published between 1963-2003 to determine if they met criteria for high quality research and had been replicated. Of the 30 studies identified, none had been replicated and all failed to establish the highest standard of evidence recommended by the What Works Clearinghouse. As a result of the review, Ferrell identified 16 "promising practices" to be used with students with visual impairments during literacy and mathematics instruction. She indicated that these practices should be replicated, and that the "development of only

16 promising practices in 50 years suggests that the field of visual impairment has a weak research foundation for its pedagogy (Ferrell, 2006, p.46). The author did not identify CTD as a promising practice for students with a visual impairment.

There are a limited amount of studies completed with students with a visual impairment and the use of CTD. In fact, the investigator located only one study that used CTD to teach braille to students with visual impairments. Hooper, Ivy, and Hatton (2014) analyzed the use of CTD to teach braille word recognition. The authors completed a multiple baseline across behaviors (word sets) design with four participants who attended a specialized school for students with visual impairments. The study was completed in a one-on-one setting in a classroom that was familiar to the students. All participants received services for a visual impairment and multiple disabilities, which included, intellectual disabilities or developmental delay. Participants were between the ages of 10 years 5 months and 11 years 10 months with ethnicities of African-American (2), Hispanic (1), and Caucasian (1). The authors chose words to include in the study based on an inventory from the parents, investigator, and the participants. The words were placed into four word sets with three words each (12 total), written in contracted braille on a note card using a Perkins braillewriter. All conditions consisted of one or two sessions of 18 trials each day. The authors' intervention was a 5 s CTD with a verbal controlling prompt (saying the word and two salient features of the word) and a physical prompt to the student to track the word. Positive verbal reinforcement was given for attentive behaviors on every third trial (FR3; e.g. "Thank you for reading with me."). Two participants continued to make nonwait errors, and then the author added an attending cue to the instructional procedures. Social validity was assessed using a survey

with a four point Likert scale. Teachers, parents, and dormitory staff members of the four students completed the survey to assess the goals, procedures, and effects of the study. All participants of the survey reported positive results on the social validity statements. A functional relation was established for all four participants by an immediate change in trend when the intervention was introduced, and all words were learned to criterion.

Constant time-delay is an evidence-based practice for teaching sighted students with disabilities to recognize print words; however, little research has been done in the area of visual impairment. Additional research is needed in this area. The current research extends the literature by examining the effectiveness of a CTD procedure to teach academic words to a student with VI. In addition, this is the first study to examine the ability of students with VI to attain nontarget information on vocabulary word meanings presented as instructive feedback during CTD trials.

Section 2: Research Question

The purpose of the current study is to evaluate the use of CTD to teach mathematical key terms in braille to a student with a visual impairment. The research questions were:

1. Is there a functional relation between the use of a CTD procedure and an increase in level and trend of core content mathematic vocabulary words read correctly in braille for a middle school aged student with a visual impairment?

2. What are the effects of the delivery of nontargeted information presented verbally during the instructive feedback of instructional trials on the acquisition of the meanings of mathematic vocabulary on a middle school aged student with a visual impairment?

Section 3: Methods

Participant

A male student, given the pseudonym of Joshua was invited to participate in the study. Joshua read and signed the assent form to give his permission to participate in the study, his parent/guardian signed permission as well. He was 12 years 3 months old and enrolled as a full time 7th grade student in a rural public school system when the study began. Throughout the length of the study, he continued to be eligible for services under the category of visually impaired. He received instruction from the Expanded Core Curriculum for a minimum of 1 hour daily as provided by the teacher of visual impairments (TBVI) who was also the investigator. He also received orientation and mobility (O&M) instruction for independent travel, street crossings, and spatial awareness for 1 hour twice per month. The TBVI and O&M provided services on and off school grounds. Joshua was performing on grade level with reading comprehension and listening skills. Joshua's strengths were auditory memory recall and vocabulary. Joshua's records indicate that he has been diagnosed with keratoconjunctivitis, thygeson superficial punctate keratitis, blepharospasm, entropion, and cicatrical entropion. His visual acuity was described as light perception only per the most current eye report from a licensed optometrist. A low vision evaluation was completed on 2/27/2014 by a physician specializing in optometry. He was prescribed a portable video magnifier and a portable closed circuit television (CCTV). Joshua required average to less than average lighting. He had severe photophobia and was unable to fully open his eyes. Joshua's near vision was 5.0M@40cm without devices; with devices prescribed he was able to read at 0.4M@12cm. According to the optometry report, Joshua's acuities were 20/400 full field

of vision OD (right eye) and light perception unable to assess field of vision in OS (left eye) and he continued to meet the legal definition of blindness. Joshua received instruction in braille as this was his primary learning medium due to the size of magnification needed to read print. He is proficient in reading and writing uncontracted braille and alphabet whole-word contractions at the beginning of the study. Joshua's current Individual Education Program (IEP) objectives include the study of one cell whole word-part word contractions, in contracted braille. It is important to note that Joshua had normal vision until first grade. At that time, he developed severe allergens within his eyelids and had to have multiple surgeries to repair them. He was placed on home bound instruction during his second-fifth grade years in elementary school. During his third grade year, he was evaluated and determined to have a visual disability. He returned to school full time at the beginning of his sixth grade year. At this time he was determined to have a learning disability in addition to a visual impairment. Joshua's math skills were determined to be on first grade level during the determination. When exiting sixth grade, Joshua was reevaluated and determined to only have a visual disability, his math skills had improved to an upper third grade level. Due to the allergens that reoccur throughout the night while sleeping, Joshua is unable to open his eyes during the first 3-4 hours of his day. After the initial period, he is able to open one eye to a squint.

Joshua is currently provided math instruction in a general education setting, which is 50 minutes in duration, 5 times per week. The TBVI and instructional assistant provide assistance to the student and teacher on an as needed basis (i.e., adapting assignments, ensuring all assistive technology is working properly). Joshua was given the Brigance; Comprehensive Inventory of Basic Skills II (2010) before the study began and scored on

a 3rd grade level in math placement. Given that Joshua's math skills are below grade level, it is important for him to learn the vocabulary of the most common words used within the seventh grade curriculum to better understand the content of the subject. Braille reading is an essential tool for those who are blind or visually impaired. Braille enables them to become literate and increases their chances of becoming purposeful and successful individuals in today's society. Academic functioning and future employment will largely depend on the individual's competency to interact with written words within his environment.

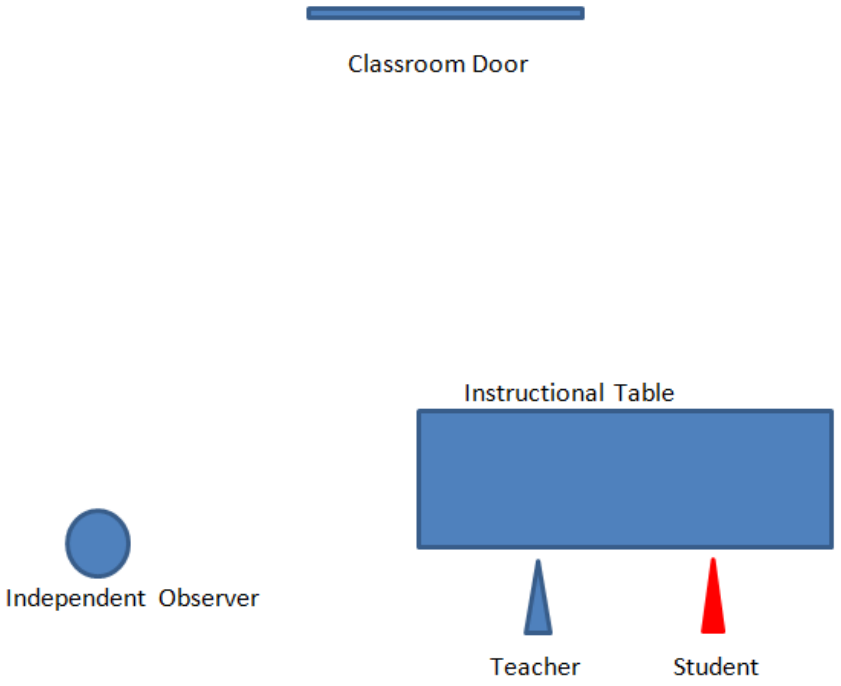
Staff. The investigator was also the TBVI was a full time employee of the public school system in which the study took place. The investigator completed degrees in the areas of moderate and severe disabilities, visual impairments, and currently assistive technology. She has 16 years of experience in teaching special education. The independent observer was also a full time employee of the public school system and has 12 years of experience teaching special education. She has completed degrees in learning and behavior disorders, moderate to severe disabilities, and administration.

Instructional Setting and Arrangement

All probe, instructional, maintenance, and generalization sessions took place in a resource special education classroom within the student's school. All sessions were conducted in a 1:1 arrangement to minimize external stimuli and to allow for direct instruction in braille reading. This was also the room that daily instruction took place in and was part of the normal routine for the school day. The room was 6.1 X 4.5 meters, with a semi-circular table being used for the sessions. The room contained a teacher's desk with a computer work station and student desks. A diagram of the classroom layout

is included in Figure 1. The primary investigator, the TBVI, sat beside Joshua, to the left, during all sessions to ensure that proper finger and hand placement was being implemented. The independent observer sat approximately 5 feet from the left of the investigator. No other students were present during the sessions. Sessions were conducted daily when both the participant and investigator were present.

Figure 1: Classroom layout



Materials/Equipment

Nine words were selected for the student based on a visual survey of the chapters and subtopics within Joshua's math textbook, discussion with Joshua's general education math teacher of the most commonly found mathematical terms introduced during the 7th grade year, and words the participant needed to learn immediately to function within the 7th grade mathematics classroom. The words were placed into three sets of three words

each. Each word set was comprised of words that were tactually different according to the way they are written in braille. Each word was written in contracted braille on a separate 10.2 cm x 15.2 cm note card using a Perkins braillewriter. All words were brailled using Unified English Braille (UEB) as recommended by the Braille Authority of North America (BANA). The top left corner of each note card was removed at an angle to ensure the student is able to locate the top and begin reading to the left. Each word was placed in the center of the card with a space on either side, with a lead-in and lead-out line (dots 2-5) prior to and after the word. Word cards were placed on a rubber pad (30.5 cm x 30.5 cm) to reduce their movement on the flat surface. Careful consideration was also given to ensure that each word set contained at least one of the contractions being taught (ence, tion, er).

Data collection sheets were also designed and used during the study. The sheets used during baseline, instructional, and maintenance sessions are included in Appendix A. Table 1 shows the words taught by word set.

Other materials included reinforcers identified by the student during a reinforcer preference assessment completed prior to beginning the study. Pennies were given as tokens. At the conclusion of each session, the student exchanged his tokens from choices based on the assessment. The student could also choose to save his tokens for a larger reward. Materials used for reinforcement were: 1 extra minute of break, a candy bar of choice/or froyo, a pass for a homework assignment, a “ticket” to select a movie of choice.

General procedures

Nine words were taught to the participant using a CTD procedure. Prior to any instruction, all target words were assessed using probe procedures. When the data became

stable, the first set of words was taught using the intervention. Once the first set of words met criterion, all words were assessed using probe procedures. When data became stable, the second set of words was taught to criterion. Another probe condition was conducted for all words. When data were stable, the third set of words was taught to criterion. A final probe condition was then implemented on all words.

The nontarget information (meanings of the vocabulary words) was assessed in a pre-test prior to any instruction occurring and in a post-test after all words had been learned to criterion.

Dependent Variable/Instructional Objective

The dependent variable within the current study was the acquisition of nine contracted braille words that were found within the participant's 7th grade math curriculum. The nine words were chosen for the student based on a visual survey of the chapters and subtopics within the textbook, discussion with the general education math teacher of the most commonly found mathematical terms introduced during the 7th grade year, and words the participant needed to learn immediately to function within the 7th grade mathematics classroom. The words were placed into three word sets of three words each. Each word set was carefully selected to ensure that the words included were tactually different (e.g., words that began with the same letter will be placed in separate sets). Each word was written in contracted braille and using only the contractions the student was able to read (alphabet contractions, and, for, of, the, with, ou-out, st-still, ch-child, sh-shall, th-this, wh-which) and the contractions that the student was to learn throughout the study (tion, ence, er). The instructional objective was: When given a collection of braille words, Joshua will begin reading by placing his fingers on the card

within 3 s and verbally stating the word within 10 s of initiation with 100% accuracy over three consecutive sessions.

Table 1

Word Sets

Word Set 1	Word Set 2	Word Set 3
Factorization	Adjacent	Proportion
Equilateral	Equivalence	Reciprocal
Circumference	Fraction	Equation

Inclusion Criteria

The inclusion criteria for participation within the current study were: a) adequate fine motor skills required to learn braille reading and writing, including line tracking; (b) a visual impairment requiring the use of braille as the primary learning medium; (c) proficiency in uncontracted braille; (d) IEP goals and objectives similar to the learning objective for the current study (braille contractions); (e) ability to follow 2 step directions; (f) a reading and listening comprehension level evidenced by IEP and/or assessment at minimum of fourth grade level; (g) hearing with normal limits; (h) ability to remain on task for a minimum of 15 minutes; (i) ability to wait for a prompt for a minimum of 3 s; and (j) regular school attendance. The participant was also required to have written parental consent (assent form) before the study began as directed by the Office of Research Integrity. Cognitive, braille, and fine motor skills were assessed through the inspection of the student's current IEP and investigator observation. Attendance was monitored through the online system within the school district.

Procedures

Screening procedures. The purpose of the screening procedures was to identify stimuli that were unknown to the student prior to selecting the specific stimuli to include in the study and to assess using probe procedures. Forty words were initially selected for the student based on the results of a visual inventory of words from the chapters and subtopics in the current math curriculum from the local school district and investigator input that the participant needs to learn immediately to function within a regular education setting. A list of the suggested words was given to the student on standard manila paper, prepared with a Perkins Braillewriter, and he was asked to read each word in order beginning with the first word in the first column. The participant was given 15 s to read each word. The investigator provided general verbal praise for each word read correctly, and provided no feedback or prompting when the student did not respond or read a word correctly. That is, the investigator provided a brief intertrial interval and directed the student to read the next word on the list. The investigator marked the words read aloud correctly and those were removed from the list of possible words for instruction. The list was then presented again the following day, minus the words marked correct, to ensure the student was not able to read them. From the remaining word list, the investigator compiled three sets of three words each (total of 9) to be taught within the current study.

Nontarget probe procedures. Nontarget information was assessed prior to instructional sessions and after criterion was reached on all word sets. The investigator provided a pre-test and post-test for all word sets in a verbal format with the pre-test completed before the first intervention tier began and the post-test completed after the

final probe. During the pre-test and post-test of each word set, the student was asked to verbally state the definition of each mathematical term presented (e.g., “What does adjacent mean?”).

Possible student responses included: (a) a correct response defined as the student verbally stating the key words of the definition of the word and retaining the essence of the definition presented correctly within 10 s of being asked the question; (b) an incorrect response defined as the student verbally stating a definition of the word that did not contain the key words of the definition or retain the meaning of the word within 10 s; and (c) a no response defined as the student not providing any verbal response within 10 s. The nontarget definitions are provided in Table 2. The keywords required for student responses to be scored as correct responses are shown in italics.

Table 2

Target words, definitions, and keywords required for correct responses.

Factorization	The operation of resolving a *quantity into factors*
Equilateral	Having *all* its *sides* of the *same length*
Circumference	The *distance around something*
Adjacent	*Next to or adjoining something else*
Equivalence	The condition of being *equal* or equivalent in value, worth, function, etc.
Fraction	A numerical quantity that is *not a whole number*
Proportion	*A part*, share, or number considered in comparative relation *to a whole*
Reciprocal	The quantity obtained by *dividing the number one by a given quantity*
Equation	A statement that the *values of two mathematical expressions are equal*

Note. The keywords required for student responses to be scored as correct are shown in italics.

Probe procedures. The investigator collected probe data was collected in a resource classroom using a 1:1 instructional arrangement, located within the student's home school within the first hour of the school day. The investigator conducted probe sessions prior to implementing the intervention for a minimum of 5 sessions and until responding data were stable. During probe sessions, the student was assessed on all words to be learned in the investigation (3 sets of 3 words). The investigator delivered two trials on each word set for a total of 18 trials each session with data recorded on the sheet shown in Appendix A. At the beginning of each session, the investigator said, "Today I'm going to ask you to tell me some words and I want to see if you know them. Are you ready to work?" The investigator waited for an attentional response from the student. Student attentional responses were any verbal comment (yes, ok), gesture (head nod, thumbs up). After attentional response was secured, the investigator placed a word card on the rubber mat and gave a task direction (i.e., "Read the word.", "What is the word?"). The investigator waited 3 s for the student to initiate the response and provided 10 s for student to complete the response. Three student responses were possible including (a) correct responses in which the student initiated reading the word (i.e., puts his hand on the card) within 3 s and verbally stated the word within 10 s, (b) incorrect responses in which the student initiated reading the word within 3 s but verbally stated a word other than the one presented, and (c) no response in which the student did not initiate reading the word within 3 s or initiated reading the word within 3s but says nothing within 10 s. For all response types, the investigator did not provide feedback on the accuracy of the response, but rather waited a brief intertrial interval and then provided the next word. The investigator provided praise on a variable ratio of every third trial (VR3) schedule of

verbal praise for attending to task (e.g., “Joshua, you are giving these words 100% of your attention, thank you!”) The data collection form is included in Appendix A.

Instructional procedures. The instructional procedures were implemented once daily, at least 4 days per week. Intervention data were collected in a resource classroom using a 1:1 instructional arrangement, located within the student’s home school within the first hour of the school day. Each instructional session consisted of 3 trials for one of the word sets, totaling 9 trials per session. The investigator delivered two sessions of 0 s delay trials followed by all subsequent sessions of 3 s delay trials.

During 0 s sessions, the controlling prompt was the investigator verbally stating the word and providing a verbal description of the braille words presented (e.g., “fraction-dot 1-2-4 f; dot 1-2-3-5 r; dot 1 a”, etc.). During each 0 s delay session, the procedures for CTD (described below) were implemented.

1. Investigator provided flash card with braille word presented.
2. Investigator provided attentional cue (i.e., “Student name find the lead-in line”, “Are you ready for the next one?”) and waited for the student’s attentional response which can be gestural (e.g., use fingers to find lead-in line, head nod) or verbal (e.g. yes, ok).
3. Investigator gave the task direction, “Read the word.” immediately following the attentional response.
4. Student tracked the word left to right (allowed 10 s).
5. Investigator said “(word)” with a verbal description when student finished tracking or 10 s expired.

6. Investigator recorded student responses and provided consequences. Only responses after the prompt were possible in 0 s delay sessions, as the student was not given the opportunity to respond prior to the prompt.
    a. If correct after the prompt (initiated 3 s by placing his hands on the card after the prompt, tracking the line of print, and then verbally stating the word within 10 s), the investigator provided descriptive verbal praise and a token. (e.g., “Great job reading circumference! Circumference is the distance around something.”)
    b. If incorrect after the prompt (initiated within 3 s, tracked correctly and stated a word other than the correct one within 10 s or the student initiated within 3 s but tracked the line of print incorrectly, the investigator verbally corrected, (e.g. “This word is fraction: dot 1-2-4 f; dot 1-2-3-5 r; dot 1 a, etc.”) and used physical guidance for line tracking.
    c. If no response after the prompt (did not initiate within 3 s or did not verbally state a word), the investigator said, “This word is fraction: dot 1-2-4 f; dot 1-2-3-5 r; dot 1 a, etc.” and used physical guidance for line tracking.
7. Repeated steps 1-7 until all trials were conducted.
8. After all trials had been delivered, the investigator said, “Great reading today!”

Following two 0 s CTD sessions, the investigator used a 3 s delay in all subsequent CTD sessions until criterion was achieved at 100% for 3 consecutive sessions. During each 3 s CTD session, the investigator implemented the procedures below.

1. Investigator placed the braille “word” card on the rubber mat.

2. Investigator stated, “Today I’m going to ask you to read me some words. Remember to wait for my help if you do not know the answer. Are you ready to work?”
3. Investigator provided attentional cue (i.e., “Student name find the lead-in line”, “Are you ready for the next one?”) and waited for the student’s attentional response which could be gestural (e.g., use fingers to find lead-in line, head nod) or verbal (e.g., yes, ok).
4. Investigator gave the task direction (e.g., “Read the word.” or “What is the word?”).
5. Investigator waited 3 s for initiation response and 10 s to complete response, then provided controlling prompt if needed.
6. Investigator recorded student response and provided consequences with nontarget information.
    a. If correct before the controlling prompt (student initiated within 3s and stated the word within 10 s before the prompt was delivered) investigator marked +B, provided verbal praise with token plus repeated the word with nontarget information. (e.g., “Great! Fraction. Fraction is a numerical quantity that is not a whole number.”).
    b. If correct response after the controlling prompt (student initiated within 3 s and stated the word after the prompt was delivered) investigator marked +A, provided verbal praise with token plus repeated the word with braille description and the nontarget information. (e.g., “Great! Equilateral: dot 1-5 e;

dot 1-2-3-4-5 q; dot 1-3-6 u, etc. “Equilateral means having all its sides of the same length.”).

c. If incorrect response before the controlling prompt investigator marked –B, verbal reminder to wait, “Remember to wait for the correct answer if you’re not sure. This word is fraction: dot 1-2-4 f; dot 1-2-3-5 r; dot 1 a, etc.”

d. If incorrect response after the controlling prompt investigator marked –A, provided verbal correction, “This word is fraction: dot 1-2-4 f; dot 1-2-3-5 r; dot 1 a, etc.”

e. If no response after the verbal prompt investigator marked NRA, provided verbal correction, “This word is fraction: dot 1-2-4 f; dot 1-2-3-5 r; dot 1 a, etc.”

7. Repeated steps 1-6 until all trials have been conducted.
8. After the investigator delivered all trials, she said, “Great reading today!” and had the student count tokens earned and select from an array of reinforcers. Choices available for exchange were: 3 tokens=1 extra minute of break, 20 tokens=a candy bar of choice/or froyo, 50 tokens=get out of 1 homework assignment free pass, 75=watch a movie of choice.

When the behavior of the first tier reached the criterion level as defined (100% accuracy over three consecutive sessions while reinforced on a CRF schedule, probe procedures were implemented for all words targeted for the study. The data collection form is included in Appendix A.

Maintenance procedures. Given the format of the multiple probe design, maintenance data were gathered during probe conditions on each set that had reached

criterion in previous tiers. That is, maintenance data were collected on the first set of words during Probe II and on the first and second set of words during Probe III. Following the final probe condition (Probe IV), maintenance on all word sets and nontarget information was assessed 1, 2, and 4 weeks after all words were learned. The investigator conducted these sessions using probe procedures. Data were collected on the data sheet provided (Appendix A).

Generalization procedures. Generalization sessions were conducted in natural contexts such as math class. Text materials were those that were already being used within the natural context of the classroom. The general education math teacher required the student to verbally read aloud a sentence containing the target word/s (e.g., word problems, directions for an assignment). For example, when the directions on a worksheet given to the class contained one of the target words for the week, the teacher would ask Joshua to read those aloud to the class, ("Complete the problems, do not forget to simplify the fractions!") Following the final probe condition, generalization on word set 1 (factorization, equilateral, circumference) was assessed at one week, word set 2 (adjacent, equivalence, fraction) was assessed at two weeks, word set 3 (proportion, reciprocal, equation) was assessed at four weeks after all words had been learned. These sessions were conducted using probe condition procedures. Nontarget information was not assessed during generalization sessions. Data were collected on the data sheet provided (Appendix A).

Experimental Design

Experimental effects were evaluated within a multiple probe (conditions) across behaviors design to evaluate the effectiveness of CTD while teaching a student

with visual impairments. When using a multiple probe design "threats to internal validity due to history, maturation, and testing are evaluated by staggering the introduction of the independent variable across tiers" (Gast & Ledford, 2014, p. 255). Therefore, threats to internal validity are minimized when using this type of single subject research design. A functional relation is shown with this design when each behavior shows similar, desired changes when the intervention is introduced.

Reliability

Dependent variable reliability. Interobserver agreement (IOA) data were collected by the independent observer, who is a special education teacher within the building. Sessions were recorded for the second observer, who is also the investigator. The observer was trained on response definitions and procedural variables and role played with the investigator until interobserver agreement of 100% was obtained for two consecutive sessions prior to the start of data collection. Data were taken during 20% of each of the session condition. If throughout the study, the IOA agreement fell below 80%; the investigator re-trained the observer until acceptable levels were reached. IOA data were calculated using the point by point method: number of agreements divided by the number of agreements + disagreements multiplied by 100 (Gast, 2014). The reliability data sheet for obtaining IOA agreement is included in Appendix B (Probe) and Appendix C (Instructional, Maintenance, Generalization).

Independent variable reliability. Procedural fidelity data were collected by the independent observer. During instructional trials, procedural fidelity data were collected on the investigator behaviors of: (a) providing the stimulus, (b) investigator presented stimulus, (c) providing the attending cue, (d) ensuring the participant's attention, (e)

providing the instructional cue, (f) waiting 0 s for 0 s CTD sessions and waiting 3 s for 3 s CTD sessions, (g) recording student's response, (h) giving correct consequence for response, and (i) delivering nontarget information. Procedural fidelity was calculated using the following formula, number of observed behaviors divided by the number of planned behaviors multiplied by 100 (Gast, 2014). The reliability data sheet is included in Appendix D (Probe), Appendix E (0 s delay), and Appendix F (3 s delay).

Section 4: Results

Reliability

Dependent variable reliability. Reliability data were collected a total of 12 sessions out of 53, including all probes and instructional sessions. Data were taken a total of 3 times (21%) during probe sessions, 8 occasions (22%) during instructional sessions, and 1 time (25%) during maintenance and generalization sessions. Throughout the study, reliability data were collected in 22% of total sessions. Mean IOA was 99% for probe, intervention and maintenance sessions. IOA for each condition was as follow: probe 97% (range, 94% to 100%), intervention 98% (range, 96% to 100%), maintenance 98% (range, 94% to 100%).

Independent variable reliability. Procedural fidelity were 100% for all sessions observed and all investigator behaviors. Investigator behaviors for baseline sessions include: (a) investigator presented stimulus, (b) investigator gave attending cue, (c) investigator ensured participant's attention, (d) investigator gave the task direction, (e) investigator waited 0 s, (f) investigator said the "word" with a verbal description, (g) student's response recorded, (h) investigator gave correct consequence for response (descriptive praise for attending), (i) no reinforcement provided for correct response. Investigator behaviors for instructional sessions include: (a) investigator presented stimulus, (b) investigator reminded student to wait for the answer if the answer was unknown, (c) investigator gave attending cue, (d) investigator ensured participants attention, (e) investigator gave the task direction, (f) investigator waited 3 s, (g) investigator provided controlling prompt if needed, (h) student's response recorded, (i) investigator gave correct consequence for response, including nontarget information.

Effectiveness Data

A graph of the dependent variable for each word set is provided in Figure 1. The participant showed an immediate increase in the percentage of correct anticipations at the start of instruction and met mastery criterion for word sets that were taught. A functional relation between CTD and the recognition of functional braille words was demonstrated by three replications. A visual analysis of the results of all word sets displayed a flat trend at 0% response during baseline conditions and quickly moved to an accelerating trend when intervention was introduced. The change in level was maintained during maintenance conditions. There was little to no variability in the level of each word set. Joshua learned three braille words, reaching 100% accuracy for 3 consecutive sessions, across 11 sessions during word set 1. Joshua learned three braille words to criterion, across 8 sessions during word set 2. Joshua learned three more braille words to criterion of 100% accuracy over 3 consecutive sessions, across 17 sessions during set 3. Joshua required more sessions to criterion in word set 3. There was an extended break due to inclement weather that may have contributed to this factor. The time period of when the break began is indicated in the graph of the results.

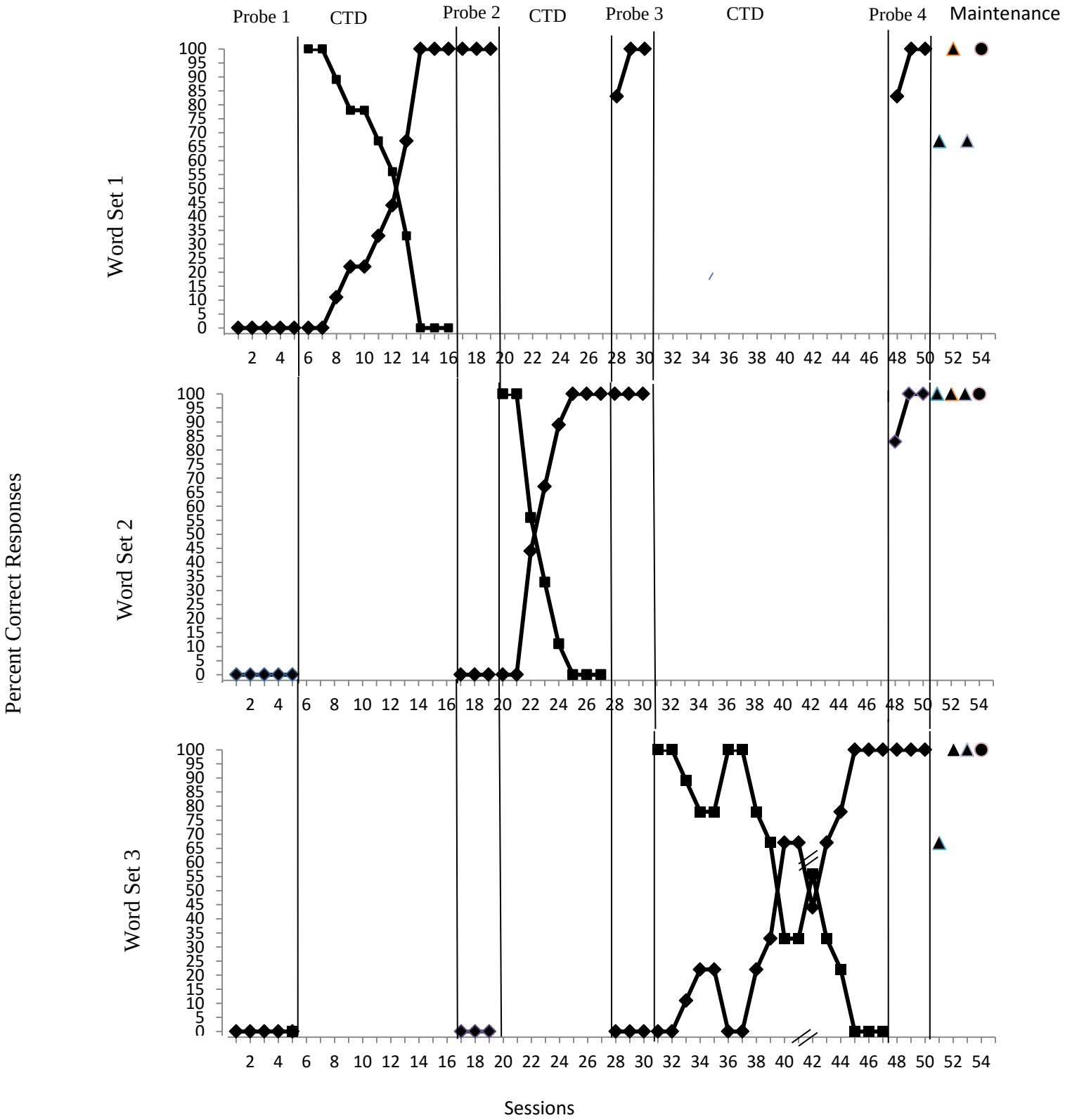


Figure 2. Graph of Results. The number of correct responses before the prompts represented by diamonds and the number of correct responses after the prompt are represented by squares. Maintenance data is represented by triangles and generalization data is represented by circles. // Indicates a break in data points.

Efficiency Data

The table of the efficiency data, including sessions through criterion, minutes through criterion, and percent of errors through criterion for each word set is provided in Table 3. The participant showed an immediate increase in the percentage of correct anticipations at the once he was given the opportunity to respond independently in 3 s delay trials. Joshua learned three braille words, reaching 100% accuracy for 3 consecutive sessions, across 11 sessions during word set 1. Mean total duration of instructional sessions across word set 1 was 4.5 minutes (range, 4-6). Transfer of stimulus was achieved during session 8, with the following session reaching 100% accuracy. There was an 11% error rate through criterion for word set 1. Joshua learned three braille words to criterion, across 8 sessions during word set 2. Mean total duration of instructional sessions across word set 2 was 4.25 minutes (range, 3.5-5.5). He was able to achieve stimulus transfer during session four of word set 2. Joshua had an 8% error rate through criterion for word set 2. Joshua learned three more braille words to criterion of 100% accuracy over 3 consecutive sessions, across 17 sessions during set 3. Mean total duration of instructional sessions across word set 3 was 5.75 minutes (range, 4-6.25). The transfer of stimulus occurred twice during word set 3, during sessions 10 and 13. There was a regression during sessions 11 and 12, with session 15 being at 100% accuracy. He had a 15% error rate during word set 3. A functional relation between CTD and the recognition of functional braille words was demonstrated by three replications. A visual analysis of the results of all word sets displayed a zero level response during baseline conditions and quickly moved to an accelerating trend when intervention was introduced. The change in level was maintained during maintenance conditions.

Table 3

Efficiency Data

Word Set	Sessions though criterion	Minutes through instruction	Number/Percent errors though criterion
Set One	11	49.5	11%
Set Two	8	34	8%
Set Three	17	97.75	15%
Total Across Sets	36	181.25	34%
Mean Across Sets	12	60.42	11.33%

Maintenance and Generalization Data

Maintenance of treatment effects after the termination of the CTD procedure was collected 1, 2, and 4 weeks after the final probe session following probe procedures. Maintenance data revealed that Joshua had retained the braille words: 1 week, 16/18 88%; 2 week, 18/18 100%; 4 week 17/18 94% accuracy over time. Maintenance data were also collected during probe sessions throughout the study on all previously instructed tiers. Maintenance data for word set one were also collected during probe 2, probe 3, and probe 4. He was able to read the words with 100% accuracy during probe 2 and 83%-100% during probe 3 and 4. Maintenance data for word set 2 were collected during probe 3 and probe 4. He maintained the reading of the targeted brailled words at 100% accuracy during probe 3 and 83%-100% during probe 4. He retained the information at 100% accuracy during probe 4 for word set 3.

Generalization of the learned words was conducted in the general education classroom using probe procedures embedded in naturally occurring activities within the classroom 1, 2, and 4 weeks after all tiers had been completed. Word set 1 was assessed 1 week following the final probe session. Joshua was able to obtain 100% accuracy for the word set. Word set 2 was assessed after 2 weeks. Joshua was able to read adjacent, equivalence, and fraction with 100% accuracy. Word set 3 was assessed 1 month after the final probe. Joshua retained word set 3 with 100% accuracy.

Nontarget Information

Data were collected on the student's current knowledge of the nontarget information prior to probe sessions (pre-test) and following instructional sessions (post-test). Baseline data revealed that the student was unable to give the correct definition of any of the nine target words presented during the pre-test. Data collected on each word set revealed that the student was able to verbally state the definition of each word set at the conclusion of the instructional sessions and furthermore was able to maintain the definition at 100% accuracy throughout the maintenance sessions. Results are included in Table 4.

Table 4

Results of Nontarget Information

Nontarget Information	Pre-Test	Post-Test	Maintenance 1 week	Maintenance 2 week	Maintenance 4 week
Word Set 1	0%	100%	100%	100%	100%
Word Set 2	0%	100%	100%	100%	100%
Word Set 3	0%	100%	100%	100%	100%

Section 5: Discussion

The purpose of this study was to evaluate the effectiveness of CTD in teaching recognition of brailled core content words, particularly in math, to a student with a visual impairment. In addition, determining the effectiveness of presenting nontarget information within a consequence was assessed. The data indicated the use of CTD as a teaching strategy was effective in teaching recognition of math content words to a middle school student with a visual impairment. Prior to the study, the student had a limited learning history using CTD procedures. Despite learning successfully with the CTD procedure in two tiers in the study, the third tier required more sessions through criterion than the previous two tiers. This most likely occurred because during Tier 3 instruction, the school district was closed for over 15 days due to inclement weather. Upon returning to school, Joshua's ability to recall the previously learned information decreased. Once consistent programming occurred, Joshua was able to reach criterion on this word set. A discussion of the procedural fidelity is warranted in that all sessions scored with 100% IOA data. A high percentage was able to be obtained because the investigator used a simplified task analysis of the procedures for each condition when administering each session.

Joshua was able to generalize the learned content words to regular education classroom with 100% accuracy. This demonstration not only validates CTD as an effective teaching strategy in a 1:1 instructional arrangement but also displays the effectiveness of the instructional content within the natural contexts of the student's school day.

Overall, the student was able to learn 9 new content words and definitions on grade

level with slightly over 3 hours (181.25 minutes) of instruction. This study extends previous research by showing how near-errorless learning procedures and related practice in reading brailled words can result in effective and efficient academically oriented instructional program for middle school students with a visual impairment. The use of CTD with students with VI has not been well studied and this demonstration of effectiveness extends its effectiveness to a new population of students.

Although the current study supports the use of CTD as an effective and efficient teaching strategy, further research should examine the effects and efficiency of this strategy in comparison to other teaching strategies. Future research should also include various age levels from 2nd grade through young adulthood who may or may not have additional impairments to a visual disability. Additional research is needed in the area of students with a visual impairment using the CTD procedure to teach various skill sets such as; daily living skills, pre-braille skills, reading comprehension, and self-advocacy. An additional component that should be considered in future research is the social validity of the goals, procedures, and outcomes of CTD with students with VI. Social validity was not addressed within the current study and is an important consideration when conducting research.

Limitations and Conclusions

Limitations within the current study would include that there was only one participant included in this study. Therefore, these outcomes invite fellow investigators to evaluate the effectiveness of the procedure with different participants and skills. Although the content words were taught in isolation, efforts to include the words in an academic setting were evident during maintenance sessions. The study aimed to assess

generalization of the content words and definitions within a classroom environment to ensure the use of learned words.

Future research should concentrate on variances within the embossed braille, area of data collection, various age groups and reading levels. To allow for variances within the braille, the investigator can include one space between each letter in a word. This would allow a braille reader with less than average tactile skills to navigate through the word easier. One could also do a comparative study using increased spaces within the words to no spaces within the words to decide through efficiency data if the strategy of spacing was effective. A comparative study could also be conducted to determine if the use of tactile diagrams or raised line drawings versus the use of only reading the braille card would increase the efficiency and effectiveness of the learned content. An investigator may also collect data on reading speeds, fluency, and comprehension skills of the words used within text during maintenance sessions or as an extension of the current study. Future research should examine the learned skill of spelling the words, in addition to reading the braille, through the use of the instructional feedback that was given within the current study. In conclusion, it can be stated that CTD is a relatively simple and inexpensive teaching strategy to employ within multiple environments (i.e., educational setting, home, community) and can be easily implemented by most investigators, paraprofessionals, parent/guardian, and peer tutors. There are currently no established literacy practices that have previously been researched and replicated for students with VI. CTD is an effective alternative for teaching students with a visual impairment.

Appendix A: Data Collection Form

Student: _____Investigator: _____
Time to initiate: _____Time to complete:_____
Date:_____Delay Interval:_____Session #:_____

	+B	-B	+A	-A	NR	NTI
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13						
14.						
15.						
16.						
17.						
18.						
#correct						
%correct						
#incorrect						
%incorrect						
#NR						
%NR						
%correct of non target information						

Comments:

Key: B+ correct before the prompt, B- incorrect before the prompt, A+ correct after the prompt, A- incorrect after the prompt, NR no response after the prompt

Appendix B: Reliability Data Form

Probe

Student: _____Investigator: _____
Time to initiate: _____Time to complete:_____
Date:_____Delay Interval:_____Session #:_____

	+	-	NR
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13			
14.			
15.			
16.			
17.			
18.			
#correct			
%correct			
#incorrect			
%incorrect			
#NR			
%NR			

IOA Total:_____

Procedural reliability data total:_____

Appendix C: Reliability Data Form

Student: _____ Observer: _____
Time to initiate: _____ Time to complete: _____
Date: _____ Delay Interval: _____ Session #: _____

	+B	-B	+A	-A	NR	NTI
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13						
14.						
15.						
16.						
17.						
18.						
#correct						
%correct						
#incorrect						
%incorrect						
#NR						
%NR						
%correct of non target information						

IOA Total: _____

Procedural reliability data total: _____

Appendix D: IOA Probe Data Collection Form

Student: _____Investigator: _____Start Time: _____Stop Time:_____Date:_____
Delay Interval:_____ Session #:_____Behavior:_____ Condition/Phase:_____
Observer:_____

Trial	T gives attending cue	T ensures participant attends	T presents stimulus	T gives task direction	T waits total of 13 s	Records student responding	T administers consequences correctly	T delivers praise on a FR3 schedule
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
Reliability Percentage								

Appendix E: IOA 0s delay Data Collection Form

Student: _____Investigator: _____Start Time: _____Stop Time:_____Date:_____
Delay Interval:_____ Session #:_____Behavior:_____ Condition/Phase:_____
Observer:_____

Trial	T presents stimulus	T gives attending cue	T ensures participant attends	T gives task direction	T waits 0 s after student completes reading (10 s)	T says "word" with description	Records student responding	T administers consequences correctly
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
Reliability Percentage								

Directions: While observing investigator, please record whether investigator emitted behavior during instructional for each trial.
Key: (+) = occurrence; (-) =nonoccurrence

Appendix F: IOA 3s delay Data Collection Form

Student: _____Investigator: _____Start Time: _____Stop Time:_____Date:_____

Delay Interval:_____ Session #:_____ Behavior:_____ Condition/Phase:_____

Observer:_____

Trial	T presents stimulus	T reminds student to wait	T gives attending cue	T ensures participant attends	T gives task direction	T waits 3s	T gives controlling prompt if needed	T records student response	T administers consequences correctly	T delivers NTI with correct responses
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
Reliability Percentage										

Directions: While observing investigator, please record whether investigator emitted behavior during instructional for each trial.

Key: (+) = occurrence; (-) =nonoccurrence

References

Aldemir, Ozgul, & Gursel, Oguz, (2014). The effectiveness of the constant time delay procedure in teaching pre-school academic skills to children with developmental disabilities in a small group teaching arrangement. *Educational Sciences: Theory & Practice, 14*(2), 733-740.

Browder, D.M., Ahlgrim-Delzell, L., Courtade, G., Gibbs, S.L., & Flowers, C., (2008). Evaluation of the effectiveness of an early literacy program for students with significant developmental disabilities. *Exceptional Children, 75, 33-52.*

Collins, Belva C., (2012). Systematic instruction for students with moderate and severe disabilities. Baltimore, Maryland: Brooks Publishing Company.

Brigance; Comprehensive Inventory of Basic Skills II. (2010). North Billerica, MA: Curriculim Associates.

Daugherty, S., Grisham-Brown, J., & Hemmeter, M. L. (2001). The effects of embedded skill instruction on the acquisition of target and nontarget skills in preschoolers with developmental delays. *Topics in Early Childhood Special Education, 21*(4), 213-221.

Dogoe, M. S., Banda, D. R., Lock, R. H., & Feinstein, R. (2011). Teaching generalized reading of product warning labels to young adults with autism using the constant time delay procedure. *Education and Training in Autism and Developmental Disabilities, 46(*2), 204-213.

Doyle, P. M., Gast, D. L., Wolery, M., Ault, M. J., & Farmer, J. A. (1990). Use of constant time delay in small group instruction: A study of observational and incidental learning. *Journal of Special Education, 23*(4), 369-385.

Ferrell, K. A. (2006). Evidence-based practices for students with visual impairments. *Communication Disorders Quarterly, 28*(1), 42-48.

Gast, D. L. (2014). General factors in measurement and evaluation. In D. L. Gast & J. R. Ledford (Eds.), *Single case research methodology: Applications in special education and behavioral sciences* (2nd ed., pp. 85-104). New York, NY: Routledge.

Gast, D. L., & Ledford, J.R. (2014). *Single-subject research methodology in special education and behavioral sciences.* New York, NY: Routledge.

Hirsch, Jr. E.D. (2003). Reading comprehension requires knowledge of words and the world. *American Educator,* Spring, 11-30.

Hooper, J. D., Ivy, S. E., & Hatton, D. D. (2014). Using constant time delay to teach braille word recognition. *Journal of Visual Impairment & Blindness, 108*(2), 107-121.

Hua, Y., Woods-Groves, S., K., Kaldenberg, E. R., & Scheidecker, B. J. (2013). Effects of vocabulary instruction using constant time delay on expository reading of young adults with intellectual disability. *Focus on Autism and Other Developmental Disabilities, 28*(2), 89-100.

Hughes, T. A., & Fredrick, L. D. (2006). Teaching vocabulary with students with learning disabilities using classwide peer tutoring and constant time delay. *Journal of Behavioral Education, 15*(1), 1-23.

Keel, M. C., & Slaton, D. B. (2001). Acquisition on content area vocabulary for students with learning disabilities. *Education and Treatment of Children, 24*(1), 46-71.

Koscinski, S. T., & Gast, D. L. (1993). Use of constant time delay in teaching multiplication facts to students with learning disabilities. *Journal of Learning Disabilities, 26*(8), 533-567.

Mechling, L.C., Gast, D.L., & Krupa, K. (2007). Impact of SMART board technology: An investigation of sight word reading and observational learning. *Journal of Autism & Developmental Disorder, 37*, 1869-1882.

Morrison, C. E. (2013). Acquisition of mathematical vocabulary using constant time delay with individuals with moderate and severe disabilities. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 73*(7-A)(E).

National Reading Panel: Teaching Children to Read (NICHD, 2000) *The Braille literacy crisis in America.* National Federation for the Blind. Baltimore, MD: National Federation for the Blind, Jernigan Institute.

Pruitt, B. A., & Cooper, J. T. (2008). Ready, set, go: Three strategies to build reading fluency. *Beyond Behavior, Spring*, 8-13.

Savaiano, M. E., Compton, D. L., Hatton, D. D., & Lloyd, B. P., (2016). Vocabulary word instruction for students who read Braille. *Exceptional Children, 82*(3), 337-353.

Saviano, M. E., & Hatton, D. D. (2013). Using repeated reading to improve reading speed and comprehension in students with visual impairments. *Journal of Visual Impairment & Blindness, March-April*, 93-106.

Scheithauer, M. C., & Tiger, J. H. (2014). Teaching Braille line tracking using stimulus fading. *Journal of Applied Behavior Analysis, 47*, 612-616.

Seward, J., Schuster, J. W., Ault, M. J., Collins, B. C., & Hall, M. (2014). Comparing simultaneous prompting and constant time delay to teach leisure skills to students

with moderate intellectual disability. *Education and Training in Autism and Developmental Disabilities, 49*(3), 381-395.

Tiger, J. H. (2014). Teaching braille line tracking using stimulus fading. *Journal of Applied Behavior Analysis, 47*(3), 612-616.

Vervloed, M.P.J., Loijens, N.E.A., & Waller, S.E. (2014). Teaching the meaning of words to children with visual impairments. *Journal of Visual Impairment & Blindness. Sept.-Oct.,* 433-438.

Wall, M. F., & Gast, D. L. (1997). Caregivers as investigators: Using constant time delay to teach adults how to use constant time delay. *Education & Training in Mental Retardation & Developmental Disabilities, 32*(3), 213-28.

Winterling, V. (1990). The effects of constant time delay, practice in writing or spelling, and reinforcement on sight word recognition in a small group. *Journal of Special Education, 24*(1), 101-116.

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