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THE EFFECTS OF USING CONSTANT TIME DELAY TO TEACH DIGRAPHS TO ELEMENTARY STUDENTS WITH MILD DISABILITIES

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THESIS

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

By

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ABSTRACT OF THESIS

THE EFFECTS OF USING CONSTANT TIME DELAY TO TEACH DIGRAPHS TO ELEMENTARY STUDENTS WITH DISABILITIES

Constant time delay (CTD) is a near-errorless response prompting procedure that involves a presentation of a stimulus, a delay interval, and a controlling prompt. The purpose of this study was to determine the effectiveness of teaching vowel/consonant digraph sounds to children with mild disabilities using constant time delay. A multiple probe (conditions) across behaviors design, replicated with three students, was used. The results indicated that CTD is effective in teaching vowel/consonant digraphs to elementary students with mild disabilities which then generalize to reading words containing those same digraphs.

KEYWORDS: constant time delay, mild disabilities, digraphs, elementary students

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CHAPTER 1. THE EFFECTS OF USING CONSTANT TIME DELAY TO TEACH DIGRAPHS TO STUDENTS WITH MILD DISABILITIES

1.1 Introduction

Literacy, or the ability to read and write, is fundamental for students to be able to access education. In 2000, the National Reading Panel (NRP) released an evaluation of hundreds of research studies that have been published about reading from 1966 to 1998. This review was in response to a charge sent out by Congress in 1997 to determine standards for instructional practices in reading by evaluating existing research and evidence. The NRP identified five main areas essential to successful reading instruction: phonemic awareness, phonics, fluency, vocabulary and comprehension. Bradley and Noell (2013) explained the definitions of these five essential areas:

> The most fundamental of these skills, phonemic awareness is the ability to manipulate phonemes in spoken language. Phonics involves blending and segmenting phonemes with letters. Fluency requires reading with speed, accuracy, and proper expression. Possessing appropriate vocabulary plays an important role in facilitating comprehension. Finally, comprehension is the ability to understand what has been read and is the cornerstone of achieving literacy (p. 880).

In the 20 years since the NRP report, these five areas have been studied by researchers around the country in an effort to create effective reading programs.

One of the key strategies described in the NRP report for teaching the five areas of reading is explicit and systematic instruction. The sentiment in education, then and now, is that we cannot afford to leave learning to chance. Instruction must be effective, therefore, explicit and systematic. In the area of phonics, explicit and systematic

instruction is recommended. Explicit instruction is such because there is a direct approach to teaching both in instructional design and delivery. Students are guided through the learning process in a clear and supported method until mastery is achieved (Archer & Hughes, 2011). Systematic instruction is carefully planned and sequenced (Collins, 2012). In systematic phonics instruction, the planned set of phonics skills are taught sequentially (Ehri et al., 2001).

1.1.1 Phonics Instruction

Phonics instruction is a general term used to describe a teaching method for acquisition of letter-sound correspondence and is one piece of the reading puzzle (National Reading Panel, 2000). According to the NRP report summary, phonics instruction is essential to the development of decoding skills, reading fluency, and reading comprehension (NRP, 2000). Phonics encompasses several foundational skills including alphabetic understanding (letter-sound knowledge) and phonological recoding (http://reading.uoregon.edu/, 2002). Knowing how letters are linked to sounds is letter sound knowledge. Letter sounds are represented either by one grapheme (letter) having a single sound or multiple graphemes having a single sound (blends, digraphs and trigraphs). Knowing how to put those sounds together is phonological recoding.

Phonics instruction can be approached in two ways: synthetically or analytically. Synthetic instruction uses explicit teaching of letter sounds and how to blend them into words. Analytic instruction uses previously learned words and sounds to decode or make sense of unfamiliar words. Said differently, synthetic instruction uses a part to whole approach whereas analytic instruction uses a whole to part approach (Ehri et.al, 2001). Both methods have points of effectiveness, however, the National Reading Panel (NRP)

recommends a more synthetic approach to phonics instruction. The NRP (2000) describes their review of literature findings on phonics instruction. The findings indicated that systematic and explicit instruction produces significant benefits for students in kindergarten through sixth grades, including those with reading difficulties. However, more research is needed on specific and effective phonics instruction procedures for students with disabilities.

As noted by Joseph and Seery (2004), little research exists on effective phonics instruction for students with disabilities. Since phonics instruction is an essential component of reading, this is an area that warrants further research. Joseph and Seery reviewed studies conducted from 1990-2003 on phonics instruction and students with mild to moderate intellectual disability. Their search resulted in seven articles from six different journals. Most of the participants fell within the mild to moderate intellectual disability category according to IQ scores. Six of the seven articles examined different phonics instruction approaches. Two studies used computer-assisted programs. The other studies used the following approaches: picture-fading and tactile-kinesthetics to teach letter-sound correspondence, comparing letter patterns and sounds instruction to whole-word instruction, teaching phonics through error-correction, teaching word analysis skills, and a comprehensive literacy approach that embedded phonics instruction. Despite the variety of instructional procedures, the results of all studies revealed phonics instruction, specifically phonetic-analysis strategies, to be effective for students with disabilities; however no clear strategy emerged more efficient than another. The authors noted disappointment in the number of research studies located since a research analysis conducted in 1992 (Connor, 1992), found approximately the same amount of research.

This lack of research highlights the need for further research on phonics instruction procedures used for students with mild to moderate disabilities.

1.1.2 Digraphs

In this study, the systematic and explicit response prompting strategy of constant time delay was used to teach vowel and consonant digraphs. Vowel and consonant digraphs are two graphemes that represent one phoneme or sound (Eldredge, 2004). Some examples of vowel and consonant digraphs are: *ch, sh, ng, ai, ee, ie,* and *ue*. Methods for teaching digraphs range from using word games to general word study (Bear, 2007; Cunningham, 2000). Often digraph instruction is embedded within the teaching of word families and general word study (Bear, 2007).

1.1.3 Constant Time Delay

Constant time delay (CTD) is a near-errorless response prompting procedure (Bradley & Noell, 2018; Collins, 2012). The procedure involves a presentation of a stimulus, a delay interval, and a controlling prompt presented by the instructor. The delay interval begins with the simultaneous presentation of the target stimulus and the prompt, otherwise known as a 0-s delay. Then the prompt is faded by inserting a constant amount of time between the target stimulus and the prompt (e.g., 4-s). One of five responses is possible: correct/incorrect response before the prompt, correct/incorrect response after the prompt, or a no response after the prompt (Koscinski & Hoy,1993; Wolery & Gast, 1984).

Constant time delay was used for investigation in this study. It was chosen for its reported effectiveness and efficiency (Aldosiry, 2020; Bradley & Noell, 2018; Doyle,

Wolery, Gast & Ault, 1990; Morton & Flynt, 1997;) in teaching discrete skills to students with disabilities and without disabilities. Several studies have found that time delay is easy to implement, provides near-errorless learning, and can be used for a variety of tasks (DiPipi-Hoy & Jitendra, 2004; Ledford et al., 2012; Stevens & Schuster, 1998). Time delay has been used to teach learners with a variety of disability levels and both chained and discrete responses. Constant time delay is often chosen to teach discrete skills because of its proven effectiveness and efficiency (Doyle 1990; Mattingly & Bott, 1990; Wolery & Gast, 1984). Among other skills, it has been used effectively to teach both math and literacy skills.

In one study by Morton and Flynt (1997), CTD was compared to prompt fading to teach multiplication facts to students with learning disabilities. Here the authors used three students in third grade and one student in fourth grade. Systematic prompt fading and CTD were used in an alternating treatments design using the five-step "try" procedure. In the first step, the researcher compiled a pool of unknown math facts for each student. The students were then probed for three consecutive days on the 100 unknown facts. From those facts, the second step was to compile unique fact sets. In the third step, one of the teaching procedures was employed and the other procedure was alternated the next day. Step four was a one-minute probe condition just after each teaching session. The final step was to analyze the data and determine the more effective teaching approach. The results showed both methods were effective. Two students learned more math facts when CTD was used. The other two students learned more efficiently with prompt fading. This has a positive teaching implication in that either

procedure, prompt fading or constant time delay, can work for students with learning disabilities. Teachers have tools to use and can tailor instruction toward the students.

In a more recent study related to literacy, CTD was used to teach young adults vocabulary words relating to health care and money management (Hua et al., 2013). In this study the researchers used an alternating treatments design to examine the usefulness of teaching vocabulary words and definitions using CTD and then testing for reading comprehension using expository texts. Overall, they found teaching vocabulary and definitions using CTD led to more successful vocabulary acquisition and retention than not using CTD as was done in the control condition.

Bradley and Noell (2018) examined the use of CTD to supplement phonics instruction for students identified by the teacher as struggling first grade readers. These students did not have a diagnosed disability in reading or otherwise. The researchers sought to answer three questions. First, would CTD be an effective intervention to teach phonics skills to struggling readers? Second, would CTD be effective when applied to more complex phonemic constructions (i.e., digraphs). And third, would the addition of a systematic contingent reward procedure accelerate the learning? The researchers chose six first grade students who were identified as struggling readers with an oral reading fluency score of less than 29 words per minute. The desired target behavior was correct sounding out and blending of pseudowords. An adapted three-phase reversal design with phases of baseline, CTD, and CTD plus percentile shaping (contingent rewards) were used. During the CTD phases, the researchers used a set of pseudowords for five trials per session. During the first trial, a 5 s delay was used to allow for data collection and instruction. If during the first trial the student did not respond, the researcher provided a

verbal model of the word and waited an additional 5-s for the student to respond. The second trial used a 0-s delay and then the researchers returned to a 5 s delay for the remaining three trials. The study resulted in noteworthy gains of phonics skills during the CTD phases consistent across all participants. The study also concluded that adding the contingent rewards did not accelerate learning in this instance. This study and its results reinforce the research on the effective nature of using CTD to teach discrete skills (i.e., phonics) to young students.

1.2 Research Questions

The current study extends the literature by examining the effects of CTD in teaching digraph instruction. The purpose of this study was to determine the effectiveness of teaching phonics skills to children with mild disabilities using constant time delay. The research questions to be answered included:

Is CTD effective to teach vowel/consonant digraphs to students with mild disabilities in lower elementary grades?

Does teaching isolated sounds generalize to reading words containing those sounds?

CHAPTER 2. METHOD

2.1 Participants

2.1.1 Students

Three participants were included in this study: two boys and one girl. Two of the participants were identified with developmental delay as defined by the state of Kentucky regulations. Developmental delay (DD) is a label often used when a child between the ages of 3-8 years that has not acquired or achieved commensurate with performance

expectations for their age in or more developmental areas. One student was identified with emotional and behavioral disabilities according to state regulations. All three students were in the second grade at a public elementary school and received services between 1-4 hours daily in a special education resource room. All received services for reading, reading comprehension, and math. All participants met the inclusion criteria for the study that included a learning history with time delay, difficulty with decoding skills, and mastery (at least 23/26) of single letter-sound correspondence.

Ace was a 7-year-old male identified with developmental delay. Most of his day was spent in the general education classroom with adult support for reading. He received 2 hours a day of resource time, attended occupational therapy twice a week, and received speech language services three times a week. His targeted areas of weakness were basic reading strategies (decoding and sight word fluency) above a first grade level, comprehension skills, oral reading fluency, acquiring new skills rapidly, and attention to task beyond 2 minutes. He showed relative strengths with his listening comprehension, receptive language, and basic motor skills.

Brittany was a 7-year-old female. Her primary disability label was developmental delay. She spent 1 hour a day in a resource room and received direct adult support for time spent in the general classroom. She received speech language therapy three times a week and occupational therapy two times a week. She showed relative weaknesses in the areas of attending to tasks for longer than 2-3 minutes, basic reading skills, and acquiring knowledge without direct adult instruction. She had recently shown an interest in learning about words and reading.

The third student selected for the study was Chris, an 8-year-old with a primary disability label of emotional behavior disorder (EBD). He had a medical diagnosis of bi-polar disorder with attention deficit and hyperactivity disorder (ADHD) and obsessive-compulsive disorder (OCD). Academically, he was weak in the areas of basic reading of sight words above a first-grade level, listening comprehension, language processing and attention to tasks longer than 2 minutes. He worked best when tasks were presented visually and in small amounts.

2.1.2 Others

The researcher of this study also served as the special education resource teacher. She held a Bachelor's degree in Special Education with an emphasis in Learning and Behavior Disorders. She was certified to teach elementary school and special education. As of the date the study was conducted, she had 8 years teaching experience and was enrolled in a master's degree program. The reliability observer was a paraeducator who regularly assisted and interacted with the students who participated in this project. She was trained by the researcher in the use of constant time delay and was familiar with taking observation data.

2.2 Rationale

The dependent variable in this study was decoding vowel/consonant digraphs. Examples of vowel/consonant digraphs include: *ae, ch, th, ck,* and *ee.* This was an isolated skill that the identified students had not mastered. It also was an objective listed on their individualized education programs. To ensure the skill was needed, I consulted various reading/phonics resources and resource specialists. For instance, it is a required

skill to decode words containing digraphs on numerous phonics assessments, including GRADE (Williams, Cassidy, & Samuels, 2014) and DIBELS (Good & Kaminski, 2002). By learning to quickly decode isolated digraphs, the students increase their overall decoding speed therefore, increasing reading fluency. Reading fluency directly relates to reading comprehension and therefore, overall reading proficiency. All agreed the skill was valid for the targeted students. The initial teaching of the isolated digraphs was followed by the expected generalization of those digraphs into decoding actual words.

2.3 Materials

Twenty digraphs divided into four groups of five digraphs each were taught to each participant. Table 1shows the digraphs for each participant. The vowel and consonant digraphs were hand printed in black ink on 76x127mm (3x5 in.) white index cards at a height of approximately 2.54 cm (1 in.). The researcher had a set of cards and a data recording sheet for each session. For the generalization conditions, the 76x127mm (3x5in.) white index cards were hand-printed with selected words containing targeted digraphs. Screening stimuli were chosen by consulting several phonics/reading instruction resources including: Phonics for Teachers: Self Instruction, Methods and Activities (Eldredge, 2004), Phonics They Use (Cunningham, 2000), Words Their and Way for English Learners: Word Study for Phonics, Vocabulary, and Spelling Instruction (Bear, 2007).

[Table 1.1 Digraphs used in Intervention Sessions for Ace, Brittany, and Chris]

	Ace	Brittany	Chris
Set A	ck	ck	wh
	sh	sh	ay
	ue	ee	ie
	oa	au	ea
	ew	ei	ui
Set B	nk	nk	nk
	ch	ch	ch
	ee	ue	ee
	au	oa	au
	ei	ew	ei
Set C	th	wh	th
	ai	ay	ai
	oo	ie	oo
	ey	ea	ey
	aw	ui	aw
Set D	wh	th	ck
	ay	ai	sh
	ie	oo	ue
	ea	ey	oa
	ui	aw	ew

2.4 Data Collection

The constant time delay procedure to be used in the study lends itself to controlled presentation data collection. Data were collected on the accuracy of student responding either before or after the delivery of the controlling prompt or if no respond at all occurred following the prompt. There were five types of possible student responses. First, if the student verbally stated the correct digraph sound within 3-s of the task request, an unprompted correct response was recorded. Second, if the student stated the correct digraph sound after the prompt was delivered, a prompted correct response was recorded. Third, if the student stated a sound other than the correct digraph sound within 3-s or before the prompt was delivered, it was recorded as an unprompted error. Fourth, if the student responded stated an incorrect digraph sound after the prompt was delivered, that was recorded as a prompted error. And fifth, if the student did not state any sound after the prompt was delivered, it was recorded as a prompted no response. At the end of each session, the number of unprompted correct responses were plotted on graphs.

2.5 Procedures

The instructional objective for this study was as follows: When presented with vowel/consonant digraphs, the students will correctly say each digraph sound within 3-s of the visual stimulus with 15/15 correct responses over three consecutive sessions for each set of digraphs. The independent variable in this study was a 3-s constant time delay to measure the dependent variable, which is learning the 20 vowel/consonant digraphs.

All phases of the study (screening, probe conditions, intervention sessions, and generalization sessions) were conducted in the special education resource room

containing no more than five students at any given time. Sessions were conducted in a 1:1 instructional arrangement. The student and researcher sat at a designated table with the student's back to the class to reduce distractions. While sessions were occurring, other students were working independently or with an instructional assistant. These students were instructed not to interrupt the researcher or student while sessions are conducted.

The researcher first conducted initial screening sessions to identify a collection of digraphs the student could not read. Once initial screening of all digraphs took place, the set of digraphs were assigned to three sets of five digraphs. The researcher then conducted probe sessions on all 20 stimuli (unknown digraphs) for three sessions over three consecutive days. The researcher then conducted intervention sessions on the first set of digraphs. These sessions continued until criterion was met. Once criterion was met, the probe condition was repeated on all stimuli. Then intervention on the second set of unknown digraphs began. This process was repeated until all four sets of unknown digraphs had been learned to criterion.

2.5.1 Screening Procedures

Initially, each student was screened using isolated digraph sounds. From those unknown digraphs, 20 were chosen for instruction. Also, during the initial screening session, words containing vowel and consonant digraphs were assessed to determine if students could read words containing the digraphs. Twenty (20) of these words were used in the generalization sessions of the study. See Table 1.2 for the list of digraphs and words.

Three screening sessions were conducted with each participant across a 2 week period with two trials per stimuli which totaled 40 trials per session. For each session, the sounds were presented written on cards and students were asked, “What sound?” A 3-s response interval was given after each visual stimulus was presented. There were three responses possible for screening sessions: unprompted correct, unprompted error or no response. An unprompted correct response for screening was when the student verbally stated the correct digraph sound within 3-s of the stimulus (visual presentation of the digraph) and was marked with a +. An unprompted error was when the student verbally stated a response other than the correct one within 3-s of the stimulus and was marked with a 0. A no response was when the student said nothing within 3-s of seeing the stimulus and was also marked with a 0. The inter-trial interval was less than 2-s. Verbal praise was given for unprompted correct responses and unprompted errors were ignored. No prompts were delivered in screening sessions.

[Table 1.2 Vowel/Consonant Digraphs used in Screening and Words used in Generalization Sessions]

ck	**back**
ng	**ring**
ay	**day**
ea	**meat**
oo	**food**
nk	**sank**
th	**that**
ue	**blue**
aw	**paw**
ie	**tie**
ch	**chop**
wh	**whip**
ee	**deep**
au	**haul**
ui	**suit**
sh	**shut**
ai	**rain**
oa	**soak**
ew	**new**
ey	**key**

2.5.2 Probe Condition Procedures

During probe conditions, all 20 digraph sounds were assessed during the same session with three trials per stimulus equaling 60 trials per session. Sessions took place for at least three sessions are until the data were stable. The target stimuli were presented to the students one at a time in random order. The researcher began the session by gaining the students attention by saying, “Let’s get ready to read.” The students were presented with the card and asked, “What sound?,” and the researcher waited 3-s for the response. Possible responses in probe conditions were unprompted correct responses in which the student stated the correct digraph sound within 3 seconds, unprompted incorrect responses in which the student stated anything other than the correct digraph sound within 3-s, or unprompted no responses in which the student did not state anything within 3-s. When the student responded with an unprompted correct response, the researcher provided verbal praise (e.g., “Great job.”). All other responses were ignored.

2.5.3 Instructional Session Procedures

For the instructional sessions, one set of digraphs was taught at a time in a 1:1 setting. Constant time delay sessions consisted of the presentation of targeted stimuli set (the unknown digraphs) three times for a total of 15 trials per session. Sessions for each set took place until criterion is reached. Criterion was 100% mastery (15/15 correct responses) for three consecutive sessions. Each stimulus was initially presented at a 0-s delay during the first session for each set of sounds. For this presentation, the researcher explained that the word would be shown, and the digraph sound would be modeled and then should be repeated by them. (i.e., “The sound is __. What sound? Good.”). This

procedure was repeated throughout the 0-s delay session for each set of sounds. The remaining sessions were conducted using a 3-s delay interval in which attention was gained, the digraph card was presented, and the researcher waited 3-s for a response. If the student did not respond, the researcher presented the verbal model (i.e., controlling prompt). There were 5 possible student responses: unprompted correct, prompted correct, unprompted error, prompted error and prompted no response. After all correct responses, either before or after the prompt, the researcher delivered verbal praise (i.e., "Good."). Incorrect responses before the prompt were corrected by modeling, "The sound is…, what sound?" and incorrect responses after the prompt were ignored. What was the consequence for a prompted no response? Inter-trial intervals were no longer than 3-s.

2.6 Maintenance

Maintenance probes were integrated into probe condition sessions. As each set of digraphs was mastered, previously mastered sets were tested, and results were plotted on the graphs.

2.7 Generalization

After each student reached criterion for all four instructional sets, a generalization condition took place. The generalization sessions were conducted exactly like probe condition sessions except that instead of isolated digraphs, words containing those mastered digraphs were used. The students were expected to correctly read the entire word for a correct response. The response was marked as partially correct if the newly learned vowel/consonant digraph was correctly pronounced but the rest of the word was incorrect. An incorrect response was marked if the entire word was pronounced

incorrectly. Words were recorded as incorrect if any part was said incorrectly. For instance, “back” was said as “bake” as well as if initial or vowel sound was incorrect. Words were only assessed in screening and generalization sessions. There were no intervention sessions for the words.

2.8 Experimental Design

A multiple probe (conditions) across behaviors design, replicated with three students, was used to assess the effectiveness of constant time delay to teach vowel/consonant digraph sounds. In a multiple probe design with conditions, all sets of stimuli are probed and then again, each time a subject reaches criterion on a set of stimuli. Experimental control is demonstrated by a change in the target behavior occurring when and only when the independent variable is implemented.

2.9 Threats to Validity

With any experimental study, threats to validity exist. To combat these threats in this study, several steps were taken. By choosing a multiple probe across conditions several threats were lessened. The threat of testing, instrumentation, and maturation were minimized because testing occurs in intermittent sessions during probe conditions. By conducting independent and dependent variable reliability, the instrumentation threat was also minimized. Attrition was minimized in this study by selecting three students with excellent attendance records. The parents are informed of the study and made to understand the importance of attendance to school. To control for history threats, the teachers and parents were informed of the procedures to be used and all agreed to avoid teaching digraphs if possible. Intermittent checks were made with teachers about

upcoming lesson plans involving decoding strategies. History was most likely the largest threat to the validity of this study.

2.10 Reliability

Reliability data were collected by a paraprofessional that was trained by the researcher of the study on how to collect both interobserver agreement data and procedural fidelity reliability. Reliability data were collected in 20% of the sessions in each condition by the trained observer. The formula used to calculate procedural fidelity was (the number of behaviors observed / number of behaviors planned) x100. The planned researcher behaviors included: delivery of attentional cue, giving of task stimuli and prompt, waiting the appropriate response interval, delivering the model, if appropriate, and delivering consequence. Interobserver agreement data were calculated using a point-by-point method formula:

(number of agreements / number of agreements + disagreements) x 100.

An acceptable level of reliability was 80% but the preferred level was 90%.

CHAPTER 3. RESULTS

3.1 Reliability

Interobserver agreement was collected for probe conditions, intervention and generalization sessions. Interobserver reliability data were collected for 20% or 31 of the sessions with reliability being 90%. Reliability data were gathered during 20% or 2 of the generalization sessions for 100% reliability.

Procedural fidelity on the researcher behaviors was taken during probe conditions. During probe conditions, procedural fidelity data was collected for 20% or 24 of the sessions with overall reliability being 90%. The procedural fidelity data reliability on researcher delivery of attentional cue, giving of task stimuli and prompt, waiting the appropriate response interval, and delivering the model was 100% while researcher delivery of appropriate consequence ranged from 80-90%.

3.2 Data Analysis

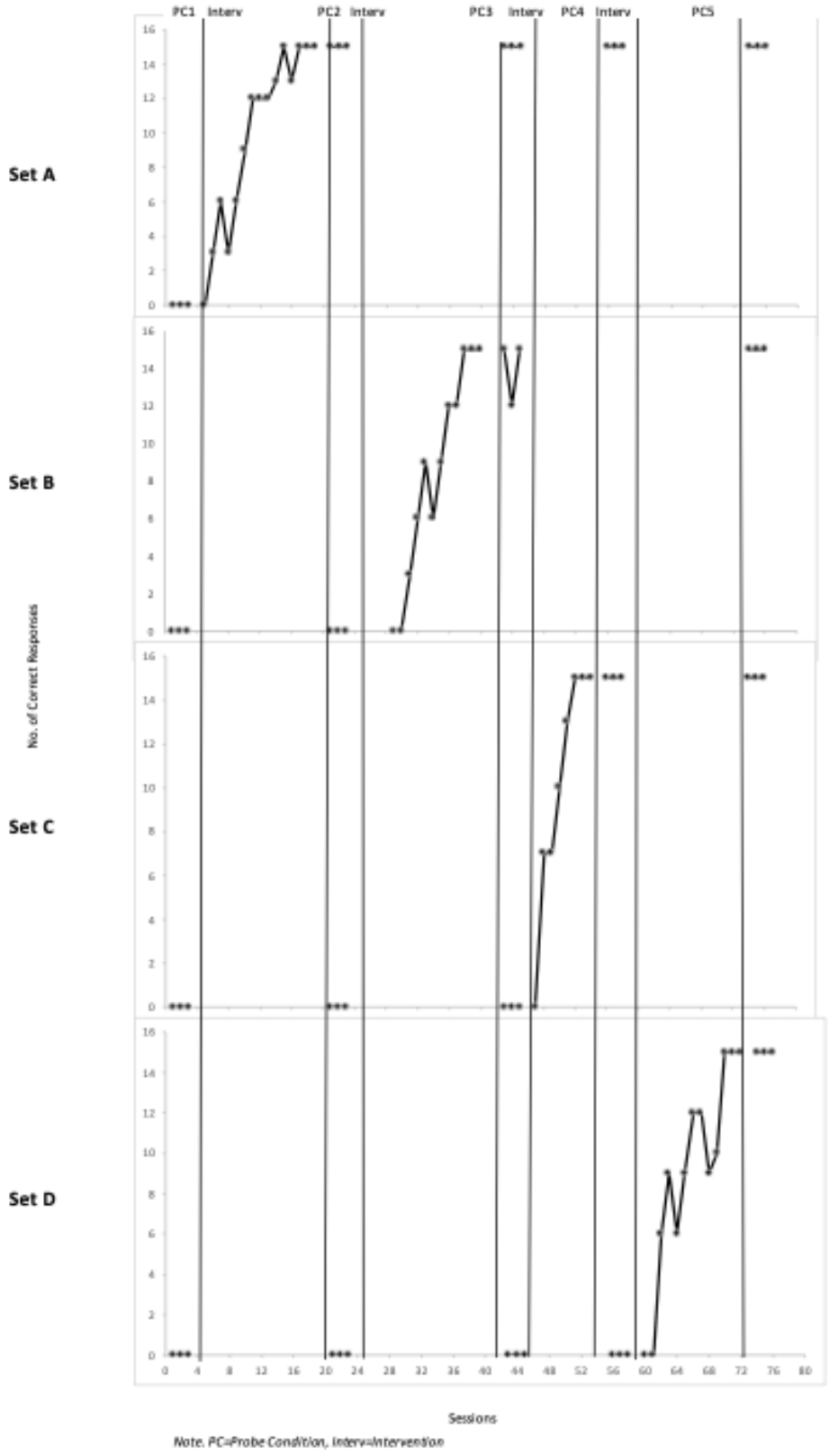
Figure 3.1 shows the number of correct responses in all four sets for Ace. All baseline probes were at 0 correct responses for untrained stimuli. For each set of stimuli, once the intervention was implemented, the data showed an increasing trend, reaching criterion. The average number of sessions across all set of words was12 sessions to reach criterion. All but two of the maintenance data points were still at 15 correct responses. To reach criterion, a minimum of three sessions at 15 correct responses were required.

Figure 3.2 shows the results for Brittany. All baseline probes for untrained stimuli were at 0 correct responses. Once intervention was implemented for each set of stimuli, the data showed an increasing trend, reaching criterion. The average number of sessions across all sets to reach criterion was 10 sessions. Maintenance session data points remained at 15 correct responses. Thus, staying at criterion for all maintenance sessions.

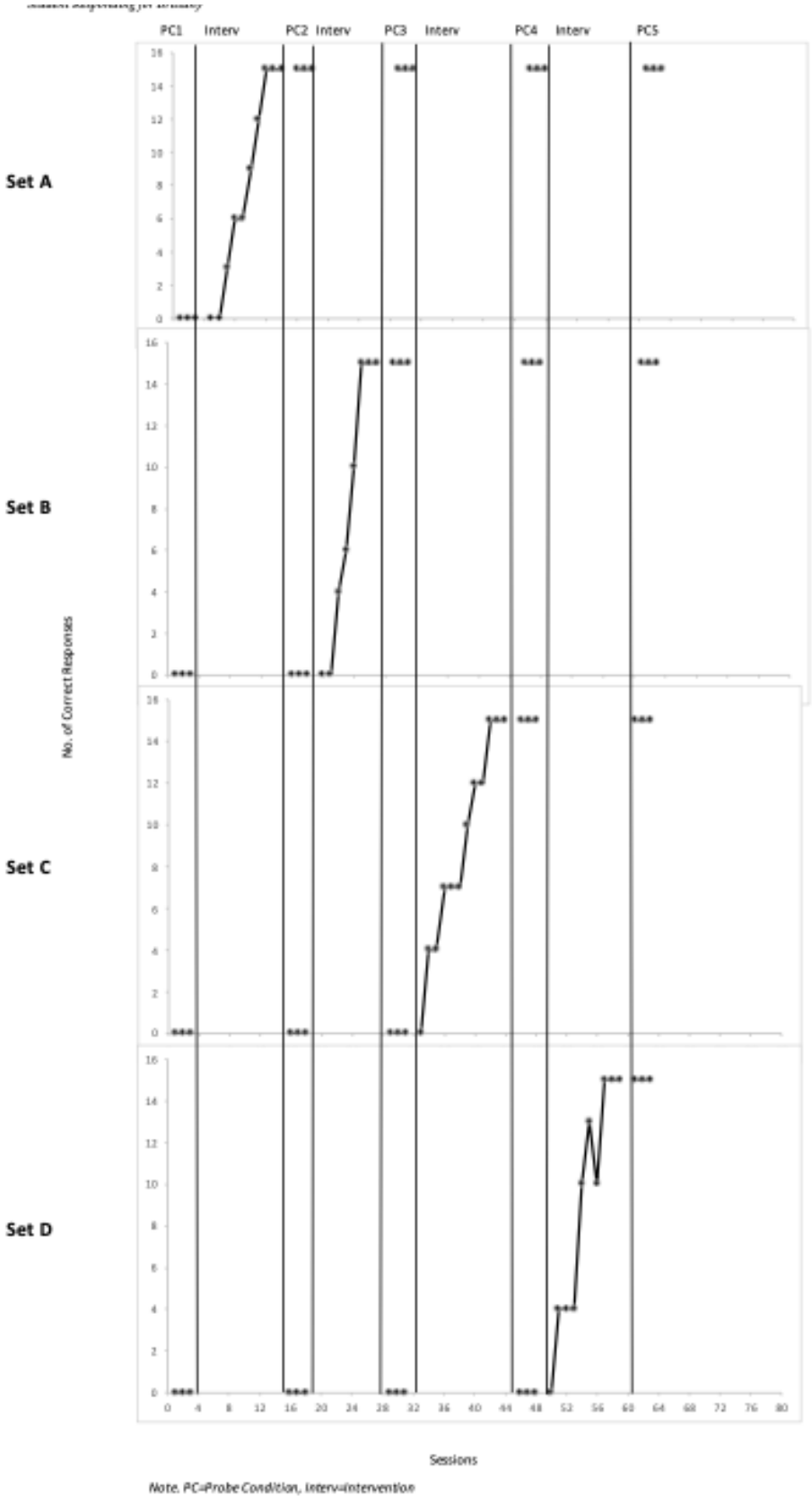
Chris' results are shown in Figure 3.3. All baseline probes for untrained stimuli were between 0-3 correct responses. For each set of stimuli once intervention was implemented, the data showed an increasing trend to reach criterion. The average across

all set of words was of 11 sessions to reach criterion. All maintenance session data points were between 12-15 correct responses.

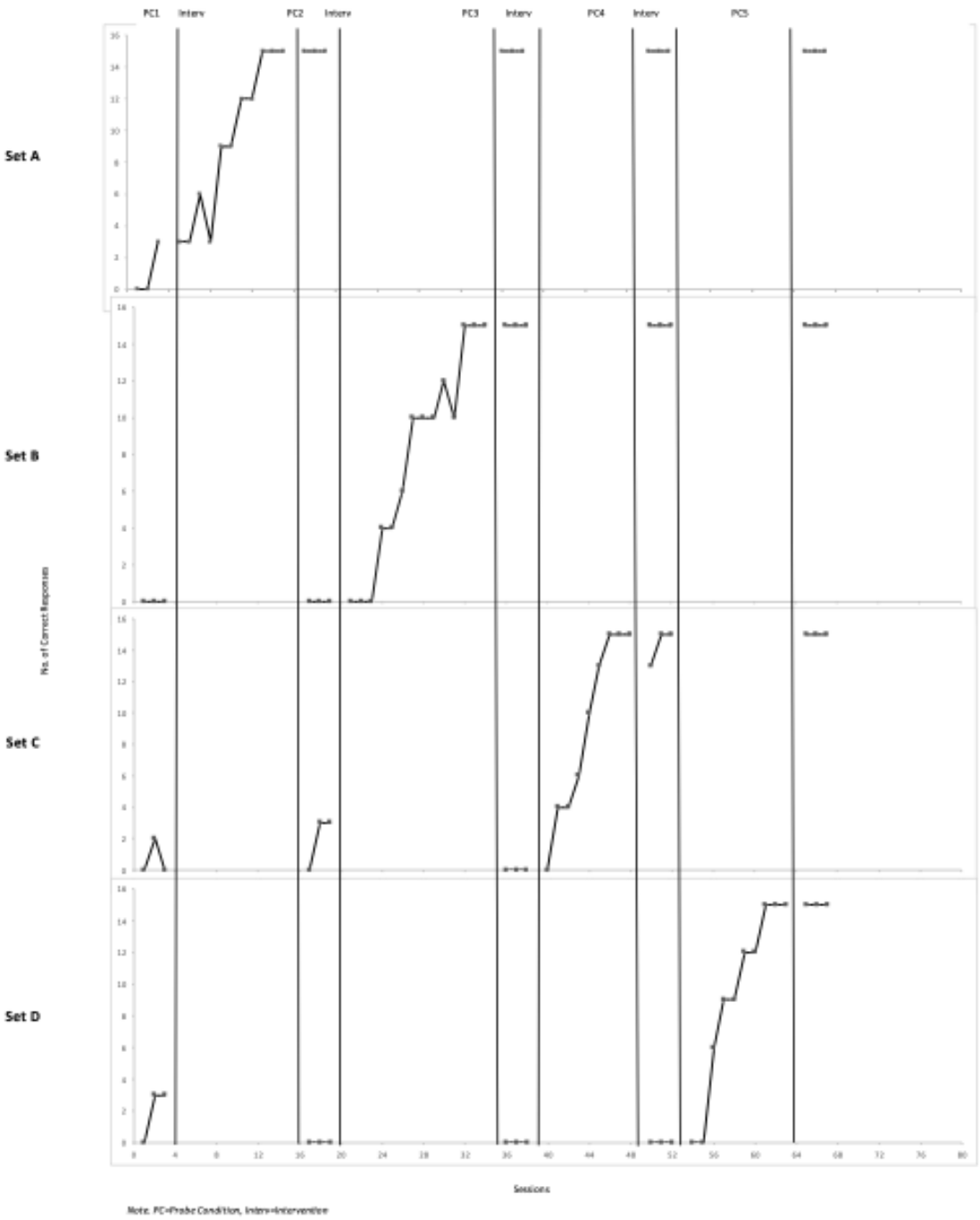
For the generalization phase of the study, each student generalized the isolated sounds into decodable words in the range of 15-20 correct responses over 3 consecutive sessions. Over three sessions, Ace responded with an average of 17 of 20 words read correctly. Brittany correctly read an average of 19 of 20 words. Chris' average was an average of 17 of 20 words read correctly.



[Figure 3.1 Student Responding for Ace]



[Figure 3.2 Student Responding for Brittany]



[Figure 3.3 Student Responding for Chris]

CHAPTER 4. DISCUSSION

Experimental control was demonstrated when the intervention resulted in all three students meeting criterion for each set of digraphs and by replication of intervention effects across sets and students. All students reached criterion within a relatively short amount of time (between 8-14 sessions). As shown in the maintenance data, learning of the isolated digraphs was maintained over time. Overall, the students generalized the isolated digraphs into reading words containing those digraphs to an acceptable level.

Advantages of using CTD are many. Expensive materials or equipment are not required, and the procedure is relatively easy for teachers or instructional assistants to learn. Sessions are brief and could be done more frequently throughout the day with the same task or another. Data collection is straightforward, and graphs can even be completed by the students as part of motivation building.

The results of this study show that CTD was an effective method for teaching isolated vowel/consonant digraphs to three students with mild disabilities. CTD has been shown effective with a variety of skills and it appears learning vowel/consonant digraph sounds can be added to that list. The results are also favorable for the generalization of decoding digraphs to reading words. Since the study used only three students with mild disabilities, future research is needed with a wider population of disabilities.

4.1 Conclusion

In this study, CTD was an effective method for teaching isolated vowel/consonant digraphs. CTD has been shown effective with a variety of skills and it appears learning

vowel/consonant digraph sounds can be added to that list. The results are also favorable for the generalization of decoding digraphs to reading words.

4.2 Implications for Practice

As the educational world continues to grow and change with new technology and need for in person instruction, it is important for all teachers to have easy yet effective tools to use with all students. It is the recommendation of the researcher that CTD be used as part of a comprehensive approach to teaching phonics and reading. By investigating phonics skills and time delay, the study adds to the research on effective tools for teachers to use. Not only would time delay be a tool to use in reading, but its adaptability also makes it a tool to use in many other academic and skill areas.

REFERENCES

Archer, A.L., Hughes, C.A. (2011). *Explicit instruction: Efficient and effective teaching*. The Guilford Press..

Bear, D.R. (2007). *Words their way with english learners: Word study for phonics, vocabulary, and spelling instruction*. Pearson Merrill Prentice Hall.

Bradley, R.L., Noell, G.H. (2018). The effectiveness of supplemental phonics instruction employing constant time delay instruction for struggling readers. Psychology in the Schools,55(7), 880-892. http://dx.doi.org.ezproxy.uky.edu/10.1002/pits.22148

Collins, B.C. (2012). *Systematic instruction for students with moderate and severe disabilities.* Baltimore, MD: Paul H. Brooks Publishing Co.

Cunningham, P.M. (2000). *Phonics they use: Words for reading and writing* (3rd ed.). Longman.

DiPipi-Hoy, C., & Jitendra, A. (2004). A parent-delivered intervention to teach purchasing skills to young adults with disabilities. *The Journal of Special Education*, 38(3), 144-157 http://dx.doi.org/10.1177/00224669040380030201

Doyle, P.M., Wolery, M., Gast, D.L., & Ault, M.J. (1990). Comparison of constant time delay and the system of least prompts in teaching preschoolers with developmental delays. *Research in Developmental Disabilties,11*(1). 1-22.

Ehri, L.C., Nunes, S.R., Stahl, S.A., & Willows, D.M. (2001). Systematic Phonics Instruction Helps Students Learn to Read: Evidence from the National Reading Panel's Meta-Analysis. https://doi-org.ezproxy.uky.edu/10.3102/00346543071003393

Eldredge, J.L. (2004). *Phonics for teachers: Self-instruction, methods, and activities.* Upper Saddle River, NJ: Pearson Education, Inc.

Good, R.H., & Kaminski, R. A. (2002). *Dynamic indicators of basic early literacy skills (6th ed.)*. Eugene, OR: Institute for the Development of Educational Achievement.

Hua, Y., Woods-Groves, S., 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. https://doi.org/10.1177/1088357613477473

Joseph, L.M. & Seery, M.E. (2004). Where is the phonics?: A review of literature on the use of phonetic analysis with students with mental retardation. *Remedial And Special Education, 25*(2). 88-94.

Koscinski, S.T. & Hoy, C. (1993). Teaching multiplication facts to students with learning disabilities: The promise of constant time delay procedures. *Learning Disabilities Research & Practice, 8* (4). 260-263.

Ledford, J. R., Lane, J. D., Elam, K. L., & Wolery, M. (2012). Using response-prompting

procedures during small-group direct instruction: Outcomes and procedural variations: AJMR. *American Journal on Intellectual and Developmental Disabilities, 117*(5), 413-34. http://ezproxy.uky.edu/login?url=https://www.proquest.com/scholarly-journals/using-response-prompting-procedures-during-small/docview/1081340636/se-2?accountid=11836

Mattingly, J.C. & Bott, D.A. (1990). Teaching multiplication facts to students with learning problems. *Exceptional Children, 56*(5). 438-449.

Morton, R.C. & Flynt, S.W. (1997). A comparison of constant time delay and prompt fading to teach multiplication facts to students with learning disabilities. *Journal of Instructional Psychology, 24*(1).

National Reading Panel (2000). Report of the National Reading Panel: Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups. Rockville, MD: NICHD Clearinghouse. https://www.nichd.nih.gov/publications/pubs/nrp/smallbook

Neitzel, J., & Wolery, M. (2009). Steps for implementation: Time delay. Chapel Hill, NC: The National Professional Development Center on Autism Spectrum Disorders, Frank Porter Graham Child Development Institute, The University of North Carolina.

Stevens, K.B. & Schuster, J.W. (1988). Time delay: Systematic instruction for academic

tasks. *Remedial and Special Education, 9*(5). 16-21.

University of Oregon (2002). Big ideas in beginning reading. http://reading.uoregon.edu/

Williams, K.T., Cassidy, J. & Samuels, S.J. (2014). *GRADE: Group Reading Assessment and Diagnostic Evaluation.* Pearson. https://www.pearsonassessments.com/content/dam/school/global/clinical/us/assets/grade-gmade/grade-manual.pdf

Wolery, M. & Gast, D.L. (1984). Effective and efficient procedures for the transfer of stimulus control. *Topics in Early Childhood Special Education, 4* (3). 52-77.

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