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Extending Research on the Comparative Efficacy of Computer Flashcard Reading Interventions in Elementary-School Students with Intellectual Disability

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Extending Research on the Comparative Efficacy of Computer Flashcard Reading Interventions

in Elementary-School Students with Intellectual Disability

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Dedication

For my loving and supportive family.

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Abstract

This dissertation is comprised of three studies, replicating and extending research on the effectiveness of computer flashcard reading interventions in teaching sight words to students with intellectual disability. In Study I, a multiple-baseline across students design was used to evaluate the effectiveness of a computer-based flashcard reading intervention with 2-s intervals for post-secondary students with intellectual disability. All three students quickly acquired words through this computer flashcard reading intervention, with average learning rates ranging from around one word acquired every 1.5 to 2.5 min of instruction. Maintenance and generalization data varied across participants.

In Study II, a multiple-baseline across-tasks design was implemented with elementary school students with intellectual disability to evaluate the effectiveness of a computer flashcard reading intervention with self-determined response intervals. During this intervention, instead of having set response intervals, the students had autonomy over the progression of the computer flashcard reading slides. Both participants rapidly acquired formerly unknown words after the implementation of this intervention.

In Study III, an adapted alternating treatments design was used to evaluate the comparative effectiveness of two computer flashcard reading programs (3-s vs self-determined condition) among three elementary school students with intellectual disability. The researchers examined learning rates to determine which intervention resulted in the greatest learning gains. Maintenance data along with information on student preferences regarding which condition they favored were also collected.

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Chapter I

Introduction

As students progress through school, their ability to read and comprehend texts becomes increasingly foundational to the learning process. Because students begin reading to learn in the latter grades, as schooling progresses, the ability to decode and understand words is necessary to gain knowledge from text (Skinner, 2008; Therrien, 2004). A majority of students acquire basic reading skills through explicit instruction of phonemic awareness (Snow, Burns, & Griffin, 1998; Stahl, 2001). Specifically, allowing students to manipulate letters while teaching them individual phoneme sounds and how these sounds blend together to form words is an effective strategy in teaching young students how to read (National Reading Panel, 2000).

Roughly 80% of students with specific learning disability in reading and intellectual disability struggle to gain phonemic awareness skills through direct instruction of blending, segmentation, and letter-sound relationships (Gersten, Fuchs, Williams, & Baker, 2001; National Institution of Child Health and Human Development, 2000). Consequently, while phonemic approaches to reading instruction are often beneficial, these strategies can leave children with intellectual disability at a disadvantage (National Institution of Child Health and Human Development, 2000). According to Fisher and Berliner (1985), students who struggle with reading increase their learning rates when they engage in "high-success" reading (Allington, 2006). Sight-word reading approaches can allow for this "high-success" reading because students end each interval with feedback and correct responses (Barbetta, Heward, & Bradely, 1993). Instead of spending more time on teaching phonemic awareness to struggling readers, sight word reading approaches may be more effective in teaching children with intellectual disability to read (Bliss, Skinner, Adams, 2006; Burns & Sterlin-Turner, 2010).

Flashcard-Reading Procedures

Flashcard reading is an approach to sight word reading instruction that can effectively increase word acquisition along with maintenance for previously learned words among students with intellectual disability (Browder & Xin, 1998; Nist & Joseph, 2008). Stimulus-response-stimulus learning trials are typically applied during flashcard reading procedures. Students are first presented with the word and are then prompted to read the word. The teachers then provide feedback in the form of reading the word aloud to the student. After the student hears the word read aloud, they are then prompted to repeat the word back, ensuring that their final response is a correct reading of the presented word (Browder & Xin, 1998; Nist & Joseph, 2008). With repeated flashcard trials, students may achieve a mastery of the words being presented (Tan & Nicholson, 1997).

Teacher-directed flashcard reading trials enable struggling readers to recognize high-frequency sight words so they can become more independent readers (Tan & Nicholson, 1997). Frequent exposure to flashcards paired with immediate feedback to incorrect responses allows teachers to scaffold reading instruction. This corrective feedback prompts correct final responses, possibly leading to greater word acquisition rates (Kulik & Kulik, 1988; Robinson & Skinner, 2002). Also, teachers may apply time delay procedures to prompt automatic responses to reduce errors during flashcard reading trials (Barbetta, Heward, & Bradely, 1993). For example, teachers may begin by allowing very short response intervals to discourage inaccurate responding and then gradually lengthen the intervals to promote independent, accurate responding (Kulik & Kulik, 1988).

Tan & Nicholson (1997) found that implementing flashcard-reading procedures with struggling readers is more effective than having the teacher simply read the words aloud to students. Flashcards expose children to high-frequency words on a regular basis while allowing them to interact with the words through verbal feedback. Struggling readers often have difficulties with fluid reading and comprehending texts (Pinnell, Pikulski, Wixson, Campbell, Gough, & Beatty, 1995). Flashcard reading procedures benefit these students by increasing their word acquisition and fluency while also improving their comprehension of passages, as they are able to devote more of their cognitive resources towards comprehending instead of reading (Robinson & Skinner, 2002; Tan & Nicholson, 1997). When students are able to read more fluently, they are able to devote more cognitive resources towards comprehending the passages versus solely reading the words.

Teacher-directed flashcard reading procedures are not always the most beneficial instructional approach for learning to read. Oftentimes, these flashcard-reading procedures place a high demand on teacher time, as they often require one-to-one teacher attention. Because of this demand for teacher time, feedback on responses may not always be administered with high integrity, which may reduce student learning (Moore & Fisher, 2007). To mitigate this strain on resources, researchers suggest implementing these flashcard reading procedures in larger groups, as students may learn through incidental learning (Hanely-Maxwell, Wilcox, & Heal, 1982; Orelove, 1982); still, students may feel social shame during teacher-led flashcard procedures when corrected by their teacher in front of their peers during the learning process, which may impede word acquisition (Phillips, 1978). Learning gains may also be hindered if teachers continue to review words that have been previously mastered by some students instead of replacing them with unknown words specific to each student (Nist & Joseph, 2008). When

teachers have large classrooms filled with struggling readers, individualizing each flashcard set and going through the words with each student may not be feasible.

Computer Flashcard Readings

Computer flashcard reading procedures are similar to teacher-directed flashcards with stimulus-response-stimulus learning trials (Browder & Lalli, 1991). Through these programs, the word appears on the computer screen for the student to read (*stimulus*), which prompts the students to say the word aloud (*response*). After the student reads the word, a recording of the word is played through the computer program (*stimulus)*, which prompts the participant to repeat the word again (Yaw, 2012). When students struggle with reading, teachers may implement time-delay procedures to effectively control for response intervals. These computer flashcard reading programs can be effective in facilitating sight word reading among diverse populations, specifically students with intellectual disability, autism, and specific learning disability in reading (Baumgart & VanWalleghem, 1987; Hilton, Hopkins, Skinner, & McCane-Bowling, 2011; Kodak, Fisher, Clements, & Bouxsein, 2011; Yaw, Skinner, Parkhurst, Taylor, Booher, & Chambers, 2011; Yaw, 2012). Also, these programs may allow for maintenance of acquired words during the intervention (Yaw, 2012).

For instance, researchers developed a computer flashcard reading intervention with a 2-s response interval for a 4th grade student with moderate to severe intellectual disabilities (Yaw, Skinner, Orsega, Parkhurst, Chambers, & Booher, 2012). In this study, three word lists, each containing 10 words, were developed. The student quickly acquired words through the use of the computer flashcard reading program with the 2-s response interval and maintained 28 of the 30 words eight weeks after the last intervention session. This study also illustrates that the words

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the student learned through the computer flashcard reading program generalized well to different reading contexts. During the study, the assessments were conducted via PowerPoint slides; however, when the words were written on index cards for the maintenance assessment eight weeks after the completion of the intervention, the student still maintained 93% of the words (Yaw, et. al., 2012). This generalization across stimuli (PowerPoint slide to index card) is important because students using the computer flashcard reading interventions need to be able to read the words that they acquire in the program in other contexts. In doing so, the words they learn through the computer flashcard reading programs gain contextual meaning and help facilitate future learning.

Computer flashcard reading procedures are effective at alleviating the inefficiencies involved with one-to-one flashcard procedures. Because these programs are self-directed by the students, teachers do not need to monitor the implementation of these interventions, allowing them to have more time to devote to other students and classroom activities (Kodak, Fisher, Clements, & Bouxsein, 2011). In allowing students to self-direct their computer flashcard reading interventions, they are also afforded more autonomy over their learning, possibly enhancing their self-efficacy (Yaw et. al., 2012). These programs may also facilitate student motivation, as they are active participants in the learning process (Moore & Calvert, 2000).

Computer flashcard reading interventions may also be implemented with more integrity than traditional flashcard instruction, as teachers may easily track student's acquisition of words, replacing their acquired words with unknown words to further enhance learning (Hilton, Hopkins, Skinner, & McCane-Bowling, 2011; Moore & Fisher, 2007; Kodak, Fisher, Clements, & Bouxsein, 2011). For example, Yaw, et. al., (2011) developed a program for a sixth-grade

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student with autism that flowed through three word lists as he acquired words. The original computer flashcard reading program targeted the first word list. Visual analysis of the time series data trends were used to determine when the intervention should shift to target words from the second and third word lists, respectively; these transitions occurred when the student mastered roughly 70% of the words in each targeted list. In flowing through word lists, the student was maximizing his learning because he was not continually reviewing words that he had previously mastered. Furthermore, the word lists were individualized to the student, ensuring that he was focusing on unknown words instead of reviewing words he may already know (Yaw, et. al., 2011).

These computer flashcard reading procedures also allow teachers to manipulate response intervals. Teachers may select shorter response intervals or allow students to self-determine their response intervals (Riley, 1986). Previous researchers have found that reducing response intervals enhances learning rates (Yaw, Skinner, Maurer, Skinner, Cihak, & Wilhoit, Delisle, & Booher, 2014). Shorter response intervals allow students to complete more learning trials in less time, facilitating the quality of instruction by making the learning sessions more efficient (Darch & Gersten, 1985; Skinner, McCleary, Poncy, Cates, & Skolits, 2013). These shorter response intervals may also increase student attention, possibly leading to greater word acquisition (Hawkins, Skinner, & Oliver, 2005). Regardless of the length of the response interval, when students attempt to read the word, they get immediate reinforcement from the program. As immediate reinforcement is more potent than delayed reinforcement, word acquisition may be enhanced through this immediate feedback (Kulik & Kulik, 1988).

Computer Flashcard Reading and Learning Rates

When students struggle to learn to read, some schools allocate more time to reading instruction while taking away time from other activities, such as recess. Since the onset of No Child Left Behind in 2001 (No Child Left Behind [NCLB], 2002), recess time has slowly been eliminated in order to devote more time to instruction during the school day. This drastic shift in scheduling has had the largest impact on students in urban school districts (Jarrett, 2003; Roth, Brooks-Gunn, Linver, & Hofferth, 2003; NCES, 2006). In spite of the benefits of physical exercise for young children, according to a national survey of recess time, 30% of third graders have 15 minutes or less of recess on a daily basis (Jarrett, 2002). Despite this trend, taking away recess time, or time from other activities, such as art, and physical education in favor of instructional time, does not necessarily result in increased learning gains in reading (Skinner, Fletcher, & Henington, 1996).

When seeking instructional support for students who are struggling to acquire words, it is important to remember that students who are referred for reading difficulties are still learning, but their learning rate is not sufficient to achieve academic goals (Cates, Skinner, Watson, Meadows, Weaver, & Jackson, 2003; Skinner, Fletcher & Henington, 1996). Instead of devoting more time to instruction, fitting more learning trials into a fixed time period enhances learning rates (Skinner, Fletcher, & Henington, 1996; Skinner, Cooper, & Cole, 1997). In order to get a more accurate depiction of an intervention's effectiveness over time, the focus should shift to measuring precise instructional time by dividing behavior change by the time spent on the intervention (Skinner & Daly, 2010). Researchers have found that computer flashcard reading programs that are only 2-5 min in length are still effective in facilitating word acquisition (Yaw,

et. al., 2014). As students do not need to devote a lot of time to computer flashcard reading programs in order to enhance their word reading, they will have more time to devote to other activities (i.e. recess, art, and physical education).

Researchers suggest that faster paced instruction may increase the amount learned per trial while also enhancing response accuracy (Darch & Gersten, 1985). When the instructional pace is increased, students may be more motivated to stay engaged with the activity. This sustained attention may explain the increase in the amount of learning that occurs per learning trial (Hawkins, Skinner, & Oliver, 2005). Computer flashcard reading interventions that are fast-paced also allow for more learning trials within a fixed period of time (Skinner, et. al., 1996; Skinner, Cooper, & Cole, 1997). Through increasing the quantity of learning trials within a fixed time period, word acquisition, fluency, and maintenance are all enhanced (Ebbinghaus, 1885; Greenwood, Delquadri, & Hall, 1984; Ivarie, 1986; Malone, 1990; Roediger, 1985; Skinner & Shapiro, 1989).

Self-Determination and Computer-Flashcard Reading Programs

Self-determination is a construct based on the theory that humans are causal agents of their behaviors; in other words, people are authors of their own actions (Little, Hawley, Henrich, & Marsland, 2002). Wehmeyer, Kelchner, & Richards (1996) developed a more applied definition of self-determination, outlining four important characteristics of self-determined actions: self-determination allows people to behave in an autonomous manner, allows behaviors to be self-regulated, allows individuals to personally respond to an event with empowerment, and allows people to recognize and fulfill their possibilities (Shogren, Wehmeyer, Palmer, Soukup, Little, Garner, & Lawrence, 2008; Wehmeyer, Kelchner, & Richards, 1996). Students with

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intellectual disability often have limited opportunities in the classroom to develop their sense of autonomy and self-determination. Specifically, students with intellectual disability typically report lower levels of self-determination when compared to their peers (Shogren, et. al., 2007; Williams-Diehm, Wymeyer, Palmer, Soukup, & Garner, 2008). These limitations result from a lack of opportunity for this population to select personal preferences and make decisions throughout the day (Stancliffe, Abery, & Smith, 2000). Despite the inequalities in levels of self-determination, all students are capable of developing these skills with appropriate instructional strategies (Wehmeyer & Garner, 2003).

Instructional strategies that allow students to make their own personal decisions are strongly correlated with the development of self-determination in people with intellectual disability (Algozzine, Browder, Karvonen, Test, & Wood, 2001; Cobb, Lehmann, Newman-Gonchar, & Alwell, 2009; Nota, Ferrari, Soresi, & Wehmeyer, 2007; Shogren, Wehmeyer, Palmer, Soukup, Little, Garner, & Lawrence, 2007). Self-determination skills can be acquired through computer-flashcard reading interventions that allow students some autonomy over the program. Instead of selecting set intervals, researchers may implement self-directed computer flashcard reading programs that allow students to select their own response intervals. In these self-directed programs, participants will have more autonomy over the reading intervention (Driscoll, 2005).

In implementing computer flashcard reading programs with self-determined response intervals, students can selectively spend more or less time on words, depending on their familiarity with them. Giving students time to decode words and apply their phonemic skills may be an important step in their application of previously learned words; after students attempt

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to apply these reading skills, they can press the space bar to receive automatic feedback (Yaw, 2012). Allowing students to set the pace for their instruction can enhance learning rates while also increasing their motivation to continue to engage with the intervention. Students may also like being active participants in the intervention and enjoy having the opportunity to beat their past times while also reading accurately (Moore & Calvert, 2000).

The characteristics of self-determined actions outlined by Wehmeyer, Kelcher, and Richards (1996) align well with computer-flashcard reading interventions with self-determined response intervals (Shogren, Wehmeyer, Palmer, Soukup, Little, Garner, & Lawrence, 2007; Wehmeyer, Kelchner, & Richards, 1996). Because students are able to self-determine their response intervals through this computer-flashcard reading program, the students are able to act autonomously and regulate their own behavior. This computer-flashcard reading program also allows students to self-regulate their behaviors, as they can decide how long of an interval they want for each word that appears on the screen. If they automatically know the word, the students may elect to read the word quickly and then immediately press the space bar. However, if the student wants to attempt to sound the word out, they may opt for a longer response interval, allowing them more time before they hear the feedback (Yaw, 2012). Computer-flashcard reading procedures with self-determined response intervals enable students to personally respond to the intervention and feel empowered to maximize their potential. Allowing students to engage with reading interventions through choice may also increase their motivation to continue learning (Brooks, Freiburger, & Grotheer, 1998; Moore & Calvert, 2000).

Several positive outcomes may result from allowing students with intellectual disability to develop their self-determination skills during school. When students with intellectual

disability are instructed in ways that increase their self-determination, they may be more likely to be active participants in transition planning for post-high school (Arndt, Konrad, & Test, 2006). Self-determination skills also allow for these students to have better post-graduation outcomes (Wehmeyer & Palmer, 2003). Specifically, students with intellectual disability who develop adequate self-determination skills are more independent after graduation and are more likely to be compensated with higher salaries in their future careers (Lachappelle, Wehmeyer, Haelewyck, Courbois, Keith, Schalock, Verdugo, & Walsh, 2005). Thus, programs that help students with intellectual disability acquire self-determination skills, like self-directed computer flashcard reading interventions, contribute to positive outcomes for this population.

Previous researchers have illustrated the effectiveness of computer flashcard reading interventions to promote the acquisition of words. Researchers have illustrated that computer flashcard reading procedures with fixed response intervals are effective at increasing sight word reading in elementary school students (Yaw, et. al., 2011; Yaw, et. al., 2012). With Study I, this research was extended and replicated to evaluate the effectiveness of a computer flashcard reading program with a fixed response interval (2-s) on three post-secondary students with intellectual disability.

Study II was designed to evaluate the effectiveness of a computer flashcard reading program when the participants self-determined their response intervals. Two elementary school students with intellectual disability participated in this study. Instead of the computer flashcard reading program automatically triggering responses, these students were able to have autonomy over each response interval.

Study III was designed to replicate and extend previous research by evaluating and comparing two computer flashcard reading interventions; one of these interventions had fixed response intervals (3-s.) and one had self-determined response intervals. Researchers examined words learned and word learning rates (e.g., words learned per minute) to determine which computer flashcard reading intervention (3-s. or self-determined condition) was more effective for each student. Maintenance data along with information on student preferences were also collected. Together, these studies will help researchers identify and create interventions that are efficient at alleviating reading deficits in students with intellectual disability.

Research Questions

The following questions are considered:

Study 1. Is a fixed-interval computer flashcard reading program a valid intervention for adults in post-secondary education programs?

Study 2. Is the computer flashcard reading intervention still effective for children with intellectual disability when students have control over the response intervals?

Study 3. Which computer flashcard reading intervention causes the highest learning rate across children with intellectual disability (3-s vs. self-determined condition)? Which intervention (3-s or self-determined condition) do the participants prefer?

Chapter II

Study I: Extending Research on a Computer-Based Flashcard Reading Intervention to Post-

Secondary Students with Intellectual Disabilities

Authors Notes

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Abstract

A multiple-baseline across students (three adults with intellectual disabilities enrolled in a post-secondary college education program) design was used to evaluate the effects of a computer-based flashcard reading (CFR) intervention, developed using Microsoft® Power Point® software, on students' ability to read health-related words within 3-s. Results support the effectiveness of CFR intervention for enhanced word reading in all students with average learning rates ranging from approximately one word acquired per 1.5 min of instruction to one word acquired per 2.5 min of instruction. Data collected one month after intervention procedures ceased showed that maintenance and generalization (i.e., ability to read words embedded within passages) varied across students, which supported previous findings conducted with younger children and easier words. Discussion focuses on directions for future research and applications to post-secondary education.

School psychology training is broad enough to have application across settings, populations, and professional activities (National Association of School Psychologists, 2010; Pfohl, 2005). Although school psychology training may be focused on identifying, preventing, accommodating, and remedying learning problems and academic skills deficits in pre-school through high-school students (Shapiro, 2011), this training may also be applied to adult learners, including college students with disabilities (Winn, Skinner, Oliver, Hale, & Ziegler, 2006). School psychologists have been involved with identifying disabilities in college students and advocating for and/or recommending accommodation and remediation services (Maller & McDermott, 1997). Additionally, school psychologists have provided consultation, counseling, program development, and therapy services to college students with mild disabilities (Sulkowski & Joyce, 2012; Vess, 2002).

The recent increase in the number of post-secondary education programs for students with intellectual disabilities provides another opportunity for school psychologists to apply their skills. In the United States, there are over 100 post-secondary programs catered toward students with intellectual disabilities (College Transition Connection, 2013). Students in these programs often take a mix of required courses designed specifically for them (e.g., courses targeting life and/or social skills) and elective general university courses (Grigal, Hart, Smith, Domin, & Suleski, 2013). One of the challenges associated with general education courses is that students are often exposed to course-specific printed words. In many instances, because students are taking courses that fit their specific interests, they may understand the word when it is spoken and be able to use the word while speaking, but have difficulty reading the very same word.

Word Reading Instruction. Teacher-directed flashcard procedures can be used to enhance word reading acquisition (the ability to read words in isolation) and maintenance (Browder & Xin, 1998; Nist & Joseph, 2008). Additionally, researchers have found evidence that students can read words learned during flashcard instruction when they are embedded within connected text (Joseph, Eveleigh, Konrad, Neef, & Volpe, 2012). Most flashcard instruction has involved one-to-one, student-to-teacher ratios, where stimulus-response-stimulus learning trials are applied. First, the printed flashcard is presented and then the student attempts to read the word. The trial is ended with feedback, which often includes the teacher reading the word aloud (e.g., *correct, the word is coal* or *no, the word is coal*). In order to enhance rates of accurate responding and the probability that the students' last response is correct, students may be prompted to repeat the word following the teacher's feedback (Skinner & Smith, 1992; Yaw, Skinner, Maurer, Skinner, Cihak, & Wilhoit, Delisle, & Booher, 2014).

One of the advantages of teacher-led flashcard instruction is that educators can provide immediate feedback. Such feedback may enhance learning by reinforcing accurate responding and providing prompts designed to correct inaccurate responding (Barbetta, Heward, & Bradley, 1993; Espin & Deno, 1989). Additionally, when working one-on-one with students, educators can apply time-delay procedures by manipulating the response intervals or the time between the words being presented and the feedback/prompting (Worsdell, Iwata, Dozier, Johnson, Neidert, & Thomason, 2005). Time-delay procedures may enhance learning by reducing inaccurate responding and prompting automatic responding (Bliss, Skinner, & Adams, 2006; Browder & Spooner, 2011; Browder & Xin, 1998; McCallum, Skinner, & Hutchins, 2004).

Although flashcards can be effective, one-to-one teacher-to-student ratios can strain limited resources. Several approaches have been used to address this concern (McCurdy,

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Cundari, & Lentz, 1990). For example, researchers investigating incidental learning and small group instruction have found that some students with intellectual disabilities learned by observing their peers respond to flashcard instruction (Browder & Spooner, 2011; Hanely-Maxwell, Wilcox, & Heal, 1982; Orelove, 1982). Others have relied on technology to mitigate instructional inefficiencies associated with one-to-one flashcard instruction. Researchers have found that merely asking students to read words aloud along with a recording (e.g., taped-words interventions) has enhanced word acquisition in students with disabilities (Freeman & McLaughlin, 1984; Shapiro & McCurdy, 1989; Skinner & Shapiro, 1989; Sterling, Robinson, & Skinner, 1997). When some researchers slowed the speed of the tapes, they found that students would frequently use the interval between words like a flashcard learning trial (Skinner, Johnson, Larkin, Lessley, & Glowacki, 1995; Skinner, Smith, & McLean, 1994). Specifically, rather than reading with the tape, students attempted to read words before the audio recording was played. Then, when the audio recording was played, it allowed students to self-evaluate their word reading accuracy. These observations led researchers to develop interventions with students being instructed to attempt to "*beat the tape*" by responding accurately before they heard the recorded accurate response (Bliss, Skinner, & Adams, 2006; McCallum, Evans, Friedrich, & Long, 2011; McCallum, Skinner, & Hutchins, 2004).

One limitation with reading words along with a recording is that students may lose their place, which could result in the intervention causing inaccurate responding (Taylor, Skinner, McCallum, Poncy, & Orsega, 2013). By presenting only one word at a time, computer-based flashcard instruction allows educators to address this limitation (Hilton, Hopkins, Skinner, & McCane-Bowling, 2011). Another drawback of audio recordings is that several tapes have to be made with words in different arrangements to ensure students do not respond to word sequences

(Skinner & Shapiro, 1989). The process of rearranging word order can be done much more efficiently with computers (Hilton, Hopkins, Skinner, & McCane-Bowling, 2011). Computer-based flashcard reading instruction allows for more efficient word replacement than taped words; as words are learned, rather than making new tapes and word lists, educators can use ubiquitous software words to remove learned word files and replace them with new ones (see Hopkins, Hilton, & Skinner, 2011 for instructions using Microsoft® Power Point® software to create a computer flashcard reading intervention).

Researchers have shown that computer flashcard reading procedures are effective at increasing sight word reading in students at risk, English Language Learning students, and students with autism, intellectual disabilities, and learning disabilities (Baumgart & VanWalleghem, 1987; Hilton et al., 2011; Kodak, Fisher, Clements, & Bouxsein, 2011; Yaw, Skinner, Parkhurst, Taylor, Booher, & Chambers, 2011; Yaw, Skinner, Orsega, Parkhurst, Chambers, & Booher, 2012). Baumgart and VanWalleghem (1987) compared computer-based flashcards with teacher instruction along with a speech synthesizer. Results show that two of the subjects performed equally well under both methods, while one performed better under the teacher-instruction condition. Therefore, in at least some instances, computer flashcard reading instruction may free up teacher time without reducing student learning. When working with elementary school students with disabilities, previous researchers have found both greater and weaker rates of words maintained and generalized per minute of instruction when they applied teacher-led and computer-based flashcard instruction (Joseph, Eveleigh, Konrad, Neef, & Volpe, 2012; Nist & Joseph, 2008; Yaw, Skinner, Maurer, Skinner, Cihak, Wilhoit, Delisle, & Booher, 2014).

Rather than focusing on teacher time, other researchers focused on the amount of time students devoted to instruction (Black, Forbes, Yaw, & Skinner, 2013; Yaw et al., 2014). Working with students with intellectual disabilities, Yaw et al. (2014) manipulated response intervals during computer flashcard reading and found that shorter 1-s intervals resulted in greater learning rates (more words acquired per minute of instructional time) than longer 5-s response intervals. These findings may have been caused by the briefer response interval allowing more computer flashcard reading trials in a fixed period of instructional time (Forbes, Skinner, Black, Yaw, Booher, & Delisle, 2013; Skinner, Fletcher, & Henington, 1996; Yaw et al., 2014). Thus, when applying computer flashcard reading instruction, educators may want to apply brief intervals because they are efficient and may free student time for other activities (Skinner, McCleary, Poncy, Cates, & Skolits, 2013).

Although researchers have established that computer flashcard reading interventions can enhance word reading acquisition and maintenance, there are several external validity limitations associated with this research base. Most studies have been conducted with school-aged children and have targeted frequently used elementary-level (e.g., pre-primer through 4th-grade Dolch words) words (e.g., Hilton et al., 2011; Yaw et al., 2011). Evaluations following computer-based instruction revealed evidence of maintenance (e.g., over summer recess) and generalization to hand-printed flashcards (Yaw et al., 2014). Joseph et al. (2012) found evidence that teacher-led one-to-one flashcard instruction enhances students' ability to read words when they were imbedded within printed sentences; however, no articles were found where researchers assessed generalization from computer-based flashcards to reading words within connected text.

Purpose

Data supporting the effectiveness of computer flashcard reading interventions with elementary students with disabilities suggest that these procedures may help meet the needs of post-secondary students with intellectual disabilities. While enrolled in these programs, students often take college classes where they are exposed to course-specific printed words. Computer-based flashcard instruction may prove to be an effective procedure that allows students to learn to read course-specific words prior to, or as they are taking, college-level classes. Thus, the primary purpose of the current study was to extend word-reading research using computer flashcard reading interventions across students and target words.

Our participants were post-secondary students with intellectual disabilities who chose to enroll in an introductory nutrition or sports nutrition course. Both courses included numerous health and nutrition-related objectives. Rather than targeting commonly used elementary-school words, we targeted higher-level and unusual words from their current curricula. Additionally, we evaluated generalization by asking students to read words acquired during computer flashcard reading instruction within connected texts (Joseph et al., 2012).

Method

Participants, Setting, and Materials

Participants were three college students (who will be referred to as Mike, Carl, and Cindy), ages 20 to 25, with intellectual disabilities, who attended a Post-Secondary Education (PSE) program. Each participant received special education services during primary and secondary education, had a diagnosis of an intellectual disability, and agreed to participate in the study. Table 1.1, which provides recent standardized assessment data across the participants,

revealed second to third-grade reading comprehension levels. Procedures were run at a table in a quiet room that was adjacent to the students' regular classroom where they took core courses that were specifically designed for college students with intellectual disabilities (e.g., career and life planning, digital literacy, and life skills).

Mike and Carl were enrolled in a sports nutrition class and Cindy was enrolled in an introductory nutrition course. Due to the instructional focus on health, flashcard instruction targeted health-related words selected from the index of *Introduction to Human Nutrition* (Gibney, Lanham-New, Cassidy, & Vorster, 2009). This textbook was required for all students taking the introductory nutrition course and was a supplement for the sports nutrition for athletes' course. Experimenter-developed flashcards were printed on the center of index cards using Times New Roman, 16-point font. Directions provided by Hopkins et al. (2011), a personal computer, and the Microsoft® PowerPoint® program were used to create the computer-based flashcard reading intervention. Personal cell phones were used as stopwatches.

Design and Dependent Variables

An across-students multiple-baseline design was used to evaluate the effectiveness of the computer flashcard reading intervention. Assessments were conducted using index cards and words were scored as correct when they were read correctly within 3 s. Our primary dependent variable was words acquired. Words were considered acquired after they were read correctly across two assessment sessions. Decisions regarding when to apply the intervention were based on visual analysis of time-series graphs depicting word acquisition. One month following the last intervention, maintenance was assessed using the same index cards and generalization was assessed using experimenter-developed paragraphs that contained acquired words. In all instances, words were considered correct when read correctly within 3 s.

Procedures

General procedures. Each student participated in four phases: pre-test, baseline, intervention, maintenance and generalization. Across phases, two graduate students were present for most sessions. The primary experimenter ran all sessions. The other experimenter observed and recorded procedural errors and collected inter-observer agreement data. Sessions were scheduled for three days per week, between 9AM and 11AM; however, about 20% of the sessions had to be canceled because of scheduling conflicts and/or absenteeism.

Pre-test. Two days were scheduled for pre-test sessions. For each student, sessions lasted around 10 min. Working with one student at a time, the primary experimenter escorted a participant from her/his classroom to the experimental room where they sat across from each other at a table. The primary experimenter had a stack of 185 experimenter-constructed flashcards faced down so the words written on the cards were not visible to the student. Therefore, each student was presented with the same 185 words at the beginning of this study. The primary experimenter shuffled the index cards and then told the student that he or she was going to be asked to read some flashcard words that would be presented for 3 s each. Flashcards read correctly within 3 s were placed in one pile and those not read correctly within 3 s were placed in a separate pile. If a word was read correctly on either day, it was considered known and was not eligible for inclusion in the study. Thus, after the pre-test, each student had his or her own list of personal, unknown words.

Baseline. At the end of the pre-testing phase, we had a flashcard set of unknown words that was individualized for each participant (see Appendix B). For each student, we randomly sequenced the unknown words and began the intervention targeting the first 15 unknown words. Next, we applied baseline procedures that were identical to pre-testing, except only the 15 target

words were assessed. Participants were required to read the words on their flashcards correctly across two sessions within 3 s in order for the words to be considered acquired.

Computer-based flashcard reading. The computer flashcard reading intervention was applied sequentially across students. Decisions about when to apply the intervention were based on visual analysis of baseline-phase data. During the intervention phase, each student's computer flashcard reading intervention was developed using their list of unknown words, the Microsoft® PowerPoint® program, and instructions provided by Hopkins and colleagues (2011). Each program was stored in an electronic folder with his or her name. When the students entered the room, they were told that they were going to use the computer to practice reading some difficult words. They were told that words would appear on the screen and that they should try to read them before they heard a recording of the word (i.e., try to beat the computer). After they heard the word, they were told to repeat the word before the next word appeared. After answering any questions, the experimenter opened their file, and the word *START* was displayed on the computer screen. The experimenter instructed the student to click *START* and try to read each word before the tape and repeat each word after the tape. Students were reminded to pay attention because words would be presented rapidly.

Each computer flashcard reading intervention was designed so that each word was presented for 4 s. Exactly 2 s after a word was presented, the recording of the word being read was played (see Hopkins et al., 2011 for instruction on how to develop this intervention using Microsoft® PowerPoint®). After the 15 target words were presented once, the process repeated two more times. The 15 words were presented in random order each time. Thus, each computer flashcard reading intervention session lasted 3 min and included a total of 45 trials, 3 trials per word. Immediately following each computer flashcard reading intervention, the experimenter

closed the laptop and applied baseline procedures (i.e., 3 s to read each index card) to assess students' reading of the 15 target words and any previously acquired words.

When a word was considered acquired (i.e., read correctly within 3 s across two consecutive assessment sessions), it was replaced with an unknown word. Following each assessment, the primary experimenter identified acquired words, removed the computer files containing those words from the intervention, and replaced them with computer files targeting the student's next unknown words. Therefore, the intervention always targeted 15 words. However, as sessions continued and students acquired words, the number of words assessed following each computer flashcard reading intervention increased because assessments included the 15 current target words and all words that had been acquired and removed from the intervention.

Maintenance and generalization. Maintenance and generalization were assessed in a single session that was applied 29 days after the last computer flashcard reading intervention. Maintenance procedures were identical to those used during baseline and intervention-phase assessments (e.g., students were given 3 s to read each index card), but only computer flashcard reading words acquired during the intervention phase were assessed. For each student, a generalization assessment immediately followed his or her maintenance assessment. To assess for generalization, acquired words were integrated into experimenter-developed paragraphs (see Appendix C). Students were instructed to read the paragraphs aloud from printed-paper. The experimenter followed along on a written passage, writing a slash through any word not read correctly within 3 s. If a student did not read a word within 3 s, then the experimenter read the word aloud for the student. Also, if a student lost his or her place, the experimenter re-directed the student.

Treatment Integrity and Inter-observer Agreement

The primary experimenter used a printed experimental protocol (see Appendix D) to guide her activities during intervention sessions. A second experimenter monitored all sessions using the same protocol. If the primary experimenter made an error (e.g., forgot to read instructions), then the second experimenter was there to interrupt procedures (e.g., remind the experimenter to read instructions) and record procedural errors on the protocol. Across all conditions, the second experimenter recorded no procedural errors, which suggests the procedures were applied with integrity 100% of the time.

During all assessments (baseline, intervention, maintenance and generalization), both experimenters independently scored word reading accuracy. Experimenters then selected 22% of the assessments taken during baseline and intervention phases and calculated inter-observer agreement for each assessment. Percent inter-observer agreement was calculated by dividing the number of agreements on words read correctly by the number of agreements plus disagreements on words read correctly; the resulting number was then multiplied by 100. Inter-observer agreement ranged from 87% to 100%, with a mean of 93%.

Results

Table 1.2, which includes the aggregate learning data across conditions and measures for each student, suggests that across all measures the computer flashcard reading procedure was most effective for Carl. Carl acquired the most words (22), had the highest acquisition rates (0.73 words per min of instruction or about one word per every 1.5 min of computer flashcard reading), and had the highest percentage of acquired words read correctly during the maintenance (i.e., 82%) and generalization (i.e., 82%) assessments. Relative to Carl, Cindy and

Mike acquired fewer words (13 and 6, respectively), had lower average word acquisition rates (.39 and .40 words per min of computer flashcard reading, respectively), and maintained and generalized both fewer words and a smaller percentage of acquired words (i.e., 62% maintained and 67% generalized).

In Table 1.2, the final column displays the percentage of maintained words (i.e., students read the word on the flashcard correctly within 3 s following a one month no-treatment interval) that were read correctly when they were embedded within paragraphs. This final column indicates that Carl was able to read the same 18 words correctly during his maintenance and generalization assessments. Mike and Cindy read the same number of acquired words correctly across maintenance and generalization assessments (see Table 1.2, columns 5 and 6); however, they read some words correctly when they were embedded in passages that they did not read correctly during the maintenance assessment, and they each read some words correctly during maintenance assessment that they did not read correctly during generalization assessment (see Table 1.2, column 7).

Figure 1.1 displays the graphs depicting cumulative words acquired, along with the number of acquired words read correctly on the maintenance and generalization assessments (see Appendix B for words targeted and acquired for each student). Data displayed in Figure 1.1 shows that none of the students acquired any words during baseline and all of the students showed an almost immediate acquisition after the intervention was applied. This pattern provides evidence of experimental control (Kazdin, 2011).

Visual analysis of Figure 1.1 suggests that for Cindy and Carl, the average word acquisition rate data presented in Table 1.2 are misleading because their word acquisition rates were not stable. More specifically, both Cindy's and Carl's word acquisition rates declined as

the study progressed. Across all 11 sessions, a total of 30 min of computer flashcard reading, Carl acquired about 1 word per min and a half. However, over the first 7 sessions (21 min of computer flashcard reading), Carl acquired 19 words, almost 1 word acquired per min of instructional time. Over the final three sessions (9 min of computer flashcard reading), Carl only acquired 3 additional words or 1 word for every 3 min of computer flashcard reading. Visual analysis of Figure 1.1 shows that Cindy's decrease in word acquisition rates was more abrupt than Carl's. When all sessions are averaged (33 min of computer flashcard reading), Cindy acquired 1 word for about every 2.5 min of computer flashcard reading, a rate much lower than Carl's. However, over the first four intervention sessions (12 min of computer flashcard reading), Cindy acquired 11 words, almost 1 word acquired per min of computer flashcard reading. Thus, Cindy's word acquisition rate over her first four computer flashcard reading sessions was very similar to Carl's word acquisition rate over his first seven sessions. Following the first four sessions, Cindy's word acquisition rate decreased abruptly. Over the final eight sessions (24 min of computer flashcard reading), Cindy only acquired 2 more words, or 1 word acquired for every 12 min of computer flashcard reading.

Discussion

Previous researchers who targeted commonly used elementary-school words found that computer flashcard reading interventions enhanced word reading acquisition in children and adolescents with disabilities. Our primary purpose was to extend this research to college students while assessing acquisition of college-level words. During the current study, each student showed an increase in word reading acquisition after the intervention was applied, and those still in the baseline phase showed no concurrent increases when the intervention was

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applied to other students. Thus, the current study supports previous findings that suggest computer-based flashcard instruction can enhance word reading in students with disabilities (e.g., Baumgart & VanWalleghem, 1987; Hilton et al, 2011; Kodak, Fisher, Clements, & Bouxsein, 2011; Yaw et al., 2011) and extends this line of research to post-secondary students with intellectual disabilities who read specific, health-related words appropriate for college students.

In our current study, acquisition, maintenance, and students' ability to generalize accurate reading to passages were assessed. Previous researchers working with elementary students with disabilities have found both greater and weaker rates of words learned per minute of instruction and levels of maintenance when they targeted lower-level words with teacher-led and computer-based flashcard instruction (Joseph et al., 2012; Nist & Joseph, 2008; Yaw et al., 2014). Joseph et al. found some evidence that teacher-led flashcard instruction enhanced at-risk first-grade students' abilities to read commonly used words when they were embedded within sentences. Our generalization data, which were collected one month after the procedures were discontinued, showed that participants' abilities to read words presented in printed paragraphs varied across students.

Such inconsistent findings with respect to generalization are not uncommon. Joseph et al. (2012) found that students who were taught words via incremental rehearsal were able to generalize to reading sentences containing those words at a higher percentage than students taught via flashcard drills; while Volpe, Mule, Briesch, Joseph, and Burns (2011) found no significant differences in word maintenance and generalization across the two procedures. Thus, while our results support and extend previous research establishing the effectiveness of computer flashcard reading, more research is needed to enhance our understanding of generalization. Furthermore, as a number of factors varied within and across studies (e.g., number of unknown

words targeted per session, session length, difficulty of target words, students, intervention schedules, procedures for measuring acquisition, generalization, and maintenance), no across-study relative comparisons can or should be made (Cates, Skinner, Watson, Meadows, Weaver, & Jackson, 2003; Poncy, Solomon, Moore, Simons, & Skinner, in press).

Limitations and Future Research

In the current study, two students read some words correctly during their maintenance assessment, but not immediately after, when the same words were embedded within a paragraph. When this occurs, it may be interpreted as a failure to generalize. However, we also found the opposite pattern; the same two students who failed to read some words correctly during the maintenance assessment did read them correctly when they were embedded within a paragraph. As it is difficult to conceptualize generalization without maintenance, future researchers should investigate these findings. Maintenance assessment procedures may have occasioned relearning and allowed for generalization (Skinner & Shapiro, 1989; Yaw et al., 2014). Also, providing words in connected text may have enhanced students' ability to read words, especially if they comprehended the text. Regardless, researchers may want to determine if specific procedures may enhance maintenance and generalization. For example, researchers may find that immediately after words are acquired, providing definitions of words, prompting students to read those words in printed sentences, or encouraging them to use words in their verbal or written communication may enhance both maintenance and generalization (Daly, Neugebauer, Chafouleas, & Skinner, 2015).

Although we found evidence that the computer flashcard reading intervention enhanced word reading acquisition within and across students, these improvements were inconsistent. With about one word acquired for every 1.5 min of computer flashcard reading, Carl showed the

largest average growth rates. When data was averaged across the computer flashcard reading phase, both Mike's and Cindy's average word acquisition rates were small, about 1 word acquired for every 2.5 min. However, Cindy's initial word acquisition rate (i.e., over the first four computer flashcard reading sessions) was almost one word per min of computer flashcard reading, followed by an abrupt drop in acquisition rates (i.e., one word per 12 min of computer flashcard reading). Therefore, although her average word acquisition rates appear to suggest a small effect, it may be better to characterize Cindy's word acquisition rates as inconsistent.

Although there are numerous reasons why word acquisition rates may have varied across subjects, (e.g., word difficulty level, attendance, within-subject differences), researchers should investigate the decelerating word acquisition rates evident for Carl and Cindy. Relative to Carl's deceleration, Cindy's drop-off was very abrupt. For Cindy, the initial rapid learning may be evidence of novelty effects and/or the deceleration may be evidence of fatigue, boredom, or dissatisfaction. Carl's more gradual deceleration may be evidence of limitations associated with either the intervention or the interaction between word difficulty and our flow list procedures. Specifically, for each student, it is likely that some of the initial 15 targeted words were very challenging. As less challenging words were learned, they may have been replaced with new, unknown, challenging words. This process would have caused the number of more challenging target words to increase as the study progressed (Forbes et al., 2013). Unfortunately, this hypothesis cannot be evaluated because researchers did not keep a record of how many sessions were run with each word. If future researchers collect such data and find support for this explanation, then educators may want to periodically remove words that are not being learned via computer flashcard reading and attempt to teach them using alternative procedures.

Although all students appeared to be engaged, smiled when they heard recordings which confirmed their accurate reading, and expressed a desire to do the procedures (e.g., asked if they could go first when experimenters arrived), no formal student acceptability data were collected. If future researchers find evidence that students became bored or dissatisfied with computer flashcard reading, then they could conduct additional studies to determine if supplemental procedures would enhance the effectiveness of the interventions. For example, including self-monitoring, reinforcement, and/or feedback could mitigate these limitations and may have prevented Cindy's abrupt decrease in word acquisition rates (Daly, Neugebauer, Chafouleas, & Skinner, 2015).

Negating one of the primary advantages of computer-based instructions, experimenters were present for all sessions and administered assessments. Future researchers should make efforts that allow students to independently apply the entire procedure. For example, researchers should determine if after the computer flashcard reading procedure is finished, students could use recordings played by the computer to conduct self-evaluations of their word-reading accuracy and replace acquired words with new, unknown words. Such studies could provide evidence that these procedures could be conducted without much teacher involvement (Pindriprolu & Forbush, 2009; Rodriguez, Filler, & Higgins, 2012; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2011).

Our multiple baseline design provided evidence that the computer flashcard reading intervention enhances word acquisition, allowing us to address our primary question. We also sought to investigate maintenance and generalization; however, there were numerous limitations associated with our maintenance and generalization evaluations that could be addressed by future researchers. We purposefully selected health-related words that were used in each student-

selected university course. As the students were attending these classes during the study, any maintenance and generalization may be partially attributed to these experiences. Also, both maintenance and generalization were only assessed one time. Future researchers who conduct multiple maintenance and generalization checks may find that the opportunities to respond provided by additional maintenance assessments allow students to relearn words (Skinner & Shapiro, 1989). Additionally, researchers should consider applying brief, computer flashcard reading relearning trials to determine if students can rapidly relearn acquired words that they have not maintained (see Yaw et al., 2014).

The quality of the experimenter-constructed generalization passages is also a limitation. Although researchers attempted to construct cohesive passages that included all acquired words; in some instances, sentences seemed forced and were not well integrated with other content. For example, in the final sentence in the first paragraph of Carl's generalization passage ("He was dealing with some pretty pernicious issues"), the word "pernicious" is used in a way that is not linked to health, and thus, is not well integrated into the paragraph. Thus, passage quality may have impacted students' ability to use context cues.

In other ways, passages were not equivalent across students. Flesch-Kincaid Grade-Level Readability Scores were 5.5, 7.3, and 8.7 for passages assigned to Mike, Cindy, and Carl respectively. These data suggest that the passages may have been too difficult for the participants (see Table 1.1 for each student's reading comprehension score), even when one considers that they had previously acquired some of the more complex words in the passages. Also, passage lengths ranged from 69 words to 207 words. Additional research is needed to determine if across-student differences in maintenance and generalization were caused by within-student factors (e.g., reading skill development), passage differences, and/or differences

in acquisition rates. Although generalization to intact passages was assessed, no measures of passage comprehension were collected. Because the primary purpose or function of reading is comprehension, future researchers should include comprehension measures.

A final direction for future researchers is related to the 3-s response intervals used during assessments and the 2-s intervals used during computer flashcard reading. We applied 2-s response intervals during the intervention because previous researchers found that brief intervals enhanced acquisition rates (Black, Forbes, Yaw, & Skinner, 2013; Yaw et al., 2014). Although no unknown words were read correctly during baseline, it is possible that participants may have been able to use phonemic skills (e.g., decoding, blending) to read some unknown words correctly if they had been given more time. Thus, in addition to conducting additional research on computer flashcard reading intervention response intervals, researchers may want to manipulate assessment response intervals.

Summary and Encouraging Remarks

The current findings enhance the research-base supporting the internal and external (across students and words) validity of computer-based flashcards for enhancing word reading accuracy. As computer flashcard reading interventions appear to be effective and efficient, computer flashcard reading may prove useful in post-secondary education programs where students with intellectual disabilities may be exposed to unusual, course-specific words. In some instances, where students choose courses that meet their interests, they may know what some course-specific words mean and use them in their verbal interactions, but have difficulty reading these words. In the current study, the word "Alzheimer's" was an example with one participant.

Students with disabilities who attend post-secondary education programs often have age-appropriate interests and aspirations that may be well met with college classes; however, in some

instances, their academic skill deficits may hinder their ability to capitalize on these interests. With their training in learning, remediation, and disabilities, school psychologists have skills and competencies that can be used to enhance the learning of students with intellectual disabilities in post-secondary education (National Association of School Psychologists, 2010; Pfohl, 2005). We hope these findings will encourage school psychologists, trainers of school psychologists, and school psychology students to continue to develop this line of research and determine if this or similar procedures can enhance post-secondary education experiences for students with intellectual disabilities. For example, researchers may find that students who learn to read course-specific words are less frustrated or intimidated by college classes. They might enjoy classes more, participate more in class, and have increasing confidence in their ability to succeed when they are able to read often difficult and phonemically irregular course-specific words.

Chapter III

Study II: Evaluating a Computer Flashcard Reading Intervention with Self-Determined

Response Intervals in Elementary School Students with Intellectual Disability

Abstract

A multiple-baseline, across-tasks design was used to evaluate the effectiveness of a computer flashcard reading intervention with elementary-school students with intellectual disability. This intervention allowed the participants to self-determine each response interval and resulted in both participants acquiring previously unknown words across all word sets. Discussion focuses on the need to evaluate and compare computer flashcard reading interventions with fixed and self-determined response intervals across students and dependent variables, including self-determination in students with intellectual disability.

Flashcard instruction can enhance sight-word reading and comprehension in students with disabilities (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006). Computer flashcard reading instruction allows teachers to efficiently individualize instruction, occasion high rates of responding, and enhance learning with relatively immediate feedback (Cazzell, et. al., in press; Hilton, Hopkins, Skinner, & McCane-Bowling, 2011; Kodak, Fisher, Clements, & Bouxsein, 2011; Worsdell, Iwata, Dozier, Johnson, Neidert, & Thomason, 2005; Yaw, Skinner, Parkhurst, Taylor, Booher, & Chambers, 2011). Researchers who developed computer flashcard reading programs using fixed response intervals generally found that briefer intervals increased learning rates (Black, Forbes, Yaw, & Skinner, 2013; Yaw, Skinner, Mauer, Skinner, Wilhoit, Delisle, & Booher, 2014).

Researchers created a computer flashcard reading program that enabled an adult post-secondary student with intellectual disability to self-determine each response interval (Cazzell, Browarnik, Skinner, Skinner, Cihak, Ciancio,…Forbes, in press). This alteration allowed the student more time to respond when needed (e.g., attempting to decode the word on the screen). When she responded rapidly, this alteration allowed for more immediate feedback and error correction and more rapid pacing, both of which have been shown to enhance learning and learning rates (Kulik & Kulik, 1988; Yaw et al., 2014). As students with intellectual disability often have fewer opportunities to develop their self-determination skills (Wehmeyer & Garner, 2003), this intervention addressed another objective of the post-secondary education program by occasioning high rates of self-determination. Additional data suggested that the procedures enhanced word reading acquisition. The current study was designed to extend this research to children with disabilities. Specifically, a multiple-baseline across-tasks (i.e. word sets) design was used to evaluate the effects of a computer flashcard reading program with self-determined

response intervals on sight-word acquisition in two elementary students with intellectual disability.

Method

Participants, Setting, and Materials

Two students with intellectual disability attending an elementary school in the Southeastern United States were nominated by their teacher to participate in this study. Mark was a 12-year-old, fifth-grade student and Susan was a 9-year-old, third-grade student[1]. Procedures were conducted at a table in the back of the students' classroom. An experimenter used a wide, felt-tip black marker to create flashcards used during assessments. Instructions provided by Hopkins, Hilton, and Skinner (2011) guided the creation of the computer flashcard reading programs using Microsoft® PowerPoint® and a laptop computer. The researchers used 12 point, Times New Roman font for the computer flashcards.

Design, Dependent Variable, and Procedures

A multiple-baseline across-tasks (i.e., three mutually exclusive word sets of 10 unknown words) design was used to evaluate the computer flashcard reading intervention. When a student read a word correctly across two consecutive assessment sessions, the word was considered acquired. After a student acquired 8 of 10 words (80%) in a set, the intervention was applied to another word set. The primary experimenter was a school psychology graduate student completing a required consultation-intervention experience.

General procedures. This study included three phases: pre-test, baseline, and intervention. Sessions were conducted with one student at a time and scheduled during classroom

rotations between 10:30 and 11:00 A.M. three days per week. Some sessions were canceled because of absences, school closings, and scheduling conflicts.

Assessment procedures: Pre-testing and baseline. Pre-testing assessments were used to identify a pool of unknown words. Each student started with a different set of 60 flashcard words. Based on informal assessments, the words for Mark were obtained from a 4th grade Dolch word list ("Dolch List 4th Grade," n.d.) and the words for Susan were selected from a list of 6th grade Dolch words ("Sixth Grade Sight Word List," n.d.). During assessments, words hand-printed on white 3 x 5 index cards were presented in random order, and the student was told to try his or her best to read each word correctly within 3 s. This process was repeated the following session. If a word was read correctly within 3 s on either pre-testing day, the word was considered known. Pre-testing yielded 39 unknown words for Mark and 31 unknown words for Sarah. The primary experimenter used stratified (based on number of letters in each word) random assignment to develop three mutually exclusive, 10-word sets (see Appendix B).

Computer-based flashcard reading procedures. For each student, a computer flashcard reading intervention was created for each of the three sets of 10 unknown words. Each of these 10 unknown words was presented in random order to the student three times during each intervention session; therefore, each student completed 30, computer flashcard reading learning trials each session. Prior to the first intervention, the primary experimenter taught each student to use the computer flashcard reading program. The following instructions, from Cazzell, et. al. (in press), were used:

> *We are going to have you read some words today with a computer program. When you*
> *are ready, press the space bar to see your first word. When the word appears, attempt to*
> *read the word to the best of your ability. After you read the word, press the space bar to*

hear the word read aloud to you. Upon hearing this word read aloud, repeat the word

before pressing the space bar to move on to the next slide. Do you have any questions?

After these instructions were read, each student was presented with a training computer flashcard reading session containing three PowerPoint slides. The first slide contained the word START, and the student was instructed to press the space bar to begin. Their respective names were on the next slide, which the students could always read. The last slide contained the word "coyote." The word "coyote" was not included in the 30 unknown target words and both students failed to read this word correctly during pre-testing. Thus, each student had a practice trial with both a known and an unknown word, which allowed them to press the space bar to hear the word being read aloud and repeat the word after they heard the recording played. Additionally, they learned to press the space bar again to display the next word.

Immediately after completing this single, brief training, the intervention for each student began with his or her respective Set A words. Before beginning the intervention, each student was told that the 10 words in the intervention may be difficult for them to read and that they should try their best because they would have multiple opportunities to read the words. During the intervention, the program always began with the START slide displayed on the laptop. The student then pressed the space bar to progress through the word Set.

After completing each intervention program, each student was assessed across all 30 words. Assessment procedures were the same as those used during baseline. A word was considered acquired when it was read correctly within 3 s, across two consecutive assessments. After acquiring eight (80%) words in a set, the students were told that they were starting with a new set of unfamiliar and potentially challenging words.

Treatment Integrity and Inter-observer Agreement

The primary experimenter used a checklist to guide her procedural integrity and record notes on any additional prompts (see Appendix D). A second experimenter independently recorded procedural integrity across 50% of the intervention sessions and word reading accuracy across at least 50% of the assessments for each phase (pre-testing, baseline, and intervention). Results showed 100% procedural integrity across all sessions and neither experimenter ever noted the delivery of any additional prompts. To calculate percent inter-observer agreement per session, the number of agreements on words read correctly was divided by the number of agreements plus disagreements on words read correctly and then multiplied by 100. As each student was clear in his or her diction, inter-observer agreement was always 100%.

Results

Repeated-measures graphs illustrating the number of words acquired across phases are provided in Figures 2.1 and 2.2. Figure 2.1 illustrates that Susan did not acquire any words during the baseline phase across the three sets of words. After the computer flashcard reading intervention was applied, Susan quickly acquired words across each word set, meeting the criteria for each set (8 words acquired) after three sessions. Mark did not acquire any words during the baseline phase across the three Sets (see Figure 2.2). Mark required five sessions to meet the criteria for Set A, but only three sessions for Sets B and C (80%) words.

Discussion

Comparing baseline and intervention phase data illustrates that both Mark and Susan acquired words following the implementation of the computer flashcard reading intervention. As

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no words were acquired during the baseline phases, these findings suggest that the computer flashcard reading intervention increased word acquisition. These results are consistent with Cazzell, et. al.,'s (in press) conclusions based on her work with an adult student with intellectual disability and demonstrate that computer flashcard reading procedures can be effective when elementary students with intellectual disability self-determine each response interval (Cazzell, et. al., in press).

As computer flashcard reading interventions can be effective when the participants are given brief, fixed response intervals (Black, Forbes, Yaw, & Skinner, 2013; Yaw, Skinner, Maurer, Skinner, Cihak, Wilhoit, Delisle, & Booher, 2014), future researchers should investigate the comparative effectiveness of computer flashcard reading interventions with self-determined response intervals and fixed response intervals across different populations. As previous researchers have found that providing choices can reduce students' inappropriate behavior (e.g., Dyer, Dunlap, & Winterling, 1990), comparative effectiveness studies should also measure desired (e.g., on-task) and undesired behaviors. Although the primary researchers initiated all sessions, the computer flashcard reading program should allow students to complete the program independently. Researchers should investigate student preference for each intervention type and evaluate whether students are more likely to choose to complete computer flashcard reading interventions when they have the opportunity to self-determine response intervals. We only measured isolated word reading accuracy. Researchers should evaluate whether computer flashcard reading generalizes to reading words in text and comprehension of printed text (Cuvo & Klatt, 1992; Nist & Joseph, 2008; Yaw, Skinner, Orsega, Parkhurst, Chambers, & Booher, 2012).

As they are developing, students with intellectual disability may have fewer opportunities to make choices than general education students, which may hinder their development of self-determination skills and sense of autonomy (Wehmeyer & Garner, 2003). During the computer flashcard reading intervention, students self-determine response intervals 90 times in each session, which averaged under 3 min. Researchers should evaluate the effects of the current intervention and similar academic interventions that occasion high rates of choice on students' self-determination skills and behavior choices. Such studies may show that computer flashcard reading interventions with self-determined intervals do more than enhance reading skills; they may enhance students' development in other critical areas (Gaumer-Erickson, Noonan, Zheng, & Brussow, 2015; Wehmeyer, Palmer, Lee, Williams-Deihm, & Shogren, 2011).

Chapter IV

Study III: Extending Research on the Comparative Efficacy of Computer Flashcard Reading

Interventions in Elementary-School Students with Intellectual Disability

Abstract

An adapted alternating treatments design was used to assess the comparative effectiveness of two computer flashcard reading programs (3-s vs self-determined condition) among three elementary school students with intellectual disability. The researchers examined learning rates and words acquired to determine which intervention resulted in the largest learning gains. Maintenance data along with student preference data regarding which condition they favored were also collected.   Students quickly acquired words through both interventions.

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Researchers have illustrated that computer flashcard reading procedures with short, fixed response intervals are effective in teaching students with intellectual disability to acquire previously unknown words across conditions (Black, Forbes, Yaw, & Skinner, 2013; Yaw, Skinner, Maurer, Skinner, Cihak, Wilhoit, Delisle, & Booher, 2014). For example, Cazzell (see Study I) developed a computer flashcard reading program with 2 s. fixed response intervals for students with intellectual disability in a post-secondary program. While the researchers were present during this intervention, the students were still able to complete the program autonomously, attempting to read the words correctly within the 2 s. response interval. After 2 s., the presented word was automatically read aloud to them through the computer flashcard reading program, eliminating the necessity of having another individual there to monitor the intervention. The students quickly acquired words through this program, illustrating that computer flashcard reading interventions with short response intervals are effective programs that do not require individual, teacher attention (see Study 1).

Researchers have also illustrated that computer flashcard reading procedures are effective when students are allowed to self-determine their response intervals. In Study II, Cazzell created a computer flashcard reading intervention to occasion high rates of self-determined responding among elementary school children with intellectual disability. In this program, students were allowed to self-determine their own response intervals to learn words. Results suggest that elementary school students with intellectual disability were able to independently select response intervals to quickly acquire words when allowed to self-determine each response interval (see Study II).

In implementing computer flashcard reading programs with self-determined response intervals, students can selectively spend more or less time on words, depending on their familiarity with them. For instance, in Study II, Cazzell found that students would typically opt to quickly go through a majority of the words, but would sometimes pause to think about some words, especially when they felt confident that they could remember the word. Giving students time to decode words may be an important step in their application of previously learned words. Cazzell (see Study II) noted that the students enjoyed being active participants in the learning process, often attempting to not only read the words accurately, but also to reduce their session time. The elementary school children found beating their past times especially enjoyable, as they would often look over at the timer to see how quickly they went through the word lists, while also reading accurately.

Purpose

While flashcard reading procedures have proven to be effective in teaching students with intellectual disability to acquire words, researchers still need to determine which intervention allows for more efficient word acquisition (Baumgart & VanWalleghem, 1987; Hilton, Hopkins, Skinner, & McCane-Bowling, 2011; Kodak, Fisher, Clements, & Bouxsein, 2011; Yaw, Skinner, Parkhurst, Taylor, Booher, & Chambers, 2011; Yaw, 2012). The purpose of Study III is to evaluate whether computer flashcard reading programs with short response intervals (3-s) or self-determined response intervals are more effective in teaching students with intellectual disability previously unknown words. Researchers compared words learned and word learning rates (e.g., words learned per minute) to determine which computer flashcard reading intervention produced greater word learning gains for each student.

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Method

Participants, Setting, and Materials

Three students with intellectual disability attending an elementary school in the Southeastern United States elected to participate in this study. Procedures were conducted at a small, quiet table in the back of the students' classroom. An experimenter used a black marker to create the flashcards that were used during assessments. Instructions provided by Hopkins, Hilton, and Skinner (2011) guided the creation of the computer flashcard reading programs with the use of Microsoft® PowerPoint® and a laptop computer. The researchers used 12 point, Times New Roman font for the computer flashcards.

Design, Dependent Variable, and Procedures

An adapted alternating treatments design was used to evaluate two computer flashcard reading interventions, one with 3-s response intervals and one with self-determined response intervals. Students were pretested to determine a list of unknown words to be targeted across three lists (3-s., self-determination, and control list); roughly 25-30 words were assigned to each list using stratified random assignment.

Following guidelines provided by Kazdin (2011), each participant completed both the self-determination and the 3-s interventions during each session. These interventions were applied in a counterbalanced manner across sessions to account for treatment effects. The two treatments required about 8 min. and the assessments less than 3 min. After completing the interventions, students were assessed across all of the target words. In order to control for environmental factors that may lead to word acquisition during the experiment, a no-treatment control list of words was solely assessed (Sindelar, Rosenburg, & Wilson, 1985).

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When a student read a word correctly across two consecutive assessment sessions, the word was considered mastered. The main dependent variable in this study is the number of words mastered. Flow list procedures were used during this experiment; as one word was mastered, it was replaced with an unknown word in both the intervention and the assessment for each student (Hubbert, Weber, & McLaughlin, 2000).

General procedures. A special education teacher agreed to let the experimenter work with three selected students after noticing improvement in her student's sight word reading ability after the implementation of a computer flashcard reading intervention the prior year. Words were obtained from a list of Dolch words that were appropriate for each student's reading level. None of the words that were targeted in the previous study were used in developing these interventions. At the end of the intervention, the students were asked which condition (3-s vs. self-determination) they enjoyed the most and under which condition they felt they mastered the most words.

Assessment procedures: Pre-testing/baseline. Pre-testing assessments were used to identify a pool of unknown words for each of the three participants. The experimenter wrote the pre-testing words on index cards for the students to read. During the first session of pre-testing, the index cards were presented to the students for 3-s each. If the student read the word correctly within 3-s, it was considered correct and if the student did not read the word correctly within 3-s, it was considered incorrect. Only the words read incorrectly on the first day were pre-tested again on the second day. The words that were read incorrectly across both pre-testing days were the unknown words that were targeted during the intervention. The data collected during pre-testing, along with a third day of assessment-only procedures, accounted for the three baseline data points.

Alternating treatment design computer flashcard reading procedures. Every intervention session included the 3-s and the self-determination computer flashcard reading condition presented in a counterbalanced manner. These interventions were followed by an assessment of these words along with the control words. Each intervention condition included roughly 30 words that were mutually exclusive across lists. The 30 words in each list were the words that were considered unknown after being read incorrectly across the two pre-testing sessions. Each list of words was assigned to a condition (3-s, self-determination, or control). Within each word list, the 30 words were ordered based on the number of letters in the word. After being ordered, the first 10 words in each list were selected to begin each intervention condition. As words were mastered, the next word in that word list was chosen to replace the acquired word. These sets of words were customized across each student.

All three word lists (3-s, self-determination, and control) contained 10 unknown words. The computer flashcard reading 3-s and self-determination conditions repeated these 10 target words three times each session. Thus, the participants went through 30 learning trials for each word list across each intervention condition. Across both interventions (3-s and self-determination condition), the words were presented in a random order every session. Before the first intervention began, the primary experimenter taught the participants to use each computer flashcard reading program. The following modified instructions from Study II were read aloud to the participants before beginning the intervention:

General directions: We are going to have you read some words today using two different computer programs. Please read each word to the best of your ability.

3-s condition directions: When you are ready, press the space bar to see your first word. When the word appears, attempt to read the word to the best of your ability within 3-s. After reading the word, wait to hear the word being read aloud to you. Once you hear the word, repeat the word out loud. The slides will transition automatically. Do you have any questions?

Self-determination condition: When you are ready, press the space bar to see your first word. After you read the word, press the space bar to hear the word being read aloud to you. Upon hearing this word being read aloud, repeat the word before pressing the space bar to move on to the next slide. Do you have any questions?

Assessment. The same procedures used to collect pre-testing and baseline data were used during the assessment phase. During assessment, the 10 unknown words across each condition (3-s, self-determination, and control) were presented in random order on index cards. The students were instructed to read the words within 3-s. When a word was read correctly across 2 consecutive sessions within 3-s, the word was considered mastered and was replaced in both the intervention and assessment conditions with an unknown word from the appropriate word list.

Maintenance and re-learning computer flashcard reading procedures. Three weeks after the completion of the intervention, maintenance of the previously acquired words was assessed via flashcards. The primary experimenter also collected qualitative data on the individual preferences of each student regarding which intervention they favored (3-s vs. self-determination condition). A re-learning intervention that aligned with each personal preference

(3-s or self-determined condition) was developed for each student to target words from the control list that were not originally used during the intervention.

Treatment Integrity and Inter-observer Agreement

The primary experimenter created a checklist to guide her procedural integrity (see Appendix D). A secondary experimenter independently recorded procedural integrity across 50% of the intervention sessions. Word reading accuracy was also assessed across at least 50% of the assessments for each phase (pre-testing/baseline, alternating treatment computer flashcard reading condition, and maintenance). To calculate percent inter-observer agreement per session, the number of agreements on words read correctly was divided by the number of agreements plus disagreements on words read correctly and then multiplied by 100. As each student was clear in his or her diction, inter-observer agreement was always 100%.

<div align="center">

Results

</div>

Word Acquisition

Table 3.1 provides descriptive data across students (Sam, Dan, and Alice) and intervention conditions (SD and 3-s). The data in this table will be referenced in more detail when discussing the results for each student.

Sam. Figure 3.1 depicts the cumulative words Sam acquired across his 11 intervention sessions. During the pre-testing phase, Sam did not acquire any words. In total, Sam acquired 18 words in the 3-s condition and 22 words in the self-determination condition (see Table 3.1). Sam did not acquire any control words.

Visual analysis of Figure 3.1 illustrates that Sam quickly acquired words under both the self-determination and 3-s conditions. Both interventions led to similar increases in sight words

acquired through the first 5 or 6 intervention sessions. From intervention sessions 6 through 8, the session-series lines appear to be separating, with more self-determined words being acquired; however, over the final 3 intervention sessions (i.e., intervention sessions 9 through 11), word acquisition rates were similar across the two interventions. On average, Sam acquired 2 words per session under the self-determination condition and 1.6 words per session under the 3-s condition (see Table 3.1). Overall, visual analysis of Figure 3.1 suggests that the two interventions caused similar increases in word acquisition. Additionally, the failure to find any increases in control words acquired suggests that history, spillover, or testing effects did not contaminate the study.

Figure 3.2 depicts the cumulative words Sam acquired when data was plotted as a function of cumulative instructional time (i.e., cumulative seconds spent working on each computer program). Over his 11 intervention sessions, Sam's cumulative instructional time for the 3-s intervention was fixed at 180s per session or 1980s of cumulative instructional time. Sam's cumulative instructional time for the self-determination interventions was 1922s for an average of roughly 175s per session. On average, it took Sam 87.4s to acquire each word under the self-determination condition and 110s to acquire each word under the 3-s condition (see Table 3.1). Figure 3.2 is similar to Figure 3.1, which was caused by Sam consistently completing the self-determination intervention in about the same amount of time as the 3-s intervention (i.e., around 180s). Figure 3.2 suggests that neither intervention results in superior sight-word acquisition rates.

Dan. Figure 3.3 depicts the cumulative words Dan acquired across his 10 intervention sessions. Dan did not acquire any words during the pre-testing phase. In total, Dan acquired 19 words in the 3-s condition and 25 words in the self-determination condition (see Table 3.1).

Visual analysis of Figure 3.3 suggests that Dan quickly acquired words under both the self-determination and the 3-s conditions and did not acquire any words under the control condition throughout the intervention. While the self-determination condition led to a steeper growth in words acquired during intervention sessions 4, 6, and 7, the 3-s condition led to a steeper growth in the number of words acquired during intervention sessions 5 and 9. Because neither intervention resulted in consistently superior learning, Figure 3.3 does not depict a growing separation across the two intervention series. On average, Dan acquired 2.5 words per session under the self-determination condition and 1.9 words per session under the 3-s condition (see Table 3.1). Overall, Dan, like Sam, showed no clear differences between the 3-s and self-determination words acquired. As with Sam, the failure to acquire any control words suggest that both interventions were effective and word learning was not influenced by history, spillover, or testing effects.

Figure 3.4 depicts the number of words Dan acquired across cumulative instructional seconds. Over his 10 intervention sessions, Dan's cumulative instructional time for the 3-s intervention was fixed at 180s per session or 1800s of cumulative instructional time. Dan's cumulative instructional time for the self-determination interventions was 1922s for an average of roughly 192s per session. On average, Dan acquired one word every 76.9s under the self-determination condition and one word every 94.7s under the 3-s condition (see Table 3.1). Figure 3.4 is similar to Figure 3.3, which was caused by Dan completing the self-determination intervention in roughly the same amount of time as the 3-s intervention (i.e. around 180 to 192s per session). Thus, Figure 3.4 further suggests that both interventions are similarly effective in increasing sight-word acquisition rates.

Alice. Figure 3.5 depicts the cumulative words Alice acquired across her 11 intervention sessions. Alice did not acquire any words during the pre-testing phase. In total, Alice acquired 16 words in the 3-s condition and 15 words in the self-determination condition (see Table 3.1).

Visual analysis of Figure 3.5 suggests that Alice quickly acquired words under both the self-determination and the 3-s conditions and did not acquire any words under the control condition throughout the intervention. While the 3-s condition led to more growth in number of words acquired during intervention session 7, for the remainder of the sessions, word acquisition rates were similar across the two interventions. On average, Alice acquired 1.4 words per session under the self-determination condition and 1.5 words per session under the 3-s condition (see Table 3.1). Overall, visual analysis of Figure 3.5 indicates no difference in words acquired across sessions under these conditions.

Figure 3.6 depicts the number of words Alice acquired across cumulative instructional seconds. Over her 11 intervention sessions, Alice's cumulative instructional time for the 3-s intervention was fixed at 180s per session or 1980s of cumulative instructional time. Alice's cumulative instructional time for the self-determination condition was 2021s for an average of roughly 184s per session. On average, Alice acquired one word every 134.7s under the self-determination condition and one word every 123.8s under the 3-s condition (see Table 3.1). Because Alice completed the self-determination and the 3-s interventions in roughly the same amount of instructional time, neither intervention resulted in superior sight-word acquisition rates.

Acquisition summary. The acquisition data show some differences across students. Alice acquired fewer words across both conditions than Sam or Dan. Additionally, when time spent under the interventions was compared, Dan and Alice spent more time working on the self-

determined intervention, relative to the 3-s intervention, while Sam spent more time working on the 3-s intervention. However, these differences in time spent learning were not enough to influence conclusions regarding learning rates. Thus, for all three students, analysis of words acquired per session and words acquired per cumulative instructional second suggest no difference in word acquisition across the two conditions. Therefore, analysis of data across all three students supports the same conclusion; both interventions enhanced sight word acquisition, but neither cause superior increases in words acquired per session or word acquisition rates.

Maintenance

Maintenance data for Dan and Alice was collected 15 days after the intervention sessions concluded. Dan maintained 38 out of the 44 total words (86%) that he had previously acquired during the intervention sessions. Specifically, Dan maintained 21 out of the 25 words (84%) that he acquired under the self-determination condition and 17 out of the 19 words (89%) that he acquired under the 3-s condition (see Figure 3.7). On average, it took Dan 91.5s to learn each word that he maintained under the self-determination condition and 105.9s to learn each word that he maintained under the 3-s condition (see Table 3.1).

Alice maintained 24 out of the 31 total words (77%) that she had previously acquired during the intervention sessions. Specifically, Alice maintained 9 out of the 15 words (60%) that she had acquired under the self-determination condition and 15 out of the 16 words (94%) that she had previously acquired under the 3-s condition (see Figure 3.8). On average, it took Alice 224.6s to learn each word that she maintained under the self-determination condition and 132s to learn each word that she maintained under the 3-s condition (see Table 3.1). Maintenance data was not collected for Sam because he stayed in the intervention phase after this break to gather

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more conclusive data on the relative effectiveness of the self-determination condition and the 3-s condition.

Student preference condition

All three of the students (Sam, Dan, and Alice) preferred the self-determination condition across 100% of the student preference condition sessions (5 out of the 5 sessions). A visual analysis of Figure 3.9 indicates that Sam, Dan, and Alice quickly acquired words under the self-determination condition. Specifically, during these 5 student preference sessions, Sam acquired 12 words, Dan acquired 7 words, and Alice acquired 8 words (i.e. control words not originally targeted during the intervention). Although Sam, Dan, and Alice all selected the self-determination condition across all 5 of the student preference intervention sessions, visual analysis of Figure 3.10 illustrates that their cumulative instructional time differed slightly under this condition.

Sam's cumulative instructional time for the student preference condition was 868s for an average of 174s per session. On average, Sam acquired one word every 72.3s during the student preference phase. Dan's cumulative instructional time across this condition was 928s for an average of roughly 186s per session. On average, Dan acquired one word every 132.6s during this condition. Finally, Alice's cumulative instructional time for the student preference condition was 939s for an average of roughly 188s per session. On average, Alice acquired one word every 117.4s under the student preference phase. When asked why they selected the self-determination condition across each student preference session, the students stated they liked to have choice and they enjoyed going at their own pace through the computer program.

Discussion

Comparing baseline and intervention phase data illustrates that Sam, Dan, and Alice all acquired words following the implementation of both the fixed interval (3-s) and self-determination computer-flashcard reading programs. When comparing the number of words acquired across cumulative instructional time in seconds, the learning rates for each student are similar across both the 3-s and self-determination conditions. During maintenance, both Dan and Alice maintained a larger percentage of the words they had previously acquired under the 3-s condition (see Table 3.1); however, when looking at the total number of words they each maintained, Dan maintained a larger number of words under the self-determination condition while Alice maintained a larger number of words under the 3-condition (see Table 3.1). Thus, while both Dan and Alice maintained a larger percentage of the words they had previously acquired under the 3-s condition, Dan still maintained more total words under the self-determination condition. As this maintenance data is inconclusive, future researchers should continue to collect data on maintenance to get a better understanding of which condition leads to better overall maintenance across students.

During the student preference condition, all students selected the self-determination condition across all sessions and quickly acquired words under this condition. When comparing the number of words acquired over cumulative instructional time in seconds for each student, Sam spent less total time on this condition and acquired the most words, while Dan and Alice spent more total time on this condition and acquired fewer words. When the researcher asked the students why they preferred the self-determination condition over the 3-s condition, they

responded by saying that they liked to be able to have choices and enjoyed being able to go as fast as they wanted through the program.

Limitations and Future Research

Although the primary researcher was present for all sessions during this study, students are capable of implementing these computer-flashcard reading programs independently. Future researchers should allow students to progress through the computer-flashcard reading interventions independently by creating programs that automatically replace acquired words with unknown words and allow students to assess their knowledge autonomously. Focusing on ways to allow students to independently complete the computer-flashcard reading program may bolster the evidence that teachers are free to devote their resources elsewhere as students guide themselves through these programs (Rodriguez, Filler, & Higgins, 2012; Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2011).

Although researchers in this study collected student preference data, future researchers may want to create a more standardized questionnaire to gain a better understanding of what students prefer about particular computer-flashcard reading conditions. In using this standardized format, student preferences may be compared across studies and computer-flashcard reading programs. Researchers may also ask students for ways they think the program could be improved to help guide future development. In this study, researchers observed students getting distracted by noises and activity in the classroom more during the 3-s condition than the self-determination condition. Therefore, future researchers may further explore why students become disengaged with certain computer-flashcard reading conditions, and then supplement those programs with more reinforcement to mitigate off-task behavior (Daly, Neugebauer, Chafouleas, & Skinner, 2015).

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While researchers in this study examined the comparative word acquisition rates across the 3-s and self-determined computer-flashcard reading program, future researchers could expand this focus by evaluating the impact the self-determination condition has on the overall self-determination skills and behavior of students. For instance, future researchers may precisely measure self-determination skills and inappropriate behavior before and after each intervention to evaluate the impact these interventions have on student development (Wehmeyer, Palmer, Lee, Williams-Deihm, & Shogren, 2011). Furthermore, as word acquisition rates did not differ between the two conditions (3-s vs. self-determination) in this study, future researchers may want to further investigate the impact student preference has on overall motivation to engage with and complete the intervention.

The primary purpose of this study was to determine the comparative effectiveness of the fixed (3-s) versus the self-determination computer-flashcard reading conditions. Although maintenance data was collected, researchers did not evaluate how well students could generalize acquired words to passages. Future researchers could examine the percentage of acquired words from each computer-flashcard reading condition that students are able to generalize to outside texts. These researchers may also focus on measuring how student's ability to generalize words to passages impacts their overall comprehension of that text (Nist & Joseph, 2008; Yaw et al., 2012). To facilitate generalization and comprehension of previously acquired words, researchers may wish to target words within sentences or provide word definitions to encourage both comprehension and generalization.

Summary

Implementing computer-flashcard reading interventions with fixed (3-s) and self-determined intervals allows for students to quickly acquire words without straining teacher resources.

Because the word acquisition rates under both conditions are similar, researchers and educators

may continue to explore the impact that student preference has on overall learning rates. Student

preference data may also help guide intervention decisions that possibly encourage student

participation and increase motivation.

Chapter V

Conclusion and General Discussion

This dissertation is comprised of three studies that replicate and extend research evaluating the effectiveness of computer-flashcard reading interventions on teaching sight words to students with intellectual disability. While previous researchers have found that computer-flashcard reading programs are effective with students with intellectual disabilities (Baumgart & VanWalleghem, 1987; Hilton, Hopkins, Skinner, McCane-Bowling, 2011; Kodak, Fisher, Clements, & Bouxsein, 2011; Yaw, Skinner, Parkhurst, Taylor, Booher, & Chambers, 2011; Yaw, Skinner, Orsega, Parkhurst, Chambers, & Booher, 2012), this series of studies extends this research by focusing on different populations and altering the response intervals.

Results from Study I demonstrate that post-secondary students with intellectual disability quickly acquired words through the implementation of a computer-flashcard reading intervention with 2-s intervals. While previous researchers found that computer-flashcard reading programs facilitate word acquisition in elementary-school students with intellectual disability (Hilton et al, 2011; Kodak, Fisher, Clements, & Bouxsein, 2011; Yaw et al., 2011), this study extends this line of research to post-secondary students learning college-level words. Study I supports previous research, illustrating students quickly acquire words through computer-flashcard reading interventions with fixed response intervals (Yaw et al., 2011; Yaw et al., 2012). In developing Study II, we wanted to evaluate whether word acquisition would improve under a condition where students were allowed to self-determine their computer-flashcard reading response intervals. In transitioning from computer-flashcard reading programs with fixed response intervals to self-determined response intervals, we were also interested in getting feedback from the students regarding their thoughts about being given autonomy to choose their response intervals.

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Results from Study II illustrate that elementary-school students with intellectual disability rapidly acquired formally unknown words when given autonomy to self-determine their response intervals. While previous researchers found that computer-flashcard reading programs with self-determined response intervals facilitate word acquisition in an adult, post-secondary student with intellectual disability (Cazzell, Browarnik, Skinner, Skinner, Cihak, Ciancio,…Forbes, in press), this study extends this research to elementary-school students with intellectual disability. Expanding upon this research, we developed Study III to compare the effectiveness of a computer-flashcard reading program with fixed (3-s) versus self-determined response intervals. In developing Study III, we were interested in specifically comparing the word acquisition rates of the two computer-flashcard reading conditions along with obtaining student preference data.

Results from Study III demonstrate that elementary-school students with intellectual disability quickly acquired words under both the 3-s and self-determination conditions. While their learning rates under both conditions (3-s and self-determination) were similar, during the student preference condition when the students were allowed to choose the condition they preferred, all three participants selected the self-determination condition across all 5 days of this phase. When the researcher asked the participants why they preferred the self-determination condition, the students stated that they enjoyed having choices and being able to go at their own pace through the intervention.

Implications

Theoretical. When developing academic interventions for students who are struggling, it is important for researchers and educators to use precise measures when monitoring the effectiveness of each intervention. Instead of devoting more time to academic instruction, educators should consider programs that focus on increasing the learning rates of students with

academic concerns. In these studies, computer-flashcard reading programs with short response

intervals proved effective in enhancing sight-word acquisition without requiring large amounts

of instructional time. Thus, students participating in these computer-flashcard reading

interventions have more time to devote to other activities in school. Increasing learning rates

also allows for more learning to take place within a fixed period of time, enabling students to

continue to engage in supplemental, academic activities (i.e. physical education, recess, and art)

within the school day (Skinner, Fletcher, & Henington, 1996; Skinner, Cooper, & Cole, 1997).

As students with intellectual disability typically report lower levels of self-determination

than their peers (Shogren, Wehmeyer, Palmer, Soukup, Little, Garner, & Lawrence, 2007),

interventions that encourage high rates of safe choices may increase their autonomy while also

reducing inappropriate behaviors (Dyer, Dunlap, & Winterling, 1990). During Study III, the

researcher noted that the students were less likely to get distracted by other activities in the

classroom and were more likely to maintain focus on the computer screen during the self-

determination condition than the 3-s condition. When given more autonomy over their

instruction during the self-determination condition, the students appeared more engaged with the

intervention.

Allowing students to have autonomy over their instruction during the self-determination

condition may have also increased their motivation to participate in the program. Student

preference data illustrating that all participants preferred the self-determination condition

supports research suggesting that motivation increases when students are given more

independence over their instruction (Moore & Calvert, 2000). Thus, researchers and educators

should consider implementing interventions that continue to enhance word acquisition rates

while occasioning high rates of safe choices, and possibly building self-determination skills across students.

Applied. Computer-flashcard reading programs with both fixed and self-determined response intervals can effectively alleviate strains on resources without eliminating teacher input (Kodak, Fisher, Clements, & Bouxsein, 2011). Across these interventions, teachers still have the flexibility to adjust the response intervals and target words prior to the implementation of the program. Across all three studies, the researcher was present during the interventions to ensure implementation fidelity and to answer any questions. This level of individual monitoring in the classroom environment is not required. Although teacher presence is not necessary to implement these computer-flashcard reading programs, teachers may still manually adjust target words and alter response intervals based on each student's academic goals to increase learning (Moore & Fisher, 2007; Kodak, Fisher, Clements, & Bouxsein, 2011).

Allowing students autonomy over response intervals in computer-flashcard reading interventions facilitates word acquisition while allowing participants to control the pace of their instruction. As the learning rates across the fixed and self-determined conditions in Study III were similar across students, educators may begin focusing on developing interventions based on student preference data to encourage student engagement. When asked by the researcher during Study III why they preferred the self-determination condition, the students stated that they "liked to have choices." One of the students claimed, "I like to be able to go as fast as I want" through the intervention program. Researchers also observed that students were more engaged throughout the self-determination conditions than the 3-s conditions. For instance, when waiting to hear a word under the 3-s condition, the students would sometimes get distracted and look around the room. During the self-determination condition, however, the students focused more

on the computer screen, as they were interested in moving quickly through the program. In application, allowing students to make high rates of safe choices may increase student engagement, enhance learning, and increase self-determination (Yaw, Skinner, Orsega, Parkhurst, Chambers, & Booher, 2012).

Limitations and Future Research

As maintenance and generalization data show inconsistencies across the studies in this series, future researchers should continue to investigate maintenance and generalization of previously acquired words. To measure generalization, future researchers may integrate words acquired into passages appropriate for the student's reading level. Researchers may also integrate target words into phrases on flashcards to help increase student's generalization (Nist & Joseph, 2008; Yaw et al., 2012).

Previous researchers have illustrated the importance of precisely measuring learning rates to determine the effectiveness of interventions (Skinner & Daly, 2010). In this series of studies, researchers found that students quickly acquired words under short, fixed response intervals (3-s) and self-determined response intervals. Future researchers should continue to manipulate response intervals in an effort to further enhance learning rates. As students do not need to devote a lot of instructional time to the computer-reading interventions to acquire words, future researchers could implement programs that allow for students to simultaneously read words while hearing feedback to further explore word acquisition rates.

As student preference data was not collected across all studies in this series, future researchers may explore creating a standardized questionnaire for gathering student preference data across a variety of computer-flashcard reading conditions. As researchers suggest that allowing students choices during instruction may reduce off-task behaviors, future researchers

may focus on measuring off-task behaviors throughout the implementation of the intervention to better determine if these programs reduce inappropriate behaviors (Dyer, Dunlap, & Winterling, 1990). Furthermore, as previous researchers have found that immediate reinforcement is more potent than delayed reinforcement (Kulik & Kulik, 1988), future researchers may focus on integrating more reinforcing stimuli throughout the intervention. For instance, researchers may integrate a bar at the top of the page that progressively fills in as the students' progress through the program.

Computer-flashcard reading programs may allow for self-directed implementation, enabling students to independently complete the program without teacher assistance (Kodak, Fisher, Clements, & Bouxsein, 2011). Future researchers should permit students to have complete autonomy over the program and continue to provide students with choices regarding response interval preference. Researchers could also develop interventions to automatically load new target words based on words acquired while also allowing students to self-monitor their assessments.

Summary and Concluding Remarks

In considering of this line of research, educators are encouraged to select interventions that precisely measure learning rates and allow for high rates of safe choices that encourage student autonomy. While interventions with fixed and self-determined response intervals are effective in allowing students to quickly acquire words, researchers and educators should consider student preference data to help develop interventions that are engaging to students. Ensuring students enjoy participating in the intervention may further facilitate student learning and success.

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Appendices

Appendix A

Tables and Figures

Table 1.1

Participant Characteristics

Participants	Age	Intelligence (Standard Scores)	Adaptive (Standard Scores)	Reading Comprehension (grade level equivalent)
Mike	20	60[a]	71[c]	2.0[d]
Cindy	23	53[a]	71[c]	3.2[d]
Carl	25	65[b]	75[c]	2.1[d]

Note.   a = Wechsler Intelligence Scale for Children-III (Schrank, Becker, & Decker, 2001); b = Stanford-Binet-5 (Roid, 2003); c = Vineland Adaptive Scales (Sparrow, Cicchetti, & Balla, 2005); d = Brigance Transition Skill Inventory (Brigance, 2010).

Table 1.2

Aggregate Learning Data for Each Participant

Student	Total Seconds and (Min) of Instruction	Total Words Acquired	Mean Words Acquired per Min	Mean Seconds to Acquire One Word	Total Words Maintained (% Acquired Words Maintained)	Total Words Generalized (% Acquired Words Generalized)	Total Maintained Words Generalized (% Maintained Words Generalized)
Cindy	1980 (33)	13	.39	154	8 (62%)	8 (62%)	5 (63%)
Carl	1880 (30)	22	.73	87	18 (82%)	18 (82%)	18 (100%)
Mike	900 (15)	6	.40	140	4 (67%)	4 (67%)	2 (50%)
Across Student Mean			.51	127	78%	73%	83%

Table 3.1

Descriptive data across students and self-determined (SD) words and three-second words.

	Sam		Dan		Alice	
	SD	3-s	SD	3-s	SD	3-s
Cumulative words acquired	22	18	25	19	15	16
Average number of words acquired per session	2	1.6	2.5	1.9	1.4	1.5
Average time taken to acquire each word	87.4s	110s	76.9s	94.7s	134.7s	123.8s
Number of maintained words	N/A	N/A	21	17	9	15
Percentage of acquired words that were maintained	N/A	N/A	84%	89%	60%	94%
Average time taken to learn each maintained word	N/A	N/A	91.5s	105.9	224.6s	132s
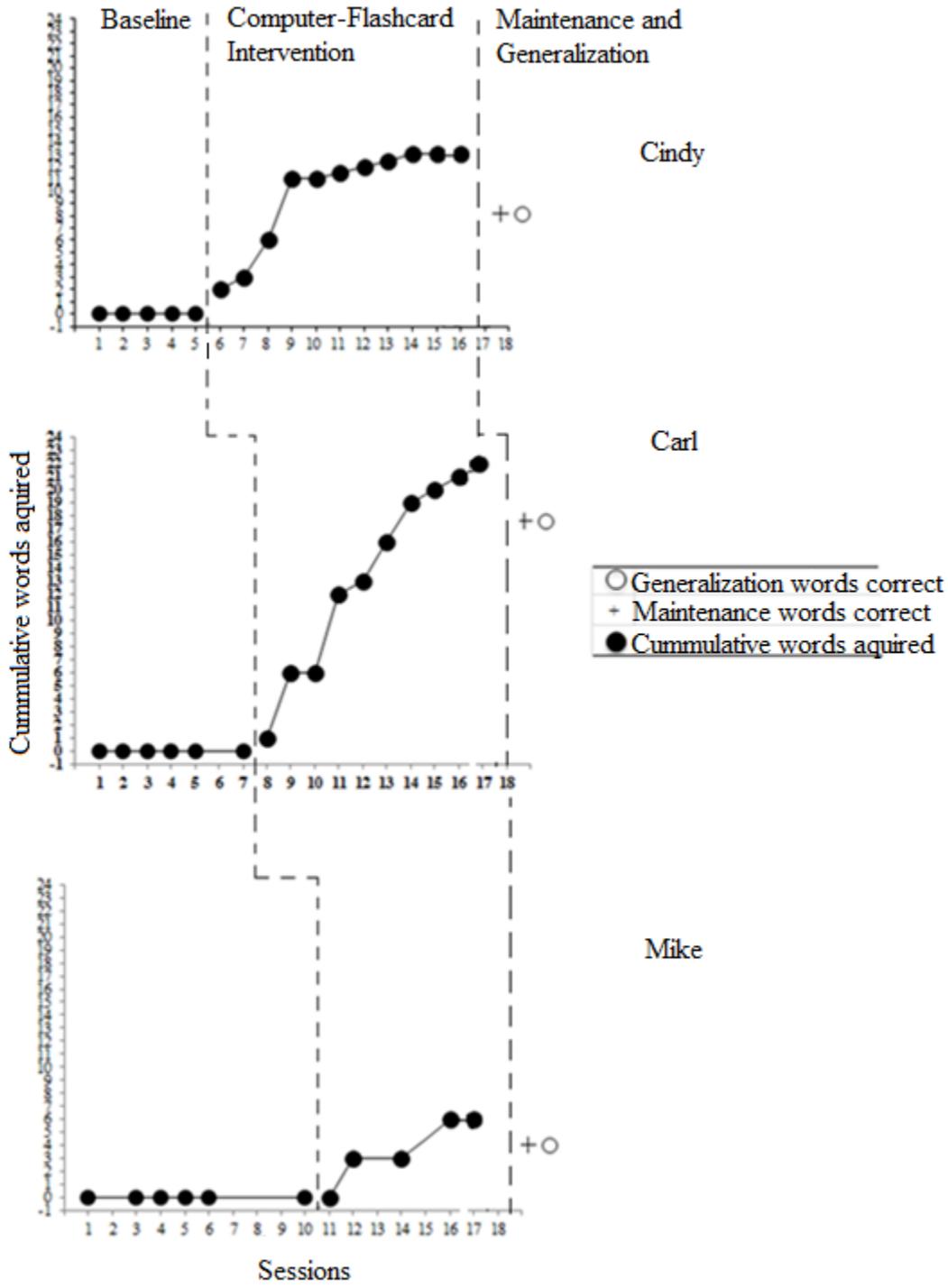
Figure 1.1: Cumulative words acquired across sessions.
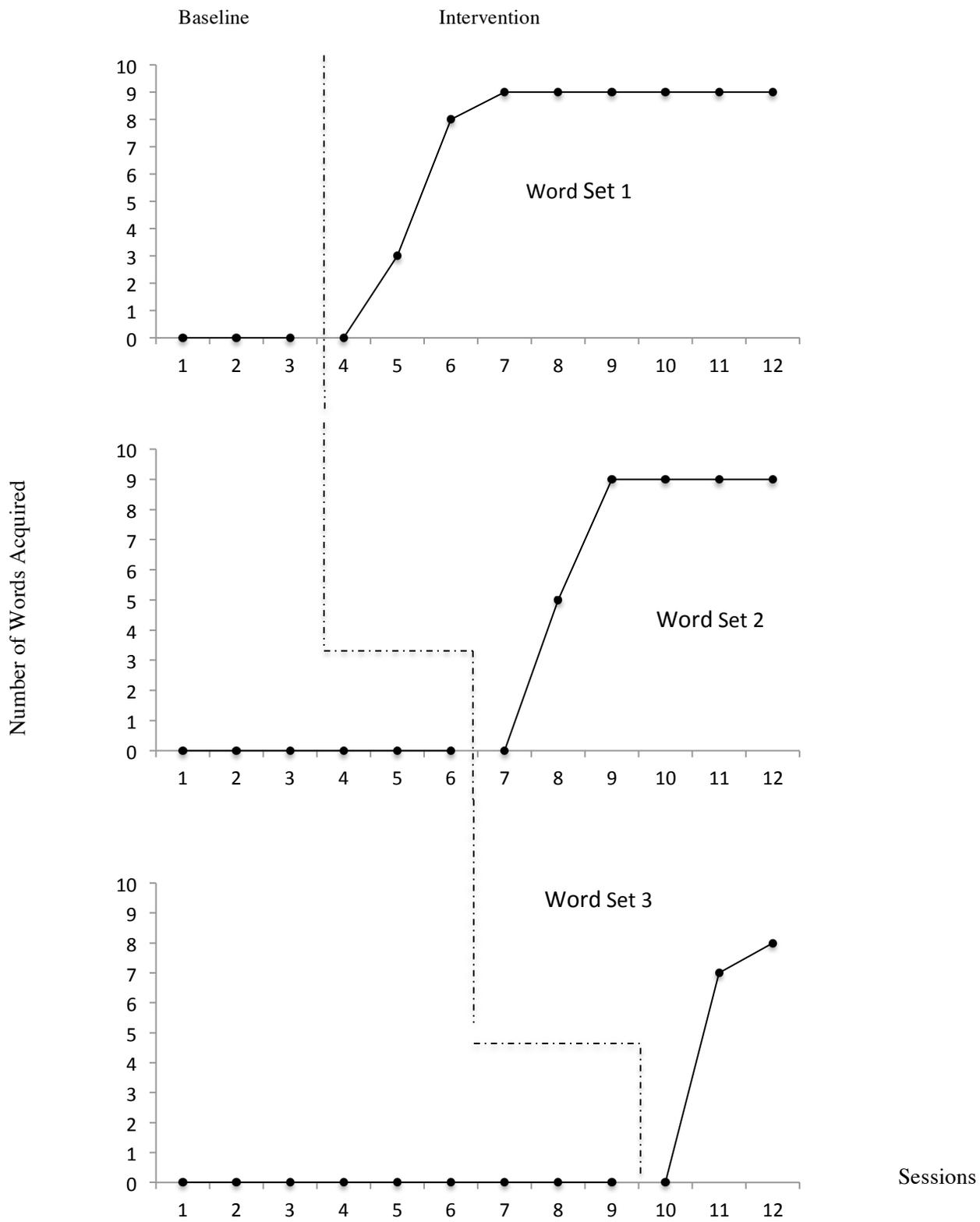
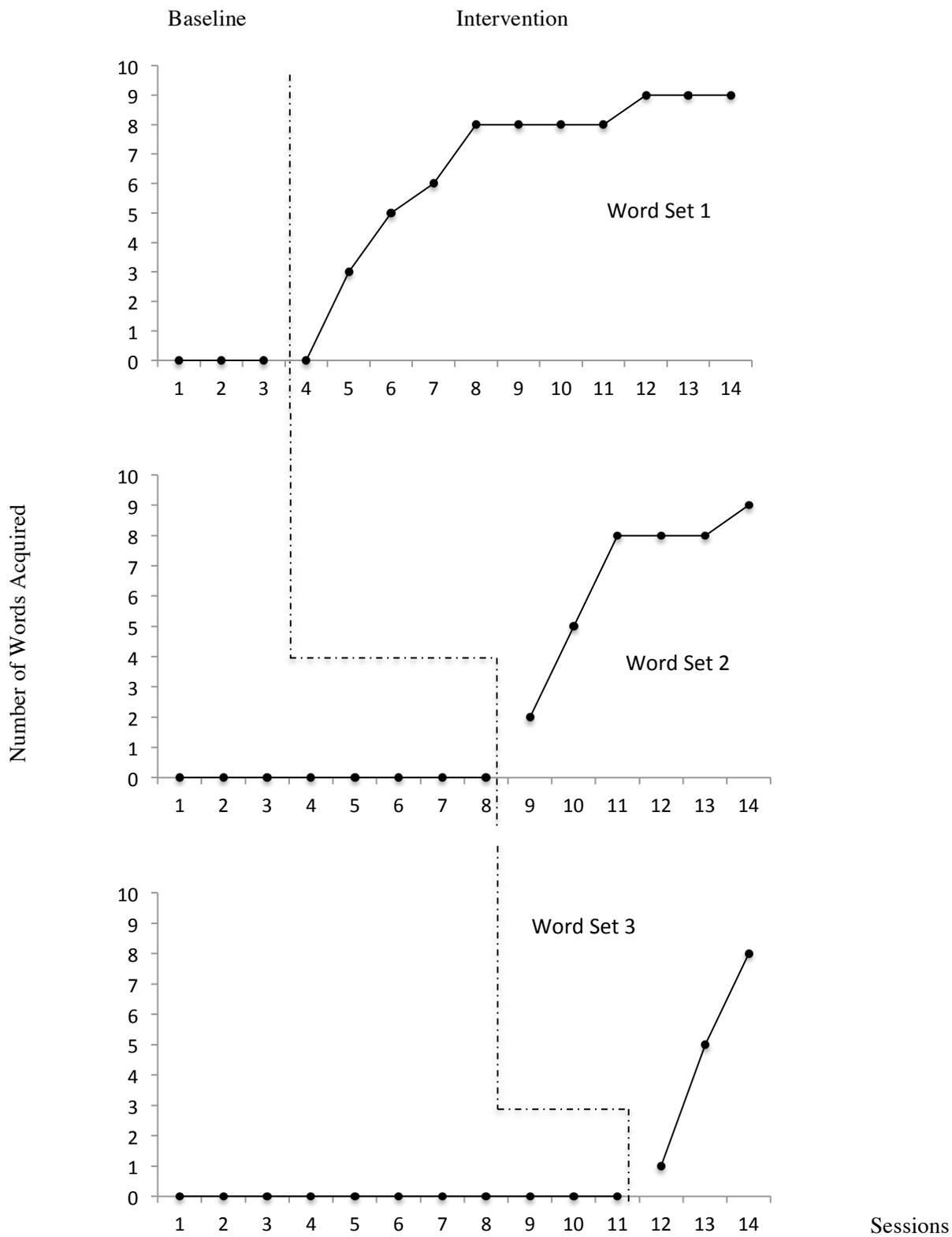*Figure 2.1*. The number of words Susan acquired across sessions.

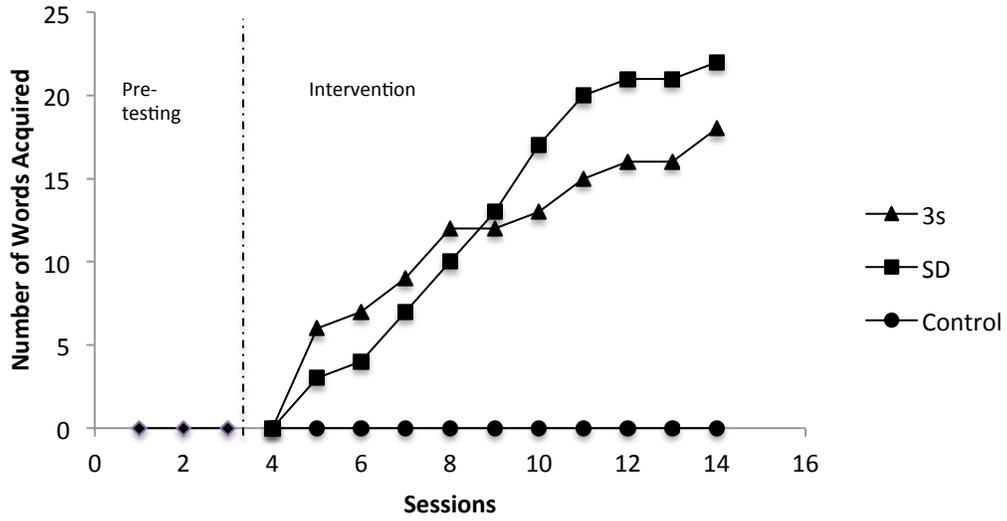*Figure 2.2*. The number of words Mark acquired across sessions

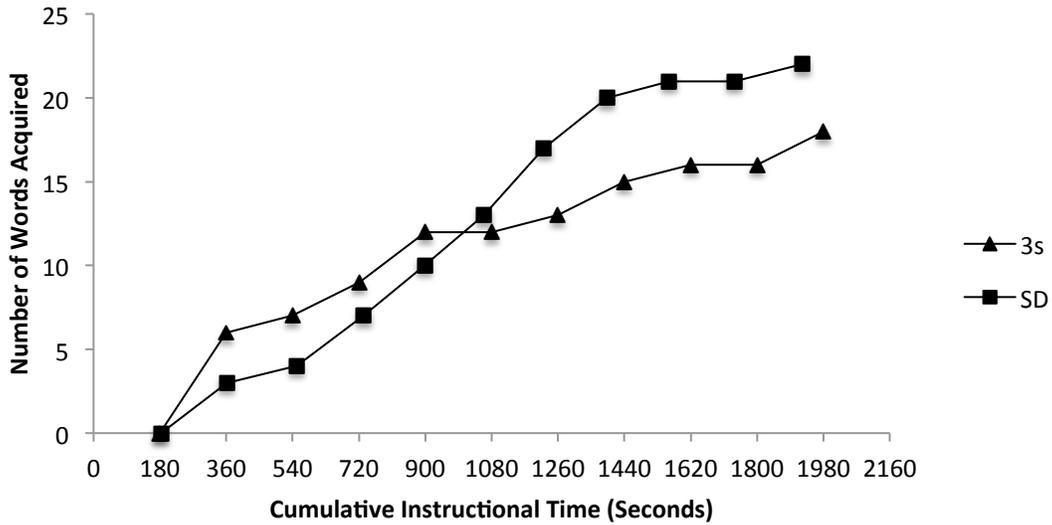*Figure 3.1*. Number of words Sam acquired across sessions

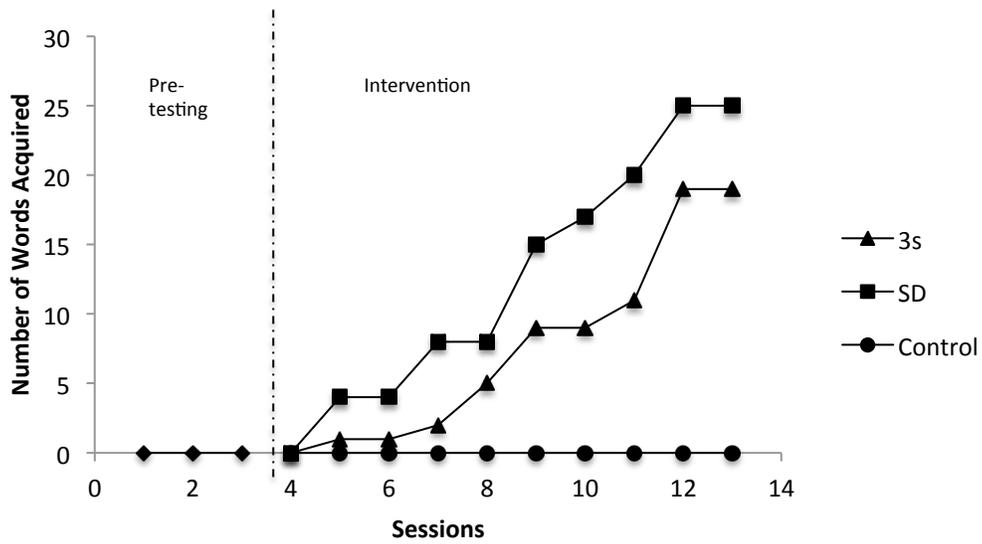*Figure 3.2*. Number of words Sam acquired across instructional seconds
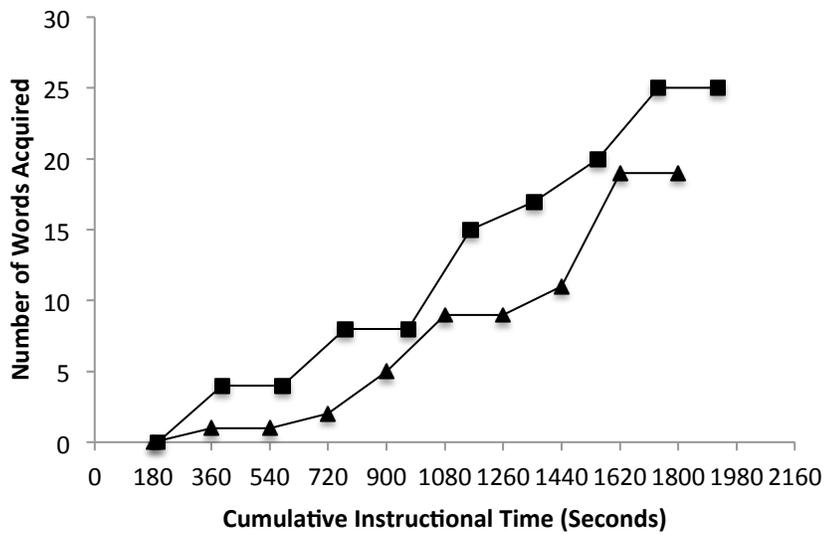
Figure 3.3. Number of words Dan acquired across sessions.

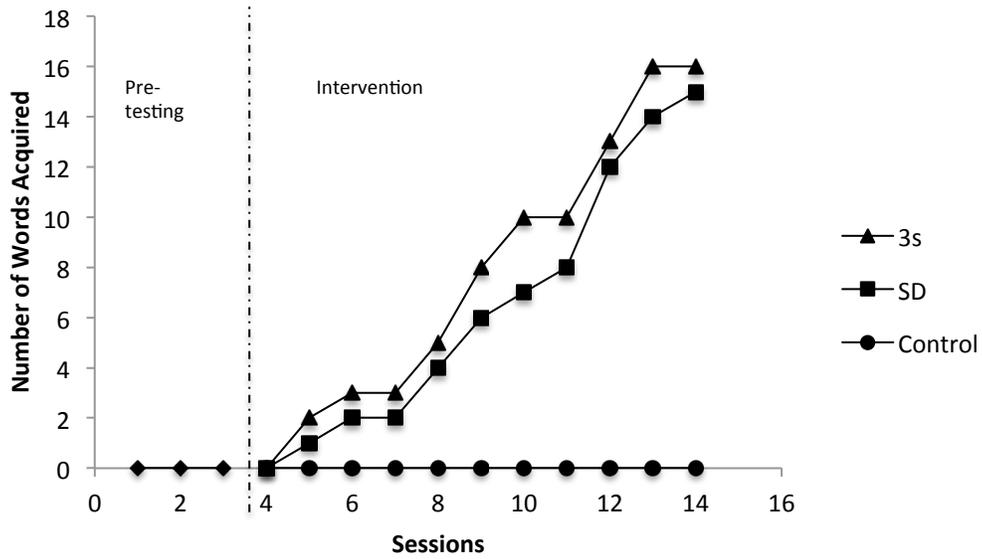*Figure 3.4.* Number of words Dan acquired across instructional seconds.

Figure 3.5. Number of words Alice acquired across sessions.
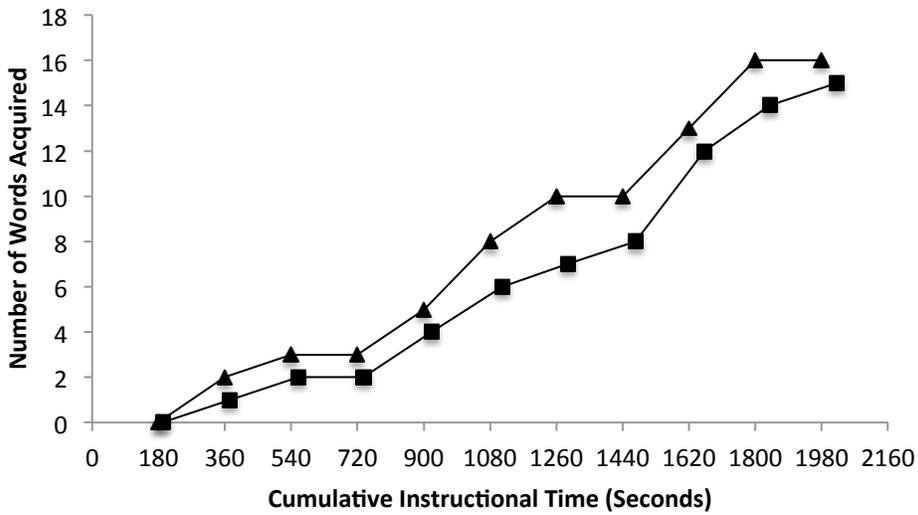

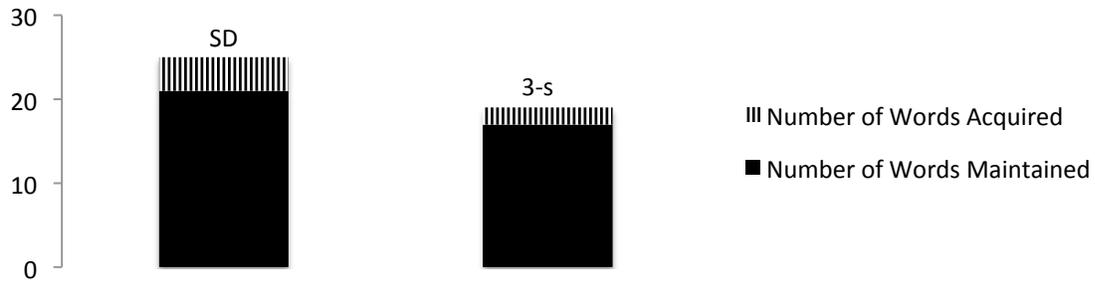*Figure 3.6*. Number of words Alice acquired across instructional seconds.

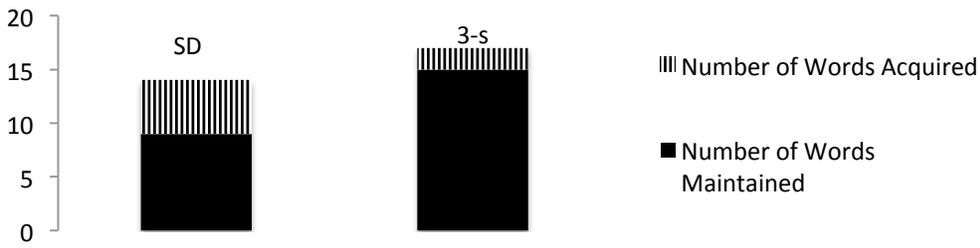*Figure 3.7.* The number of words Dan maintained across conditions.

Figure 3.8. The number of words Alice maintained across conditions.
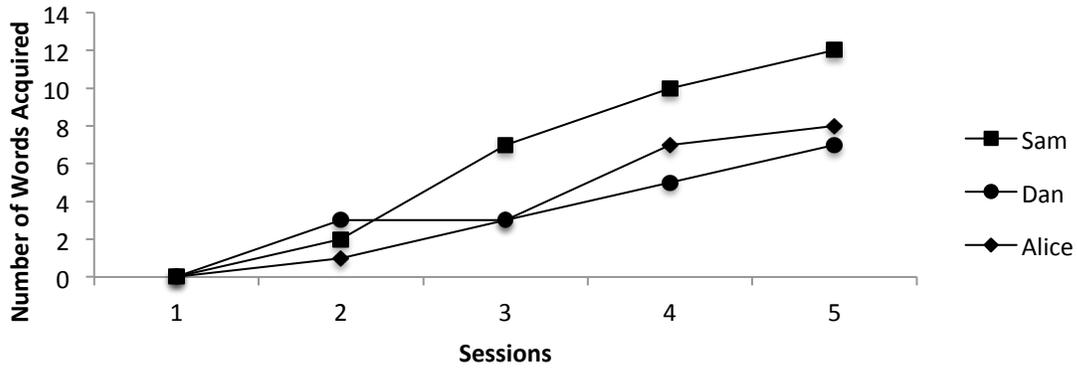
Figure 3.9. Number of words acquired across students during the student preference condition.
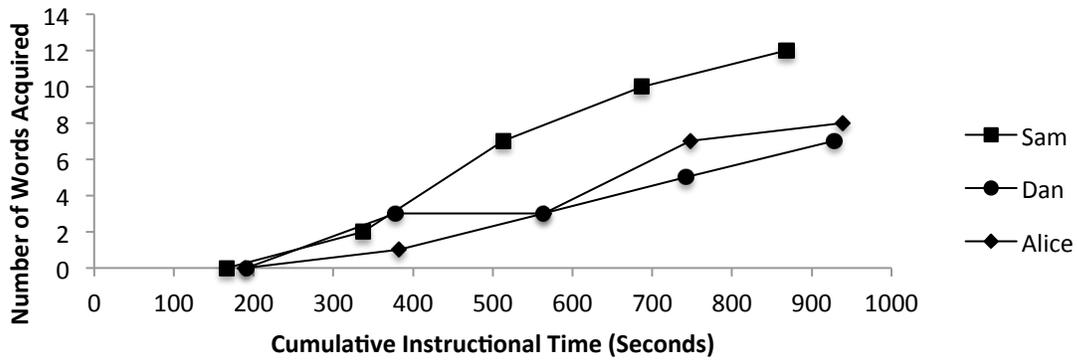

Figure 3.10. Number of words acquired across instructional time (seconds) during the student preference condition.

Appendix B

Targeted Words:

Acquired Words are in Italics

Study I:

Cindy
Coronary, Cytochrome, Lysine, Cadmium, *Butyrate*, Cholera, *Cystic*, Derivatives, *Desaturation*,
Dopamine, Ecological, *Hepatitis*, Hyperthyroidism, *Isomers*, *Urinary, Fluoride,*, *Additives*,
Folate, Hydrogenated, Anemia, Fungicides, *Phenotype*, Pathogens, Intracellular, Homeostasis,
Echovirus, Impedance, Pernicious

Carl
Contaminants, Emulsification, Alzheimer's, Basal, Cardiovascular, Colorectal, Digestibility,
Dioxins, *Emulsifiers, Estrogen, Excretion, Intolerance, Lectins, Scurvy, Thermic,* Arsenic,
Aspartate, Peripheral, Anemia, Cadmium, *Cholera, Pernicious, Megoblastic, Lipemia ,*
Interactance, Germanium, Flavonoids, Insecticides, Saturated, Linoleate, Hypothalamus,
Retinol, Polychlorinated, Isoflavones, Postprandial, Galactose

Mike
Folate, Adipose, Ammonia, Carcass, Choline, Ecological, Fermentation, Fructose, Herbicides,
Insulin, Metabolic, *Oxidase*, Selenium, Viamers, *Pathogens*, Lysine, Cystic, Endocrine, Biotin,
Bioavailability, Butyrate

Study II:

Sarah
Set A: *sign, heir, thigh, align, fright,* benign, *hydrant, polygon, hydrogen, incision*
Set B: *myth, dough,* cycle, *admire, system, rhythm, cyclone, antonym, moveable, quotient*
Set C: cyst, *pedal, lymph, ought, resign, coarse,* foreign, *campaign, patience, admirable*

Mark
Set A: *bit, bend, felt, lift, shut, till,* creek, *knock, stood, broken*
Set B: *cap, busy, lead, seat, soap, brick, early, march,* sweep, *center*
Set C: hid, *chin, leaf, seem, suit,* cause, *fresh, shook, trade, course*

Appendix C

Generalization Paragraphs *(acquired words in italics)*

<u>Study I:</u>

Mike:

          Mary's dog is sick and has a lot of problems. For example, it does not have a lot of *adipose*. Mary thinks her dog is sick because it is not getting enough *folate*. Her mother thinks the dog is sick because it does not have *oxidase* and has low levels of *insulin*. Mary's dad disagrees. He says the dog is sick because it lives near harmful *pathogens* and *ammonia*.

Cindy:

          Fluoride and *folate* are sometimes added to our drinking water. Some people believe these additives cause *coronary* and *cystic* problems. Other people believe they cause *urinary* problems and *hepatitis*. Scientists have not been able to support these beliefs.

          We learned a lot in Biology today. We found out that it is important that humans eat *lysine*. We also learned that *phenotypes* determine a person's appearance. Later, we were taught about the state of *desaturation*. Another important fact we learned is that *isomers* do not have to share similar properties. Once class was over, we were given a homework assignment: create a model plant tissue. The model must include all parts of the tissue, including the *cytochrome*. Next week, we will learn about *butyrates*. I do not know much about butyrates. I only know that they give energy to cells.

Carl:

          Eating that fatty food affected the man's *digestibility*. Not only that, the man had a milk *intolerance* as well as *Alzheimer's*. To top it all off, his wife had *cardiovascular* disease, and *basal* cell cancer. He also knew a pirate with *scurvy*, a man with *colorectal* cancer, a girl with a *megoblastic* crisis, a lady with a high *lipemia* index, and a boy with *cholera*. He was dealing with some pretty *pernicious* issues.

          Today in science class, we learned about the element, *germanium*. We also did a lab in which *emulsifiers* were added to a liquid to suspend one liquid in another. After the lab, we learned about *aspartate*, and *lectins*. The teacher also taught us about lab safety, teaching us to wear glasses to avoid *contaminants*. To end class, we learned about the "*interactance* hypothesis" and *thermic* energy.

          In biology, we learned about human bodies. We learned that women have more *estrogen* than men and that *emulsification* prepares fat for digestion. We also learned about plants, and animals. The teacher, who was very interested in plants, taught the class about *flavonoids*. After learning about plants, the teacher moved on to teaching us about animal digestion. We learned that through *excretion*, animals get rid of their waste.

Experimental Protocols

<u>Study I:</u>

1. _____ The experimenter set up a workstation containing a laptop and two chairs.

2. _____ The experimenter told student to sit in his/her chair of choice.

3. _____ The student was instructed that upon pressing the computer space bar, words would be displayed, and they were to try to "beat the recording" by saying the word before they heard the recording. Students were also instructed to repeat the word after they heard the recording.

4. _____ The student then proceeded by pressing the space bar.

5. _____ When the 2-s intervention was completed, steps 3-4 were completed with the other two PowerPoints containing the same words arranged in different orders.

6. _____ After the intervention was completed each day, the student was handed a pile of flashcards.

7. _____ The student was instructed to read the words on the flashcards to the best of his/her ability. If they did not read the words within 3 s, the words would be read aloud to them.

8. _____ The student went through the flashcards as the experimenters recorded correct and incorrect responses on datasheets.

9. _____ Upon completing the flashcards, the student left the room.

10. _____ After the student left the room; the experimenters compared their datasheets, checking for interrater agreement.

11. _____ Steps 2-10 were completed for each student.

12. _____ All Assessment sessions were recorded for interrater reliability data.

<u>Study II:</u>

1. _____ The experimenter set up a work area containing a laptop and three chairs.

2. _____ The experimenter instructed the student to sit in his/her chair of choice.

3. _____ The student was instructed that upon pressing the computer space bar, words would appear on the screen. Upon pressing the space bar a second time for each slide, the words would be read aloud. The student was told to press the space bar again to move onto the next slide.

4. _____ The student then proceeded by pressing the space bar.

5. _____ The student attempted to read the word, pressed the space bar, and repeated the word again after hearing it read.
6. _____ After the intervention was completed each day, the experimenter got out a pile of flashcards.
7. _____ The student was instructed to read the words on the flashcards to the best of his/her ability. If he/she did not read the word within 3 seconds, it would be read aloud to him/her.

8. _____ The student went through the flashcards as the experimenters recorded correct and incorrect responses.
9. _____ Upon completing the flashcards, the student returned to his/her classroom tasks.
10. _____ After the student completed the computer flashcard reading procedures, the experimenters compared their datasheets, checking for interscorer agreement and treatment integrity.

Note any additional prompts that may have been needed:_____

_____

Study III:

1. _____ The experimenter set up a workstation containing a laptop and two chairs.
2. _____ The experimenter told student to sit in his/her chair of choice.
3. _____ The researcher went through flashcards targeting treatment words with the student. The student was told to read each word to the best of his/her ability within 3-s. Correct responses were recorded by the experimenter in datasheet.
4. _____Under the 3-s condition, the student was instructed that upon pressing the computer space bar, words would be displayed, and they were to try to "beat the recording" by saying the word before they heard the recording. Students were also instructed to repeat the word after they heard the recording.
5. _____ The student then proceeded by pressing the space bar.
6. _____ Under the self-determined condition, the student was instructed to attempt to read the words displayed on the computer screen and then press the space bar to hear feedback. After hearing feedback, they were instructed to repeat the word.
7. _____ Upon completing both interventions, the student went back to classroom work.
8. _____ After completing the intervention with each student, the experimenters compared their datasheets to check for interrater agreement.
9. _____Steps 2-8 were completed for each student.

Appendix E

Student Consent Form, Study I

My name is Samantha Cazzell and I am a graduate student in the Ph.D. School Psychology Program at the University of Tennessee. I am studying reading and would appreciate your help. If you decide to help, you will be asked to spend about 5 minutes per session reading some words on PowerPoint slides and flashcards.

If you choose to help, you can quit at any time by letting me know you wish to quit. You will not be punished for choosing to quit the study. If this intervention takes more than 15 sessions, it will also be concluded so you don't get tired.

If you agree to help, please mark the space next to "yes." If you do not want to help, please mark the space next to "no" and your teacher will give you something else to work on while we do this study. Please write your name on the line below.

Thank you for your help.

Sincerely,
Samantha Cazzell

____ yes

____ no

Name:_____
            Date:_____

Appendix F

Student Assent Form, Study II

My name is Samantha Cazzell and I am a graduate student in the Ph.D. School Psychology Program at the University of Tennessee. I am studying reading and would appreciate your help. If you decide to help, you will be asked to spend about 5 minutes per session reading some words on PowerPoint slides and flashcards.

If you choose to help, you can quit at any time by letting me or your teacher know you wish to quit and you will be allowed to do work assigned by your teacher. You will not be punished for choosing to quit the study, and you will not get a grade in your classroom for how well you read.

If you agree to help, please mark the space next to "yes." If you do not want to help, please mark the space next to "no" and your teacher will give you something else to work on while we do this study. Please write your name on the line below.

Thank you for your help.

Sincerely,
Samantha Cazzell

____ yes

____ no

Name:_____
             Date:_____

Appendix G

Student Assent Form, Study III

My name is Samantha Cazzell and I am a graduate student in the Ph.D. School Psychology Program at the University of Tennessee. I am studying reading and would appreciate your help. If you decide to help, you will be asked to spend about 5 minutes per session reading some words on PowerPoint slides and flashcards.

If you choose to help, you can quit at any time by letting me or your teacher know you wish to quit and you will be allowed to do work assigned by your teacher. You will not be punished for choosing to quit the study, and you will not get a grade in your classroom for how well you read. If this intervention takes more than 15 sessions, it will also be concluded so you don't get tired.

If you agree to help, please mark the space next to "yes." If you do not want to help, please mark the space next to "no" and your teacher will give you something else to work on while we do this study. Please write your name on the line below.

Thank you for your help.

Sincerely,
Samantha Cazzell

____ yes

____ no

Name:_____ Date:_____

Appendix H

Parent Consent Form, Study II

Dear Parent,

My name is Samantha Cazzell and I am in my third year in the School Psychology doctoral program at the University of Tennessee. I am currently working on research designed to compare different reading instruction techniques. I am seeking your consent for your child to participate in this study. I will be working with and be supervised by Dr. Christopher H. Skinner, a professor at the University of Tennessee.

If you agree to allow your child to participate, your child will work one-on-one with a UT school psychology student. Your child will be asked to read some words on PowerPoint slides and flashcards. They will receive feedback on whether or not they read the word correctly via the PowerPoint program. Their knowledge will be assessed with the flashcards after they finish the PowerPoint.

The study will require your child to spend approximately 5 minutes doing these reading activities during their reading period on a day that has been arranged by the teacher. These sessions will continue throughout the semester. If you agree to allow your child to participate, your child may quit the study at any time. This will have no effect on your child's grade. Furthermore, if this intervention takes more than 20 sessions, it will be discontinued to prevent fatigue. Although results of our research may be shared with others through professional publications or presentation, your child's name will never be revealed. Instead of listing your child's name with his/her performance data, we will give your child a pseudo name.

If you have any questions about this study or consent form, feel free to contact me, Samantha Cazzell at (937) 750-3782. If you agree to allow your child to participate in this research, please check the appropriate box and sign the form in the space provided for parental signature or legal guardian.
Thank you for your and your child's time and consideration,
Samantha Cazzell
University of Tennessee, Educational Psychology and Counseling
Knoxville, TN 37996
(937) 750-3782
scazzell@vols.utk.edu

Check One

_____ I DO agree to allow my child to participate in this research.
_____ I DO NOT agree to allow my child to participate in this research.

Child's Name: _____

Signature: _____ Date: _____
               Parent or Legal Guardian

Appendix I

Parent Consent Form, Study III

Dear Parent,

My name is Samantha Cazzell and I am in my third year in the School Psychology doctoral program at the University of Tennessee. I am currently working on research designed to compare different reading instruction techniques. I am seeking your consent for your child to participate in this study. I will be working with and be supervised by Dr. Christopher H. Skinner, a professor at the University of Tennessee.

If you agree to allow your child to participate, your child will work one-on-one with a UT school psychology student. Your child will be asked to read some words on PowerPoint slides and flashcards. They will receive feedback on whether or not they read the word correctly via the PowerPoint program. Their knowledge will be assessed with the flashcards after they finish the PowerPoint.

The study will require your child to spend approximately 5 minutes doing these reading activities during their reading period on a day that has been arranged by the teacher. These sessions will continue throughout the semester. If you agree to allow your child to participate, your child may quit the study at any time. This will have no effect on your child's grade. Furthermore, if this intervention takes more than 15 sessions, it will be discontinued to prevent fatigue. Although results of our research may be shared with others through professional publications or presentation, your child's name will never be revealed. Instead of listing your child's name with his/her performance data, we will give your child a pseudo name.

If you have any questions about this study or consent form, feel free to contact me, Samantha Cazzell at (937) 750-3782. If you agree to allow your child to participate in this research, please check the appropriate box and sign the form in the space provided for parental signature or legal guardian.

If you have any questions about your rights as a research participant, please contact the UT Office of Research Compliance Officer at (865) 974-7697.

Thank you for your and your child's time and consideration,

Samantha Cazzell
University of Tennessee, Educational Psychology and Counseling
Knoxville, TN 37996
(937) 750-3782
scazzell@vols.utk.edu

<u>Check One</u>

_____ I DO agree to allow my child to participate in this research.

_____ I DO NOT agree to allow my child to participate in this research.

Child's Name: _____

Signature: _____ Date: _____

Parent or Legal Guardian

Appendix J

Teacher Consent Form, Study II

Dear Teacher,

My name is Samantha Cazzell. I am in the School Psychology Ph.D. program at the University of Tennessee. I would like to conduct research in your classroom under the supervision of my advisor, Dr. Christopher H. Skinner, a professor at the University of Tennessee. The purpose of my study is to learn how to best facilitate reading instruction. Likewise, I would like to spend 3-5 minutes across the semester with some of your students (whose parent has provided consent) to conduct this reading intervention. By the end of the study, we hope to have taught the students words that were previously unknown to them. In addition, we hope to evaluate whether or not they enjoyed the computer reading intervention implemented. We are in the process of getting principal support for this project at Eagleton.

If you agree to participate, your students will be asked to spend 3-5 minutes for each session reading words from a PowerPoint and then from flashcards. Each student who agrees to participate (and whose parent has provided consent) would meet with me individually for this intervention. For the intervention component, the students will be presented with 15 words on PowerPoint slides. They will be asked to read the words aloud, press the space bar to hear the word being read aloud to them, and then repeat the word again after they hear it. Upon completing this intervention each session, they will be assessed via flashcards to determine what words they have learned.

I will be involved in this project until each student learns 80% of the words in their list; thus, the length of the study may vary from child to child. You are free to request that my involvement in the classroom be discontinued at any time with no penalty to you or the participating students. Furthermore, if a student takes more than 20 sessions to complete this intervention, it will be discontinued to prevent fatigue and frustration.

No risks for teachers or students are anticipated from this study other than those ordinarily encountered in the classroom. Your name will not be recorded on any of the materials in this study. Student participants' names will not be on the data forms; instead, pseudo names will be used so that student names are not revealed.

Participation in this study is voluntary, which means that you do not have to participate and can stop at any time without penalty. Although results of our research may be shared with others through professional publications or presentation, your name or the names of your students will never be revealed.

Enclosed is a copy of this letter for your records. If you agree to participate in this research, please complete the section below on one copy of this letter and return it to me. Your signature indicates that you have read and understand the information above, that you willingly agree to participate, and that you may withdraw at any time and discontinue participation without penalty. If you have any questions about this consent form or this study, please feel free to contact my faculty advisor, Christopher Skinner at (865) 974-8403, or myself (Samantha Cazzell) at (937) 750-3782 **before** you sign this form.

Thank you for your time and consideration,

Samantha Cazzell
University of Tennessee
Educational Psychology and Counseling
Knoxville, TN 37996
(937) 750-3782

<u>Check One</u>

_____ I DO agree to participate in this research.

_____ I DO NOT agree to participate in this research.

Name: _____

Signature: _____ Date: _____
               Teacher

Appendix K

Teacher Consent Form, Study III

Dear Teacher,

     My name is Samantha Cazzell. I am in the School Psychology Ph.D. program at the University of Tennessee. I would like to conduct research in your classroom under the supervision of my advisor, Dr. Christopher H. Skinner, a professor at the University of Tennessee. The purpose of my study is to learn how to best facilitate reading instruction. Likewise, I would like to spend 3-5 minutes across the semester with some of your students (whose parent has provided consent) to conduct this reading intervention. By the end of the study, we hope to have taught the students words that were previously unknown to them. In addition, we hope to evaluate whether or not they enjoyed the computer reading intervention implemented. We are in the process of getting principal support for this project at Eagleton.

     If you agree to participate, your students will be asked to spend 3-5 minutes for each session reading words from a PowerPoint and then from flashcards. Each student who agrees to participate (and whose parent has provided consent) would meet with me individually for this intervention. For the intervention component, the students will be presented with words on PowerPoint slides. Under one condition, they will be asked to read the words aloud, press the space bar to hear the word being read aloud to them, and then repeat the word again after they hear it. Under the second condition, they will be asked to read the words aloud before automatically hearing the word being read aloud to them after 2 seconds. Upon completing this intervention each session, they will be assessed via flashcards over all the words to determine what words they have learned.

     I will be involved in this project until visual analysis of data illustrates obvious differences between the two conditions or through session 15, whichever comes first; thus, the length of the study may vary from child to child. You are free to request that my involvement in the classroom be discontinued at any time with no penalty to you or the participating students. Furthermore, if a student takes more than 15 sessions to complete this intervention, it will be discontinued to prevent fatigue and frustration.

     No risks for teachers or students are anticipated from this study other than those ordinarily encountered in the classroom. Your name will not be recorded on any of the materials in this study. Student participants' names will not be on the data forms; instead, pseudo names will be used so that student names are not revealed.

     Participation in this study is voluntary, which means that you do not have to participate and can stop at any time without penalty. Although results of our research may be shared with others through professional publications or presentation, your name or the names of your students will never be revealed.

Enclosed is a copy of this letter for your records. If you agree to participate in this research, please complete the section below on one copy of this letter and return it to me. Your signature indicates that you have read and understand the information above, that you willingly agree to participate, and that you may withdraw at any time and discontinue participation without penalty. If you have any questions about this consent form or this study, please feel free to contact my faculty advisor, Christopher Skinner at (865) 974-8403, or myself (Samantha Cazzell) at (937) 750-3782 before you sign this form.

If you have any questions about your rights as a research participant, please contact the UT Office of Research Compliance Officer at (865) 974-7697.

Thank you for your time and consideration,

Samantha Cazzell
University of Tennessee
Educational Psychology and Counseling
Knoxville, TN 37996
(937) 750-3782

<u>Check One</u>

_____ I DO agree to participate in this research.

_____ I DO NOT agree to participate in this research.

Name: _____

Signature: _____ Date: _____
                Teacher

Vita

Samantha Turnbull is originally from Centerville, Ohio. She graduated from Centerville High School in 2009 and then began attending Cedarville University. In 2012, she graduated from Cedarville University with a B.A. in Psychology. Samantha began the doctoral School Psychology program at the University of Tennessee in the fall of 2012. In December of 2014, she received an M.S. in Applied Educational Psychology. Samantha will receive her Ph.D. in August of 2017 after completion of a year-long, pre-doctoral internship.