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The Impact of Computer-Assisted Sight Word Instruction on the Reading Skills of Students with Significant Intellectual Disabilities

Colleen Frances Wood-Fields
Old Dominion University

THE IMPACT OF COMPUTER-ASSISTED SIGHT WORD INSTRUCTION ON THE READING SKILLS OF STUDENTS WITH SIGNIFICANT INTELLECTUAL DISABILITIES

by

Colleen Frances Wood-Fields
B.S., June 1984, Trenton State College
M.Ed., May 1990, College of New Jersey

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Approved by:

Sharon L. Judge (Chair)

Anastasia M. Raymer (Member)

Silvana M. Watson (Member)

ABSTRACT

THE IMPACT OF COMPUTER-ASSISTED SIGHT WORD INSTRUCTION ON THE READING SKILLS OF STUDENTS WITH SIGNIFICANT INTELLECTUAL DISABILITIES

Colleen Frances Wood-Fields
Old Dominion University, 2011
Chair: Dr. Sharon L. Judge

There is a paucity of research identifying instructional methods that promote the reading development of students with significant intellectual disabilities (ID). This research study employed a single subject, multiple baseline design to evaluate the effects of computer-assisted sight word instruction employing constant time delay (CTD) procedures with incidental phonics and comprehension stimuli on the reading skill development of six elementary students with moderate ID and expressive language impairments. Study results suggest that the seven week PowerPoint slide show sight word intervention had very small to moderate intervention effects on receptive sight word identification. However, students learned some incidental letter-sound correspondences and demonstrated gains in sight word comprehension. Study results suggest that the computer-assisted sight word intervention may provide a means to foster the development of foundational reading skills with students with moderate ID. Future research is needed to determine if students generalize the essential reading skills acquired through the computer-assisted intervention to the reading material they encounter in home, school, and community environments.

This dissertation is dedicated to the memory of Kimberly Gail Hughes who shared both her promise and her mission with us.

"There is a subtle difference between a mission and a promise. A mission is something you strive to accomplish—a promise is something you are compelled to keep. One is individual, the other is shared. When a mission and a promise are one in the same.. .that's when mountains are moved and races are won."

Hala Moddelmog

And to my husband Paul who ensured that my dream was achieved.

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CHAPTER 1

INTRODUCTION

Teaching students the skills needed to become proficient readers is a national priority. In accordance, educational legislation, including the No Child Left Behind Act of 2001 (NCLB) and the Individuals with Disabilities Education Improvement Act of 2004 (IDEA) have made reading an instructional priority for students with disabilities (Browder, Gibbs, Ahlgrim-Delzell, Courtade, Mraz, & Flowers, 2008). Yet, the curricular emphasis for students with significant intellectual disabilities (ID), those with IQs of 55 or less, with or without autism spectrum disorder, speech and language, sensory, or physical impairments (Browder, Gibbs, et al., 2008), has historically been functional skill development (Alberto, Frederick, Hughes, McIntosh, & Cihak, 2007; Dymond & Orelove, 2001; Mirenda, 2003). Although research suggests that students with significant ID can learn some essential phonemic awareness, phonics, vocabulary and text comprehension skills, reading instruction for students with significant ID has largely been confined to functional sight word identification (Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006; Browder & Xin, 1998; Conners, 1992; Joseph & Seery, 2004). Consequently, students with significant intellectual disabilities have been "left behind" in reading skill development.

Background

Reading is defined as the ability to make meaning of print through the application of phonemic awareness, decoding, fluency, prior knowledge, vocabulary and text comprehension skills (National Institute for Literacy [NIL], 2007). Sight word recognition and comprehension provides a foundation for reading as it enables struggling readers to access text (Karemaker, Pitchford, & O'Malley, 2009). For some students with significant ID, sight word identification and comprehension may serve as the student's only reading skills (Browder & Xin, 1998). Research indicates that students with significant ID can learn grade level, high frequency, and functional sight words in a variety of contexts, using a variety of instructional techniques (Browder et al., 2006; Browder & Xin, 1998; Conners, 1992). However, sight word instruction does not expose students with significant ID to all the words they will need to meaningfully interact with the print material they encounter in daily life, nor does it foster the ability to read novel words (Bradford, Shippen, Alberto, Houchins, & Flores, 2006).

According to Ehri (2005), students progress through four phases when learning to read sight words. With typically developing children, this word reading progression occurs between preschool and eighth grade (Ehri & McCormick, 1998). During the first, pre-alphabetic phase, the visual features of the word are used to remember the word and its meaning due to a lack of alphabetic knowledge (Ehri & McCormick, 1998). Sight word acquisition at the pre-alphabetic phase is characterized by rote memorization and the use of visual cues such as word length, letter configurations, or logos as mnemonic aids. To progress to the next phase, phonemic awareness and phonics skill development are essential as in the second, partial-alphabetic phase students begin to use rudimentary phonemic awareness and phonics skills, including the ability to make connections between initial and final position letters and sounds in a word, to recall sight words (Ehri, 2005; Ehri & McCormick, 1998; Mirenda, 2003). Ongoing, phonics instruction enables students to decode novel words, characteristic of the third, full alphabetic phase and then to use chunks of letters such as affixes and root words to decode and remember sight words, characteristic of the final, consolidated alphabetic phase of word learning (Ehri, 2005).

Sight word instruction for students with significant ID typically focuses on visual word recognition confining the word reading skills of students with significant ID to the pre-alphabetic phase. Limited exposure to phonemic awareness and phonics instruction affords little opportunity for progression to the partial-alphabetic phase of word reading. Further, as much of the research examining sight word instructional methods fails to include a comprehension component, the sight word reading of students with significant ID is frequently restricted to word naming (Browder & Lalli, 1991; Browder et al., 2006; Browder & Xin, 1998). Providing students with significant ID instruction that promotes phonemic awareness and phonics skill development would both enhance sight word learning and foster the ability to read novel words, enabling more meaningful interaction with print material. Further, as students with significant ID may not demonstrate reading readiness until late childhood and may take longer to learn reading skills (Browder, Ahlgrim-Delzell, Courtade, Gibbs, & Flowers, 2008; Browder, Gibbs, et al., 2008), instructional time must be optimized. As reported by Allor, Mathes, Champlin, and Cheatham (2009), students with significant ID need to learn to integrate, apply, and generalize the essential reading skill components identified by the National Reading Panel. To illustrate, Allor and colleagues (2009) suggest that phonemic awareness skills should be linked to oral vocabulary comprehension by teaching the meaning of the words used during phonemic awareness activities. Likewise, phonemic awareness instruction should facilitate word-attack skill development, which should support the ability to read novel, untaught words (Bradford et al., 2006; Saunders, 2007). In turn, word reading should be linked with text comprehension (National Reading Panel, 2000). Ehri's (2005) four phases of word learning provides an instructional framework for integrating phonemic awareness, phonics and word reading instruction for students with significant ID. Integrating phonemic awareness, phonics, and word reading instruction optimizes instructional time by providing students with significant ID instruction that effectively and efficiently fosters reading skill development.

Instructional reading methods for students with significant ID. Reading ability is fostered through the use of evidence-based instructional methods (National Reading Panel, 2000). While the National Reading Panel identified numerous evidence-based instructional methods that promote the reading development of typically developing students, only one evidence-based practice has been identified for promoting the reading development of students with significant ID. This singular evidence-based practice is the use of time delay procedures to promote "errorless" picture and sight word recognition (Browder, Ahlgrim-Delzell, Spooner, Mims, & Baker, 2009). During initial time delay instructional trials, a task direction is given and immediately followed with a controlling prompt to teach the student the correct response for the stimulus. In subsequent trials, time delays are inserted between the task direction and the controlling prompt to provide the opportunity for independent student response. Error correction in the form of corrective feedback or consequences is used to promote correct responding; differential reinforcement is used to foster the transfer of stimulus control from modeled to independent responding (Browder et al., 2009).

Time delay procedures include progressive time delay (PTD) and constant time delay (CTD). While both delay procedures initially employ the concurrent presentation of the instructional stimulus and the controlling prompt, with PTD the delay between the presentation of the stimulus and the controlling prompt is systematically increased by predetermined increments during successive trials. Alternately, with CTD procedures, the subsequent delay is fixed at a predetermined interval. Limited comparative research indicates that instruction employing CTD is more efficient than instruction employing the system of least prompts, more efficient than stimulus fading procedures, and comparable with instruction employing PTD (Wolery et al., 1992). On the other hand, a review of the reading research conducted by Conners (1992) indicated that CTD was more efficient than PTD. According to Wolery and colleagues (1992), the transfer of stimulus control from the controlling prompt to the target stimulus typically occurs around the fourth CTD instructional session. The empirical research indicates that CTD procedures effectively foster skill acquisition, including sight word identification, letter recognition, and spelling skills, with 97.7% of 3- to 13-year-old students with and without disabilities, although procedural modifications were needed to foster skill acquisition with some students (Browder et al., 2009; Browder and Xin, 1998; Wolery et. al., 1992). In sum, the use of time delay procedures, specifically CTD, to teach sight word recognition provides a viable means for promoting the reading development of students with significant ID.

Efficient instruction fosters the acquisition of more information in the same time it takes to learn a single skill or reduces the time needed to acquire an equal amount of information with reduced preparation time and material development (Werts, Wolery, & Holcombe, 1991). Research suggests that embedding incidental information within an instructional trial efficiently and effectively promotes the acquisition of target and incidental stimuli, including sight words, with verbal students with significant disabilities. Incidental stimuli can be inserted in the antecedent event as part of the attentional cue, prior to the instructional trial or in the consequent event as part of the response feedback condition (Werts et al., 1991). There is no direct student response to incidental material and no reinforcement accompanies the presentation of incidental material (Werts et al., 1991). Providing exposure to incidental stimuli during target skill instruction increases instructional efficiency (Campbell & Mechling, 2009; Doyle, Schuster, & Meyer, 1996; Ledford, Gast, Luscre, & Ayres, 2008; Wall & Gast, 1999) as students are exposed to and acquire more information with minimal increases in instructional time (Ledford et al., 2008) with minimal instructional effort (Wall & Gast, 1999).

While the research suggests that sight word instruction employing CTD and incidental stimuli may provide one method for promoting the reading development of students with significant ID, there is a paucity of research on sight word instruction and incidental learning with nonverbal students with significant ID (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Mims, et al., 2008; Browder, Trela, et al., 2007). This lack of research may be due to the language and communication impairments associated with significant ID which prevent exposure to reading instruction and the fact that reading programs are designed for students with language skills (Browder, Gibbs, et al., 2008). Limited research provides some suggestions for fostering and assessing the reading skill development of nonverbal students with significant ID. For example, Browder, Gibbs, and colleagues (2008) suggest the pairing of phonemes with printed letters and pictures to provide nonverbal students a visual referent for the demonstration of knowledge. The

Nonverbal Reading Approach provides another option for teaching and assessing phonics and word reading skill development to nonverbal students with significant ID.

The Nonverbal Reading Approach is used in conjunction with a systematic, direct instruction reading curriculum to promote phonics skill acquisition with students with severe speech and physical impairments with mild to moderate ID who are unable to verbalize (Coleman-Martin, Heller, Cihak, & Irvine, 2005; Heller & Coleman-Martin, 2007). Using guided practice, the Nonverbal Reading Approach teaches students to use "internal speech" as a metacognitive strategy to sound out words (Coleman-Martin et al., 2005). Distractor arrays consisting of pictures of target words and words of similar configurations are used to evaluate the student's acquisition of decoding skills, identify skill application errors, and evaluate comprehension of sounded out words. Research indicates that after one year of instruction using the Nonverbal Reading Approach, students with mild to moderate ID mastered 58% to 88% of words taught, demonstrated between 4.5 and 7.5 month gains in word attack skills, and between 4.5 months and 1.75 years gains in comprehension skills (Heller, Fredrick, & Diggs, 1999). These results suggest that teaching students to use internal speech and assessing skill acquisition through the use of picture or word arrays is a viable method for promoting the phonemic awareness, phonics, and sight word development of nonverbal students with significant ID. Moreover, these instructional and assessment strategies correspond with the learning strengths of nonverbal students with significant ID.

Cognitive research suggests that visual-spatial thinking, auditory processing (Bergeron & Floyd, 2006), simple visual-spatial short-term working memory storage, and phonological storage plus processing (Henry & MacLean, 2002) are areas of relative strength in some children with moderate ID. Reading instruction that accommodates the learning characteristics of students with significant ID may promote skill acquisition. However, Henry (2001) suggests that visual and spatial instructional methods are potentially more effective than verbal methods and that verbally, visually, and spatially presented information should be limited to three "meaning-carrying" words (Henry, 2001). One instructional method which accommodates the learning needs of students with significant ID is computer-assisted instruction.

Computer-assisted instruction. The benefits of computer-assisted instruction are numerous. First, research suggests that computer-assisted instruction fosters greater time on task during reading instruction as compared with traditional book based instruction (Williams, Right, Callaghan, & Coughlan, 2002). The increased time on task may be due to increased student motivation as computer-assisted instruction alleviates the boredom associated with traditional drill and practice methods (Basil & Reyes, 2003; Coleman-Martin et al., 2005; Hitchcock & Noonan, 2000). Next, computer-assisted instruction enables instruction to occur in multiple settings (Beck, 2002; Coleman-Martin et al., 2005; Hitchcock & Noonan, 2000). Therefore, computer-assisted reading instruction can be provided in special education, inclusive, and home environments. Finally, computer-assisted instruction supports the modifications and adaptations needed by individuals with disabilities to participate and demonstrate progress in reading skill development (Beck, 2002; Hitchcock & Noonan, 2000). To illustrate, computer-assisted instruction employing *PowerPoint*™ animation, sound, font style, and color features enables customization of instruction to meet student's learning needs (Parette, Blum, Boeckmann, & Watts, 2009). *PowerPoint*™ animation features provide for sequential skill instruction in which letters appear one at a time, sequentially, with the letter sound provided, to promote letter-sound correspondence (Parette, Hourcade, Boeckmann, & Blum, 2008). Meanwhile, presenting a vocabulary word slide, followed by a slide containing a picture, animation, or definition of the word fosters vocabulary comprehension (Parette et al., 2008).

Research conducted by Campbell and Mechling (2009) demonstrates the potential efficacy of computer-assisted *PowerPoint*™ instruction employing CTD with incidental stimuli in promoting letter-sound correspondence and letter naming with students with disabilities. Three kindergarten students with learning disabilities participated in the computer-assisted, *PowerPoint*™ instruction presented on a SMART board. The CTD instructional trial began with the presentation of a slide containing a target letter and the controlling prompt, "What sound?" The second slide portrayed three letters and the student was instructed to "Touch (letter sound)." Correct selection of the letter corresponding to the letter sound resulted in the advancement to the final trial slide, the visual presentation of the target letter, with consequent feedback that included a verbal affirmation statement providing the incidental naming of the letter and its target associated sound. With computer-assisted, CTD instruction with consequent incidental stimuli the three students learned six target letter-sound correspondences in 6- to 12-sessions. More, the students learned some of the incidentally presented letter names. While these results are promising, there is a paucity of research exploring the effects of computer-assisted, *PowerPoint*™ instruction employing CTD and incidental stimuli on integrated phonemic awareness, phonics, and sight word reading instruction with verbal and nonverbal students with significant ID.

Statement of Purpose

There is limited research on instruction that effectively and efficiently promotes the phonemic awareness, phonics, and sight word reading development of verbal and nonverbal students with significant ID. Therefore, the purpose of this study is to examine the effects of computer-assisted sight word instruction employing CTD and incidental stimuli on the reading skill acquisition of verbal and nonverbal students with significant ID.

Problem Statement

To bridge the reading gap experienced by students with significant ID, reading instruction must accommodate the learning characteristics and needs of students with intellectual, speech and language, physical, and sensory impairments. More, as students with significant ID characteristically demonstrate reading readiness later than typically developing children, there is a need to optimize on instructional time. This study will examine the effects of computer-assisted sight word instruction employing CTD procedures, with incidental phonics and vocabulary comprehension stimuli, on the reading skill acquisition of elementary school, verbal and nonverbal students with significant ID.

Research Questions

This study seeks to answer the following research questions:

1. How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching verbal and nonverbal students with significant ID to identify target sight words?

2. How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching the acquisition of letter-sound correspondence with verbal and nonverbal students with significant ID?
3. How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching vocabulary comprehension with verbal and nonverbal students with significant ID?
4. Do verbal and nonverbal students with significant ID generalize the phonemic awareness and phonics skills learned through computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli to novel high frequency sight words with similar initial phonemes?
5. What value do teachers and parents of students with significant ID place on computer-assisted sight word instruction employing CTD procedures with incidental stimuli on the development of reading skills with students with significant ID?

Significance of the Study

Reading is a functional skill that enhances participation and independence in home, vocational, leisure, and community environments (Browder, Gibbs, et al., 2008). As reported by Browder, Gibbs, and colleagues, limited or ineffective reading instruction impedes reading development, and negatively affects an individual's quality of life. Yet, the importance of reading instruction for students with significant ID has been limited by the belief that students with significant ID do not have the ability to learn to read, nor should they be taught to read (Browder, Gibbs, et al., 2008).

Cognitive impairments affect reading development, but they do not portend that individuals with significant ID cannot learn to read. Despite the late demonstration of reading readiness, and the need for extended time to learn reading skills, research indicates that the number of students with significant ID who achieve minimum literacy skills in word recognition, reading comprehension, and phonemic awareness increases from elementary to high school (Katims, 2001). Moreover, recent advances in promoting reading development and advances in the available assistive technology provide new methods for providing reading instruction (Browder, Gibbs, et al., 2008). Students with significant ID may not learn the breadth and depth of reading skills needed to interact with the range of text material they will encounter in daily life. Even so, the skills acquired will allow students with significant ID to more independently and meaningfully interact with print materials in home, school, and community environments while expanding receptive and expressive communication skills, enhancing quality of life.

While there is some evidence that verbal students with significant ID can learn aspects of essential reading skills, research examining the efficacy of reading instruction methods with nonverbal students with significant ID is sparse and relatively novel. To ensure that nonverbal students with significant ID have access to reading instruction, alternative methods for fostering student acquisition and demonstration of phonemic awareness, phonics, vocabulary, and text comprehension skills must be identified and utilized. These alternative methods include providing students with significant disabilities the tools needed to participate in reading development (Erickson & Koppenhaver, 1995).

Computer-assisted instruction is one tool that enables students with significant ID to participate in reading development. Specifically, *PowerPoint*™ features allow for the customization of instructional slideshows that accommodate student learning needs, while assistive technology switches and switch interface allow for independent interaction with instructional slideshows. This study seeks to add to the literature on reading instruction for verbal and nonverbal students with significant ID by examining the effects of a computer-based, *PowerPoint*™ sight word instructional intervention employing CTD and incidental phonics and sight word comprehension stimuli on the development of phonemic awareness, phonics, and sight word vocabulary skills of verbal and nonverbal, elementary students with significant ID.

Delimitations

To examine the effects of computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli, this study will employ six students, ages 5- to 12-years-old, with significant ID who attend a public elementary school in a large, urban school district in a Mid-Atlantic state. The students will be identified as having moderate to severe ID through district assessment criteria. Student disabilities may include Down syndrome, autism spectrum disorder, genetic mutations, and cerebral palsy. Participating students will demonstrate limited speech and language skills, but may vocalize, sign, use augmentative and alternative (AAC) communication systems, or use a limited repertoire of spoken words to communicate. The study will be conducted in a quiet area in the students' self-contained, special education classroom.

DEFINITION OF TERMS

Antecedent Condition: When an additional stimulus is presented in the attentional cue component of the instructional trial.

Attentional Cue: The component of the instructional trial in which the teacher obtains the student's attention through the use of a command or presentation of stimulus.

Computer-Assisted Instruction: The use of computer programs such as *PowerPoint*™ slide shows, electronic books, and computer software programs to teach, review, or practice skills.

Consequent Feedback: The component of the instructional trial in which the teacher provides feedback for the behavior elicited by the controlling prompt.

Constant Time Delay: A two phase instructional procedure (Browder et al., 2009). In initial instructional trials the teacher presents the stimulus and task direction and immediately provides the controlling prompt or model of the desired response to teach the correct stimulus response. In subsequent trials, time delays (e.g., 4-seconds) are inserted between the presentation of the stimulus and task direction and the provision of the controlling prompt to provide the opportunity for independent response. Error correction and differential reinforcement are used to foster the transfer of stimulus control from modeled to independent responding (Browder et al., 2009).

Evidence-Based Instruction: Instructional methods supported as effective in promoting skill development through "rigorous scientific research" (NCLB, 2001).

Incidental Learning: Learning that occurs as the result of exposure to information (Wolery, Ault, Gast, Doyle, & Mills, 1990). No direct instruction or reinforcement is provided to promote learning.

Incidental Stimuli: Additional stimuli inserted in the antecedent condition as part of the attentional cue, prior to the instructional trial or in the consequent condition as part of the response feedback (Werts et al., 1991). There is no direct student response to incidental material and no reinforcement accompanies the presentation of the incidental material (Werts et al., 1991).

Consequent Feedback Condition: When an additional stimulus is presented as part of the consequent feedback of the instructional trial. No student response is requested when the incidental stimulus is presented and no reinforcement is provided if student does respond to the instructive feedback (Werts, Caldwell, & Wolery, 2003).

Reading: "The ability to make meaning of print through the application of phonemic awareness, decoding, fluency, prior knowledge, vocabulary comprehension and text comprehension strategy skills" (National Institute for Literacy, 2007).

Sight Word Recognition: The automatic recognition of a printed word.

Significant Intellectual Disability (ID): A significant intellectual disability is characterized by an IQ of 55 or less, with or without autism spectrum disorder, speech and language, sensory, or physical impairments (Browder, Gibbs, et al., 2008).

CHAPTER II

LITERATURE REVIEW

Seminal and contemporary reviews of the literature on reading instruction suggest that students with significant ID can learn sight word identification (Browder & Xin, 1998; Conners, 1992; Whalon, Al Otaiba, & Delano, 2009) and text comprehension skills (Chiang & Lin, 2007; Whalon et al., 2009). Furthermore, there is some evidence that students with significant ID benefit from phonological awareness, phonics, word-attack, and fluency instruction (Conners, 1992; Joseph & Seery, 2004; Saunders, 2007; Whalon et al., 2009). However, students with significant ID may not demonstrate reading readiness until late childhood and may take longer to learn reading skills (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Gibbs, et al., 2008; Katims, 2001). Therefore, to maximize the reading potential of students with significant ID, instructional methods must effectively and efficiently foster the skills identified as essential in promoting reading development: phonemic awareness, phonics, vocabulary and text comprehension and fluency skill development (National Reading Panel, 2000).

The purpose of this review is to identify instructional methods that effectively and efficiently foster the reading development of students with significant ID. First an overview of the factors that have influenced the reading development of students with significant ID will be discussed. Next, a synthesis of the empirical research on reading instruction for students with significant ID is presented in the following order: phonemic awareness, phonics, fluency, vocabulary comprehension, and text comprehension. Finally, implications for providing instruction that effectively promotes reading development are offered.

To identify reading interventions that promote the reading development of 5- to 18-year-old students with significant ID, IQ of 55 or below, empirical research studies published between 1990 and 2009 were located through an electronic search of peer reviewed journals in the Education Research Complete, Education Full Text, Eric, PsychARTICLES, PsychINFO, and Academic Search Complete databases. This publication time frame was utilized to reflect the shift from a functional to an academic curricular emphasis propagated by reauthorizations of educational legislation (e.g., NCLB, IDEA) which occurred during this period. Research studies targeting reading interventions for students with ID associated with specific genetic syndromes such as Down or William's syndrome were excluded from the review due to the distinct reading and language skill profiles associated with these syndromes (Pulsifer, 1996). When research studies included participants of mixed ID etiology, results associated with participants with identified genetic syndromes were excluded from the discussion of the reported findings when possible.

Research studies were located using one or more of the following descriptors: *significant disabilities, intellectual disabilities, cognitive impairment, mental retardation, reading, literacy, sight word instruction, phonemic awareness, phonics, fluency, decoding, comprehension, vocabulary, letter-sound correspondence,* and *phonetic analysis*. Next, the reference sections of studies meeting inclusion criteria were reviewed to locate additional research studies. Finally, the following journals were hand searched to identify research studies not identified through the electronic or reference section searches: *Education and Training in Developmental Disabilities, Exceptional Children, Focus on Autism and Other Developmental Disabilities, Mental Retardation, and*

American Journal on Mental Retardation.

Factors Influencing Reading Development

Reading, the ability to make meaning of print through the application of phonemic awareness, decoding, fluency, prior knowledge, vocabulary, and text comprehension (National Institute for Literacy, 2007), promotes participation and independence in school, home, and community activities. However, students with significant intellectual disabilities (ID), those with IQs of 55 or less, with or without autism spectrum disorder, speech and language, sensory, or physical impairments (Browder, Gibbs, et al., 2008; Browder et al., 2006), have experienced limited exposure to instruction that promotes reading development (Browder et al., 2006; Conners, 1992). This instructional deficit stems from opportunity and access barriers that have minimized the importance of reading instruction for students with significant ID (Pufpaff, 2008; Zascavage & Keefe, 2004).

The opportunity and access barriers that have limited reading development arise from professional and societal attitudes, educational practice, instructional priority, lack of knowledge, and a paucity of research-based instructional methods (Pufpaff, 2008; Zascavage & Keefe, 2004). First, the belief that literacy skill limitations are "innate" (Kliewer & Biklen, 2001) has influenced the instructional curriculum of students with significant ID. As identified by the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (American Psychiatric Association, 2000) the projected cumulative academic skill attainment for students with significant ID is second-grade or lower. The projected potential for students with severe ID is limited to "some" sight word acquisition, with little benefit derived from pre-academic skill instruction.

These presumed limitations in reading potential and learning competence (Kliewer, Biklen, & Kasa-Hendrickson, 2006, Weikle & Hadadian, 2004) have encouraged differential instructional programming, programming that supports a disability rather than an academic curricular emphasis (Kliewer & Landis, 1999, Pufpaff, 2008) Accordingly, the curricular priority for students with significant ID has been that of functional skill development (Alberto et al , 2007, Durando, 2008, Dymond & Orelove, 2001, Rao, 2009, Weikle & Hadadian, 2004, Zaslow, Dorey, & Limbos, 2008) Consequently, low expectations associated with disability status have restricted access to the instruction needed to foster reading development (Kliewer & Biklen, 2001, Kliewer, Fitzgerald, Meyer-Mork, Hartman, English-Sand, & Raschke, 2004, Pufpaff, 2008, Zascavage & Keefe, 2004)

As with low expectations, lack of knowledge and a paucity of research-based instructional methods (Pufpaff, 2008, Zascavage & Keefe, 2004) have prevented students with significant ID from accessing reading instruction This is particularly true for students with significant ID and associated speech and language, physical, and sensory impairments that impede access to and engagement with print material (Browder et al., 2006; Hetzroni, 2004, Erickson & Koppenhaver, 1995, Koppenhaver, Hendrix, & Williams, 2007; Weikle & Hadadian, 2004; Zaslow et al , 2008) and deter participation in instructional activities (Beck, 2002; Coleman-Martin et al , 2005; Pufpaff, 2008; Zascavage & Keefe, 2004). Due to limited knowledge, parents and professionals lack the skills needed to understand children's nonsymbolic communication, identify and use available assistive technologies, adapt literacy materials and provide alternative means for participation, thereby preventing access to activities that promote reading development (Pufpaff, 2008; Zascavage & Keefe, 2004).

The negative effects of limited parental knowledge on reading development are illustrated by parental responses on surveys examining the home literacy experiences of young children with disabilities. These survey results indicate that young children with disabilities interact less frequently with reading materials than typically developing peers and experience a more passive role in story reading activities, with fewer opportunities to retell stories, answer why questions, or make predictions about story material (Light & Smith, 1993; Marvin, 1994; Marvin & Mirenda, 1993). Thus, young children with ID and associated disabilities enter school with less exposure to foundational prereading activities (Light & Smith, 1993). Likewise, school based reading development has been limited by a paucity of evidence-based reading instruction methods, the scarcity of appropriate instructional materials (Browder et al., 2006; Joseph & Seery, 2004; Pufpaff, 2008; Zascavage & Keefe, 2004), and the lack of a comprehensive literacy approach for individuals with significant ID (Rao, 2009). The cumulative effects of these opportunity and access barriers is illustrated by Katims (2001) who reported that only about 1 of 5 elementary, middle, and high school students with mild to moderate ID demonstrate minimal literacy skills, including the ability to read and comprehend narrative text at a primer level.

Despite the challenges that have historically constrained the reading development of students with significant ID, current educational legislation mandates (e.g., IDEA, NCLB) have made reading development an instructional priority (Browder, Gibbs, et al., 2008). According to Browder, Gibbs, and colleagues, this reversal in curricular prioritization is associated with advances in literacy and reading development, advances in available assistive technology, and increased educational expectations for individuals with significant ID. Although the cognitive impairments associated with ID may negatively affect skill development (Baddeley, Gathercole, & Papagno, 1998; Pulsifer, 1996), some researchers have documented that children with significant ID demonstrate variable cognitive strengths and weaknesses (Begeron & Floyd, 2006; Henry, 2001; Henry & MacLean, 2002; Saldaña, 2004). This suggests that students with significant ID demonstrate variable skill potential. Moreover, there is no research that suggests that students with significant ID cannot develop literacy skills (Weikle & Hadadian, 2004). On the contrary, empirical research supports the contention that students with significant ID can learn some aspects of the essential reading skills identified by the NRP (2000) including phonemic awareness.

Phonemic Awareness

Phonemic awareness, the ability to recognize and manipulate the sounds of spoken words, fosters decoding, comprehension, and improves reading (National Reading Panel, 2000). Although limited, the empirical research on phonemic awareness instruction with students with significant ID indicates that verbal and nonverbal students receiving phonemic awareness instruction as part of a multi-component reading instruction program demonstrate greater gains on phonemic awareness and phonics skill development measures than students who do not receive PA instruction (Browder, Ahlgrim-Delzell, et al., 2008; Conners, Rosenquist, Sligh, Atwell, & Kiser, 2006). For example, a random assignment, treatment and control group design was used to evaluate the efficacy of instruction using the *Early Literacy Skill Builder* ([ELSB]; Browder, Gibbs, et al., 2007) reading curriculum as compared to sight word or picture instruction on the reading development of verbal and nonverbal students with moderate and severe ID. Students in both the intervention and control groups also participated in shared story lessons. ELSB word segmentation and beginning and ending sound identification skills were taught using a scripted, model, lead, test instructional method and the system of least prompts. Analysis of treatment and control group pre- and post-test scores indicated a large treatment effect size (1.35) on phonemic awareness/phonics skill measures for students participating in ELSB instruction (Browder, Ahlgrim-Delzell, et al., 2008). In comparison, a medium treatment effect size (.51) was identified for control group students, who participated in sight word or picture instruction and shared story reading lessons.

Similarly, participation in a phonological intervention fostered higher post-test sounding out scores for verbal students with moderate ID as compared with those obtained by students in a control group who did not receive phonological skill instruction (Conners et al., 2006). The phonological intervention included an oral sound blending component that targeted word and nonword, syllable, onset-rime, vowel-consonant, and consonant-vowel-consonant blending. Blending instruction consisted of the oral presentation of the individual sounds to be blended, student repetition of the individual sounds, and prompts directing the student to say the sounds "fast".

Although limited, the findings of this study suggest that verbal and nonverbal students with significant ID who receive phonemic awareness instruction as part of a multi-component reading intervention demonstrate greater gains on phonemic awareness measures than students who do not receive phonemic awareness instruction. However, it is difficult to assess the extent of phonemic awareness skill development with nonverbal students with significant ID as phonemic awareness skill scores were not differentiated by skill, verbal status, or level of ID. Additionally, it is difficult to ascertain whether the phonemic awareness gains were related to the efficacy of the specific instructional methods employed, or to the integration of phonemic awareness and phonics skill instruction.

Phonics

While phonemic awareness instruction provides a foundation for understanding and using the alphabetic system, phonics instruction provides the skills needed to decode novel words (National Reading Panel, 2000). Consistent with empirical studies examining phonemic awareness instruction, phonics instruction for students with significant ID was frequently provided as part of a multi-component reading intervention. However, the findings of phonics research document more substantial evidence that students with significant ID can learn letter-sound correspondences with direct instruction (Bradford et al., 2006; Browder, Ahlgrim-Delzell, et al., 2008; Browder, Trela, et al., 2007; Cohen, Heller, Alberto, & Fredrick, 2008; Coleman-Martin et al., 2005; Conners et al., 2006; Flores, Shippen, Alberto, & Crowe, 2004; Hanser & Erickson, 2007; Heller & Coleman-Martin, 2007; Waugh, Fredrick, & Alberto, 2009). The results of research on direct instruction of phonics indicate that some verbal and nonverbal students with moderate ID can learn to blend sounds and decode words (Bradford et al., 2006; Cohen et al., 2008; Coleman-Martin et al., 2005; Conners et al., 2006; Flores et al., 2004; Heller & Coleman-Martin, 2007; Waugh et al., 2009). In these studies, participating students' verbal ability and degree of ID were critical factors in determining instructional strategy and phonics skills targeted. Thus, the research will be reviewed in the following order: (a) phonics instruction with verbal students with moderate ID, (b) instruction with nonverbal students with moderate ID, and (c) instruction including both verbal and nonverbal students with moderate, severe, and profound ID.

Although the primary focus of the research on phonics instruction for verbal students with moderate ID was to identify instructional methods that effectively promoted phonics development, a secondary goal was to identify the cognitive characteristics associated with phonics skill acquisition. In keeping with the primary focus, researchers (e.g., Bradford et al., 2006; Cohen et al., 2008; Conners et al., 2006; Flores et al., 2004; Waugh et al., 2009) identified several instructional programs that fostered the letter-sound correspondence, blending, and decoding skill development of verbal students with moderate ID. These programs provided direct instruction on letter-sound correspondences and blending skills to promote word decoding. For example, Waugh et al. (2009) taught three students to read five consonant-vowel-consonant or consonant-vowel-consonant-consonant sight words representing concrete objects using simultaneous prompting. They supplied the controlling prompt immediately prior to providing the instructional cue. Students were then taught 10 letter-sound correspondences associated with the sight words. Initially students were taught three letter-sound correspondences, with additional letter-sound correspondences introduced as instruction progressed. After mastering letter-sound correspondences, blending instruction was provided. Students were taught to say each sound in isolation, to say the sounds slowly without stopping, and then to say the sounds together "fast". With simultaneous prompting the students learned the 10 letter-sound correspondences and to blend the sounds to read five novel sight words in 55- to 64-instructional sessions. While skill generalization to novel words was minimal, all students were able to apply the blending skills learned to read one novel word. As the phonics intervention was conducted over the end of one school year and the beginning of another, student retention of skills varied, although students regained skills with fewer instructional sessions (Waugh et al., 2009).

Similar results were obtained by Cohen and colleagues (2008) who employed a three-step decoding strategy with constant time delay (CTD) procedures to promote letter-sound correspondence, blending, and decoding skill development with verbal students with moderate ID. Through the three-step decoding strategy, students were taught to point to and slowly say each sound in a word, then to say the sounds together quickly. Students receiving the decoding instruction acquired between 11 and 13 letter-sound correspondences and the ability to decode targeted words in only 5 to 14 instructional sessions (Cohen et al., 2008). Additionally, some students were able to generalize the skills learned to decode novel consonant-vowel-consonant words consisting of targeted letters. Likewise, for verbal students with mild to moderate ID, participation in a 10-week phonological instruction intervention resulted in better performance on posttest sounding out measures, though individual performance was highly variable. The phonological intervention used picture integration, errorless discrimination, and time delay procedures to teach six letter-sound correspondences. After the targeted letter-sound associations were learned, modeling was used to teach students to sound out words and nonwords consisting of the targeted letters. While phonics skill development in these studies was limited by the number of letter-sound correspondences targeted and the brevity of the intervention, Bradford and colleagues

(2006) provide evidence that more intensive instruction fosters greater phonics skill development with verbal students with moderate ID.

Bradford and colleagues (2006) used the Decoding Level A (Engelmann, Carnine, & Johnson, 1988) scripted, cumulative skill program with three verbal students with moderate ID who had limited decoding skills over a 6-month period. Decoding Level A instruction included word-attack skill development, group reading, individual reading checkouts, and workbook exercises. At the end of the instructional period, participating students were able to identify letter-sound correspondences, blend sounds, and decode irregularly spelled and unknown sight words. The decoding skills acquired enabled the students to read short paragraphs at a second grade level. Moreover, for two students reading fluency increased from zero to 39 and 46 words correct per minute, respectively. These results extended the findings of an earlier study conducted by Flores and colleagues (2004) in which five verbal students with moderate ID learned and used four letter-sound correspondences to decode target and novel consonant-vowel-consonant words through the use of a modified version of the first lesson of the Decoding Level A program.

The research on phonics instruction provides some evidence that verbal students with moderate ID can learn phonics skills with direct instruction and also provides insight to the cognitive characteristics that affect phonics skill acquisition. First, in the study conducted by Conners and colleagues (2006) 40, 7- to 12-year-old students with mild to moderate ID of mixed etiology, not associated with a genetic syndrome, were matched for IQ, nonword reading, phonemic awareness, and language comprehension based on pre-instruction assessment and randomly assigned to the phonological reading instruction intervention or the control group. Comparison of intervention and control group pre- and post-tests suggests that IQ was not predictive of decoding skill acquisition (Conners et al., 2006). Based on these results, Conners and colleagues suggest that although beginning reading skill, phonemic awareness, and articulation speed contributed to the guided, sounding out ability of verbal students with mild to moderate ID, phonological reading instruction appears to compensate for weak phonemic awareness and slow speech articulation skills. Moreover, for this sample verbal working memory was not correlated with sounding out ability. Meanwhile, an earlier comparison of the IQ, language ability, phonemic awareness, and phonological memory scores of 8- to 12-year-old students with mild to moderate ID indicated that the ability to refresh phonological codes in working memory, not phonemic awareness, differentiated students with strong versus weak decoding skills (Conners, Atwell, Rosenquist, & Sligh, 2001). In interpreting these results, Conners and colleagues (2001) hypothesized that word decoding was facilitated either by the speed in which phonological information was rehearsed in working memory, or that the efficacy of the rehearsal process was facilitated by greater exposure to sounding-out instruction. Furthermore, Cohen and colleagues (2008) reported that students with moderate ID who obtained low scores on phonological memory or phonemic awareness measures were able to learn decoding skills. Although further research is needed to identify the cognitive processes that affect the reading development of students with significant ID (Conners et al., 2001), the research reviewed suggests that students with moderate ID who obtain low scores on phonological memory or phonemic awareness measures can learn decoding skills (Cohen et al., 2008).

In sum, the research on phonics instruction suggests that verbal students with moderate ID can learn some letter-sound correspondence, blending, and decoding skills with intense, direct instruction While students demonstrated difficulty blending sounds quickly, or telescoping sounds (Cohen et al , 2008, Flores et al , 2004, Waugh et al , 2009), the difficulties experienced may be associated with inadequate understanding of the blending task direction (e g , "Say it fast ") more than the inability to learn decoding skills (Hoogeveen, Kouwenhoven, & Smeets, 1989) The phonics research is promising, but must be viewed with caution due to the small study sample size, lack of replication, and the limited breathe and depth of the phonics instruction provided

As with research targeting verbal students with moderate ID, research targeting nonverbal students with significant ID is limited However, in contrast with a prior review of the reading research published prior to 2003 which failed to identify any phonics research including nonverbal students with significant ID (Browder et al , 2006), four studies including nonverbal students with significant ID were published between 2005 and 2009 Two of these studies evaluated the effectiveness of a multi-component, reading instruction intervention designed to accommodate the learning needs of verbal and nonverbal students with significant ID (Browder, Ahlgrim-Delzell, et al , 2008, Browder, Trela, et al , 2007) First, the ELSB reading curriculum (Browder, Ahlgrim-Delzell, et al , 2008) includes a phonics component that fosters letter-sound correspondence using easy to hard discrimination and the system of least prompts Analysis of ELSB instruction treatment and control group pre- and post-test measures indicates that participation in the ELSB reading curriculum fosters greater gains on phonics skill measures than the control treatment (Browder, Gibbs, et al , 2007)

The second reading intervention, use of a 25-step storybook task analysis, was developed to help educators plan and implement shared story reading instruction that promotes reading skill development with verbal and nonverbal students with significant ID (Browder, Trela, et al., 2007). The phonics component of the task analysis fosters teacher identification of letter sounds to target during shared story reading. CTD procedures, the system of least prompts, and praise are used to facilitate student acquisition of the targeted sounds. Resulting from teacher use of the 25-step task analysis, students' ability to identify target sounds, vocally or through the use of an AAC device, increased from a mean of 1% to a mean of 50%. Initial research indicates that students participating in the ELSB curriculum and the 25-step story reading task demonstrate gains in phonics skills. Still, as the study included verbal and nonverbal students with varying degrees of ID, it is difficult to differentiate skill gains by degree of ID, verbal status, and individual phonics skill.

More explicit evidence of phonics skill acquisition by nonverbal students with moderate ID is provided by research employing reading interventions typically used with students with severe speech and physical impairments who use augmentative and alternative communication systems (AAC). These instructional methods include The *Literacy Through Unity: Word Study* program (Erickson & Hanser, 2007) and the Nonverbal Reading Approach (Coleman-Martin et al., 2005). *The Literacy Through Unity: Word Study* program is used with students who utilize AAC systems with Unity® (Hanser & Ericson, 2007). Explicit, scripted word wall, making words with icons, and making words with letters lessons link "oral" and written language. Participation in the Unity making words with letters integrated phonics and "letter-by-letter" spelling lessons promoted improved developmental spelling skills for one nonverbal student with moderate ID who used an AAC device. On the other hand, the Nonverbal Reading Approach is used in conjunction with a systematic reading program to teach students with severe speech and physical impairments, who are unable to verbalize, to use "internal speech" to sound out words (Coleman-Martin et al., 2005; Heller & Coleman-Martin, 2007; Heller et al., 1999; Heller, Fredrick, Tumlin, & Brineman, 2002). During the Nonverbal Reading Approach instruction, the student is taught to use internal speech to say and blend sounds in his/her head while the teacher models the skills aloud. Following instruction, diagnostic arrays, which include the targeted word and words of similar letter configurations, are used to evaluate the student's ability to apply the decoding skills learned and to identify errors in skill application. Word comprehension is assessed using picture arrays and sentence completion tasks. Coleman-Martin and colleagues (2005) reported that two nonverbal students with severe speech impairments who received instruction in a class for students with moderate ID learned to decode novel vocabulary after participating in computer-assisted, PowerPoint Nonverbal Reading Approach instruction.

In all, the phonics research provides some evidence that verbal and nonverbal students with significant ID can learn letter-sound correspondence and word attack skills. Still, while the research results are promising, they must be viewed with caution. First, only a limited number of letter-sound correspondences were targeted in some studies (Conners et al., 2006; Flores et al., 2004; Waugh et al., 2009). Next, only one study included a measure to assess comprehension of the words decoded (Bradford et al., 2006). Further, while phonics instruction fosters the ability to decode novel words (National Reading Panel, 2000; Saunders, 2007; Truxler & O'Keefe, 2007) and decoding contributes to reading development, decoding does not ensure comprehension (Conners et al., 2006; Nation & Norbury, 2005).

Fluency

The literature provides some insight into methods that effectively promote phonics skill development. Conversely, there is a paucity of research on promoting reading fluency, the ability to read text quickly, accurately, and with expression (National Reading Panel, 2000), with students with significant ID. Nevertheless, Bradford and colleagues (2004) reported that decoding skill gains improved reading fluency for two verbal students with moderate ID who participated in Corrective Reading Program, Decoding A instruction. Without a doubt, there is a need for research that identifies methods that effectively promote the reading fluency of students with significant ID. These methods may include improving sight word identification speed and accuracy (Browder, Gibbs, et al., 2008).

Vocabulary Comprehension

Reading vocabulary comprehension encompasses the ability to recognize and apply meaning to words in print (National Reading Panel, 2000). Consistent with earlier reviews of the reading literature (Browder & Lalli, 1991; Browder et al., 2006; Browder & Xin, 1998, Conners, 1992), sight word instruction dominates the reading research conducted with students with significant ID. The extant research indicates that students with significant ID can learn to recognize or read functional, high frequency, and academic content sight words in an array of contexts, using a variety of instructional strategies (Browder & Lalli, 1991; Browder & Xin, 1998; Conners, 1992; Joseph & Seery, 2004; Whalon et al., 2009) including simultaneous prompting (Collins, Evans, Creech-Galloway, Karl, & Miller, 2007), and peer tutoring (Butler, 1999; Miracle, Collins, Schuster, & Grisham-Brown, 2001). Additionally, evidence suggests that sight word acquisition is facilitated through the use of error correction procedures (Wordell, Iwata, Dozier, Johnson, Neidert, & Thomason, 2005) and by providing high levels of opportunity to respond (Burns, 2007). Nonetheless, the preponderance of the sight word research focused on examining the efficacy of the following three instructional methods: the use of time delay procedures, picture stimulus procedures, and incidental learning.

Time delay procedures. The use of time delay procedures to teach sight word recognition has been identified as an evidence-based reading practice for students with moderate ID, and a promising practice for students with severe ID (Browder, Ahlgrim-Delzell, et al., 2008). Time delay, a response prompting procedure used to promote errorless learning (Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003), includes the insertion of progressive or constant time delays within the instructional trial. Both progressive and constant time delay procedures initially provide a 0-second delay between the presentation of the task request (e.g., "What word?") and the controlling prompt (e.g., instructor naming of the word). Then, with progressive time delay (PTD) procedures, after a predetermined number of 0-second delay trials, the delay interval between the task request and the controlling prompt is increased in 1-second increments (Doyle et al., 1996). Alternately, with constant time delay (CTD), after a predetermined number of 0-second time delay trials, the delay between the task request and the controlling prompt is increased to a set level (e.g., 4-seconds) and held constant across subsequent trials (Riesen et al., 2003).

Research on sight word instruction employing CTD provides insight on the versatility of this instructional method. First, sight word instruction employing CTD procedures is effective when the instructional language is either English or Spanish (Rohena, Jitendra, & Browder, 2002). Next, CTD can be implemented in both the special education classroom (Rohena et al., 2002) and within typical general education classroom activities and routines (Johnson, McDonnell, Holzwarth, & Hunter, 2004; McDonnell, Johnson, Polychronis, & Risen, 2002; Riesen et al., 2003). For example, sight word instruction using CTD provided during breaks in general education instruction, transitions, and opening and closing activities fostered the acquisition and maintenance of 15 first grade curriculum sight words (Johnson et al., 2004). Additionally, CTD procedures can be used in conjunction with a variety of instructional formats, including computer-assisted instruction.

In a landmark study Mechling, Gast, and Krupa, (2007) utilized small group, SMART board computer-assisted sight word instruction employing CTD with three verbal adult students with moderate ID. During instruction, grocery sight words were presented on a SMART board and CTD procedures were used to promote sight word acquisition. Following each sight word identification trial, students were shown four grocery item photographs on the SMART board, and told to touch the grocery item that corresponded with the sight word. Through the computer-assisted instruction, the students learned to read their nine targeted sight words and to match the sight words to the appropriate photograph. Moreover, students also learned some of the sight words targeted for peers through observational learning.

The research reviewed indicates that sight word instruction employing time delay procedures effectively promotes sight word acquisition. In addition, sight word instruction employing CTD procedures is the sole evidence-based reading instruction method identified for students with significant ID (Browder, Ahlgrim-Delzell, et al., 2008). However, CTD is not the only instructional method that promotes sight word identification. Findings from empirical research suggest that the use of picture stimulus procedures effectively promotes sight word acquisition with some students with significant ID.

Picture stimulus procedures. Research has examined the use of picture stimuli as a means to reduce the complexity of learning novel words (Van der Bijl, Alant, & Lloyd, 2006). Picture stimulus procedures include picture integration (Didden, de Graaff, Nelemans, Vooren, & Lancioni, 2006; Pufpaff, Blischak, & Lloyd, 2000; Van der Bijl et al., 2006), picture fading (Birkan, McClannahan, & Krantz, 2007; Didden et al., 2006), word-picture pairing (Didden, Prinsen, & Sigafoos, 2000; Fossett & Mirenda, 2006), and picture-to-text matching (Fossett & Mirenda, 2006). Picture-integration, also known as modified orthography, involves embedding a line drawing in a word or a word in a picture representing the word (Didden et al., 2006) to promote sight word acquisition. Frequently used in conjunction with picture integration, picture fading involves the gradual fading of the picture stimulus until only the word is displayed (Van der Bijl et al., 2006). Alternately, word-picture pairing, or paired associate learning, involves pairing unknown words with known pictures (Fossett & Mirenda, 2006). Research studies comparing the efficacy of text alone versus picture stimulus procedures report mixed results which suggest that the efficacy of picture stimulus procedures may vary in relation with the degree of ID. For students with mild to moderate ID, instruction utilizing text has been identified as more effective than picture integration (Didden et al., 2006; Didden et al., 2000; Pufpaff et al., 2000) or picture fading procedures (Didden et al., 2006) in promoting sight word acquisition. To illustrate, Didden and colleagues (2006) reported that students with moderate ID reached sight word criterion faster and retained more words when sight words were presented as text alone. In contrast, a comparison of picture-integrated, picture-integrated paired with text, and text alone sight word instruction indicated that pairing picture integrated words with text was more effective than text alone in promoting sight word identification with students with moderate to severe ID (Van der Bijl et al., 2006). Picture-integrated sight word instruction fostered higher levels of sight word retention, however (Van der Bijl et al., 2006).

To explain the variable efficacy of picture stimulus procedures, Didden and colleagues (2000) hypothesized that picture prompts may interfere with sight word learning due to a “blocking effect”. This blocking effect occurs when attending and responding to the picture stimuli interferes with attending and responding to the printed word (Didden et al., 2000; Fossett & Mirenda, 2006). Despite the potential interference of the blocking effect, Van der Bijl and colleagues (2006) suggest that pairing integrated pictures with printed words may enable students with moderate to severe ID to make associations between the integrated picture and text sight word formats, fostering generalization.

An alternative picture stimulus procedure that potentially prevents the blocking effect is picture-to-text matching. With picture-to-text matching, text is matched to an associated picture that is presented separately from the text (Fossett & Mirenda, 2006). Fosset and Mirenda compared the effects of picture-to-text matching with paired associate instruction, in which pictures were paired with text, on the sight word acquisition of two students with significant developmental delays. Results suggest that picture-to-text matching was more effective in promoting sight word acquisition and generalization of sight word reading to novel, functional activities. Based on these results, Fossett and Mirenda (2006) hypothesized that pairing pictures with words fostered passive learning, which prevented stimulus equivalence, resulting in the blocking effect. Conversely, matching pictures to text fostered active learning, which promoted stimulus equivalence, and thereby prevented the blocking effect.

Thus, the efficacy of sight word instruction employing picture stimulus may be restricted by the occurrence of a blocking effect (Didden et al., 2006; Didden et al., 2000; Fossett & Mirenda, 2006; Van der Bijl et al., 2006), resulting from passive rather than active learning (Fossett & Mirenda, 2006). Despite the reported variable efficacy, the use of picture stimulus procedures may promote sight word acquisition for some students with significant ID (Birkan et al., 2007; Didden et al., 2006; Fossett & Mirenda, 2006; Van der Bijl et al., 2006). Furthermore, picture stimuli procedures provide a method for fostering vocabulary comprehension.

Incidental learning. Picture stimulus and time delay procedures effectively promote sight word acquisition with students with significant ID. Still, as it may take longer for students with significant ID to learn reading skills (Browder, Ahlgrim-Delzell, et al., 2008), instructional efficiency is critical. Instructional effectiveness is evidenced by the acquisition of more information within an instructional period, a decrease in the instructional time needed to promote skill development, reduced preparation time, and ease of instructional implementation (Doyle et al., 1996; Werts, Wolery, & Holcombe, 1991). Incidental learning is one strategy for increasing instructional efficiency. To encourage incidental learning, incidental stimuli consisting of extra information related to the target skill is presented during the instructional trial, but no direct instruction is provided to promote the learning of the stimuli and student response to the incidental stimuli is not solicited or reinforced (Werts, Caldwell, & Wolery, 2003; Werts et al., 1991; Wolery, Schuster, & Collins, 2000). Research indicates that inserting incidental stimuli within instructional trials employing the system of least prompts (Doyle, Gast, Wolery, Ault, & Meyer, 1992; Werts, Wolery, Holcombe, & Gast, 1995; Taylor, Collins, Schuster, & Kleinert, 2002), simultaneous prompting (Griffen, Schuster, & Morse, 1998; Werts et al., 1995), progressive time delay (Doyle et al., 1996; Werts et al., 1995), and CTD procedures (Campbell & Mechling, 2009; Werts et al., 1995; Wolery et al., 2000) fosters the acquisition of target stimuli and some or all of the incidental stimuli.

Incidental stimuli can be inserted into four elements of the instructional trial, including the antecedent condition, the consequent, instructive feedback condition, the task request, or the response prompt system (Doyle et al., 1996). First, incidental stimuli can be embedded in the antecedent condition, as part of the attentional cue (Werts et al., 1991). Research on inserting incidental stimuli in the antecedent condition has primarily focused on promoting skill acquisition with students with learning disabilities and mild ID (Holcombe-Ligon, Wolery, & Werts, 1992). The only study conducted with students with mild to moderate ID reported that inserting incidental sight word stimuli prior to the task request in sight word instruction trials employing CTD resulted in the acquisition of five target sight words and two to four of five incidentally presented sight words (Wolery et al., 2000). Based on the limited research in this area, Holcombe-Ligon and colleagues (1992) suggested that the potential of this instructional strategy is relatively unknown.

A second, more frequently utilized strategy is to present incidental stimuli in the consequent condition of the instructional trial When presented in the consequent condition, the incidental stimulus is presented after the student responds to the target stimuli, as part of the error correction or praise instructive feedback (Werts et al , 2003, Werts et al , 1995) The efficacy of inserting incidental stimuli as consequent feedback is demonstrated by Ledford and colleagues (2008) Ledford and colleagues utilized CTD to teach three students with autism and significant cognitive impairments environmental sight words Wordless environmental signs incidental stimuli were presented as instructive feedback Post-instruction assessment probes indicated that the students learned to identify the target sight words and between 50% and 100% of the incidental environmental signs

In an earlier study, five students with moderate ID were provided sight word instruction employing simultaneous prompting with two pieces of incidental information presented in the consequent feedback condition on either an intermittent or continuous schedule (Griffen et al , 1998) Target sight words were community business or activity center (e g , Commonwealth Stadium) names and incidental stimuli included identification of community location photographs and naming activities performed at the community locations Study results indicated that students learned to identify the target sight words and 50% to 100% of the incidental location photographs Moreover students learned to identify the incidentally presented activities performed at the targeted venues with 100% accuracy Although the intermittent presentation of incidental stimuli was associated with a slight reduction in instructional time, only minimal differences in incidental stimuli acquisition were noted between the two presentation schedules These results suggest that learning efficiency can be increased when two pieces of incidental information that promote target stimuli comprehension are inserted in the consequent feedback condition of the instructional trial (Griffen et al., 1998).

Including incidental stimuli in either the antecedent or consequent condition of the instructional trial fosters immediate and future learning effects. To exemplify, Wolery and colleagues (2000) compared the effects of CTD sight word instruction with incidental sight word stimuli presented antecedently, prior to the task request, consequently as feedback, and with no incidental stimuli. Students with mild to moderate ID learned target sight words faster when incidental stimuli were presented in the antecedent condition, but fewer target sight word identification errors occurred with the consequent presentation of the incidental stimuli. More significantly, inserting incidental stimuli within the instructional trial had beneficial effects on future learning. With direct instruction, incidentally presented sight words were learned in 6- to 12-sessions, while target sight words were learned in 16- to 22- sessions. Further, during instruction, error rates were lower for incidentally presented sight words. Student learning of two to four of the five incidental sight words prior to receiving direct instruction contributed to the reduction in instructional time. These results extend the findings of earlier studies conducted by Wolery, Doyle, Ault, Gast, Meyer, and Stinson (1991), which compared the instructional effects of teaching students with moderate ID to identify community occupation and restaurant photographs using progressive time delay procedures with and without the consequential feedback presentation of incidental occupational and restaurant sight word stimuli. Comparison of the instructional time needed to teach the occupational and restaurant sight words in each condition indicated that the consequent feedback sight word stimuli presentation resulted in more rapid sight word learning as students learned to read one or more of the four incidentally presented sight words (Wolery et al., 1991). Although some individual variability was noted, incidental learning reduced instructional time.

The last incidental learning strategy is the insertion of incidental stimuli within the prompt hierarchy used to elicit the desired response for the target stimuli. Using the system of least prompts, incidental food cost and meal classification (e.g., breakfast, lunch, dinner) stimuli were presented as part of the prompt hierarchy to teach two elementary students with moderate ID to read target restaurant sight words (Doyle et al., 1992). As a result of the instruction the students learned to read the target food words and to classify some of the foods by cost and meal. According to Doyle and colleagues, the study results indicated that students with moderate ID can learn target sight words and two pieces of related incidental stimuli using the system of least prompts in a small group instructional format.

The research on incidental learning is promising. First providing exposure to incidental stimuli during instruction increases instructional efficiency (Campbell & Mechling, 2008; Doyle et al., 1996; Ledford et al., 2008; Wall & Gast, 1999; Wolery et al., 2000) as students are exposed to and acquire more information with minimal increases in instructional time (Ledford et al., 2008), with minimal instructional effort (Wall & Gast, 1999). Equally important, including incidental information in the instructional sequence does not interfere with the acquisition of target stimuli (Doyle et al., 1996; Wolery et al., 1991; Wolery et al., 2000). Rather, this instructional technique has beneficial effects on the future learning of the incidentally presented stimuli (Wolery et al , 1991, Wolery et al , 2000) Finally, embedding incidental stimuli within the instructional trial can foster target sight word comprehension (Griffen et al , 1998)

Although the research on sight word instruction employing CTD, picture stimulus, and incidental learning is promising, several limitations compromise results First, only five of the sight word research studies contained a comprehension measure (Doyle et al , 1992, Fossett & Mirenda, 2006, Griffen et al , 1998, Mechling et al , 2007, Rohena et al , 2002) Next, all the studies reviewed targeted verbal students or students able to verbally imitate a model (Griffen et al , 1998), none included nonverbal students Therefore, the efficacy of the use of these sight word instructional methods with nonverbal students with significant ID is unknown

Sight word instruction with nonverbal students. While the instructional strategies employed with verbal students with moderate ID taught sight word identification in isolation, sight word instruction with nonverbal students with significant ID was provided as part of a multi-component reading program or intervention These reading programs include *The Literacy Through Unity: Word Study* program (Hanser & Erickson, 2007), teacher use of story reading task analyses (Browder, Mims, Spooner, Ahlgrim-Delzell, & Lee, 2008, Browder, Trela, et al , 2007), and the ELSB (Browder, Ahlgrim-Delzell, et al , 2008) reading curriculum Participation in Unity word wall instruction promoted a 28% increase in vocabulary identification for one student with moderate ID and cerebral palsy (Hanser & Erickson, 2007) However, performance was highly variable Meanwhile, teacher use of story reading task analyses promoted student identification and reading of story vocabulary in isolation and within the story context (Browder, Trela, et al , 2007) and the use of sensory or concrete object representations to teach vocabulary comprehension (Browder, Mims, et al., 2008). In combination with the system of least prompts with feedback, teacher use of the task analyses with verbal and nonverbal students with moderate and severe ID promoted gains in naming or using an AAC device to name vocabulary (Browder, Trela, et al., 2007). More, nonverbal students with profound ID and physical impairments demonstrated increased independent responding during shared story lessons (Browder, Mims, et al., 2008).

Lastly, sight word instruction provided through the ELSB curriculum targeted reading and identifying vocabulary words, completing sentences by filling in the blank with the appropriate word, and identifying pictures of spoken words (Browder, Ahlgrim-Delzell, et al., 2008). Sight word instruction included flash card drills employing CTD procedures and use of the system of least prompts to promote correct responding. Analysis of pre- and post-test scores identified large ELSB treatment effect sizes for all reading measures (range1.15-1.57), and moderate interaction effects (.46) on the *Peabody Picture Vocabulary Test-III*. Conversely, control group scores indicated extremely small to moderate interaction effects. This limited research suggests that with direct instruction, verbal and nonverbal students with significant ID can learn to identify, read and comprehend sight word and story vocabulary (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Mims, et al., 2008; Browder, Trela, et al., 2007). Still, these results must be viewed with caution as gains in sight word reading were not differentiated by degree of disability or verbal status.

In all, the sight word research provides evidence that verbal and nonverbal students with significant ID can learn to identify a printed word when the word is spoken or to say a word when shown the word in print (Truxler & O'Keefe, 2007), using a variety of instructional methods. The importance of these findings are limited by the fact that less than a third of the studies, primarily those including nonverbal students, incorporated a measure to evaluate vocabulary comprehension (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Mims, et al., 2008; Browder, Trela, et al., 2007; Doyle et al., 1992; Fossett & Mirenda, 2006; Griffen et al., 1998; Mechling et al., 2007; Rohena et al., 2002). These finding are similar to earlier reviews of the reading research in which only half or less of the studies reviewed measured the participant's comprehension of the sight words learned (Browder & Lalli, 1991; Browder & Xin, 1998). Thus, the emphasis of sight word instruction continues to focus on the visual discrimination of sight words or word naming (Browder & Lalli, 1991). Keeping in mind that vocabulary development is critical for text comprehension, sight word and vocabulary instruction must include a comprehension component.

Text Comprehension

Reading comprehension occurs when prior knowledge is used to interact with and make meaning of textual material (National Reading Panel, 2000). Impairments in intellectual functioning, language, and integration of text and external knowledge due to limited life experiences, may negatively affect the reading comprehension of students with significant ID (Browder, Ahlgrim-Delzell, et al., 2008; Hetzroni, 2004; Koppenhaver et al., 2007; Nation & Norbury, 2005; Weikle & Hadadian, 2004; Zaslow et al., 2008). Among the studies reviewed on comprehension, the majority of the research with verbal and nonverbal students with significant ID placed emphasis on listening comprehension. However, one study examined the effects of an 18-session reciprocal teaching intervention (Palinscar & Brown, 1984) on the reading comprehension of 19 verbal students with mild to moderate ID (Alfassi, Weiss, & Lifshitz, 2009). With the reciprocal teaching intervention, an expository text passage was read in a group format to promote discussion and shared responsibility for text comprehension. During the initial text reading, the instructor modeled comprehension strategies including question generation, summarization, word meaning, text clarification, and event prediction. Then, scaffolding, prompting, questioning, and remodeling was provided as students practiced the strategies. Pre- and posttest measure analysis indicated significantly improved experimental group performance, with a 10% gain demonstrated on the mean posttest standardized reading test measure score and a 22% improvement on the mean posttest standardized literacy reading assessment score. Comparatively, the control group demonstrated no significant difference on comprehension measures. Further, students participating in the reciprocal teaching intervention maintained the ability to ask relevant questions and summarize material at 12-weeks post instruction. The only identified drawback associated with reciprocal teaching was that time and effort were needed to promote participation in instructional discussions. While the research on fostering listening comprehension with verbal students with moderate ID was limited to this lone study, four research studies targeted listening comprehension instructional methods designed to accommodate the learning needs of verbal and nonverbal students with moderate to profound ID.

Three of the instructional strategies designed for verbal and nonverbal students with moderate to profound ID used adapted books and the system of least prompts to promote listening comprehension (Browder, Mims, et al., 2008; Browder, Trela, et al., 2007; Mims, Browder, Baker, Lee, & Spooner, 2009). Book adaptations included inserting sensory or concrete objects in the book (Browder, Mims, et al., 2008; Mims et al., 2009), inserting pictures of key vocabulary above the vocabulary words (Browder, Mims, et al., 2008; Browder, Trela, et al., 2007), inserting a repeated story line, and abbreviating or reducing text complexity (Browder, Mims, et al., 2008; Browder, Trela, et al., 2007; Mims et al., 2009). For students with severe and profound ID and visual impairments, the use of adapted books with embedded concrete objects representing noun referents and the system of least prompts supported increased correct responding to comprehension questions (Mims et al., 2009). Meanwhile, for verbal and nonverbal students with moderate to profound ID, teacher use of a story reading task analysis that fostered story topic identification (Browder, Trela, et al., 2007), prediction (Browder, Trela, et al., 2007; Browder, Mims, et al., 2008), and sentence completion comprehension skills (Browder, Mims, et al., 2008; Browder, Trela, et al., 2007) in conjunction with adapted storybooks promoted increased responding to comprehension questions (Browder, Trela, et al., 2007) and increased independent response rates (Browder, Mims, et al., 2008). On the other hand, ELSB curriculum (Browder, Ahlgrim-Delzell, et al., 2008) instruction employed scaffolding and the system of least prompts to teach verbal and nonverbal students with moderate to severe ID to complete sentences and answer questions about story material (Browder, Ahlgrim-Delzell, et al., 2008). Participation in the ELSB *curriculum resulted in greater gains on comprehension measures in comparison* with control group scores (Browder, Ahlgrim-Delzell, et al., 2008).

As opposed to the relative plethora of research on listening comprehension, only one identified study examined a means to promote the comprehension of independently read material. This study evaluated the efficacy of using a sticker reward system to teach a student with moderate ID and visual impairments to read a Braille menu and answer five comprehension questions about the menu items (Creech & Golden, 2009). The criterion for earning the sticker reinforcement was increased over the course of the study to promote correct responding to five comprehension questions. To facilitate correct responding, the student was able to review the menu section after each question was asked. Student performance indicated that the reward system assisted in improving the student's work behaviors and as a result, reading comprehension (Creech & Golden, 2009).

The text comprehension research suggests that verbal and nonverbal students with significant ID can improve listening comprehension skills with explicit instruction and the use of adapted reading materials (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Mims, et al., 2008). Still, as skill gains were not differentiated by degree of disability, verbal status, or comprehension skill, it is difficult to fully evaluate the efficacy of these interventions. Due to the paucity of research on independent reading comprehension skill development, no conclusions can be drawn regarding skill potential in this area.

Summary

In summary, the literature provides evidence that students with significant ID can learn some phonemic awareness, phonics, vocabulary comprehension, and reading comprehensions skills. However the preponderance of the research has focused on promoting the reading development of verbal students with moderate ID. While limited research suggests that nonverbal students with significant ID can learn some letter-sound correspondence and decoding skills (Hanser & Erickson, 2007; Heller & Coleman-Martin, 2007), vocabulary comprehension skills (Browder, Ahlgrim-Delzell, et al., 2008;

Browder, Trela, et al., 2007; Hanser & Erickson, 2007) and reading comprehension skills (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Mims, et al., 2008; Browder, Trela, et al., 2007; Creech & Golden, 2009; Mims et al., 2009), small study sample size and undifferentiated reporting of skill gains make it difficult to assess the true extent of skill development. Furthermore research on reading instruction for students with significant ID continues to focus on sight word identification, with only a superficial examination of phonemic awareness, phonics, fluency, and text comprehension skill development.

While sight word instruction provides a foundation for text comprehension, automatic sight word reading is fostered by phonemic awareness and knowledge of letter-sound correspondence, which assists in retrieving word pronunciations and meanings stored in memory (Ehri, 2005; Parette et al., 2009). To maximize reading development, students with ID must be taught to integrate, apply, and generalize all essential reading skills (Allor et al., 2009; Katims, 2000). As the use of time delay procedures to teach sight word recognition has been identified as an evidence-based reading practice for students with moderate ID, and a promising practice for students with severe ID (Browder, Ahlgrim-Delzell, et al., 2008), there is a need for research to identify how this evidence-based practice can be used to promote the development of integrated sight word vocabulary, phonemic awareness, phonics, and text comprehension skills.

One potential strategy for integrating the development of essential reading skills using time delay procedures is the use of incidental learning. Research suggests that embedding incidental information within sight word instructional trials enables students to learn target information and two pieces of incidental information (Griffen et al., 1998). However, there is a paucity of research examining the efficacy of inserting incidental phonemic awareness or phonics stimuli within the sight word instructional trial on the phonemic awareness and phonics skill acquisition of students with significant ID. Further, no research examining the use of incidental learning with nonverbal students with significant ID was identified through the review of the literature. Thus, there is a need for research to identify the efficacy of instruction employing time delay procedures and incidental learning in the development of phonemic awareness and phonics skills with verbal and nonverbal students with significant ID.

Finally, research indicates that computer-assisted instruction can be as effective and efficient, if not more so than teacher-assisted instruction in teaching reading skills to struggling readers and students with disabilities (Basil & Reyes, 2003; Coleman-Martin et al., 2005; Hitchcock & Noonan, 2000; Karemaker et al., 2009). Moreover, computer assisted *PowerPoint*™ features enable customization of computer-assisted instruction to meet student's learning needs and can be used to foster sequential skill instruction (Parette et al., 2009; Parette et al., 2008). Despite the research supporting the benefits of computer-assisted instruction, there is a paucity of research exploring the use of this instructional method with students with significant ID. As cognitive research suggests that visual and spatial instructional methods are potentially more effective than verbal methods for students with ID (Henry, 2001), computer-assisted PowerPoint instruction may prove an effective method for promoting integrated, reading skill development. Thus, there is a need for research to evaluate the efficacy of computer-assisted instruction on the reading development of verbal and nonverbal students with significant ID.

Rationale for Study

This study seeks to add to the literature on instructional methods that promote the reading development of students with significant ID by examining the effects of computer-assisted instruction employing CTD procedures, with incidental phonics and comprehension stimuli. The results of this study will identify the effects of computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching sight word identification, phonemic awareness, letter-sound correspondence, and vocabulary comprehension skills with verbal and nonverbal students with significant ID.

CHAPTER III

METHOD

This study seeks to add to the literature on instructional methods that promote the reading development of students with significant ID by identifying the effects of computer-assisted instruction employing CTD procedures, with incidental phonics and comprehension stimuli. This chapter describes the study method employed to answer the following research questions:

1. How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching verbal and nonverbal students with significant ID to identify target sight words?
2. How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching the acquisition of letter-sound correspondence with verbal and nonverbal students with significant ID?
3. How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching vocabulary comprehension with verbal and nonverbal students with significant ID?
4. Do verbal and nonverbal students with significant ID generalize the phonemic awareness and phonics skills learned through computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli to novel high frequency sight

words with similar initial phonemes?

5. What value do teachers and parents of students with significant ID place on computer-assisted sight word instruction employing CTD procedures with incidental stimuli on the development of reading skills with students with significant ID?

Participants

Six verbal and nonverbal elementary school students between the ages of five and twelve identified as having a moderate intellectual disability who attended a public elementary school in a large urban school district in a Mid-Atlantic state participated in the study. For the purpose of this study, a moderate intellectual disability was defined as an IQ of 35 to 55, with concurrent deficits in adaptive behavior (American Psychiatric Association, 2000), with or without coexisting autism spectrum disorder, speech and language, and physical disabilities (Browder, Wakeman, et al., 2006). Participant disability status was verified through a review of each participant's cumulative, educational record. A verbal student was defined as a student who independently used spoken word approximations, phrases, or simple sentences to communicate. A nonverbal student was defined as a student with limited or no intelligible speech, who might be able to vocalize sounds and approximate single word utterances in imitation of a model. To be eligible for participation in this study, students had to demonstrate limited basic reading skill development, verified through a review of the participant's educational assessments and teacher report. Additional eligibility criteria included: a) the ability to attend to a teacher or activity for 15 minutes, b) the ability to indicate a choice when given three object, picture, or word choice items through pointing or eye gaze, and d) educational placement in a public elementary school self-contained, special education classroom for students with a moderate to severe ID Students who demonstrated hyperlexia were excluded from participation in the study Prior to conducting the study, the research proposal was submitted to the Human Subjects Institutional Review Board (IRB) for review and approval to conduct the study was obtained (No 10-195) Potential student participants were identified by classroom, special education teachers Parental consent was obtained for the student's participation in the study Student names have been changed to protect confidentiality Five of the students who participated in the study were Caucasian, one was Asian A brief narrative description of each student follows

Jon. Jon is an 8-year, 10-month old, fourth-grade, verbal student with Down syndrome and moderate ID He wears glasses for farsightedness While he exhibited selective mutism during early childhood, Jon currently uses short phrases and simple sentences to make his wants and needs known However, Jon often parrots directions, questions, and comments, particularly in unfamiliar situations and his speech is not always intelligible Jon recognizes his name in print, names the letters in his name, and matches most upper and lower case alphabet letters His teacher reports that Jon recognizes some letter sounds and over 20 high frequency sight words Jon answers simple comprehension questions about story material with prompting Speech/language therapy and occupational therapy are provided as part of Jon's educational programming

Francis. Francis is an 11-year, 5-month old, verbal, fifth-grade male student with Down syndrome Psychological assessment indicates that Francis' cognitive skills reflect a moderate ID Francis uses single words and short phrases and sentences to communicate with familiar staff and peers, yet his speech is often unintelligible to others As Francis' speech rate increases, intelligibility decreases Although English is Francis' primary language, Tagalog is also spoken in the home. Francis recognizes his name and the names of his classmates in print. He names and identifies most alphabet letters. Francis answers questions about story material with prompting. When provided two answer choices, Francis often selects the answer choice on the right. Francis receives speech/language and occupational therapy as part of his educational program.

Elijah. Elijah is a 9-year, 10-month old, nonverbal, fourth-grade student. Elijah has multiple disabilities, including cerebral palsy, a profound speech and language impairment, and optic atrophy. He uses a wheelchair for seating and mobility. Due to the complexity of Elijah's multiple disabilities, psychological assessment has not been conducted. His educational performance suggests a moderate to severe intellectual disability. Elijah's primary mode of communication is eye gaze, supplemented by vocalizations, facial expressions, and a limited number of word approximations (e.g. hi, home). Elijah will sometimes indicate choice selection by touching a choice item using his hand, elbow, or head. To participate in classroom activities, Elijah is presented two to three objects or high contrast picture choices from which he selects his answer. He frequently favors the left side when selecting his answer choice. Resultant to his visual and motor impairments, an extended response interval and prompting are needed to facilitate visual attention to answer choices and answer selection. Elijah receives speech/language, occupational, physical, and vision services.

Jackson. Jackson is a 9-year, 4-month old fourth-grade, verbal student identified as having a moderate ID. Jackson demonstrates tactile and auditory defensiveness. Jackson's expressive communication skills include greetings, humming sounds, and some words. He imitates modeled phonemes. Jackson participates in classroom activities by responding to yes/no questions and using picture/word choices, but extended wait intervals are needed as he demonstrates a delayed response time. Multiple prompts are needed to promote task completion. According to his teacher, Jackson inconsistently recognizes some letters. Speech/language, occupational, and physical therapy services are provided as part of Jackson's educational program.

Maybeth. Maybeth is an 11-year, 9 month old fifth-grade, nonverbal student with 1p-syndrome. Maybeth uses a Springer Board Lite AAC communication system, sign language approximations, gestures, and some vocalizations to communicate and participate in classroom activities. Using her AAC device, Maybeth spontaneously creates two word messages to ask questions and relate her feelings. District eligibility assessments indicate that Maybeth's cognitive and adaptive behaviors fall within the moderate range of intellectual ability. Maybeth identifies upper case letters and recognizes her name and those of her classmates and teachers in print. She uses her AAC device to name the common environmental signs, logos and words she has learned. Maybeth's IEP objectives include reading 15 high frequency words. Maybeth receives speech/language, occupational, and physical therapy services.

Paul. Paul is a 5-year, 9-month old, nonverbal, kindergarten student with multiple disabilities, including an intellectual disability and cerebral palsy. Due to his age and the complexity of his disability, psychological assessment to obtain an IQ score has not been conducted. However, his cognitive and adaptive behaviors are consistent with those associated with a moderate to severe ID. Paul demonstrates self-stimulatory behaviors and tactile defensiveness. Eye contact is fleeting and prompting is needed to promote attention to task. Paul communicates through body language, inconsistent and limited vocalizations, and low-tech communication aids including a single switch voice output device, picture, and object choices. He is beginning to mimic simple words such as up, hi, and on, following a model. Pointing and hand over hand assistance are needed to promote scanning of answer choices and meaningful selection of just one answer choice. During less preferred activities, Paul often pushes materials away or grabs at the person working with him. Paul enjoys looking at books. Speech/language, occupational, and physical therapy services are provided as part of Paul's educational program.

Setting

District and school. The study was conducted in a public elementary school in a large school district located in a southern Mid-Atlantic state. The school district served 40,000 students. The urban, public elementary school attended by the students who participated in the study served students from preschool through fifth grade, with an enrollment of 784 students. The school's instructional staff included 45 teachers, one principal, one assistant principal, two guidance counselors, one reading recovery teacher, nine general education paraprofessionals, eight special education paraprofessionals, two speech therapists, one occupational therapist, and one physical therapist. As the special education magnet school for the surrounding area, services were provided for 79 students with disabilities. The elementary school housed two early childhood special education classrooms, two classrooms for students with moderate ID, two classrooms for students with mild ID, and five classrooms for students with learning disabilities. The school's student population was 86% Caucasian, 5% Black/African American, 4% Asian, 2% Hispanic, 2% unspecified, and 1% American Indian. Less than ten percent of the school's student population was eligible for free or reduced lunch.

Classroom. The computer-assisted sight word intervention was conducted in a self-contained classroom for kindergarten to second grade students with moderate to severe ID. Paul's instructional program was provided in this classroom by the primary researcher and two paraprofessionals who had two and three years of experience working with students with significant disabilities. The other five students received instruction in a classroom for third to fifth grade students with moderate ID. The special education teacher in this class had a Master's degree and 8-years of teaching experience students with significant disabilities. The classroom paraprofessional had 10-years of experience working with students with ID. All six students were familiar with the primary researcher, who was an educator at the students' school and had provided instructional services at some point for Elijah and Paul.

Instructional and assessment probe sessions were conducted at the computer station on one side of the 31' x 29' self-contained, special education classroom for students with moderate to severe ID, during regular school hours in a one-on-one format. Instructional sessions were conducted at the classroom computer with the researcher sitting next to the student at the computer table. Probe sessions were conducted next to the computer station, with the researcher facing the student across a desk or tray. Instructional and assessment probes for Jon, Francis, Elijah, Jackson, and Maybeth occurred in the afternoon, between 12:00 p.m. and 2:00 p.m., during normally scheduled instruction. Paul participated in intervention sessions in the morning, between 8:30 a.m. and 9:30 a.m. All baseline, instructional, and probe sessions were videotaped to allow reliability measures to be completed.

Instructional Materials

Instructional materials consisted of two Microsoft® PowerPoint™ 1997-2003 slideshow presentations. The word set 1 slideshow contained two noun and two action verb high frequency sight words. The word set 2 slideshow contained one noun and three action verb high frequency sight words. Targeted sight words were obtained from the Dolch word list, the Dolch Noun list, the Picture Nouns word list, and the Primary Students' Most Used Words (In Writing) list (Fry & Kress, 2006). Each PowerPoint slideshow consisted of 41 slides, including a Sight Word title slide and eight, 5-slide sight word instructional sets. Each high frequency sight word 5-slide instructional set was presented twice. The order of the second presentation of the sight word instructional slides was determined through random sight word selection.

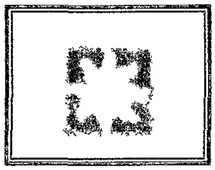
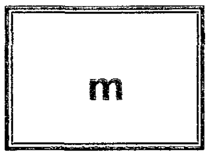
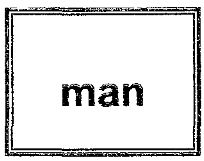
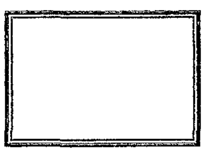
The slide show was created using the following format. The first slide in each 5-slide word set displayed an animated clipart (e.g., pulsing sun) obtained from Microsoft® Office Online, Images and More (Microsoft® Corporation, 2010) to gain the participant's attention. The second slide presented the initial letter of the targeted sight word. Using PowerPoint animation and sound features, the initial sight word letter appeared slowly. The researcher provided an audio production of the letter sound after the letter had been presented. The targeted sight word was exhibited on the third slide. The controlling prompt and the naming of the sight word were provided by the researcher, in accordance with the instructional trial protocol. The fourth slide in each word set contained a picture representation of the sight word paired with the sight word. The researcher provided audio reinforcement, "Good looking," followed by the naming of the picture embedded in the slide, "This is a picture of (sight word)". The final slide in the instructional set was a blank slide which was displayed during a 5- to 8-second inter-trial delay.

The PowerPoint letter and sight word slides were created using lower-case, Arial, bold, 166-point font. Sight word picture representations consisted of 4-inch by 5-inch color photograph images obtained from Microsoft Online, Images and More (2010) and Picture This Professional Edition (2000-2002). An example of a 5-slide, sight word instructional set is provided in Table 1. The two PowerPoint slide presentations were created and presented on an Optiplex 740 Dell computer with a built in speaker. The slideshow was displayed on a Dell monitor with a 10 ½' x 13 ¼' screen. The slide show was advanced frame by frame by the researcher, following the instructional trial time delay protocol.

Assessment materials included sight word flashcards, alphabet letter flashcards, and picture representation flashcards. Sight word and alphabet letter flashcards were created using lower case, 120-point, Arial font and were printed on 127 mm x 177 mm (5" x 7") plain white index cards. Picture representation flashcards were created using a 3-inch-by-3-inch color photographs from Microsoft Online, Images and More (2010) and Picture This Professional Edition (2000-2002), glued on 127 mm x 177 mm (5" x 7") plain white index cards.

Table 1

Sight Word Instructional Set

Slide Number	Slide Visual Content	Slide Features
Slide 1		Animated pulsing sun clipart
Slide 2		Sight word initial letter appears slowly in the center of the slide
Slide 3		Target sight word
Slide 4		Sight word and picture representation
Slide 5		Blank slide

Note. Man pictorial representation obtained from Microsoft Office Images

Experimental Design

A multiple probe, multiple baseline design (Tawney & Gast, 1984) across participants and two word sets was employed to evaluate the effects of computer-assisted sight word instruction employing CTD procedures with incidental stimuli in teaching sight word identification, letter-sound correspondence, phonemic awareness, and sight word comprehension skills to verbal and nonverbal students with moderate ID. Six students participated in the intervention to ensure sufficient replication upon which to evaluate the functional relation between the intervention and behavioral effects (Murphy & Bryan, 1980). The multiple probe design fosters experimental control and identification of a functional relation between the intervention and student skill acquisition, when the behaviors under study are unlikely to revert to pre-instructional baseline levels when the intervention is discontinued (Murphy & Bryan, 1980). The use of intermittent assessment probes increased the internal validity of the study by eliminating increased attending, or reactivity, to the incidental stimuli due to extended measurement (Horner & Baer, 1978; Werts et al., 2003). However, potential threats to internal validity associated with the multiple probe design include decreased sensitivity in identifying abrupt behavioral change (Kennedy, 2005).

To increase study sensitivity, individual baseline probes were conducted to assess participant naming and identification of all target and incidental stimuli. After baseline probes were conducted, instruction on word set 1 sight words was implemented. Daily sight word probe trials were conducted prior to each instructional session to monitor student attainment of study sight word set criterion. Criterion for verbal students was 100% correct word set reading on two consecutive daily probes or the completion of 15 instructional sessions. Criterion for nonverbal students was 100% correct word set identification on two consecutive daily probes or the completion of 15 instructional sessions. Upon attainment of word set 1 criterion, dependent variable expressive and receptive probes were conducted to assess performance on word set 1 and 2 sight words, incidental letter-sound correspondence, and sight word comprehension. Additionally, post-test word set 1 PA and letter-sound correspondence generalization probes were conducted. Following word set 1 probes, instruction on word set 2 was implemented. A final probe of all expressive and receptive target and incidental stimuli was conducted when participants achieved criterion on word set 2 sight words or completed 15 sessions of intervention. Then post-test word set 2 phonemic awareness and letter-sound correspondence generalization probes were conducted. If students did not achieve criterion on a word set prior to the end of the school year, word set criterion probes were conducted on the last day study intervention sessions were to occur to assess target and incidental stimuli acquisition. No additional classroom sight word or phonics instruction was provided during the duration of the study to reduce the possibility of confounding instructional variables on study results.

Independent Variable

The study's independent variable was computer-assisted sight word instruction employing CTD procedures with incidental, letter-sound correspondence and vocabulary comprehension stimuli. Incidental letter-sound correspondence stimuli were presented in the antecedent attention cue of the CTD instructional trial. Incidental vocabulary comprehension stimuli were presented as part of the consequent feedback condition of the CTD instructional trial.

Dependent Variables

The study's dependent variables included the number of high frequency sight words named expressively and identified receptively, the number of letter-sound correspondences produced expressively and identified receptively, the number of sight words matched with corresponding pictorial representations, the number of initial letter-sound correspondences generalized to novel words, and the number of initial sounds generalized to novel word picture representations. For the purpose of this study, receptive identification was operationally defined as the ability to touch, point to, or look at the printed item that corresponded to a spoken word or letter-sound, when provided multiple-choice options. Sight word comprehension was operationally defined as the ability to touch, point to, or look at the pictorial representation that corresponded with a printed word when provided multiple choices.

Measures

Dependent variable measures evaluated the effects of computer-assisted CTD sight word instruction on the acquisition of target and incidental stimuli. Target sight word stimuli measures assessed receptive identification and expressive naming of target sight words. Incidental stimuli measures assessed expressive and receptive letter-sound correspondence, comprehension of sight words, and phonemic awareness and initial letter-sound correspondence generalization. Receptive identification probes assessed students' ability to identify target and incidental stimuli when provided multiple choice options. Expressive identification probes conducted with verbal students assessed student ability to name target sight words and incidental phonics and comprehension stimuli. Expressive identification probes conducted with nonverbal students measured the number of vocalizations produced when the student was asked to name target and incidental stimuli. Dependent variable measure probes were conducted by the researcher near the computer station on the side of the classroom, in a one-on-one format. During probes, the researcher sat across from the student. Assessment materials were presented on a desk or tray placed between the researcher and student. A description of each dependent variable measure follows.

Receptive sight word identification. Receptive identification baseline, daily word set, and word set criterion probes consisted of eight randomly presented sight word identification trials, one trial for each set 1 and set 2 target sight word. During receptive identification probe trials three sight word flashcards were randomly presented on the table/tray in front of the participant. The flashcard choices included the target word and two distractor words. Distractor words were randomly selected from the pool of 16 high frequency noun and action verb sight words less frequently identified by students during item selection probes and included sight words targeted in the study. After placing the flashcards on the work surface, the researcher delivered the attention cue, "Look." Upon gaining the student's attention, the researcher pointed to each of the three sight words on the work surface beginning with the word on the student's left. After pointing to each word choice, the researcher provided the controlling prompt, "Point to, look at, touch (target word)". A 4-second delay using an inner count (one Mississippi, two Mississippi, three Mississippi, four Mississippi) was provided to allow for student response. Non-contingent reinforcement, "Good looking" was provided after each trial to promote attending and on task behavior. A 5–8 second inter-trial delay, using an inner count was inserted between the completion of one trial and initiation of the next trial.

Correct or incorrect receptive identification of the named sight word, through pointing, eye gaze, or selection with a head-stick or head-pointer, was recorded on a paper and pencil data collection sheet. To be counted as a choice selection, the student had to maintain physical or eye contact with the selected item for a 2-second inner count. A plus was recorded to indicate correct word identification and a minus to indicate incorrect identification. The number of sight words correctly identified during each probe session was calculated by counting the number of pluses recorded.

Expressive sight word identification. Expressive sight word identification probes were conducted during baseline, daily word set, and word set criterion probes. Expressive identification baseline and word set criterion probes consisted of eight randomly presented identification trials, one trial for each set 1 and set 2 target sight word. Trials consisted of presenting an attentional cue, "Look," showing the student a targeted sight word flashcard, and providing the controlling prompt, "What word?" A 4-second delay using an inner count was employed to allow for student response. Non-contingent reinforcement, "Good looking," was provided after each trial to encourage attending and on-task behavior. A 5- to 8-second inter-trial delay, using an inner count, was inserted between the completion of one probe trial and initiation of the next trial. Expressive sight word identification probes were used to assess verbal students' naming of target sight words and nonverbal students' vocalizations.

Verbal students' correct or incorrect naming of target sight words and nonverbal students' vocalizations were recorded on a paper and pencil word list data collection sheet. To be counted as correct, the student had to clearly name the sight word presented. A plus was recorded to indicate correct reading of the sight word and a minus was used to indicate incorrect reading of the sight word. A letter V was recorded to indicate that a nonverbal student vocalized in response to the presentation of the sight word, but that the vocalization was unintelligible. The number of sight words correctly read during each probe session was calculated by counting the number of pluses recorded. Vocalization frequency was calculated by adding up the number of vocalizations produced by a nonverbal student during the probe session.

Expressive letter-sound correspondence. Expressive letter-sound baseline, daily word set, and word set criterion probes consisted of eight randomly presented trials, one trial for each of the initial letter-sound correspondences represented in set 1 and set 2 target sight words. During expressive letter-sound correspondence trials, the researcher presented the attentional cue, "Look," showed the student a letter flashcard, and provide the controlling prompt, "What sound does this letter make?" A 4-second delay using an inner count was provided to allow for student response. Non-contingent reinforcement, "Good looking," was provided to encourage attending and on-task behavior. A 5- to 8-second inter-trial delay, using an inner count, was inserted between the completion of one probe trial and the initiation of the next trial.

Verbal students' correct or incorrect expressive production of letter-sound correspondences and nonverbal students' vocalizations were recorded on a paper and pencil data collection sheet. To be counted as correct, the student had to clearly produce the sound associated with the letter presented. A plus was recorded to indicate correct letter-sound production and a minus was used to indicate incorrect production. A letter V was recorded to indicate that a nonverbal student vocalized in response to the presentation of the letter, but that the vocalization was unintelligible. The number of letter-sounds correctly produced during each probe session was calculated by counting the number of pluses recorded. Vocalization frequency was calculated by adding up the number of vocalizations produced by a nonverbal student during the probe session.

Receptive letter-sound correspondence. Receptive letter-sound baseline and word set criterion probes consisted of eight randomly presented trials, one trial for each of the initial letter-sound correspondences represented in set 1 and set 2 target sight words. During receptive letter-sound probe trials, three letter flashcard choices were placed on the table/tray in front of the participant. Randomly presented letter choices included the letter associated with the trial sound, and two distractor letters. Distractor letters were randomly selected from the pool of 13 letters associated with the item selection words. The researcher delivered the attentional cue, "Look" and pointed to each of the letter choices on the work surface beginning with the letter on the student's left. The researcher then provided the controlling prompt, "Point to, look at, touch the letter for (letter sound)". A 4-second delay using an inner count was provided to allow for student response. Non-contingent reinforcement, "Good looking" was provided after each trial to promote attending and on task behavior. A 5- to 8-second inter-trial delay, using an inner count, was inserted between the completion of one trial and initiating the next trial.

Student correct or incorrect receptive identification of letter-sound correspondences were recorded on a paper and pencil data collection sheet. A plus was recorded to indicate correct identification of the letter corresponding with the instructor produced sound and a minus was used to indicate incorrect identification. The number of letter-sounds correctly identified during each probe session was calculated by counting the number of pluses recorded.

Sight word comprehension. Sight word comprehension baseline and word set criterion probes consisted of eight trials, one trial for each set 1 and set 2 sight word. During comprehension probes, three sight word picture representations were randomly placed on the table/tray in front of the participant. One picture representation represented the target sight word, one represented another word set sight word, and one was a distractor sight word depicting a word of the same category (e.g., noun, action verb). Probe trials consisted of delivering the attentional cue, "Look", pointing to each of the pictorial representations of the sight words on the work surface, beginning with the item on the student's left, and then showing the student a printed sight word flashcard and providing the controlling prompt, "Point to, look at, touch the picture that goes with this word." A 4-second delay was provided to allow for student response. Non-contingent reinforcement, "Good looking" was supplied after each trial. A 5- to 8-second inter-trial delay, using an inner count, was inserted between trials.

Student correct or incorrect demonstration of sight word comprehension was recorded on a paper and pencil data collection sheet. A plus was recorded to indicate correct identification of the corresponding picture representation and a minus indicated incorrect identification. The number of sight words correctly identified with their picture representations during the probe session was calculated by counting the number of pluses recorded.

Letter-sound correspondence generalization. Pre-test letter-sound correspondence generalization probes were conducted at the conclusion of item selection trials. Post-test letter-sound correspondence generalization probes were conducted after participants reached criterion on word set 1 and word set 2 sight words. Word set letter-sound correspondence generalization probes consisted of eight randomly presented trials, one trial for each initial letter-sound correspondence represented in the word set sight words. During letter-sound correspondence generalization probe trials, three sight word choices were placed on the table/tray in front of the participant. Randomly presented sight words included a novel word that began with the trial letter and sound, a novel word that began with the letter and sound of another sight word targeted during instruction, and a novel word of similar configuration. The researcher presented the attentional cue, "Look," and pointed to each of the word choices on the work surface beginning with the word on the student's left. The researcher then provided the controlling prompt, "Point to, look at, touch the word that begins with (letter sound)". A 4-second delay using an inner count was provided to allow for student response. Non-contingent reinforcement, "Good looking" was provided after each trial to promote attending and on task behavior. A 5- to 8-second inter-trial delay, using an inner count, was inserted between the completion of one trial and initiation of the next trial.

Student correct or incorrect demonstration of letter-sound correspondence generalization was recorded on a paper and pencil data collection sheet. A plus was recorded to indicate correct identification of the corresponding word and a minus to indicate incorrect identification. The number of novel words corresponding with target initial sounds correctly identified was calculated by counting the number of pluses recorded.

Phonemic awareness generalization. Pre-test phonemic awareness generalization probes were conducted at the conclusion of item selection trials. Post-test phonemic awareness generalization probes were conducted after participants reached criterion on word set 1 and word set 2 sight words. Word set phonemic awareness generalization probes consisted of eight randomly presented trials, one trial for each initial letter sound represented in the word set sight words. During phonemic awareness generalization probe trials, three pictorial representation choices were placed on the table/tray in front of the participant. Randomly presented pictorial representations included a novel picture of an object that began with the trial sound, a picture of a novel object that began with the sound of another sight word targeted during instruction, and a picture of a randomly chosen novel Dolch word list sight word. The researcher presented the attentional cue, "Look," and pointed to and named each of the picture choices on the work surface beginning with the picture on the student's left. The researcher then provided the controlling prompt, "Point to, look at, touch the picture that begins with (letter sound)". A 4-second delay using an inner count was provided to allow for student response. Non-contingent reinforcement, "Good looking" was provided after each trial to promote attending and on task behavior. A 5- to 8-second delay, using an inner count was inserted between the completion of one trial and initiation of the next trial.

Student correct or incorrect demonstration of phonemic awareness generalization was recorded on a paper and pencil data collection sheet. A plus was recorded to indicate correct identification of the corresponding pictorial representation and a minus to indicate incorrect identification. The number of novel pictures corresponding with target initial sounds correctly identified was calculated by counting the number of pluses recorded.

Item Selection

Sight word stimuli were selected through individual student screening of 32 high frequency noun and action verb sight words obtained from the Dolch word list, the Dolch Noun list, the Picture Nouns word list, and the Primary Students' Most Used Words (In Writing) list (Fry & Kress, 2006). Sight word screening included expressive naming and receptive identification of potential sight words, expressive naming and receptive identification of initial letter-sound correspondences associated with potential sight words, and expressive naming and receptive identification of pictorial representations of potential sight words. Item selection sight words, letter-sound correspondences, and pictorial representations are provided in Table 2. Item selection assessments were conducted in a quiet area in the kindergarten to second grade, self-contained special education classroom for students with moderate to severe ID. Each expressive and receptive screening session consisted of one trial per sight word, initial letter-sound correspondence, and picture representation naming. Item selection was scheduled to be conducted over four days, with the first and second days used for expressive naming screening and the third and fourth days used for receptive identification screening. However, student fatigue prevented expressive and receptive picture naming item selection probes from being conducted during expressive and receptive item selection probes. Consequently, expressive and receptive picture item selection probes were conducted after sight word and letter-sound correspondence probes were completed. Only the eight pictures representing the selected target sight words were included in picture naming and identification probes.

Table 2

Potential Target and Nontarget Stimuli

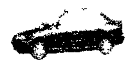
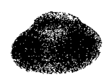
Category	Sight Word	Letter-sound Correspondence	Pictorial Representation
Nouns	baby[a]	/b/	
	ball[a]	/b/	
	bell[a]	/b/	
	boy[a]	/b/	
	car[b]	/c/	
	cat[b]	/c/	
	cow[b]	/c/	
	dad[a]	/d/	
	dog[b]	/d/	
	fox[a]	/f/	
	hat[b]	/h/	

Table 2 *(continued)*

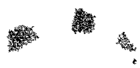
Category	Sight Word	Letter-sound Correspondence	Pictorial Representation
Nouns	man[a]	/m/	
	mom[a]	/m/	
	pig[b]	/p/	
	pin[a]	/p/	
	sun[a]	/s/	
	water[a]	/w/	
Verbs	buy[a]	/b/	
	cut[b]	/c/	
	give[b]	/g/	
	hit[b]	/h/	
	jump[b]	/j/	

Table 2 *(continued)*

Category	Sight Word	Letter-Sound Correspondence	Pictorial Representation
Verbs	pay[a]	/p/	
	pull[a]	/p/	
	put[a]	/p/	
	ride[b]	/r/	
	run[b]	/r/	
	see[a]	/s/	
	sit[b]	/s/	
	take[a]	/t/	
	walk[b]	/w/	
	wash[a]	/w/	

Note. Pictorial representations were obtained from [a]Microsoft Online, Images and More (2010) and [b]Picture This Professional Edition (2000-2002)

Expressive naming and receptive identification screening began with the random presentation of potential sight word flashcards, followed by the presentation of letter flashcards. During expressive naming probes, the researcher delivered the attention cue, "Look." Additional prompts to look were provided to gain visual attending as needed. Upon gaining the student's attention, the researcher showed the student a potential sight word or alphabet letter and said, "What is this word/ letter-sound?" The researcher provided a 4 second delay using an inner count. Non-contingent reinforcement, "Good looking," was provided after every trial to reinforce attention to task and following directions. A 5- to 8-second inter-trial delay, using an inner count, was provided between the completion of one trial and initiating of the next trial. Expressive picture identification probes were conducted in the same manner as expressive sight word and letter-sound correspondence probes.

Receptive identification screening probes consisted of placing three randomly selected, high frequency sight word or alphabet letter flashcards on the table or tray in front of the student. The researcher provided the attention cue, "Look". Additional prompts to "Look" were provided as needed to secure student attending. Upon gaining the student's attention, the researcher pointed to each item beginning with the item on the student's left. After promoting the visual scanning of the three words or letters, the researcher provided the controlling prompt "Point to, look at, touch (sight word name or the letter that says letter-sound)". A 4-second delay using an inner count was provided. Non-contingent reinforcement, "Good looking," was delivered after each trial to reinforce attending and following directions. No feedback was provided for correct or incorrect word identification. A 5- to 8-second inter-trial delay, using an inner count, was provided between the completion of one trial and initiating of the next trial. Receptive picture identification probes were conducted in a like manner.

A paper and pencil checklist was used to score the expressive and receptive item selection screening responses for sight word, letter-sound correspondences, and pictorial representations. A plus was used to identify sight words, letter-sound correspondences, and pictorial representations correctly named or identified and a minus was used to identify incorrect responses. A letter V was recorded to indicate that a nonverbal student vocalized in response to the presentation of the target or incidental stimuli.

On the first day of expressive sight word and letter-sound correspondence assessments, it was revealed that five of the students had been exposed to the words mom, dad, and dog during classroom instruction. Accordingly, those words were removed from the sight word pool. As dad and dog were the only words in the pool beginning with the letter d, the letter-sound correspondence /d/ was removed as well. Furthermore, Jackson repeatedly vocalized "Ba-ba" during the first day of expressive letter-sound correspondence, so the letter b and all five words beginning with the letter b were removed from the item selection pool. Eight sight words that were identified on both receptive assessment probes by one or more students were removed from the sight word pool. Eight of the remaining 16 sight words, three nouns and five action verbs, were selected as target words; no target words shared the same initial letter. Words selected were those that were less frequently identified by students during item selection probes. Upon selection of the eight target sight words, pretest letter-sound correspondence and phonemic awareness generalization probes were conducted.

Procedure

To identify the effects of computer-assisted, CTD sight word instruction with incidental antecedent and consequent stimuli on sight word identification, letter-sound correspondence, and vocabulary comprehension, specific baseline and intervention procedures were employed. Dependent variable interrater agreement procedures were implemented to ensure consistent reporting of student behaviors (Kennedy, 2005). Procedural fidelity was monitored to ensure consistent implementation of intervention instructional and probe components.

Baseline. As a measure of control in this single subject experiment, participants completed three to five consecutive baseline probe sessions prior to exposure to the sight word intervention. Consecutive baseline probes were incremented by one prior to successive subjects' systematic exposure to the sight word intervention (Horner & Baer, 1978). The first and second participant engaged in three baseline probes and the third and fourth participant participated in four baseline probe sessions. The fifth and sixth participant engaged in five baseline sessions. Baseline probes included expressive and receptive sight word identification probes, expressive and receptive letter-sound correspondence probes and sight word comprehension probes. Paul participated in intervention sessions in the morning, between 8:30 a.m. and 9:30 a.m., after completing classroom morning routines. Jon, Francis, Elijah, Jackson, and Maybeth participated in the intervention after lunch, between 12:00 p.m. and 1:30 p.m. The order in which students participated in the sight word intervention was determined by student availability to ensure that intervention sessions did not interfere with regular student programming.

Intervention. Instructional sessions for word set 1 sight words were implemented with each participant following the last baseline probe. Instructional sessions for word set 2 were implemented after each participant completed word set 1 criterion and generalization probes. Instructional sessions were conducted daily, five days a week, between the hours of 8:30 a.m. and 2:00 p.m. The daily order of participant instruction was determined by student availability. The computer-assisted sight word instructional format employed a CTD, massed trial procedure utilizing an initial 0-second time delay between the presentation of the stimulus paired with the controlling prompt and the naming of the sight word. The 0-second time delay was employed for five consecutive training sessions to familiarize the student with the CTD procedure and to promote learning of the target sight words. On the sixth instruction session, a 4-second time delay was inserted between the presentation of the stimulus word paired with the controlling prompt and the researcher's naming of the sight word. The 4-second time delay was then employed until the participant reached study criterion of 100% correct word set reading on two consecutive probes or 15 instructional sessions were completed for verbal students, or 100% correct word set identification on two consecutive probes or 15 instructional sessions were completed for non-verbal students. Instructional sessions consisted of eight trials, one trial for each targeted sight word. A 5- to 8-second inter-trial delay, using an inner count was provided between the completion of one trial and initiation of the next trial.

Instructional sessions began with the presentation of the PowerPoint title slide and an introduction to the session, "It's time to learn our words." The researcher then advanced the slideshow to the first animated clipart slide and provided the attention cue, "Look." Upon gaining the student's attention, defined as visual attending to the blank PowerPoint slide, the researcher presented the antecedent stimulus letter-sound correspondence slide. Using an inner count, a 2-second pause was provided prior to the researcher's production of the letter sound. Then the researcher advanced the slideshow to the sight word slide. After displaying the sight word slide, the researcher provided the controlling prompt, "What word?" The researcher waited the required delay interval and then named the sight word. Next, the researcher advanced to the slide with the sight word and picture representation and provided the consequent feedback, "Good looking. This is a picture of (sight word)." The researcher then advanced the slide show to the word set blank slide and provided a 5- to 8-second inter-trial delay prior to providing the attentional cue for the next sight word trial. Instruction continued until the eight slide show instructional trials were completed.

During intervention, daily word set probes were conducted prior to each instructional session to monitor student attainment of study criterion. Daily word set probes consisted of eight expressive and eight receptive sight word identification trials, one trial per each set 1 and 2 sight word. Daily expressive and receptive word set identification probes were conducted in the same manner as expressive and receptive sight word identification probes.

All six students completed item selection and baseline probes. Maybeth, Jon, Jackson, and Paul reached criterion on Word Set 1. Francis participated in 11 word set 1 instructional sessions but did not reach criterion due to frequent absences and the ending of the school year. Elijah was dropped from the study after 6-sessions as the extended time needed to obtain visual attention to assessment items and to provide an adequate response interval (20- to 30-minutes per assessment probe) impinged on his instructional programming. Only Maybeth and Jon participated in word set 2 instructional sessions. Maybeth reached criterion on word set 2 sight words. Jon participated in seven word set 2 instructional sessions, but did not reach criterion before the school year ended. Francis, Jackson, and Paul did not participate in word set 2 instruction due to the ending of the school year.

Dependent Variable Interrater Agreement

Prior to conducting item selection assessments, a doctoral student was trained on dependent variable measure scoring. Training included a review of the dependent measure operational definitions, with guided practice of dependent measure scoring of videotaped role-played probe sessions, and independent scoring of videotaped role-played probe sessions. Training continued until the graduate student and researcher obtain 100% interrater agreement. Dependent measure interrater agreement data collection forms are provided in Appendix A.

Dependent measure scoring reliability was assessed on 33% of item selection, baseline and test probe sessions across students by the trained doctoral student and researcher. All intervention baseline and probe sessions were videotaped. Dependent measure scoring was conducted both during baseline and probe sessions and through viewing videotapes of baseline and probe sessions. Doctoral student and researcher interrater reliability was calculated using the point by point method in which the total number of observer agreements are divided by the total number of agreements plus disagreements and multiplying by 100 (Kennedy, 2005). When the rater's scores differed, both the researcher and doctoral student reviewed the video to identify the source of the disagreement. If items were mis-scored, scoring was corrected. As the audio quality of the intervention videos did not capture faint vocalizations, particularly when background noise was present, the researcher and trained rater reviewed videos of student performance together, when verbalization/vocalization differences were noted. Reviewing the videos together, using the same computer ensured consistent, accurate scoring. Interrater agreement scores of 95% and above were deemed acceptable for determining dependent variable reliability (Kennedy, 2005). Interrater agreement for item selection, word set 1, word set 2, and criterion probes was 100%.

Procedural Fidelity

The researcher implemented the computer-assisted CTD sight word intervention using intervention and probe procedure protocols created by the researcher. Prior to conducting item selection procedures, a doctoral student was trained to assess procedural fidelity. Training included a review of the intervention protocol and protocol operational definitions and guided and unguided scoring of videotaped role-played baseline, training, and probe sessions. Training continued until the graduate student and researcher obtained 100% interrater agreement.

All intervention baseline, intervention, and probe sessions were videotaped. Procedural observations were conducted through both direct observation and through viewing videotapes of intervention and probe procedures. The doctoral student and researcher observed 33% of baseline, training and probe sessions across participants. Procedural implementation was evaluated using a checklist of baseline, intervention and assessment probe procedural behaviors. Baseline, intervention, and probe procedural fidelity checklists are provided in Appendix B. Procedural fidelity was calculated by dividing the number of observed procedural behaviors by the number of identified procedural behaviors and multiplying by 100% (Griffen et al., 1998). Procedural fidelity agreement scores of 95% and above will be deemed acceptable for determining procedural fidelity.

Procedural fidelity for item selection and baseline probes was 99.6%, for word set 1 assessment probes was 98.5%, and for word set 2 assessment probes was 99.3%. Word set 1 instructional session procedural fidelity was 99.5% and word set 2 instructional session procedural fidelity was 100%. Criterion probes were conducted with 99.6% procedural fidelity. Deviations from procedural behaviors were most frequently related to shortened delay interval times. During the course of the study, 41 of the 4-second delays provided to allow time for student response were only between 3.0- and 3.5-seconds and 19 of the 5-second intertrial delays were only 4.0- to 4.5- seconds. Over half of these shorted delay intervals occurred during sessions conducted with Paul to accommodate his short attention span and aggressive behavior. In all, only one procedural step, providing feedback in the form of "Good looking," was omitted, although one word set 1 assessment probe session randomly selected for fidelity assessment could not be viewed by the trained rater due to a video recorder malfunction.

Social Validity

Social validity measures included teacher and parent subjective evaluations of the procedures, goals, and outcomes of the sight word instructional intervention. To identify special education teachers' perceptions of the importance and utility of the computer-assisted, CTD sight word instruction, five teachers of students with intellectual disabilities were shown the computer-assisted CTD sight word intervention with incidental phonics and comprehension stimuli PowerPoint. The teachers completed a survey consisting of five statements, each formatted with a 4-point Likert-type scale, ranging from "1" (strongly disagree) to "4" (strongly agree). Teachers were asked to rate their agreement with statements regarding the degree to which teaching students with moderate ID sight word identification, comprehension, and phonics skills is an instructional priority, how easy the computer-assisted CTD sight word intervention would be to implement, and the beneficial effects the intervention may have on reading skill development. Additionally, teachers were asked to answer two open-ended questions, "Would you use this intervention with your students? Why or why not? What skills does a child with moderate ID need to be successful in his/her home, school, and community?" The teacher evaluation survey is located in Appendix C.

To identify parents' perceptions of the importance and utility of the intervention, participating students' parents were shown the computer-assisted sight word intervention media and a video clip of their child participating in an instructional session. Parents were then asked to complete a survey consisting of five statements, each formatted with a 4-point Likert-type scale, ranging from "1" (strongly disagree) to "4" (strongly agree). Parents were asked to rate their agreement with statements regarding the degree to which the targeted skills are relevant to their child's learning needs, the degree to which skills targeted in the reading intervention will promote independent functioning, the appropriateness of the instructional format, and the degree to which the intervention provides exposure to the skills needed to interact with print material. Additionally, parents were asked to answer two open-ended questions, "Would you use the computer-assisted sight word intervention with incidental phonics and comprehension stimuli with your child at home if the program were available? Why or why not? What skills does your child need to be successful in his/her home, school, and community?" The parent survey is provided in Appendix D.

Data Analysis

Formative data analysis included visual analysis of graphed, with-in phase baseline expressive and/or receptive sight word identification, incidental letter-sound correspondence, and vocabulary and phrase comprehension data, and intervention phase expressive and receptive sight word identification data. With-in phase analysis included identification of data level, stability, variability, and trend. Pre-instructional levels and baseline stability were evaluated through baseline probes conducted prior to intervention implementation. Data obtained during intervention phase probes were calculated, graphed, and visually analyzed to monitor the level, trend, and stability of participants' expressive and/or receptive identification of targeted sight words and to identify when students reached criterion. Formative procedural fidelity assessment were conducted on 33% of baseline, instruction, and probe sessions across participants to ensure assessment and instructional sessions were conducted according to intervention protocol. Dependent measure interrater reliability was assessed on 33% of baseline and dependent measure probes to ensure accurate data collection throughout the study.

Summative data analysis was conducted after participants reached expressive and/or receptive identification criterion. Summative analysis included visual analysis of between phase, baseline and intervention data to identify if a functional relation existed between computer-assisted, CTD sight word instruction and sight word and incidental phonics and comprehension skill acquisition. Between phases, visual analysis included evaluation of the immediacy of effect, change in level, change in trend, and data overlap. Next, the number of letter-sound correspondences and vocabulary comprehension items correctly identified during baseline and after intervention was compared to evaluate the effects of antecedent and consequent incidental stimuli presentation on letter-sound correspondence and vocabulary comprehension skill development. The mean number of nonverbal student vocalizations produced during baseline and intervention was compared to evaluate the effects of the intervention on the expressive communication attempts of nonverbal students. Additionally, the number of initial letter-sound correspondences generalized to novel sight words and novel sight word pictorial representations was calculated to evaluate the effects of the sight word intervention with incidental stimuli on phonics and phonemic awareness skill generalization. Finally, computer-assisted, CTD effect size was calculated using the improvement rate difference (IRD) to quantify the functional relation between the computer-assisted, CTD sight word instruction and the acquisition of sight words (Parker, Vannest, & Brown, 2009).

Descriptive, frequency analysis of parent and teacher social validity questionnaire responses was performed to evaluate parent and professional perceptions of the non-target stimuli intervention. Qualitative analysis of open-ended survey questions included coding to identify the central themes and patterns associated with teacher and parent responses. Teacher and parent questionnaire responses and the themes revealed through responses to open ended questions was compared to identify similarities and differences.

Limitations

Several limitations associated with the use of single subject designs may have affected study results. Limitations pertaining to study external validity include the limited population size, non-random participant selection, and the potential for participant attrition due to the fragile health associated with the population involved in the study. Next, the brevity of the intervention may have confounded results, while selection of different target sight words and letter-sound correspondences might have altered student acquisition of target and incidental stimuli. Finally, the study did not include an evaluation of skill maintenance.

CHAPTER IV

RESULTS

This study sought to identify the effects of computer-assisted instruction employing CTD procedures with incidental phonics and comprehension stimuli on the reading skill development of elementary students with moderate ID. Additionally, the social validity and utility of the instructional media was examined. Study results will be discussed as they pertain to the research questions in the following order: (a) How effective is computer-assisted sight word instruction employing CTD with incidental phonics and vocabulary comprehension stimuli in teaching verbal and nonverbal students with significant ID to identify target sight words?; (b) How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching the acquisition of letter-sound correspondence with verbal and nonverbal students with significant ID?; (c) How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching vocabulary comprehension with verbal and nonverbal students with significant ID?; (d) Do verbal and nonverbal students with significant ID generalize the phonemic awareness and phonics skills learned through computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli to novel high frequency sight words with similar initial phonemes?; and (e) What value do teachers and parents of students with significant ID place on computer-assisted sight word instruction employing CTD procedures with incidental stimuli on the development of reading skills with students with significant ID? To determine the effects of the computer-assisted sight word instruction on sight word identification, study results were graphed and effect sizes were calculated using the IRD procedure. IRD effects of .70 and above were considered large to very large, .50 to .70 were considered moderate, and .50 and below were considered small- to very small (Parker et al., 2009).

Question 1: Effectiveness in Teaching Target Sight Words

Expressive word naming and receptive word identification baseline, intervention, and criterion probes were conducted to determine if the computer-assisted sight word intervention with incidental phonics and comprehension stimuli was effective in teaching sight word identification. Additionally, the percentage of vocalizations produced by nonverbal students during baseline, intervention, and criterion probes was compared to evaluate the effects of the intervention on expressive communication attempts. The analysis of word identification results begins with expressive word identification.

Expressive Word Identification. To determine the effects of the sight word intervention on expressive word naming, the number of sight words named during baseline, intervention, and criterion probes were compared for two verbal students, Jon and Francis. Although no students named sight words during assessment probe sessions Jon and Francis named word set sight words during 4-second time delay instructional sessions. Figure 1 shows that Jon increasingly named more word set 1 sight words during 4-second delay sessions as the study progressed. On the final instructional session he named all eight sight words prior to the researcher's model. Likewise, Jon named seven of the eight words on each of the two, 4-second delay sessions he participated in prior to the end of the school year. Meanwhile, Figure 1 shows that Francis named two word set 1 sight words, 'man' and 'run', on one 4-second delay instructional trial prior to the researcher's naming of the words during the 11 instructional sessions he participated in prior to the end of the school year. Further examination of intervention expressive word naming data indicated that on 0-second delay intervals, Jon repeated a maximum of four set 1 and set 2 sight words per session following the researcher's naming of the word. Francis however frequently repeated all eight word set 1 sight words following the researcher's model during 0- and 4-second time delay instructional sessions. These results suggest that the computer-assisted sight word instruction did not promote verbal student's expressive word naming when the words were presented on index cards. Still, data analysis suggests that participation in the computer-assisted sight word intervention sessions fostered Jon's expressive naming of target sight words during instructional sessions.

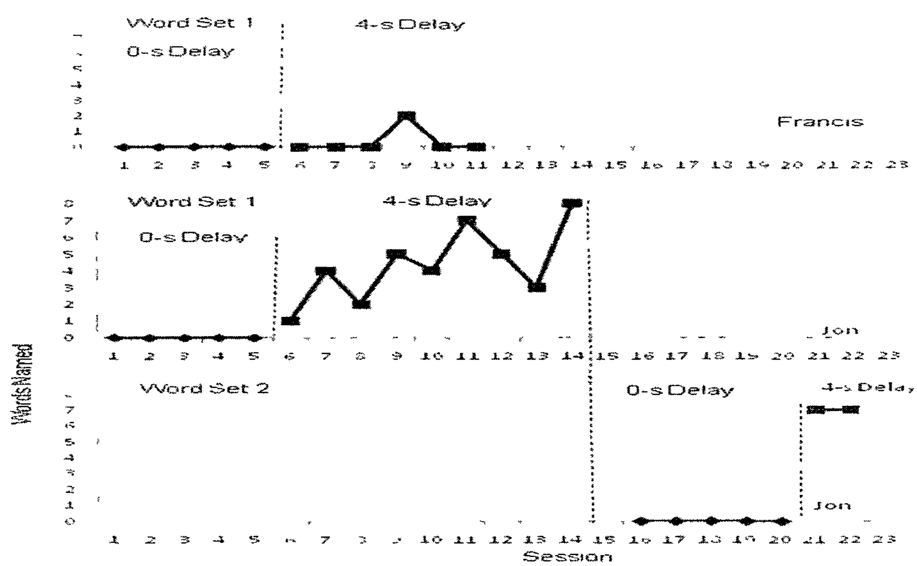


Figure 1. Expressive naming of word set sight words during 4-second delay instructional sessions.

Student Vocalizations. The frequency of student verbalizations and vocalizations produced during baseline, intervention, and criterion expressive word probes were compared to evaluate the effects of the sight word intervention on the expressive communication attempts of two verbal (Jon and Francis) and three nonverbal students (Jackson, Paul, Maybeth). Verbalization/vocalization frequency data provided in Table 3 suggest that participation in the computer-assisted sight word instruction had differential effects on the students' communicative attempts. Both Jon and Jackson repeated the controlling prompt "What word?" verbally or through vocal intonations on approximately 78% of baseline expressive word probe trials. As Jon's parroting of the controlling prompt decreased during intervention instruction, he began naming the initial letter of the target sight word. Alternately, Jackson's production of unintelligible verbalizations and clearly verbalized simple words/sounds such as "mama", "baba", "buh" and "nah" decreased during intervention and were not demonstrated during criterion probes. Francis' unintelligible multiple sound phrases/sentence verbalizations decreased significantly from baseline to criterion. During assessment probes, Maybeth's multiple syllable vocalizations sounded the same for each target word. These vocalizations were produced more frequently in the course of intervention assessment probes than baseline and item selection probes. Although Maybeth produced sign approximations for five words during item selection trials, she did not sign during intervention or criterion probes. Meanwhile, Paul's unintelligible vocalizations decreased 13% from baseline to intervention, and then another 13% from intervention to criterion probe. However, Paul's production of intelligible sounds such as "aw" and "ook" increased from baseline to intervention to criterion. These results suggest that participation in the sight word intervention did not foster increased verbal/vocal communicative attempts nor did it foster the expressive naming of target sight words by verbal or nonverbal students.

Table 3

Frequency of Vocalizations Produced During Expressive Word Probes

		Phase			
Student	Verbalization	Baseline	Word Set 1	Word Set 2[a]	Criterion
Jon	"What word?"	79%	63%	52.5%	87.5%
	Letter name	0%	27%	27.5%	0%
	Unintelligible verbalization	0%	5%	7.5%	0%
Jackson	"What word?"	78%	65%	-	75%
	Unintelligible verbalization	18%	11%	-	0%
	Simple words/discrete sounds	4%	.7%	-	0%
Francis	Unintelligible phrases	94%	63%	-	0%
Paul	Vocalizations	63%	50%	-	37.5%
	Intelligible sounds ("aw", "ook")	0%	8%	-	25%
Maybeth	Multi-syllable vocalizations	81%	98%	97.5%	87.5%

Note. [a] Jackson, Francis, and Paul did not participate in Word Set 2 Instruction.

Receptive Sight Word Identification. To identify the effects of the sight word intervention on receptive word identification, word set 1 and 2 receptive sight word identification baseline, intervention, and criterion probe data were graphed and visual analysis of within and between phase data was conducted. Word set 1 and 2 data sets with trend lines for Paul, Francis, and Jackson are provided in Figure 2. Word set 1 and 2 data sets with trend lines for Jon and Maybeth are provided in Figure 3. With-in phase analysis included identification of data level, stability, trend and variability. Between phases, visual analysis included evaluation of the immediacy of effect, change in level, change in trend, and data overlap. Effect sizes were calculated using the improvement rate difference (IRD) to quantify the functional relation between the computer-assisted, CTD sight word instruction and the receptive identification of target sight words (Parker et al., 2009).

Paul and Jackson completed 15 word set 1 instructional sessions, but they were unable to identify all four target words in any assessment probe session. Francis completed 11 instructional sessions but did not reach word identification or instructional session criterion due to frequent absences and end of the school year activities. Jon completed 14 word set 1 instructional sessions. While Jon did not reach expressive naming criterion, he did reach receptive word identification criterion. Similarly, Maybeth reached receptive word identification criterion on word set 1 sight words. Jon and Maybeth were the only students who participated in word set 2 instruction. Maybeth reached criterion on word set 2 sight words, but Jon participated in only seven word set 2 instructional sessions prior to the end of the school year. Analysis of student receptive word identification data follows.

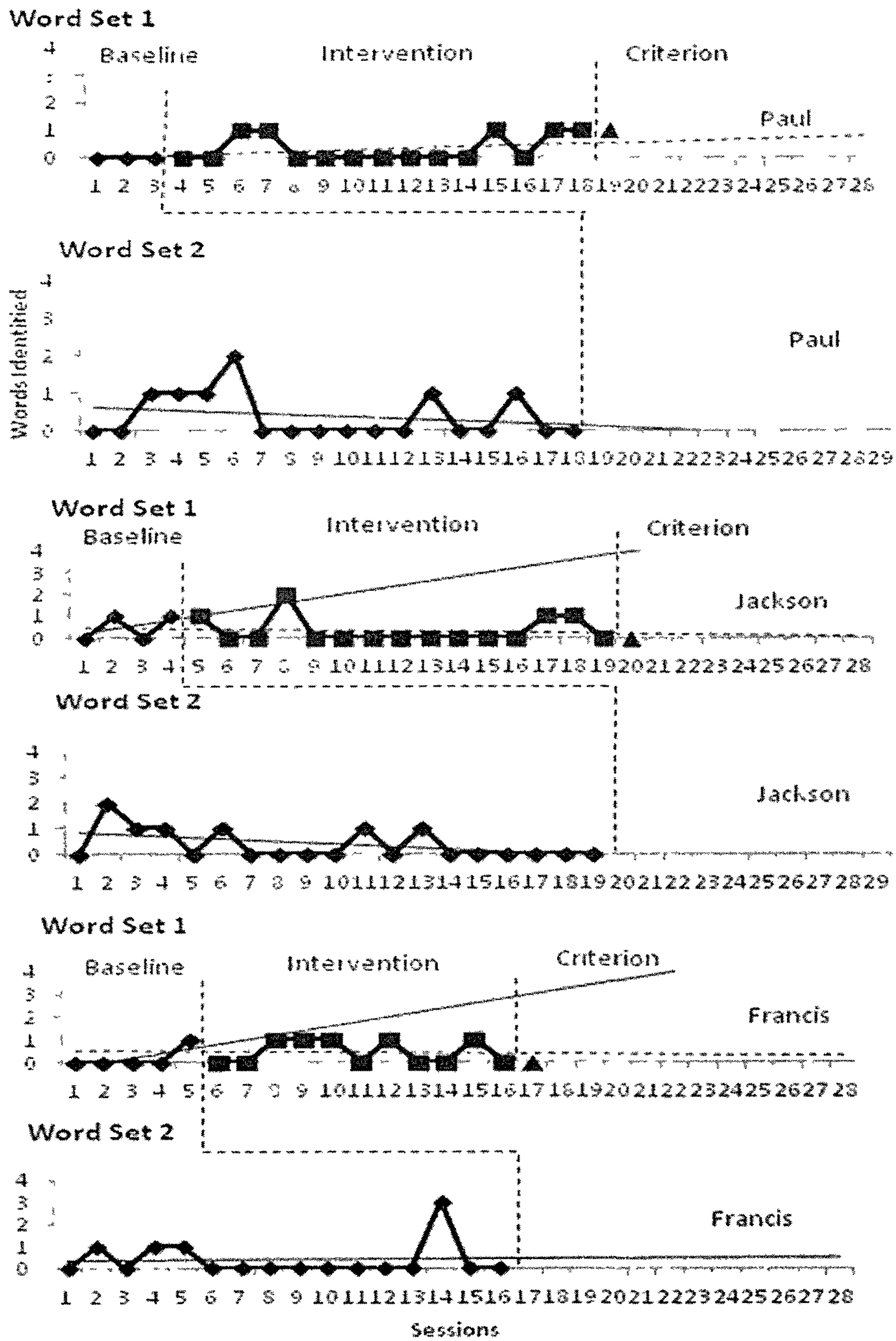


Figure 2. Word set 1 and 2 data sets for receptive sight word identification with linear trend lines for Paul, Jackson, and Francis. Baseline trend lines are represented by solid black lines, intervention trend lines are represented by dashed lines

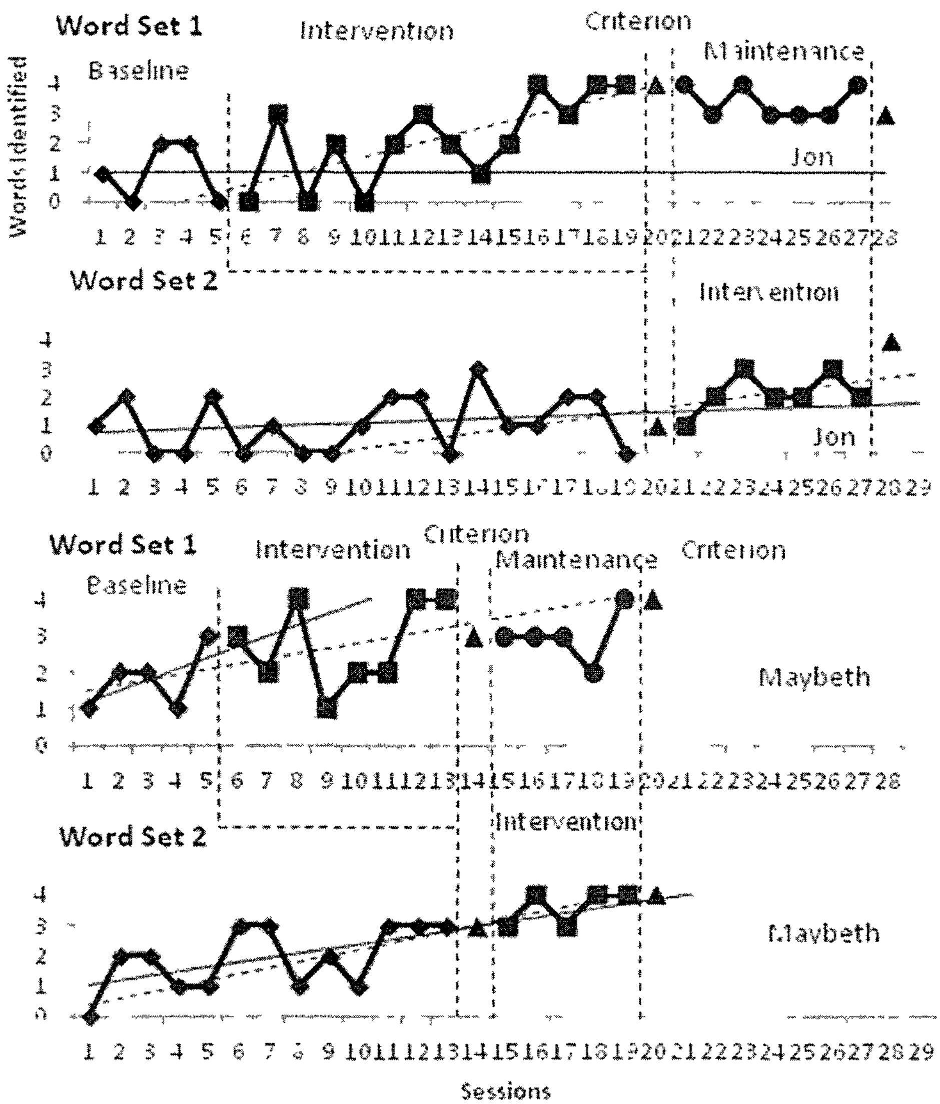


Figure 3. Word set 1 and 2 data sets for receptive sight word identification with trend lines for Jon and Maybeth Baseline trend lines are represented by solid black lines, intervention trend lines are represented by dashed lines

Visual analysis indicated that Paul's word set 1 baseline level was 0 and performance was stable. Paul's intervention data demonstrated low variability and a marginal rise in phase level. A very slow, low magnitude positive trend was evidenced as Paul identified the word 'sit' in two probe sessions and the words 'pin', 'run', and 'man' in one probe session. Between phase visual analysis noted a very slow immediacy of effect and a 67% overlap of intervention and baseline data. Word set 2 baseline data was unstable with a low magnitude, negative trend. Paul identified the words 'hit' and 'fox' in three assessment probe sessions and the word 'wash' in one probe session. Paul did not participate in word set 2 instructional sessions due to end of the school year. Visual analysis of word set 1 data provides weak evidence of a functional relation between the sight word intervention and Paul's receptive sight word acquisition. The contrast between the positive trend observed in the word set 1 intervention phase and the negative trend displayed during the word set 2 baseline phase provides some evidence of a functional relation between the sight word intervention and receptive sight word acquisition.

Jacksons' baseline level was 0.50 and data demonstrated low variability as he identified each of the words 'man' and 'sit' on one baseline probe. Baseline variability fostered a low magnitude positive trend. Jackson's intervention phase data demonstrated low variability, a marginal decrease in phase level, and a slow, very low magnitude negative trend. During the intervention phase Jackson identified the word 'run' in three probe sessions and the words 'man' and 'sit' in one probe session. There was a 93% overlap between intervention and baseline data. Jackson's word set 2 baseline data stabilized during the final 6 baseline probes, which fostered a low magnitude negative trend. He identified the word 'wash' on three baseline probes and the words 'hit' and 'cut' on two probes. The school year ended before Jackson could participate in word set 2 instruction. Visual analysis provides no evidence of a functional relation between the sight word intervention and sight word acquisition for Jackson. However, Jackson's identification of run during the word set 1intervention phase suggests that participation in word set 1 instructional sessions may have increased his awareness of this sight word.

Meanwhile, Francis' baseline level was 0.20 and data were stable until the final baseline probe session when he receptively identified the word 'run'. The intervention phase level rose slightly to 0.45. Intervention data demonstrated low variability and a slow, very low magnitude negative trend. Francis identified the word 'sit' in three probe sessions, and the words 'run' and 'man' during one probe session. As Francis selected the answer choice placed toward his right side on 94.8% of intervention assessment probes, his word identification performance is questionable. A 100% overlap between word set 1 baseline and intervention data was noted. Although Francis did not participate in word set 2 instruction, he did participate in word set 2 baseline probes. After initial variability, Francis' word set 2 baseline was stable for all but one assessment probe session during which he identified the sight words 'cut', 'wash', and 'fox'. Visual analysis provides no support for a functional relation between the sight word intervention and Francis' ability to identify sight words.

Visual analysis of Jon's word set 1 data noted a flat baseline trend with a baseline level of 1. The baseline data were unstable as only 20% of baseline data points were within 15% of the mean line. Jon's sight word identification during the baseline phase was inconsistent as he identified 'run', 'man' and 'sit' on one occasion each and 'pin' on two occasions. During the word set 1 intervention phase the mean phase level increased to 2. Use of the split-middle technique revealed a low magnitude, positive intervention trend. While Jon's maintenance phase level rose to 3.4, a low magnitude, negative trend was demonstrated. Due to variability, more data are needed to identify a clear maintenance trend. Between phase analysis revealed a moderate immediacy of effect from baseline to intervention. The baseline to intervention phase level change for Jon was low to moderate and a 57% overlap was noted between the intervention and baseline data. Visual analysis of word set 1 data provides promising evidence of a functional relation between the sight word intervention and receptive sight word acquisition for Jon.

While Jon participated in seven word set 2 instructional sessions he did not meet criterion prior to the end of the school year. Jon's word set 2 baseline was unstable and demonstrated a low magnitude, positive trend. His baseline performance suggests that Jon knew some of the set 2 sight words prior to the experiment, as he identified the word 'hit' on 19 of 19 daily probes, the word 'cut' on five probes, and the words 'fox' and 'wash' on four probes each. Within the intervention phase, Jon identified the word 'fox' on 5 of 7 probes, the word 'hit' on 4 of 7 probes, and the words 'cut' and 'wash' on 3 of 7 probes each. Jon's mean phase levels increased from 1.05 to 2.0 words correct. A low magnitude positive trend was demonstrated during the intervention phase. There was a 100% overlap in Jon's word set 2 intervention and baseline data. Although Jon only identified a maximum of three set 2 sight words during the intervention phase, he identified all four word set 2 words during the word set 2 criterion probe, administered at the end of the study. Word set 2 visual analysis provides very weak evidence of a functional relation between the sight word intervention and Jon's sight word identification.

Maybeth's word set 1 baseline phase level was 1.8, but low to moderate variability was apparent. As she identified the words 'pin', 'run' and 'man' on three baseline probes each and 'sit' on one probe, Maybeth's word set 1 baseline evidenced a moderate to high magnitude positive trend. Similarly, use of the split-middle technique revealed a moderate magnitude, positive intervention trend. Intervention phase data were unstable until the final two sessions during which Maybeth met sight word criterion. While word set 1 maintenance data demonstrated a decline in performance after word set 1 instruction concluded. Set 1 word identification returned to criterion level when Maybeth met criterion on set 2 sight words. Maybeth continued to identify all four set 1 sight words on the word set 2 criterion probe. Between phase analysis noted a low to moderate immediacy of effect. However the immediacy of effect may in fact represent a continuation of the low magnitude positive trend identified in the baseline phase. Maybeth's baseline to intervention phase level change was moderate. A 62.5% overlap was identified between Maybeth's intervention and baseline data. Word set 1 visual analysis provides weak evidence of a functional relation between the computer-assisted intervention and Maybeth's sight word identification.

Maybeth's word set 2 baseline was unstable and demonstrated a low magnitude, positive trend. The baseline mean phase level was 1.9. Like Jon, Maybeth's baseline performance indicated that she knew some of the word set sight words prior to the experiment. Maybeth identified the word 'fox' on 12 of 13 probes, 'cut' on six probes, 'wash' on four probes, and 'hit' on three baseline probes. During the intervention phase, Maybeth reached criterion on set 2 words in five sessions. Intervention phase data demonstrated a low magnitude positive trend. There was a 40% overlap between intervention and baseline data. Visual analysis of word set 2 phases provides weak to promising evidence of a functional relation between the sight word intervention and Maybeth's sight word identification gains.

Visual analysis of within and between phase data provided no evidence of a functional relation between the sight word intervention for Jackson and Francis, weak evidence of a functional relation between the intervention and word acquisition for Paul, and weak to promising evidence of a functional relation between the instructional method and word recognition gains for Jon and Maybeth. To quantify the effects of the sight word intervention on receptive sight word identification, word set 1 and 2 baseline and intervention IRDs were calculated. According to Parker and colleagues (2009), IRD scores of .70 and above signify large to very large treatment effects, scores between .50 and .70 suggest moderate effects, and scores of .50 and below imply that treatment effects are very small or questionable as improvement is at a chance level. Word set IRD data are provided in Table 4. Word set 1 IRD was at 33% for Paul, 31% for Jon, 28% for Maybeth, and 25% for Francis. These IRD results suggest the computer-assisted sight word instructional intervention had questionable to very small treatment effects (Parker et al., 2009). Jackson's IRD of -23% suggests the intervention had no effect on his receptive sight word identification as intervention performance was below baseline performance. Of significance, Maybeth's IRD for word set 2 was 60%, suggesting the intervention had a moderate effect on her receptive word identification. Meanwhile, Jon's word set 2 IRD of 24%, suggests small to questionable intervention effects.

Table 4

Word Set 1 Improvement Rate Difference Data

Student	Word Set 1		Word Set 2	
Improvement	Baseline	Intervention	Baseline	Intervention
Maybeth				
Improved	3	7	0	3
Not Improved	2	1	13	2
Total	5	8	13	5
Improvement Rate	60%	88%	0%	60%
Jon				
Improved	2	10	1	2
Not Improved	3	4	18	5
Total	5	14	19	7
Improvement Rate	40%	71%	5%	29%
Francis				
Improved	1	5		
Not Improved	4	6		
Total	5	11		
Improvement Rate	20%	45%		
Jackson				
Improved	2	4		
Not Improved	2	11		
Total	4	15		
Improvement Rate	50%	27%		
Paul				
Improved	0	5		
Not Improved	3	10		
Total	3	15		
Improvement Rate	0%	33%		

Question 2: Effectiveness in Teaching Letter-Sound Correspondence.

To determine if computer-assisted sight word instruction with incidental letter-sound stimuli promoted the acquisition of letter-sound correspondence skills, the number of letter-sound correspondences expressively produced and receptively identified during baseline and criterion probes was compared. Further, the mean number of vocalizations produced by nonverbal students during baseline and criterion probe sessions was compared to identify if participation in the intervention affected vocalization attempts. Results of the expressive letter-sound correspondence analysis are presented first, followed by analysis of vocalization data. This section concludes with an analysis of receptive letter-sound correspondence data.

Expressive letter-sound correspondence. The results of the letter-sound correspondence task are shown in Figure 4. During baseline expressive letter-sound correspondence probes, Jon produced the /s/ and /r/ sounds on one probe each. He failed to produce any letter-sounds on the word set 1 criterion probe, or on the word set 2 probe administered at the end of the intervention. None of the other students expressively named any of the letter-sounds during baseline, daily assessment, or criterion probes. Yet, Figure 3 shows that Jon and Francis repeated letter-sounds after the letter-sound was provided by the researcher during instructional sessions. Jon repeated a mean of 4 word set 1 letter-sounds per session (Range = 0-5 sounds) and a mean of 2 word set 2 letter-sounds per session (Range = 0-6 letter-sounds). Likewise, Francis repeated a mean of 6 word set 1 letter-sounds per session (Range = 3-8 letter-sounds). No opportunity to produce the letter-sound prior to the model was provided during instructional sessions. These results indicate that inserting incidental letter-sound stimuli within the sight word instructional trial elicited letter-sound repetition, but did not promote expressive letter-sound correspondence skills.

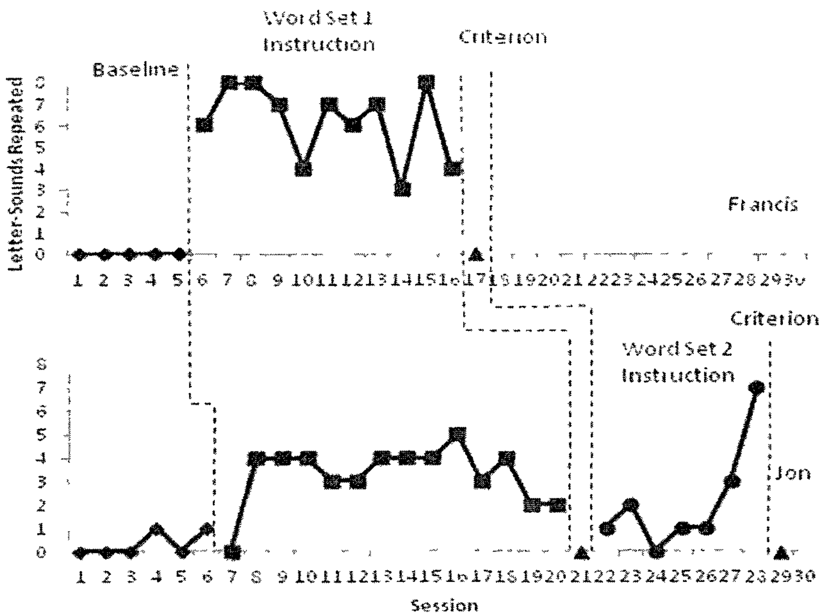


Figure 4. Comparison of the number of letter-sounds named during baseline and criterion pobes (max = 8 different sounds) and the number of letter-sounds repeated by Francis and Jon during word set instructional sessions (max = 8 sounds; 2 trials per sound).

Table 5

Frequency of Expressive Letter-sound Correspondence Vocalizations

		Phase	
Student	Verbalization	Baseline	Criterion
Jon	"What word/sound?"	58%	0%
	Named letter	27%	81%
	Unintelligible verbalization	11.5%	12.5%
Jackson	"What sound?"	35%	100%
	Unintelligible verbalization	7.5%	0%
	Simple words/discrete sounds	4%	0%
Francis	Unintelligible phrases	63%	0%
Paul	Vocalizations	70%	75%
Maybeth	Multiple syllable vocalizations	80%	100%

Student vocalizations. Comparison of the frequency of student verbalizations and vocalizations produced during baseline and criterion expressive letter-sound probes suggests that participation in the computer-assisted sight word instruction had differential effects on the students' communicative attempts. Similar to vocalizations during expressive word naming probes, Jon and Jackson repeated the prompt, "What sound?" on 58% and 35% of baseline probes respectively. As illustrated in Table 5, Jon's parroting of the controlling prompt decreased during criterion probes while his naming of the letter increased from baseline to criterion probes. Conversely, Jackson's parroting of the controlling prompt increased to 100% and his vocalizations decreased to 0% during the criterion probe. Likewise, the frequency of Francis' vocalizations decreased to 0% during the word set 1criterion probe. Maybeth and Paul demonstrated small increases in vocalizations during criterion probes. These results suggest that including incidental letter-sound correspondence stimuli to the antecedent condition of the sight word instructional trial did not foster increased verbal/vocal communicative attempts nor did it foster the expressive naming of letter-sound correspondences by verbal or nonverbal students.

Receptive letter-sound correspondence. Receptive letter-sound correspondence probes reported in Table 6 suggest that Jon, Maybeth, and Francis had some knowledge of target letter-sound correspondences at baseline. For example, Jon receptively identified seven letter-sound correspondences with 80% to 100% accuracy at baseline. His accuracy in identifying the eighth letter-sound correspondence, /p/, improved from 40% accuracy during baseline to 100% during criterion probes. Maybeth's baseline and criterion probe performance was relatively consistent. In contrast, Francis' performance was more variable. Francis identified three letter-sound correspondences (/m/, /s/, and /w/) with 60% to 80% during baseline. He continued to identify /m/ and /w/ on criterion probe 1, administered as a post test as he did not reach word set 1 criterion prior to the end of the school year. Further analysis indicates that Francis' performance must be viewed with caution as Francis selected the item choice located on the right side for 87% of criterion 1 assessment trials. Thus, the data suggest that the incidental letter-sound correspondence stimuli had little impact on enhancing pre-existing letter-sound correspondence knowledge for Maybeth and Francis, although it may have aided in bolstering Jon's knowledge of the letter-sound correspondence for /p/.

On the other hand, Jackson, who demonstrating minimal to no letter-sound correspondence skills during baseline appeared to have benefitted more from the incidental letter-sound correspondence stimuli. Jackson correctly identified the letter-sound correspondence for /w/ and /k/ on one baseline probe each and the letter-sound correspondences for /m/, /p/, and /w/ on criterion probe 1. As /m/ and /p/ are word set 1 letter-sound correspondences not previously identified during baseline probes, results suggest that the incidental letter-sound correspondence stimuli may have increased Jackson's awareness of target letter-sound correspondences for Jackson. Alternately, Paul did not identify any letter-sound correspondence stimuli during baseline probes identified the word set 2 letter-sound correspondence for /h/ on the criterion 1 probe.

Table 6

Frequency of Receptive Letter-Sound Correspondences Identified During Probes

	Maybeth		Francis[a]		Jon		Jackson[a]		Paul[a]	
Letter	Pretest	Criterion	Pretest	Criterion	Pretest	Criterion	Pretest	Criterion	Pretest	Criterion
r	20%	50%	20%	0%	80%	100%	0%	0%	0%	0%
m	100%	100%	80%	100%	80%	50%	0%	100%	0%	0%
p	20%	50%	20%	0%	40%	100%	0%	100%	0%	0%
s	40%	100%	60%	0%	80%	50%	0%	0%	0%	0%
w	60%	50%	60%	100%	100%	100%	25%	100%	0%	0%
c	20%	50%	20%	0%	80%	50%	25%	0%	0%	0%
f	40%	100%	0%	100%	100%	100%	0%	0%	0%	0%
h	60%	50%	20%	0%	80%	50%	0%	0%	0%	100%

Note. [a]Criterion probe percentages for Francis, Jackson, and Paul are based on one criterion probe.

Question 3: Effectiveness in Teaching Vocabulary Comprehension

The number of vocabulary comprehension items identified during baseline and criterion probes was compared to evaluate the effects of embedding comprehension stimuli in the consequent feedback of instructional trials on vocabulary comprehension. Table 7 shows the number of pictures identified by students during baseline and criterion probes. Jon and Maybeth demonstrated comprehension of some target sight words prior to the start of the intervention. Maybeth identified the pictures for 'pin' and 'fox' with 100% accuracy; 'sit' with 75% accuracy; 'hit' with 50% accuracy; and 'man', 'run', and 'wash' with 25% accuracy. During the criterion 1 probe, Maybeth continued to identify the pictures for 'pin' and 'fox'. On the second criterion probe Maybeth identified the picture for seven of the eight targeted sight words. She did not identify the correct picture for 'man'. Likewise, Jon correctly identified the picture for 'man' and 'cut' in 60% of baseline trials; 'hit' and 'sit' in 40% of baseline trials; and 'run', 'pin', and 'fox' in 20% of trials. He did not identify the picture for 'wash' on any baseline trials. In the first criterion probe, Jon identified the correct picture for all sight words but 'pin' and 'fox'. He identified the picture for all words except 'pin' during the second criterion probe.

Paul, Jackson, and Francis demonstrated more limited comprehension of target sight words at baseline. Paul identified the corresponding pictures for the sight words 'hit' and 'wash' in one baseline probe. He identified the picture for the word set 1 sight words 'run', 'man', and 'sit' during the word set 1 criterion probe. Jackson failed to match any pictures that corresponded with target sight words during baseline, but identified the correct pictures for the words 'run' and 'cut' after training. As 'cut' was not a word set 1 sight word, Jackson's performance is questionable. Meanwhile, Francis' baseline sight word comprehension performance was inconsistent. He identified the pictures that corresponded with the words 'hit', 'pin', and 'wash' in two, non-consecutive probes, and the words 'sit', 'man', 'cut', and 'fox', in one probe each.

Criterion probe performance indicates that Francis did not demonstrate gains in sight word comprehension as a result of the intervention. More, Jackson's performance suggests chance improvement during criterion probes. Nevertheless, comparison of baseline and criterion comprehension probe results suggest that embedding consequent, incidental sight word comprehension stimuli in the instructional trial may have improved sight word comprehension skills for Paul, Maybeth, and especially Jon.

Table 7

Number of Pictures Identified During Comprehension Probes (max=8)

	Pretest					Criterion	
Student	Probe 1	Probe 2	Probe 3	Probe 4	Probe 5	Probe 1	Probe 2
Paul	0	2	0			3	
Jackson	0	0	0	0		2	
Maybeth	5	6	3	2		2	7
Jon	3	4	0	2	4	6	7
Francis	4	0	1	2	3	1	

Question 4: Effectiveness in Promoting PA and Phonics Skill Generalization

The number of initial letter-sound correspondences generalized to novel sight words and novel sight word pictorial representations during pretest and criterion probes was compared to evaluate the effects of the sight word intervention with incidental letter-sound correspondence stimuli on phonics and phonemic awareness skill generalization. While Francis participated in pretest letter-sound correspondence and PA generalization probes, he did not complete end of intervention criterion probes due to absences and the conclusion of the school year so his generalization skills could not be evaluated. The comparative analysis of letter-sound correspondence generalization is presented first, followed by the analysis of PA generalization data. Student generalization data are provided in Table 8.

Jackson did not correctly identify any novel words that corresponded with word set 1 or 2 letter-sound correspondence generalization items during pretest or criterion probes. In the same way, Paul did not demonstrate any letter-sound correspondence generalization during pretest probes. While Paul identified the word that began with /k/ during the word set 1 criterion probe, he had not been provided instruction on this letter-sound correspondence. Next, Maybeth identified the novel word that began with /f/ on both pretest generalization probes and the novel word that began with /p/, /c/, and /w/ on one pretest probe each. During the criterion 1 probe, Maybeth identified the novel words that began with /s/, /k/, /f/, and /r/. During criterion probe 2 she identified the words that began with /m/, /h/, /w/, and /f/. Lastly, Jon identified novel words that began with the letter-sounds /p/, /k/, /r/, and /s/ on both pretest probes and /m/, /w/, /h/, and /f/ on one pretest probe each. He generalized all word set 1 and 2 letter-sounds except /h/ to novel words during criterion probe 1 and all word set 1 and 2 letter-sounds but /w/ during criterion probe 2. Results suggest that including incidental letter-sound correspondence stimuli in the instructional trial promoted Jon's letter-sound correspondence generalization, but had little impact on the letter-sound generalization of the other students.

Comparative analysis of PA pretest and criterion probe data yielded similar results to letter-sound correspondence generalization results. Jackson did not demonstrate any PA generalization during pretest probes. Yet he identified the novel pictures that corresponded with the sounds /f/ and /k/ during the word set 1 criterion PA generalization probe. Paul correctly identified that the picture of a fork began with the /f/ sound during one PA pretest probe and identified the picture that began with /w/ during the criterion 1 PA assessment probe. However, the letter-sound generalizations demonstrated by Jackson and Paul were not word set 1 target sounds.

Alternately, both Maybeth and Jon were able to generalize some letter-sounds to novel pictures during the pretest probes. Maybeth identified the picture that began with /f/ on both pretest probes and Jon identified the novel picture that began with /m/ and /r/ on both pretest probes. Maybeth and Jon continued to demonstrate PA generalization on these letter-sounds during criterion 1 and 2 probes. Demonstration of PA generalization of other target letter-sound correspondences during criterion probes 1 and 2 was variable. PA generalization results suggest that embedding incidental letter-sound correspondence stimuli in the computer-assisted sight word instructional trial did not foster PA generalization.

Table 8

Number Correct on Pretest and Criterion, Phonics and PA Probes.

	Pretest		Criterion	
Student	Probe 1	Probe 2	Probe 1	Probe 2
Letter-Sound Correspondence Generalization				
Paul	0	0	1	
Jackson	0	0	0	
Maybeth	3	2	4	4
Jon	7	5	7	7
Francis	4	1		
Phonemic Awareness Generalization				
Paul	1	0	1	
Jackson	0	0	2	
Maybeth	2	2	2	1
Francis	2	1		
Jon	3	2	4	3

In sum, computer-assisted sight word instruction employing CTD procedures with incidental stimuli fostered variable gains in sight word identification, vocabulary comprehension, letter-sound correspondence, letter-sound correspondence generalization and PA generalization skills. Table 9 shows that both verbal and nonverbal students demonstrated gains in the acquisition of target and incidental stimuli. Still, Jon appears to have benefited most from the computer-assisted sight word intervention as he demonstrated gains, although limited, in all areas except expressive letter-sound correspondence. Conversely, Jackson derived the least benefit from the sight word intervention. The sight word intervention frequently fostered gains in receptive sight word acquisition and word comprehension, but failed to promote gains in expressive letter-sound correspondence.

Table 9

Summary of Student Target and Incidental Stimuli Gains

Stimuli	Jon	Francis	Jackson	Maybeth	Paul
Sight Word Acquisition					
Expressive	X	X			
Receptive	X	X		X	X
Letter-Sound Correspondence					
Expressive					
Receptive	X		X		
Word Comprehension	X	X	X	X	X
Generalization					
Letter-Sound	X			X	
PA	X				
Verbalizations	X				X

Note. An X indicates that the student demonstrated gains in the identified area.

Question 5: Social Value and Validity

Descriptive frequency analysis of parent and teacher social validity questionnaire responses was performed to evaluate respondent's perceptions of the computer-assisted sight word intervention with incidental stimuli. Qualitative analysis of open-ended survey questions included coding to identify the central themes and patterns associated with teacher and parent responses. To identify similarity and differences between teacher and parent perceptions, questionnaire responses and the themes revealed through responses to open-ended questions were compared.

Five teachers with experience teaching students with moderate ID viewed the computer-assisted sight word instructional media and completed the Teacher Evaluation Survey. All five teachers strongly agreed that sight word identification and comprehension were instructional priorities for elementary students with moderate ID. Three teachers agreed and two strongly agreed that phonics and phonemic awareness were instructional priorities. Furthermore, all five teachers strongly agreed that the computer-assisted sight word intervention would promote the reading skill development of elementary students with moderate ID, with four strongly agreeing and one agreeing that the sight word instructional intervention would be easy to implement.

In response to an open ended question asking if they would use the computer-assisted sight word intervention with incidental phonics and comprehension stimuli with their students, all five teachers reported that they would use the computer-assisted sight word instructional media with their students. Teacher rationales for using the instructional media included that computers are motivating to students, that the instructional media would capture and sustain student attention, and that the repetition and visual presentation were instructional methods appropriate for the students' learning needs. Additionally, three teachers reported that the instructional media would be "easily adapted for a variety of students." Finally, one respondent indicated that the effects of the instructional intervention would be greater if parents and teachers both utilized the computer-assisted sight word instruction.

To obtain parent perspectives, the parents of the six students who participated in the study were invited to view the instructional media and complete a parent questionnaire. Four parents completed consent forms, identifying interest in participating in the study. At the study's completion, two of the student's parents met with the researcher and viewed a demonstration of the instructional media and a short video clip of their child participating in the sight word intervention. Both parents agreed that the sight word and comprehension skills targeted in the intervention were relevant to their child's learning needs. Moreover, both parents strongly agreed that the targeted phonics skills and the instructional format were appropriate for the child's learning needs, and that the instruction provided exposure to the skills needed to interact with print material. In accordance with their perceptions regarding the appropriateness of the intervention, the two parents indicated strong agreement that the skills targeted in the intervention would help their child function more independently in his/her home, school and/or community. The two parents noted that they would use the computer-assisted sight word intervention with their child at home if the program were available. One parent's rationale for using the instructional media was that the sight word instructional media provided "another way to help my child to learn words and letter sounds, enabling him to advance to his best level and possibility."

Finally, teachers and parents were asked to identify the skills a child with ID needs to be successful in his/her home, school, and community. Parent and teacher responses are provided in Table 10. Teacher's most frequently identified basic reading and communication skills as being necessary for home, school, and community success. In contrast, parents most frequently identified that children with ID needed exposure to the same skills as other children and exposure to other children and other environments to be successful. Additionally, parents identified that fine motor and communication skills were important for students with ID, as these skills provided children opportunities to participate during instructional activities. Basic reading skills were identified by both teachers and parents more frequently than any other academic skill area as being needed for student success.

Results of the teacher and parent questionnaires suggest that computer-assisted sight word instruction with incidental phonics and comprehension stimuli targets essential reading skills in a manner that accommodates the learning needs of elementary students with ID. More, teachers and parents agree that the sight word intervention would be easy to implement in both the home and school environment. As both parents and teachers identified basic reading skills as necessary for student success, the computer-assisted sight word intervention may provide one instructional method for promoting the reading skill development of students with moderate ID. In the words of one parent, "The program will help him to advance to his best level and possibility."

Table 10

Skills Needed to be Successful

Skills Needed	Response Frequency	
	Teachers	Parents
Learning Behaviors (i.e., attention to task, ability to follow directions, interest in material)	2	1
Exposure (i.e., to same skills as other children, to other children and other environments)		2
Instruction		1
Home/school collaboration (i.e., continuity of routine, parent/caregiver support, parent training opportunities)	2	2
Functional Skills		
Communication Skills	3	1
Social Skills	2	
Self Help Skills	2	
Fine Motor Skills		1
Job Skills	1	
Academic Skills		
Functional Math and Math Computation	2	
Basic Reading Skills (sight words, comprehension)	3	1
Letters		1
Basic Writing/keyboarding	1	

CHAPTER V

DISCUSSION

Introduction

This chapter provides an overview of the study and conclusions that can be inferred from the study results presented in Chapter IV. Study results are discussed in relation to the research question, the student's learning characteristics and previous research. Study limitations are described and areas for future research are identified. Finally, implications for promoting the reading development of students with moderate ID are presented.

Summary of Purpose

This study examined the effects of computer-assisted sight word instruction employing CTD procedures, with incidental phonics and vocabulary comprehension stimuli, on the reading skill development of verbal and nonverbal elementary school students with moderate ID. The study sought to answer the following research questions. a) How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching verbal and nonverbal students with significant ID to identify target sight words?; b) How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching the acquisition of letter-sound correspondence with verbal and nonverbal students with significant ID?; c) How effective is computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli in teaching vocabulary comprehension with verbal and nonverbal students with significant ID?; d) Do verbal and nonverbal students with significant ID generalize the phonemic awareness and phonics skills learned through computer-assisted sight word instruction employing CTD procedures with incidental phonics and vocabulary comprehension stimuli to novel high frequency sight words with similar initial phonemes?; e) What value do teachers and parents of students with significant ID place on computer-assisted sight word instruction employing CTD procedures with incidental stimuli on the development of reading skills with students with significant ID? A single subject, multiple baseline design was employed to accommodate the diverse learning characteristics demonstrated by students with moderate ID. Study assessment measures included receptive identification and expressive naming of target sight words and incidental letter-sound correspondence, sight word comprehension, and PA and letter-sound correspondence generalization. A discussion of the study results, limitations, implications, and areas for future research follows.

Sight Word Naming and Identification

Unlike previous research on sight word instruction with incidental stimuli (Doyle et al., 1992; Griffen et al., 1998; Ledford, et al., 2008; Mechling et al, 2007; Taylor et al., 2002; Wolery et al., 1991; Wolery et al., 2000), students participating in the computer-assisted sight word intervention demonstrated limited gains in target sight word acquisition. However, students participating in previous research were verbal, while those participating in the current study were nonverbal or demonstrated expressive language impairments. It is possible that the students' reduced expressive language abilities contributed to the gain differential in the current study.

Although none of the students demonstrated gains on expressive sight word assessment probes, Jon and Francis named some target sight words during 4-second delay instructional sessions. This suggests that the computer-assisted sight word intervention fostered gains in word naming or “reading” for some verbal students. However, the word naming skills were not generalized to assessment probes. Several factors may have contributed to Jon’s and Francis’ inability to generalize word naming, including inadequate exposure to the target sight words, incidental stimuli interference, and memorization of the order in which words were presented during instructional sessions.

Blevins (2001) reported that students with disabilities require 40 or more exposures to a novel word before they are able to read the word with automaticity. During the intervention, Jon was exposed to each word set 1 sight word 28 times and to each word set 2 sight word 14 times. Francis’ participation resulted in 22 exposures to each word set 1 sight word. It is possible that the sight word exposure provided was insufficient for fostering word reading automaticity and generalization. Exposing students to the sight word intervention for a longer period of time may have fostered word naming generalization. However, incidental stimuli interference could have inhibited word naming generalization.

Previous research indicates that including incidental information in the instructional sequence does not interfere with the acquisition of target stimuli (Doyle et al., 1996; Wolery et al., 1991; Wolery et al., 2000). Jon frequently repeated the researcher’s production of the incidental letter sound prior to naming target sight words during 4-second time delay instructional sessions. Furthermore, he frequently named the initial letter of target words during expressive word naming assessment probes. These behaviors suggest that exposure to the incidental letter-sound stimuli heightened Jon’s awareness of the importance of the initial letters of the target sight words. Ehri (2005) reported that learning to use the initial and final letter sounds of words to aid in word reading demonstrated progression from the pre-alphabetic to the partial alphabetic phase of word reading. It is possible that the sequential presentation of the incidental letter-sound stimuli followed by the target sight word during instructional sessions afforded guided practice on using the initial letter-sound of sight words to assist in naming the sight words. Learning to use letter-sound correspondences to assist in word recall may have interfered with Jon's naming of target sight words during assessment probes. Given that the current study did not include a control condition where computer-assisted sight word instruction was provided without incidental letter-sound correspondence stimuli, it is impossible to substantiate this possibility. Further research that compares the effects of computer-assisted sight word instruction with and without incidental letter-sound correspondence is needed to determine the impact incidental letter-sound correspondence stimuli may exert on expressive word naming.

It is also feasible that Jon and Francis memorized the order in which sight words were presented during instructional sessions as the same PowerPoint slide shows were used throughout the study. What's more, Jon may have tried to memorize the presentation of letter-sound correspondences along with the sight words. Memorization of the presentation order of letter-sound correspondence and sight word stimuli could explain both word naming during instructional sessions and the lack of word naming generalization. The randomized use of multiple word set PowerPoint instructional slide shows would have eliminated this potential confound.

Regardless of the underlying reason, Jon's and Francis' inability to generalize expressive word naming from instructional to assessment sessions is a significant concern. As reported by Browder and Xin (1998), students need to generalize the ability to read sight words to the print material they encounter daily, or the ability to "read" the words has no value. In the current study, word naming and word identification generalization was limited to assessment probe flashcards. Additional research is needed to identify if students generalize the words learned using the computer-assisted sight word intervention to the print material encountered in their home, school, and community environments.

The computer-assisted sight word instruction employing CTD procedures with incidental stimuli did not foster word naming gains with verbal and nonverbal students with moderate ID. Still, receptive sight word identification assessment data may present a more accurate assessment of the intervention's effectiveness since the potential confound associated with the students' expressive language impairments is removed. Study results show that the sight word intervention had variable effects on students' receptive identification of target sight words. While the sight word intervention had little impact on Jackson's and Francis' receptive sight word identification, Francis' performance was likely affected by frequent absences and his unwillingness to participate in instructional activities. Nevertheless, Paul, Maybeth, and Jon learned some word set 1 sight words, although only weak evidence of a functional relation between the sight word intervention and receptive sight word identification was noted. Maybeth's acquisition of word set 2 sight words provided more noteworthy evidence of a functional relation between the intervention and receptive word identification. Her word set 2 IRD suggests the intervention had a moderate effect on Maybeth's receptive word identification.

Although two-thirds of the students who participated in the computer-assisted sight word instruction with incidental stimuli demonstrated gains in sight word identification, in most cases the gains were more limited than in previous research on sight word instruction with incidental stimuli. The methodology employed in the current study may have contributed to the limited gains demonstrated by study participants. In contrast with previous research (Doyle et al., 1992; Griffen, et al., 1998; Ledford et al., 2008; Taylor et al., 2002; Wolery et al., 1991; Wolery, et al., 2000), students who participated in this study had no prior experience with instruction employing systematic response prompting procedures. The novel instructional methodology may have impeded sight word learning as the students needed to become familiar with instructional demands while concurrently learning target sight words. Maybeth's improved performance during word set 2 instruction may reflect increased familiarity with the instructional methodology.

Next, in previous research sight word instruction continued until participants were able to read all target sight words (Doyle et al., 1992; Griffen et al., 1998; Mechling et al., 2007; Wolery et al., 2000). Instruction in the current study was limited to 15 sessions unless students reached word naming or word identification criterion prior to that time. Significantly, this is the first study to use computer-assisted sight word instruction employing CTD procedures with two pieces of incidental reading stimuli with nonverbal students with moderate ID. It is possible that the students' expressive language impairments, the type of reading stimuli inserted in the instructional trial, or both, inhibited sight word acquisition. Finally, the sight words targeted in the study were arbitrarily selected from a pool of high frequency sight words. Students may have demonstrated greater gains in naming or identifying target sight words if the targeted sight words were more relevant to the students' interests or to classroom instruction.

Acquisition of Incidental Stimuli

The computer-assisted sight word instruction with incidental stimuli fostered some sight word identification with some students. Even so, sight word identification does not promote the ability to read novel words, nor does it guarantee comprehension of the sight words learned (Bradford et al., 2006; Browder & Xin, 1998). Incidental letter-sound correspondence and comprehension stimuli were inserted in the sight word instructional trial to encourage the development of essential reading skills that allowed for more meaningful interaction with print material. Consistent with the results of previous studies on sight word instruction with incidental stimuli (Campbell & Mechling, 2009; Griffen et al., 1998; Ledford et al., 2008; Werts et al., 1995; Wolery et al., 2000), students in the current study acquired some of the incidental stimuli.

Exposure to the incidental letter-sound correspondence stimuli fostered gains in receptive letter-sound identification. One student who demonstrated minimal or no letter-sound correspondence skills appeared to obtain greater benefit from exposure to the incidental stimuli than those with preexisting knowledge of letter-sound correspondences. To illustrate Jackson did not identify any word set 1 letter-sound correspondences at baseline, but identified two word set 1 letter-sound correspondences on the word set 1 criterion probe. In contrast, Jon receptively identified 6 target letter-sound correspondences with 80% to 100% accuracy at baseline, but identified only four letter-sound correspondences with 100% accuracy during criterion probes. Increased attention to the initial letter of target words and possible difficulty in distinguishing between letter names and letter sounds may have affected Jon's receptive identification of letter-sound stimuli.

Ehri and Wilce (1985) asserted that letter-sound knowledge is essential to word learning. Results of this study suggest that computer-assisted sight word instruction with incidental letter-sound correspondence stimuli may foster knowledge of letter-sound correspondences with some students with moderate ID who are nonverbal or have expressive language impairments. Exposure to the incidental letter- sound correspondence stimuli however, did not appear to foster letter-sound or PA correspondence generalization. Jon's ability to generalize the letter-sound correspondences he learned during the intervention is most likely related to preexisting knowledge, rather than exposure to the incidental letter-sound stimuli. According to Truxler and O'Keefe (2007), it is difficult for students with expressive language impairments to learn PA skills. Further, Ehri and McCormick (1998) suggest that direct instruction is needed to help students learn the complexity of letter-sound relationships (Ehri & McCormick, 1998). Thus, it is not surprising that students did not generalize the letter-sound correspondences learned to novel pictures in that no explicit or incidental PA instruction was provided during the computer-assisted sight word intervention.

Phonemic awareness and knowledge of letter-sound correspondences assist in naming and identifying words, but it is the ability to recognize and comprehend sight words that provides beginning readers access to text (Karemaker et al., 2009). Yet reviews of the sight word literature indicate that less than a third of the existing research on sight word instruction incorporated a measure to evaluate vocabulary comprehension (Browder & Lalli, 1991; Browder et al., 2006; Browder & Xin, 1998). Current study results suggest that embedding incidental comprehension stimuli in the feedback condition of the sight word instructional trial fostered sight word comprehension with some students with moderate ID. After instruction, Paul was able to identify the corresponding pictures for three sight words while Jon and Maybeth each demonstrated comprehension of one previously unknown sight word. The pictures used in the intervention may have contributed to comprehension gain variability. For example, the comprehension picture array for the sight word man included the picture of a man used in the instructional slideshow and a picture of a boy, two similar and closely related pictures. Maybeth's inability to identify the picture associated with the sight word man during comprehension probes may have been caused by difficulty in discriminating between the two, similar pictures. Additionally, the pictures used to promote comprehension may not have been meaningful to some of the students.

Consistent with previous research on sight word instruction employing CTD with incidental stimuli (Campbell & Mechling, 2009; Werts et al., 1995; Wolery et al., 2000), students acquired some of the incidental letter-sound correspondence and comprehension stimuli, although the type and amount of stimuli learned varied across students. Werts and colleagues (1995) explained that the type of incidental stimuli embedded in the instructional trial, stimuli difficulty, student interest, and student's background knowledge result in differential acquisition of the incidental stimuli. Nevertheless, students in this study demonstrated limited gains in both target and incidental stimuli acquisition. Henry (2001) suggested that verbally, visually, and spatially presented information should be limited to three "meaning-carrying" words. The number of stimuli and the complexity of the stimuli presented in the sight word instructional trial may have been too cognitively demanding for some of the students who participated in the study. Students may have demonstrated greater gains if only one piece of incidental stimuli had been embedded in the instructional trial.

Unexpected Findings

This is the first study to examine the use of sight word instruction employing CTD procedures with incidental stimuli with students with moderate ID and expressive language impairments. Participation in the computer-assisted sight word intervention did not foster increased verbal or vocal communicative attempts, naming of sight words, or the production of expressive letter-sound correspondences. However, beginning on the eighth instructional session, Paul began to vocalize "ook" in imitation of the attentional cue, "Look" during daily assessment probes. Unexpectedly, Paul's vocalization of "ook" was accompanied by increased attentiveness to assessment probe materials. He more willingly allowed the researcher to help him touch each answer choice to facilitate scanning of answer choices and he visually attended to each answer choice as it was touched. By the end of word set 1 instruction, Paul was scanning the three assessment probe answer choices with gestural prompting and sometimes independently. More, he began to purposefully select one answer choice. It appears that daily participation in the sight word intervention probes fostered attending and visual scanning skills. Paul's improved learning behaviors supported gains in receptive sight word identification, receptive letter-sound correspondence, and sight word comprehension.

Value

Young children with ID, like Paul, often enter school with less exposure to foundational pre-reading activities as parents lack the knowledge needed to identify and use existing assistive technologies and adapted literacy materials that enable active engagement in home literacy activities (Light & Smith, 1993; Marvin, 1994; Marvin & Mirenda, 1993; Pufpaff, 2008; Zascavage & Keefe, 2004). Pennington (2010) reported that computer-assisted instruction employing Microsoft© PowerPoint technology enables parents with limited technological and instructional knowledge a means to provide access to literacy instruction at home. Consistent with Pennington's assertion, parents who viewed the computer-assisted sight word media indicated that they would use the instructional media if it were available as it would be easy to implement at home.

Similarly, school based reading development is frequently constrained by the paucity of appropriate instructional materials (Browder et al., 2006; Joseph & Seery, 2004; Pufpaff, 2008; Zascavage & Keefe, 2004). Special education teachers who viewed the computer-assisted sight word instructional media felt the reading skills targeted by the intervention were relevant to the learning needs of elementary students with moderate ID. Teachers reported that they would use the sight word intervention in the classroom as the instructional media would capture and sustain student attention. These perceptions are consistent with research suggesting that computer-assisted instruction fosters greater time on task during reading instruction as compared with traditional book based instruction (Williams et al., 2002). Additionally, many teachers indicated that the instructional media could be easily adapted to accommodate the individual needs of students. As both parents and special education teachers reported that basic reading skills are important for success in the home, school, and community, computer-assisted sight word instruction with incidental stimuli may provide one method for exposing students with moderate ID to essential reading skills in home and school environments.

Implications for Practice

Reading is a functional skill that enhances participation and independence in home, vocational, leisure, and community environments (Browder, Gibbs, et al., 2008). According to Erickson, Hatch, and Clendon (2010), intensive, comprehensive reading instruction that targets all essential reading skill components and provides meaningful engagement with print is vital for fostering the reading skill development of students with significant ID. Although students who participated in the current study demonstrated limited target and incidental stimuli gains, study results of the current study have several implications for promoting the reading development of students with moderate ID.

As students with moderate ID may take more time to learn reading skills (Katims, 2001), providing exposure to incidental stimuli during sight word instruction may increase instructional efficiency (Campbell & Mechling, 2009; Doyle, Schuster, & Meyer, 1996; Ledford et al., 2008; Wall & Gast, 1999). The computer-assisted sight word instruction with incidental stimuli provides exposure to phonics, sight word, and sight word comprehension stimuli in a format that accommodates the learning needs of students with moderate ID and is easy to implement. Used in conjunction with existing classroom instruction, the computer-assisted sight word intervention may help students learn content sight word vocabulary, foster word reading automaticity, reinforce sight word comprehension, and expose students to foundational phonics skills that can be expanded upon with direct instruction. Additionally, since little technical or instructional knowledge is needed to implement the computer-assisted sight word instruction, the instructional media may provide a way for parents to expose their young child with moderate ID to foundational reading skills.

While there is some evidence that verbal students with significant ID can learn aspects of essential reading skills, research identifying instruction methods that promote the reading development of nonverbal students with significant ID is sparse and relatively novel (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Mims, et al., 2008; Browder, Trela, et al., 2007). To ensure that nonverbal students with significant ID have access to reading instruction, alternative methods for fostering acquisition and demonstration of reading skills must be identified and utilized. The results of this study suggest that some nonverbal students with moderate ID can learn sight word identification, comprehension, and letter-sound correspondences through computer-assisted sight word instruction employing CTD procedures, with incidental letter-sound correspondence and comprehension stimuli. However, it is possible that the rate of target and incidental stimuli acquisition may be affected by a student's expressive language skills. If this conjecture is valid, students with moderate ID who are nonverbal or who have speech impairments may require longer periods of instruction before target and incidental stimuli gains are demonstrated. Additional research is needed to determine the effect expressive language skills have on the rate of target and incidental stimuli acquisition.

More, study results support the assertion made by Browder, Gibbs, and colleagues (2008) that pairing phonemes with printed letters and matching pictures with target sight words provide nonverbal students a visual referent that can be used to demonstrate knowledge. Likewise, the current study results support the use of distractor arrays consisting of letters, words of similar configurations, and pictures of target words to evaluate nonverbal students' acquisition of target and incidental stimuli and comprehension of target sight words (Coleman-Martin et al., 2005).

Next, the current study extends the research on sight word instruction with incidental stimuli. Only one other study has inserted incidental stimuli in the antecedent condition, prior to the task request, of the sight word instructional trial (Wolery et al., 2000). In the study conducted by Wolery and colleagues (2000), students with mild to moderate ID acquired 40% - 80% of the incidental sight word stimuli. Likewise, results of the current study suggest that students with moderate ID can learn letter-sound correspondences when incidental letter-sound correspondence stimuli are inserted in the antecedent condition of the sight word instructional trial. This study also extends the research on inserting two pieces of incidental stimuli in the sight word instructional trial conducted by Griffen and colleagues (1998). Griffen et al. (1998) reported that students with moderate ID can learn two pieces of incidental stimuli embedded in the feedback condition of the sight word instructional trial. Meanwhile, current study results suggest that inserting one piece of incidental stimuli in the antecedent condition and one piece of incidental stimuli in the feedback condition of the sight word instructional trial fostered limited gains in target sight word and/or incidental letter-sound and comprehension stimuli with some verbal and nonverbal students with moderate ID. In sum, embedding incidental reading stimuli in the sight word instructional trial may provide a way to expose students with moderate ID to essential reading skills that promote reading development.

Limitations

Several limitations affect the internal and external validity of this study. Threats to the internal validity of the study include history effects, reactive testing effects, and participant attrition. History effects that may have affected study results include the time of year and time of day during which the study was conducted, student illness, and behavioral changes that manifested as reluctance to engage in instructional activities. Reactive testing effects pose another threat to the internal validity of the study. Repeated exposure to word set sight words during assessment probes may have facilitated sight word acquisition. Likewise, exposure to incidental stimuli during assessment probes may have fostered heightened awareness of the incidental stimuli. Given that students who participated in the study did not complete all phase sessions or intervention phases, attrition poses another threat to the validity of study results.

Additional limitations that may impact study results arise from the study methodology. Students participated in three to five baseline sessions prior to receiving the intervention. However, some student baselines demonstrated instability. A more discerning evaluation of the functional relation between the intervention and sight word acquisition might have been obtained if unstable baseline phases were extended until data were stable or demonstrated a clear trend. Moreover, the sight words and pictorial representations used in the intervention may have influenced student performance.

Finally, only five students completed the computer-assisted sight word intervention. All five students attended the same school, and four of the students received instruction in the same classroom. Though all the students were identified as having moderate ID, students' expressive language skills, preexisting knowledge, and cognitive strengths and weaknesses differed. Therefore, small sample size, setting, and unique student characteristics limit the generalization of study results to similar student populations.

Future Research

The existing research suggests that students with significant ID may take longer to learn reading skills (Browder, Ahlgrim-Delzell, et al., 2008; Browder, Gibbs, et al., 2008; Katims, 2001). Therefore, there is a need to identify methods for providing efficient and effective reading instruction. To identify the utility of computer-assisted sight word instruction employing CTD procedures with incidental stimuli with students with moderate ID, there is a need to replicate the current study with other students with moderate ID who are verbal, have expressive language impairments, and are nonverbal.

To increase the relevance of sight word instruction, the words targeted should provide access to the print material the student is exposed to in his/her home, school, and community environments. The arbitrary selection of sight words targeted in the computer-assisted sight word intervention may have impacted students' learning of the words. Future research is needed to identify if sight words obtained from the print materials students are exposed to in their classroom are acquired more quickly than those less relevant words employed in the current study. In addition, research is needed to identify if signing and naming target sight words during instructional trials would assist students who communicated via sign language in learning target sight words.

Though two students were able to name some of the intervention sight words during instructional sessions, word naming was not generalized to assessment probe sessions. Students must be able to read the words they learn in a variety of contexts and formats (Browder and Xin; 1998). Future research is needed to identify if extending the duration of participation in the computer-assisted sight word intervention fosters expressive word naming to assessment probes and to other print materials. Likewise, research is needed to identify if receptive sight word identification, comprehension, and letter-sound correspondences acquired through computer-assisted sight word instruction are generalized to the print materials that students interact with.

Previous research reported that inserting incidental stimuli within the instructional trial had beneficial effects on future learning as students demonstrated more rapid learning of incidental stimuli when direct instruction was provided (Wolery et al., 1991; Wolery et al., 2000). The current study did not assess the effects incidental exposure had on the future learning of letter-sound correspondence and sight word comprehension skills. Future research is needed to identify if including incidental letter-sound correspondence and computer-assisted sight word instruction in the sight word instructional trial fostered more efficient learning of these forms of incidental stimuli. Finally, as knowledge of letter names and sounds is needed to foster the PA skill development (van Bysterveldt, Gillon, Moran, & Moran, 2006) future research is needed to identify effective methods for promoting PA skill development with verbal and nonverbal students with moderate ID

Conclusion

In sum, students with significant ID may not learn the breadth and depth of reading skills needed to interact with the range of text material they encounter. Even so, the reading skills acquired allow students with significant ID to more independently and meaningfully interact with print materials in home, school, and community environments. This study contributes to the literature on reading instruction for students with significant ID in three ways. First, study results suggest that sight word instruction with incidental stimuli employing CTD fostered variable gains in receptive sight word identification with some students with moderate ID who have expressive language impairments or are nonverbal. Next, embedding incidental letter-sound correspondence stimuli prior to the controlling prompt fostered some limited gains in receptive letter-sound correspondence skills with some verbal and nonverbal students with moderate ID. Yet, one student with limited knowledge of letter-sound correspondences appeared to benefit more from the incidental letter-sound correspondence stimuli. Finally, embedding incidental sight word comprehension stimuli in the feedback component of the instructional trial fostered gains in sight word comprehension with some verbal and nonverbal students with moderate ID. Future research is needed to identify the degree to which expressive language skills affect the acquisition of sight word, letter-sound correspondence, and sight word comprehension stimuli and to identify if students generalize receptive sight word identification to the printed material they interact with daily.

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APPENDIX A

DEPENDENT MEASURE DATA COLLECTION FORMS

Daily Instruction Sight Word Probes Data Collection Sheet

Scoring:
Correct naming/identification = plus (+)
Incorrect naming/identification = minus (-)
Student vocalized but response was unintelligible = V

Date:		**Date:**	
Observer:		**Observer:**	
Student Number:		**Student Number:**	
Expressive Sight Word Naming		**Receptive Sight Word Identification**	
Sight Word	**Performance**	**Letter-Sound**	**Performance**

Expressive Probe Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)
Student vocalized but response was unintelligible = V

Date:		**Date:**	
Observer:		**Observer:**	
Student Number:		**Student Number:**	
Expressive Sight Word Identification		**Expressive Letter-Sound Correspondence**	
Sight Word	**Performance**	**Letter-Sound**	**Performance**

Receptive Probe Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)

Date:		**Date:**	
Observer:		**Observer:**	
Student Number:		**Student Number:**	
Receptive Sight Word Identification		**Receptive Letter-Sound Correspondence**	
Sight Word	**Performance**	**Letter-Sound**	**Performance**

Sight Word Comprehension Probe Data Collection Sheet Scoring: Correct response = plus (+) Incorrect response = minus (-)	
Date:	
Observer:	
Student Number:	
Sight Word	**Performance**

Generalization Probe Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)

Date:		**Date:**	
Observer:		**Observer:**	
Student Number:		**Student Number:**	
Letter-Sound Correspondence Generalization Probe		**Phonemic Awareness Generalization Probe**	
Sight Word	**Performance**	**Sound**	**Performance**

Expressive Sight Word Identification Item Selection Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)
Student vocalized but response was unintelligible = V

Date:

Observer:

Student Number:

Sight Word	Performance		Sight Word	Performance

Receptive Sight Word Identification Item Selection Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)

Date:

Observer:

Student Number:

Sight Word	Performance		Sight Word	Performance

Sight Word Comprehension Item Selection Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)

Date:

Observer:

Student Number:

Sight Word	Performance		Sight Word	Performance

Expressive Letter-Sound Correspondence Item Selection Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)
Student vocalized but response was unintelligible = V

Date:

Observer:

Student Number:

Letter-Sound Correspondence	Performance		Letter-Sound Correspondence	Performance

Receptive Letter-Sound Correspondence Item Selection Data Collection Sheet

Scoring:
Correct response = plus (+)
Incorrect response = minus (-)

Date:

Observer:

Student Number:

Letter-Sound Correspondence	**Performance**		**Letter-Sound Correspondence**	**Performance**

APPENDIX B

PROCEDURAL PROTOCOL CHECKLISTS

Sight Word Instructional Trials with 0-Second Delays Protocol
Scoring: Behavior observed = + Behavior not observed = -

Observer:	Date:

Student Number:

Researcher Behavior	**Sight word**					
1. Researcher presented the slideshow title slide.						
2. Researcher stated, "It's time to learn our words."						
3. The researcher advanced the slideshow to the first, animated slide.						
4. The researcher provided the attentional cue, "Look."						
5. The researcher obtained the student's visual attention.						
6. The researcher presented the letter-sound correspondence slide.						
7. The researcher produced the letter-sound.						
8. The researcher provided a 2-second delay after production of the letter sound.						
9. The researcher advanced the slideshow to the sight word slide.						
10. The researcher provided the controlling prompt, "What word?"						
11. The researcher immediately named the sight word.						
12. The researcher advanced the slideshow to the feedback slide and provided the consequent feedback, "Good Looking. This is a picture of (word)."						
13. After the consequent feedback was provided, the researcher advanced the slideshow to the next, blank slide.						
14. The researcher provided a 5-second delay before initiating the next trial.						

Sight Word Instructional Trials with a 4-Second Delay Protocol
Scoring: Behavior observed = plus (+) Behavior not observed= minus (-)

Observer: **Date:**

Student Number:

Researcher Behavior	**Sight word**					
1. Researcher presented the slideshow title slide.						
2. Researcher stated, "It's time to learn our words."						
3. The researcher advanced the slideshow to the first, animated slide.						
4. The researcher provided the attentional cue, "Look."						
5. The researcher obtained the student's visual attention.						
6. The researcher presented the letter-sound correspondence slide.						
7. The researcher produced the letter-sound.						
8. The researcher provided a 2-second delay after production of the letter sound.						
9. The researcher advanced the slideshow to the sight word slide.						
10. The researcher provided the controlling prompt, "What word?"						
11. Researcher provided a 4-second delay to allow for student response.						
12. The researcher named the sight word.						
13. The researcher advanced the slideshow to the feedback slide and provided the consequent feedback, "Good Looking. This is a picture of (word)."						
14. After the consequent feedback was provided, the researcher advanced the slideshow to the next, blank slide.						
15. The researcher provided a 5-second delay before initiating the next trial.						

Daily Expressive Naming Instructional Probe Protocol

Scoring: Behavior observed = plus (+) Behavior not observed = minus (-)

Observer: **Date:**

Student Number:

Researcher Behavior	**Sight word**					
1. The researcher provided attentional cue, "Look."						
2. The researcher obtained student attention.						
3. The researcher showed the student a target sight word flashcard.						
4. The researcher provided the controlling prompt, "What word?"						
5. Researcher provided a 4-second delay to allow for student response.						
6. The researcher provided non-contingent reinforcement, "Good looking."						
7. The researcher recorded the student response on the data sheet.						
8. The researcher provided a 5-second delay, before initiating the next word trial.						

Daily Receptive Naming Instructional Probe Protocol Scoring: Behavior observed = plus (+) Behavior not observed = minus (-)						
Observer:	**Date:**					
Student Number:						
	Sight word					
Researcher Behavior						
1. The researcher placed three sight words on the tray/table in front of the student.						
2. The researcher provided the attentional cue, "Look."						
3. The researcher obtained student attention.						
4. The researcher pointed to each sight word in turn, beginning with the sight word on the left.						
5. The researcher provided the controlling prompt, "Touch/point to/look at (target sight word)."						
6. The researcher provided a 4-second delay to allow for student response.						
7. The researcher provided non-contingent reinforcement, "Good looking."						
8. The researcher recorded the student response on the data sheet.						
9. Researcher provided a 5-second delay before initiating the next word trial.						

Receptive Sight Word Identification Probe Protocol Scoring: Behavior observed = plus (+) Behavior not observed= minus (-)						
Observer:	**Date:**					
Student Number:						
	Sight word					
Researcher Behavior						
1. The researcher placed three sight word flashcards on the table/tray in front of the student						
2. The researcher provided the attentional cue, "Look."						
3. The researcher obtained student attention.						
4. The researcher pointed to each of the sight words, beginning with the word on the student's left.						
5. The researcher delivered the controlling prompt, "Point to/ look at/ touch, (target word)."						
6. Researcher provided a 4-second delay to allow for student response.						
7. The researcher provided non-contingent reinforcement, "Good looking."						
8. The researcher recorded the student response on the data sheet.						
9. The researcher provided a 5-second delay prior to initiating the next trial.						

Expressive Sight Word Identification Probe Protocol Scoring: Behavior observed = plus (+) Behavior not observed = minus (-)						
Observer:	**Date:**					
Student Number:						
Researcher Behavior	**Sight word**					
1. The researcher provided the attentional cue, "Look."						
2. The researcher obtained student attention.						
3. The researcher showed the student a sight word flashcard.						
4. The researcher provided the controlling prompt, "What word?"						
5. The researcher provided a 4-second delay to allow for student response.						
6. The researcher provided non-contingent reinforcement, "Good looking."						
7. The researcher recorded the student response on the data sheet.						
8. Researcher provided a 5-second delay before initiating the next trial.						

Expressive Letter-Sound Correspondence Probe Protocol Scoring: Behavior observed = plus (+) Behavior not observed= minus (-)						
Observer:	**Date:**					
Student Number:						
Researcher Behavior	**Letter-sound correspondence**					
1. The researcher provided the attentional cue, "Look."						
2. The researcher obtained student attention.						
3. The researcher showed the student a letter flashcard.						
4. The researcher provided the controlling prompt, "What sound does this letter make?"						
5. Researcher provided a 4-second delay to allow for student response.						
6. The researcher provided non-contingent reinforcement, "Good looking."						
7. The researcher recorded the student response on the data sheet.						
8. The researcher provided a 5-second delay prior to initiating the next trial.						

Receptive Letter-Sound Correspondence Probe Procedural Fidelity
Scoring: Behavior observed = plus (+) Behavior not observed= minus (-)

Observer:	**Date:**

Student Number:

Researcher Behavior	**Letter-sound correspondence**					
1. The researcher placed three letter flashcards on the desk/tray in front of the student.						
2. The researcher provided the attentional cue, "Look."						
3. The researcher obtained student attention.						
4. The researcher pointed to each of the letters on the desk/tray, beginning with the letter on the student's left.						
5. The researcher provided the controlling prompt, "Point to/look at/touch (letter sound)."						
6. The researcher provided a 4-second delay to allow for student response.						
7. The researcher provided non-contingent reinforcement, "Good looking."						
8. The researcher recorded the student response on the data sheet.						
9. The researcher provided a 5-second delay prior to initiating the next trial.						

Sight Word Comprehension Probe Protocol
Scoring: Behavior observed = plus (+) Behavior not observed= minus (-)

Observer: **Date:**

Student Name:

Researcher Behavior	**Sight word**					
1. The researcher placed three picture flashcards on the desk/tray.						
2. The researcher provided the attentional cue, "Look."						
3. The researcher obtained student attention.						
4. The researcher pointed to each of flashcards, beginning with the picture flashcard on the student's left.						
5. The researcher showed the student a target sight word flashcard.						
6. The researcher provided the controlling prompt, "Point to/look at/touch the picture that goes with this word."						
7. The researcher provided a 4-second delay to allow for student response.						
8. The researcher provided non-contingent reinforcement, "Good looking."						
9. The researcher recorded the student response on the data sheet.						
10. The researcher provided a 5-second delay, using an inner count prior to initiating the next trial.						

Letter-Sound Correspondence Generalization Probe Protocol
Scoring Behavior observed = plus (+) Behavior not observed= minus (-)

Observer:	**Date:**

Student Number:

Researcher Behavior	**Sound**					
1 The researcher placed three sight word flashcards on the desk/tray						
2 The researcher provided the attentional cue, "Look "						
3 The researcher obtained student attention						
4 The researcher pointed to each of the sight words on the desk/tray, beginning with the word on the student's left						
5 The researcher provided the controlling prompt, "Point to/look at/touch the word that begins with (letter sound) "						
6 Researcher provided a 4-second delay to allow for student response						
7 The researcher provided non-contingent reinforcement, "Good looking "						
8 The researcher recorded the student response on the data sheet						
9 The researcher provided a 5-second delay before initiating the next trial						

Phonemic Awareness Generalization Probe Protocol Scoring: Behavior observed = plus (+) Behavior not observed= minus (-)						
Observer:	**Date:**					
Student Number:						
Researcher Behavior	**Sound**					
1. The researcher placed three pictorial representation cards on the desk/tray in front of the student.						
2. The researcher provided the attentional cue, "Look."						
3. The researcher obtained student attention.						
4. The researcher pointed to and named each of the pictorial representations on the desk/tray, beginning with the picture on the student's left.						
5. The researcher provided the controlling prompt, "Point to/look at/touch the picture that begins with (letter-sound)"						
6. The researcher provided a 4-second delay to allow for student response.						
7. The researcher provided non-contingent reinforcement, "Good looking."						
8. The researcher recorded the student response on the data sheet.						
9. The researcher provided a 5-second delay prior to initiating the next trial.						

APPENDIX C

TEACHER EVALUATION SURVEY

Teacher Code ___________

Part I.

Directions: Circle the number which corresponds with your level of agreement with the statement provided.

	Strongly Disagree 1	Disagree 2	Agree 3	Strongly Agree 4
1. Sight word identification and comprehension are instructional priorities for elementary students with moderate intellectual disabilities.	1	2	3	4
2. Phonics is an instructional priority for elementary students with moderate intellectual disabilities.	1	2	3	4
3. Phonemic awareness is an instructional priority for elementary students with moderate intellectual disabilities.	1	2	3	4
4. The computer-assisted sight word intervention will promote reading skill development with elementary students with moderate intellectual disabilities.	1	2	3	4
5. The computer-assisted sight word intervention with incidental phonics and comprehension stimuli would be easy to implement.	1	2	3	4

Part II

Directions: Please answer the following questions.

1. Would you use the computer-assisted sight word intervention with incidental phonics and and comprehension stimuli with your students? Why or why not?

2. What skills does a child with moderate intellectual disabilities need to be successful in his/her home, school, and community?

APPENDIX D

PARENT SURVEY

Parent Code __________

Part I.

Directions: Please circle the number which corresponds with your level of agreement with the statement provided.

	Strongly Disagree 1	**Disagree 2**	**Agree 3**	**Strongly Agree 4**
1. The sight word identification and comprehension skills targeted in the intervention are relevant to my child's learning needs.	**1**	**2**	**3**	**4**
2. The phonics skills targeted in the intervention are relevant to my child's learning needs.	**1**	**2**	**3**	**4**
3. Learning the skills targeted by the computer-assisted instruction will help my child function more independently in his/her home, school, and/or community.	**1**	**2**	**3**	**4**
4. The instructional format is appropriate for my child's learning needs.	**1**	**2**	**3**	**4**
5. The computer-assisted reading instruction provides exposure to the skills my child with a disability needs to interact with printed material.	**1**	**2**	**3**	**4**

Part II

Directions: Please answer the following questions.

1. Would you use the computer-assisted sight word intervention with incidental phonics and comprehension stimuli with your child at home if the program were available? Why or why not?

2. What skills does a child with intellectual disabilities need to be successful in his/her home, school, and community?

VITA

Colleen Frances Wood-Fields
603 Channing Arch
Chesapeake, Virginia 23322

EDUCATION

ABD
Old Dominion University, Darden College of Education, Norfolk, VA
Area of Concentration: Special Education, Emphasis on Severe/ Profound Disabilities
Anticipated Graduation Date: December, 2011
Dissertation Topic: *The Impact of Computer-Assisted Sight Word Instruction on the Reading Skills of Students with Significant Intellectual Disabilities*

Learning Disabilities Teacher Consultant Certificate
The College of New Jersey, Trenton, NJ
Coursework Completed: July 1997

MEd
Master of Education
The College of New Jersey, Trenton, NJ
Area of Concentration: Special Education
Graduation Date: May, 1990

BS
Bachelor of Science
Trenton State College, Trenton, NJ
Area of Concentration: Special Education
Graduation Date: June, 1984

EXPERIENCE

ACADEMIC

Fall 2010 Course Content Development, ESSE 404/504 – Medical Aspects of Disabling Conditions (Online); Old Dominion University Norfolk, VA

Fall 2008 Assistant Professor, ESSE 715/815 –Alternative Strategies for Elementary Students: Prevention and Intervention; Old Dominion University, Norfolk, VA

Spring 2004 Adjunct Instructor, ICL 7000: Analysis and Practice of Teaching; Department of Instruction and Adjunct Instructor Curriculum Leadership, University of Memphis. Memphis, TN

NON-ACADEMIC

2005-Present - Southeastern Elementary School, Chesapeake, VA; Cross Category & Intellectual Disabilities (K-5)
2006-2009 - Southeastern Elementary School, Chesapeake, VA; Member, Virginia Grade Level Assessment and Virginia Alternate Assessment Program Scoring Team
2004-2005 - Millington Elementary School, TN; Expanded Resource (Grade 5)
2003-2004 - Millington East Elementary School, TN; Expanded Resource (Grades 4-5)
2002-2003 - E. W. Chittum Elementary School, VA; Cross Category Special Education (K-5)
1999-2002 - Cook Elementary School/Gilbert J. Mircovich Elementary School, TX; Inclusion/Life Skills/Functional Academics (K-4)
1998-1999 - O.T. Blaschke/Sheldon Elementary School,TX; Life Skills (Grades 6-9)
1997-1998 - Nayer Elementary School, TX; Early Childhood Special Education
1985-1997 - Regional Day School, NJ; Life Skills/Functional Academics (K-6)
1984-1985 - Walnut Street School, NJ; Resource (Grades 5-8)

PUBLICATIONS

Judge, S., Floyd, K., & Wood-Fields, C. (2010). Creating a technology-rich learning environment for infants and toddlers with disabilities. *Infants & Young Children, 23,* 84-92. doi:10.1097/IYC.0b013e3181d29b14

CURRICULAR MATERIALS

Biegun, D., Crumb, P., Johnson, B., Knightes, M., McGarity, K., & Wood-Fields, C. (2010). American leaders: ASOL instructional unit for students with intellectual disabilities [Curriculum unit with activity CD]. Norfolk, VA: Old Dominion University Training and Technical Assistance Center (T/TAC).

Biegun, D., Crumb, P., Johnson, B., Knightes, M., McGarity, K., & Wood-Fields, C. (2010). Motion: ASOL instructional unit for students with intellectual disabilities [Curriculum unit with activity CD]. Norfolk, VA: Old Dominion University Training and Technical Assistance Center (T/TAC).

PROFESSIONAL WORKSHOPS AND PRESENTATIONS

Floyd, K., & Wood-Fields, C. (2010, October). *Using an assistive technology toolkit to promote inclusion.* Presented at the Division for Early Childhood of the Council for Exceptional Children 26th Annual International Conference on Young Children with Special Needs and Their Families, Kansas City, MO.

Judge, S., Floyd, K., & Wood-Fields, C. (2010, April). *Creating a technology-rich learning environment for young children with disabilities.* Poster Session presented at the Council for Exceptional Children Convention and Expo, Nashville, TN.

Wood-Fields, C. & Floyd, K. (2009, February). *Solving the instructional dilemma: Blending functional life skill and academic instruction.* Presented at the North Carolina Council for Exceptional Children State Conference, Wilmington, NC.

Wood-Fields, C. (2008, October). *Solving the instructional dilemma: Blending functional life skill and academic instruction.* Presented at the Virginia Federation of the Council for Exceptional Children 49th Annual Conference, Fredericksburg, VA.

Floyd, K., Griffin, H., Canter, L.L.S., & Wood-Fields, C. (2008, February). Alternate assessment: Creating a portfolio of academic proportions. Presented at the North Carolina Council for Exceptional Children State Conference, Wilmington, NC.

LOCAL WORKSHOPS AND PRESENTATIONS

Wood-Fields, C. (2008, January). *Special education: A service not a placement.* Presented to students in the course ECI 435, Developing Instructional Strategies, PK - 6, Social Studies at Old Dominion University, Norfolk, VA.

Wood-Fields, C. (2007, November). *Social studies/history instruction for students with significant intellectual disabilities.* Presented to students in the course ECI 435, Developing Instructional Strategies, PK- 6, Social Studies at Old Dominion University, Norfolk, VA.

Wood-Fields, C., & Sheperty, M. (2006, August). *Aligned SOLs and communication skills: enhancing instruction for students with significant cognitive delays.* Presented at the Chesapeake Paraprofessional inservice training, Chesapeake, VA.

HONORS AND ACHIEVEMENTS

2009-Present Member, Phi Kappa Phi Honor Society

2009-2010 Darden College of Education Doctoral Fellowship,
Old Dominion University, Norfolk, VA

1990- Governor's Award for Outstanding Teaching
Regional Day School Teacher of the Year
Mercer County Special Services School District, Trenton, NJ

CERTIFICATION AND LICENSURE

Virginia Postgraduate Professional License
Endorsements: Severe Disability K-12, Mental Retardation K-12, Specific Learning Disability K-12, Emotional Disturbance K-12, Elementary Education, PREK-6
Teacher of the Handicapped, NJ
Teacher of Nursery School, NJ
Elementary School Teacher, NJ
Learning Disabilities Teacher/Consultant, NJ
Texas Generic Special Education
Tennessee Professional License, Special Education Modified K-12

MEMBERSHIP IN PROFESSIONAL SOCIETIES/ORGANIZATIONS

2008 - Present	Member, Council for Exceptional Children (CEC) Council for Educational Diagnostic Services (CEDS) Division on Autism and Developmental Disabilities (DADD)
2010-Present	Division for Early Childhood (DEC) Division for Physical, Health and Multiple Disabilities (DPHMD) Technology and Media Division (TAM)
2009-Present	Phi Kappa Phi Honor Society
2005-Present	Virginia Education Association