Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

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DECODING SKILLS OF MIDDLE-SCHOOL STUDENTS WITH AUTISM:
AN EVALUATION OF THE NONVERBAL READING APPROACH

by

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Bachelor of Science
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2007

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ABSTRACT

Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

by

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Students diagnosed with autism demonstrate a deficit in communication skills, which affects their literacy skills. Federal legislation mandates that students with disabilities receive a free appropriate public education, be taught how to read, and have access to the general education curriculum. Students with autism are being included more in the general education classroom. Prior literacy instruction for students with moderate to severe forms of disabilities has shown promising results. The whole language approach to teaching students with autism how to read has been researched extensively, particularly in the area of sight-word identification. One major limitation to this approach, however, is that students are unable to read unknown words. This greatly impacts their ability to read text that has not been explicitly taught.

The purpose of this study was to determine if the Nonverbal Reading Approach (NRA) is an effective method for teaching 11-14 year old students with autism to read unknown words. Two students with autism were included in the study, and all phases of the study were conducted in a self-contained classroom in a middle-school located in the southwestern United States. Ten target words were identified using a phonics survey, and were taught using the teacher-led and the computer-assisted components of the Nonverbal Reading Approach. A multiple probe design across participants combined
with an adapted alternating treatment design was used to determine the effectiveness of both components of the Nonverbal Reading Approach on unknown word reading ability.

The researchers measured the percentage correct at which students were able to read unknown words using the teacher-led and computer-led approaches of the Nonverbal Reading Approach. Data were collected on student responses, on the fidelity of implementation by the teacher, and on the perceptions of teachers in regards to the method. Results indicate that the teacher-led and computer-assisted components of the NRA were effective for improving the students’ unknown word identification skills. The participating teacher reported a positive attitude toward the effectiveness of the NRA for her students prior to and following the study.
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Dedicated to my three children,

Nicholas, Melanie, and Jonah
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CHAPTER 1
INTRODUCTION

Students diagnosed with autism are characterized by repetitive behaviors and deficits in social and communication skills (American Psychiatric Association [APA], 2000). One of the ways to ameliorate communication deficits is to provide instruction in both oral language skills and literacy, as they are “mutually enhanced by each other” (Sénéchal, LeFevre, Smith-Chant, & Colton, 2001, p. 444). Bishop and Snowling (2004) and Catts and Kamhi (2005) suggest that children are at a higher risk for literacy failure when they demonstrate poor oral language skills. Nearly half of the autism population has language impairments and/or limited speech (Nation & Norbury, 2005; Tager-Flusberg & Joseph, 2003). Thus, it can be concluded that students with autism who have communication deficits will most likely demonstrate deficits in literacy.

Federal policy has shaped the education system in the United States since the early 1970s (West & Whitby, 2008). The reauthorization of the Elementary and Secondary Education Act (ESEA, 2002) mandates that (a) all students, including those with disabilities, receive a free public education and (b) all students learn how to read by third grade. The Individuals with Disabilities Education Act (IDEA, 2004) further stipulates that students who have a documented disability and require special education services (a) receive a free appropriate public education and (b) have access to the general education curriculum. These tenets – free public education, access to the general education curriculum, and learning to read – suggest students with autism should be provided instructional strategies and accommodations in order to fully participate in the curriculum.
Students with low-incidence disabilities such as autism are being included more in the general education classroom (Simpson, Boer-Ott, & Smith-Myles, 2003). Trend data from the U.S. Department of Education (2010) shows students with autism are spending more time in the general education environment and less time in the self-contained environment. Literacy skills, therefore, are essential in order for students with autism to participate in the academic curriculum (Fossett & Mirenda, 2006; Kliewer & Landis, 1999). “Literacy is an important tool for functioning in inclusive educational and vocational environments” (Calhoon, 2001, p. 491).

Reading instruction for students with moderate to severe forms of disabilities has shown promising results (Browder, Wakeman, Spooner, Algrim-Delzell, & Algozzine, 2006). Of the components of reading instruction identified (e.g., sight words, pictures, comprehension, fluency, phonics, phonemic awareness), sight word instruction using prompts and fading procedures was the focus of early interventions. Browder et al. (2006) further conclude that few studies exist which examined a systematic phonics-based approach to reading instruction, and therefore future studies should address this gap within the literature. Chiang and Lin (2007), Flores and Ganz (2007), and O’Connor and Klein (2004) confirm the conclusion of Browder et al. (2006) that minimal studies exist on the phonics-based approach to reading instruction for students with autism. Therefore, future studies need to be conducted that identify whether or not a systematic phonics-based approach to reading instruction can produce positive results.

Literacy can be defined as a specific set of skills that needs to be taught in order for an individual to read and understand text (Adams, 1990). It encompasses reading, writing, speaking, listening, and viewing (van Kraayenoord, 2001). The ultimate goal for
teaching students how to read is to either comprehend the words found within a passage or to perform daily living skills (Browder & Lalli, 1991). Typically developing students learn to read words in four ways: (a) by sight; (b) by predicting; (c) by analogizing; and (d) by decoding (Ehri, 2005). These four methods can be grouped into two main approaches: whole language (sight, predicting) and skills-based (analogizing, decoding) (Kouri, Selle, & Riley, 2006).

**Whole Language Approach to Reading**

Whole language advocates suggest reading occurs when students bring their background knowledge to the reading experience, where meanings and words can be constructed as the text is read (Adams, 1990; Kouri et al., 2006; & Snow, Burns, & Griffin, 1998). The whole language approach to reading has demonstrated improved reading ability for students with language impairments (Kouri et al., 2006). Students with autism typically exhibit language impairments (APA, 2000). Therefore, the whole language approach, particularly sight word identification, has been used to increase the reading ability of this population (Browder & Lalli, 1991).

However, one major criticism of using sight word identification strategies is that students with autism may not relate their background knowledge to the words being read due to a lack of exposure to print and books while toddlers and pre-schoolers (Browder et al., 2006). Given this lack of early exposure to print, students with autism do not have background knowledge to contribute to the reading experience, thus decreasing their ability to read words from the text. Teaching students with autism to identify words by sight may not be the most effective way to teach reading. While students with autism have delayed language, their development of phonological, morphological, and syntactic
skills is intact (Diehl, Bennetto, & Young, 2006). This suggests that students with autism do have the ability to decode words.

In general, whole language/sight word instruction may be better suited for teaching daily living skills, whereas skills-based instruction (given the increased focus to the general education curriculum) requires the ability to decode words (Browder & Lalli, 1991). The increase in participation in the general education curriculum necessitates instructional strategies that will help students with autism be successful in acquiring the academic content (Fossett & Mirenda, 2006; Kliwer & Landis, 1999). Therefore, students with autism need instruction from a skills-based approach to learn how to read (Kouri et al., 2006).

**Skills-Based Approach to Reading**

Skills-based approach advocates suggest reading occurs when students are able to automatically decode known and unknown words (Adams, 1990; Kouri et al., 2006; Snow et al., 1998). A skills-based approach for learning how to read addresses phonemic awareness, phonics, vocabulary development, fluency, comprehension, and critical literacy (Adams, 1990; Freebody & Luke, 1990; National Institute of Child Health and Human Development [NICHD], 2000; Stevens & Bean, 2007). Of particular interest to this research is the phonics component, which is defined as teaching students to acquire letter-sound correspondence to be able to decode known and unknown words fluently (NICHD, 2000). The report commissioned by NICHD (2000) further identified the benefits of phonics instruction:

The level of performance [for children who have difficulty decoding text] falls below that of younger non-disabled readers who read at the same grade-
equivalent level, indicating a serious deficit in decoding skill. Phonics instruction that teaches disabled readers to decode words should remediate this deficit and should enable these students to make better progress in learning to read. (p. 2-106)

Teaching students to read words using a skills-based approach is crucial to helping them access the academic content.

Allor, Champlin and Gifford (2010) suggest that all students develop the ability to phonetically read text in a similar manner. Children who have less than one year of reading instruction have relatively low scores in word identification and reading comprehension (Byrne et al., 2007). An inability to correctly read words seriously affects fluency and comprehension (Perfetti & Hogaboam, 1975; Share & Stanovich, 1995). Acquiring a sound phonological basis before learning to read improves the overall reading ability of students, and this becomes more apparent as reading instruction focuses on decoding known and unknown words (Colin, Magnan, Ecalle, & Leybaert, 2007). Students who are taught using a systematic-phonics program show better reading outcomes than those who are taught with nonsystematic phonics programs (de Graaff, Bosman, Hasselman, & Verhoeven, 2009; Ehri, Nunes, Stahl, & Willows, 2001). Phonological development for students with autism parallels the development of typically developing students (Diehl et al., 2006). Therefore, students with autism should be taught using a systematic-phonics program to increase their ability to read words in text and to access the academic content.
Computer-Assisted Instruction

Computer-assisted instruction (CAI) is a method for delivering instruction via a computer to increase both academic and functional skills (Everhart, Albert-Morgan, & Park, 2011). Research conducted on the effectiveness of CAI has focused on typically developing students and/or students with mild disabilities. Of the studies conducted on students with moderate to severe disabilities, researchers have typically focused on addressing functional skills through CAI (Everhart et al., 2011). Everhart et al. further suggest that more research needs to be conducted on the efficacy of CAI. In regards to teaching students with autism how to read, appropriately designed computer programs could be effective (Bernard-Opitz, Sriram, & Nakhoda-Sapuan, 2001). Specifically, CAI (a) uses fixed visual cues (e.g., pictures, written words) which increases motivation and engagement (Chen & Bernard-Opitz, 1993; Heimann, Nelson, Tjus, & Gillberg, 1995), (b) offers an opportunity to engage in a one-on-one teaching format, similar to the discrete trial teaching component of ABA (Steege & Mace, 2007) with minimum supervision from a teacher (Torgesen, Waters, Cohen, & Torgesen, 1988), (c) resembles an errorless learning strategy when designed in such a manner (Mueller, Palkovic, & Maynard, 2007), and (d) ensures correct implementation of various prompting procedures (Kodak, Fisher, Clements, & Bouxsein, 2011).

Nonverbal Reading Approach

The Nonverbal Reading Approach (NRA) is one instructional method that teaches students with language impairments to decode words using computer-assisted instruction (Coleman-Martin, Heller, Cihak, & Irvine, 2005). This method is grounded in the skills-based approach to teaching reading. The NRA is a strategy that utilizes active
participation, guided practice, and evaluation procedures for determining whether or not students are reading words (Heller & Coleman-Martin, 2007). Active participation involves having the student attempt to say the word being taught while the teacher reads the word aloud. This step is usually conducted in a 1-to-1 setting, wherein the teacher instructs the student to say the word out loud, if possible. During the guided practice component of the NRA, the student uses a three-step decoding process to internally sound out the word. First, the teacher points to the beginning letter of the word and instructs the student to make the sound of the letter in his head while the teacher says the sound out loud. Second, the student is instructed to continue sounding out each phoneme as the teacher points to and says each phoneme out loud. Third, the student is told to internally say the word slowly, then fast, while the teacher says it out loud. Once the word is taught five times using the three-step decoding strategy, the student is evaluated on whether or not he can read the word. This is accomplished by presenting a distracter array (four words that are phonetically similar to the word being learned), and asking the student to read the word. If the student is not successful in selecting the correct word, then the three-step decoding process is taught again.

One reason that the NRA may not be an effective strategy for teaching students with autism to decode words may be due to inner speech impairments (Lidstone, Fernyhough, Meins, & Whitehouse, 2009; Whitehouse, Maybery, & Durkin, 2006). Whitehouse et al. (2006) conducted three experiments to look at the inner speech processing of students with autism. They hypothesized that typically developing students would demonstrate significantly higher results than students with autism when asked to recall pictures that were presented. Pictures are processed via two pathways: image and
verbal. This dual processing is limited for students with autism; thus the lower performance by this population in comparison to the control (typically developing) group. They further hypothesized that there would be no significant difference between the two groups when presented with text, and the results confirmed this hypothesis. Students with autism, in fact, recalled a slightly higher percentage of printed words than the typically developing group, although there is no significance in this difference. These results indicate that students with autism are able to employ inner speech when presented with printed words in a similar manner to their typically developing peers. The Nonverbal Reading Approach (NRA) uses printed words instead of pictures. Therefore, the suggested inner speech impairment should not affect the ability of students with autism to identify words.

The NRA may be an effective intervention for teaching students with autism to read words. First, the NRA incorporates three components of Applied Behavior Analysis: (a) task analysis; (b) prompting procedures; and (c) whole task instruction (Steege & Mace, 2007). Task analysis, “involves identification of the distinct behaviors and their sequence needed to perform a complex task” (p. 97). The NRA uses a similar approach, where a chosen word is broken down into phonemes and presented in sequential order. Prompting procedures are used to “promote initiation and completion of each step in the task” (p. 97). The NRA also employs this technique, offering a verbal prompt and model of the task. Whole task instruction is when the individual is asked to complete the entire sequence during each trial. The NRA asks the individual to complete the entire sequence before being reinforced. The second reason the NRA may be an effective intervention for teaching students with autism to read words is because CAI utilizes the visual/perceptual
strengths of students with autism (American Speech-Language-Hearing Association, 2006; Kluth & Darmody-Latham, 2003). Third, the NRA has been shown to be effective for at least one individual with autism. At the time of this writing, no other study had been conducted to determine the effectiveness of using the NRA and CAI with students with autism to read words by decoding.

**Statement of the Problem**

Students with autism demonstrate deficits in their ability to communicate (APA, 2000). One way to improve the communication abilities of students with autism is to teach them how to read (Lanter & Watson, 2008). Learning to read is a critical skill that students with autism need to learn as they participate more in the general education curriculum (U.S. Department of Education, 2010). Higher literacy levels correlate to successful school-to-work transitions (Hanser & Erickson, 2007). Of the two methods for teaching reading, a whole language/sight word approach may not be as effective for teaching students with autism (Kouri et al., 2006). Many students with autism typically acquire phonics-skills more easily (O’Connor & Klein, 2004), yet they still demonstrate low levels of reading accuracy (Nation, Clarke, Wright, & Williams, 2006). Teaching students decoding skills may improve their ability to read text. Currently, limited research exists on effective decoding strategies that use a skills-based approach (Chiang & Lin, 2007) for older struggling readers (Edmonds et al., 2009). Older students may, in fact, benefit from interventions that focus on basic decoding skills to read words (Scammacca et al., 2007). One method that has demonstrated positive results for one student with autism is the Nonverbal Reading Approach (Coleman-Martin et al., 2005). This method, coupled with computer-assisted instruction (CAI), has shown that students with severe
speech, physical impairments, and/or autism, can learn to read words using a skills-based approach. The current study will further the research of the NRA by replicating the results obtained by Coleman-Martin et al. (2005) and will determine whether or not this decoding strategy is effective for students with autism.

**Purpose of the Study**

The purpose of this study is to determine whether or not a skills-based approach (i.e., the Nonverbal Reading Approach) is an effective method for teaching 11-14 year old students with autism to read unknown words. To address this purpose, the following questions will be answered:

1. Does the Nonverbal Reading Approach teacher-led component increase the percentage of unknown words read for 11-14 year old students with autism?
2. Does the Nonverbal Reading Approach computer-assisted component increase the percentage of unknown words read for 11-14 year old students with autism?
3. Which of the two components (i.e., teacher-led, computer-assisted) shows a larger increase of the percentage of unknown words read for 11-14 year old students with autism?
4. What attitudes does a special education teacher of middle-school students with autism have regarding the Nonverbal Reading Approach prior to and after the intervention?

**Significance of the Study**

Students with autism who have communication deficits typically demonstrate impaired reading ability. Federal legislation requires students with disabilities to receive a free public education and have access to the general education curriculum. One outcome
of the federal legislation is students with autism are accessing the general education curriculum. However, literacy impairments by this population limit their ability to access the academic content. The whole language approach, in particular sight word instruction, has been one method for increasing the reading abilities of students with autism. Despite teaching students with autism to read words by sight, this approach is not effective for teaching how to read unfamiliar text. A skills-based approach, particularly phonics, is another method for increasing the reading abilities of students with autism. Limited research exists on the effectiveness of using phonics instruction to improve the reading ability of students with autism.

Teaching students with autism to read words using a phonics-based approach increases their ability to read text fluently and comprehend what is being read (Perfetti & Hogaboam, 1975; Share & Stanovich, 1995). Direct instruction in phonological awareness and alphabetic skills improves students’ performance in early reading and spelling. Students who are taught using a systematic-phonics program show better reading outcomes than those who are taught with nonsystematic phonics programs (NICHD, 2000). One deficit identified within the literature regarding systematic phonics instruction is that most have focused on students in pre-school to 1st grade (Fletcher, Lyon, Fuchs, & Barnes, 2006). “[Little] is known about effective intervention for older readers with reading difficulties and disabilities” (Denton, Wexler, Vaughn, & Bryan, 2008, p. 79). One reason for the lack of studies conducted on this age group may be because students with moderate to severe forms of a disability were considered not educable. Students in this age group may, in fact, benefit from interventions that focus on basic decoding skills to read words.
In addition to using a skills-based approach to teaching students with autism to read, computer-assisted instruction (CAI) is another method that has been used to increase the academic and functional skills of students with disabilities. Limited research has been conducted on the effectiveness of using CAI to teach students with autism to read words. The Nonverbal Reading Approach (NRA) is one method that incorporates the skills-based approach to word identification using CAI. Limited research exists in regards to the effectiveness of this strategy with students with autism. The purpose of this study is to investigate the effectiveness of the NRA for teaching 11-14 year old students with autism how to read unknown words.

**Limitations of the Study**

One limitation to this study was the geographic location of the students. The students who meet the criteria for inclusion in the study all resided in a large, southwest urban city. Furthermore, the students are 11-14 years old; this sample does not represent the overall population of students with autism. As such, this limitation affects the generalizability of the findings to the population (Barlow, Nock, & Hersen, 2009; Horner et al., 2005). The students who participated in this study were selected from a convenience sample, which limits the ability of the student investigator (SI) to generalize the findings to the population (Barlow et al., 2009). Fidelity of implementation did not occur when the computer-assisted intervention was being delivered. Several steps needed to be followed prior to and during the intervention. Despite checklists and training, human error was prevalent. Another limitation involved the lack of emphasis on teaching the meaning of the word (National Institute of Child Health and Human Development, 2000b).
Definition of Terms

**Active engagement.** A student is demonstrating on-task and on-schedule behavior (Carnahan, Musti-Rao, & Bailey, 2009).

**Applied Behavior Analysis.** A systematic method of selecting a socially valid behavior and applying principles of behaviorism to effect change in said behavior (Baer, Wolf, & Risley, 1968).

**Autism Spectrum Disorder.** A disability characterized by repetitive behaviors and deficits in social and communication skills (APA, 2000).

**Computer-assisted instruction.** Delivering instruction via a computer to increase academic skills (Everhart et al., 2011).

**Decoding.** The process of reading phonemes in a word and blending the phonemes to say a word that has a recognizable meaning (NICHD, 2000).

**Emergent literacy.** The period of time when students are developing necessary skills before they begin reading (e.g., phonemic awareness, letter-sound correspondence, text directionality) (Lanter & Watson, 2008).

**Errorless learning.** “A set of teaching procedures designed to reduce incorrect responding as the student gains mastery over the work materials” (Mueller et al., 2007, p. 691).

**Literacy.** A specific set of skills that need to be taught in order for an individual to read and understand text (Adams, 1990). It encompasses reading, writing, speaking, listening, and viewing (van Kraayenoord, 2001).
**Nonverbal Reading Approach.** A three-step decoding strategy for teaching students who have severe speech, physical impairments, and/or autism how to say a word using internal speech (Heller & Coleman-Martin, 2007).

**Phoneme.** “The smallest unit of sound that can be identified in a spoken language” (Heward, 2013, p. G-10).

**Phonics.** “A way of teaching reading that stresses the acquisition of letter-sound correspondences and their use to read and spell words” (NICHD, 2000, p. 2-89).

**Skills-Instruction.** A skills-based approach to learning how to read addresses phonemic awareness, phonics, vocabulary development, fluency, and comprehension (Adams, 1990; NICHD, 2000).

**Systematic phonics instruction.** Sequential instruction of prespecified sets of phonics skills (de Graaff et al., 2009).

**Task analysis.** Identifying the steps taken to complete a specific task; usually given in sequential order (Steege & Mace, 2007).

**Whole language.** “A process whereby the most important thing a child can bring to the reading experience is his or her prior knowledge of language and the world” (Kouri et al., 2006, p. 237).

**Word identification.** Teaches students to match letters to sounds and then blend those sounds to make words (NICHD, 2000).

**Summary**

Students with autism are characterized by repetitive behaviors and deficits in social and communication skills (APA, 2000). One way to improve the communication skills of students with autism is to teach reading skills; the development of
communication parallels the development of reading skills (Sénéchal et al., 2001). Federal laws (NCLB, 2001; IDEA, 2004) mandate students with disabilities have access to the general education curriculum and learn how to read. Literacy skills, therefore, are essential in order for students with autism to participate in the academic curriculum (Fossett & Mirenda, 2006; Kliewer & Landis, 1999). Of the two methods for teaching literacy – whole language and skills-based – students with autism may show greater gains in reading ability when instructed using a skills-based approach (Kouri et al., 2006). Of particular interest to this research are strategies that are phonics-based. When students are able to accurately decode words after being taught a phonics-based approach, they are better able to read unfamiliar text and improve their comprehension (de Graaff et al., 2009; Ehri et al., 2001). The Nonverbal Reading Approach (NRA) is one strategy that incorporates a phonics-based approach to teaching students how to read (Coleman-Martin et al., 2005).

The Nonverbal Reading Approach (NRA) is a strategy that relies on internal speech to phonetically teach students how to read (Heller & Coleman-Martin, 2007). This strategy contains three parts: active participation, guided practice, and evaluation. These parts reflect principles of Applied Behavioral Analysis (Green, 1996; Hagopian, Crockett, van Stone, DeLeon, & Bowman, 2000; NAC, 2009). Of the studies published on the NRA (Coleman-Martin et al., 2005; Heller, Fredrick, & Diggs, 1999; Heller, Fredrick, Tumlin, & Brineman, 2002; Swinehart-Jones & Heller, 2009), one student was identified as having autism (Coleman-Martin et al.). Results from Coleman-Martin et al. indicate that the NRA may be an effective method for teaching students with autism to read unknown words. This research will attempt to determine the effectiveness of the
method of delivery, whether by teacher-led or by computer-assisted instruction (CAI). Research still needs to be conducted to determine the efficacy of this method of delivery. This research will add to the body of literature in regards to CAI and students with autism and determine the effectiveness of the NRA on the reading abilities of students with autism.

The following chapters contain information regarding the current study. A review of the literature in regards to literacy, sight word instruction, phonics-based instruction, the Nonverbal Reading Approach, and computer-assisted instruction (CAI) is presented in Chapter II. Methodology used in the current study is presented in Chapter III. The results and discussion of the results, including implications for future research, are presented in Chapters IV and V.
CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter contains reviews of existing professional literature related to sight-word instruction, phonics-based instruction, computer-assisted instruction, and the Nonverbal Reading Approach (NRA). Four systematic searches through two computerized databases (Education Resource Information Center, PsychINFO) were conducted in order to locate all studies related to sight-word strategies, phonics-based strategies, computer-assisted instruction, and the Nonverbal Reading Approach (NRA). The following descriptors were used to identify studies that addressed sight-word strategies: (a) sight word; and (b) autism. For studies that addressed phonics-based strategies, the following descriptors were used: (a) phonics; (b) decoding; (c) word recognition; (d) word identification; and (e) autism. For computer-assisted instruction, the following descriptors were used: (a) computer-assisted instruction; (b) computer-based instruction; (c) computer-assisted learning; and (d) autism. To identify studies that addressed the Nonverbal Reading Approach, the following descriptor was used: nonverbal reading approach. The last step in the search process involved an ancestral search through the reference lists of the studies identified through the computerized search.

In order to be included in the review each study had to be (a) be peer reviewed; (b) be quantitative (experimental, quasi-experimental, single-subject); (c) contain at least one subject 11-14 years old that was diagnosed with autism; and (d) have at least one dependent variable that addressed a component of reading. The studies included in this review followed the inclusion criteria previously discussed, except for those regarding the
NRA. Limited research exists on the NRA, and therefore all studies that have been published were included. Studies excluded from this review were those that (a) involved the use of a qualitative design; (b) contained subjects that did not have a diagnosis of autism; (c) included participants younger than 11 or older than 14; and (d) did not address a reading outcome.

The following chapter begins with a review of three historical studies that describe a phonics-based approach to teaching reading. Next, experimental studies related to sight-word strategies, phonics-based strategies, computer-assisted instruction, and the NRA are summarized and analyzed. Finally, a summary and synthesis of the research on reading strategies for 11-14 year old students with autism is provided.

**Historical Perspectives**

**Beginning to Read**

Adams (1990), writing on behalf of the Center for the Study of Reading and under the support by the Office of Education Research and Improvement under cooperative agreement No. G 0087-C1001, synthesized the then current research literature on learning how to read. Adams described reading in regards to the history and development of orthographic language, the skills that need to be taught (alphabet, phonemic awareness, concept of print, syllable, phonemes, etc.), and how those skills should be taught (explicit, systematic phonics-based approach). She concluded her work by stating that typically developing students acquire reading abilities through understanding letters, through identifying spelling patterns and words, and by being able to use all three skills simultaneously.
One critique of this work suggests that the experimental studies cited were conducted in contrived settings that focused on small components of language (Adams, 1990). Another critique is the limited scope provided for practitioners to make sound instructional decisions. Adams suggests direct instruction in phonics and the acquisition of letter-sound correlations is necessary before a child can comprehend what is being read. These critiques suggest a reading program and/or strategy should incorporate an integrated language arts approach that is explicit and based on a systematic phonics approach delivered in naturalistic, contextualized settings.

**Preventing Reading Difficulties in Young Children**

Snow et al. (1998) were commissioned by the National Academy of Sciences and reported on the declining ability of children to read well enough to successfully compete in the workplace. The researchers identified four factors that contribute to the declining ability of children learning how to read: (a) societal challenges (poverty, disabilities, cultural differences); (b) technological advancements (increased distribution of technology); (c) biological deficits (cognitive and genetic factors); and (d) instructional influences (poor delivery of instruction). All four of these factors can be found among the autism population: disability, increasing access to technology, cognitive deficits, and poor instructional approaches (Bolt & Ferreri, 2011). Snow et al. (1998) identified word identification as an important component of literacy development for typically developing students. Given the deficits exhibited by students with autism, future reading strategies need to combine technology with evidenced-based practices in order to improve the ability of students with autism to read words.
National Reading Panel

The National Institute of Child Health and Human Development [NICHD] (2000) was commissioned to identify research-based interventions for teaching students how to read. Five main categories were identified as being important to literacy development: (a) alphabetics (phonemic awareness instruction, phonics instruction); (b) fluency; (c) comprehension (vocabulary instruction, text comprehension instruction, teacher preparation, comprehension strategies instruction); (d) teacher education and reading instruction; and (e) computer technology and reading instruction. One major finding of this report is that substantial growth in reading occurs through systematic phonics approaches (NICHD, 2000). Another major finding is that systematic phonics approaches were significantly more effective in teaching students to acquire reading abilities than approaches that were non-phonics based. The word identification model of reading identified in the report suggests that children learn how to read by matching letters to sounds and then blending those sounds into words (i.e., a synthetic phonics approach). The researchers conclude that a synthetic phonics based approach to teach word identification to children is an effective way to improve the reading ability.

Overall, these three studies suggest (a) an integrated phonics-based approach is one key component to literacy development (Adams, 1990), (b) reading strategies need to incorporate technology with evidenced-based practices (Snow et al., 1998), and (c) a synthetic phonics-based approach to teaching word identification is an effective way to improve the reading ability of children (NICHD, 2000). The following review of the literature identifies evidenced-based strategies (sight-word, phonics-based, computer-assisted instruction) for teaching students with autism to read words.
Review and Analysis of Studies Related to Sight-Word Strategies

Before analyzing the professional literature regarding phonics-based approaches to teaching students with autism how to decode words, a review of the literature regarding previous strategies, in particular sight-word strategies, was conducted. Sight-word strategies have been effective for teaching students with autism to identify words (Browder & Lalli, 1991). Interventions reported in the literature were used to teach sight-word identification using superimposition and background fading (Birkan, McClannahan, & Krantz, 2007), paired associate and picture-to-text matching (Fossett & Mirenda, 2006), and direct instruction, discrete trials, and time delays (Spector, 2011). Some benefits of sight-word instruction included teaching students that print is a means of communication (Broun, 2004), that learning an entire word is more concrete than learning abstract phonemes (Broun & Oelwein, 2007), and that sight-words can serve as a foundation for the alphabetic principle (Kaderavek & Rabidoux, 2004). The following review of the literature involves analysis of sight word strategies for 11-14 year old students with autism (see Table 1). Of the five studies reviewed, two addressed instructional formats (McGee, Krantz, & McClannahan, 1986; Kamps, Walker, Locke, & Delquadri, 1990), and three addressed instructional strategies (Rincover, 1978; Fossett & Mirenda, 2006; Collins, Hager, & Galloway, 2011).

McGee et al. (1986) investigated the effects of incidental teaching on reading instruction for two children diagnosed with autism. Incidental teaching practices at that time focused more on developing the functional language of students. McGee et al. (1986) sought to extend the research on incidental teaching to examine the effect of incidental teaching on reading instruction for students with autism. The first student was
Table 1

*Sight-Word Instruction for Students with Autism*

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Design</th>
<th>N</th>
<th>Disability</th>
<th>Age (in years)</th>
<th>IQ</th>
<th>Dependent Variable</th>
<th>Independent Variable(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McGee, Krantz, &amp; McClannahan</td>
<td>1986</td>
<td>MBD</td>
<td>2</td>
<td>Autism</td>
<td>5-13</td>
<td>*</td>
<td>Number of words read</td>
<td>Incidental Teaching</td>
</tr>
<tr>
<td>Kamps, Walker, Locke, &amp; Delquadri</td>
<td>1990</td>
<td>Alternating Treatment</td>
<td>3</td>
<td>Autism</td>
<td>8-11</td>
<td>39-53</td>
<td>Number of words read</td>
<td>1:1 teaching, small-group</td>
</tr>
<tr>
<td>Rincover</td>
<td>1978</td>
<td>Experimental</td>
<td>8</td>
<td>Autism</td>
<td>7-15</td>
<td>&lt;32</td>
<td>Number of words read</td>
<td>Stimulus Fading, Discrimination</td>
</tr>
<tr>
<td>Fossett &amp; Mirenda</td>
<td>2006</td>
<td>Alternating Treatment</td>
<td>2</td>
<td>Autism, Soto Syndrome</td>
<td>10-11</td>
<td>40</td>
<td>Number of words read</td>
<td>Paired associate, Picture-to-Text Matching</td>
</tr>
<tr>
<td>Collins, Hager, &amp; Galloway</td>
<td>2011</td>
<td>MBD</td>
<td>3</td>
<td>Autism</td>
<td>14-15</td>
<td>41-55</td>
<td>Number of words read</td>
<td>Constant Time Delay</td>
</tr>
</tbody>
</table>

*Note. MBD = Multiple Baseline Design. * = Not reported*
a 5 year old female with a primary diagnosis of autism and a secondary diagnosis of neurologically impaired. The second student was a 13 year old male with a primary diagnosis of autism and a secondary diagnosis of Childhood Schizophrenia and moderate Intellectual Disability. Both students demonstrated severe functional language delay and slow progress in using the Edmark Reading Program. Intervention occurred within the subjects’ classrooms, in an area of the room designated as the play area.

The study was conducted in four parts. First, the students were assessed on their preferences for toys that were able to fit inside a standard-size shoe box. Second, students were given acquisition probes, wherein the researchers assessed the student’s ability to identify previously learned words. Students were presented with five words (3 target and 2 discrimination), and asked, “Give me the word ___.” No verbal feedback was given for either correct or incorrect responses. The purpose was to ascertain whether or not the student was able to recall previously learned words.

Third, students were taught using an incidental teaching procedure that occurred during daily 25-minute play activities in the play area of the classroom. Words taught during these play sessions were divided into three sets: Each set contained three target and two discriminating words. Both the teacher and the student sat on the floor, and the teacher presented two toys (target and non-target) to the student. If the student chose the non-target toy, s/he was allowed to play with it without any response. If the student made an attempt to play with the target toy, the teacher placed the target word in front of the toy and said, “Give me the word ____.” while extending her hand. A correct response was indicated by the student picking up the target word and placing it in the teacher’s hand. Correct responses after the first prompt meant the student was allowed to play with
the toy for 60 seconds. Incorrect responses after the first prompt meant the word cards was shuffled, and the teacher again said, “Give me the word ____.” while extending her hand. If the student incorrectly answered after the second prompt, the teacher shuffled the word cards, gave the verbal prompt, and this time guided the student’s hand to select the correct target word. The student was then allowed to play with the target toy for 60 seconds.

These three levels of prompts ensured errorless learning. As the student answered correctly after the first prompt, another word from the first set of target words was added to the presentation, and the verbal prompt was given again. This cycle continued until all five words within the first word set were presented to the student. As the student answered incorrectly after the first prompt, one word was removed from the presentation. If the student was able to correctly identify all three target words before the end of the 25 minute session, incidental teaching continued, this time using previously learned words. The criterion for advancement to learning a new target word was 80% accuracy over two consecutive sessions.

Fourth, generalization probes occurred every fifth teaching session and were conducted using three separate events. The first generalization probes were conducted in another area of the classroom. The toys were placed in shoe boxes on a shelf, and the word cards were placed in front of the shoe box, with a rubber band securing the lids. The teacher gave the instruction, “Find the ____.” If the student selected the correct shoe box, the teacher said, “You found the ____, so you can play with it now.” The student was given 60 seconds to play with the toy. If the student selected the incorrect shoe box, it was taken from the student and replaced on the shelf. The second generalization probe
changed the size and type of font used for the word cards, and followed the same procedure used for the first generalization probe. The third generalization probe consisted of cued and uncued reading from a book, where nine target words were typed on white paper, one word per page, and put into book form. During the cued reading probe, the teacher turned each page of the book and said, “Read.” No feedback was given for correct or incorrect responses. During the uncued reading probe, the book was presented to the student and no direction was given.

A multiple baseline design across target words was used to assess the student’s ability to read the target words. Data were collected on the independent variable (incidental teaching) and the dependent variable (number of words read). Four components of incidental teaching were recorded: (a) child initiation; (b) teacher prompts; (c) correct child response; and (d) access to the item. The researchers did not specify how the data were analyzed, but it can be concluded that they used percentages (number correct / total number of target words in each set). In terms of the child responses, both students met criterion for all three word sets (80% identified over two consecutive sessions). The first student met criterion for each word set after six to nine sessions (85%, 100%, and 93% for word sets 1-3); the second student met criterion for each word set after eleven to 21 sessions (96%, 100%, and 89% for word sets 1-3). In terms of child initiation, the first student initiated an average of 25 times per session, and the second student initiated an average of 35 times per session. In terms of teacher prompts, 86% of all teaching episodes yielded correct responses after the first prompt was given. Results from the generalization probes were similar to the acquisition results for the first student: shoebox – same type (85%, 84%, 89% for each set of words); shoebox –
different type (100% for all three sets of words); cued reading (100%); and uncued reading (100%). Results for the second student were not similar to his acquisition results: shoebox – same type (97%, 95%, 100% for each set of words); shoebox – different type (100%, 100%, 89%); and cued reading (33%, 33%, 22%). Remedial training was provided to this student and results after the training improved for word set one and two, but remained at baseline levels for word set three.

McGee et al. (1986) concluded that incidental teaching can be used to teach students to acquire reading skills. Students were able to learn nine target words and generalize to novel situations. Furthermore, McGee et al. suggested that the incidental teaching strategy was effective for students with autism because it maintained their attention, provided access to preferred toys, and was quick in its pacing. One positive finding was the ability to demonstrate comprehension of targeted words. Another positive finding was the demonstration of an experimental effect across two subjects. However, one major limitation was the inability to explain why the second student did not perform as well on the generalization probe for the third set of target words. The researchers listed the student’s perseverative inclination towards one of the words (“owl”) as a possible reason why he did not perform as well. Further analysis on why he performed well on the first two sets and not the third is warranted. The two students were not comparable in terms of age (5, 13, respectively). The only similarities exhibited were their primary diagnosis of autism, severe speech delays, and slow progress on the reading program. Another limitation was the 1:1 format of the acquisition and generalization probes. As students with autism are being given greater access to the general education environment, teaching in a 1:1 format is not always possible.
Kamps et al. (1990) addressed one of the limitations from the McGee et al. (1986) study: 1:1 teaching format. Kamps et al. (1990) sought to determine the effectiveness of the 1:1 teaching format versus small group arrangements on word recognition skills of three students with autism. They further assessed the difference between instructional agents (peer, teacher, classroom aide). The first two students in this study were eight year old boys with similar IQ scores (50, 53, respectively). The third student was eleven years old with a lower IQ (39). Expressively, the first and second student demonstrated some appropriate phrase usage with errors in speech patterns, while the third student demonstrated echolalic responses. Three different instructional agents (teacher, teaching assistant, and peer) were used in this study. The teacher had taught for more than 10 years and had experience teaching small-group instruction. The teaching assistant supported the teacher during instructional time, and assisted students as needed. The peer tutors were fifth grade students who had training as academic tutors for students with autism.

Before the intervention began, the experimenters provided training to the instructional agents (peers, teaching assistant, and teacher) in how to deliver the discrete trial presentation, along with a description and practice in error correction procedures. Instructional agents were given four different ways of presenting the discrete trial format: (a) present the word card; (b) present a group of word cards and solicit a response through pointing; (c) present a group of word cards and have students match; and (d) present a group of word cards and solicit a verbal response. During the baseline phase, experimenters assessed the student’s performance on the Dolch Basic Sight Words by presenting four columns of 10 words each, one at a time, and saying, “Read these words.”
This occurred for five days, after which the incorrect words were identified as target words to teach during the subsequent instructional phases.

The first instructional phase was first taught in a 1:1 format by a typical peer, followed by 1:1 format by the teaching assistant, and finally small-group instruction by the teacher. Each of the 1:1 sessions lasted for 8 minutes, and the small-group instruction lasted 32 minutes. A fifteen minute break was given to the students after each session. Ten words were taught during each session, for a total of 30 words taught for the first instructional phase. During the small-group instruction, all three students were taught the same five words collectively and five different words individually. This instructional phase occurred over a four week period, totaling 13 probes per each instructional agent.

The second baseline phase was similar to the first, wherein 30 new words were presented to the students. Upon selection of the target words, the second instructional phase began. This phase was similar to the first, except the teacher delivered instruction in the 1:1 format and the teaching assistant delivered the small group instruction. The length of time was diminished: 2 weeks totaling 6 probes per instructional agent. A third baseline phase was instituted, which assessed the acquisition of all words taught to the students (60 words for the first and second student; 105 words for the third student). The third student demonstrated mastery more quickly than the first and second student, and was therefore taught more words. A maintenance probe was conducted which was similar to the first instructional phase in terms of instructional agent presentation (1:1 peer, 1:1 teaching assistant, and small-group teacher). The only exception was that all words previously taught were re-taught.
An adapted alternating treatment design was used in this study which allowed the experimenters to compare the different instructional formats (1:1, small-group) to the instructional agents (peer, teaching assistant, and teacher). Four dependent variables were measured: (a) words correctly read; (b) on-task behavior; (c) self-stimulatory behavior; and (d) incidentally learned words. For the first dependent measure, students were assessed immediately after each instructional format, resulting in percentage identified correctly. For on-task and self-stimulatory behavior, students were assessed using a 15-second momentary time sampling for five minutes during each instructional format. For incidental learning, students were randomly assessed five times after the small-group instructional format. Four components of the independent variable (instructional procedure) were measured: (a) number of trials; (b) number of modeled responses; (c) number of prompts; and (d) number of opportunities to respond. These components were measured using a 5-minute event recording procedure, 7 of the 1:1 sessions and 9 of the small-group sessions.

Results from the two instructional and one maintenance phases suggested that the effectiveness of the procedure was influenced by the instructional format (1:1, small group) and the delivering agent (teacher, peer, teaching assistant). All students obtained 100% accuracy in the small-group format delivered by the teacher in the first instructional phase, and again obtained 100% accuracy in the 1:1 format delivered by the teacher in the second instructional phase. Data for the peer tutors suggest the acquisition of target words was slower and produced lower accuracy rates (40-70% in phase one, 60-100% in phase 2, and 65-70% in the maintenance phase). When small-group instruction was delivered by the teacher’s aide, the second and third student demonstrated slower
acquisition of the target words but ultimately achieved 90-100% accuracy. In terms of the incidental teaching probes conducted on the words learned via the small-group format, the first student demonstrated no incidental learning, the second student learned two words, and the third student learned all 15 words. While the researchers do not discuss the differences between the three students on the incidental teaching probes, it can be concluded that the first student was not successful due to behavioral limitations (i.e., unable to attend to task). The second student was more capable of attending to task when instruction was delivered by a teacher; however, he failed to remain on task during independent instruction. The third student demonstrated rote memorization skills, which could account for the acquisition of all 15 words. Results for student behaviors indicated that students behaved better for the teacher in the 1:1 teaching format and behaved poorly for the aide in the small-group teaching format.

Kamps et al. (1990) concluded that the 1:1 and the small-group formats when delivered by a teacher produced more effective results than when delivered by a peer or a teaching assistant. Kamps et al. further concluded that these findings do not suggest instruction by the teacher is superior to the other two agents. The student’s demonstrated acquisition of the target words with all three agents; the only difference was in the rate of learning. This finding suggests that typical peers could serve as effective models as students with autism are included more within the general education environment. Kamps et al. further concluded that formats delivered by the teaching assistant required further examination. Negative behaviors were higher for the aide during small-group instruction, and it was suggested future research look at the prerequisites for staff.
Strengths of this study include (a) identifying 1:1 and small-group formats as effective means of teaching sight word recognition to students with autism; (b) demonstrating that peers, aides, and teachers can all be taught effective means of discrete trial presentations; and (c) the adapted alternating treatment design used, despite the inability to counterbalance the two teaching formats and three instructional agents, was a solid design, according to prior research. One limitation, however, is the length of the second instructional phase and the maintenance phase. The first phase occurred over a 4-week period, the second phase over a 2-week period, and the maintenance phase over a 1-week period. In conjunction with this limitation is the number of times the instructional format by the instructional agents was utilized. For example, the first phase and the maintenance phase assessed 1:1 peer, 1:1 teaching assistant, and small-group teacher, whereas the second phase assessed 1:1 peer, 1:1 teacher, and small-group teaching assistant.

Stimulus fading and discriminative responding are techniques used to train students with autism to identify words (Rincover, 1978). However, Rincover concluded that these techniques failed to demonstrate how students with autism transfer from the prompt to the training stimulus and failed to demonstrate if learning was occurring. Rincover conducted two experiments to answer these two deficit areas in the research. The same eight students were used for both experiments. Each student lived in an institution, demonstrated impaired verbal ability (mute, echolalia), engaged in self-stimulatory behaviors (hand-flapping), and did not respond to verbal instructions. IQ scores were unavailable for four of the students due to being untestable; the other four students scored below 32. The age range of the students was from 7-15 years old. This
first experiment occurred in a 10 x 10 foot room, where the student sat at a rectangular table directly across from the experimenter. The sight word cards were placed on the table in front of the student.

The purpose of the first experiment was to determine how students with autism transfer from the prompt to the training stimulus. Four variables were assessed during this experiment: within-stimulus distinctive feature, extra-stimulus distinctive feature, within-stimulus nondistinctive feature, and extra-stimulus nondistinctive feature. For the within-stimulus distinctive feature condition, a feature (i.e., line, curve) of the target word was identified and taught before the presentation of the target and non-target words (prompt pretraining). First the student was taught to correctly touch the feature card. A phase change occurred once the student identified (touched) the feature card in 10 consecutive sessions. Second, the feature card and a blank card were presented to the student, wherein the student was asked to touch the feature card. A phase change occurred once the student discriminated (touched) the feature card in 10 consecutive sessions. The next six steps used a prompt fading procedure, where both target and non-target word cards were presented to the student, with the distinctive feature gradually being reduced in size until it blended with the target word. A phase change occurred after the student correctly identified (touched) the target word in 5 consecutive sessions. A modified backup fading procedure was used if the student incorrectly identified the target word; the experimenter presented the last phase in which the student correctly identified the target word in 5 consecutive sessions. The procedures were the same for the remaining three variables being assessed. The extra-stimulus distinctive feature presented a feature from the target word, but the location of the feature was above, not blended into, the target word. The
within-stimulus nondistinctive feature presented a feature that was similar to both words. For example, a “u” shape was used when the target word was “JAR” and the nontarget word was “SON”; the “u” shape matched the bottom curve of the “J” and the bottom curve of the “S”. The extra-stimulus nondistinctive feature presented a feature that was similar to both words, but the location of the feature was above, not blended into, the target word. Each session lasted 20-30 minutes, once per day, five days per week.

A Latin square design was used as the experimental design, with the Cochran Q test used to assess the interaction effects of the two variables (distinctive, nondistinctive). The dependent variable was whether or not the student was able to correctly discriminate the target word. Results suggested the within-stimulus distinctive fading feature was most effective in teaching students to identify target words, whereas the extra-stimulus nondistinctive fading feature was the least effective. Furthermore, the main effect for within- versus extra-stimulus and distinctive versus nondistinctive was significant (p<.01); interaction was not significant. Rincover (1978) concluded the within-stimulus and distinctive variables were more likely to teach students with autism to identify sight words. One strength to this first experiment was the ability to replicate the results from the description provided. However, one limitation was the sight words taught did not resemble what typically developing students would have been learning. The target words were bun, jar, gin, and rum. No 7-15 year old student is going to be learning the sight word “gin” and “rum” in an educational setting.

The purpose of the second experiment was to assess whether or not the students were learning to identify sight words using more than the stimulus. Four probes were administered to the students in the same setting as described previously. Probe 1 was a
maintenance probe to see if the students were able to identify the sight words with a variable reinforcement schedule rather than a constant reinforcement schedule. Probe 2 removed the pretrained feature. Probe 3 presented the pretrained feature on both the target and nontarget word card. Probe 4 replaced the first letter of the nontarget word with the first letter of the target word. Each probe was presented for 20 trials. Results indicated the ability to identify the sight words was maintained (Probe 1) for almost all 20 trials across all students (p<.001). Probe 2 and 3 results indicated the students were still able to identify the sight words when the pretrained feature was removed (Probe 2) and when the feature was presented on both the target and nontarget word cards (Probe 3) (p<.02). Results from Probe 4 were not significant.

Rincover (1978) concluded students with autism are able to identify sight words using multiple features of the target word, and not just the single feature directly taught during Experiment 1. Another conclusion is these students performed better when the feature was presented in the within-stimulus variable (i.e., the location of the feature was on the letter itself, not above). One major finding is students with autism were not able to look at the other letters in the target words. They were taught to identify the stimulus on the first letter of the word, but when the first letter was removed (as in Probe 4), six of the eight students were unable to identify the target word.

One iteration to the stimulus fading and discriminative responding strategy researched by Rincover (1978) is the paired associate method (PA) and the picture-to-text matching method (Fossett & Mirenda, 2006). The PA method has one major limitation, the “blocking effect”, where the use of pictures interferes with learning sight words. Stimulus fading has been studied as one method to reduce the blocking effect, and has
been shown to be effective. The PTM method suggests that pictures are effective in teaching sight word recognition. Fossett and Mirenda (2006) looked at comparing two methods of sight word instruction (paired associate, picture-to-text matching) when using pictures to determine which one is more effective.

Two subjects were selected for this study. Inclusion criteria for the subjects were they had to be at least 7 years old, speak English as their primary language, not be able to read sight words, be able to work in 1-hour sessions with breaks, and be able to match 10 picture symbols. The first subject, Jason, was 10 ½ years old, diagnosed with autism, and, according to the Peabody Picture Vocabulary Test-III, had a standard score of 40 and an age equivalent score of 3 years, 3 months. Jason could only say 10 words or less. The second subject, Sam, was 11 ¾ years old, diagnosed with Soto Syndrome, and had a standard score of 40 and an age equivalent score of 3 years, 9 months on the PPVT-III. Sam could engage in functional speech (request and obtain information).

Baseline data were taken for 5 days, with 1 hour sessions per day. During each baseline session, subjects were presented with a 3-ring binder, either the PA binder or the PTM binder. The selection of which binder came first was “counterbalanced across sessions to control for an order effect” (p. 417). Each page in the binder had one of the five sight words. The teacher randomly placed all five flash cards on the table, and told the subject, “Read.” The subject then had to put a flash card on the page, and then the next page was turned and instruction to read was given again. This occurred for all 10 words.

Each 1-hour session during the intervention phase began with a probe session, which followed the procedures used during baseline. Next, the target words to be taught
during this session were determined using a pre-defined criteria. In short, each level increased the number of words being taught at the same time. Errorless trials were used when targeting new words and discrimination trials were used when targeting learned words. Third, a flash card activity was conducted, where the target words being taught were placed on a slant board, and the subjects were asked to “read”. Correct response was when the subject placed the correct flash card into the teacher’s hand. Fourth, a “Find it” activity was used, and is identical to the flash card activity. The only difference was instead of the words being placed on a slant board at a table, the words were placed on a Velcloth that hung on a wall. Fifth, a matching worksheet was then given for each treatment (PA and PTM). The subjects needed to match the picture and/or text (depending on which matching treatment worksheet was given) by drawing a line to the one that matched. Sixth, a pasting worksheet was then given for each treatment. The subjects were to paste the correct picture or text + picture card next to the corresponding picture on the worksheet.

Only the PTM treatment was tested for generalization. The subjects were presented with the five pictures from the PTM treatment, asked to select one, were guided to a shelf that contained 5 opaque containers, asked to provide the name of the card, picked up the container, and brought it back to the table. Follow-up occurred 9 and 123 days after the final treatment was delivered. The procedure followed was from the intervention phase of the study.

Fossett and Mirenda (2006) used an alternating treatment design to compare the two different approaches. It was considered adapted because it used four phases: baseline, intervention, generalization, and follow-up. Results indicated both subjects demonstrated
mastery of all 5 sight words for the PTM condition, and learned 3 words or less during the PA condition. Generalization results for the PTM condition showed continuing mastery of all 5 sight words for Sam, and variable mastery for Jason (i.e., three sessions were conducted and Jason showed generalization of 4, 2, 5 words, respectively). Follow-up results were only collected for Jason (Sam was unavailable), and results showed Jason mastered all five sight words 9 days after generalization phase, and three sight words 123 days after generalization phase.

One major limitation to this study was too many activities occurring during the two condition phases (probe, instruction, flash card, find it, matching worksheet, and pasting worksheet). These activities could serve as confounding variables and lead the reviewer to question whether or not one activity was more effective in increasing sight-word recognition than another, or were they all equally important in teaching sight words. Another limitation was the incompatibility of the subjects; they were not similar in abilities (e.g., Sam used verbal speech more so than Jason). A second issue discussed in relation to the subjects was the inability to generalize findings to the greater population, given the small size of the subjects. Fossett and Mirenda (2006) suggested further research needed to be conducted on individuals with varying diagnoses and learning abilities. A third limitation to this study was the number of target words addressed ($n = 5$ words), which made it difficult to generalize the results to larger sight word vocabularies. The researchers further reported that Jason’s parents continued administering the PTM condition over a 2 year period, and he was able to learn 140 additional words. However, this was not conducted using a controlled experiment, and thus is more anecdotal.
One positive finding was the use of counterbalancing the conditions “across sessions to control for order effect” (Fossett & Mirenda, 2006, p. 417). However, no mention was made of how it was determined which conditions were selected to be first and second, nor whether the time of day was counterbalanced (Barlow et al., 2009). Discussion of these issues may lead to a stronger argument in favor of the results. The instructional levels and presentation of target words was an excellent guide to know how many words to teach at once, using what type of trial (e.g., errorless learning, discrimination). But no mention was made of how these criteria were established.

In terms of procedural reliability, the mean was high for the probe sessions, PTM and PA conditions (above 95.9%), and the range was low (75 – 100%, 88 – 100%, and 82.5 – 100%, respectively). Fossett and Mirenda did not address possible reasons for the low score. A discussion on this may help in solidifying the procedures, and may help prevent future researchers from making the same mistakes. The probe procedure was changed for Jason after the twelfth session. Fossett and Mirenda suggested this was necessary to minimize distractions from target words not learned; Jason played with the target word cards. Unfortunately, the condition phase ended, and no attempt was made to determine whether or not he learned the words due to chance or due to actual learning.

Collins et al. (2011) recently examined the effects of constant time delay (CTD) when teaching sight words using core content and functional curriculum. While the researchers looked at three different domains (language arts, science, and math), for the purpose of this review, the language arts domain was addressed. The purpose of this study was to teach both core and functional content simultaneously to three students receiving special education services. The first student, Jason, was a 14-year old male with
an IQ of 56 and high expressive abilities; the second student, Morgan, was a 14-year old male with autism and IQ of 47; and the third student, Rena, was a 15-year old female with Down syndrome and IQ of 41. All students were able to receptively follow directions and had been taught with direct instruction coupled with a response-prompting procedure. Instruction for all three students occurred in a resource room setting, with a class size of four students, one licensed teacher, and two paraprofessionals.

The study began with a generalization probe for core and functional words. Jason’s generalization probe consisted of reading a newspaper and identifying sight words. Morgan’s and Rena’s generalization probe consisted of looking at three 5 inch x 7 inch white unlined index cards that had sight words pasted to each card. These sight words were cut out from a newspaper. Following the generalization probe, the baseline phase began. Students were each presented with three words written on 3 inch x 5 inch white unlined index cards. Jason was asked to orally read the word when pointed to by the teacher; Morgan and Rena were asked to point to the word said by the teacher. Responses were counted correct if the students read/pointed to the correct word within 3 seconds. Next, the teacher began instruction in core and functional sight words using constant time delay in a 1:1 setting. During the first session, the teacher immediately prompted the student, ensuring a correct response; the time changed to 3 seconds for the remaining sessions. Verbal praise was given for correct responses. A model of the correct response (i.e., teacher pointing to the right card) was given for incorrect or no response behaviors. Once criteria was reached (100% on three consecutive session), three more generalization probes were conducted. Maintenance probes were then conducted for the remainder of the study.
A multiple baseline design across behaviors was used to assess the ability of students to identify sight words from core academic content and functional content. Data on the dependent variable were analyzed using descriptive statistics (i.e., percent correct responses). Results for Jason indicate he met criterion during intervention “in an average of 12.5 sessions” (p. 31), met criterion during generalization phase after the first session, and maintained language arts content with 92.5% accuracy. Morgan met criterion during intervention “in an average of 30 sessions” (p. 32), met criterion during all three sessions in the generalization phase, and maintained language arts content with 75% accuracy. Rena met criterion during intervention “in an average of 9 sessions” (p. 33), met criterion during generalization after the first session, and maintained language arts content with 90.8% accuracy.

Collins et al. (2011) concluded that using a constant time delay strategy was effective in teaching core academic and functional content to students with autism. Despite these findings, several limitations reduced the overall generalizability of this study. First, Collins et al. cite the 1:1 teaching format conducted in a resource room setting as a limitation. According to their report, the number of students in the resource room was only four, with one teacher and two instructional aides. Delivering the content in a 1:1 format in a room with more students and reduced support is not discussed within this study. A second limitation found in the baseline and maintenance probes for Jason was that he demonstrated a greater ability to identify functional sight words (60%) whereas his ability to identify academic sight words was lower (0%). Maintenance data suggest variability in the functional sight words, with multiple sessions (7) returning to the baseline data (60%) from criterion (100%). This variability was not explained by the
researchers, and since no parametric or nonparametric statistical analyses were conducted, it was difficult to determine whether or not this variability was significant. Rena demonstrated two outliers in her maintenance data, and no plausible explanations were provided. Third, the instructional procedure was altered during the intervention phase for Morgan (constant reinforcement after correct responses was replaced with differential reinforcement before each prompt). Collins et al. (2011) suggested this change in the delivery of reinforcement was necessitated by Morgan’s slow progress. Furthermore, new phases of the intervention (science, math) began before criterion was met due to time constraints. These limitations impacted the ability of the researchers to generalize these findings to the greater population.

**Summary of Research Related to Sight Word Approaches**

In terms of instructional formats (incidental teaching, 1:1, small group, and peers), McGee et al. (1986) concluded that incidental teaching can be used to teach students with autism to identify sight words. Results further indicated students are able to generalize to three different settings (shoe box, different font-type, and cued/noncued reading). Kamps et al. (1990) addressed one of the limitations of McGee et al. (1986): 1:1 teaching format. Kamps et al. concluded that students with autism could learn from three different instructional formats: 1:1, small group, and from peers. In terms of instructional strategies, Rincoveer (1978) demonstrated students with autism identified sight words using stimulus fading and discriminative responding. However, these students only attended to the stimulus prompt, and were therefore unable to generalize to other words. Fossett and Mirenda (2006) sought to determine which strategy was more effective: paired associate (PA) or picture-to-text matching (PTM). They concluded the PTM
intervention was more effective in teaching students with autism to identify sight words. Finally, Collins et al. (2011) looked at the effectiveness in using a constant time delay procedure for teaching academic and functional content to students with autism. They concluded that CTD was an effective means for teaching sight words to this population.

Despite the positive findings from these five studies, the limitations discussed previously seriously inhibit the generalizability of these results to the general autism population. One criticism of sight word instruction for students with autism is that students are only taught to identify words that have been explicitly taught (Spector, 2011). Ehri (2005) further suggested that students with autism demonstrated confusion when attempting to read words that have similar orthographic patterns. These two criticisms were demonstrated by McGee et al. (1986), when the students were not able to generalize the stimulus prompt to the rest of the letters in the word. Furthermore, in order to successfully read sight words, students must be able to relate their background knowledge to the words being read (Kouri et al., 2006). Students with autism lack background knowledge due to a lack of exposure to print and books while in their early childhood years (Browder et al., 2006). The characteristics of the students in the studies reviewed suggest diminished vocabularies, lower IQs, and repetitive behaviors; therefore, it is most likely that they did not have much background knowledge on the sight words being taught, nor were they exposed to print and books while young. These criticisms suggest that teaching students with autism to identify words by sight may not be the most effective way to teach reading.
Review and Analysis of Studies Related to Phonics-Based Word Identification Strategies

A phonics-based approach to learning how to read addresses phonemic awareness, phonics, vocabulary development, fluency, comprehension, and critical literacy (Adams, 1990; Freebody & Luke, 1990; National Institute of Child Health and Human Development [NICHD], 2000; Stevens & Bean, 2007). One component of a skills-based approach to reading is phonics, and more specifically word identification strategies. Word identification strategies teach students to match letters to sounds, and then blend those sounds to make words (NICHD, 2000). The following review of the literature analyzes word identification strategies for 11-14 year old students with autism (see Table 2). Of the six studies reviewed, one addressed medical aspects related to word/speech acquisition (Wilcox, Tsuang, Ledger, Algeo, & Schnurr, 2002), four addressed disparities between decoding skills and comprehension (Nation et al., 2006; Newman, Macomber, Naples, Babitz, Volmar, & Grigorenko, 2007; Huemer & Mann, 2010; Åsberg, Kopp, Berg-Kelly, & Gillberg, 2010), and the remaining study addressed a structured intervention for improving the literacy skills of students with autism (Bailey, Angell, & Stoner, 2011).

Wilcox et al. (2002) analyzed cerebral blood flow in 28 subjects whose ages ranged from 3-37 years old. The purpose of the study was to determine whether or not a causal link could be found in language/word identification skills. Of the 28 subjects, 14 were diagnosed with autism (experimental group), and 14 were typically developing individuals (control group). Both groups were matched in terms of gender, age, and handedness. The participants in the control group did not have any neurological
Table 2

Phonics Instruction for Students with Autism

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Design</th>
<th>N</th>
<th>Disability</th>
<th>Age (in years)</th>
<th>IQ</th>
<th>Dependent Variable</th>
<th>Independent Variable(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilcox, Tsuang, Ledger, Algeo, &amp; Schnurr</td>
<td>2002</td>
<td>Experimental</td>
<td>28</td>
<td>Autism, TYP</td>
<td>3-37</td>
<td>*</td>
<td>Blood flow</td>
<td>SPECT</td>
</tr>
<tr>
<td>Nation, Clarke, Wright, &amp; Williams</td>
<td>2006</td>
<td>Experimental</td>
<td>41</td>
<td>ASD</td>
<td>6-15</td>
<td>*</td>
<td>Words read</td>
<td>Reading assessments</td>
</tr>
<tr>
<td>Newman, Macomber, Naples, Babitz, Volkmar, &amp; Grigorenko</td>
<td>2007</td>
<td>Experimental</td>
<td>41</td>
<td>ASD, HPL</td>
<td>5-20</td>
<td>&gt;70</td>
<td>Words read</td>
<td>Achievement tests</td>
</tr>
<tr>
<td>Huemer &amp; Mann</td>
<td>2010</td>
<td>Experimental</td>
<td>484</td>
<td>ASD, Dyslexia</td>
<td>10-11**</td>
<td>*</td>
<td>Words read</td>
<td>Measures of reading performance</td>
</tr>
<tr>
<td>Åsberg, Kopp, Berg-Kelly, &amp; Gillberg</td>
<td>2010</td>
<td>Experimental</td>
<td>110</td>
<td>ASD, ADHD</td>
<td>8-17</td>
<td>&gt;70</td>
<td>Words read</td>
<td>Reading and Writing Assessments</td>
</tr>
<tr>
<td>Bailey, Angell, &amp; Stoner</td>
<td>2011</td>
<td>MBD</td>
<td>4</td>
<td>ASD, DS</td>
<td>12-15</td>
<td>*</td>
<td>Words read</td>
<td>Structured Literacy</td>
</tr>
</tbody>
</table>

Note: MBD = Multiple Baseline Design; * = Not reported; ** = Average age report; ASD = Autism Spectrum Disorders; HPL = Hyperlexia; ADHD = Attention Deficit Hyperactivity Disorder; DS = Down Syndrome; TYP = Typically developing individual.
impairment, and were not taking any medications. While the researchers do not specify where the study occurred, it can be inferred that it took place within a medical office type setting. Each of the individuals underwent a Single Photon Emission Computed Tomogram (SPECT) for 10 minutes. Results suggested the decrease in blood flow in the prefrontal cortex of individuals with autism was significant when compared to the control group ($t = 8.25, p < 0.001$). This finding was similar across all ages assessed. Wilcox et al. further identified a high correlation in the diagnosis of autism and the decreased blood flow to the cerebral cortex ($r = 0.88, p = 0.003$). Finally, the results suggest decreased blood flow to the speech areas (left temporal lobe) of the brain “became quite profound in older subjects” (p. 14; $r = 0.79, p < 0.001$).

Previous researchers who investigated a similar dependent variable were unable to account for variations in age, but the results suggested poor blood flow to the left temporal lobe and poor glucose utilization accounted for “poor performances on verbally mediated tasks” (p. 15). Wilcox et al. (2002) further refined the results by matching all subjects by age. They suggested language acquisition (i.e., word identification skills, language formation skills) and social behavior may be caused by decreased blood flow to the frontal cortex and left temporal lobe in the brains of individuals diagnosed with autism. This finding suggested older individuals with autism may have a medical reason for not being able to acquire word identification skills. Despite having a more refined inclusion criterion, Wilcox et al. examined a broad range of individuals (3-37 years old). Future studies should focus on the middle-school age range (11-14 years old) to determine whether or not these findings continue to be significant.
Several researchers have suggested that students with autism exhibit low and high abilities reading sight words, decoding nonwords, reading connected text, and comprehending what is being read (Nation, 1999). Nation et al. (2006) investigated this variability in reading abilities for students with autism. A total of 41 children ages 6 to 15 years old participated in the study. This sample was further defined by severity of the disability: 16 students met the criteria for autism; 13 students met the criteria for atypical autism; and 12 students met the criteria for Asperger’s syndrome. At the outset of the study, 9 students were excluded due to an inability to read. Nation et al. (2006) do not mention how it was determined that these students were unable to read. The remaining 32 students (10 with autism, 10 with atypical autism, and 12 with Asperger’s) were administered the four part battery of assessments. The students were assessed in a single session lasting 1.5 hours within their home environment or in a quiet room in their schools.

Four assessments were administered to the students to measure their reading abilities: (a) reading accuracy; (b) reading comprehension; (c) oral language skills; and (d) nonverbal ability. The specific procedures for administering these tests were not mentioned by the researchers; it is assumed that they followed the protocol for each standardized assessment. To assess reading accuracy, the following assessments were administered: the British Ability Scales-II test was administered to determine the student’s ability to read words by sight; the Graded Nonword Reading test was administered to determine the student’s ability to decode unknown words; and the Neale Analysis of Reading Ability-II test was administered to determine the student’s ability to read connected text. To assess reading comprehension, the Neale Analysis of Reading
*Ability-II* was administered. Two measurements were administered to assess oral language skills: the *British Picture Vocabulary Scale* (for receptive vocabulary) and the *Wechsler Intelligence Scale for Children* (for oral language comprehension). Finally, the *Block Design* subtest was administered to measure the nonverbal ability of the students. Nation et al. did not mention the experimental design used.

Results from the reading accuracy test suggest students performed similar to a normative sample in sight-word reading abilities, in nonword decoding abilities, in within context word reading, and in comprehension. In terms of language skills, specifically receptive vocabulary, the students performed in the low-end of the normal distribution. Oral language comprehension scores and nonverbal ability scores were relatively lower.

As predicted, the researchers identified variability in performance from the data collected. The range of data for word reading and nonword reading abilities suggest variability in the autism population. Students performed poorly on sight-word reading and on nonword reading, but performed well on these same measures. This suggests that within the autism population many different types of readers exist. Furthermore, Nation et al. (2006) concluded low decoding skills was one reason for low levels of reading accuracy within this population. One limitation to this study was that the researchers assessed the broad range of the autism spectrum disorder. Obtained results cannot be generalized to the three subsets identified due to the low participation. Another limitation was the length of time per session: 1.5 consecutive hours. A future study should contain multiple sessions to ensure continual attention to task. As such, the results reported may be negatively affected by the length of the session.
Children sometimes demonstrated hyperlexia, or the ability to read words that are higher than others of their same age group yet demonstrate lower comprehension skills (Newman et al., 2007). Some children diagnosed with an autism spectrum disorder have demonstrated hyperlexia. It is unclear, however, whether this strong reading and poor comprehension suggest hyperlexia in students with autism. Furthermore, it is unclear whether this ability to read text is due to stronger decoding skills or visual memory skills.

Third, little research exists as to how students with autism and hyperlexia compare to other students with autism (without hyperlexic characteristics) and typically developing peers. Lastly, previous researchers suggest typical students catch up to students with autism and hyperlexia in terms of comprehension ability by age 10. Newman et al. (2007) investigated these four problem areas within the field of word reading abilities and comprehension for students with autism.

A total of 41 students participated in this study: 20 students demonstrated hyperlexia and were diagnosed with ASD, 20 students demonstrated delayed reading skills and were diagnosed with ASD, and the remaining 18 students were typically developing peers. The ages of the students ranged from 9 to 12 years old. Two settings were used to deliver the study: the Yale University clinic and the student’s homes. Of the students with ASD+HPL, 10 were assessed in the Yale University clinic and 10 in their homes. All of the students with ASD-HPL were assessed in the clinic. Nine of the TYP students were assessed in the clinic and nine were assessed in the home.

Achievement tests were used to assess the current reading abilities of all three groups. Selected subtests from the Woodcock-Johnson Tests of Achievement-III (Woodcock, McGrew, & Mather, 2001), the Comprehensive Tests of Phonological...
Processing (Wagner, Torgeson, & Rashotte, 1999), and the Test of Visual Perceptual Skills (Gardner, 1996) were used to determine the performance differences in reading abilities of all three groups. A fourth, study-specific assessment, was developed to measure the visual short-term memory of all three groups. No mention is made by Newman et al. (2007) as to what order the tests were administered and which subjects received the tests in the home or clinical setting. Data were analyzed using parametric (ANOVA) and non-parametric (Kruskal-Wallis Test) for each measure. It is assumed that the researchers followed the protocols in the administration of the subtests. The researchers did not state the experimental design used in the study. Data were analyzed using standard scores and number correct (for subtests of the WJ-III) and time in seconds (for the CTOPP).

Results from the first question investigated by Newman et al. (2007) indicate a significant difference in the single-word recognition among the three groups: students with ASD+HPL were able to read words significantly better than students with ASD-HPL; and TYP students read words significantly better than students with ASD-HPL. ASD+HPL students and TYP students were matched in their abilities (no data reported). Comprehension results were similar to single-word reading results: ASD+HPL comprehended text significantly better than ASD-HPL, and TYP comprehended text significantly better than ASD-HPL. Results from the nonparametric analysis on comprehension indicate that there is no significant difference in the comprehension abilities of ASD+HPL and ASD-HPL, but a significant difference exists between TYP and ASD+HPL.
Results from the second question investigated by Newman et al. (2007) indicated significant group differences on pseudoword decoding abilities. On the parametric analysis, students with ASD+HPL performed significantly better than students with ASD-HPL, and no significant difference was found between ASD+HPL and TYP students. On the simple visual memory tasks, there was no significant difference between all three groups. However, TYP students performed significantly better on this task than ASD-HPL. Nonparametric results indicated a significant difference between two groups: ASD+HPL performed significantly better than ASD-HPL and TYP performed significantly better than ASD-HPL. Again, performance between TYP and ASD+HPL was not significant. In terms of the complex visual memory tasks, similar results were obtained, where ASD-HPL performed worse than the other two groups. Results for the remaining two questions investigated by Newman et al. will not be discussed here, as they provide no relevance to the current study being proposed.

Newman et al. (2007) concluded that students with ASD+HPL performed equal to TYP students, and students with ASD-HPL performed more poorly than the other two groups. While this study focused more on students with ASD+HPL, one conclusion was that students with ASD-HPL demonstrated the ability to read words using decoding skills, but at a level which was significantly lower than students with ASD+HPL. As mentioned previously, relatively few studies were identified that addressed how to teach decoding skills to 11-14 year old students with autism. Newman et al. broadened the literature by suggesting students with ASD-HPL can decode words, just not at the level of their ASD+HPL counterparts. Future studies need to address how students with ASD-HPL decode words.
Huemer and Mann (2010) conducted a similar study to the one by Newman et al. (2007). Newman et al. investigated reading abilities among students with an autism spectrum disorder (ASD) who did and did not display hyperlexia and compared these two groups to typically developing students. Huemer and Mann (2010) investigated the reading abilities of students with ASD and dyslexia, specifically looking at the decoding and comprehension skills of these two populations. A total of 484 students participated in this study: 171 with a diagnosis of autism; 94 with a diagnosis of Asperger’s; 119 with a diagnosis of PDD-NOS; and 100 with a diagnosis of dyslexia. Participants attended the Lindamood-Bell Learning Processes (LBLP) centers throughout the United States (1 in London, England) from 2001-2006.

As students enrolled in the LBLP learning centers, they were assessed on nine measures of decoding and comprehension in the centers by an experienced technician in a 4-hour block of time or two 2-hour sessions if needed. The analyzed data were generated from the intake assessment. A factor analysis of z-scores was first conducted to analyze the relationship between decoding and comprehension abilities. Two factors were identified which accounted for, respectively, 36% and 34% of variance. Results from repeated-measures GLM using the diagnostic group as the between-subject factor indicated that students with autism had the lowest factor scores (-.21), followed by PDD-NOS (-.14), Dyslexia (.23), and lastly Asperger’s (.31). The interaction between factors and diagnostic groups indicated a significant difference between the autism and the dyslexia group, but no significant difference between all four groups was found. In terms of gender and center location, no effects were reported between subjects. However, age demonstrated an effect on the factor scores. Finally, a MANCOVA of standard scores
was conducted to examine the effect of age across all measures; Older students performed more poorly than younger students.

Overall, the ASD population scored lower on comprehension measures, whereas the dyslexia population scored lower on decoding measures. The finding that students with autism performed better on decoding measures suggests there is another reason for the poor performance on comprehension. These results suggest that students with autism can learn decoding skills. On average, students with autism scored the lowest in terms of decoding and comprehension measures. Students with Asperger’s showed improvement with age, and the other three groups actually fell in their abilities. These results suggest students with autism do have the capability to learn how to decode words, yet as they advance in age, this ability diminishes. Huemer and Mann (2010) suggest more research on the disassociation between decoding and comprehension abilities in students with autism is warranted, especially due to the result that with age comes a decreased decoding ability.

One limitation to the study was the diagnostic criteria used to identify the participants. Parents simply reported to the center that their child(ren) had an autism spectrum disorder, and no follow-up diagnostic measure was administered to confirm the parent report. Huemer and Mann (2010) rationalized the nonconfirmation of the diagnosis by assuming another agency (e.g., school district, pediatrician, etc.) had already conducted the assessment. The cost to receive the services provided by the center was high, and the parents that paid via medical insurance would have had to have an independent diagnosis. Furthermore, the information provided by the center was collected as the students enrolled in the center. As such Huemer and Mann were unable to confirm
the diagnosis, since the data were analyzed post hoc. Future studies need to identify at what age do students with autism digress in their ability to learn how to decode words.

Åsberg et al. (2010) analyzed the literacy skills of girls identified as having either an autism spectrum disorder (ASD) or attention deficit hyperactivity disorder (ADHD). Specifically, they examined the students’ performance on standardized assessments that measured word decoding, spelling, and reading comprehension. Second, they examined the rates of reading and writing deficits within both groups of students. Lastly, they examined whether or not reading comprehension and word decoding skills could be predicted based on symptomatology. A total of 110 students participated in this study (20 with ASD, 36 with ADHD, and 54 typically developing peers). Mean ages were similar across the three groups (m = 11.8, 13.0, 12.5, respectively), and all students demonstrated normal IQ scores (95.2, 94.8, and 108.0, respectively). All students were tested in their reading and writing abilities by a special educator in a clinic in Sweden and took between 90 and 120 minutes per student.

Åsberg et al. (2010) did not indicate the order of the assessments; therefore, it is assumed they followed the pattern established in their report. First, two word decoding tests were administered to all students: the H4 test (Franzén, 1997) for 8-12 year old students, and the LS test (Johansson, 1992) for students 13 and older. These tests measured the student’s ability to efficiently decode single, out of context words. Second, two spelling tests were administered to all students: the Stavning spelling test (Rockberg & Johansson, 1994) for 8-12 year old students, and the LS test for students 13 and older. A sentence was presented to the students, and they were asked to spell a target word from that sentence. Third, two reading comprehension tests were administered to all students:
the ‘Diagnostiska läs- och skrivprov’ for 8-12 year old students (Björkquist & Järpsten, 1975/1976; Jävpsten & Taube, 1997), and the LS test for students 13 and older. After reading a passage, students answered multiple-choice questions. Fourth, the WISC-III (Wechsler, 1992) was administered to assess nonverbal ability. Fifth, the oral vocabulary subtest of the WISC-III was administered to all students to measure their oral reading vocabulary. Sixth, the Conners’ Teacher Rating Scale-Revised (Conners, Sitatenios, Parker, & Epstein, 1998) and the “Five to Fifteen” questionnaire (Kadesjö, Janols, Korkman, Mickelsson, Strand, & Trillingsgaard, 2004) were administered to the students and their parents to determine AD/HD symptomatology. Finally, the Autism Spectrum Screen Questionnaire (Ehlers, Gillberg, & Wing, 1999) was administered to the students to determine autistic symptomatology. Standard scores were collected and analyzed using various statistical procedures. Non-parametric statistics were used to evaluate group differences in reading, spelling, and background data. The Kruskal-Wallis test was used to compare all three groups on word decoding, reading comprehension, and spelling test performance. A Mann-Whitney U-test for pairwise comparisons was used if the results from the Kruskal-Wallis test were significant. A Chi-square test was used to compare all three groups on reading comprehension, word decoding, and spelling to determine rates of reading and writing disorders.

When comparing students with ASD to students with AD/HD and typically developing students, no significant differences were found in reading and spelling test performance in word decoding, reading comprehension, or spelling. Furthermore, no significant differences were found in reading and writing disorders in reading comprehension, word decoding, or spelling when comparing students with ASD to
students with AD/HD and typically developing students. Åsberg et al. (2010) concluded that girls with autism spectrum disorder did not differ from students with AD/HD and typically developing students in terms of reading comprehension, word decoding abilities, and spelling skills. They further concluded that students with ASD demonstrated normal word decoding skills, as suggested by Nation et al. (2006), and Newman et al. (2007). These conclusions, however, can only be generalized to students with ASD who demonstrated IQs > 70. Furthermore, these results do not indicate whether or not students with ASD who have IQs lower than 70 are able to perform as well on word decoding, reading comprehension, or spelling measures.

Of the six studies identified to be included in the literature review, only one could be found that assessed a decoding strategy for the older population of students with autism. Bailey et al. (2011) investigated the effects of a structured literacy intervention on four 12-15 year old students with Down Syndrome or Autism Spectrum Disorder (ASD) on their phoneme and decoding abilities. Specifically, they attempted to determine if students with complex communication needs (CCN) who use alternative and augmentative communication (AAC) could acquire the ability to improve their letter-sound correspondence and reading of novel words. Of the four students, three were diagnosed with ASD, and all four were considered moderately cognitively impaired with CCN. In terms of communication abilities, their verbal exchanges ranged from intelligible to unintelligible (100%, 20%, 80%, 100%). Lastly, all four students were unable to decode “novel” words (i.e., regular words that they had not seen). The setting for this study occurred within two self-contained classrooms.
This intervention consisted of two components: (a) small-group interactive reading; and (b) individual phoneme lessons. During the small-group interactive reading component, one of the phoneme-loaded picture books was read to the students. At the end of each page, one of the investigators would identify the targeted phoneme by following a script. Bailey et al. (2011) did not specify the order in which the books were read to the students. Each book adhered to a set of guidelines, one of which included the phoneme being underlined within the word. During the individual phoneme lessons, students worked in a 1:1 setting with a graduate assistant within the classroom. Ten scripted lessons were created that targeted the 18 phonemes, and each lesson increased in difficulty (e.g., sound-to-letter matching to identifying words from a verbal cue). The researchers did not specify whether the ten scripted lessons were designed for each of the targeted 18 phonemes. Assessment of the students’ ability to identify individual phonemes occurred pre-intervention, during, post-intervention, and 5 months afterwards (maintenance), with data collected daily on their overall ability to identify each phoneme. Assessment on the students’ ability to read novel words occurred pre-intervention, three times during intervention, post-intervention, and 5 months afterwards (maintenance), with data collected on their overall ability to identify 54 target words. A multiple baseline design across subjects was used to evaluate the effectiveness of the intervention.

Data were collected by determining the accuracy on all steps in the lessons, with overall mean scores reported. Phoneme identification results for Lucy on the three sets of phonemes indicate a positive trend line for Set 1 and Set 2 from pre- to acquisition to maintenance (Set 1 = 58%, 69%, 75%; Set 2 = 57%, 59%, 67%). Results for Set 3 are mixed (41%, 45%, 42%). Novel word reading results for Lucy on the three sets of words
indicate a positive trend line for Sets 1 and 2 from pre- to acquisition to post- to
maintenance (Set 1 = 36%, 38%, 50%, 75%; Set 2 = 42%, 44%, 42%, 67%). Results for
Set 3 indicate a negative trend line (56%, 42%, 42%, 42%). Phoneme identification
results for Randy on the three sets of phonemes indicate a positive trend line for all three
sets of phonemes from pre- to acquisition (Set 1 = 27%, 44%; Set 2 = 26%, 69%; Set 3 =
25%, 43%). No data are specifically reported for maintenance probes; however, results
are shown in the figures. Novel word reading results for Randy on the three sets of words
indicate a positive trend line for Sets 1, 2, and 3 from pre- to acquisition to post- to
maintenance (Set 1 = 28%, 50%, 53%, 83%; Set 2 = 56%, 64%, 56%, 83%; Set 3 = 53%,
47%, 53%, 75%). Phoneme identification results for Amy on the three sets of phonemes
indicate a positive trend line for Sets 1 and 2 from pre- to acquisition (Set 1 = 23%, 36%;
Set 2 = 23%, 34%). Results from Set 3 indicate a negative trend line (22%, 21%). No
data is specifically reported for maintenance probes; however, results are shown in the
figures. Novel word reading results for Amy on the three sets of words for pre-,
acquisition, post-, and maintenance are mixed (Set 1 = 33%, 42%, 53%, 33%; Set 2 =
33%, 59%, 39%, 42%; Set 3 = 39%, 39%, 36%, 25%).

Phoneme identification results for Matthew on the three sets of phonemes indicate a
positive trend line for Sets 1 and 2 from pre- to acquisition (Set 1 = 33%, 40%; Set 2 =
38%, 62%). Results from Set 3 indicate a stable trend line (35%, 35%). No data is
specifically reported for maintenance probes; however, results are shown in the figures.
Novel word reading results for Amy on the three sets of words for pre-, acquisition, post-, and maintenance indicate a positive trend line for Sets 1 and 2 from pre- to acquisition to
post- to maintenance (Set 1 = 42%, 47%, 53%, 50%; Set 2 = 44%, 61%, 33%, 75%). Results for Set 3 indicate a negative trend line (44%, 53%, 39%, 33%).

Bailey et al. (2011) concluded that, despite the variability in the data, a functional relationship existed between a structured literacy intervention and sound-to-letter matching skills. They further concluded that a functional relationship between identification and decoding of novel words existed. Finally, the researchers concluded that the phoneme picture books and the phoneme intervention provide evidence of the importance of using these two methods together. The conclusions drawn by Bailey et al. are suspect and not substantiated by statistical analyses. First, it appears that the researchers conducted a visual inspection of the data. While Barlow et al. (2009) suggest that a visual inspection can be an effective manner to analyze data, the visual representation suggested variability in baselines (positive, stable, and negative trend lines across all subjects) and variability in the results of the interventions (trend lines similar to baseline trend lines). A statistical analysis to determine if the difference between baseline and intervention was significant would have contributed additional information. Without this specific analysis, it is difficult to conclude that the intervention increased the phoneme and word reading abilities of the students.

Another limitation to this study is the type of prompting used when presenting the phoneme-word booklets to the students. In each book the phoneme being emphasized was underlined. Rincover (1978) suggests that students with autism have difficulty identifying other aspects of a word when a visual prompt (such as underlining the phoneme) is used. Bailey et al. (2011) did not assess the removal and/or fading of the prompt in the phoneme book. This may explain the overall poor performance in the
students’ ability to decode words after being taught individual phonemes. The researchers further indicate that a major limitation to this study is the combination of phoneme-books plus 10 individual lessons. Future studies need to look at each component separately to determine which, if any, are more effective at teaching phonemes and/or word recognition.

Summary of Research Related to Skills-Based Word Identification Strategies

Limited studies exist within the literature which specifically addresses decoding skills for 11-14 year old students with autism. One reason may be due to medical evidence which suggests older individuals with autism are not capable of learning decoding skills because of a decreased blood flow to the areas of the brain which command reading (Wilcox et al., 2002). Another reason may be that, as Nation et al. (2006) and Newman et al. (2007) suggest students with autism demonstrate variability in their decoding and comprehension abilities: some students with autism demonstrate normal decoding abilities and lower comprehension abilities; some students with autism demonstrate poor decoding abilities and poor comprehension abilities. Åsberg et al. (2010) further corroborated the findings by Nation et al. (2006) and Newman et al. (2007) that students with autism who demonstrated IQs > 70 performed similarly to typically developing peers. The question remains as to whether or not students with autism who have an IQ below 70 are able to perform as well on word decoding tasks. Only one study identified a strategy that taught decoding skills in conjunction with a phonemic awareness skill (Bailey et al. 2011). While results from this study are difficult to demonstrate significance, Bailey et al. demonstrated that using a word book and phoneme instruction produced higher percentages of reading ability. No studies included for review contained
a sample that was specifically from the autism spectrum; each study compared the performance of students with autism to students with ADHD, dyslexia, or hyperlexia.

Review and Analysis of Studies Related to Computer-assisted Instruction

One component that has emerged within the literature as being an effective strategy for teaching various skills and concepts is computer-assisted instruction. Computer-assisted instruction (CAI) is a method for delivering instruction via a computer to increase both academic and functional skills (Everhart et al., 2011). Several advantages and disadvantages have been identified within the literature in regards to CAI (see Table 3). Despite the disadvantages, Bernard-Opitz et al. (2001) suggest appropriately designed computer programs could be an effective aid for teaching word identification to students with autism because this population is good at responding to fixed visual cues. The following review of the literature analyzes the use of CAI for 11-14 year old students with autism (see Table 4). Heimann et al. (1995) investigated the effects of computer-assisted instruction (CAI) on reading, phonological awareness, sentence imitation, and verbal behavior and motivation. Three groups of students were included in this study: (a) autism (n = 11, Mental Age = 6:9 years, Chronological Age = 9:4 years, Language Age = 4:9 years); (b) mixed handicaps (n = 9, MA = 5:8, CA = 13:1, LA = 4:1); and (c) normal preschool students (n = 10, MA = 6:3, CA = 6:4, LA = 7:10). The students with autism attended a clinic that specialized in teaching students with this disability. No mention was made by the researchers as to where the students with mixed handicaps (motor impairment, sensory impairment, Down Syndrome) attended school. The normal preschool students attended a normal day-care facility.
Table 3

Advantages and Disadvantages of Computer-Assisted Instruction

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students can engage in CAI independently with minimal to no support</td>
<td>Ayres, Maguire, &amp; McClimon (2009)</td>
</tr>
<tr>
<td>Students with ASD present heterogeneous learning characteristics and require intensive instruction. CAI is a way to provide individualized instruction.</td>
<td>Heimann, Nelson, Tjus, &amp; Gillberg (1995)</td>
</tr>
<tr>
<td>Stimulus overselectivity</td>
<td></td>
</tr>
<tr>
<td>Motivational support</td>
<td></td>
</tr>
<tr>
<td>Improving interaction</td>
<td></td>
</tr>
<tr>
<td>Ensures correct implementation of various prompting procedures</td>
<td>Kodak, Fisher, Clements, &amp; Bouxsein (2011)</td>
</tr>
<tr>
<td>Allows for control over the presentation of stimuli</td>
<td></td>
</tr>
<tr>
<td>Parents can implement CAI in the home environment</td>
<td></td>
</tr>
<tr>
<td>Decreases behavior problems</td>
<td>Chen &amp; Bernard-Opitz (1993)</td>
</tr>
</tbody>
</table>

<p>| Disadvantages                                                            | Authors                                                               |
|-------------------------------------------------------------------------|                                                                      |
| Increased isolation                                                     | Ramdoss, Lang, Mulloy, Franco, O’Reilly, Didden, &amp; Lancioni (2011)   |
| May reinforce negative stereotypes                                       |                                                                        |
| Reduced opportunity to practice social interactions                      | Bernard-Opitz, Ross, &amp; Tuttas (1990)                                 |
| Therapists, teachers, and caregivers do not always implement interventions with high levels of integrity | Moore &amp; Fisher (2007)                                                |</p>
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Design</th>
<th>N</th>
<th>Disability</th>
<th>Age (in years)</th>
<th>IQ</th>
<th>Dependent Variable</th>
<th>Independent Variable(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heimann, Nelson, Tjus, &amp; Gillberg</td>
<td>1995</td>
<td>Experimental</td>
<td>30</td>
<td>Autism, TYP</td>
<td>6-13</td>
<td>&lt; 70</td>
<td>Reading / Communication</td>
<td>ALPHA computer program</td>
</tr>
<tr>
<td>Tjus, Heimann, &amp; Nelson</td>
<td>1998</td>
<td>Experimental</td>
<td>13</td>
<td>Autism</td>
<td>4-11</td>
<td>*</td>
<td>Language and Reading Development</td>
<td>Delta Messages computer program</td>
</tr>
<tr>
<td>Bosseler &amp; Massaro</td>
<td>2003</td>
<td>MBD</td>
<td>9</td>
<td>Autism</td>
<td>7-12</td>
<td>*</td>
<td>Vocabulary and language</td>
<td>Computer-animated tutor</td>
</tr>
<tr>
<td>Massaro &amp; Bosseler</td>
<td>2006</td>
<td>MBD</td>
<td>5</td>
<td>Autism</td>
<td>8-13</td>
<td>*</td>
<td>Vocabulary</td>
<td>Computer-animated tutor</td>
</tr>
<tr>
<td>Hetzroni &amp; Shalem</td>
<td>2005</td>
<td>MBD</td>
<td>6</td>
<td>Autism</td>
<td>10-13</td>
<td>*</td>
<td>Orthographic symbols</td>
<td>Fading procedure computer program</td>
</tr>
<tr>
<td>Yaw, Skinner, Parkhurst, Taylor, Booher, &amp; Chambers</td>
<td>2011</td>
<td>Parallel Treatment</td>
<td>1</td>
<td>Autism</td>
<td>12</td>
<td>*</td>
<td>Sight word</td>
<td>Constant Time Delay</td>
</tr>
<tr>
<td>Coleman-Martin, Heller, Cihak, &amp; Irvine</td>
<td>2005</td>
<td>MBD</td>
<td>3</td>
<td>Autism, CP, BI</td>
<td>11-16</td>
<td>*</td>
<td>Word recognition</td>
<td>Teaching method</td>
</tr>
</tbody>
</table>

*Note: MBD = Multiple Baseline Design; * = Not reported; CP = Cerebral Palsy; BI = Brain Injury.*
This study occurred in three phases: first, a familiarization period with the CAI program; second, intervention; and third, maintenance test. The purpose of the familiarization period was to identify those students who were motivated and interested in the program, to provide some pre-training in the basic navigation and structure of the program, and to identify the appropriate starting level. The familiarization period varied for each group of students (autism = 5.9 sessions, mixed handicaps = 13.0 sessions, normal preschool = 3.2 sessions). Second, the intervention phase varied for each group of students, with the autism and mixed handicaps groups receiving over three times the amount of sessions than the normal preschool group (25.6 sessions, 21.8 sessions, and 7.8 sessions, respectively). Overall, the entire intervention period lasted between 3 and four months. The maintenance phase of the intervention occurred 26.2 weeks after the intervention phase.

The computer-assisted program used during this study was called the Alpha program (Nelson & Prinz, 1991), and was designed to present nouns and sentences using voice, animation, and video formats. Four different modules were available to the student to work on; however, the teacher was the one who moved the student through the different modules. The first module, Individual Words, provided opportunities for the students to learn about nouns for a particular lesson. Once the student demonstrated mastery of the lesson on nouns through the Testing Words module (the researchers did not report the criterion for mastery), the student was then moved to the Creating Sentences module for that lesson. This module provided opportunities for the student to create sentences by combining the previously learned nouns with new verbs. As the student created sentences, an animation showing the action was displayed (either via the
computer program or the student was shown an animation from a video disc player). Once the student reviewed the lesson two times, the teacher selected the Testing Sentences module, wherein the student was presented with an animation of a sentence and the student was to identify the nouns and verb used. Mastery of this module was set at 80%.

In addition to measuring the student’s reading abilities using the Alpha program, other measures were used to assess each student’s phonological awareness, sentence imitation, and verbal behavior and motivation before and after the intervention. Two sets of flashcards with sentences on them, one set of flashcards with words on them, and Umesol (a letter identification/word reading assessment used in Sweden) were used to assess language skills of all students. Phonological awareness was measured by a Swedish instrument (Tornéus, Taube, & Lundberg, 1984). For sentence imitation, a researcher generated test was used to determine the student’s ability to imitate a sentence in his/her mode of communication (i.e., spoken, sign, symbols). Verbal behaviors and motivation (compliance, off-task, seeking help, verbal expressions, enjoyment) were measured by video recordings made of one initial and one final lesson, totaling 9 minutes for each lesson. Finally, the Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988) was used to measure the level of autism for the autism and mixed handicaps students. Heimann et al. (1995) used a quasi-experimental design to investigate the reading, phonological awareness, sentence imitation, and verbal behavior and motivation of the three groups. Parametric analyses (paired t-test) and nonparametric analyses (Wilcoxon) were used to analyze the changes over time in behaviors.
Results from the Alpha program indicate all three groups made significant progress in the number of lessons mastered from the familiarization period to the end of the intervention (p < .01). Results from the reading measures (Flashcards, Umesol) from the start of the familiarization period to the end of the intervention indicate the autism and normal preschool groups made significant progress in their reading abilities (p < .05), whereas the mixed handicap group did not achieve significance (p = .06). All three groups, however, did reach significance when measuring from the familiarization period to the maintenance period (p < .01). Only the normal preschool students demonstrated significant gains in reading ability from intervention to maintenance phase (p < .01). Results from the phonological awareness measure were significant for all three groups when compared from the familiarization period to the intervention and from the familiarization period to the maintenance period (p < .05). Only the normal preschool students demonstrated significant gains in phonological awareness from intervention to maintenance phase (p < .05). Results from the sentence imitation measure were not significant for any of the three groups. Finally, results from the video observations of behavior indicate significance on three of the five behaviors observed from the autism group (seeks help: p < .029; verbal expressions: p < .008; enjoyment: p < .026). No change in off-task behavior was observed. Compliance behavior decreased over time, and was not significant. The only result reported from the video observations for the mixed handicap group was verbal expression (p < .10). No results were reported for the normal preschool children. Heimann et al. (1995) also reported the predicted treatment effects. Of the five predictors (sentence imitation, mental age, language age, phonological awareness, and reading), none significantly predicted gains in phonological awareness or
sentence imitation. However, mental age was a good predictor for reading gains (p<.05) from the beginning of the study to the end of the intervention. Sentence imitation, mental age, and language age were good predictors for reading scores from the beginning of the study to the end of the maintenance phase of the study.

One conclusion drawn by Heimann et al. (1995) is that the Alpha program produced significant results in language learning for all three groups. Heimann et al. further conclude that verbal behavior and motivation for the three groups increased because of the Alpha program. This was demonstrated through a description of one of the students with autism who, despite showing no gains in reading ability, demonstrated gains in motivation for learning. Another student with autism showed positive gains in his writing ability despite having reading skills that were towards the ceiling at the beginning of the study. However, several limitations exist in this study. First, the students selected for inclusion in this study were selected by recommendations of the teachers on the students’ readiness and willingness to learn. This convenience sampling limits the generalizability of the findings. Second, not all of the students who were assessed at the beginning of the study were assessed at the end. This occurred for several reasons: (a) lack of teacher fidelity in assessing all students; and (b) loss of funding at one of the school sites which reduced the number of participants. One student was not assessed due to increased negative behaviors exhibited during the training sessions. The students with autism and the students with mixed handicaps received longer training periods than their typically developing comparison group.

In a follow-up study, Tjus, Heimann and Nelson (1998) attempted to replicate the results reported in the Heimann et al. (1995) study and to further refine their theory as to
why students with autism learn how to read. Tjus et al. (1998) investigated the effects of computer-assisted instruction (CAI) and positive teacher interactions on reading and phonological awareness. Thirteen students with autism were included in this study (Mental Age = 7:3 years; Chronological Age = 9:8 years; Language Age = 5:2 years). Twelve of the thirteen participants attended a specialist school for students with autism, and one attended a special daycare setting. Of the thirteen students, only three were eleven years old.

This study occurred in three phases: baseline, intervention, and maintenance. The purpose of the baseline phase was to assess the student’s reading and phonological awareness levels, and lasted between one and two months (Mean 6.5 weeks). The intervention period occurred over 15 sessions that lasted between 15 and 30 minutes. The purpose of the maintenance period was similar to the baseline and lasted between one and two months (Mean 6.7 weeks). Overall, the entire intervention period lasted between three to four months.

The computer-assisted program used during this study was called the DeltaMessages program, and was developed to reflect the improvement in multimedia development as well as to improve the motivation of the users (Nelson & Heimann, 1995). The program is divided into two categories: learning exploration and tests. During the learning exploration category, students write sentences by clicking on phrases; afterwards a graphic image is displayed followed by the sentence being read aloud by the program. During the test category, the graphic image is first presented and the student is then asked to create a sentence using the phrases presented. A total of ten lessons were
created, with the first six focusing on noun-verb sequences, the seventh and eighth focusing on propositions, and the final two focusing on conjunctions and adjectives.

In addition to measuring the student’s reading abilities using the DeltaMessages program, other measures were used to assess reading, phonological awareness, proportion of correct sentences (PCS), and response time index (RTI). One set of flashcards with sentences on them, one set of flashcards with words on them, and Umesol (A letter identification/word reading assessment used in Sweden) were used to assess the language skills of all students. Phonological awareness was measured by a Swedish instrument (Tornéus et al., 1984). The PTI was a built-in measurement to determine the number of sentences correctly identified over the total number of sentences presented. The RTI was a measure to compare the response times of typically developing students to students with autism. Six typically developing students completed the DeltaMessages program two times. Their response times were averaged to produce a mean response time, and were used as the denominator when evaluating the response times of the students with autism. Tjus et al. (1998) used a quasi-experimental design to investigate the reading and phonological awareness of thirteen students with autism. Parametric analyses (paired t-test) were used to analyze the changes over time in behaviors.

Overall, results from the measures indicate significant progress in the reading and phonological gains for students with autism. In reading, the number of words and sentences read was significant between baseline and intervention (p < .01), but no significance was found between intervention and maintenance. In phonological awareness, the phonological skills were significant between all three phases of the study (p < .05). Results from the PCS measure indicate no significance, whereas the RTI
measure indicated a significant increase in response time from the beginning to the end of the study \((p < .01)\). Tjus et al. (1998) also reported results on reading and phonological gains as they related to the mental age and language age of the students. Reading gains occur regardless of the student’s mental level; however, the gains for students who are below the 5th percentile demonstrate less progress. Phonological gains occurred for students higher than the 5th percentile, where students below the 5th percentile did not demonstrate growth during maintenance.

One conclusion by Tjus et al. (1998) is that the DeltaMessages program produced significant results in literacy learning for students with autism, and further validated results from previous studies. Tjust et al. further conclude that learning to read can occur despite a student’s mental or language age. These gains are attributed to the interactive nature of the program (i.e., text, voice, and graphics). One limitation, however, is the low number of teaching sessions. No conclusive evidence was presented that the DeltaMessages program will produce similar results for the entire autism population. Another limitation identified by the researchers is the absence of a control group from which to compare the results. Future studies are warranted that address these limitations.

Bosseler and Massaro (2003) furthered the research on the effectiveness of using computer-assisted instruction to improve the language abilities (acquisition of vocabulary, grammatical usage) of students with autism by using a computer-animated tutor, Baldi. Two experiments were conducted to investigate the effectiveness. In the first experiment, eight students with autism were included (Chronological Age = 7 to 12 years). The participants attended two school programs; no further description of the setting was provided by the researchers.
The first experiment occurred in three stages: pre-test, intervention, and maintenance. During the pre-test stage, the students were taught how to use the computer-assisted program through a series of training sessions that occurred over several months. Skills taught to the students included (a) sitting at the computer, (b) putting on the head phones, (c) listening and responding to Baldi, and (d) using the mouse. Once students demonstrated the ability to use the program, they were assessed on their language abilities. No mention is made as to how fluency with the program was measured during this stage or how the students were assessed on their language abilities. Bosseler and Massaro do indicate that the vocabulary taught using the program was derived from the school curriculum, magazines, and books, which produced a total of 84 vocabulary lessons. Each student participated in a unique curriculum that was dependent upon their abilities. Again, no description was given on how each student was assessed. During the intervention stage, the students participated in two sessions per week, with a minimum of two lessons per session. Each lesson consisted of an assessment and became increasingly difficult in the presentation of the material (easy to medium to difficult). During each level of difficulty, five exercises were presented to the students: (a) pretest, (b) presentation, (c) recognition, (d) production, and (e) posttest. Students progressed through each level of difficulty as they correctly identified 100% of the vocabulary words being presented in the lesson. The computer-animated tutor, Baldi (a three-dimensional talking head that has realistic visible speech and facial expressions) was used to provide directions to the students as they completed lessons. Maintenance occurred 30 days after the final posttest was administered to the students. Overall, the entire intervention period lasted for six months.
Students were assessed on their acquisition and retention of new vocabulary and grammatical usage. No mention is made by the researchers as to what types of analyses were conducted; only that data was collected and calculated on the number of words already known (pre-test stage), the number of words learned (intervention stage), and the number of words retained (maintenance stage). It is assumed that a paired samples t-test was used to analyze the differences in performance. Furthermore, the experimental design was not explicitly stated. It appears that the researchers employed a quasi-experimental design to determine vocabulary acquisition and student response to the computer-assisted program. Results indicate that, on average, students identified 39 words during the pre-test stage, learned 49 words during the intervention stage, and maintained 42 during the maintenance stage. The amount of words acquired from the pre-test to the end of the intervention stage was significant ($p < .001$), and the amount of words acquired from the pre-test to the maintenance test was significant ($p < .001$).

Statements made by the students during the intervention were recorded but not analyzed. Of the statements reported by the researchers, all were positive.

Bosseler and Massaro conclude that the computer-assisted tutor, Baldi, was effective in teaching students with autism to learn and maintain new vocabulary words and grammar skills. One limitation, however, is the lack of information reported as to the type of statistical analyses conducted. T-test results were reported, but no data table was presented to allow the reviewer to further analyze. Another limitation is with the design. Each student participated in a curriculum designed specifically for him/her. No comparison can be made between the students as to the effectiveness of the intervention since each student was learning different vocabulary. Students were taught before the
study in how to use the computer-assisted software. While the purpose for pre-teaching how to use the computer-assisted program was reported, no discussion as to the possible carryover effects were suggested. Students may have improved in their ability to learn new words because they already knew the teaching format, which may suggest that the students included in this study may have demonstrated similar gains if pre-trained and taught a separate computer-assisted program. Finally, no discussion is made as to the generalizability of these findings; students were taught using a computer-assisted program, but were not assessed on their ability to identify the words in a different setting.

Results from the first experiment provided additional questions to be answered. Bosseler and Massaro (2003) reported a second experiment conducted to answer the following questions: (a) Did the students learn the words on account of the computer-assisted program or from an outside source, and (b) Would the students be able to generalize the new vocabulary to different pictures and environments. Six of the students who participated in the first experiment were included in the second experiment.

The second experiment was conducted over five different types of sessions: (a) pre-training, (b) training, (c) probe, (d) generalization across stimuli, and (e) generalization across environments. Before the pre-training sessions, eighteen words were selected for each student, and divided into three sets of six words each. During the pre-training sessions, each word set was assessed across four days and presented three times each during each session. The training sessions were identical to the intervention stage from the first experiment (as described previously). Probe sessions occurred as the student achieved 100% mastery on any of the training sessions, wherein the student’s were assessed on their ability to identify all of the words. Generalization across stimuli
sessions was conducted after the students achieved 100% on the final stage of training. This occurred by presenting new images of the vocabulary word in different positions on the screen and assessing the student’s response. If the students were unable to identify each vocabulary item at least two out of three times, a tutorial was administered. No description of what constituted this tutorial was given by the researchers. Criterion was set at four consecutive sessions with unique images. Finally, sessions that assessed generalization to new environments were administered. This occurred by the teacher presenting a word set and asking the student to receptively identify the words. A single-subject multiple-baseline design was used to examine whether or not students with autism would be able to generalize new vocabulary to different images and environments. No mention is made as to how the data was analyzed nor what types of measures were used. It is assumed that the Baldi computer-assisted program maintained data on student performance.

Results indicate that all students were able to learn significantly more words during the posttest than during the pretest (p < .05). On average, generalization of words to new image was .91, and generalization of words to new environments was .93. Bosseler and Massaro (2003) conclude that the Baldi computer-assisted program was effective in teaching students with autism to learn and generalize new words across images and environments. However, they cite three limitations to their study. First, they recognized that the baseline sessions demonstrated variability. Visual inspection of all baseline sessions appears to reflect a positive trend line. Bosseler and Massaro suggest this may be due to the normal development of language. Nevertheless, this improving baseline data seriously inhibits the ability of the researchers to conclude that the
intervention was the cause of the learning. Second, several students demonstrated an unwillingness, at first, to participate in the pretraining sessions. The researchers suggest this may be due to unfamiliarity with the new words being presented. Another possible explanation may be the students did not want to engage in another intervention using this computer-assisted program. A third limitation to the study identified by the researchers was the development of perseverance on different aspects of the sessions. For instance, one student clicked on a preferred word during pretraining and generalization sessions, yet during training sessions he correctly identified the word. One final limitation to the findings not identified by the researchers is the inability to conclude which aspect of the computer-assisted program (e.g., facial cues, voice level, etc) produced learning.

Massaro and Bosseler (2006) conducted a follow-up study to answer questions posited in a previous study of the computer-assisted program Baldi. Five students with autism were included in this study (Chronological Age = 8 to 13 years) and all attended a school program. No description is given of the setting. Four of the five students participated in the Bosseler and Massaro (2003) study just reviewed.

The study occurred in three stages: (a) pretraining, (b) training, and (c) post-training. Before the pretraining sessions, 24 words were selected for each student. No description is given by the researchers of how this selection occurred. The words were divided into four sets of six words each. During the pretraining sessions, three counterbalanced assessments were conducted across three consecutive sessions to determine the students’ ability to receptively (i.e., click on the word) and productively (i.e., say the name) identify the words. Sixteen training sessions per student were implemented using an alternating treatment design counterbalanced across days and
students. One intervention was using the computer-assisted program with facial expressions and the other intervention was using the computer-assisted program without facial expressions. Sessions lasted 30 minutes, three days per week. The procedures for the training sessions followed the first experiment described in Bosseler and Massaro (2003) and were described previously. Three post-training sessions occurred at the conclusion of the alternating treatment sessions, and followed the same procedure from the pretraining session. No measures were identified by the researchers. It is assumed that the number of words learned was being measured by the computer program.

Data analysis was conducted on the difficulty of the lessons, training results, comparing the pre to post training results, and individual performance. Lesson difficulty was analyzed to ensure that both conditions (face, no face) were equal in difficulty. An analysis of variance was performed (dependent variable = proportion of correct identification, independent variable = type of condition), and results indicate no difference among lessons. Another analysis of variance was performed to analyze the difference between the two conditions, and results indicate no difference between conditions. Results from the training sessions indicate that, on average, students increased their ability to learn new words when using both conditions (face, no face), and no significance was found between these two conditions. Students learned with both conditions, however, learning took longer when presented without the face component than with. Visual analysis of the graph indicates that, on average, more learning occurred when the face condition was used, yet learning still occurred when the face was not present. In regards to the pre-training versus post-training performance, results were similar to the training session analysis conducted. Individual performance results indicate
that three of the five students appeared to show a substantial advantage of learning when the face condition was implemented. However, no statistical analysis was performed.

Massaro and Bosseler (2005) conclude that some students with autism benefit from a computer-assisted program tutor when the face is present. One limitation mentioned by the researchers is previous research that suggests students with autism do not respond to facial cues. Results from the Massaro and Bosseler suggest students with autism may perform well with the facial cue when coupled with auditory and visually motivating components.

Hetzroni and Shalem (2005) investigated the effects of using a computer-assisted program to teach students with autism to identify and generalize words. A gradual fading procedure was implemented through the computer-assisted program. Six 10-13 year old students diagnosed with autism and moderate intellectual disability were included in this study. Each student used a communication board and did not have any previous sight word instruction or participation in a reading curriculum. All students came from middle to upper class families, and the study was conducted in a computer room at the school where the students attended.

Target words used for this study were identified *a priori* by both the teacher and the parents. These words focused on food items. After the teacher received the word lists from the parents, the students were assessed on their logographic knowledge of the food items. They were presented with both a picture and a word card for each food item. The eight words identified for each student to be taught in the study were ones that were identified by the logos and not the orthographic symbol (i.e., word). The study included five stages. The first (preliminary generalization task) and the last (postintervention
generalization task) stage were similar to one another. During these two stages, two tasks were presented to the students. After presenting the eight logos to the student, the teacher held up a flash card that had one of the target words written upon it. The student was asked to put the card next to the logos. All eight words were presented in this manner. Next, the actual food items were placed in front of the student, and the same flash card presentation occurred. These two tasks occurred during the pre-generalization and post generalization stages of the study.

The baseline stage of the intervention occurred as students were presented with the computer-assisted program. Three words were displayed to the student (one being the target word and the other two distractor words), along with the logos for the target word, and the student was asked to match the word to the logos. Baseline for each student occurred for five sessions. The students were divided into three groups of two, and while all six students began baseline at the same time, two moved into the intervention stage and the remaining two groups of two students each remained in baseline. Baseline probes were taken every fourth day. The intervention stage implemented the seven-step fading procedure to teach the students to match the words with the logos. The seven-step fading procedure consists of (a) shrinking the scanned photo; (b) changing the color-type from color to black and white; (c) deleting some of the background information; (d) deleting 20% more of the background information; (e) eliminating all background information except for the information around the word; (f) eliminating all background information around the word, leaving just the word itself; and (g) presenting the word in a normal-type font. At each step of the fading procedure, the students were assessed on their ability to identify the picture by being presented with three symbols and being asked to click on
the symbol that matched the logo. After two successful attempts of selecting the correct symbol, the next fading procedure was taught. Once the two students in the intervention stage learned 75% of the words, the next group of two students began intervention. The maintenance stage occurred in a similar manner as the baseline stage, with the only difference being the probes were conducted one time per week. Hetzroni and Shalem (2005) used a multiple-probe design across students to investigate the effectiveness of the computer-assisted instruction on word acquisition. Data were collected on the accuracy of the students to identify the words during each stage of the study.

Results from the study indicate that all students were able to learn all eight words during the intervention stage, and were able to maintain almost all of the words learned. Visual inspection of the multiple baseline graphs indicate the absence of a trend, marked improvement once intervention began, and steady maintenance of words learned. Results from the two generalization tasks (matching words to pictures and matching words to actual food items) indicate four of the six students were able to match all eight words to pictures and actual food items. Two students were only able to match less than half of the words on both tasks. Hetzroni and Shalem (2005) conclude that students with autism were able to match pictures of food items to printed words, and were able to maintain this knowledge over time. The researchers concluded that the seven-step fading procedure was an effective strategy for teaching. Of the two students who did not perform as well as their peers on the generalization tasks, the researchers identify a reduced number of sessions due to absenteeism as one reason for one of the students. The other student who performed poorly demonstrated increasing aggressive behaviors across all environments and this affected his performance during the study.
One limitation to this study is that the words identified for instruction were generated from highly desirable food items. Conclusions drawn in regards to the effectiveness of the intervention have to be viewed from this point of view. Future studies should look at whether results would be similar if the targeted words were for food items (or academic words) that are not as motivating to the student. Another limitation is found in the inclusion criteria for the students. The researchers state that the students were to have no prior instruction in sight-word strategies or have not participated in a reading curriculum. Given the ages of the students (10-13 years old), it is difficult to believe that they have not been exposed to any type of sight word instruction and/or participated in a reading curriculum. More information as to why this particular criterion was used is warranted. Furthermore, the researchers only reported overall percentages for each stage of the study. Visually the data suggest improvement; statistically, however, the reviewer is left to determine whether or not the change between stages is significant enough to justify the conclusion that the intervention was successful for all of the students.

Yaw, Skinner, Parkhurst, Taylor, Booher, and Chambers (2011) investigated the effects of a computer-based sight-word reading intervention (CBSWRI) on the sight word reading abilities of a 12 year old boy with autism. The student, Craig, attended a self-contained classroom in a rural elementary school with nine other students. A multiple-baseline design across word lists was used to evaluate the effectiveness of the CBSWRI. A list of 30 Dolch sight words (from primer to first grade) were identified by his teacher as target words for the intervention. The words were divided into three groups, with ten words in each group. Two types of computer-based programs were created for the intervention: one to measure Craig’s ability to say the words and one to instruct. For the
computer-based program that measured his ability to say words, a PowerPoint was created for each group of words, wherein each slide was designed using a constant time delay of 2 seconds to move from one slide to the next. Craig’s responses were recorded for future inter-observer agreement. For the computer-based program that provided instruction, a PowerPoint was created for each group of words, wherein a recording of the word was played after two seconds and the slide advanced to the next. A 40 slide PowerPoint was created for each group of words, with the set of 10 words presented four times.

Maintenance probes for the first word list were conducted after a stable baseline was observed for the second word list, and the same criterion was used to begin maintenance for the second word list. No maintenance data was collected for the third word list. Results from the study indicate that, across all three baselines, the number of words identified by Craig ranged from 0 to 1. Intervention results indicate immediate positive word acquisition once the intervention was applied for each word list. For example, the three baseline data probes from the first word list (0,1,0) immediately rose as the intervention was applied (5,4,5,6,7). This trend occurred across all three word lists. Of the maintenance data collected, the words learned from the first and second word lists were maintained at or above the intervention ceiling. For example, the most number of words acquired during the intervention of the first word list was seven, yet maintenance probes indicate acquisition of eight and nine words. The same trend was seen for the second word list. Interobserver agreement was calculated at 100%.

Yaw et al. (2011) conclude that the CBSWRI was effective for increasing the sight word recognition of one student with autism. However, several limitations affect the
generalizability of these findings. First, the researchers acknowledge that given the small sample size (n=1), results are not generalizable. Future studies are warranted to verify the success of the constant time delay procedure used in the CBSWRI. Second, the maintenance probes were conducted consecutively, which means that no time passed between intervention and assessment. One possible reason that the student maintained the ability to read the learned words may be due to the constant review of the words. Future studies need to include maintenance probes that are taken later rather than consecutively.

Third, the researchers state that interventions began once a stable baseline was visible. However, this is not reflected in the data reported. Baseline data for the third word set was stable at 0 words for 14 sessions. If, according to the researchers, intervention should begin after identifying a stable baseline, then the third intervention should have begun in conjunction with the second. The number of intervention sessions for the first, second, and third word list were variable (5, 6, 5, respectively), so it cannot be concluded that intervention began after the intervention phase had five sessions. Future studies need to address this lack of clarity in movement from baseline to intervention.

Coleman-Martin et al. (2005) investigated the effects of computer-assisted instruction on word identification using the Nonverbal Reading Approach (NRA). Three students (ages 11, 12, and 16) and disabilities (Cerebral palsy, autism, brain injury) were selected for this study. The criteria for inclusion were as follows: (a) have a severe speech impairment, (b) have letter-sound correspondence, (c) have a reading recognition level above first and below third grade, (d) have a minimum of two year difference between age and reading level, (e) have never used the NRA, and (f) are able to see print.
Although never specifically stated, the intervention occurred within the classrooms that
the students were attending.

Three main procedures were followed for this study. First, the students were
administered a preintervention assessment to determine unknown words. The words were
generated from the classroom reading series currently being used; the researchers did not
mention which classroom series. The teachers provided the researchers with a list of
potential words. Next, the researchers created flash cards and presented all 25 words for
three sessions. Words that were identified with less than 33% accuracy were included in
the final target word selection. Each student had a list of 15 unknown words. These
words were further divided into three groups of five words each.

During the instructional phase, students were taught to read the target words using
the NRA in either a teacher-led, computer-assisted, or combination of the two formats.
As described previously in Chapter 1, the NRA is an approach that utilizes active
participation, guided practice, and evaluation procedures for determining whether or not
students are reading words (Heller & Coleman-Martin, 2007). During active
participation, the students were instructed to read the word while the teacher (or
computer) read the word aloud. Then, during the guided practice component of the NRA,
the student used a three-step decoding process to internally sound out the word. First, the
teacher pointed to the beginning letter of the word and instructed the student to make the
sound of the letter in his head while the teacher said the sound out loud. Second, the
student was instructed to continue sounding out each sound (phoneme) in the word as the
teacher pointed to and said each phoneme out loud. Third, the student was told to
internally say the word slowly, then fast, while the teacher said it out loud. This process was repeated two more times for a total of three times the words were taught.

After the students were taught each word in a set three times, the teachers provided a short break to the students. When the students returned to their instructional setting (i.e., desk), the teachers presented a distractor array for each word. A distractor array consisted of the target word and three words that were similar. The student was asked to choose the correct word. If the student chose incorrectly, the data were recorded and analyzed for patterns. Next, an evaluation session occurred, wherein the teacher presented a flash card with one of the target words on it, and, in a similar fashion to the active participation component of the NRA, guided the student to sound out the word. The teacher did not provide any vocalizations during this evaluation. Once the student read (or attempted) to read the word, the teacher removed the flash card, informed the student that she would say four words, and the student would have to orally say the target word just shown.

A multiple-conditions design with drop-down baselines was used to evaluate the effectiveness of the NRA when using teacher-led, computer-assisted, and the combination of the two methods. Baseline occurred before each intervention (teacher-led, computer-assisted, combination), for a total of three baseline stages. Each baseline stage assessed the student’s ability to read one of the three sets of words. For example, the first baseline stage was used to assess the first word set; the second baseline, the second word set; and the third baseline, the third word set. The teacher-led and computer-assisted components followed the procedure as described previously, with the only difference being who was delivering the intervention. For the computer-assisted component, a
PowerPoint slide was created for each target word, and contained identical dialogue used in the teacher-led component. The combination of the two methods followed the same procedure, where the words were taught one time each using the teacher-led component, and then the words were taught two times each using the computer-assisted component.

Data were analyzed on the percentage correct that the students were able to orally identify the target word from a distractor array presented orally. Results from the intervention indicate that all three students reached criterion (80% in two consecutive sessions) with all three components (teacher-led, computer-assisted, and combination). Visual inspection of the graphs indicates that all three students demonstrated word acquisition in shorter sessions when either the computer-assisted or combination components were used. Data were analyzed on the teachers’ perceptions in regards to the NRA. A survey was developed by the researchers based on a 5-point Likert scale. Results from the survey indicate that both teachers had favorable perceptions of the strategy. One result indicated that both teachers thought the computer-assisted component was as equally effective as the teacher-led component (3.5 Mean). Interobserver reliability (97.3%) and teacher fidelity (98.6%) was calculated.

The researchers conclude that the NRA can effectively be used either in a teacher-led, computer-assisted, or combination of the two. One limitation identified by the researchers was the difficulty encountered with the technology. One student was using a Windows 98 based platform, which caused the PowerPoint slides to not run as fast or as smoothly as on the XP based platform. Another limitation is the time it takes to create each PowerPoint. As teachers become more familiar with the script, the amount of time should reduce. Another limitation to this study is the inability to compare groups and
treatments. Having three separate disability categories with each student learning fifteen
different words makes it impossible to compare the effectiveness of the interventions.
Future studies should employ a more robust design (i.e., multiple baseline or alternating
treatment) using the same words and include students with the same disability.

Summary of Research Related to Computer-assisted Instruction

Heimann et al. (1995) investigated the effects of the Alpha program on the
reading skills and motivational level for three different groups of students (autism, mixed
handicaps, and typically developing), and demonstrated significant gains. One limitation
to this study was the lack of teacher fidelity in the implementation of the study. Future
studies should ensure teacher fidelity. Tjus et al. (1998) refined the study conducted by
Heimann et al. and used an updated computer program (DeltaMessages) to assess the
reading skills of students with autism. Significant gains were reported and, more
importantly, Tjus et al. identified that regardless of mental age, all of the students
included in this study acquired reading skills. These two studies established the
importance of incorporating graphics and sounds when using computer-assisted programs
to teach vocabulary.

Bosseler and Massaro (2003) furthered the research by Heimann et al. and Tjus et
al. by investigating the effects of graphics, sounds, and a digitized tutor (Baldi) to teach
word skills to students with autism. In the second experiment conducted, Bosseler and
Massaro evaluated the ability of the students to generalize the words learned to different
images and environments. In both experiments significant gains were reported. One
important limitation identified from this study was the variability in baseline data. Future
studies should demonstrate a stable baseline to more accurately conclude that the
computer-assisted component was as effective as reported. Massaro and Bosseler (2006) further refined their study by assessing whether or not learning occurred more when the digital tutor was present or not. Results from this study indicate that the students learned the words in both conditions, but greater gains were demonstrated when the digital tutor was present. Further research should address the incorporation of facial cues with the presentation of the method.

At the same time that Bosseler and Massaro (2003) and Massaro and Bosseler (2005) were conducting research studies on the effectiveness of computer-assisted digital tutoring program, Hetzroni and Shalem (2005) attempted to determine the effectiveness of a computer-assisted program that incorporated a seven-step fading procedure to teach words to students with autism. Results were significant in that all students acquired the ability to read new words, yet in terms of generalization, only four of the six students were able to identify words in different settings. One limitation to this study was the target words were selected from highly motivating, functional items. Future research should identify target words that are not as highly motivating, such as academic terminology. Yaw et al. (2011) investigated the effectiveness of a computer-based sight-word reading intervention for students with autism. A constant time delay procedure was incorporated into the design, and results indicate positive gains. However, only one student was included in this study, and future studies should increase the number of subjects in order to replicate the findings. The focus of words taught during the Hetzroni and Shalem (2005) and Yaw et al. (2011) studies was on functional words, not academic. As mentioned previously, sight word instruction may not be effective for teaching academic vocabulary to students with autism.
One study that incorporated many of the features (i.e., visual and auditory components) of an effective computer-assisted program was conducted by Coleman-Martin et al. (2005). They demonstrated that students can acquire target words when presented in a computer-only format or in conjunction with a teacher-led and computer-assisted format. However, one major limitation to this study is the inclusion of only one student with autism. Future studies are warranted to determine if the NRA is an effective method for teaching students with autism to read unknown words.

**Review of Literature Summary**

Sight word instructional strategies – such as incidental teaching (McGee et al., 1986), instructional formats (Kamps et al., 1990), stimulus fading (Rincover, 1970), picture-to-text matching (Fossett & Mirenda, 2006), and constant time delay (Collins et al., 2011) – have demonstrated positive gains in word reading abilities for students with autism. Yet despite these positive approaches, several limitations exist. Specifically, students with autism are only able to read words that have been explicitly taught (Spector, 2011), and are unable to read words that have similar orthographic patterns to the sight words learned (Ehri, 2005). Effective sight word instruction should include components that assess background knowledge and how to incorporate that knowledge to the words being learned (Kouri et al., 2006). Students with disabilities tend to lack background knowledge due to a lack of exposure to print and books while young (Browder et al., 2006). The characteristics of the students in the studies reviewed suggest diminished vocabularies, lower IQs, and repetitive behaviors; therefore, it is most likely that they did not have much background knowledge on the sight words being taught, nor were they exposed to print and books while young. These criticisms suggest that teaching
students with autism to identify words by sight may not be the most effective way to teach reading.

Students with autism demonstrate similar phonological development patterns and therefore should be able to learn to read from a skills-based approach (Diehl et al., 2006). However, limited studies exist within the literature that specifically addresses decoding skills for 11-14 year old students with autism. Medically, students with autism demonstrate decreased blood flow to the area of the brain which commands reading (Wilcox et al., 2002). Characteristically, students with autism demonstrate variability in their decoding and comprehension abilities (Nation et al., 2006; Newman et al., 2007). Some students with autism are great decoders and yet have poor comprehension skills, whereas other students with autism are poor decoders and have poor comprehension skills. The students who demonstrate good decoding skills typically have IQ scores greater than 70 (Åsberg et al., 2010). However, only two studies were identified through the review of the literature that specifically addressed decoding skills for students within the mild to moderate range of mental functioning who have autism (Bailey et al., 2011; Coleman-Martin et al., 2005). Bailey et al. incorporated the use of a word book to teach phonemes to students with autism and Down syndrome. Coleman-Martin et al. used a Nonverbal Reading Approach in conjunction with computer-assisted instruction to teach at least one student with autism to decode words using internal speech. Further research needs to focus on the autism population that is cognitively functioning within the mild to moderate range to address the lack of decoding strategies identified through a review of the literature.
Computer-assisted instruction (CAI) strategies – such as the Alpha program (Heimann et al., 1995), the DeltaMessages program (Tjus et al., 1998), a digital tutor (Bosseler & Massaro, 2003; Massaro & Bosseler, 2006), fading procedures (Hetzroni & Shalem, 2005), constant time delay (Yaw et al., 2011), and the Nonverbal Reading Approach (Coleman-Martin et al., 2005) – have demonstrated the effectiveness of using CAI to teach words to students with autism. The fading procedures (Hetzroni & Shalem, 2005) and the constant time delay (Yaw et al., 2011) were used to teach sight words to students with autism. Sight word instruction, although effective, has been previously identified as not being effective for teaching academic content. Components of the Alpha program (Heimann et al., 1995) and the DeltaMessages program (Tjus et al., 1998) suggest a CAI strategy should incorporate both audio and visual materials in the presentation of the word being taught. The Nonverbal Reading Approach (Coleman-Martin et al., 2005) is a systematic skills-based approach that incorporates both audio and visual materials during CAI. Despite including only one student with autism, Coleman-Martin et al. reported that the student did make positive gains in her word reading abilities. Future research is needed to verify the effectiveness of this approach when used with CAI for students with autism.
CHAPTER 3

METHODOLOGY

The purpose of this study was to determine if the Nonverbal Reading Approach (NRA) was an effective method for teaching students with autism to identify unknown words. More specifically the current study answered the following questions:

1. Does the Nonverbal Reading Approach teacher-led component increase the percentage of unknown words read for 11-14 year old students with autism?

2. Does the Nonverbal Reading Approach computer-assisted component increase the percentage of unknown words read for 11-14 year old students with autism?

3. Which of the two components (i.e., teacher-led, computer-assisted) shows a larger increase of the percentage of unknown words read for 11-14 year old students with autism?

4. What attitudes does a special education teacher of middle-school students with autism have regarding the Nonverbal Reading Approach prior to and after the intervention?

Participants

The students with autism selected to participate in this study were (a) 11-14 years old, (b) had a primary diagnosis of autism according to their confidential school records, (c) at one time received direct speech and language related services according to their Individualized Education Program (IEP), (d) demonstrated basic computer skills (e.g., able to sit in front of a computer and use a mouse), (e) received the majority of their specially designed instruction in a self-contained classroom, and (f) had no prior instruction using the NRA (see Table 5). The student inclusion criteria were modeled
after the 2005 study conducted by Coleman-Martin et al. Of the seven possible students, five were selected who gave assent to participate and whose parents gave consent for their child to participate in the study and receive the intervention (teacher-led, computer-assisted). Three of the five students were excluded after the study began due to reaching criterion during baseline. One student did not meet the inclusion criteria because he did not receive the majority of instruction within a self-contained setting. Another student was not able to maintain attention to task while sitting at a computer.

**Student Participants**

The first student, Brenda, was a 12 year old female student diagnosed with autism. According to her most recent multidisciplinary report, Brenda qualified as a student with autism due to her difficulty with social skills and communication.
Furthermore, Brenda does have basic computer skills, receives the majority of her specially designed instruction in a self-contained classroom, and has had no prior instruction using the NRA. Her current Individualized Educational Program (IEP) indicated that she did not receive speech and language pathology related services; these services were deemed unnecessary while she was a fifth grade student. Brenda is using the Edmark Reading Program and is on Level 1. Behavorially, Brenda’s outbursts have increased since last year, particularly when told “No” or when she does not get her way. The decision to include her in this study were as follows: (a) her current IEP indicates that she struggles with communication and social interactions; (b) her reading ability is well below that of typically developing peers; (c) she still demonstrates aggressive behavior when not allowed to do something of interest. Brenda’s inclusion in this study may improve her ability to read unknown words and improve her ability to communicate effectively.

Curtis is a 13 year old 8th grade student with autism according to his current IEP. He is very well-mannered, well-behaved, and is able to work independently once he understands what is expected of him. He enjoys receiving positive social praise from teachers. Curtis does receive speech and language related services to improve his communication and social skills; he is nonverbal. Furthermore, Curtis does have basic computer skills, receives the majority of his specially designed instruction in a self-contained classroom, and has had no prior instruction using the NRA. In terms of reading ability, Curtis is able to read certain high frequency words as well as colors, shapes, animals, and numbers when paired with a pictorial representation. Currently, Curtis is using the Edmark Reading Program, and is on Level 1.
Special Education Teacher

One special education teacher was selected to participate in this study. She met the following inclusion criteria: (a) held a valid state license to teach special education, (b) had an endorsement to teach autism, (c) obtained a Master’s degree in Special Education, and (d) received training in the CORE Phonics Survey. She has been teaching special education for the past 7 years.

Sampling Method

Convenience and purposeful sampling procedures were used to select students and the teacher for inclusion in this study (Johnson & Christensen, 2008). Convenience sampling refers to identifying students to participate in a study because they attend a classroom where the study will occur. Purposeful sampling refers to identifying the characteristics of the students and teachers needed to answer the research questions of the study. The students who attended a local middle-school self-contained autism classroom (i.e., convenience sampling) met the inclusion criteria to answer the specific research questions for this study (i.e., purposeful sampling).

Setting

This study was conducted in a middle-school classroom that provided services to students with autism in a large urban school district in the Southwestern United States. The middle schools in this region provide instruction for students in the sixth, seventh, and eighth grades in a variety of classroom arrangements (e.g., general education, resource rooms, self-contained). This study focused on the self-contained classroom population. Self-contained autism classrooms typically provide instructional opportunities that focus on academic, functional, social, behavioral, communicative,
transition, and/or daily living skills to improve the quality of life (Beck, Broers, & Hogue, 1994). The baseline and teacher-led sessions were carried out at a kidney-shaped table in the classroom, and the computer-assisted sessions were carried out at a computer in the classroom that was designated for student use.

Materials

Several materials were purchased, modified, and created in order to complete this study. The miniHD cameras and generic headphones were purchased through monies obtained from the Doug Sperber Research grant awarded to the Student Investigator (SI). The CORE Phonics Survey and teacher perception surveys were provided by the SI. The SI created the additional materials (e.g., teacher-fidelity checklist, student response checklist, spiral-bound word booklets, and PowerPoints). The computer used to run the PowerPoint during the computer-assisted sessions was already in the classroom where the study occurred.

CORE Phonics Survey

The Consortium on Reading Excellence (CORE) Phonics Survey is an instrument that was used to assess the student’s ability to identify letter names/sounds and their knowledge of beginning decoding skills (e.g., short vowels, consonant blends; Diamond, & Thorsnes, 2008). This survey was adopted for use by the local school district (Wright, 2011) and was used to determine the ten unknown words to teach using the NRA (see Appendix A). The survey was divided into two subtests: (a) Alphabet Skills and Letter Sounds, and (b) Reading and Decoding Skills (see Appendix A). The Alphabet Skills and Letter Sounds subtest assessed the student’s ability to identify the upper- and lower-case letters of the alphabet, and identify consonant and vowel sounds (both long and short).
The Reading and Decoding Skills subtest assessed the student’s ability to read one hundred twenty nine regular and irregular words based upon different phonetic principles (short vowels, consonant blends, digraphs, r-controlled vowels, long vowels, variant vowels, low-frequency vowel and consonant spellings, multisyllabic words). For each phonetic principle, three rows of words were presented to each student. The first two rows displayed real words (e.g., sip, rut) and the third row displayed pseudo words (e.g., nop, sut). The survey contained a script to use while administering the inventory to the students. Validity (i.e., content, criterion, construct) and reliability (i.e., test/retest, interrater, internal consistency) data analyses were conducted on the CORE Phonics Survey, and results suggest this instrument shows evidence of validity and reliability \((r = .92)\) in identifying phonics skills deficits (Brandt, 2009). Permission was obtained from the publisher to use this resource (see Appendix B).

**Checklists**

The Teacher Fidelity Checklist (see Appendix C) was used to measure the teacher’s ability to adhere to all components of the intervention. Sessions were video-recorded and assessed by the SI, and one inter-observer assessed 33% of the total sessions per student. This checklist was created according to the following three guidelines: (a) a task analysis of the intervention was developed; (b) the classroom teacher recorded each session; and (c) the percentage of treatment integrity was computed (Lane & Beebe-Frankenberger, 2004).

The Student Response Checklist (see Appendix C) was used to measure the student’s responses. Sessions were video-recorded and assessed by the SI, and one inter-
observer assessed 33% of the total sessions per student. This checklist was used to verify the student responses recorded by the teacher.

**Teacher Perceptions Surveys**

The Teacher Pre-Intervention Acceptability Rating Survey and the Teacher Post-Intervention Acceptability and Importance of Effects Survey (Lane & Beebe-Frankenberger, 2004) were used to assess the teacher’s perception regarding the social validity of the NRA. Each item was rated on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Specifically, results from this instrument determined the teacher’s acceptability of using the NRA, as well as the importance of using the NRA for improving student performance on reading unknown words.

Permission was obtained from the publisher to use this resource (see Appendix B).

**Spiral-bound Word Booklets**

The students included in this study demonstrated two separate levels of phonics abilities: beginner (i.e., identified less than half of the words in each skill set tested) and advanced (identified more than half of the words in each skill set). Data collected from the CORE Phonics Survey indicated that two students were at a beginner phonics level and three students were at an advanced phonics level. Ten words were identified for the beginning phonics level and ten words were identified for the advanced phonics level. For each of the words that were taught, a spiral-bound word booklet was created (see Appendix D). The first page of each booklet contained the word (a) printed in lower-case form (as suggested by Massaro, Venezky, & Taylor, 1979), (b) centered on an 8 ½ x 11 in. white piece of copy paper, (c) written in black Times New Roman font, and (d) 150 points in font size. The second page contained the entire word printed in 25% gray ink.
except for the first phoneme, which was printed in black ink. Each subsequent page contained the word printed in 25% gray ink with the next phoneme printed in black ink. The final page of the booklet contained the word in black ink with no letters grayed out. A total of twenty spiral-bound word booklets were created.

**PowerPoint Slides**

A PowerPoint presentation was created for each of the words and was created in the exact form of the spiral-bound word booklets previously described. A total of twenty PowerPoint presentations were created (one per word). Each PowerPoint contained audio components that paralleled the teacher scripted portion of the intervention protocol. As the student viewed the PowerPoint slides during the computer-assisted sessions, he/she heard the same script being given.

**Equipment**

One desktop computer running the Windows XP Professional operating system was used to create the spiral-bound word booklets and PowerPoint presentations for each word. The computer system and software used to create the PowerPoint slides are widely used in the local school district where the study was conducted. Generic headphones were used when the intervention was delivered via the computer, allowing for the student to hear the instruction without disturbing the learning of other students within the classroom. A mini-HD camera was used to video record each session of the study. It was set up by the teacher within the classroom before the start of each session, and captured both the teacher and the student during each session for the purpose of assessing teacher fidelity and student responses.
Design

A multiple probe design across students was combined with an adapted alternating treatment design to investigate the student’s ability to read unknown words when given the interventions (Gast, 2010). The multiple probe design was selected to demonstrate the change in the dependent variable (i.e., number of unknown words read) occurred when and only when the independent variables (IVs) were applied (e.g., teacher-led, computer-assisted) and to reduce the influence of confounding variables, such as history and maturation (Barlow et al., 2009). This design further demonstrated that when the IVs were applied to the first student, no change in baseline behaviors was noted in the other students. Finally, the multiple probe design minimized the sequential confounding effects by replicating the treatments across two students. The adapted alternating treatment design (AATD) was selected to (a) compare two instructional practices (i.e., teacher-led, computer-assisted) with a nonreversible behavior (i.e., word reading) and (b) provide a quicker treatment phase (Gast, 2010).

During the intervention phase of the design, the two IVs (i.e., teacher-led, computer-assisted) were randomly alternated. This was determined \textit{a priori} by inputting the following formula into a Microsoft Excel spreadsheet: \texttt{=RANDBETWEEN(1,2)}, where the number 1 represented “Teacher-led” and the number 2 represented “Computer-assisted” (see Table 6). If the number of consecutive occurrences was greater than four, then the SI changed the third occurrence to the alternate treatment (Barlow, et al., 2009). Two instances of consecutive occurrences greater than four occurred after running the formula; the SI, then, changed the third treatment assignment on both of the consecutive
Table 6

*Alternating Treatment Assignment*

<table>
<thead>
<tr>
<th>Student ID</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>7</th>
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<th>14</th>
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<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda</td>
<td>B</td>
<td>B₂</td>
<td>B</td>
<td>T</td>
<td>C</td>
<td>T₂</td>
<td>C</td>
<td>T</td>
<td>T₂</td>
<td>C</td>
<td>C₂</td>
<td>T</td>
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<td>C</td>
<td>C₂</td>
<td>M₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curtis</td>
<td>Bₐ</td>
<td>B</td>
<td>B</td>
<td>Bₐ</td>
<td>C</td>
<td>Cₐ</td>
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<td>Mₐ</td>
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<td></td>
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</tr>
</tbody>
</table>

occurrences to the alternate treatment. The two IVs were randomly assigned to each student using this formula.

**Internal Validity**

Internal validity refers to the accuracy in which the investigator can conclude that the dependent variable changed when the independent variables were applied (Salkind, 2012). Threats to internal validity of the multiple probe design include (a) baseline variability, (b) poor design; (c) procedural fidelity, and (d) carryover/interaction effects (Barlow et al., 2009; Horner et al., 2005). At least three consecutive baseline sessions for each student provided sufficient data points to establish a stable baseline (i.e., one which has little to no variability and the absence of a trend; Barlow & Hersen, 1973; Kazdin, 2003). The design was adequate to account for the effectiveness of treatment. Procedural fidelity was measured using the teacher fidelity checklists. Furthermore, carryover/interaction effects were reduced by the rapid change in treatments being applied. Threats to internal validity of the AATD include (a) maturation, (b) history, (c) lack of procedural integrity, and (d) instrumentation (Gast, 2010). The relatively short length of the study (i.e., 10 days) reduced the likelihood of maturation from occurring. The potential for history to influence the results was accounted for through the use of the multiple probe design which allowed for the staggering of the introduction of the IVs. Procedural integrity was assessed through fidelity checklists by the Student Investigator (SI) and an outside observer. Instrumentation was assessed through the collection of inter-observer agreement (IOA) data.
External Validity

External validity “is enhanced through replication of the effects across different participants” (Horner et al., 2005, p. 171). The design adequately provided for the independent variables to be assessed across different students. Three participants is the recommended minimum number of participants to be included in a study (Gast, 2010). Five students were originally included to participate in the study. However, three students were dropped due to reaching criterion during baseline probes. The attrition of three students resulted in only two students remaining to participate. This low number of students reduced the ability of the SI to generalize the findings to the autism population.

Social Validity

Social validity “refers to the assessment of the social significance of intervention goals, the social acceptability of intervention procedures to attain the goals, and the evaluation of the social importance of the effects resulting from an intervention” (Lane & Beebe-Frankenberger, 2004, p. 85). Assessment of the significance of the research questions occurred through the data collected. The acceptability and importance of effects were assessed using the teacher perception survey discussed previously (see Appendix E).

Procedures

The study was organized into pre-intervention, baseline, intervention, and debriefing phases. During the pre-intervention phase, (a) the participants were selected, (b) the teacher was trained, (c) the target words were identified, and (d) the materials were created. After the baseline phase began, the two IVs were administered in a
randomized, alternating fashion. A brief maintenance phase occurred. Finally, the teacher was debriefed on the outcome of the study.

Pre-intervention Phase

**Participant selection.** Before receiving approval from the Institutional Review Board (IRB) at the University of Nevada, Las Vegas (UNLV), the SI sent an email to three middle school principals soliciting their support to allow the study to be conducted on their campus (see Appendix F). These three principals were selected by the PI based on prior knowledge that these middle schools contain self-contained autism classrooms. This email identified the Principal Investigator (PI) and the SI, stated the purpose of the email, provided a description of the study, and ask for the principals’ consent to participate. One principal agreed to participate, and a “Letter of Acknowledgement” and a “Letter of Authorization” were sent to this principal. These two letters were then signed and returned to the SI to be included in the IRB protocol for UNLV. Upon receiving approval from the Institutional Review Board (IRB) at the University of Nevada, Las Vegas (UNLV) and approval from the IRB from the local school district, an email was sent to the self-contained autism program teacher who taught at the school of the principal who agreed to participate (see Appendix F). This email (a) identified the PI and SI, (b) stated the purpose of the email, (c) provided a description of the study, and (d) asked for the teachers’ consent to participate in the study. The teacher gave consent and was sent a confirmation email indicating selection to participate in the study.

The consenting teacher was then given the consent forms to be sent home for the parents of the potential students to be included in the study (see Appendix G). These consent forms explained to the parents the purpose of the study and what they need to
know and do in order to allow their son/daughter to participate in the study. Once consent was obtained from the parents, the SI presented the assent forms to the students. Agreement to participate in this study was determined by the student independently signing the form. After consent forms from the teacher and parents and assent forms from the students were collected, the teacher was trained to use the NRA.

**Teacher training.** The next part of the pre-intervention phase was training the teacher in how to administer the NRA. The SI met with the teacher in her classroom after school hours on Monday, March 4, 2013, to conduct the two-hour training, which occurred in the following format: (a) general orientation, (b) how to use the instruments, (c) practice collecting data, and (d) debriefing after the intervention (Barlow et al., 2009).

**General orientation.** The teacher was taught the purpose of the study (i.e., to determine if the NRA is an effective method for teaching students with autism to read unknown words). Time frames were discussed, including the start and end dates of the intervention and how long each session should last.

**Observation system.** The teacher was given instruction in the operational definitions used in the study. Specifically, the terms *Nonverbal Reading Approach*, *computer-assisted intervention*, *teacher-led intervention*, and *fidelity checklists* were taught. Each phase of the study was explained, with opportunities for questions to be asked at any time. After this discussion, examples of how to score student responses were discussed.

**Analogue practice.** Next, the teacher was given the opportunity to practice filling out the CORE Phonics Survey form (Diamond & Thorsnes, 2008). The teacher administered the survey to the SI to practice reading the prompts and filling out the data
collection sheet. Upon completion of the survey, the SI modeled how to score it. Then, the SI gave instruction on how to implement the teacher-led and computer-assisted components and collect data. The teacher was given training in how to use the video recording equipment (how to record, what to record, where to store the information). Finally, the teacher was given the video-recording devices to be used in the study. After the teacher learned about the study, had the opportunity to practice administering the various assessments/data collection sheets and set up the video recording equipment, she was given the Teacher Pre-Intervention Acceptability Rating Survey.

**Debriefing.** Originally, the participating teacher was to be debriefed one week after the final day of data collection. Due to time limitations, the teacher was debriefed on the last day of data collection (March 18, 2013). The purpose of the debriefing session was to provide an opportunity to receive direct feedback on the effectiveness of the intervention. A discussion relating to continued use of the intervention occurred. Finally, the teacher was given the Teacher Post-Intervention Acceptability and Importance of Effects Survey.

**Target word identification.** After receiving training from the SI, the teacher administered the CORE Phonics Survey to each participating student (see Appendix A). Each student sat in front of the teacher and was asked to read the letters and words as the teacher pointed to the letters/words. Letters and words read correctly and incorrectly were marked according to the directions on the survey. The assessment was terminated when the student incorrectly identified 10 words. Once all students were assessed using the CORE Phonics Survey, the SI compared the results. Two groups were identified: beginning phonics group and advanced phonics group. Students in the beginning phonics
group were unable to identify half of the words in each word set. Students in the advanced phonics group were able to identify at least half of the words in each word set. For the beginning phonics group of students, the SI identified two words that were read incorrectly in each section of the Reading and Decoding Skills subtest. The first two words that were missed by both students in this group from each word set were identified as the target words for the beginning phonics group. For the advanced phonics group of students, the SI identified the all words that were read incorrectly in each section of the Reading and Decoding Skills subtest. The first two words that were missed from each word set were identified as the target words for the advanced phonics group. The variability in the abilities of the students in the advanced phonics group necessitated the change in identification procedures.

**Materials created.** After the twenty target words were identified (10 for the Beginning Phonics, 10 for the Advanced Phonics), the SI created the spiral-bound word booklets and the PowerPoint slides (as previously discussed). These materials were then delivered to the teacher.

**Baseline Phase**

Baseline sessions began on the same day for the first four students and lasted approximately one and a half minutes per student. The fifth student began baseline during Session 10. This student was included in the study after two of the original students reached criterion during baseline, and was no longer able to continue participating in the study. The students were assessed on their ability to receptively identify the ten target words, according to their group (beginning or advanced; see Appendix H). All ten spiral-bound word booklets were randomly placed face-up on a table and the teacher instructed
the student to point to a word. If, within 5 seconds, the student was able to point to the correct word, a “+” was marked on the data collection sheet (see Appendix I). If the student failed to point to the correct word within 5 seconds, or pointed to an incorrect word, a “-” was marked on the data collection sheet. This procedure was repeated for the remaining nine words. After three baseline sessions, the first student began the intervention phase of the design. To counteract potential student fatigue of baseline assessment, baseline probes were administered every third session to the second student; therefore, the second student received a total of four baseline sessions (Session 1 through 3, Session 6).

**Intervention Phase**

Once the pre-intervention phase and baseline phase began, the intervention phase of the study commenced. As described in the “Design” section, a multiple baseline with alternating treatment design was used to assess the functional relationship of the IVs to unknown word identification ability. Two sessions occurred each day – once in the morning and once in the afternoon – over the course of 10 school days for a total of 20 sessions.

**Teacher-led sessions.** For these sessions the student was instructed on all ten target words using the teacher-led component of the NRA (see Appendix H). The NRA consists of four steps: (a) active participation, (b) saying each sound, (c) saying the word slowly, and (d) saying the word quickly. For active participation, the teacher placed the spiral-bound word booklet in front of the student. The student was asked to read the word with the teacher using an errorless learning strategy (Heward, 2013). Next, the student was asked to say each phoneme in the word using internal
speech while the teacher said the phonemes out loud. Third, the student was asked to say the word slowly using internal speech while the teacher said the word out loud. Finally, the student was asked to say the word quickly using internal speech while the teacher said the word out loud. Once the process was finished, the student was given social praise.

Each of the remaining nine words was taught using the procedures described previously. All ten words were then taught two more times. The student was then evaluated on his/her ability to read the target words. This procedure was similar to the baseline sessions discussed previously. After randomly placing all ten spiral-bound word booklets in front of the student, the teacher instructed the student to point to a word. This assessment process continued until all ten words were assessed. Correct responses were marked with a “+” sign; incorrect responses were marked with a “-“ sign (see Appendix I).

**Computer-assisted sessions.** For these sessions the student was instructed on all ten target words using the computer-assisted instruction (CAI) component of the NRA (see Appendix H). All four steps of the computer-assisted component of the NRA were delivered by the PowerPoint slides (see Figure 1). The student put on the headphones and viewed the PowerPoint slide for each target word. After viewing all ten PowerPoint slides, the process were repeated two more times, for a total of three times that the student was instructed in each target word. The student was then evaluated on his/her ability to point to the target words using the same procedure outlined previously (see Appendix I).
<table>
<thead>
<tr>
<th>PowerPoint Slide</th>
<th>Computer Voice Output</th>
<th>Slides</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>chop</strong></td>
<td>“Read with me.”</td>
<td>Slide 1: Promotes active participation</td>
</tr>
<tr>
<td></td>
<td>“Your turn.”</td>
<td></td>
</tr>
<tr>
<td><strong>chop</strong></td>
<td>“Now in your head say this sound: Ch.”</td>
<td>Slide 2: Say each sound using internal speech component of the NRA.</td>
</tr>
<tr>
<td><strong>chop</strong></td>
<td>“…o…”</td>
<td>No break occurs between the individual phonemes.</td>
</tr>
<tr>
<td><strong>chop</strong></td>
<td>“…p…”</td>
<td></td>
</tr>
<tr>
<td><strong>chop</strong></td>
<td>“Now in your head say this word slowly. Don’t stop between the sounds.”</td>
<td>Slide 6: Say the word slowly using internal speech.</td>
</tr>
<tr>
<td><strong>chop</strong></td>
<td>“Now in your head say this word fast.”</td>
<td>Slide 7: Say the word quickly using internal speech.</td>
</tr>
</tbody>
</table>

*Figure 1.* Sample of the PowerPoint portion of the NRA. Each slide automatically advanced on a set timer as students viewed it. Adapted with permission from *Using computer-assisted instruction and the nonverbal reading approach to teach word identification* by M. B. Coleman-Martin, K. W. Heller, D. F. Cihak, & K. L. Irvine (2005).

**Maintenance Phase**

Once a student identified 80% of his/her target words for two consecutive sessions, maintenance probes were administered every third session. Probe sessions
adhered to the baseline procedures discussed previously (i.e., no intervention was delivered; only assessment of the student’s knowledge of the words was conducted).

**Debriefing**

On the final day of data collection, the SI and the teacher met to discuss the results of the study. A discussion relating to continued use of the intervention occurred. Finally, the Teacher Post-Intervention Acceptability and Importance of Effects Survey was administered to the teacher.

**Inter-Observer Agreement**

Inter-observer agreement (IOA) was calculated in relation to the procedural fidelity of the teacher to adhere to the script and to record student responses correctly. Gast (2010) suggests 20-33% of each intervention should be assessed for procedural fidelity and for student responses per student per intervention. The following steps were taken to adhere to commonly accepted IOA practices (Barlow et al., 2009). First, the behaviors being observed (teacher fidelity, student response) were defined (see Appendix C). Second, two scorers were assigned to score the two behaviors: the first was the SI, and the second was a doctoral student who had no involvement with the students and/or teacher. Third, a technically-enhanced observation method (i.e., video-recording) was selected as a way to record, view, and score teacher fidelity and student responses. The teacher was given a video camera to record both the teacher and student while the intervention occurred. At the end of each day, the SI collected, edited, and scored each session. The SI met with the inter-observer after the final session, so she could watch and score the videos.
**Procedural Fidelity**

Procedural fidelity was calculated to assess the teacher’s ability to adhere to the established procedure for each phase of the study (see Appendix C). To determine procedural fidelity, the data from the SI was reported using the following point-by-point method: \[\frac{\text{number of sessions with 100% fidelity}}{\text{total number of sessions}} \times 100 = \text{percent of procedural fidelity}\]. The SI observed 100% of each phase (baseline, intervention, maintenance) for Brenda and Curtis.

Procedural fidelity was calculated by comparing data collected from the inter-observer with data collected from the SI. Inter-observer agreement (IOA) procedural fidelity was calculated using the following formula: \[\frac{\text{agreements}}{\text{agreements} + \text{disagreements}} \times 100 = \text{percent of agreement}\]. The inter-observer and the SI observed 33% of each phase (baseline, intervention, maintenance) for Brenda and Curtis.

**Student Response**

Student responses were calculated to assess the reliability of the number of words read by the student during each phase (see Appendix C). To determine the accuracy of student responses, the SI and the inter-observer used the following point-by-point method: \[\frac{\text{agreements}}{\text{agreements} + \text{disagreements}} \times 100\]. The inter-observer and the SI observed 33% of each phase (baseline, intervention, maintenance) for Brenda and Curtis.

**Treatment of Data**

Data from the target word data collection sheets were used to answer the following questions:
Research Question 1: Does the Nonverbal Reading Approach teacher-led component increase the percentage of unknown words read for 11-14 year old students with autism?

Research Question 2: Does the Nonverbal Reading Approach computer-assisted component increase the percentage of unknown words read for 11-14 year old students with autism?

Analysis: In order to determine whether the interventions were effective, a visual inspection of the data (Gast, 2010) and a Percent of nonoverlapping data (PND) procedure (Scruggs, Mastropieri, & Casto, 1987) was used to analyze baseline variability, slope, and trend. Visual analysis of data has been widely used in single case research because it “is holistic and can simultaneously detect curvilinear trends, repeating patterns or cycles in data, delayed or lagged responses following intervention onset, and within-phase changes in variability” (Parker & Hagan-Burke, 2007, p. 96). In order to demonstrate a functional relation between the independent variables (teacher-led, computer-assisted) and the dependent variable (number of words read/identified), (a) the data must be stable during baseline, (b) the change in the dependent variable (DV) occurs only when the independent variable (IV) is introduced, (c) the baselines of the other students remain unchanged once the IV has been introduced, and (d) the change in behavior is replicated across students (Lieberman, Yoder, Reichow, & Wolery, 2010).

Percentage of nonoverlapping data was calculated by identifying the highest data point in each baseline, adding up the total teacher-led data points that were above the highest baseline data point, and dividing by the total number of teacher-led sessions (Scruggs et al., 1987).
Research Question 3: Which of the two components (i.e., teacher-led, computer-assisted) shows a larger increase of the percentage of unknown words read for 11-14 year old students with autism?

Analysis: The data were compared using the standardized mean difference (SMD), a non-regression parametric approach (Busk & Serlin, 1992; Olive & Franco, 2008), and percentage of nonoverlapping data (PND).

Data from the pre- and post-test teacher perception surveys were used to answer the following question:

Research Question 4: What attitudes does a special education teacher of middle-school students with autism have regarding the Nonverbal Reading Approach prior to and after the intervention?

Analysis: Descriptive statistics were used to determine the trend within the data reported.
CHAPTER 4

RESULTS

The purpose of this study was to determine if the Nonverbal Reading Approach (NRA) was an effective method for teaching students with autism to identify unknown words. A total of four research questions were answered in this study. This chapter is organized according to these questions. For each research question, the data analysis procedures that were used to answer the question as well as the results obtained are reported. Procedural fidelity results of the teacher to both independent variables (teacher-led, computer-assisted) are reported next, along with the data analysis procedures used. Finally, inter-observer agreement (IOA) between the SI and a doctoral student are reported on procedural fidelity and student responses.

Analysis of the Teacher-led Component

The first research question identified for this study was as follows: Does the Nonverbal Reading Approach teacher-led component increase the percentage of unknown words read for 11-14 year old students with autism? The data were analyzed using descriptive statistics, percentage of nonoverlapping data (PND), and visual inspection of the graphs (see Figure 2).

No students were able to reach criterion (80% over two consecutive sessions) during the teacher-led component of the NRA. Brenda identified 7% of the unknown words during the baseline sessions. During the teacher-led sessions, Brenda identified 38% of the unknown words over five sessions, and identified 80% of the unknown words on the twelfth session. A maintenance probe administered on the nineteenth session indicated Brenda maintained her ability to identify 80% of unknown words. Curtis
identified 0% of the unknown words during the baseline sessions for the ten words selected. During the teacher-led sessions, Curtis identified 80% of the unknown words over three sessions, and identified 100% of the unknown words on the tenth session. A maintenance probe administered on the sixteenth session indicated Curtis maintained his
ability to identify 100% of the unknown words. A second maintenance probe was not administered due to Curtis being ill on the day that the data were to be collected. A second maintenance probe was not administered to Brenda due to the combination of the multiple probe design and the adapted alternating treatment design: the total number of sessions (baseline, intervention, maintenance) equaled 20, and since Brenda reached criterion on the sixteenth session, only one maintenance probe was accounted for in the design on the nineteenth session.

Percentage of nonoverlapping data was calculated by identifying the highest data point in each baseline, adding up the total teacher-led data points that were above the highest baseline data point, and dividing by the total number of teacher-led sessions (Scruggs et al., 1987). Brenda’s highest baseline data point was one, with four of the five teacher-led data points being above the highest baseline data point. Curtis’s highest baseline data point was zero, with all three of the teacher-led data points above the highest baseline. Results indicate that the teacher-led component of the NRA was fairly effective for Brenda (80%), and highly effective for Curtis (100%).

Visual analysis of the graphic data presented in Figure 2 was conducted on the relative level change within the teacher-led condition, between baseline and teacher-led conditions, and on the trend direction and variability for both baseline and teacher-led data points. The change in level for the teacher-led component was determined by (a) calculating the median value of the first half of the data series, (b) calculating the median value of the second half of the data series, and (c) subtracting the smaller value from the larger (Gast, 2010). Brenda’s relative level change was 4.5, indicating an improving direction, whereas Curtis’s relative level change was 0, indicating no direction. Relative
level change between baseline and teacher-led conditions was determined by (a) calculating the median value of the last half of the baseline condition, (b) calculating the median value of the first half of the teacher-led condition, and (c) subtracting the smaller value from the larger (Gast, 2010). Brenda’s relative level change between the baseline condition and the teacher-led condition was .5, and Curtis’s level change was 7. These results indicate a positive change in behavior between the baseline and teacher-led condition for both students.

Trend direction was determined by (a) identifying the mid-point between the first two data points, (b) identifying the mid-point between the last two data points, and (c) drawing a straight line between the two identified points (Gast, 2010). An absence of a trend during the baseline condition for both students was found, and the trend direction during the teacher-led sessions was accelerating for Brenda and slightly decelerating for Curtis. Variability was determined by visually determining if the trend direction for each phase was positive, neutral, or negative. Baseline variability for both students was neutral, and teacher-led intervention variability for both students was positive, suggesting an increase in the ability of both students to read unknown words. The visual analysis of both graphs suggests the teacher-led component was an effective intervention for Brenda and a fairly effective intervention for Curtis.

**Analysis of the Computer-assisted Component**

The second research question identified for this study was as follows: Does the Nonverbal Reading Approach computer-led component increase the percentage of unknown words read for 11-14 year old students with autism? The data were analyzed
using descriptive statistics, percentage of nonoverlapping data (PND), and visual
inspection of the graphs.

Both students were able to reach criterion (80% over two consecutive sessions)
during the computer-assisted sessions of the NRA. Brenda identified 7% of the unknown
terms during the baseline sessions. During the computer-assisted sessions, Brenda
identified 43% of the unknown words over seven sessions. She reached criterion on the
fifteenth and sixteenth sessions, identifying 80% of the unknown words during both
sessions. A maintenance probe administered on the nineteenth session indicated Brenda
maintained her ability to identify 80% of unknown words. Curtis identified 0% of the
unknown words during his baseline sessions. During the computer-assisted sessions,
Curtis identified 76% of the unknown words over five sessions. He reached criterion on
the thirteenth and fourteenth sessions, identifying 100% of the unknown words during
both sessions. A maintenance probe administered on the sixteenth session indicated
Curtis maintained his ability to identify 100% of the unknown words.

Percentage of nonoverlapping data was calculated by identifying the highest data
point in each baseline, adding up the total computer-assisted data points that were above
the highest baseline data point, and dividing by the total number of computer-assisted
sessions (Scruggs, et al., 1987). Brenda’s highest baseline data point was one, with five
of the seven computer-assisted data points being above the highest baseline data point.
Curtis’s highest baseline data point was zero, with all five of the computer-assisted data
points above the highest baseline. Results indicate that the computer-assisted component
was fairly effective for Brenda (71%), and highly effective for Curtis (100%).
Visual analysis of the graphic data presented in Figure 2 was conducted on the relative level change within the computer-assisted condition and between baseline and computer-assisted conditions, and on the trend direction and variability for both baseline and computer-assisted data points. The change in level for the computer-assisted component was determined by (a) calculating the median value of the first half of the data series, (b) calculating the median value of the second half of the data series, and (c) subtracting the smaller value from the larger (Gast, 2010). Brenda’s relative level change was 4, and Curtis’s relative level change was 5, indicating an improving direction for both students. Relative level change between baseline and computer-assisted conditions was determined by (a) calculating the median value of the last half of the baseline condition, (b) calculating the median value of the first half of the computer-assisted condition, and (c) subtracting the smaller value from the larger (Gast, 2010). Brenda’s relative level change between the baseline condition and the computer-assisted condition was 1.5, and Curtis’s level change was 5. These results indicate a positive change in behavior between the baseline and computer-assisted condition for both students.

Trend direction was determined by (a) identifying the mid-point between the first two data points, (b) identifying the mid-point between the last two data points, and (c) drawing a straight line between the two identified points (Gast, 2010). An absence of a trend during the baseline condition for both students was found, and the trend direction during the computer-assisted sessions was accelerating for both Brenda and Curtis. Variability was determined by visually determining if the trend direction for each phase was positive, neutral, or negative. Baseline variability for both students was neutral, and computer-assisted intervention variability for both students was positive, suggesting an
increase in the ability of both students to read unknown words. The visual analysis of both graphs suggests the computer-assisted component was an effective intervention for Brenda and a fairly effective intervention for Curtis.

**Comparison of the Two Types of Approaches**

The third research question identified for this study was as follows: Which of the two components (teacher-led, computer-assisted) shows a larger increase of the percentage of unknown words read for 11-14 year old students with autism? The data were compared using the standardized mean difference (SMD), a non-regression parametric approach (Busk & Serlin, 1992; Olive & Franco, 2008), and percentage of nonoverlapping data (PND). To determine the SMD, the mean average for the teacher-led sessions was subtracted from the mean average for the baseline sessions and divided by the standard deviation of the teacher-led sessions. Olive and Smith (2005) suggest the standard deviation be calculated using the superior treatment, and SMD should be calculated for each participant. The SMD for the teacher-led sessions was 1.17 for Brenda and 4.62 for Curtis (see Table 7). The SMD for the computer-assisted sessions

**Table 7**

<table>
<thead>
<tr>
<th>Participant</th>
<th>M&lt;sub&gt;Baseline&lt;/sub&gt;</th>
<th>M&lt;sub&gt;Teacher&lt;/sub&gt;</th>
<th>SD&lt;sub&gt;Teacher&lt;/sub&gt;</th>
<th>SMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda</td>
<td>.07</td>
<td>.38</td>
<td>.27</td>
<td>1.17</td>
</tr>
<tr>
<td>Robbie</td>
<td>.00</td>
<td>.80</td>
<td>.17</td>
<td>4.62</td>
</tr>
</tbody>
</table>

*Note. SMD = Standard Mean Difference.*
Table 8

*Standard Mean Difference for Computer-assisted Intervention*

<table>
<thead>
<tr>
<th>Participant</th>
<th>M&lt;sub&gt;Baseline&lt;/sub&gt;</th>
<th>M&lt;sub&gt;Computer&lt;/sub&gt;</th>
<th>SD&lt;sub&gt;Teacher&lt;/sub&gt;</th>
<th>SMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brenda</td>
<td>.07</td>
<td>.43</td>
<td>.27</td>
<td>1.35</td>
</tr>
<tr>
<td>Robbie</td>
<td>.00</td>
<td>.76</td>
<td>.17</td>
<td>4.39</td>
</tr>
</tbody>
</table>

*Note.* SMD = Standard Mean Difference.

was 1.35 for Brenda and 4.39 for Curtis (see Table 8). According to PND results listed below, the teacher-led sessions were identified as the superior treatment; therefore, the standard deviation was calculated for the teacher-led sessions. When combining the results from both students, the SMD for the teacher-led sessions was 2.28 and for the computer-assisted sessions was 1.73. These results indicate the teacher-led intervention was more effective than the computer-assisted intervention in teaching 11-14 year old students with autism to read unknown words (see Table 9).

Table 9

*Standard Mean Difference for Both Interventions*

<table>
<thead>
<tr>
<th>Intervention</th>
<th>M&lt;sub&gt;Baseline&lt;/sub&gt;</th>
<th>M&lt;sub&gt;Brenda+Robbie&lt;/sub&gt;</th>
<th>SD&lt;sub&gt;Teacher&lt;/sub&gt;</th>
<th>SMD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher-led</td>
<td>.03</td>
<td>.54</td>
<td>.22</td>
<td>2.28</td>
</tr>
<tr>
<td>Computer</td>
<td>.03</td>
<td>.57</td>
<td>.31</td>
<td>1.73</td>
</tr>
</tbody>
</table>

*Note.* SMD = Standard Mean Difference.

Gast (2010) suggests comparing the two interventions using PND is a critical component of an alternating treatment design. Percentage of nonoverlapping data was calculated by comparing each condition against the other. For example, the first teacher-
led data point was compared to the first computer-assisted data point for Brenda, and so on until all data points were compared. Over ten comparison sessions for Brenda, the teacher-led condition was superior to the computer-assisted condition on four of the five sessions, yielding a PND of 80%. Over six comparison sessions for Curtis, the teacher-led condition was superior to the computer-assisted condition on two of the three sessions, yielding a PND of 67%. Results indicate that the teacher-led session for Brenda was fairly effective, and the teacher-led session for Curtis was questionable.

**Analysis of Teacher Perceptions**

The fourth research question answered in this study was as follows: What attitudes does a special education teacher of middle-school students with autism have regarding the Nonverbal Reading Approach prior to and after the intervention? Descriptive statistics were used to determine if there was a difference in attitudes and beliefs toward the NRA before and after the study. The first survey consisted of 12 positive statements using a Likert-type scale. Each statement was rated between 1 (strongly disagree) to 5 (strongly agree). Scores that approach the minimum number (12) suggest the teacher does not see much benefit to using the NRA with her students, whereas scores that approach the maximum number (60) suggests the teacher saw much benefit to using the NRA with her students. The second survey consisted of 14 positive statements, where the additional two addressed the maintenance and social validity of the NRA. The findings indicated a positive attitude towards using the NRA before the intervention was conducted, and a slightly higher attitude upon the completion of the intervention (see Table 10). No inferential statistics were used to assess whether the
change in means was significant due to the low number (n = 1) of teacher participants. In the “Comments” section of the post survey, the teacher wrote, “I thought this was a very easy to implement program and am very surprised/pleased with the results. I didn’t think we’d get such positive gains so quickly.”

Table 10

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>SD</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likert Pre</td>
<td>4.08</td>
<td>1</td>
<td>2.18</td>
<td>2.18</td>
</tr>
<tr>
<td>Likert Post</td>
<td>4.50</td>
<td>1</td>
<td>2.47</td>
<td>2.47</td>
</tr>
</tbody>
</table>

**Inter-observer Agreement**

Two types of inter-observer agreement were conducted on the data to determine procedural fidelity to the intervention as well as reliability of student responses. Thirty-three percent of each phase (baseline, intervention, maintenance) were observed. Results from the analysis follow.

**Procedural Fidelity**

First, the SI observed 100% of each session for Brenda and Curtis using the fidelity checklist (see Appendix C). Fidelity to the teacher-led condition was calculated by (number of teacher-led sessions with 100% fidelity)/(total number of sessions) x 100 = percent of teacher-led fidelity. A total of 7 sessions with 100% fidelity were recorded out of a possible 8 sessions. Fidelity to the teacher-led condition was 87.5%. This finding indicates an acceptable percent of procedural fidelity to the teacher-led conditions.
Fidelity to the computer-assisted condition was calculated by (number of computer-assisted sessions with 100% fidelity)/(total number of sessions) x 100 = percent of computer-assisted fidelity. A total of 8 sessions with 100% fidelity were recorded out of a possible 12 sessions. Fidelity to the computer-assisted condition was 66.7%. This finding indicates a moderate percent of procedural fidelity to the computer-assisted sessions.

**Student Response**

The SI and a doctoral student performed inter-observer agreement (IAO) checks on procedural fidelity to the teacher-led conditions and the computer-assisted conditions (see Appendix C). Reliability for teacher-led fidelity was calculated by (number of agreements)/(agreements + disagreements) x 100. Inter-observer agreement for three teacher-led sessions was 100%. Reliability for computer-assisted fidelity was calculated by (number of agreements)/(agreements + disagreements) x 100. Inter-observer agreement for four computer-assisted sessions was 100%. This finding indicates that the teacher was able to deliver both conditions (teacher-led, computer-assisted) with a high degree of fidelity.

Inter-observer agreement for student responses was conducted for 33% of the total sessions for each student. Reliability for student responses in the teacher-led sessions was calculated by (number of agreements)/(agreements + disagreements) x 100. Inter-observer agreement for three teacher-led sessions was 100%. Reliability for student responses in the computer-assisted sessions was calculated by (number of agreements)/(agreements + disagreements) x 100. Inter-observer agreement for four computer-assisted sessions was 100%. These findings indicate a high level of IOA for both conditions.
Summary of Findings

The purpose of this study was to determine if the NRA was an effective strategy for teaching 11-14 year old students with autism to read unknown words. Both students were able to learn how to read the majority of the unknown words after using the teacher-led and the computer-assisted components of the NRA. Curtis demonstrated the quickest acquisition of word reading ability compared to Brenda. When determining which of the two conditions was more effective, results from SMD and PND analysis suggest the teacher-led condition was the superior condition. Results from the teacher survey indicate that attitude of the teacher towards the NRA improved slightly from pre-intervention to post. Lastly, the NRA was an intervention that demonstrated high levels of procedural fidelity and accurately measured student responses to unknown words.
CHAPTER 5
DISCUSSION

Students with autism demonstrate communication deficits (APA, 2000). Reading instruction is one way to improve communication skills (Lanter & Watson, 2008). Data from the U.S. Department of Education shows students with autism are increasing their participation in the general education environment and decreasing their participation in the self-contained setting (2010). One of the outcomes of increased participation in the general education environment is greater access to grade-level content. Students with autism will need literacy skills that will enable them to read unfamiliar text in order to access the content.

Two approaches to literacy instruction are whole language and phonics (Ehri, 2005). The whole language approach, in particular sight word instruction for students with autism, has been shown to be effective for teaching this population to read sight words. However, one of the limitations to this approach is the inability of the students to read unknown/untaught words (Kouri et al., 2006). In order to improve the ability of students with autism to read unknown words, a phonics approach should be used. A phonics approach should improve the ability of students with autism to read unknown/untaught words, thereby increasing their access to the general education curriculum. Minimal research has been conducted on teaching older students with autism to read using a phonics approach (Chiang & Lin, 2007).

Of the studies reviewed that focused on reading instruction for 11-14 year old students with autism, one incorporated a phonics approach and computer-assisted instruction (Coleman-Martin et al., 2005). Computer-assisted instruction (CAI) is one
strategy that may be effective for teaching students with autism to read (Everhart et al., 2011). In the Coleman-Martin et al. (2005) study, only one student with autism was included. Further research needs to identify whether or not the NRA is an effective strategy for teaching phonics to middle-school students with autism.

The purpose of this study was to determine if the NRA was an effective method for teaching students with autism to identify unknown words. A total of four research questions were answered in this study. Findings related to each research question in this study are discussed in the subsequent section of this chapter. Next, conclusions drawn from these findings are shared. Finally, practical implications of the study are described and recommendations for future research are provided.

**Effectiveness of the Teacher-led Component**

The first research question answered in this study was: Does the Nonverbal Reading Approach teacher-led component increase the percentage of unknown words read for 11-14 year old students with autism? The findings suggest that a functional relationship exists between the teacher-led component of the NRA and the number of words read by both students. The findings further corroborate the findings reported on sight word instruction, phonics-based instruction, and computer-assisted instruction. Students with autism can improve their performance on a behavioral objective in various instructional formats, such as in a 1:1 teaching format (Kamps et al., 1990; McGee et al., 1986), or when delivered via the computer (Heimann et al., 1995; Tjus et al., 1998).

Students with autism demonstrate variability in their reading abilities, and this finding paralleled results from Nation et al. (2006) and Newman et al. (2007). At the start of this study, four students were included as participants. After the first baseline sessions,
two groups of decoding abilities emerged: beginning level phonics and advanced level phonics. The two students in the advanced level phonics group were re-assessed on their phonics abilities, and new words were presented to ascertain whether or not they could still be included. Results from the second set of words indicated that their receptive identification of the words was greater than their expressive, and they were removed from participation in the study. A fifth student was then assessed on her phonics abilities. She performed similarly to the advanced level phonics group and was removed from participating. Despite efforts by the SI to include students with similar characteristics (i.e., majority of the day in a self-contained classroom, receiving speech and language therapy services), the variability in the convenience sample corroborates the findings by Nation et al. (2006) and Newman et al. (2007) that the reading ability of students with autism varies.

Bailey et al. (2011) reported an increase in the decoding skills of students with autism when instruction was delivered via a word book and in conjunction with phoneme instruction. The NRA is one strategy that uses a word book to teach phonemes to students (Coleman-Martin, et al., 2005). Brenda received five teacher-led sessions and was able to identify more words when compared to the computer-assisted sessions. During the baseline sessions, when asked to identify a word, she would systematically move from one word to the next without looking to see if it was correct. The words were placed in front of her in three columns, and for each baseline session she would pick a word on the bottom right or bottom left column, and move upward. After the first teacher-led session, she continued in the same fashion. After her first computer-assisted session, however, she made a noticeable attempt to pick the right word. Instead of starting at the bottom and
moving up, she started looking at the words and trying to identify the one being asked by
the teacher. This behavior (actively looking for the correct word) continued for the
remainder of the sessions. While receiving the teacher-led component, Brenda would
attempt to say the sounds and words according to the script that the teacher was
following, which indicated that she was engaged during the lesson. The results suggest a
functional relationship between the teacher-led component and number of words read.
The SI predicted that the teacher-led component of the NRA would increase the ability of
11-14 year old students with autism to read unknown words. Descriptive, PND, SMD,
and visual analysis support the prediction. The effect of the teacher-led component was
demonstrated for the first student, as the change from the baseline phase to the
intervention phase increased over instructional sessions. These findings were replicated
through Curtis. As Brenda began intervention, Curtis remained in baseline phase until a
predetermined time. The same effect was repeated for Curtis as he began the intervention
phase.

Curtis received three teacher-led intervention sessions and performed similarly to
Brenda. During the baseline sessions, when asked to identify a word, he would attempt to
locate the correct word, but was unsuccessful on all four sessions. After his first teacher-
led session, Curtis demonstrated an ability to identify words at a similar rate to the
computer-assisted sessions. He attempted to say the sounds and words according to the
script that the teacher was following. This finding is important to note because according
to his current IEP, Curtis has been identified as a student who is mostly nonverbal. The
purpose of this study, however, was only to evaluate whether or not the two components
of the NRA could improve the percentage of unknown words read. Future studies will
need to address whether or not communicative interactions improve as a student learns to read.

While being assessed midway through the study, Curtis demonstrated the ability to identify phonemes of words. For example, Curtis was asked to identify the word, “dirt”. He looked at all of the words on the table, and pointed to the word, “quit”. On another occasion, when asked to identify the word, “quit”, he pointed to the word, “let”. This demonstrates that Curtis was attending to the final phoneme of the word, “t”, and was searching for a word that fit that criteria. Rincover (1978) found that when students with autism were taught to read sight words using stimulus fading and discriminative responding, they demonstrated difficulty generalizing to other words because they only attended to the stimulus prompt. Results from the current study suggest that, at first, Curtis was attending to one component of the word, the final phoneme. By the end of the study, Curtis appeared to have been able to identify the entire word, for he no longer made those errors when attempting to identify the correct word. While the current results do not allow for further analysis of this finding, future studies should incorporate distractor arrays to determine if the students are able to use the phonetic ability to identify words (Coleman-Martin et al., 2005). Wilcox et al. (2002) reported that older students with autism may not be capable of learning decoding skills due to a decreased blood flow to the areas of the brain which command reading. The findings of this study suggest the opposite: 11-14 year old students with autism can learn decoding skills.

**Limitations**

Despite the positive findings that a functional relationship may exist between the teacher-led component and the number of words read, several limitations exist. One
limitation may be the length of the teacher-led sessions. Kamps et al. (1990) reported 1:1 teaching sessions that lasted 8 minutes. The average teaching session for the teacher-led component of the NRA was 18 minutes. While both students did not demonstrate any signs of discomfort or irritability during the lengthy sessions, other students with autism may not be able to attend to task for as long. In the “Comments” section of the post teacher survey, the teacher reported,

Once I became familiar with the script and conducting each session, it was much easier to implement and faster. The only difficult part was repeating each word three times. I understand the importance of it, but it got a little tedious with so many words to present during each session.

Future studies may need to limit the amount of time spent on the teacher-led session. This may be accomplished by reducing the number of words taught during each session. From the studies discussed in Chapter 2, the number of words taught at any time was between three and five, not ten.

The amount of time needed to conduct the teacher-led session may be impractical for a teacher to commit to one student at a time. Evidence from the videos suggests the other students in the class were either relocated to another class during tapings or were engaged in independent, quiet seatwork activities (e.g., reading books). Future studies should attempt to deliver the teacher-led component in a small-group setting (Kamps et al., 1990; Mechling, Gast, & Krupa, 2007; Xin & Sutman, 2011). This would minimize the amount of time needed to provide direct instruction to students with autism.
Effectiveness of the Computer-assisted Component

The second research question answered in this study was: Does the Nonverbal Reading Approach computer-assisted component increase the percentage of unknown words read for 11-14 year old students with autism? The findings suggest that a functional relationship exists between the computer-assisted component of the NRA and the number of words read by both students. The findings further corroborate the findings reported on sight word instruction, phonics-based instruction, and computer-assisted instruction. Heimann et al. (1995) and Tjus et al. (1998) reported that students with autism were able to read words after using a computer program. Bosseler and Massaro (2003) further reported that students with autism were able to improve their reading ability when the computer program incorporated graphics, sounds, and a digitized tutor. The PowerPoint slides used in the current study incorporated a graphical representation of the parts of the words being learned as well as an auditory prompt. Hetzroni and Shalem (2005)

Brenda received seven computer-assisted sessions and was able to identify words at a slower acquisition rate when compared to the teacher-led sessions. Her first computer-assisted session was not videotaped, so it is difficult to ascertain why she was not able to identify any words. However, as mentioned previously, after her first computer-assisted session, she made a noticeable attempt to pick the right word. Instead of starting at the bottom and moving up, she started looking at the words and trying to identify the one being asked by the teacher. While receiving the computer-assisted component, Brenda would attempt to say the sounds and words according to the script that the PowerPoint slide was saying, which indicated that she was engaged during the
lesson. During Session 11, both she and Curtis were on the computer at the same time viewing their words. Brenda remained focused on her words and continued to attempt to sound out each word and blend the sounds together. This finding indicates that she was able to attend to task during the computer-assisted sessions. The amount of time spent on the computer-assisted sessions remained unchanged over the course of the study, with an average time of 16:28 minutes. The results suggest the computer-assisted component was slightly less effective than the teacher-led component for Brenda.

These results suggest a functional relationship between the computer-assisted component and the number of words year. The SI predicted that the computer-assisted component of the NRA would increase the ability of 11-14 year old students with autism to read unknown words. Descriptive, PND, SMD, and visual analysis support the prediction. The effect of the computer-assisted component was demonstrated for the first student, as the change from the baseline phase to the intervention phase increased over instructional sessions. These findings were replicated through Curtis. As Brenda began intervention, Curtis remained in baseline phase until a predetermined time. The same effect was repeated for Curtis as he began the intervention phase.

Curtis received seven computer-assisted intervention sessions and demonstrated a marked increase from baseline to the first two sessions. After his first computer-assisted session, Curtis identified three words; after his second computer-assisted session, he identified seven. These first two intervention sessions occurred on the same day (Friday), which may limit the correlation found between intervention and words identified. However, when he returned to school on Monday, Curtis was able to identify five of the seven words identified on Friday, and identified two additional words after receiving a
teacher-led session. As mentioned previously, the teacher did not record the computer-assisted sessions until Session 11. This video shows both Brenda and Curtis sitting side by side, viewing their respective word lists via PowerPoint. Curtis appeared to not be as engaged with the PowerPoint slides as was Brenda. During the session he can be seen looking at other students in the class, looking at Brenda’s screen, and even moving his head in front of Brenda. He did not demonstrate the same sounding out behaviors exhibited during the teacher-led sessions. Yet despite his inattentiveness, he still was able to reach criterion (80%). Future studies need to address whether or not inattentive behaviors impede the learning of the student, or if the auditory component of the PowerPoint slide was the contributing factor to Curtis identifying eight words. Overall, the computer-assisted and teacher-led components may both be effective in teaching students with autism to identify unknown words.

Limitations

Despite the positive findings that a functional relationship may exist between the computer-assisted component and the number of words read, several limitations exist. First, prior studies focused on teaching functional words (Hetzroni & Shalem, 2005; Yaw et al., 2011). The participation of students with autism in the general education environment is increasing (U.S. Department of Education, 2010). As such, functional sight words may not allow students with autism to access the general education curriculum, especially as the type of text for the 11-14 year old age group does not contain as many pictures as the type of text for younger students. Fossett and Mirenda (2006) did identify a picture-to-text matching strategy as an effective way to teach sight words; however, this strategy may not produce the positive results as 11-14 year old
students are expected to read academic content (Spector, 2011). Future studies should identify unknown academic content words to teach using the computer-assisted component of the NRA.

**Comparison of the Teacher-led and Computer-assisted Components**

The third research question answered in this study was: Which of the two components (i.e., teacher-led, computer-assisted) shows a larger increase of the percentage of unknown words read for 11-14 year old students with autism? According to SMD and PND analyses, the teacher-led component was superior to the computer-assisted component. Brenda was able to read more than 80% of the words after receiving instruction from the teacher in fewer sessions than the computer. This finding was replicated across Curtis.

While not particularly addressed in the research questions, one behavior identified from viewing the videos of each session was on-task behavior. During the teacher-led component, both Brenda and Curtis appeared to remain focused on the teacher and the words being taught. Both students produced more vocal sounds during this component. During the computer-assisted component, however, both students did not appear to remain focused on the PowerPoint slides, and were found looking elsewhere while the slideshow was running. Future studies will need to identify whether or not students with autism maintain the same level of attention to task for both components of the NRA.

One limitation, however, is the amount of time required to implement both components. At the beginning of the study, the amount of time it took the teacher to deliver the teacher-led component to Brenda was over 25 minutes. By the end of the study, the amount of time decreased to 14 minutes. The amount of time required for the
computer-assisted component remained at 16 minutes. This limitation was addressed by the teacher on her post survey. When she was asked if the intervention fit into her regular schedule, she indicated a “3”, or “Neutral” response, and then wrote the following, “Only because I teach Reading in the middle of the day so doing morning and afternoon sessions didn’t fit in with my schedule.” Future studies need to reduce the amount of time required for each component, to make it more socially valid.

**Teacher Perceptions Regarding the Nonverbal Reading Approach**

The fourth research question answered in this study was: What attitudes does a special education teacher of middle-school students with autism have regarding the Nonverbal Reading Approach prior to and after the intervention? Prior to the intervention, the teacher reported a favorable opinion regarding the NRA and the importance it would have regarding the reading ability of her students. After the intervention, the teacher’s opinion regarding the NRA increased slightly. Of the twelve questions that were the same in the pre and post survey, the teacher strongly agreed with her ability to implement the procedure, as well as viewed this intervention as having lasting positive effects. Two additional questions were added to the post survey and asked the teacher whether or not she will use the NRA again and will recommend this to others. The teacher reported that she strongly agreed with using the NRA again and recommending it to others. In terms of social validity, the results from the survey suggest the NRA is an intervention that will be used again by this teacher. The teacher reported in the “Comments” section of the post survey, “I thought everything went really well! The program was a success with my two kiddos.” Future studies will need to be conducted with more classroom teachers to determine if this positive finding is valid.
Conclusions

Seven conclusions can be drawn from this study. They are based on the descriptive, PND, SMD, and visual analyses of the data that were collected. The limitations of this study should be considered when evaluating these conclusions.

1. Eleven to fourteen year old students with autism can learn to read words using the teacher-led component of the phonics-based NRA.
2. Eleven to fourteen year old students with autism can learn to read words using the computer-assisted component of the phonics-based NRA.
3. The teacher-led component, when compared to the computer-assisted component, produced slightly greater gains in word reading ability.
4. The materials and design used to instruct 11 to 14 year old students with autism to read unknown words parallels previous research on effective instructional materials and designs.
5. The NRA is an effective phonics-based strategy for teaching 11 to 14 year old students with autism to read unknown academic words.
6. Eleven to fourteen year old students with autism should have access to quality literacy interventions regardless of current research that suggests physiological features and variability characteristics of the population limit their ability to learn.
7. One self-contained autism teacher can effectively implement the NRA for 11 to 14 year old students with autism.

Recommendations for Future Research

The following three recommendations can be made for future research. First, the design of the study needs to be updated and improved. Second, generalization measures
need to be implemented and analyzed. Third, evaluation of behavioral characteristics needs to be assessed in relation to the number of words read.

With every design an investigator must look at the threats to internal validity, external validity, social validity, and what general guidelines should be followed. The current study employed a combination of multiple probe and adapted alternating treatment designs (Gast, 2010). Some of the guidelines not adhered to for the multiple probe design include (a) inclusion of at least three participants and (b) sequential introduction of the intervention when the first participant reaches criterion. Some of the guidelines not adhered to for the adapted alternating treatment design include (a) applying the intervention to separate behavior sets, such as word lists; (b) attrition of students in the study; (c) observing the superior treatment; and (d) incorporating a control group to evaluate multitreatment interference. Another way to improve the overall design of this study is to use distractor arrays to assess the ability of students to read unknown words using the decoding skill taught (Bailey et al., 2009; Coleman-Martin et al., 2005). The current study did not assess whether or not the students were reading words based on phonetic principles or simple memorization. The length of each session will need to be decreased. Spending over 20 minutes on one intervention does not adhere to time suggestions in previously published studies. A reduced length of time spent on the intervention may provide quicker acquisition of reading ability.

Maintenance and generalization measures need to be further developed. Maintenance probes are one way to improve the internal validity of what is being studied (Yaw et al., 2011). Generalization needs to occur to other instructors, to other students with autism, and to other behaviors. McGee et al. (1986) and Kamps et al. (1990)
reported that paraprofessionals and peers were effective in delivering interventions, although positive results required more time with these two other instructors. In looking at the increasing inclusion of students with autism in the general education environments, a special education teacher may not be able to deliver instruction in that setting. Other sources of teachers need to be identified to increase the likelihood that the student with autism will be able to learn to read words in that setting. The students included for the current study were drawn from a convenience sample, which limits the ability of the SI to generalize the findings to other students with autism. Future studies need to identify specific groups of students with autism, such as hyperlexic readers, students with lower IQs, verbal and nonverbal students, and older students, in order to generalize the findings. Lastly, generalization measures need to assess the ability of students to read words in different environments.

Finally, future studies need to identify whether or not the behavioral characteristics of students with autism (communicative, social, repetitive behaviors) are confounding variables in determining the functional relationship between intervention (NRA) and number of words read. This can be done by videotaping all sessions, and identifying what characteristics are prevalent during study. By analyzing behavior the investigator should be able to determine whether the length of a session is too long, whether the words are too difficult, and whether the student is displaying discomfort at having to attend to the task through negative behaviors.

**Summary**

Students with autism demonstrate communication deficits (APA, 2000). Reading instruction is one way to improve communication skills (Lanter & Watson, 2008). Data
from the U.S. Department of Education shows students with autism are increasing their participation in the general education environment and decreasing their participation in the self-contained setting (2010). One of the outcomes of increased participation in the general education environment is greater access to grade-level content. Students with autism will need literacy skills that will enable them to read unfamiliar text in order to access the content. The NRA is one strategy that does improve the reading ability of students with autism.

This study contributes to the field of special education and literacy in that it first addresses the lack of effective decoding strategies (Browder et al., 2006; Chiang & Lin, 2007; Flores & Ganz, 2007; and O’Connor and Klein, 2004). Snow et al. (1998) identified systematic phonics strategies as more effective for teaching students how to read than non-systematic phonics instruction. The lack of studies within the field of special education suggests more studies need to be conducted to validate this finding by Snow et al. Furthermore, findings from this study suggest older students with autism can learn to read academic words, despite physiological deficits (Wilcox et al., 2002). This study further corroborated the findings by Coleman-Martin et al. (2005) that students with autism can be taught to read unknown words using the NRA. As future studies continue to increase the generalizability of these findings, students with autism are going to be able to continue their academic progress in the general education curriculum.
CORE Phonics Survey—Record Form

Name ____________________________ Grade ______ Date ______

SKILLS SUMMARY

Alphabet Skills and Letter Sounds

___/26  A. Letter names—uppercase

___/26  B. Letter names—lowercase

___/21  C. Consonant sounds

___/5   D. Long vowel sounds

___/5   E. Short vowel sounds

Reading and Decoding Skills

___/15  E. Short vowels in CVC words

___/15  F. Consonant blends with short vowels

___/15  G. Short vowels, digraphs, and -ich trigraph

___/15  H. R-controlled vowels

___/15  I. Long vowel spellings

___/15  J. Variant vowels

___/15  K. Low frequency vowel and consonant spellings

___/24  L. Multisyllabic words

Skills to review: ____________________________

Skills to teach: ____________________________

Alphabet Skills and Letter Sounds

**PART A  Letter names—uppercase**

Say to the student: *Can you tell me the names of these letters?* If the student cannot name three or more consecutive letters, say: *Look at all of the letters and tell me which ones you do know.*

D A N S X Z J L H
T Y E C O M R P W
K U G B F Q V I

---

**PART B  Letter names—lowercase**

Say to the student: *Can you tell me the names of these letters?* If the student cannot name three or more consecutive letters, say: *Look at all of the letters and tell me which ones you do know.*

d a n s x z j l h
t y e c o m r p w
k u g b f q v i

---

**PART C  Consonant sounds**

Say to the student: *Look at these letters. Can you tell me the sound each letter makes?* Be sure to ask if he or she knows of another sound for the letters g and c. If the sound given is correct, do not mark the Record Form. If it is incorrect, write the sound the student gives above each letter. If no sound is given, circle the letter. If the student cannot say the sound for three or more consecutive letters, say: *Look at all of the letters and tell me which sounds you do know.*

d l n s x z j
t y p c h m r
k w g b f q v

---

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PART D  Vowel sounds

Ask the student: Can you tell me the sounds of each letter? If the student names the letter, count it as the long vowel sound. Then ask: Can you tell me another sound for the letter? The student should name the short vowel sound.

e ___ l ___ a ___ o ___ u ___

l = long sound  s = short sound

Record "l" on the first line for the long sound (letter name) and "s" for the short sound on the second line. If the student makes an error, record the error over the letter.

___/5  Long vowel sounds (count the number of l's above)

___/5  Short vowel sounds (count the number of s's above)

Reading and Decoding

For Parts E through K students must read both real and pseudowords (made-up words). For the real word lines, tell the student: I want you to read each line of words aloud. If the student cannot read two or more of the real words in each line, do not administer the line of pseudowords; go to the next set of items. Before asking the student to read the line of pseudowords, say: Now I want you to read some made-up words. Do not try to make them sound like real words. When using this assessment as a specific skills test or screening measure, do not discontinue testing if a student does not do well on one of the items in Parts E through K. Instead, move to the next item and continue testing.

PART E  Short vowels in CVC words

___/5 slip mat let bun hog (real)
___/5 rut fit bat hot set (real)
___/5 nep suit tilt perm fam (pseudo)

___/15

PART F  Consonant blends with short vowels

___/5 stop trap quit spell pian (real)
___/5 silk fast sank lump held (real)
___/5 nask dilt qued cang dran (pseudo)

___/15

CORE Phonics Survey—Record Form, Page 3

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Reprinted with permission from Assessing reading: Multiple measures for kindergarten through twelfth grade by L. Diamond and MB. J. Thorsnes (2008)
PART G  Short vowels, digraphs, and -tch trigraph

---/5  when  chop  thin  shut  wick  (real)
---/5  dodge  rash  ring  then  match  (real)
---/5  child  shom  dath  phid  furch  (pseudo)

PART H  R-controlled vowels

---/5  harm  dirt  form  fern  surf  (real)
---/5  worn  pert  bark  turn  bird  (real)
---/5  nerm  slrt  gorf  murd  corn  (pseudo)

PART I  Long vowel spellings

---/5  tape  key  toe  paid  feet  (real)
---/5  leap  boat  tie  ray  blow  (real)
---/5  toe  hine  beap  faim  soat  (pseudo)

PART J  Variant vowels

---/5  few  down  moon  hawk  coin  (real)
---/5  cue  loud  cook  haunt  toy  (real)
---/5  voct  rew  fout  zoy  bawk  (pseudo)

PART K  Low frequency vowel and consonant spellings

---/5  kneel  cent  type  ghost  wrist  (real)
---/5  giant  sweat  gnat  bomb  sigh  (real)
---/5  bice  knod  dimb  thig  wrap  (pseudo)
PART I  Multisyllabic words

To administer, say to the student: I want you to read aloud the first column of words. Each of the real words in this column has two syllables. Point to the first column. If the student can read at least five out of eight of the words in this column, point to the second column and say: Now I want you to read aloud the next column of words. If the student can read at least five of the words in the second column, point to the third column and say: Now I want you to read some made-up words. Do not try to make them sound like real words.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed-closed</td>
<td>unless</td>
<td>consent</td>
<td>timbut</td>
</tr>
<tr>
<td>Closed-silent e</td>
<td>competes</td>
<td>admire</td>
<td>rompote</td>
</tr>
<tr>
<td>Open/closed-other</td>
<td>depend</td>
<td>radishes</td>
<td>podated*</td>
</tr>
<tr>
<td>Open or closed</td>
<td>zero</td>
<td>menu</td>
<td>gromu*</td>
</tr>
<tr>
<td>Silent e</td>
<td>locate</td>
<td>inhaled</td>
<td>pentate</td>
</tr>
<tr>
<td>Consonant -le</td>
<td>stable</td>
<td>dimple</td>
<td>morkle</td>
</tr>
<tr>
<td>-e-Controlled</td>
<td>further</td>
<td>bordered</td>
<td>darber</td>
</tr>
<tr>
<td>Vowel team</td>
<td>railways</td>
<td>roaring</td>
<td>faunnton</td>
</tr>
</tbody>
</table>

*The first syllable of these words can be either open or a closed (long or short vowel sound, respectively); the second syllable of podated can be either a closed (short vowel sound) or a silent -e (long vowel sound) syllable, due to the rules for adding -ed.*
CORE Phonics Survey—Student Material
Alphabet and Letter Sounds

PART A
D A N S X Z J L H
T Y E C O M R P W
K U G B F Q V I

PART B
d a n s x z j l h
T y e c o m r p w
K u g b f q v i

PART C
d l n s x z j
T y p c h m r
K w g b f q v

PART D
e i a o u

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Reprinted with permission from Assessing reading: Multiple measures for kindergarten through twelfth grade by L. Diamond and MB. J. Thorsnes (2008)
PART H

harm  dirt  form  fern  surf
worn  pert  bark  turn  bird
nerm  sirt  gorf  murd  carn

PART I

tape  key  toe  paid  feet
leap  boat  tie  ray  blow
loe  hine  beap  faim  soat

PART J

few  down  moon  hawk  coin
cue  loud  cook  haunt  toy
voot  rew  fout  zoy  bawk

PART K

kneel  cent  type  ghost  wrist
giant  sweat  gnat  bomb  sigh
bice  knod  dimb  tigh  wrep

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</tr>
<tr>
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<td>menu</td>
<td>gromu</td>
</tr>
<tr>
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<td>pentate</td>
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<td>further</td>
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</tr>
<tr>
<td>railways</td>
<td>roaring</td>
<td>fauntoon</td>
</tr>
</tbody>
</table>
APPENDIX B

PERMISSION TO USE COPYRIGHTED MATERIAL
Consortium on Reading Excellence, Inc. (CORE)
2550 Ninth Street, Suite 102
Berkeley, California 94710

To Whom This May Concern:

I am completing a doctoral dissertation at the University of Nevada, Las Vegas entitled, “Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach.” I am seeking permission to reprint excerpts from the following:


The excerpts to be reprinted are the CORE Phonics Survey (pp. 44-58). My intervention study will use this inventory as a tool to measure the decoding skills of my subjects. This survey will provide the target words to be used for the study.

The requested permission extends to any future revisions and editions of my dissertation, including non-exclusive rights in all languages and to the prospective publication of my dissertation by ProQuest Information and Learning (ProQuest) through its UVaR Dissertation Publishing business. ProQuest may produce and sell copies of my dissertation on demand and may make my dissertation available for free internet download at my request. These rights will in no way restrict republication of the material in any other form by you or by others authorized by you. Your signing of this letter will also confirm that the company owns the copyright to the above-described material.

If these arrangements meet with your approval, please sign this letter where indicated below and return it to me at the address below. Thank you very much.

Sincerely,
Patrick A. Leytham
Doctoral Candidate
Department of Educational & Clinical Studies
4505 S. Maryland Pkwy
Box 5453014
Las Vegas, NV 89154-3014
PERMISSION GRANTED FOR THE USE REQUESTED ABOVE.

[Signature]

Date: 1st May 2013
Georgia State University
Kathryn W. Heller
Department of Educational Psychology and Special Education
PO Box 3979
Atlanta, GA 30302-3979

Dear Dr. Heller:

I am completing a doctoral dissertation at the University of Nevada, Las Vegas entitled, "Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach". I am seeking permission to adapt an excerpt from the following:


The excerpt to be adapted and reprinted is Figure 1: A sample of PowerPoint slides for one word showing the steps and the voice output provided by the computer. This figure will enhance the reader's understanding of the process for the NRA, as well as what the subjects will be seeing as they engage in the CAI. My intervention study will use the NRA to determine if it is an effective intervention for individuals with mild to moderate autism. Part of the inclusion criteria for my study is for the subjects to have limited speech output. I predict that the NRA will be an effective strategy for teaching this population.

The requested permission extends to any future revisions and editions of my dissertation, including non-exclusive rights in all languages and to the prospective publication of my dissertation by ProQuest Information and Learning (ProQuest) through its UMI® Dissertation Publishing business. ProQuest may produce and sell copies of my dissertation on demand and may make my dissertation available for free internet download at my request. These rights will in no way restrict republication of the material in any other form by you or by others authorized by you. Your signing of this letter will also confirm that the company owns the copyright to the above-described material.

If these arrangements meet with your approval, please sign this letter where indicated below and return it to me at the address below. Thank you very much.

Sincerely,
Patrick A. Leytham
Doctoral Candidate
Department of Educational & Clinical Studies
4505 S. Maryland Pkwy
Box 453014
Las Vegas, NV 89154-3014

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE:

[Signature]
Kathryn W. Heller, Ph.D.

Date: 3/24/3
Gratis

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Apr 10, 2013

PATRICK A. LEYTHAM
Department of Educational & Clinical Studies
4505 S. Maryland Pkwy
Box #453014
Las Vegas, NV 89154-3014

Dear Mr. Leytham:

You have our permission to include content from our text, SCHOOL-BASED INTERVENTIONS: THE TOOLS YOU NEED TO SUCCEED, 1st Ed. by LANE, KATHLEEN L.; BEEBE-FRANKENBERGER, MARGARET., in your doctoral dissertation for your studies at University of Nevada, Las Vegas.

Content to be published in PDF format on ProQuest UMI Dissertation Publishing (www.proquest.com):

- Page: 113 Teacher Post-Intervention Acceptability and Importance of Effects Survey
- Page: 118 Teacher Pre-Intervention Acceptability Rating Survey

Thesis title: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

Please credit our material as follows:

Sincerely,

Cheryl Freeman, Permissions Administrator
# Teacher Fidelity Checklist

**Student ID**  
**Session ID**  
**Person Completing**

**Condition**  
(circle the correct one)

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Teacher-led</th>
<th>Computer-assisted</th>
<th>Maintenance</th>
</tr>
</thead>
</table>

**Directions:**
While watching the pre-selected video, you will mark either “+” or “-“ if the behavior is observed from the teacher implementing the intervention.

<table>
<thead>
<tr>
<th>Component</th>
<th>Present?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was the camera setup completed prior to the start of the lesson?</td>
<td>☐ ☐</td>
</tr>
<tr>
<td>2. Were both the words and the student within the video frame?</td>
<td>☐ ☐</td>
</tr>
<tr>
<td>3. Were the ten target words written on the Phase Change data sheet?</td>
<td>☐ ☐</td>
</tr>
<tr>
<td>4. Did the teacher adhere to the scripts for the condition phase?</td>
<td>☐ ☐</td>
</tr>
<tr>
<td>5. If applicable, was the student taught all ten words three times each? (If not applicable, answer “Yes”.)</td>
<td>☐ ☐</td>
</tr>
<tr>
<td>6. Was the entire session recorded?</td>
<td>☐ ☐</td>
</tr>
</tbody>
</table>

Total Number of Components Present ________ ÷ 6 = ________ * 100 = ________%
Student Response Checklist

Class ID

Person Completing

While watching the pre-selected video, you will mark either “+” or “−” if the behavior is observed from the student responding to the assessment questions.

<table>
<thead>
<tr>
<th>Word 1</th>
<th>Word 2</th>
<th>Word 3</th>
<th>Word 4</th>
<th>Word 5</th>
<th>Word 6</th>
<th>Word 7</th>
<th>Word 8</th>
<th>Word 9</th>
<th>Word 10</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>spell</td>
<td>tape</td>
<td>toe</td>
<td>let</td>
<td>quit</td>
<td>sip</td>
<td>harm</td>
<td>dirt</td>
<td>chop</td>
<td>when</td>
<td></td>
</tr>
</tbody>
</table>

Student 1

• Session 2
• Session 6
• Session 9
• Session 11
• Session 13
• Session 16
• Session 19

Student 2

• Session 1
• Session 6
• Session 8
• Session 10
• Session 12
• Session 17
• Session 20
chop
chop
chop
chop
chop
chop
# Teacher Pre-Intervention Acceptability Rating Survey

Class ID: __________________________ Date: __________________________

For each item, please circle the number that most closely represents your opinion about the proposed intervention.

<table>
<thead>
<tr>
<th>The proposed intervention will:</th>
<th>Strongly Disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fit into my regular schedule</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Not take too much time</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Teach important skills</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Be a fair way to handle the problem</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Be appropriate given the problem</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Be suitable given the classroom culture</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Be easy to implement and maintain</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Be within my skill level to implement</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Quickly improve the student’s skill</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Be acceptable to other students</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. Have lasting positive effects</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12. Improve student’s overall performance</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Comments/Opinions: ........................................................................................................................................

Adapted with permission from *The tools you need to succeed* by K. L. Lane and M. beebe-Frankenberger (2004)
# Teacher Post-Intervention Acceptability and Importance of Effects Survey

**Class ID:** __________________________  
**Date:** __________________________

For each item, please circle the number that most closely represents your opinion about the proposed intervention.

<table>
<thead>
<tr>
<th>The intervention:</th>
<th>Strongly Disagree</th>
<th>Neutral</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fit into my regular schedule</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Did not take too much time</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Taught important skills</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Was a fair way to handle the behavior</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Was appropriate given the behavior</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Was suitable given the classroom culture</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Was easy to implement and maintain</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Was within my skill level to implement</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Quickly improved the student’s skill</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Was acceptable to other students</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Will have lasting positive effects</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Improved student’s overall performance</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Is one I will use again when needed</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Is one I will recommend to others</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments/Opinions:**

Adapted with permission from *The tools you need to succeed* by K. L. Lane and M. beebe-Frankenberger (2004).
Letter of Acknowledgement of a Research Project at a CCSD Facility

Office of Research Integrity – Human Subjects
University of Nevada, Las Vegas
4505 S. Maryland Parkway, Box 451047
Las Vegas, NV 89154-1047

Subject: Letter of Acknowledgement of a Research Project at a CCSD Facility

Dear ORI – Human Subjects:

This letter will acknowledge that I have reviewed a request by Patrick A. Leytham to conduct a research project entitled, Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach at Hyde Park Middle School.

When the research project has received approval from the UNLV Institutional Review Board and the Department of Research of the Clark County School District, and upon presentation of the approval letter to me by the approved researcher, as site administrator for Hyde Park Middle School I agree to allow access for the approved research project.

If we have any concerns or need additional information, the project researcher will be contacted or we will contact the UNLV Office of Research Integrity – Human Subjects at 895-2794.

Sincerely,

[Signature]

Authorized Facility Representative Signature

[Date]

Anna Belknap, Principal

Print Representative Name and Title
Letter of Authorization to Conduct Research at Facility

Office of Research Integrity – Human Subjects
University of Nevada Las Vegas
4505 Maryland Parkway Box 451047
Las Vegas, NV 89154-147

Subject: Letter of Authorization to Conduct Research at Hyde Park Middle School.

Dear Office of Research Integrity – Human Subjects:

This letter will serve as authorization for the University of Nevada, Las Vegas ("UNLV") researcher/research team, Dr. Thomas B. Pierce (Principal Investigator) and Patrick A. Leytham (Student Investigator) to conduct the research project entitled "Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach" at Hyde Park Academy of Science and Math, 900 Hinson Street, Las Vegas, NV 89107 (the "Facility").

The Facility acknowledges that it has reviewed the protocol presented by the researcher, as well as the associated risks to the Facility. The Facility accepts the protocol and the associated risks to the Facility, and authorizes the research project to proceed. The research project may be implemented at the Facility upon approval from the UNLV Institutional Review Board.

If we have any concerns or require additional information, we will contact the researcher and/or the UNLV Office of Research Integrity – Human Subjects.

Sincerely,

[Signature]
Facility's Authorized Signatory

[Date]

Anna Belknap, Principal
Printed Name and Title of Authorized Signatory
To: Corinne Sunakoda  
From: Patrick A. Leytham, Doctoral Candidate  
Re: Potential Participation in a Study  

My name is Patrick A. Leytham, and I am a doctoral candidate at the University of Nevada, Las Vegas. I am conducting a research study on the effectiveness of the Nonverbal Reading Approach for teaching words to students with autism. I am sending you this email because you teach in a self-contained classroom in the Clark County School District (CCSD) and you may have students who meet the following inclusion criteria for the study: (a) be 11-14 years old, (b) have a primary diagnosis of autism according to their confidential school records, (c) currently receive direct speech and language related services according to their current Individualized Education Program (IEP), (d) click a mouse, (e) currently receive the majority of their specially designed instruction in a self-contained classroom, (f) have no prior instruction using the NRA, and (g) the self-contained classroom has at least one computer.

As the federal mandates (NCLB, 2001; IDEA, 2004) to provide access for students with disabilities to the general education environment increases, reading deficits become more prevalent. In particular, trend data suggest students with autism are receiving special education services in general education, resource, and self-contained environments. After conducting a review of the literature, several conclusions can be drawn:
• Students with autism who have an IQ greater than 70 are able to decode words (Newman, Macomber, Naples, Babitz, Volkmar, & Grigorenko, 2007).

• Students with autism who have an IQ less than 50 have been taught to identify words by sight (Collins, Hager, & Galloway, 2011).

• No studies on a phonics-based word identification strategy have been conducted on students with autism with IQs between 60 and 75.

The purpose of this email is to solicit your involvement as a potential participant in the study. The overall procedure for this research study is: (a) recruit teachers and students; (b) instruct teachers in the NRA; (c) conduct the intervention; (d) debrief the teachers. The entire study will occur during a 4 week time period, and will take approximately 15-20 minutes of your instructional day to implement. The research study will occur in your classroom. Attached to this email is a consent form. If you agree to participate, please sign the consent form and mail it to myself at the address listed below. Thank you for your time and effort in helping me with this study.

Sincerely,

Patrick A. Leytham
Doctoral Candidate, Special Education
UNLV Department of Educational & Clinical Studies
Department Office CEB 118
4505 S. Maryland Parkway
Box #453014
Las Vegas, NV 89154-3014
leythamp@unlv.nevada.edu
To: Corinne Sunakoda

From: Patrick A. Leytham, Doctoral Candidate

Re: Confirmation Email of Teacher Participation in the NRA Study

Congratulations! You have been selected to participate in the study. In order to begin the study, I will need to meet with you to discuss the next steps. Please indicate in a return email what day and time work best for you. I will travel to your school site to discuss the required consent and assent needed from both parents and students.

Sincerely,

Patrick A. Leytham
Doctoral Candidate, Special Education
UNLV Department of Educational & Clinical Studies
Department Office CEB 118
4505 S. Maryland Parkway
Box #453014
Las Vegas, NV 89154-3014
leythamp@unlv.nevada.edu
APPENDIX G

INFORMED CONSENT/ASSENT FORMS
INFORMED CONSENT – SITE ADMINISTRATOR
Department of Educational & Clinical Studies

TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

INVESTIGATOR(S): Patrick A. Leytham and Thomas Pierce

For questions or concerns about the study, you may contact Dr. Thomas Pierce or Patrick A. Leytham at (702) 895-1104.

For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted, contact the UNLV Office of Research Integrity – Human Subjects at 702-895-2794, toll free at 877-895-2794 or via email at IRB@unlv.edu.

Purpose of the Study
You are invited to participate in a research study. The purpose of this study is to determine the effectiveness of using the Nonverbal Reading Approach to teach 11-14 year old students with autism to phonetically read words.

Participants:
You are being asked to participate in the study because you fit these criteria: (a) are the Principal at a middle school, and (b) have a self-contained autism program on your campus.

Procedures:
If you volunteer to participate in this study, you will be asked to do the following: allow the Student Investigator access to the building in order to provide training to the classroom teacher and collect data collection sheets and video recording devices on a daily basis. It is anticipated that the study will last for 12 days. Results will be shared with the teacher and Principal upon completion of the study. The Student Investigator will meet with the teacher and the Principal and show the results of all students who participated in the study; specifically, how many words each student learned using the Nonverbal Reading Approach, and which approach (teacher-led or computer-assisted) produced greater effect on word decoding ability.

Benefits of Participation
There may not be direct benefits to you as a participant in this study. However, we hope to determine if middle-school aged students with autism are successful in reading words once being instructed in the Nonverbal Reading Approach.

Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

Risks of Participation
There are risks involved in all research studies. This study may include only minimal risks. The incorporation of accepted teaching approaches will ensure student access to literacy instruction for all students. This study involves the unobtrusive observation of students via videotapes. Because of this there are minimal risks to the teachers from participation. Minimal risks include breach of confidentiality. To minimize this risk, the teacher will be given a unique identifier (i.e., Teacher 1). An Excel spreadsheet will contain the information that identifies which identifier matches which teacher, and this spreadsheet will be stored in a locked file cabinet at UNLV. Only the Principal Investigator and Student Investigator will know which number correlates to which teacher.

Cost/Compensation
There is no financial cost to you to participate in this study because all instruction will occur in your classrooms during the typical school day and all consumable materials will be provided by the Student Investigator. The study will last approximately 4 weeks (10 days of direct intervention over a two-week period, 2 days of maintenance data collection over a two-week period). You will not be compensated for your time. At the end of the study your classroom will receive the hand-held video recording devices as an expression of our gratitude. If you decide to withdraw from participating while the study is in progress, the self-contained autism classroom where the study was occurring will not receive the video recording devices and the data collected up until this point will be destroyed.

Confidentiality
All information gathered in this study will be kept as confidential as possible. No reference will be made in written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for three years after completion of the study. After the storage time the information gathered will be destroyed.

Voluntary Participation
The school’s participation and your participation in this study are voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with UNLV. You are encouraged to ask questions about this study at the beginning or any time during the research study.

Participant Consent:
I have read the above information and agree to participate in this study. I have been able to ask questions about the research study. I am at least 18 years of age. A copy of this form has been given to me.

Deemed exempt by the ORI-BS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

Signature of Participant

Date

Participant Name (Please Print)

Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
INFORMED CONSENT – LICENSED TEACHER

Department of Educational & Clinical Studies

TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

INVESTIGATOR(S): Patrick A. Leytham and Thomas Pierce

For questions or concerns about the study, you may contact Dr. Thomas Pierce or Patrick A. Leytham at (702) 895-1104.

For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted, contact the UNLV Office of Research Integrity – Human Subjects at 702-895-2794, toll free at 877-895-2794 or via email at IRB@unlv.edu.

Purpose of the Study
You are invited to participate in a research study. The purpose of this study is to determine the effectiveness of using the Nonverbal Reading Approach to teach 11-14 year old students with autism to phonetically read words.

Participants
You are being asked to participate in the study because you fit these criteria: (a) licensed to teach special education; and (b) hold either a Bachelor’s degree in Special Education, a Master’s degree in Special Education, or is currently pursuing a degree through an alternate route to licensure program in order to teach students with autism.

Procedures
If you volunteer to participate in this study, you will be asked to do the following: (a) be videotaped and involved in the teacher-led instruction using the sight-word booklets as well as the computer-assisted instruction to teach students how to phonetically read words; (b) deliver a 20-minute lesson for at least 10 days; (c) attend one training meeting for a total of 2 hours to learn how to administer the lesson and set up the video camera; and (d) set up a video camera to record both the teacher and student during the lessons. The research team will view the videos to measure adherence to the lesson components and may provide you with feedback. It is anticipated that the study will last for 12 days. Results will be shared with the teacher and the Principal upon completion of the study. The Student Investigator will meet with the teacher and the Principal and show the results of all students who participated in the study; specifically, how many words each student learned using the Nonverbal Reading Approach, and which approach (teacher-led or computer-assisted) produced greater effect on word decoding ability.

Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
**Benefits of Participation**
There may not be direct benefits to you as a participant in this study. However, we hope to determine if middle-school aged students with autism are successful in reading words once being instructed in the Nonverbal Reading Approach.

**Risks of Participation**
There are risks involved in all research studies. This study may include only minimal risks. The incorporation of accepted teaching approaches will ensure student access to literacy instruction for all students. This study involves the unobtrusive observation of students via videotapes. Because of this there are minimal risks to the teachers from participation. Minimal risks include breach of confidentiality. To minimize this risk, the teacher will be given a unique identifier (i.e., Teacher 1). An Excel spreadsheet will contain the information that identifies which identifier matches which teacher, and this spreadsheet will be stored in a locked file cabinet at UNLV. Only the Principal Investigator and Student Investigator will know which number correlates to which teacher.

**Cost /Compensation**
There is no financial cost to you to participate in this study because all instruction will occur in your classrooms during the typical school day and all consumable materials will be provided by the Student Investigator. The study will last approximately 4 weeks (10 days of direct intervention over a two week period, 2 days of maintenance data collection over a two week period). You will not be compensated for your time. At the end of the study your classroom will receive the hand-held video recording devices as an expression of our gratitude. If you decide to withdraw from participating while the study is in progress, you will not receive the video recording devices and the data collected up until this point will be destroyed.

**Confidentiality**
All information gathered in this study will be kept as confidential as possible. No reference will be made in written or oral materials that could link you to this study. All records will be stored in a locked facility at UNLV for three years after completion of the study. After the storage time the information gathered will be destroyed.

**Voluntary Participation**
The school’s participation and your participation in this study are voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with UNLV. You are encouraged to ask questions about this study at the beginning or any time during the research study.

_Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13_
TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

Participant Consent:
I have read the above information and agree to participate in this study. I have been able to ask questions about the research study. I am at least 18 years of age. A copy of this form has been given to me.

_________________________________________  __________________________
Signature of Participant                      Date

_________________________________________
Participant Name (Please Print)

Audio/Video Taping:

By signing below I agree to be videotaped for the purpose of this research study.

_________________________________________  __________________________
Signature of Participant                      Date

_________________________________________
Participant Name (Please Print)

Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
PARENT PERMISSION FORM

Department of Educational & Clinical Studies

TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach.

INVESTIGATOR(S): Patrick A. Leytham and Thomas Pierce

CONTACT PHONE NUMBER: (702) 895-1104

Purpose of the Study

Your child is invited to participate in a research study. The purpose of this study is to determine the effectiveness of using the Nonverbal Reading Approach to teach 11-14 year old students with autism to phonetically read words.

Participants

Your child is being asked to participate in the study because he or she is currently enrolled in a self-contained special education classroom for students with autism, receives speech/language related services, and has never been instructed with the Nonverbal Reading Approach.

Procedures

If you allow your child to volunteer to participate in this study, your child will be asked to do the following: (a) be videotaped and involved in the teacher-led instruction using the decodable word booklets as well as the computer-assisted instruction to learn how to phonetically read words; (b) participate in two 10-minute lessons for 10 days; (c) participate in a maintenance probe on the last day of the third and fourth week; and (d) participate in the assessment of phonetic ability prior to the implementation of the interventions. Even if you give consent for your child to participate in the study, he or she may not be selected. The total amount of students to be included in the study is six, and if more than six parents consent to their child’s participation, a randomized selection process will be used to determine which six students to include. This process includes writing the names of all potential students on 3 inch by 5 inch index cards, placing these cards in a bowl, mixing up the cards, and selecting six cards. The special education teacher in your child’s classroom will deliver both types of interventions (teacher-led, computer-assisted) to your child using an alternating treatment design, wherein the intervention selected for each session was determined before the study began. Your child will receive both types of intervention (teacher-led, computer-assisted); the type of intervention will vary depending on the session and day. The teacher in your child’s classroom will also set up a video camera to record students when the lessons are being given. The research team will view the videos to measure student performance. It is anticipated that the study will last for 4 weeks. Results will be shared with the teacher and the Principal upon completion of the study. The Student Investigator will meet with the teacher and the Principal and show the results of all students who participated in the study, specifically, how many words each student learned using

Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach.

The Nonverbal Reading Approach, and which approach (teacher-led or computer-assisted) produced greater effect on word decoding ability.

Benefits of Participation
There may not be direct benefits to your child as a participant in this study. However, we hope to learn if middle-school aged students with autism are successful in reading words once being instructed in the Nonverbal Reading Approach.

Risks of Participation
There are risks involved in all research studies. This study may include only minimal risks. The incorporation of accepted teaching approaches will ensure student access to literacy instruction for all students. This study involves the unobtrusive observation of students via videotapes. Because of this, there are minimal risks to the students and teacher from participation. Minimal risks include breach of confidentiality, stress related to the amount of time spent on each stage of the study, discomfort at using a computer with headphones or with being recorded, not learning to read the ten target words. For each session, the student will be asked if s/he is ready to work. If the answer is negative, the subject will work on a classroom assignment. After that assignment is completed, the student will be asked again if s/he is ready. This will help minimize the potential risk of stress related to doing the same intervention every day. In regards to the potential breach of confidentiality, all participants will be given a unique identifier (i.e., Student 1). An Excel spreadsheet will contain the information that identifies which identifier matches which student, and this spreadsheet will be stored in a locked file cabinet at UNLV. Only the Principal Investigator, Student Investigator, and teacher will know which number correlates to which student.

Cost/Compensation
There will not be a financial cost to you to participate in this study. The study will require twenty minutes per day for twelve days total. Your child will not be compensated for his or her time.

Contact Information
If you or your child have any questions or concerns about the study, you may contact Dr. Thomas Pierce or Patrick A. Leytham at (702) 895-1104. For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted you may contact the UNLV Office of Research Integrity – Human Subjects at 702-895-2794, toll free at 877-895-2794, or via email at IRB@unlv.edu.

Voluntary Participation
Your child’s participation in this study is voluntary. Your child may refuse to participate in this study or in any part of this study. Your child may withdraw at any time without prejudice to your relations with the university. You or your child is encouraged to ask questions about this study at the beginning or any time during the research study.

Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
TITLE OF STUDY: Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach.

Confidentiality:
All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link your child to this study. All records will be stored in a locked facility at UNLV for three years after completion of the study. After the storage time the information gathered will be destroyed.

Participant Consent:
I have read the above information and agree to participate in this study. I am at least 18 years of age. A copy of this form has been given to me.

Signature of Parent

Child’s Name (Please print)

Parent Name (Please Print)  Date

By signing below I agree to allow my child to be videotaped during the course of the study.

Signature of Parent

Child’s Name (Please print)

Parent Name (Please Print)  Date

Deemed exempt by the ORL-HS and/or the UNLV IRB. Protocol 1301-4343M
Exempt Date: 02-13-13
ASSENT TO PARTICIPATE IN RESEARCH

Decoding Skills of Middle-School Students with Autism: An Evaluation of the Nonverbal Reading Approach

1. My name is Patrick A. Leytham.

2. I am asking you to take part in a research study because I am trying to learn more about if middle school students with autism can learn how to read words.

3. If you agree to be in this study you may learn how to be a better reader.

4. There are risks involved in all research studies. This study involves minimal risks, such as being videotaped and having other adults see how you are currently performing. Only your teacher, myself, and my supervisor will know your name. No one else at the school or at the college will know your name.

5. The benefit of participating includes improving your ability to read words.

6. Please talk this over with your parents before you decide whether or not to participate. We will also ask your parents to give their permission for you to take part in this study. But even if your parents say “yes” you can still decide not to do this.

7. If you do not want to be in this study, you do not have to participate. Remember, being in this study is up to you and no one will be upset if you do not want to participate or even if you change your mind later and want to stop.

8. You can ask any questions that you have about the study. If you have a question later that you didn’t think of now, you can call me at (702) 895-1104 or ask me next time. If I have not answered your questions or you do not feel comfortable talking to me about your question, you or your parent can call the UNLV Office of Research Integrity – Human Subjects at 702-895-2704 or toll free at 877-895-2704.

9. Signing your name at the bottom means that you agree to be in this study. You and your parents will be given a copy of this form after you have signed it.

Print your name ______________________________ Date ______________

Sign your name ______________________________

Deemed exempt by the ORI-HS and/or the UNLV IRB. Protocol 1301-4333M
Exempt Date: 02-13-13
Baseline Sessions
1. Invite the student to sit at the designated table.
2. Say, “You are going to identify some words for me.”
3. Randomly place the ten target words in front of the student.
4. The teacher selects one word in her head and says, “Point to ______.”
5. If the student answers correctly, mark it with a plus (+) sign. Incorrect is marked with a minus (-) sign.
6. Repeat for the remaining nine words.

Teacher-Led Sessions
1. Invite the student to sit at the designated desk by saying, “Sit here, please.”
2. Say, “You are going to learn to sound out a word.”
3. Randomly pick one word to teach.
   a. Active Participation
      i. Place the spiral-bound word booklet face-up in front of the student.
      ii. Point to and read the target word for the student.
      iii. Say, “Read with me.” Both the teacher and student read the word together.
      iv. Say, “You read.” The student then attempts to read the word. If s/he is not able to, move on.
   b. Internal Speech
      i. Turn to page 2 of the spiral-bound word booklet.
      ii. While pointing to the black letter(s), say, “Now, in your head, say this sound, ______.” The teacher inserts the sound.
      iii. Turn the page and continue saying each sound.
      iv. Once all of the phonemes have been sounded out, turn to the next page in the flashcard booklet that has the entire word in black letters and say, “Now, in your head, say this word slowly. Don’t stop between the sounds. ________.” The teacher says the word slowly.
      v. Say, “Now, in your head, say this word fast. ________.” The teacher says the word fast.
      vi. Turn the page and deliver positive social praise for compliance.
   c. Repeat Step 3 two more times.
4. Teach the remaining words following Step 3.
5. Assess the student using the same procedures outlined in the Baseline Sessions.

Computer-assisted Sessions
1. Invite the student to sit at the designated computer by saying, “Sit here, please.”
2. Say, “Now you are going to learn the words using the computer.”
3. Randomly pick which word to teach.
4. Play the slideshow for that word.
5. Once the slideshow is finished, pick another word to teach and run the slideshow.
6. Continue this process until all ten words have been taught.
7. Assess the student using the same procedures outlined in the Baseline Sessions.
APPENDIX I

DATA COLLECTION SHEET
1. Invite the student to sit at the designated table.
2. Say, “You are going to identify some words for me.”
3. Randomly place the ten target words in front of the student.
4. The teacher selects one word in her head and says, “Point to ______.”
5. Using the “Data Collection Sheet”, mark plus (+) if the student answers correctly, and mark minus (-) if the student answers incorrectly.
6. Repeat Steps 4-5 for the remaining nine words.

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