Effects of Word Box Instruction on the Phonemic Awareness Skills of Older, Struggling Readers and Young Children at Risk for Reading Failure

DISSERTATION

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By

Susan Keesey, M.A.

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The Ohio State University

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Dissertation Committee:

Dr. Moira Konrad – Advisor

Dr. Ralph Gardner

Dr. Laurice Joseph
Abstract

Teaching a child to read is one of the greatest gifts we can give to that individual and to society as a whole, and yet many students exit school without the necessary literacy skills. For decades, research has demonstrated the importance of phonemic awareness in the development of the alphabetic principle, a prerequisite for competent reading, along with laying the foundation for more complex reading tasks; acquiring phonemic awareness is imperative for successful literacy development. Unfortunately, many students lack the necessary phonemic awareness skills to become competent readers. Extensive research exists pertaining to the development of phonemic awareness in emergent readers, but much less research is available regarding phonemic awareness development in older, struggling readers.

The purpose of this study was to extend the research by exploring the effects of word box instruction, a research-based intervention designed to promote phonemic awareness, on the phonological, reading, and spelling skills of two groups of students: three kindergartners at risk for reading failure, and five fifth graders struggling with reading and spelling (i.e., treatment resisters). A further extension of the research was the use of nonsense words throughout the study.
Concurrent interventions, utilizing a multiple probe across three phonemic awareness skills design that was sequentially replicated across subjects (Tawney & Gast, 1984), was implemented to determine the effectiveness of the intervention. Results demonstrated a functional relation between the word box instruction and increases in all eight students’ ability to segment and develop phoneme-grapheme relationships, along with demonstrated improvements in spelling and reading skills.
Dedication

This project is dedicated to the three most important men in my life: my dad, my son, and my husband. First, to my father, Allen Mulderink, who taught me very early on the immense impact literacy plays in everyday life. Second, to my son, Matthew, who allowed me to witness first-hand the intense struggles some students withstand when learning to read and write. Your determination and perseverance are truly inspirational; you changed the course of my life. And especially, to my dear husband, Kim Keesey, who has stood by my side throughout this journey, and all the journeys life has presented to us. You are always there with love and encouragement, knowing when I need it most; I could not ask for a better life partner. Thank you.
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Vita

1989 .......................................... Bachelor of Science
University of Wisconsin–Madison
Madison, Wisconsin

1996 ................................................. Masters of Arts, Special Education
University of Nevada–Reno
Reno, Nevada

1996–1998 ................................................ Reading Tutor and Consultant
The Reading Center
Rochester, Minnesota

1998–2007 ........................................... Director and Teacher
Academic Skill Builders
Faribault, Minnesota

2000–2006 ............................................ Learning Disabilities Specialist
Coordinator of Disability Services
Carleton College
Northfield, Minnesota

2010–2011 ............................................. Student Teacher Supervisor
Special Education Department
The Ohio State University
Developers and Teacher

Skill Development Workshop

The Ohio State University

Columbus, Ohio

2011–2012 Instructor

Introduction to Special Education

The Ohio State University

Columbus, Ohio

2009–present Doctoral Student

Special Education

The Ohio State University

Columbus, Ohio

Publications

Fishley, K. M., Konrad, M., Hessler, T., & Keesey, S. (Formally Accepted). Effects of GO FASTER on morpheme definition fluency for high school students with high-incidence disabilities. *Learning Disabilities Research and Practice*.


Fields of Study

Major Field: Education

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Chapter 1: Introduction

Statement of the Problem

Learning to read is a key component to success in school and throughout life. Given its importance, reading achievement should be and is a priority in the United States (U.S. Department of Education, 2002). The past two decades have seen numerous legislative acts and federal research efforts in an attempt to improve reading, especially the skills of children at risk for reading failure.

Despite this increased emphasis, reading scores remained virtually unchanged from 1992 through 2009 for fourth, eighth, and twelfth graders (Aud & Hannes, 2011). This is unacceptable given that 33% of fourth graders and 24% of eighth graders read below the basic level, leaving these students unable to perform at minimum academic expectations (National Assessment of Educational Progress [NAEP], 2011). There are over eight million students between fourth and twelfth grades struggling to read at grade level (Biancarosa & Snow, 2006).

These reading struggles, if not remediated, often lead to students dropping out of school, which occurs in the United States at a rate of over 600,000 high school students per year (Stillwell, Sable, & Plotts, 2011). Unfortunately, many of these students never return to complete their degrees, and it is estimated that over three million non-institutionalized 16- to 24-year-olds do not possess a high school diploma or alternate
credential (Chapman, Laird, & KewalRamani, 2010). When including individuals within this age group who are incarcerated, the number grows considerably; 68% of state prison inmates are without a high school degree upon incarceration (Harlow, 2003). It is estimated that over 90 million adults in the United States lack the literacy skills necessary to function in society, resulting in a loss of income of over 200 billion dollars per year (Whitehurst, 2003). Worldwide, there are over a billion adults unable to read (Royer, Abadzi, & Kinda, 2004).

The lack of improvement in reading scores, along with the large number of students who never learned to read at a proficient level, is now a greater concern than ever before given the increasing demands for reading. Demands through increased technology and the need for higher levels of education for supportable employment make reading proficiency more critical than even a few decades ago. The jobs of the past (e.g., farming and factories) are quickly vanishing; the 25 fastest declining professions have lower than average literacy demands, whereas the 25 fastest growing professions have far greater literacy demands than most jobs (Barton, 2000). Reading is required for most employment and many everyday activities.

Given the importance of reading for daily living, and the lack of improvement in reading scores, there is a need for reexamination of current practices for literacy instruction. The federal government addressed the literacy issue through the installation of the National Reading Panel (NRP), a 14-member panel of reading experts charged to synthesize the available research to determine best practices in reading instruction. The result of the NRP’s two-year effort was the most comprehensive reading literature review
ever completed. Their report, the *Report of the National Reading Panel: Teaching Children to Read* (NRP, 2000), determined the key components necessary for effective reading instruction while providing unequivocal evidence that effective reading instruction is possible for all children if teachers are provided with the training necessary to implement the research findings (Sweet, 2004). This determination is very important because it confirms the idea that effective reading instruction *is possible* for all students, including those struggling to learn to read and write.

Students struggling with literacy are also supported through recent legislation. The NRP synthesis, combined with the National Research Panel report *Preventing Reading Difficulties in Young Children* (Snow, Burns, & Griffin, 1998), became integral in the passage of the No Child Left Behind (NCLB) Act of 2001. NCLB incorporated the findings from these reports and was a continuation and elaboration of the Reading Excellence Act of 1998. This Act was a three-year, $780 million program designed to provide teachers with the most current educational research and was the first to define “scientifically based reading research.” This comprehensive definition of scientifically based reading research was then included in NCLB where it appeared more than 110 times (Sweet, 2004). NCLB was passed in 2002 as a mandate that *all* children be taught to read. This legislation included Reading First, a program calling for the use of scientifically based reading methodology to ensure that *every* child is reading by third grade (U.S. Department of Education, 2002). Reading First was designed to narrow the achievement gap by linking funding with the effective use of research-based practices to reach *all* children, and provide the necessary support before students fall too far behind.
Despite the federal legislation and mandate requiring the use of evidence-based practices in reading instruction, an alarming number of students still fail to acquire today’s much-needed literacy skills. There are two common explanations for this failure to educate all our students: (a) The students are not able or willing to learn, and (b) our instructional methods and teaching practices do not adequately address the needs of all our students. Joshi et al. (2009) posited this question to literacy professors, and their responses attributed reading failure to socioeconomic status (69%), family background (60%), and English-language learner status (55%). All of these responses attributed failure to the characteristics of the students; not a single professor mentioned ineffective instruction as a cause despite the fact that faulty instruction is a major contributor to reading failure. It is critical that educators not blame the students, but rather look to the research to find educational solutions and heed the NRP’s finding that all students can learn to read if properly instructed using evidence-based practices.

Through the comprehensive meta-analysis of the NRP, the Panel (2000) determined the best approach to reading instruction should incorporate explicit instruction in phonemic awareness, systematic phonics instruction, methods to improve fluency, and comprehension enhancement through increased vocabulary and explicit methods to improve text comprehension. Phonemic awareness is mentioned first by the NRP and is of great importance in the development of reading because it is an integral component in the acquisition of the alphabetic principle (i.e., the understanding that letters correspond to the sounds that make up spoken words; Adams, 1990), and a necessary requisite for all the other reading skills delineated by the NRP.
Phonemic awareness is the understanding that spoken sounds combine to form words (Moats, 1996). More specifically, it is the ability to identify and manipulate the individual sounds in words (i.e., phonemes). A phoneme is the smallest unit of spoken language. The English language consists of 41–44 phonemes, depending on one’s dialect. Phonemic awareness is a subcategory of the broader category, phonological awareness. Phonological awareness is an individual’s awareness and ability to access and manipulate the sound structure of oral language (Mattingly, 1972) and includes all types of manipulation of spoken sound (e.g., rhyming and syllables); phonemic awareness only involves the manipulation of individual phonemes (Schuele & Boudreau, 2008). Effective phonemic awareness instruction teaches students to notice and manipulate the sounds in spoken language.

The NPR (2000) concluded that early literacy programs containing phonemic awareness activities are more effective than programs without it. Adams et al. (1998) estimated that without direct, explicit instruction, approximately 25% of middle-class first graders and many more students from less literacy-rich backgrounds fail to acquire phonemic awareness. This was confirmed by the NRP’s determination that the most effective way to enhance phonemic awareness, reading, and spelling skills is to teach children to manipulate phonemes explicitly and systematically. This determination came as the result of comprehensively studying the varied research methodology in teaching beginning reading (e.g., Ball & Blachman, 1991; Juel, 1988; Torgensen, Morgan, & Davis, 1992) and continues to be validated through current research studies (e.g., Anthony & Lonigan, 2004; Shankweiler & Fowler, 2004).
The research on the benefits of early acquisition of phonemic awareness and the alphabetic principle is plentiful; the benefits are clearly delineated. Difficulty arises however, when students fail to acquire these early literacy skills. Juel (1988) found the poor readers were the students who entered first grade with limited phonemic awareness. By the end of fourth grade, these struggling readers still had not mastered decoding skills comparable to the skill level obtained by the good readers at the beginning of second grade. Phonics instruction was determined to be ineffective unless children possessed some phonemic awareness upon entering first grade or began phonemic awareness instruction immediately upon entering school (Juel, Griffith, & Gough, 1986).

Not only does phonological awareness allow for the acquisition of reading, research clearly supports the importance of reading in promoting phonemic awareness; there is a definite reciprocal relationship (McGuinness, McGuinness, & Donahue, 1995). As children learn to read, there is a very dramatic increase in their phonemic awareness and phonological processing ability. This is evidenced in the young reader who suddenly “takes off” and seems to read everything in sight. However, this can be a “double whammy” for the struggling reader. The child with poor phonemic awareness skills lacks the ability to become a competent reader and thereby fails to read; as such, he loses the opportunity for the phonemic awareness gains made through reading.

As struggling readers read less and accomplished readers read more, the gap in reading proficiency increases. Stanovich (1986) explains this as the “Matthew Effect” based on the bible verse Matthew 25:29, which states, “For everyone who has will be given more, and he will have an abundance. Whoever does not have, even what he has
will be taken from him.” Stanovich uses this principle to make the case that good readers continue to practice and their reading skills grow, whereas poor readers do not read and consequently the gap between the good and the poor readers continues to widen. This demonstrates the need for early literacy instruction, phonemic awareness development in particular, so students do not fall behind because “catching up” is very difficult.

Fortunately, research clearly delineates best practices in teaching phonemic awareness to emergent readers. The NRP (2000) recommends the systematic and explicit instruction of phonemic awareness through the second grade. Numerous books designed to promote phonemic awareness in beginning readers are available (e.g., Adams et al., 1998; Blachman, Ball, Black, & Tangel, 2000), and many school reading curricula include phonemic awareness activities in kindergarten, first grade, and sometimes second grade. The real difficulty arises for the students who fail to acquire phonemic awareness and the alphabetic principle within the prescribed time. Beyond second grade, phonemic awareness is seldom taught, and research regarding best practices to teach phonemic awareness to older, struggling readers is very limited (Nithart et al., 2011).

To further compound the problems for the struggling readers, Wagner et al. (1993) suggest that phonological processing skills, including phonological awareness, remain relatively coherent and stable over time. Although there is a marked improvement as children begin to read, changes appear to be reliant on individual attributes rather than just exposure suggesting that improvements in phonological awareness may be hard for some individuals to obtain. This is often the case for students with dyslexia. By definition, dyslexia is characterized as deficits in phonological
processing (Miller et al., 2006), so it is not surprising that phonemic awareness skills are difficult for this population to acquire. These students, who despite effective intervention, fail to progress, are known as “treatment resisters.”

Whether students fail to learn to read due to lack of instruction, or even with proper instruction fall into the category of treatment resister, it is imperative that teachers continue to work on literacy development, especially phonemic awareness. Moats (2001) concluded that regardless of age, poor readers exhibit weakness in phonological processing and as a result struggle with word recognition speed and accuracy. Moats advocates for explicit phonological instruction for all beginning and struggling readers, because the inability to identify speech sounds results in limited word recognition, spelling, and vocabulary development, all critical components of literacy. Unfortunately, much more research is needed to determine how best to remediate phonemic awareness deficits in older, struggling readers.

**Potential Contributions**

Older, struggling readers present a significant instructional challenge for teachers. Prior literacy instruction has not resulted in the desired outcomes for these students, and this lack of progress often leave teachers unsure of how to provide effective reading instruction. For this population, utilizing the most efficient and effective intervention is paramount considering they need to progress at a more rapid pace than their more reading-skilled counterparts if the literacy gap is going to narrow. Despite the urgency and necessity for effective research-based practices, little research exists on how best to deliver instruction to older, struggling readers. This study utilizes the current research by
including components determined to be effective for development of phonemic awareness (e.g., systematic and explicit instruction, beginning with auditory stimuli and introducing letters to further develop phonemic awareness skill) in an attempt to address some of the questions regarding effective instruction. Comparisons are also made between emerging readers and older, struggling readers in an attempt to begin to understand how instruction should be adjusted for each of these populations.

**Purpose of the Study**

The purpose of this study was to determine the effects of an intervention designed to promote phonemic awareness on the phonological, reading, and spelling skills of two groups of students: emergent readers at risk for reading failure, and older, struggling readers (i.e., treatment resisters). Specifically, concurrent interventions, utilizing a multiple probe across skills (i.e., three phonemic awareness skills) design that was sequentially replicated across subjects (Tawney & Gast, 1984) was implemented to determine the effectiveness of word box instruction on phonemic awareness and reading and spelling skills in kindergarten at risk emergent readers, and fifth grade struggling readers.

**Research Questions**

This study sought to answer the following research questions:

1. What is the effect of the word box intervention on each student’s auditory segmenting skills, as measured by the number of words segmented correctly on 9-word nonsense word probes?
2. What is the effect of the word box intervention on each student’s segmenting of words with the correct phoneme-grapheme representation, as measured by the number of words segmented correctly on 9-word nonsense word probes?

3. What is the effect of the word box intervention on each student’s spelling skills, as measured by the number of words spelled correctly on 9-word nonsense word probes [both populations], and as determined by the AIMSweb measure of Spelling [fifth graders only]?

4. What is the effect of the word box intervention on each student’s segmenting fluency, as determined by the AIMSweb measure of Phonemic Segmentation Fluency (PSF)?

5. What is the effect of the word box intervention on each student’s understanding of the alphabetic principle, as demonstrated by his/her fluency on the AIMSweb measure of Nonsense Word Fluency (NSF)?

6. What is the effect of the word box intervention on each kindergartner’s letter naming skills, as demonstrated on the AIMSweb measure of Letter Naming Fluency (LNF)?

7. What is the effect of the word box intervention on each kindergartner’s letter sound identification, as determined by the AIMSweb measure of Letter Sound Fluency (LSF)?

8. What is the effect of the word box intervention on each student’s basic reading skills, as measured by (a) the Word Attack and Word Identification subtests of the Woodcock Reading Mastery Test (WRMT-R) [both
populations] and the (b) AIMSweb measure of Oral Reading Fluency (ORF) [fifth graders only]? 

9. What is the effect of the word box intervention on each student’s phonological processing skills, as determined by the Comprehensive Test of Phonological Processing (CTOPP)?

10. How does the acquisition of phonemic awareness skills compare between the at-risk emergent readers and the older, struggling readers?

11. How do the participants and their teachers perceive the word box intervention and its effect on the students’ literacy skills?

Definitions

Given the variations in definitions and word use among educators and researchers, the following definitions were chosen for this study. Familiarity with these definitions will aid in the understanding of the information presented.

*Alphabetic Principle:* “The understanding that there are systematic and predictable relationships between written letters and spoken sounds” (Bursuck & Damer, 2011, p. 357).

*Decoding:* “The skills and knowledge by which a reader translates printed words into speech. . .the ability to pronounce a word subvocally in silent reading or vocally in oral reading” (Henry, 2010, p. 3).

*Dyslexia:* “A specific learning disability that is neurobiological in origin. . .characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. . .result[ing] from a deficit in the phonological component of
language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction” (Lyon, Shaywitz, & Shaywitz, 2003, p. 1).

**Generalization:** “The occurrence of relevant behavior under different, non-training conditions (i.e., across subjects, settings, people, behaviors, and/or time) without the scheduling of the same events in those conditions as had been scheduled in the training conditions” (Stokes & Baer, 1977, p. 350).

**Grapheme:** “A relational or functional unit to represent an element of speech, and it is the symbol for a phoneme; it refers to any letter or letter combination that corresponds to one phoneme in a printed word” (Moats, 2010, p. 91). Graphemes may comprise one to four letters.

**Maintenance:** “The extent to which a learner continues to perform the target behavior after a portion or all of the intervention responsible for the behavior’s initial appearance in the learner’s repertoire has been terminated” (Cooper, Heron, & Heward, 2007, pp. 615–617).

**Phoneme:** Speech sounds that constitute “the basic building blocks of words, the smallest units that make one word different from another” (Moats, 2010, p. 26). The English language is comprised of 41 to 44 phonemes depending on one’s dialect.

**Phonemic Awareness:** “The ability to focus on and manipulate phonemes in spoken words” (Ehri, 2004, p. 156).
Phonological Awareness: “One’s sensitivity to, or explicit awareness of, the phonological structure of words in one’s language” (Torgesen, Wagner, & Rashotte, 1994, p. 276).

Phonological Processing: “An individual’s mental operations that make use of the phonological or sound structure of oral language when he or she is learning how to decode written language” (Torgesen et al., 1994, p. 276).

Phonology: “The study of the speech sounds of any language, including the rules and patterns by which phonemes are combined into words and phrases. . .both the sound patterns themselves and to the discipline of studying those sound patterns and their mental representations” (Moats, 2010, p. 48).

Segmenting: “The ability to break apart words into their individual phonemes or sounds” (Bursuck & Damer, 2011, p. 6).

Treatment Resisters: “Those children who, despite participating in a preventative instructional program, fail to acquire word reading skills within the ‘normal’ range” (Torgesen, 2000, p. 58).

Delimitations

There are several delimitations that affect the generalizability of the results to other individuals and differing settings beyond those included in this study. First, a single-subject design was utilized to demonstrate experimental control. This design allows for closer examination of each participant’s performance and thereby establishes practical significance rather than demonstrating statistical significance (Baer, Wolf, & Risley, 1968). Without statistical significance, results are not generalizable to larger
populations. However, this study does include two differing populations (i.e., emergent at risk readers and older, struggling readers) in an attempt to compare instructional effectiveness and possible adjustments needed for each population. These findings could glean insight into a later study that might then demonstrate statistical significance.

Second, this study utilizes all nonsense words during intervention. This was done in an attempt to eliminate any visual confusion students may possess regarding phoneme-grapheme correspondence. Numerous studies (e.g., Hayes-Harb, Nicol, & Barker, 2010; Lehtonen & Treiman, 2007; Moats, 1994; Trieman & Cassar, 1997) have demonstrated orthographic representation interferes with both children’s and adults’ ability to correctly segment phonemes. It is hypothesized that utilizing nonsense words that follow phonetic patterns will eliminate the visual confusion; however, teaching nonsense words requires students to generalize their learned knowledge for it to benefit their reading and spelling of real words. Generalization of phonemic knowledge is the goal of this intervention.

Using nonsense words with word boxes runs contrary to the majority of word box studies previously completed that implement word boxes to teach specific words and thereby directly increasing the number of words students can read and spell (Ball & Blachman, 1991; Joseph, 1998/1999, 2002a).

Lastly, although this intervention was implemented to improve students’ reading skills, decoding words was never explicitly taught during intervention. It is hypothesized that the development of phonemic awareness through segmenting and spelling will generalize to decoding ability. Decoding was monitored throughout this study by assessing Nonsense Word Fluency.
Summary

Phonemic awareness is necessary for the acquisition of the alphabetic principle and serves as a requisite for more advanced reading skills. Poor readers exhibit weakness in phonological processing and it is imperative that students’ phonemic awareness skills improve if they are to become competent readers. Research is lacking in evidence-based practices that specifically delineate how to promote phonemic awareness in older, struggling readers. This study sought to explore one intervention (i.e., word boxes) to develop phonemic awareness and subsequently improve reading and spelling skills in emergent and older, struggling readers.
Chapter 2: Review of the Literature

This chapter reviews the literature on the relationship between the development of phonemic awareness and later reading and writing success. It includes a definition of phonemic awareness, along with the role phonemic awareness plays in early literacy and how it affects individuals without sufficient literacy skills. Research on the effectiveness of one plausible intervention to improve phonemic awareness, word boxes, is discussed in detail, followed by an explanation of how word boxes can be utilized to improve phonemic awareness skills.

What Is Phonemic Awareness?

Phonemic awareness is the ability to identify and manipulate individual phonemes in spoken words (Ehri, 2004). More simply, it can be thought of as the ability to recognize that spoken words are composed of a sequence of individual sounds. Phonemic awareness encompasses the most advanced skills of the broader category, phonological awareness. Phonological awareness is a metalinguistic skill that enables the recognition and manipulation of sounds within a spoken language (Miller et al., 2006). The metalinguistic nature of phonological awareness enables the thinking of language as separate and distinct from word meaning (Schuele & Boudreau, 2008).

Phonological awareness includes the ability to identify and mentally manipulate word parts such as spoken syllables, onsets and rimes, and phonemes. It includes a
variety of skills that follow a continuum of difficulty from simple, or shallow-level phonological awareness tasks, to more complex, deep-level phonological awareness skills (see Figure 1). The shallow-level, or most basic, phonological knowledge typically emerges in preschool (Torgesen, Wagner, & Rashotte, 1994). This is often referred to as “phonological sensitivity” (Anthony & Lonigan, 2004). Children begin to divide words into syllables, rhyme, and identify words with the same final or initial sounds. All of this is done auditorily as phonological awareness tasks do not involve print.

As phonological awareness skills advance, children begin to attend to deeper-level skills and make more sophisticated judgments about the general sound structure of language. At this more complex level, individuals begin to isolate and manipulate individual sounds (i.e., phonemes). This moves the student to a higher level along the phonological awareness continuum, phonemic awareness (Schuele & Boudreau, 2008). Phonemes consist of the smallest unit of spoken language with the English language comprised of 41 to 44 phonemes depending on one’s dialect. Phonemic awareness skills include segmenting and blending individual sounds and words, along with deleting and manipulating phonemes (see Figure 1). Students progress along the hierarchy of skills development with the sophistication of skills (i.e., moving from whole word to individual phoneme manipulation) increasing as children gain phonological awareness. It is important that students possess the phonemic awareness skills of blending and segmenting phonemes and words as these are the phonemic awareness skills determined to be the most critical for success when reading and writing (National Reading Panel, 2000).
Figure 1. *Phonological Awareness Progression.*
The terms *phonological awareness* and *phonemic awareness* are often incorrectly used synonymously (Joshi et al., 2009; Moats, 1994; Podhajski, Mather, Nathan, & Sammons, 2009). Similarly, phonemic awareness is commonly confused with “phonics” (Schuele & Boudreau, 2008). It is important to understand the distinctions between the terms. Phonemic awareness is an advanced level of phonological awareness, falling within the phonological awareness umbrella. Phonics instruction includes the use of letters, matching the print symbols (i.e., graphemes) with their corresponding sounds (i.e., phonemes); phonemic (and phonological) awareness deal strictly with the oral representation and the manipulation of spoken sounds in words.

This distinction gets tricky however, because research strongly suggests the use of letters to support phonemic awareness instruction (Blachman, 1994; Bus & vanIJzendoorn, 1999; Moats, 2010; NRP, 2000). Adams et al. (1998) recommends using letters to increase phonemic awareness; specifically, they note that letters can be added to phonemic awareness instruction and still fall under the “phonological awareness” umbrella provided that the teaching is implemented in a manner that reinforces and promotes the logic of the written system rather than focusing on memorizing specific letter-sound patterns indicative of phonics instruction.

**Relationship Between Phonemic Awareness and Early Literacy**

Through the accumulation of over 50 years of reading research, robust evidence exists demonstrating the relationship between well-developed phonological skills and the ability to read and write successfully (Anthony & Francis, 2005; Schuele & Boudreau, 2008). In particular, it is the development of phonemic awareness that boosts literacy.
skills. Moats (2010) called phonemic awareness the “linchpin” for early reading success (p. 29). The National Reading Panel (2000) found more than 50 studies reporting that explicit teaching of phonemes was a critical component of reading and spelling instruction. Students who fail to learn how to detect and manipulate the individual phonemes within words struggle to learn to read and spell (Share, Jorm, Maclean, & Matthews, 1984). Adams et al. (1998) determined preschool children’s awareness of phonemes accounts for as much as 50% of the variance in students’ reading proficiency at the end of first grade.

A plethora of research demonstrates that students lagging behind their peers in phonemic awareness skills also lag behind in early reading skills, and these students rarely catch up. For example, Juel (1988) determined the poor readers were the students who entered first grade with limited phonemic awareness, and by the end of fourth grade these struggling readers still had not mastered decoding skills comparable to the skill level obtained by the good readers at the beginning of second grade. Similarly, Torgesen et al. (1994) reported that the students entering first grade with phonemic awareness skills below the 20th percentile remained behind their peers in word identification and decoding ability. Fifth grade test scores comparing the two groups of students showed a gap of more than three years; the lower phonemic awareness group demonstrated word decoding skills of 2.3 (i.e., second grade, third month) compared to the remaining 80% of fifth grade students averaging a decoding score of 5.9 (i.e., fifth grade, ninth month).

The ability to manipulate phonemes is not a skill that in and of itself is important; rather, the value of phonemic awareness lies in its role in helping students understand and
utilize the alphabetic system (National Reading Panel, 2000). The real value of phonemic awareness is that it leads children to develop the alphabetic principle (i.e., the understanding that letters correspond to the sounds that make up spoken words; Moats, 2010). More specifically, it is the awareness of the phoneme-grapheme relationship. The alphabetic principle is the basis for reading and endures all alphabetic languages. Without the awareness of phonological segments in words, alphabetic systems would not be very comprehensible given print decoding is reliant on mapping phonemes to graphemes (Fletcher, Lyon, Fuchs, & Barnes, 2007; Juel, 1988; Torgesen et al, 1994).

In addition to acquisition of the alphabetic principle, research suggests phonemic awareness is a necessary requisite for phonics. Phonics instruction was determined to be ineffective unless children possessed some phonemic awareness upon entering first grade or began phonemic awareness instruction immediately upon entering school (Juel, Griffith, & Gough, 1986). This has been demonstrated by the many studies reporting that students who begin school lagging in phonemic awareness never catch up to their peers. The relationship between phonemic awareness and later reading and writing success is so strong, Wagner and Torgesen (1987) found that measures of phonological awareness and reading were related independent of overall cognitive ability.

**Development of Phonemic Awareness**

Given the important role phonemic awareness plays in the acquisition of literacy skills, it is no wonder an abundance of literature exists exploring the development of phonemic awareness. Different types of phonological awareness tests have been administered to people of different ages, reading levels, and even differing languages. As
a result, Anthony and Francis (2005) discovered three consistent patterns of phonemic awareness development: (a) As children grow older, they become increasingly more sensitive to smaller parts of words (e.g., move from syllables to phonemes); (b) children can detect differences between words earlier than they can manipulate sounds within words; and (c) children continue to refine already acquired phonological awareness skills while they are developing more complex phonological abilities.

The progression from the most shallow levels of phonological awareness to the deeper, phonemic awareness skills required for successful reading take years to acquire; however, the very beginnings of phonemic awareness begin shortly after birth. At one month of age, infants can make phonemic distinctions between the most basic speech sounds (Eimas, Siqueland, Jusczyk, & Vigorito, 1971). Shortly thereafter, babies begin vocalizing these phonemes, creating combinations of speech sounds. These combinations begin to form words and speaking develops as a very natural and automatic process, occurring without specific thought given to individual phonemes.

Difficulty arises however, as children work to develop phoneme-grapheme correspondences. The elusiveness of the phoneme, undetectable and unimportant in everyday speech, becomes difficult to pinpoint as children attempt to isolate phonemes in individual words. Phonemes are very difficult to differentiate in natural speech because not only do they overlap and change depending on their position in a word, phonemes occur at a rate of 10–20 per second (Liberman & Liberman, 1992). Adams (1990) describes these less than discrete units as “spilling over” into the phonemes coming before it and after it within a word. Further, phonemes differ depending on the speaker’s
articulation (Moats, 2010). Difficulties with phoneme recognition are further compounded because they carry no meaning and children are accustomed to relating words to their meaning, not their linguistic characteristics (Griffith & Olson, 2004).

There are numerous models and theories explaining how children typically make the jump from the unconscious use of phonemes in everyday speech to the metalinguistic ability to recognize and manipulate phonemes within individual words as they begin to read and spell. Ehri (1995) suggests early word recognition begins without using letters or sounds, but rather children view words holistically as a single logograph (e.g., students remember the word look because they can see through the “eyes” in the middle). This is considered the pre-alphabetic stage. As students develop phonological awareness (i.e., knowledge of onsets and rimes) they move into the second, partial-alphabetic stage where the young readers utilize “phonetic cues” such as guessing the word by its first letter.

It is not until children have knowledge of the major phoneme-grapheme relationships that they move into the full-alphabetic phase. Reading at this stage is usually choppy as reading is often done through a letter-by-letter analysis; however, considerable growth usually occurs in sight vocabulary due to reading practice (Ehri & McCormick, 1998). As word learning matures (i.e., consolidation of larger units through chunking and knowledge of affixes, roots, and suffixes), students move to the consolidated-alphabetic phase. Reading becomes more fluent as sight word vocabulary continues to grow and readers are often capable of fluently reading unfamiliar words that follow known spelling patterns. The ultimate goal is to move to automatic word recognition. It is in this final stage that readers can “automatically” and fluently read
known and unknown words both in and out of context. This then frees the reader to concentrate on meaning rather than decoding (Chall, 1983).

Chall (1983) developed a model for reading that begins with children in the preliterate stage. This stage begins at birth and continues until the child begins reading, usually in kindergarten or the first grade. During the preliterate stage children play with literacy materials (i.e., books and writing) where they learn there is a connection between words and print, thus beginning to develop phonological awareness. Maclean, Bryant, and Bradley (1987) determined a strong correlation between children’s early knowledge of nursery rhymes and phonological skill, and that knowledge predicted early reading ability. The ability to break words into syllables, rhyming, and alliteration are all phonological awareness skills. As children begin to segment and blend individual phonemes within words, the phonemic awareness aspect of phonological awareness emerges (see Figure 1). This ability to segment and blend phonemes is critical for grasping the alphabetic principle and learning to use it (Shankweiler & Fowler, 2004).

Development of the alphabetic principle moves children into Chall’s (1983) next stage, the decoding stage. This is where students begin to read. Sufficient phonological awareness (i.e., phonemic awareness) is assumed to where the students are now capable of expanding their phonological knowledge into the reading and writing process. Children learn phonics so they can decode (i.e., read) and encode (i.e., spell) novel words that follow the patterns they have acquired. The basis of this stage theory is that phonological awareness lays the foundation for more complex reading tasks and suggests that phonemic awareness skill underlies reading ability.
The importance of phonemic awareness is highlighted in the “Simple View of reading” (Gough & Tunmer, 1986). According to this model, the formula for reading is the product of two factors, decoding and comprehension, and the equation is written as follows: $R = D \times C$ (i.e., Reading = Decoding x Comprehension). Decoding is defined as the process that leads to word recognition and depends greatly on the knowledge that words are composed of a sequence of sounds (i.e., phonemic awareness). Lack of phonemic awareness results in reduced comprehension, and more importantly, limited phonemic awareness results in a decrease in reading ability as demonstrated by the equation above.

**Phonemic Awareness in Struggling Readers**

Fortunately, most school-aged children become competent readers; however, there still remains a significant number of students who fail to develop necessary literacy skills as 24% of students entering high school are unable to read at a “basic” level (National Assessment of Educational Progress, 2011), suggesting these students lack the necessary literacy skills to successfully perform at the high school level. The percentages of struggling readers have remained relatively stable for decades despite continued legislative and research efforts (Aud & Hannes, 2011).

Limited research is available regarding the most efficient and effective instructional methods to assist older, struggling readers (Nithart et al., 2011). Similarly, there is a dearth of research regarding the characteristics of these individuals. However, limited research does exist comparing phonemic awareness skills of proficient readers, less-skilled readers, and non-readers.
One key research question addresses the amount by which phonemic awareness can be improved beyond the “critical period” in childhood development. Although robust research exists documenting the connection between phonemic awareness and reading skills in young children, research is less definitive on what role phonemic awareness plays beyond the critical period in childhood development. Some researchers argue phonemic awareness will occur naturally at the developmentally appropriate time; some question whether phonological analysis is far less accessible beyond childhood; yet others hypothesize that with appropriate instruction it can be developed at any age (Morais, Content, Bertelson, Cary, & Kolinsky, 1988).

In a study comparing “illiterates” (adults unable to recognize letters or words) with adults who learned to read later in life (beyond the age of 25), Morais, Cary, Alegria, and Bertelson (1979) administered an initial phoneme addition/deletion test to these Spanish-speaking adults and found significant differences between groups as the “illiterate” group was unable to complete the phonemic tasks that the reading group could easily perform. This finding suggests the ability to explicitly manipulate speech units is not acquired spontaneously. This theory was expanded (Morais et al., 1988) when a similar “illiterate” population was “trained” in one session to complete similar initial addition/deletion phonemic tasks confirming this ability could be acquired, at least temporarily, with specific instruction.

Gombert (1994) replicated Morais et al.’s (1988) study to include three different reading levels (i.e., “illiterates,” “partial-literates” [never attended school but learning to read within the last year], and literates [high school graduates]) in a different language.
(i.e., French) and with additional phonological tasks including phonological length of words, and lexical segmentation of sentences. Findings from this study confirmed and expanded Morais et al.’s results by providing a hierarchy of difficulty across the tasks. Gombert’s results suggested that “illiterate” adults possessed shallow-level phonological awareness abilities but were unable to complete the deeper, phonemic awareness tasks. This hierarchy was confirmed by Loureiro et al.’s (2004) study that determined deep level phonemic tasks were significantly related to years of schooling.

Two additional studies directly compared adults with varying degrees of literacy. Mellard, Woods and Fall (2011) compared current reading ability and scores on a comprehensive battery of tests designed to contribute to reading (e.g., Weschler Adult Intelligence Test, Comprehensive Tests of Phonological Processing, Woodcock-Johnson III, Test of Word Reading Efficiency) for participants in an adult literacy program. Results indicated that the most fluent readers had the greatest phonemic awareness, best word recognition and word attack skills, and the highest levels of comprehension. The dysfluent readers had the lowest phonemic awareness, decoding, and sight words ability while demonstrating relative strength in listening memory, inference skills, prior knowledge, and picture vocabulary. Miller et al. (2006) observed similar findings determining phonological awareness was a statistically significant predictor of current reading achievement, and phonological awareness along with rapid naming tasks were significantly related to oral reading fluency.

These studies confirm an earlier synthesis by Wagner and Torgesen (1987) determining that deficits in phonological awareness found in adult non-readers suggest a
similar correlation found between reading ability and the development of phonemic awareness in young children. The same progression observed from shallow levels of phonological awareness to deeper levels of phonemic awareness in children (see Figure 1) was also observed with adults learning to read. This also confirms the relationship between the alphabetic principle and phonemic awareness. Lourieiro et al. (2004) stated, “As far as we know, there is no study showing phonemic awareness in illiterate adults, or in preschool children before the acquisition of the alphabetic principle” (p. 500).

Studies with adults have also demonstrated the predictive value of phonological awareness, similar to that shown with children. Phonemic awareness was a significant predictor of both reading and spelling achievement in adults (Mellard et al., 2011; Miller et al., 2006), demonstrating the role phonological awareness plays well into adulthood.

Beyond the descriptive research, a very limited number of studies exist exploring effective methodology for developing phonemic awareness skills in older, struggling readers. No study has specifically compared the effects of phonological processing on the acquisition of reading skills (Nithart et al., 2011). Schuele and Boudreau (2008) warn that without studies that measure phonological awareness outcomes as they relate to quantifiable reading changes, especially for individuals with disabilities, it becomes difficult to determine how much intervention is needed, especially within special populations.

Despite the lack of true experimental research, along with the descriptive studies, there are several quasi-experimental phonemic awareness studies and analyses of reading packages that demonstrated positive phonemic awareness gains for the participants.
These intervention studies clearly demonstrated phonological awareness can be developed and improved in a variety of learners (Calhoon, 2005; Gombert, 1994; Kitz & Nash, 1992) and at any age (Royer, Abadzi, & Kinda, 2004). Phonological awareness gains were observed in single training sessions with “illiterate” adults (Loureiro et al., 2004; Morais et al., 1979; Morais et al., 1988) and also as a component of summer, semester, and year long reading intervention programs for middle school, high school, and college students (Greene 1996; Guyer & Sabatino, 1989; Kitz & Nash, 1992; Simpson, Swanson, & Kunkel, 1992; Swanson, Hodson, & Schommer-Aikins, 2005). Phonological awareness interventions directly improved phonological skills (Bhat et al., 2003; Miller & Felton, 2001; Royer et al., 2004; Swanson et al., 2005) and these gains in phonological ability not only improved decoding skills (Guyer & Sabatino, 1989) but also led to gains in other literacy areas such as fluency and comprehension (Kitz & Nash, 1992; Miller & Felton, 2001).

These studies are important because they demonstrated that readers who learned to read before the age of 25 did not vary significantly in their phonemic awareness ability compared to readers who learned to read later in life (Morais et al, 1988).

**Treatment Resisters**

The gains in phonemic awareness demonstrated above are encouraging and suggest phonemic awareness gains can be accomplished at any age. Positive results are not unexpected, however, given that studies that make it to publication typically are successful; it is far less common for ineffective interventions to be reported. However,
reading research does support a particular population, known as “treatment resisters,” who despite effective and well-implemented intervention, still fail to respond to instruction (Al Otaiba, 2001; Torgesen, 2000).

Considering that nearly one-quarter of the U.S. high school population enters high school without basic reading skills (NAEP, 2011), it seems reasonable to assume that a good portion of students fall under the “treatment resister” category. Clay (1987) warned that it is difficult to pinpoint exact causes of reading failure, suggesting many “learning disabled” labels are not the result of cognitive or neurological deficits, but rather develop due to experiential or instructional deficits. Velluntino et al. (1996) echoed this sentiment; however, these researchers went a step further and suggested reading struggles are often the result of both ineffective instruction and underlying phonological deficits.

Many researchers confirm the position that reading difficulties do often result from a combination of inadequate instruction and phonological difficulties (e.g., Moats, 1996; Velluntino, Fletcher, Snowling, & Scanlon, 2004). Phonological processing deficits are common in students with reading difficulties (Velluntino et al., 2004), especially for students diagnosed with dyslexia. By definition dyslexia is characterized as deficits in phonological processing (Lyon et al., 2003; Miller et al., 2006), so it is not surprising remediation does not occur easily with this population. Even with extensive and appropriate instruction, fundamental processing deficits still remain for some individuals with dyslexia even into adulthood (Kitz & Tarver, 1989; Moats, 1996).

Moats (1996) demonstrated through spelling analysis of writing samples from high school males that specific developmental delays in phonological awareness persisted
despite a minimum of two years of intensive instruction. These deficits also persisted in college students despite similar instruction (Kitz & Tarver, 1989). These studies provide examples of actual treatment resisters and highlight the challenges present when working with resistant learners. It also stresses the importance of early intervention along with the necessity for increased repetitions and explicit instruction while working towards automaticity in phonemic awareness and decoding skills.

Studies have also analyzed younger treatment resisters. Al Otaiba (2001) completed a two-year longitudinal study following students unresponsive to treatment (i.e., students scoring in the lowest 30th percentile of growth on segmentation and letter naming tasks) through kindergarten and first grade. Participants received supplemental instruction, including teacher-directed phonological awareness activities, for either one or both years, and were compared to the non-treatment control group.

Three important findings emerged from this study: (a) The number of unresponsive students in the control group was closely aligned with overall reading research findings (i.e., 25–30%), however the percentage of unresponsive participants receiving the intervention was only about 7%; (b) the characteristics found in the unresponsive students included slow letter naming, poor verbal ability and phonological memory, and poor attention; and (c) most children (i.e., 92%) who were unresponsive in kindergarten remained unresponsive in first grade, suggesting these students may require more intensive individualized instruction to achieve academic success.

Similar to Al Otaiba’s (2001) study, Torgesen (2000) attempted to pare out ineffective instruction as a cause of reading failure by analyzing five current studies (e.g.,
Brown & Felton, 1990; Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Torgesen et al., 1997) that utilized research-based reading methods with first- and second-grade at risk students. Results suggested that if “best practices” in reading instruction were utilized for all students, somewhere between 4% and 6% of first- and second-graders would still possess inadequate word reading skills. This estimate is a little lower than that of Lyon et al. (2003) who projected that figure at 6–8%. These students would be considered the actual “treatment resisters,” a far cry from the number of students currently possessing inadequate reading skills in our schools today.

Torgesen (2000) identified the following characteristics of these treatment resisters to include any or all of the following: (a) They scored at the lowest pretest levels of phonological awareness; (b) they came from homes with parents possessing the least amount of education and lowest income; and (c) they demonstrated the most frequent and broadest range of behavior problems in the classroom. Similar to Vellutino et al. (1996), overall differences in intelligence among participants were not of significance in explaining the differences in response to the interventions.

From this synthesis, Torgesen (2000) concluded that children with the most severe risk factors require more intensive preventive instruction for a longer duration (i.e., more than one or two years) than is commonly delivered in school settings. In addition, that instruction should consist of systematic, explicit instruction in phonemic awareness and phonetic decoding skills, along with many opportunities for word reading in connected text.
The need for preventative instruction in phonemic awareness through explicit instruction has been purported in the literature for decades (Chall, 1967, 1983; Gough, 1996; Moats, 2010); this seems to be the best solution proposed for our past and present reading crises (Al Otaiba, 2001; Chall, 1967, 1983; Torgesen, 2000). Indeed, Stanovich (1986), decades ago, suggested that if we fail to provide training in phonemic awareness to children with poor segmentation skills we are starting “a causal chain of escalating negative side effects” (p. 364) that result in poor reading [and later life] outcomes for these students (i.e., the Matthew effect).

**Skills to Develop Phonemic Awareness**

Given the extensive research base on phonological awareness, spanning over 50 years, it is clear that phonemic awareness plays a critical role in the development of literacy skills (e.g., Ball & Bachman, 1991; Ehri & Wilce, 1987; Juel, Griffith, & Gough, 1986; Wagner & Torgesen, 1987). In addition, the dire reality often facing individuals without sufficient literacy skills (e.g., dropping out of school, un- and underemployment, incarceration) makes the development of phonemic awareness skills for all students an educational priority. Three particular skills (i.e., segmenting, phoneme-grapheme correspondence, and spelling) have been demonstrated to positively impact phonemic awareness ability.

**Segmenting.** Of all the phonological skills needed for reading, segmentation has been demonstrated to be the most needed for developing reading (Stanovich, 1986). Segmenting is often taught on the whole word level by breaking words into individual syllables. On the phonemic level, segmenting requires the sequential division of each
phoneme within the word, a task far more complex than dividing words into their respective syllables. Despite its complexity, as phonemes are often difficult to individualize given the “elusive” nature of the phoneme, the benefits of phoneme segmentation as a precursor for successful decoding has been clearly established (Ball & Blachman, 1991; Liberman & Shankweiler, 1985; Nation & Hulme, 1997).

The National Reading Panel (2000) through their two-year meta-analysis of reading research concluded that blending and segmenting were the most critical phonological awareness skills for students to develop; blending is an important precursor for reading just as segmenting is a necessary prerequisite for spelling. Perfetti, Beck, Bells, and Hughes (1987) suggested blending often develops simultaneously with reading development and therefore recommended focusing on segmenting rather than blending when working on early phonemic awareness skills.

Although phonological awareness instruction often emphasizes onset-rime, the ability to segment phonemes has been demonstrated to be a more powerful predictor of early reading and spelling ability (Muter & Snowling, 1998; Nation & Hulme, 1997). Nation and Hulme (1997) compared four phonological skills (i.e., phonemic segmentation, rhyme sound categorization, alliteration, and onset-rime), and of the four analyzed, phonemic segmentation was the strongest, and onset-rime the weakest predictor of reading and spelling ability. Their findings are consistent with other researchers (e.g., Hoien, Lundberg, Stanovich, & Bjaalid, 1995; Liberman, Shankweiler, Fisher, & Carter, 1974) that determined phonemic segmentation skills increased with age and served as a strong predictor of spelling and reading ability. Given its strong predictive value, the
authors suggested that phonemic segmentation is the most sensitive measure for screening students to identify early reading problems.

The Early Childhood Research Institute agrees with the authors and has included a phonemic segmentation test [i.e., Phonemic Segmentation Fluency] as part of the AIMSweb Early Literacy Measures (Shinn & Shinn, 2002) and the Dynamic Indicators of Basic Early Literacy Skills (Kaminski & Good, 1996). These curriculum-based measures have been demonstrated to reliably and validly measure students’ early literacy skill level and possess strong predictive value.

**Phoneme-grapheme relationships (alphabetic principle).** Extensive research exists documenting the importance of phonemic awareness as a prerequisite for understanding the alphabetic principle (Foorman et. al., 2003; Griffith & Olson, 2004; McGuiness, McGuiness, & Donohue, 1995). Adams (1990) determined that a functional understanding of the alphabetic principle is equally contingent on students’ knowledge of letters and their awareness of phonemes because it is the association between them that is critical for reading success. It is the knowledge of the phoneme-grapheme relationship that allows word reading to advance (Ehri, 1995; Stahl & Murray, 1994).

The National Reading Panel (2000) supports the use of letters in phonemic awareness training because incorporating letters helps students more easily apply their phonemic awareness knowledge to reading and writing. On a more basic level, letters serve as a concrete referent for the abstract nature of the phoneme to take hold; it makes it easier for students to understand (Elkonin, 1973; Hohn & Ehri, 1983).
Letters help draw children’s attention to the sounds in spoken words and the concept that there is a correspondence between these sounds and the visual symbol for each phoneme. Considering the purpose for training phonological awareness is to make sound-symbol correspondences easier and quicker for children to learn (Fletcher, Lyons, Fuchs, & Barnes, 2007), adding letters to the training seems a natural and needed progression. Especially for at risk students and individuals with learning disabilities, choosing the most efficient and effective means by which to increase phonemic awareness skills is critical. Schuele and Boudreau (2008) warn however, that it is important not to add letters to phonemic awareness training prematurely as this will likely confuse students. Their concern is echoed by other researchers purporting the advantages of the addition of letters within phonemic awareness training (NRP, 2000).

It appears that acquisition of the alphabetic principle is best achieved through the introduction of letters at the appropriate time. Letters should not be introduced until students have demonstrated sufficient segmentation skills through strictly auditory means, for example, tapping out each phoneme in a word (Elkonin, 1973; Liberman & Shankweiler, 1985); however, letters should be available as soon as the student is ready.

Wagner and Rashotte (1993) determined that only those programs that combined phonological awareness training with alphabet recognition, and eventually spelling, had a significant effect on reading achievement (e.g., Bradley & Bryant, 1983). Ball and Blachman (1991) suggested that their results, along with those of other researchers (e.g., Bradley & Bryant, 1985; Ehri & Wilce, 1987), provide evidence that the “most
pedagogically sound method of phoneme awareness training is one that eventually makes explicit the complete letter-to-sound mappings in segmented words” (p. 64).

**Spelling.** Although there is a robust research base that focuses on the relationship between phonemic awareness and reading, there is a substantial and potent number of studies also purporting an even stronger connection between phonemic awareness and spelling skills (Bryant & Bradley, 1985; Nation & Hulme, 2001). Similarly, Groff (2001) recounted over 50 years of support for the intertwined relationship between students’ reading ability and spelling skills. Perfetti (1997) called the relationship “two sides of the same coin” (p.28). Given their reciprocal relationship, the connection between phonemic awareness, spelling, and reading can be difficult to separate (Carver, 2003; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003).

The “Simple View of reading” discussed above (see Development of Phonemic Awareness) can also be applied to writing. Similar to reading, writing is the product of two factors, spelling and ideation (Juel, 1998), and can be expressed by the equation: \( W = S \times I \) (i.e., Writing = Spelling x Ideation). This equation demonstrates the importance of spelling on the ability to write, and just as in reading, proficiency in spelling is contingent on phonemic awareness skills. Student who learn to spell easily usually possess well-developed phonemic awareness skills; the weakest spellers usually have phonological processing weaknesses (Moats, 2010).

The National Reading Panel (2000) determined improvements in phonemic awareness helped most preschoolers, kindergartners, and first graders learn to spell; it was determined superior to other types of instruction or no instruction in teaching
phonemic awareness in helping students learn to read and spell. However, the reciprocal relationship between phonemic awareness and spelling appears even stronger than that between phonemic awareness and reading (Snowling & Hulme, 1991).

Ball and Blachman (1991) suggested “the most effective phoneme awareness instruction includes attention to the connections between the sound segments of speech and the written symbols that represent those sounds” (p. 54). Spelling functions in a manner that requires very intimate connections between sounds and symbols. It is for this very reason that children attend more closely to the phonemes that letters represent when spelling than when reading (Adams, 1990; Bryant & Bradley, 1985; Moats, 2005/06). Groff (2001) found the speech-sound-to-letter approach required in spelling resulted in students successfully reading any words they could spell. Therefore, he recommended focusing on spelling because of the efficiency of teaching spelling and improving reading simultaneously.

The invented spelling of young children has long been recognized as a powerful indication of their level of phonemic awareness and letter-sound knowledge (Bear & Templeton, 1998; Cunningham & Cunningham, 1992). Spelling requires students to create the patterns without the assistance of preprinted combinations (i.e., segmenting rather than blending) as in reading. This can be difficult for students lacking strong phonemic awareness skills, especially those with learning disabilities. In fact, the National Reading Panel (2000) determined phonemic awareness training was ineffective in improving spelling skills in students with learning disabilities.
Wanzek, Vaughn, and Wexler (2006) analyzed 19 reading and spelling intervention studies designed to improve spelling outcomes in students with learning disabilities and found the interventions that were successful were those that provided explicit instruction with multiple practice opportunities, along with immediate and corrective feedback for any misspelled words. These results provide encouraging evidence that spelling intervention can be successful, even for students with disabilities.

Spelling interventions for older, struggling readers can be particularly difficult however, because these students usually possess very limited phonemic awareness skill. In addition, research suggests that as children age, they rely more on orthography and visual memory (Greenberg, Ehri, & Perin, 2002; Lehtonen & Trieman, 2006), a challenge for these spellers given their learning histories are often filled with previously incorrect spellings so visual memory is often impaired. For this reason, Gough (1996) recommended the use of nonsense words when using spelling to teach phonemic awareness to older students. This serves to eliminate some of the visual confusion students may experience, allowing them to focus on developing correct phoneme-grapheme relationships rather than attempting to spell utilizing a faulty visual memory.

In addition to their use in spelling instruction, nonsense words have also been demonstrated to be the best measure of students’ decoding ability (Carver, 2003). Reading nonsense words, especially in a timed situation, demonstrates how well students can apply their knowledge of the alphabetic principle in learning to read words fluently (Fien et. al, 2010). Children who can read nonsense words read faster and more
accurately than their classmates lacking this skill; there is even a more pronounced
difference in spelling ability (Gough, 1996).

The reading intervention program, Reading Recovery, utilizes pseudoword (i.e.,
nonsense word) reading to measure decoding accuracy. In addition, numerous literacy
subtests utilize nonsense words to determine decoding skills in many standardized testing
measures (e.g., Woodcock Reading Mastery Tests, Weschler Individual Achievement
Test). The curriculum-based measures, DIBELS and AIMSweb, also utilize nonsense
words (i.e., Nonsense Word Fluency) to measure decoding and phonics skills.

Word Box Instruction

One possible instructional technique that incorporates instruction in segmenting,
phoneme-grapheme correspondence, and spelling is word boxes. Word boxes are an
extension of the original, Elkonin boxes, named after its creator, D. B. Elkonin. Elkonin
(1963, 1973), who along with fellow Russian psychologist, L. E. Zhurova (1963) were
among the first researchers to report the relationship between phonemic awareness and
reading ability.

The original Elkonin boxes were comprised of a rectangle with vertical lines
drawn to form squares with the total number of boxes (i.e., squares) in the rectangle
equaling the number of phonemes in the word. The picture of the word to be segmented
was placed above the rectangle to serve as a visual reminder, and the diagram served as a
visual clue of the number of phonemes within the word. Counters were chosen over
alphabetic letters because letters would have “diverted the child’s attention to the written
form of language and the operation of symbolizing, whereas our concern was to focus
attention on the building of a spoken word from its component sounds…plain counters prevented any confusion of purpose” (Elkonin, p. 563).

Once a child mastered phoneme segmentation with counters, the next step was the same format utilizing two colors of counters, one color designating vowel sounds and the other consonant sounds. It was only after mastering this task that letters were introduced.

The original format used by Elkonin is still in use today with individual work pages placing the picture on the top and the number of squares matching the number of phonemes in the word box placed below (McCarthy, 2008). A more generic version of word boxes, created on blank cardstock or a dry-erase board and without pictures, is also commonly used today allowing for a single word box to be implemented with a variety of words (Joseph, 1998/1999). It is also common practice for the number of squares within the rectangular word box to remain constant despite use with words of differing numbers of phonemes thereby removing the scaffold of knowing the number of phonemes within the word before actually segmenting it.

Regardless of the specific design of the word box, the implementation of instruction remains consistent. The process is first modeled by the teacher and then implemented by the student. Students are asked to move a counter into each square, moving the counter as they pronounce the phoneme so the filled squares represent the sequence of individual phonemes in the word; the number of squares occupied by counters represent the total number of phonemes in the word. This may be different than the number of letters in the word given that graphemes are constituted of 1–4 letters.
Counters may be replaced with magnetic letters as students learn phoneme-grapheme correspondences, and eventually the letters can be replaced with the student simply writing each grapheme in the corresponding square without the aid of the pre-created letters. Some variations include the eventual fading of the vertical lines thereby removing the scaffolding for each phoneme (Joseph, 2008).

Clay (1983) greatly expanded the use of the Elkonin sound boxes by incorporating them into the popular Reading Recovery program, an intervention designed to improve reading and writing skills of first graders performing in the lowest 20% of their class. Clay found this instruction beneficial because the sound boxes (a) helped students hear the order of sounds in words; and (b) writing the letters of the words in their correct sequence required students to attend to the orthographic features of the word, thereby improving the efficiency of new word acquisition. Studies are plentiful purporting the gains demonstrated by students enrolled in Reading Recovery (e.g., Horner & O’Connor, 2007; Dougherty Stahl, Stahl, & McKenna, 1999).

Ball and Blachman (1991) further extended the use of sound boxes with their version, Say-It-and-Move-It, a segmenting activity requiring students to move tiles down the page as each phoneme in a word is spoken. Completing this skill requires one-to-one correspondence, but because this activity begins with blank tiles, it does not require phoneme-grapheme knowledge. As this knowledge develops, blank tiles are then replaced with known graphemes; however, blank tiles still remain for unknown phoneme-grapheme relationships allowing for a gradual transition into letter-sound correspondences.
*Say-It-and-Move-It* was incorporated into a complete phonological awareness curriculum, *Road to the Code* (Blachman, Ball, Black, & Tangel, 2000), designed for teachers’ use to develop phonemic awareness in young children. The authors recommend beginning each phonemic awareness lesson with *Say-It-and-Move-It* and then completing one or two additional activities designed to teach letters and sounds. Total lesson time is 15–20 minutes, consistent with the National Reading Panel’s (2000) recommendation of 15 minutes per day devoted to phonemic awareness.

Another variation of Elkonin sound boxes is letterbox lessons (Murray & Lesniak, 1999) used in the tutoring program at Auburn University. Letterbox lessons are very similar to word boxes, utilizing the same explicit and systematic format; however, they forego the initial step of segmenting with counters and work strictly with letter-sound correspondence teaching only one correspondence per lesson (usually a vowel) to avoid overloading the tutee. The authors warn however, that although a single phoneme is instructed, it is important not to limit instruction to a single word family because then the tutee tends to focus only on the initial consonants and “glosses over” the remainder of the word. Students are asked to spell the word and then read the word back to the tutor after the correct spelling is established. This order was established because spelling the word first allows the child to attend to the phonemes that the letters represent more closely than occurs when the child reads the word without spelling it. Strongest results were obtained when letterbox lessons were taught in conjunction with authentic reading and writing activities, decodable readers in particular, with average gains of 1.1 reading levels reported for these struggling readers.
In addition to the successful interventions reported with sound boxes and letterbox lessons, numerous studies reported positive results using word boxes independent of use within a reading curriculum (i.e., Reading Recovery). Word boxes provide additional phonemic awareness instruction compared to sound boxes or letterbox lessons because word boxes include segmenting, letter-sound correspondences, and spelling, all within the same intervention (Joseph, 2008). Phonemic awareness gains have been demonstrated through individualized instruction with emergent readers (e.g., Joseph, 2000; McCarthy, 2008), and elementary students with learning disabilities (e.g., Joseph, 1998/1999) and developmental delays (Joseph, 2002). Devault and Joseph (2004) utilized word boxes, combined with repeated readings, to promote reading fluency in three high school students with severe reading delays. Positive results have also been reported for word box use with small-group and whole class instruction (Joseph, 2002; Manyak, 2008), and when implemented by peer tutors (Joseph, 2002).

**Extension of Research**

Regardless of the variation (i.e., word boxes, sound boxes, letterbox lessons), all these explicit, systematic methods designed to improve phonemic awareness have proven successful for students at risk for reading failure. They incorporate several components of segmenting, letter-sound correspondence, and spelling. Word boxes, in particular, provide the added benefit of incorporating all three of these skills within the prescribed intervention. For that reason, word boxes were the instructional model utilized for this study.
This study sought to explore and analyze phonemic awareness gains in two populations, emergent at risk students, and fifth graders struggling with reading and written language. It extends the current word box research in three distinct ways. First, this is the only study known to this author to utilize word boxes with the presentation of nonsense words. This was done in an attempt to limit the amount of orthographic confusion common in older, struggling readers (Treiman et al., 2002). Further, nonsense words were chosen because the specific goal of this study was gains in phonemic awareness, not increases in the number of known words.

Second, the letter-sound correspondences were taught through modeling and practice within the context of word boxes; no additional instruction was provided utilizing any other instructional model. In addition, numerous unknown phoneme-grapheme relationships were presented concurrently through the model-lead-test format (Bursuck & Damer, 2011). This deviates from previous research that only used word boxes with known graphemes (e.g., Ball & Blachman, 1991), or taught only one new grapheme per lesson (e.g., Murray & Lesniak, 1999).

Third, this study extends the previous research by expanding the number of phonemes segmented with a single word box. Previous research commonly used words consisting of 2–4 phonemes (i.e., Joseph, 2002; McCarthy, 2008); however, in this study the fifth grade students were presented with words consisting of up to seven phonemes, including one word list containing two-syllable words; these multisyllabic words only consisted of closed syllables. The difference in the length of words presented is likely the result of the difference in age of the participants. With the exception of Devault and
Joseph (2004), previous research focused mainly on younger readers, thereby necessitating simple VC (i.e., vowel-consonant) and CVC combinations.

**Summary**

Phonemic awareness, the ability to identify and manipulate individual phonemes, is integral in learning to read and spell. It serves as the bridge between alphabetic knowledge and phonological awareness into early decoding skills. Phonemic awareness is responsible for the development of the alphabetic principle, a critical component for literacy in all alphabetic languages.

Given its important function in early literacy, it is no wonder research demonstrates the correlation between developed phonemic awareness skills and reading competency. Study after study reported the connection between early acquisition of phonemic awareness and later reading success. Similarly, readers lacking phonemic awareness skills in first grade struggle to learn to read and write, rarely catching their peers. The later students develop phonemic awareness, the more difficult reading and writing. Phonics instruction is ineffective without phonemic knowledge.

The good news is that research supports the development of phonemic awareness at any age. Obviously, models focusing on preventative instruction compared to those focusing on remediation demonstrate stronger results. However, the research is clear. Improvements in phonemic awareness are possible at any age if explicit and systematic phonemic instruction is implemented with high degrees of fidelity. Word boxes are one example of a successful explicit and systematic phonemic awareness intervention. Further research is needed to carefully examine how this instruction is most effectively
delivered, along with the intensity and duration needed so all students can become competent readers.
Chapter 3: Method

This chapter describes the process of conducting this study. Information is provided regarding obtaining approval, the participants, the intervention setting, and the researchers involved. Next, the details of the intervention are presented including the dependent and independent variables, experimental design, procedures, and data collection procedures utilized throughout the study.

Institutional Review Board Approval

Prior to beginning data collection, approval for this study was obtained from the Institutional Review Board (IRB) for Research With Human Subjects at The Ohio State University. Approval was granted for the method described below, along with the forms used for informed consent and assent. A letter from the principal granting permission for the study to occur at the two buildings was included with the submission (Appendix A).

Upon IRB approval, the classroom teachers distributed permission packets (i.e., placed them in the students’ backpacks) containing a letter explaining the purpose of the study along with two copies of the parent permission form (Appendix B). Students were prompted to remind their parents to examine the materials. Parents were asked to read the information and, if interested in having their child participate, sign the enclosed parental permission form. The parent permission form further explained the intervention, notified parents that student records would be reviewed, and informed them that participation was
completely voluntary and could be terminated at any time if they so chose. Parents
interested in having their child participate were then asked to sign the permission forms
and return one copy in the self-addressed, stamped envelope provided in the packet.
Signed permission forms were mailed back to the principal investigator (PI) at The Ohio
State University, so the identity of those returning permission slips would be known only
to the PI and the interventionist. In addition, this was an attempt to lessen any possible
perceived pressure parents felt from the school for their child to participate. Once
parental permission was obtained, the interventionist met individually with each potential
participant to discuss the intervention and answer any questions. The interventionist
followed a script (Appendix C) clearly stating that participation was voluntary and the
student was free to stop the intervention at any time. Once all questions were answered,
the interventionist asked the student if he or she would like to participate in the study. All
potential participants gave their assent. The fifth grade participants signed an asset form
(Appendix D), and the kindergartners each provided verbal assent.

Participants

Overall, there were 11 potential participants for whom both parental permission
and assent were provided. Six of these students were kindergartners, and five were fifth
graders. The students were recruited from a rural suburb of Columbus, OH. The
kindergartners were housed in a school (pre-kindergarten–fourth grade) of 528 students.
The student population was 96% white, 3% Asian, and 1% Black, Hispanic, or American
Indian/Native Alaskan. Approximately one-third of the student population was
considered economically disadvantaged.
The intermediate school that the fifth grade students attended, located next to the elementary school, consisted of 853 fifth and sixth graders. Its student population was 98% White, 1% Black, and 1% Asian. Twenty-two percent of the student population was eligible for free lunch with 5% of students eligible for reduced lunch.

To be considered for the intervention, kindergarten participants were required to perform at or below the 25th percentile in the AIMSweb kindergarten measures of Phonemic Segmentation Fluency (PSF) and/or Nonsense Word Fluency (NSF). Students also needed to demonstrate an inability to segment VC (i.e., vowel-consonant) or CVC (i.e., consonant-vowel-consonant) words as measured by the initial baseline measure for the first skill in the intervention (i.e., auditory segmentation with counters). In addition, students were excluded from the study if they were unable to isolate initial sounds in words as measured by the Sound Matching subtest of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999). This criterion resulted in three kindergarten students being excluded from the study; however, a more developmentally appropriate intervention (i.e., a program focusing on letter recognition and more shallow phonological skills) was initiated with these students. Data from this intervention will not be presented in this dissertation.

Eligibility for the fifth graders required (a) an overall score below the 25th percentile on the Phonological Awareness composite of the CTOPP, and (b) a reading grade equivalent score at least one grade level below the student’s current grade placement, as measured by the scores of the Word Identification and Decoding subtests of the Woodcock Reading Mastery Tests (WRMT-R). Similar to the kindergartners, fifth
grade participants were required to demonstrate the ability to isolate initial sounds. This was demonstrated on the AIMSweb measure of Phonemic Segmentation Fluency (PSF). The inclusion criteria were established so the participants chosen would be at a performance level indicative of potential benefit from the intervention. This resulted in eight students being eligible to participate: three kindergartners and five fifth graders (see Table 1).

Table 1. Participant Information.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Grade</th>
<th>Age</th>
<th>Gender</th>
<th>SpEd Category (yrs. w/IEP)</th>
<th>IQ</th>
<th>Basic Reading</th>
<th>Reading Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael</td>
<td>K</td>
<td>6-2</td>
<td>M</td>
<td>n/a</td>
<td>--</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Ellie</td>
<td>K</td>
<td>5-7</td>
<td>F</td>
<td>n/a</td>
<td>--</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Matthew</td>
<td>K</td>
<td>6-7</td>
<td>M</td>
<td>n/a</td>
<td>--</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Aaron</td>
<td>5</td>
<td>10-10</td>
<td>M</td>
<td>SLD (4)</td>
<td>82</td>
<td>69&lt;sup&gt;2&lt;/sup&gt;</td>
<td>76&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Tim</td>
<td>5</td>
<td>10-10</td>
<td>M</td>
<td>SLD (4) ADHD (4)</td>
<td>86</td>
<td>61&lt;sup&gt;2&lt;/sup&gt;</td>
<td>69&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Rachel</td>
<td>5</td>
<td>11-4</td>
<td>F</td>
<td>SLD/CD (5) SLI (8)</td>
<td>65</td>
<td>53&lt;sup&gt;3&lt;/sup&gt;</td>
<td>62&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td>Joy</td>
<td>5</td>
<td>11-7</td>
<td>F</td>
<td>n/a</td>
<td>79</td>
<td>--</td>
<td>82&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Evan</td>
<td>5</td>
<td>11-7</td>
<td>M</td>
<td>SLD (3) ODD (4) ADHD (4)</td>
<td>88</td>
<td>66&lt;sup&gt;4&lt;/sup&gt;</td>
<td>70&lt;sup&gt;4&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>Note</sup>. SLD = Specific Learning Disability; CD = Cognitive Delay; ADHD = Attention Deficit Hyperactivity Disorder; SLI = Speech or Language Impairment; ODD = Oppositional Defiant Disorder; n/a = not applicable; NA = Data not available; -- = Data not collected

<sup>1</sup>Weschler Individual Scale for Children – Fourth Edition (Cognitive Full Scale)
<sup>2</sup>Weschler Individual Achievement Test – 3<sup>rd</sup> Edition
<sup>3</sup>Woodcock Johnson Tests of Achievement – 3<sup>rd</sup> Edition
<sup>4</sup>Kauffman Tests of Educational Achievement – 2<sup>nd</sup> Edition
Once the participants were chosen, a more thorough reading assessment was completed to better pinpoint each student’s current reading and spelling skills. In addition to the CTOPP, the pre-test battery consisted of the Word Attack and Word Identification subtests of the WRMT-R, a researcher-created checklist of letters and phonemes used in the intervention, along with the appropriate AIMSweb benchmarks for each population. The AIMSweb Early Literacy Measures (i.e., Letter Naming Fluency [LNF], Letter Sound Fluency [LSF], Phonemic Segmentation Fluency [PSF], and Nonsense Word Fluency [NWF]) were administered to the kindergartners; the AIMSweb PSF, NWF, Spelling, and Oral Reading Fluency [ORF] were administered to the fifth graders. These same measures were re-administered at the end of the intervention. These data aided in determining the gains achieved by each student, as well as the effectiveness of the intervention. The results of this intervention were shared with the students, school, and parents as appropriate.

Setting

The intervention for the kindergarten students occurred in an empty classroom across from the students’ regular classroom. This large room was equipped with four large rectangular tables arranged in one very large rectangle. The researcher and student sat adjacent to each other at the corner of one table away from the door in an attempt to minimize distractions.

Intervention for the fifth graders took place in the bookroom adjacent to the cafeteria. This space was arranged with shelves of books, along with a long rectangular table in a corner. The table faced the wall and was in a corner away from the door. The
researcher and participant sat side-by-side at the table. There was occasional outside noise, but overall the room was fairly quiet with the exception of school staff occasionally entering the room to re-shelve books.

**Researcher**

The researcher was a third-year doctoral candidate in the Special Education and Applied Behavior Analysis program at The Ohio State University. She held a Master’s Degree in Special Education and was a classroom teacher for three years working with middle and high school students struggling with reading and written expression. In addition, she served as Learning Disability Specialist at the college-level for six years. The researcher was the only interventionist and completed this study as partial fulfillment of the requirements for the Doctor of Philosophy in Special Education degree.

**Data Collectors**

The researcher was the primary scorer. In addition, a third-year doctoral candidate in the same special education program at The Ohio State University served as the secondary data collector. She scored the dependent variables to determine inter-rater reliability and completed procedural integrity checklists throughout the intervention to monitor the interventionist’s fidelity to the intervention procedures. Two additional students from The Ohio State doctoral program also assisted on a limited basis to ensure an adequate amount of inter-rater reliability and procedural integrity data were collected. Prior to their participation in the intervention, all scorers completed the IRB approved training and received intervention-specific training provided by the researcher. No scorer participated in the research without demonstrating a thorough understanding of the
scoring process and the intervention; inter-scorer reliability of at least 95% was established before training ceased.

**Dependent Variables**

This intervention included seven dependent variables for each of the two populations. The primary dependent variables were direct measures of skills taught and were used to make experimental decisions, whereas the secondary dependent variables served as generalization measures. The assessment tools used for the pre- and post-test assessments, although not for decision-making purposes, also served as supplemental dependent variables. They provided important information regarding the current level of reading skills for each participant along with providing additional information as to the overall effectiveness of the intervention as it related to changes in reading ability.

**Primary dependent variables.** For both groups (i.e., kindergartners and fifth graders), the three primary dependent variables were (a) the number of nonsense words correctly segmented auditorily, (b) the number of nonsense words segmented using the correct grapheme-phoneme correspondence, and (c) the number of nonsense words spelled correctly. Similar nonsense words, all of which followed phonetic patterns that had been taught but were untrained (i.e., words presented during probes included the same patterns but were different than those utilized during instruction), came from three interventionist-created word lists of increasing difficulty (see Appendix E for sample word lists).

The word lists were created by determining all the possible nonsense word combinations available utilizing the graphemes for each list. Once the words for the lists
were determined, each of the three words lists was randomized using a number sequence generated by random.org. A different number sequence was utilized for each list; every word was paired with a number and the words randomized until the three lists were complete. Each dependent variable was measured by the number of nonsense words correct on each nine-word probe. Probes were also generated through the use of random.org. Each word on the word list was assigned a number and a random sequence was created for each list. Three words corresponding to the next three numbers in the sequence for each of the three word lists were combined for a total of nine words for each probe. These nine words were then randomized again using a series of number sequences to eliminate any possibility of the participants determining a pattern of word presentation. Lists for probes were generated until the words on one of the lists were depleted and few words remained on the other two lists. Probes were never repeated with the fifth graders; several of the probes utilized in establishing the initial baseline were repeated for the final spelling and maintenance probes with the kindergartners. This was necessary given the limited number of words available for the kindergartners.

The kindergarten word lists were developed as follows: (a) the green list, consisting of VC and CVC words with the vowels /ã/ and /ĩ/ with initial continuous consonants (i.e., f, l, m, n, r, s); (2) the red list, consisting of VC and CVC words introducing /e/ and /o/ with the consonants presented in list one (i.e., initial continuous consonants) along with initial stop consonants (i.e., b, d, g, p, t); and (3) the blue list, introducing /u/ with all the consonants previously presented, along with the /ã/ and /ĩ/ words containing the initial stop consonants that were not presented in list one. A fourth
list, the black list, containing equal numbers of words randomly chosen from the first three word lists was utilized for additional instruction and practice until mastery criteria were met.

The order of presentation of the phonemes was determined from previous research findings (Adams, 1990; Ball & Blachman, 1991; Bowen, 1983; Bursuck & Damer, 2011; Rome & Osman, 1972). The consonants chosen were those suggested by Adams (1990) for introduction with emergent readers, and then divided into continuous and stop consonants (Bursuck & Damer, 2011). The letters b and d are both initial stop consonants and were therefore presented together. This allowed for discrimination between the two consonants, a necessary skill given that they often present visual confusion for many students. The continuous consonants were presented first given (a) continuous consonants are recommended for initial presentation with emergent readers because of the articulatory distortion that often occurs with initial stop sounds (Ball & Blachman, 1991; Bursuck & Damer, 2011), and (b) this reduced the amount of new material presented, allowing students more repetitions with less material.

Regarding the sequence of vowel presentation, /ä/ was presented first as it is commonly the first vowel sound learned. The vowel /ü/ was presented last because during pre-testing many of the participants added /ü/ to many of their consonants sounds (e.g., /bü/ and /fü/ for the sounds of /b/ and /f/, respectively). In addition, the vowels /œ/ and /ɨ/, along with /ö/ and /û/, were separated due to their similarities (Bursuck & Damer, 2011). The order of vowel instruction for the kindergartners in this study matched Bowen’s (1983) recommendation for order of presentation.
The word lists for the fifth graders included (a) the purple list, with one-syllable, three-phoneme nonsense words containing all the vowels and consonants presented to the kindergartners, along with vowel pairs (i.e., ai, ee, oa), a diphthong (i.e., oi), and digraphs (/sh/ and /ch/); (b) the orange list, containing phonemes from list one presented in complex blends (e.g., fl-, gl-, spr-, str-, -mp) with a maximum of seven phonemes; (c) the maroon list, containing phonemes from the first two word lists presented as closed, two-syllable words with a maximum of seven phonemes, and (d) the black list, containing equal numbers of words randomly chosen from the first three word lists.

In addition to using the above lists for the intervention, the word lists formed the probes (i.e., primary dependent variables) with each probe containing nine nonsense words, three words randomized from each of the first three word lists. This process was completed for both the kindergarten and fifth grade primary dependent variables.

**Secondary dependent variables.** The secondary dependent variables were the AIMSweb probes. AIMSweb probes were administered prior to initiating intervention, before each new skill was taught, and as a maintenance measure once intervention ceased. Four probes were administered individually to each participant within each group. The kindergartners completed the AIMSweb Early Literacy Measures consisting of Letter Naming Fluency (LNF), Letter Sound Fluency (LSF), Phonemic Segmentation Fluency (PSF), and Nonsense Word Fluency (NWF). Each of these is a 1-minute fluency timing. LNF measures the number of letters correctly named in 1-minute when presented with a page of printed letters. Similarly, LSF measures the number of correct phonemes spoken in 1-minute when presented with graphemes printed on a page. PSF measures the
number of phonemes segmented correctly in 1-minute when orally presented with the words. NWF, similar to PSF, measures the correct number of phonemes spoken when presented with a page of CVC (i.e., consonant-vowel-consonant) nonsense words.

The fifth graders also completed PSF and NWF probes. Given that these probes measure early literacy skills, no probes were available at the fifth grade level. Therefore, the highest-grade level norms available (i.e., first grade) were utilized. The fifth graders also completed AIMSweb Spelling probes. Fifth grade spelling probes, along with probes at the students’ current reading level, were administered. The students’ grade equivalent score on the Word Identification subtest of the Woodcock Reading Mastery Tests (WRMT-R) was used as the measure of current reading ability. Four fifth graders scored at the second grade level; Joy scored at the fourth grade reading level. AIMSweb spelling probes consisted of 17-words presented orally, one every seven seconds, for the fourth and fifth grade probes; and 12-words with one word presented orally every ten seconds for the second grade probes. Each spelling probe was completed within two minutes.

Pre- and post-test measures. In addition to the winter and spring benchmarks for the AIMSweb progress monitoring mentioned above (i.e., LNF, LSF, PSF, NWF, and Spelling), Oral Reading Fluency (ORF) was measured using both the grade equivalent and performance equivalent (i.e., current reading level as measured by the WRMT) as a pre-post test measure. Probes were administered using the protocol designated by the authors (i.e., one-minute timing of a passage read aloud).

Two standardized tests, the Comprehensive Tests of Phonological Processing (CTOPP) and the WRMT-R, were also used as pre-post measures. The complete CTOPP
was administered individually to all eight participants both preceding and following the intervention through diligent adherence to the authors’ protocol. The composite scores for phonological awareness, alternate phonological awareness (fifth grade only), phonological memory, and rapid naming were tabulated. Only the Word Identification and Word Attack subtests of the WRMT-R were utilized for this intervention. These subtests required the students to read individual words presented in a word list (i.e., Word Identification), and also decode nonsense words (i.e., Word Attack). These tests were administered with careful adherence to the author’s protocol.

The final pre-post measure recorded was an interventionist-created checklist of letters and phonemes instructed during the intervention. The grapheme cards utilized during intervention were presented individually and students were asked to respond orally with the correct letter name and phoneme for each card presented.

**Data Collection Procedures**

**Primary dependent variables.** Probes, each containing nine nonsense words, were developed prior to the beginning of the intervention and organized randomly. Upon completion of four consecutive correct independent student responses, the researcher administered a probe. During auditory segmenting, administration consisted of the researcher verbally delivering the word prompt by asking the student, “What are the sounds in ______?” The student responded by first repeating the word, and then saying each individual phoneme as he/she placed a counter in the appropriate boxes. When segmenting with letters, following four consecutive correct independent responses, the researcher administered the probe by asking the student, “Show me the sounds in the
word _________.” After correctly pronouncing the word, the student placed the corresponding graphemes (i.e., letter cards) in the appropriate boxes. During spelling, after four consecutive correct independent responses, the researcher administered the probe by asking the student to, “Write the sounds in the word _________.” A response was considered correct if the student wrote the appropriate grapheme in each of the required boxes. No specific feedback was given to the students for any responses made on the probes. The feedback was limited to praise for working hard or completing the task as requested.

**Secondary dependent variables.** The appropriate AIMSweb tests were administered prior to beginning each skill and during maintenance. Administration was completed by the careful adherence to the prescribed protocol for each curriculum-based measurement (CBM). This included one-minute fluency timings for all (i.e., LNF, LSF, PSF, and NSF) of the AIMSweb probes except Spelling. These probes were scored by the correct number of oral responses (i.e., letter names for LNF or phonemes for LSF, PSF, and NSF) in 1-minute. Scores on the Spelling probes were tabulated by the number of correct letter sequences on the 17-word (i.e., fourth and fifth grade) or 12-word (i.e., second grade) probes. No feedback was given other than to praise the student with responses similar to those chosen for the primary dependent variables.

**Pre- and post-test measures.** AIMSweb ORF probes were scored by the number of correct words read, along with the number of errors for each 1-minute timing. The standardized tests (i.e., CTOPP and WRMT-R) were administered using the prescribed protocol, and scored using the procedures listed in the manual. Results were given as
normative data, comparing students of the same age and grade. The interventionist-created checklist of letters and phonemes presented during intervention was scored by the number of correct letters and phonemes named, yielding a percentage correct both pre- and post-intervention.

**Researcher training.** Prior to implementing the intervention, training was completed for both the scorers and the researcher. The researcher provided the training for all three scorers. It consisted of a verbal explanation with visual demonstration of the intervention, along with explicit instruction on how to fill out the procedural integrity checklist (Appendix F) and score the probes utilizing the pre-made data sheets. Review of correct pronunciation of the phonemes was also included. Training for the researcher consisted of practicing the pre-written scripts (see Appendix G) and when the protocol was fluent, the researcher ran mock intervention trials with the scorers. One scorer took the role of the student while another practiced completing the procedural integrity checklist. Then the roles were reversed allowing each scorer the opportunity to experience the intervention and also complete the checklist. Practice trials were completed for all three behaviors taught. Data from the mock trials were scored by the researcher and scorers so all were familiar with the process, and then inter-observer agreement (IOA) was calculated. Scores for procedural integrity and IOA were above 95% so training ceased.

**Inter-rater reliability.** During intervention, procedural integrity and student data were collected approximately one day per week. This resulted in data collection for 32% of kindergarten sessions and 26% of fifth grade sessions. The researcher and the scorers
collectively determined the percentage of correct steps administered for each session observed and the data were recorded.

Interobserver agreement (IOA) was also calculated for the primary and secondary dependent variables. This was determined by conducting an item-by-item analysis of each student response on each probe or CBM. The IOA was determined by dividing the number of agreements by the total number and agreements plus disagreements and then multiplying by 100.

**Social validity.** Wolf (1978) suggested that research in applied behavior analysis should determine social validity by the examining (a) the social significance of the target behaviors, (b) the social importance of the results, and (c) the appropriateness of the procedures being implemented. Interventions designed to improve phonemic awareness and reading ability clearly demonstrate social significance of the target behaviors, given the importance reading ability has on the outcomes of individuals during school and throughout life (Lyon, 2001). However, when determining the social significance of the target behaviors within a reading intervention, it is important that a demonstration be made regarding how the intervention affects reading skills so as to demonstrate its social significance. Similarly, the social importance of the results warrants the need for the researcher to demonstrate that the implemented intervention produced positive results to a degree that it made a significant and measurable change for the participants.

To determine the social significance of the procedures being implemented, it is important to discern the practical significance of the intervention by determining (a) if the intervention could realistically and effectively be implemented by individuals and in
settings other than those utilized by the researcher; (b) how costly it is to replicate the intervention, both in terms of financially and the time constraints; and (c) how well-liked the intervention is by both the students and the teachers. Interventions that are unlikely to be replicated due to implementation barriers are not socially valid and therefore provide little value to the field; it is not worthwhile to invest time with interventions that others do not want to use.

For the present study, social validity was measured through questionnaires administered to both the kindergartners and fifth graders (see Appendix H). The interventionist read the kindergartners’ questionnaire to each student individually. After each question, the students were asked to mark either the smiley face or the sad face, depending on whether they agreed or disagreed with the statement. The fifth grade students were asked to respond on a 3-item rating scale (i.e., yes, maybe, or no) to indicate their level of agreement or disagreement with each statement. The interventionist read the questions aloud to each fifth grader to ensure the sentences were read correctly.

The statements on the questionnaire addressed whether the students liked the intervention, whether they felt the intervention improved their ability to read and spell, and if they felt the intervention would be good for other students. There was also space on the fifth graders’ questionnaire to write comments. The interventionist asked both the kindergartners and the fifth grade students if there was anything they would like to say about the intervention.
**Instructional Materials**

A researcher-created “word box” was utilized throughout the intervention. The word box constructed for the kindergartners consisted of four 2 1/2” X 2 1/2” adjoining squares that formed a 2 1/2” X 10” rectangle placed on white poster board. A similar board, with seven boxes was created for the fifth grade intervention. The finished boards were laminated for durability and to allow students to write responses within the individual squares. Blue poker chips were utilized as counters for the first skill; for the second skill the researcher created and laminated cards of the graphemes that were taught. These 2” X 2” cards were cut from yellow poster board for the kindergartners, and green poster board for the fifth graders. The letter cards contained individual phonemes created with 72-point chalkboard font. During the spelling portion of the intervention, the students wrote the graphemes in the squares using an erasable marker.

Other materials included numerous pre-written word lists (i.e., 9-word randomized student probes, the 4 randomized nonsense word lists for each population, AIMSweb probes), lined and numbered paper along with pencils for students to write spelling probes, and a timer to ensure sessions were 20 minutes in duration.

**Experimental Design**

The design implemented for this study was a multiple probe across skills (i.e., three phonemic awareness skills) that was sequentially replicated across subjects (Tawney & Gast, 1984). Cronin and Cuvo (1979) utilized this design when teaching mending skills to five adolescents with intellectual disabilities. For the current study, the design was utilized twice, once with each population (i.e., kindergartners and fifth
graders). Running concurrent interventions with the two populations allowed the researcher to make intra- and inter-population comparisons. This information is beneficial given the limited research base for older, struggling readers, and subsequently the frequent reliance on the research utilizing beginning readers for developing interventions for the older, struggling readers.

A multiple probe, rather than a multiple baseline, design was chosen because a multiple baseline design was determined unnecessary and undesirable. Tawney and Gast (1984) determined it unnecessary for continuous baseline probes of academic skills once it has been documented that the student does not possess the skill because students learning a new academic skill are unlikely to acquire that skill through practice alone. A multiple baseline is undesirable because unnecessary probing takes away from instructional time and increases the likelihood of the student practicing errors given the researcher is unable to provide corrective feedback.

A multiple probe across skills is an appropriate design for studies teaching skills that include a minimum of three “similar yet functionally independent behaviors” (Tawney & Gast, 1984, p. 76). Although each of the three behaviors taught in this intervention (i.e., oral segmenting, phoneme-grapheme correspondence, and spelling) may be functionally independent, it is highly likely and even desirable from an educational standpoint, that the behavior learned in each subsequent phase of this intervention builds upon the skills learned previously, and therefore it is likely that induction will occur. Induction weakens internal validity and the ability to demonstrate a functional relation. Given the likelihood of induction, Tawney and Gast (1984)
recommend the addition of a multiple baseline across subjects into the design; this allows for the demonstration of a functional relation even if induction occurs in the later phases of the intervention. Through the addition of the multiple probe across subjects, a functional relation can be established through inter-subject replication by demonstrating a similar change of behavior occurs when, and only when, the intervention is initiated with each participant (Cooper, Heron, & Heward, 2007).

During this study, once a stable baseline was established, intervention for the new skill began. This sequence continued until the criteria were met for all three behaviors; then maintenance data were collected.

A new participant began intervention after the previous student completed the auditory segmenting portion of the intervention. This intervention began upon establishing a stable baseline for the new participant. The sequence continued until all participants entered intervention. Two fifth grade students entered intervention simultaneously after the second student reached mastery criterion for counters to allow adequate intervention time prior to the ending of the school year. The fifth participant (i.e., the student with the relatively strongest phonemic awareness skills) entered intervention upon establishing a stable baseline once the first of the two participants in the third tier met mastery criteria for counters.

During baseline, probes were individually administered to all 8 participants. A probe for each of the three behaviors was administered to each student daily (i.e., each session) for a minimum of three days and continued until at least one student from each of the two groups displayed stable responding to the auditory segmenting probe. All three
kindergartners demonstrated stable responding (i.e., they all scored zero on all three auditory segmenting probes), so the student with the highest PSF was chosen to begin intervention. This decision was made in the hope that this student would have the strongest preskills (i.e., segmenting ability) and thereby finish the first tier (i.e., segmenting with counters) most rapidly allowing for the remaining participants to enter intervention sooner.

For the fifth graders, at the initiation of the probes, only three of the five participants had been identified. Of the three, one student demonstrated significant phonemic strength relative to the others, so it was determined that he would be the last to begin intervention. Of the two remaining participants, it was predetermined that the student demonstrating the strongest stable baseline scores would begin first. Both of the participants were similar in segmenting ability; however, one participant demonstrated an ascending trend in phoneme-grapheme correspondence (i.e., letters) so he was chosen as the first fifth grader to begin intervention. The two students that had not participated at the very beginning days of probing were administered the same baseline probes as the initial participants as soon as the researcher received signed consent and assent. The same criteria were utilized each time a new participant was chosen to begin intervention.

The probes utilized during baseline for each of the behaviors were randomly generated from the three nonsense word lists previously created. Three words from each list, for a total of 9 words, were picked for each probe through a sequence of numbers generated by random.org. The nine words within each probe were again randomized using another numerical sequence generated by random.org to eliminate the possibility of
the students deciphering any type of pattern. This procedure was utilized for both the kindergarten and fifth grade probes until 62 differing probes were created for the fifth graders, and 36 possible variations of differing probes were created for the kindergartners. No probes were repeated for the fifth graders. For two of the kindergartners, the probes used to determine initial baselines were re-used, beginning with probe one, to complete the final stage of the third skill (i.e., spelling); the sequence was continued for maintenance probes for all three students.

Concurrent with the probes utilized to establish baseline, pre-testing of skills was completed. The pre-test battery was divided into thirds, determined by difficulty and type of task along with time to administer, and delivered to students individually over the first three days of probing, following the completion of the three daily probes. For several kindergartners, the pretesting was completed in separate sessions following the initial probing because it could not be completed within the 20-minute session time, and/or the student appeared too tired to continue.

**Procedures**

**Baseline.** During the establishment of baseline (i.e., a minimum of three probes along with the demonstration of stable responding), students continued with the daily classroom routine. No changes in instruction occurred due to the students’ participation in this study.

The daily classroom routine for the kindergartners consisted of rotations of play and academic skill development. The reading curricula included instruction on the letter name and its sounds presented through the “letter of the week.”
Phonological awareness was taught by clapping out the syllables in words, and small books (i.e., several pages) containing large pictures and limited text were presented for reading instruction. Students were encouraged to use context clues to “read” unknown words.

The fifth graders represented each of the three “teams” in their school: Aaron was with the Blue team, Tim and Rachel were Red team members, and Joy and Evan represented the Purple team. The students moved from teacher-to-teacher within each team for daily instruction; therefore, considerable variation in instruction occurred among the participants. Supplemental instruction, as indicated through Individualized Educational Plans (IEP) was in place for four of the five participants; Joy did not receive any supplemental instruction. Explicit phonics and reading fluency were goals targeted in the students’ IEPs. Phonics instruction consisted of the presentation of a new phoneme-grapheme relationship each week along with end of the week spelling tests. None of the phoneme-grapheme relationships presented in this intervention were taught in the classroom. Tim and Rachel worked individually on reading fluency using the computer program Read Naturally.

**Word box intervention.** The independent variable was a word box intervention teaching three behaviors designed to promote phonemic awareness, and thereby improve word reading and spelling. The researcher served as the interventionist for all eight participants. Sessions lasted 20 minutes and were conducted Monday through Thursday each week for the fifth graders. The kindergartners’ school followed an alternating day schedule so the kindergarten students attended school on Monday and Thursday one
week, and then Monday, Wednesday, and Thursday the following week. Twenty-minute intervention sessions were held following this schedule whenever the students were in attendance. Breaks were granted as needed during the sessions; this was most necessary for the kindergarten participants. At the end of the twenty-minute session, the interventionist marked the last word completed and this served as the starting point for the following session. The one exception to this rule was probes. No probe was stopped prior to its completion. The interventionist determined if sufficient time was available to complete the probe prior to its initiation. If there was not enough time, the next session began by administering the probe. Each student remained in intervention until mastery criterion (i.e., 8 out of 9 correct responses on a 9-word probe for two consecutive days) was met for each of the three behaviors: auditory segmenting, segmenting with letters, and spelling.

**Auditory segmenting.** For the first skill, students learned to segment words into their individual phonemes. Students demonstrated their segmenting skill by saying each phoneme while moving a counter into the appropriate square of the word box. Each word required correct pronunciation of each phoneme to be considered a correct response.

**Segmenting with letters.** Research suggests the best way to promote phonemic awareness is to move to letters as soon as the students are ready (Adams, 1998; Fletcher et al., 2007; Schuele & Boudreau, 2008); therefore, as a natural progression, students learned to segment with the correct phoneme-grapheme correspondence. Students demonstrated this skill by placing the grapheme card that corresponded to the each phoneme into the appropriate square of the word box. Once the student correctly
segmented the nonsense word, the trial concluded with the student blending the completed nonsense word.

**Spelling.** For the final stage, the visual letter representations (i.e., grapheme cards) were removed and students demonstrated their knowledge of phoneme-grapheme correspondence by writing each grapheme in the correct square of the word box. The same instructional procedures and criterion were utilized for each behavior taught.

The researcher closely followed the pre-written script (see Appendix G) throughout the intervention. The script began with a brief explanation of the purpose of the intervention and an explanation of how the intervention would proceed over the upcoming months. The student was asked for any questions regarding the intervention, and upon the completion of the introduction, the intervention began.

Throughout the intervention the same protocol was followed. Instruction for each new behavior followed the “Model-Lead-Test” format, also referred to as “My Turn-Together-Your Turn” (Bursuck & Damer, 2011, p. 23). This format required the interventionist to first model how to complete the skill (i.e., the “My Turn” phase), followed by the “Lead” phase where the student and interventionist completed the skill together (i.e., the “Together” phase). The interventionist gradually faded her assistance as the student began to display competency with the new behavior. The final step in this model was the testing phase. This was the “Your Turn” portion where the student independently completed the skill. Positive, and immediate, corrective feedback was provided throughout the “Model-Lead-Test” format.
Once the student correctly completed the testing portion of “Model-Lead-Test” (i.e., correctly responded in the testing phase to two consecutive prompts), the interventionist then asked the student to independently complete the behavior without the “Model-Lead” preceding it. Nonsense words from the same word list used during the testing phase (i.e., the interventionist continued down the word list from where she left off during instruction) were used for independent practice. During independent practice, the interventionist continued to provide positive and corrective feedback as appropriate. If the student completed the correct response, the interventionist provided confirmation and presented the next word for independent practice. Or, if the student made an error, the interventionist immediately replied with, “My Turn” demonstrating the correct response and then completed the “Model-Lead-Test” sequence. If the student responded correctly during this testing phase, the next word was presented for independent practice. If the student made another incorrect response, the interventionist returned to the “Model-Lead-Test” format and instruction resumed until the student provided at least two consecutive correct responses during the “testing” portion of “Model-Lead-Test.” Once two consecutive responses were provided, the interventionist once again moved the student to independent practice.

Once the student correctly completed four consecutive words during independent practice, a probe for that behavior was administered. Following the probe, the next level of word difficulty (i.e., the next word list in the sequence) was presented utilizing the same “Model-Lead-Test” format. This procedure continued until all three word lists were administered. If the student did not meet the mastery criterion (i.e., scores of 8 or 9 out of
9 on two consecutive probes) following the completion of all three word lists, the fourth and final word list (i.e., the list containing nonsense words randomly selected from all three word lists) was presented and intervention continued using the prescribed format until the mastery criterion was reached.

Once the mastery criteria were reached for the current behavior, baseline probes for the following behavior were administered until stable responding was demonstrated. A single probe for the third behavior was presented to measure either maintenance or as an additional baseline measure. Once a stable baseline was established, intervention for the new skill began. This sequence continued until the criteria were met for all three behaviors; then maintenance data were collected.

**Maintenance.** In order to measure retention of skills, maintenance data were collected after the word box intervention was completed. Maintenance data were collected every two weeks for the students completing the intervention first; as the end of the school year neared, maintenance data were collected weekly. This schedule followed for all students up until the end of the 2011–2012 school year. The students starting intervention first had considerable maintenance data; however, the later a student began intervention the less maintenance data were available given the time constraint. Maintenance data consisted of student scores on probes equivalent to those administered during intervention for all three behaviors.

**Generalization.** AIMSweb probes were administered throughout the intervention to measure generalization. NWF and PSF probes were administered for all students. Kindergarten students also completed progress monitoring probes for LNF and LSF; fifth
graders completed probes for Spelling. Progress monitoring probes were administered prior to the teaching of each new behavior. Winter and Spring Benchmark probes were administered for pre- and post-intervention scores. ORF Winter and Spring Benchmarks were also administered as pre- and post-intervention measures for the fifth grade participants, both for grade level and current reading level. Administration of these probes followed the protocol described by the authors. The Word Identification and Word Attack subtest of the WRMT were also administered pre- and post-intervention and served as a generalization measure. All formal tests were administered following the prescribed protocol and were scored using both age and grade equivalent norms.

**Procedural integrity.** Data on procedural integrity were collected through the utilization of a procedural checklist. This checklist was completed approximately weekly by one of The Ohio State doctoral students trained for this study. Completion of the checklist required the scorer to mark a plus (+) for each step properly completed, and a minus (-) for each step that was either omitted or incorrectly performed. Data were collected for 32% of kindergarten sessions and 26% of fifth grade sessions. A procedural integrity percentage was calculated for the number of correct steps completed for each day the data were collected. This data helped the researcher to avoid treatment drift and also helped to make any necessary changes to intervention steps that were omitted or incorrectly administered. All of the data collected were averaged to determine an overall procedural integrity percentage for the intervention.
Chapter 4: Results

This chapter presents the results of this investigation beginning with inter-
observer agreement and procedural integrity. Next, the effects of the Word Box
intervention on the dependent variables are presented, followed by results of the pre- and
posttest measures the AIMSweb probes, and the social validity measures.

**Inter-observer Agreement**

Inter-observer agreement (IOA) was calculated for the nonsense words presented
during invention, along with the probes and AIMSweb measures utilized throughout the
study. Outside researchers trained for the intervention scored 21% of the words presented
during intervention, 22% of probes, and 34% of the AIMSweb measures.

**Word Box intervention.** An item-by-item analysis using the formula of
agreements over agreements plus disagreements multiplied by 100 was utilized. The
mean IOA for words instructed during instruction was 99% (range: 86–100%), and the
IOA mean for the probes was 98% (range: 78–100%).

**Generalization.** An item-by-item analysis using the formula of agreements over
agreements plus disagreements multiplied by 100 was utilized to determine IOA for
AIMSweb probes, both benchmarks and progress monitoring probes. Overall,
interobserver agreement was 97% (range: 83–100%).
Procedural Integrity

Procedural integrity measures are important to determine the fidelity to which an intervention was implemented. In addition, continual monitoring of procedural integrity throughout the intervention helps minimize treatment drift along with notifying the researchers when changes in the implementation of the intervention are necessary. Procedural integrity data were collected for 32% of kindergarten sessions and 26% of fifth grade sessions, during instruction, and also for the administration of probes.

**Intervention procedural integrity.** During intervention, trained data collectors marked an interventionist-created procedural checklist with a “+” for each step correctly implemented and a “—” for each omitted or incorrect step. Data were collected for all three kindergarten participants for a total of 20 sessions. Mean adherence to the instructional procedures was 97.5% (range: 80–100%). Data were collected for all five fifth graders for a total of 27 sessions. Mean adherence to the instructional procedures was 99.3% (range: 90–100%). Overall, for the 37 sessions tabulated during intervention, the mean for procedural integrity was 98.5%.

**Probe procedural integrity.** Trained data collectors completed a procedural checklist similar to that used during instruction to determine the degree of fidelity by which the probes were administered. Data were collected across all participants and all behaviors measured. Mean adherence to the probe administration procedures for 37 kindergarten probes was 98.4% (range: 90–100%). Adherence to the probe administration procedures for the 44 probes recorded during fifth grade sessions was 99.1% (range: 90–
100%. Overall, for the 81 probes recorded, the mean for probe procedural integrity was 98.8%.

**Word Box Effectiveness**

The effectiveness of the Word Box intervention was examined using probes that directly measured the skills taught and were used to make experimental decisions; they were the primary dependent variables. These probes consisted of nine words, three words randomly selected from each of the three nonsense-word lists developed for each group of participants. Probes were scored by counting the number of nonsense words correct. To be scored as correct, the total response must have been correct; no partial credit was given. Mastery criteria required a minimum score of 8 or 9 on two consecutive probes, along with the completion of all three word lists. The instruction required for mastery is presented in Table 2 for the kindergartners and Table 3 for the fifth graders, followed by results for each student. Participants are listed in the order of their entry into intervention, beginning with the kindergarten students.

**Kindergarten participants.** Total instructional time required to reach mastery for all behaviors ranged from 5 hours and 20 minutes for both Ellie and Matthew, to 5 hours and 40 minutes for Michael. The greatest amount of instructional time was required to teach phoneme-grapheme correspondence (i.e., Letters).

Initial baselines (see Figures 2–4) for the kindergarten participants were very stable as all three students scored zero on each of the initial three probes for each of the three behaviors (i.e., auditory segmenting with counters, phoneme-grapheme matching
with pre-printed letter cards, and spelling). Baseline scores remained at or near 0. Upon instruction, scores quickly improved for all kindergartners across all behaviors. This established a functional relation; an increase occurred when, and only when, instruction was initiated.

Table 2. Number of Sessions and Words Instructed for Mastery for Kindergartners.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Counters</th>
<th>Letters</th>
<th>Spelling</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S  WI</td>
<td>S  WI</td>
<td>S  WI</td>
<td>S  WI</td>
</tr>
<tr>
<td>Michael</td>
<td>4 34</td>
<td>6 54</td>
<td>6 38</td>
<td>16 126</td>
</tr>
<tr>
<td>Ellie</td>
<td>5 71</td>
<td>10 72</td>
<td>6 41</td>
<td>17 184</td>
</tr>
<tr>
<td>Matthew</td>
<td>4 76</td>
<td>7 58</td>
<td>6 50</td>
<td>17 184</td>
</tr>
<tr>
<td>Mean</td>
<td>4.3 60.3</td>
<td>7.7 61.3</td>
<td>6.0 43.0</td>
<td>16.7 164.7</td>
</tr>
</tbody>
</table>

*Note. S = # of sessions; WI = # of words instructed.*

*Michael.* Visual analysis of Michael’s graph (Figure 2) reveals an immediate change in level and a rapid upward trend upon intervention for all three tiers. During counters there was a steep, continual upward trend. The increase was not as steep for Letters, with three of the six probes at 56% correct. The initiation of Spelling revealed a pattern similar to Letters (i.e., the first three data points are identical). No drop in level was observed following a two-week absence of instruction. Maintenance data collected weekly up to six weeks post-intervention revealed no drop in level from mastery in either Counters or Letters. Maintenance data for Spelling were more variable; however, no data...
Figure 2. Michael’s Results.

Note. BL = Baseline; WB = Word Box Intervention.
point fell below pre-intervention levels. Week 1 maintenance was higher than intervention, and week 4 was back to the mastery level.

**Ellie.** Visual analysis of Ellie’s graph (Figure 3) reveals a more varied performance compared to Michael; however, a functional relation was still established. Prior to intervention, Ellie’s baseline scores remained at zero for the first two skills (i.e., Counters and Letters). During Counters, Ellie demonstrated a rapid upward trend followed by a downward trend and then a quick return to mastery levels. During Letters, a more gradual, yet upward, trend was established with only one significant drop in performance during the seventh probe. The following probes met the mastery criterion. Although the early baseline Spelling probes were zero, upon completion of Letters Ellie’s baseline rose significantly. Once a stable baseline was established and instruction began, score remained at baseline levels for the first two probes and then rose quickly remaining near or at mastery levels for the final four probes. For all three skills taught, Ellie’s maintenance scores were above her final intervention probe (i.e., Ellie completed all maintenance tasks with 100% accuracy).

**Matthew.** Visual analysis of Matthew’s graph (Figure 4) reveals an immediate change in level and a rapid upward trend upon intervention for both Counters and Letters. Matthew correctly segmented with 100% accuracy on his second Counter probe. His score decreased slightly (i.e., downward from 9 to 7 correct) on the following probe, but then returned to mastery levels for his final two scores. Matthew’s data also ascended rapidly for Letters, expect for the fourth data point that returned to early intervention levels. This was followed by two probes at the mastery level. Matthew’s baseline scores
Note. BL = Baseline; WB = Word Box Intervention.

Figure 3. Ellie’s Results.
Note. BL = Baseline; WB = Word Box Intervention.

Figure 4. Matthew’s Results.
were at or near zero for all probes preceding instruction in Letters. Upon completion of Letters, there was change in level and the baseline stabilized at 44% words spelling correct. This level was maintained into intervention with scores rapidly ascending between the third and fourth probes and the stabilizing at or near mastery levels. Limited maintenance was available due to Matthew’s sudden and unexpected move; however, the data collected during intervention for the skills completed (i.e., Counters and Letters) suggest Matthew’s skill level was maintained with 100% accuracy.

**Fifth grade participants.** Total instructional time required to reach mastery for all behaviors varied from 3 hours for Evan to 7 hours for Tim, and even more than that for Rachel who did not complete the Spelling portion prior to the ending of the school year. The skill requiring the most instructional time varied between students.

Table 3. *Number of Sessions and Words Instructed for Mastery for Fifth Graders.*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Counters</th>
<th>Letters</th>
<th>Spelling</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S  WI</td>
<td>S  WI</td>
<td>S  WI</td>
<td>S  WI</td>
</tr>
<tr>
<td>Aaron</td>
<td>6  61</td>
<td>4  37</td>
<td>5  38</td>
<td>15  136</td>
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<tr>
<td>Tim</td>
<td>10  165</td>
<td>5  27</td>
<td>6  42</td>
<td>21  234</td>
</tr>
<tr>
<td>Rachel</td>
<td>6  82</td>
<td>10  76</td>
<td>5+ 59+</td>
<td>21+ 217+</td>
</tr>
<tr>
<td>Joy</td>
<td>4  65</td>
<td>4  33</td>
<td>6  67</td>
<td>14  165</td>
</tr>
<tr>
<td>Evan</td>
<td>2  13</td>
<td>4  23</td>
<td>3  27</td>
<td>9  63</td>
</tr>
<tr>
<td>Mean*</td>
<td>5.6 77.2</td>
<td>5.4 39.2</td>
<td>5.0 43.5</td>
<td>14.6 124.5</td>
</tr>
</tbody>
</table>

*Note. S = # of sessions; WI = # of words instructed
*Totals for Spelling and Overall Totals were calculated with the four participants who completed the intervention*
Visual analysis of the fifth graders’ graphs (see Figures 5–9) reveals considerable variability in the baseline data within and between the students, and far more variability compared to the kindergartner’s graphs. Once baselines were established, however, with only a few exceptions (i.e., Spelling for Aaron, and Counters and Letters for Evan), definite upward trends were demonstrated across skills and participants once intervention began. Therefore, a functional relation was established for all five fifth graders; an increased occurred when, and only when, instruction was initiated.

Aaron. Visual analysis of Aaron’s graph (Figure 5) reveals an initial intervention score for Counters slightly above baseline (from 2 to 3). It required two days of instruction before the first probe was administered. After the second day, however, a rapid upward trend was established until mastery levels were reached. Similarly, with Letters, after an upward baseline trend followed by a return to the initial baseline level, early intervention reveals a score at the highest baseline level with scores ascending thereafter. A somewhat more variable, yet definite upward trend was demonstrated. Baseline levels for Spelling increased after instruction with Letters with the highest baseline score at 78% correct (i.e., 7 out of 9) and then descending to the pre-Letters level. Upon intervention, scores quickly elevated to the highest baseline point and fluctuated between 7 and 8 correct until the mastery criterion was met. Maintenance for Counters remained at 100% for over eight weeks post-intervention. The one exception was seven weeks post-intervention when Aaron began adding extra sounds, then corrected his error and asked to repeat the probes that confused him, raising his score from 6 to 9. Maintenance for Letters was also very strong, scoring 100% correct for six of
Figure 5. Aaron’s Results.

Note. BL = Baseline; WB = Word Box Intervention.
the seven probes. More variability was demonstrated during maintenance for Spelling; however, all probes were at or above intervention levels.

**Tim.** Visual analysis of Tim’s graph (Figure 6) reveals a variable but relatively stable baseline prior to the initiation of Counters. Upon instruction, there was an immediate and significant change in level with a variable and upward trend eventually turning to a downward trend nearing the highest baseline level. At that point a change in the intervention occurred. Upon this change, a rapid upward trend rose to reach the mastery criterion. Upon intervention with Letters, Tim required three sessions to move beyond baseline levels and then scores quickly ascended to meet the mastery criterion. A similar pattern occurred for Spelling. Maintenance data collected up to 4-weeks post-intervention was strong for Counters with Tim’s highest score (i.e., 9 out of 9) occurring on the final probe. More variability was demonstrated with Letters and Spelling. Twice an additional probe was administered because maintenance data returned to baseline levels; however, the second probe was considerably higher so no booster sessions occurred. Tim’s final maintenance probe was a 9 out of 9 for Spelling, the only time he scored 100% for that skill.

**Rachel.** Visual analysis of Rachel’s graph (Figure 7) reveals an immediate change in level for Counters and a gradual upward trend for both Counters and Letters upon intervention. Results for Spelling were more varied with three instructional sessions required before a noticeable increase occurred. Two additional probes were administered before school ended with the first an 8 followed by a 6. Only maintenance data on the completed tiers were available with all three probes a score of 7 (i.e., 78% correct).
Note. BL = Baseline; WB = Word Box Intervention; WBI = Word Box Intervention with change in instruction.

Figure 6. Tim’s Results.
Note. BL = Baseline; WB = Word Box Intervention.

Figure 7. Rachel’s Results.
**Joy.** Visual analysis of Joy’s graph (Figure 8) reveals an immediate change in level and a gradual variable but upward trend upon intervention with Counters. Baseline levels were highest for Letters (i.e., baseline levels for Counters and Spelling were at or near 0). Joy’s first intervention probe for Letters fell below the highest intervention level but quickly ascended. An immediate change in level occurred upon instruction in Spelling with a variable and gradual upward trend. Maintenance data were very strong; all probes were at mastery level for all three skills.

**Evan.** Visual analysis of Evan’s graph (Figure 9) reveals considerable variability in baseline scores with a range from 3 to 9 (i.e., 33% to 100% correct). Scores were more variable during intervention with scores on all the probes administered during Counters and Letters at the mastery level (i.e., an 8 or 9). The first two Spelling probes were slightly above baseline (i.e., from 6 to 7) with the following two probe scores at 100%. All maintenance probes were 100% correct. A functional relation was demonstrated for Evan more from the stability of scores once intervention began, combined with his perfect scores post-intervention, than the change of level that occurred during intervention.

**Interparticipant-comparison.** Although a functional relation had already been demonstrated for each participant, the multiple probe across students and skills design provides even greater support for the establishment of a functional relationship between the word box intervention and the segmenting, letter-sound correspondences, and spelling for each of the eight participants by the consistent replication of the effects of the intervention across subjects. Figure 10 represents the multiple probe across the three
Note. BL = Baseline; WB = Word Box Intervention.

Figure 8. Joy’s Results.
Note. BL = Baseline; WB = Word Box Intervention.

Figure 9. Evan’s Results.
Figure 10. Word Box Probes Across Skills and Kindergartners.
skills (i.e., Counters, Letters, and Spelling) for the kindergartners, followed by the comparable graph (Figure 11) for the fifth graders.

**Pre- and Post-Testing (Standardized Testing)**

The Comprehensive Tests of Phonological Processing (CTOPP) was utilized as a screening tool for entry into the intervention, as well as a measure of change in phonological processing ability. In addition, the Word Identification and Word Attack subtests of the Woodcock Reading Mastery Tests (WRMT-R) were administered to determine students’ current reading level for the AIMSweb Spelling and Oral Reading Fluency (ORF) probes, along with measuring changes in word reading and decoding ability. Results are presented in Table 4. These standardized measures were administered both pre- and post-intervention; however, post-intervention data for only seven of the eight participants were available due to Matthew’s unexpected and sudden relocation.

**Comprehensive Tests of Phonological Awareness (CTOPP).** Comparisons between pre- and post-testing revealed exceptional gains in Phonological Awareness (PA) for six of the seven participants as Ellie gained more than 1 standard deviation, and five students demonstrated improvement of approximately 2 standard deviations. The composite scores for Alternate Phonological Awareness, available only for the older students, echoed the improvement in PA as gains ranged from 1 to 3 standard deviations. Results were mixed for the other two composites, Phonological Memory and Rapid Naming. Five students demonstrated minimal gain in Phonological Memory and two students displayed slight decreases; however, Aaron improved by almost 2 standard deviations. Rapid Naming results were extremely varied. The two kindergartners
Figure 11. Word Box Probes Across Skills and Fifth Graders.
Table 4. *Standardized Achievement Testing*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Michael</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ellie</td>
<td>91 (27)</td>
<td>119 (90)</td>
<td>n/a</td>
<td>n/a</td>
<td>85 (16)</td>
<td>82 (12)</td>
</tr>
<tr>
<td>Matthew</td>
<td>104 (61)</td>
<td>--</td>
<td>n/a</td>
<td>n/a</td>
<td>94 (35)</td>
<td>--</td>
</tr>
<tr>
<td>Aaron</td>
<td>57 (&lt;1)</td>
<td>94 (35)</td>
<td>88 (51)</td>
<td>106 (65)</td>
<td>59 (&lt;1)</td>
<td>88 (21)</td>
</tr>
<tr>
<td>Tim</td>
<td>73 (3)</td>
<td>82 (12)</td>
<td>82 (12)</td>
<td>106 (65)</td>
<td>79 (8)</td>
<td>82 (12)</td>
</tr>
<tr>
<td>Rachel</td>
<td>46 (&lt;1)</td>
<td>79 (8)</td>
<td>76 (12)</td>
<td>97 (42)</td>
<td>58 (&lt;1)</td>
<td>64 (&lt;1)</td>
</tr>
<tr>
<td>Joy</td>
<td>79 (8)</td>
<td>112 (79)</td>
<td>67 (1)</td>
<td>112 (79)</td>
<td>88 (21)</td>
<td>94 (35)</td>
</tr>
<tr>
<td>Evan</td>
<td>79 (8)</td>
<td>109 (73)</td>
<td>94 (35)</td>
<td>124 (95)</td>
<td>100 (50)</td>
<td>97 (42)</td>
</tr>
</tbody>
</table>

*Note. CS = Composite Score; SS = Standard Score; n/a = Not Applicable; --Data not collected.*
improved by almost 1 standard deviation, three fifth graders demonstrated minimal gains as the other two decreased in rapid naming speed.

**Woodcock Reading Mastery Tests (WRMT-R).** Prior to intervention, two of the kindergarten participants earned a raw score of 0 on both the Word Identification and Word Attack subtests. Given many kindergartners possess limited reading skills, these students still received a standard score of 83 (i.e., 13th percentile) for Word Identification and 94 (i.e., 33rd percentile) for Word Attack. The third kindergartner read 4 words correctly for a standard score of 108 on Letter Identification, placing her at the 71st percentile. Similar to the other kindergartners, Ellie was unable to decode any of the nonsense words. Word Identification post-test scores revealed a slight improvement for one student, whereas the other kindergartner’s standard score increased over 1 standard deviation resulting in both students scoring in the average range (i.e., standard scores of 100 and 110). Greater gains were observed on the Word Attack, resulting in increases greater than 1 standard deviation. Both students scored in the high average range with standard scores of 112 and 115, the 79th and 85th percentiles, respectively.

Much smaller gains were observed for the fifth grade students. Gains of less than 1 standard deviation were observed for all participants for both the Word Identification and Wood Attack subtests with the exception of Evan who read one word less on the Word Identification post-test.

**Additional Pre- and Post-Test Measures**

Prior to the beginning intervention, letter naming and letter sound knowledge was measured using a research-created list containing the graphemes presented to each
population during intervention. Students were asked to give the letter name and the
“sound the letter makes” for each grapheme card presented. This process was repeated
following completion of the intervention. In addition, AIMSweb Oral Reading Fluency
(ORF) Winter and Spring Benchmarks for both current grade and performance level were
measured for the fifth grade participants. Table 5 provides more detailed information of
the pre- and post-testing measures.

**Letter-sound knowledge.** Prior to beginning intervention, Ellie correctly
responded to all 16 letter names presented and the other two kindergartners, Michael and
Matthew, correctly named 13 and 14 letters (i.e., 81% and 88%), respectively. Post-
intervention all three students responded with 100% accuracy. Pre-intervention, correct
phoneme responses for the kindergartners varied from 1 to 6, (i.e., 6% to 38%),
respectively. Post-intervention, these students responded correctly for 15 or 16 sounds
(i.e., 94% to 100%).

The fifth grade students responded with 100% accuracy to all 16 letter names,
both pre- and post-intervention. Of the 22 graphemes presented, correct student
responding was from 5 to 14 (i.e., 23% to 64%) prior to intervention, and 18 to 22 (i.e.,
82% to 100%) post-intervention.

**AIMSweb ORF probes.** Increases in words correct per minute (WCPM) from the
fifth grade winter benchmark (i.e., pre-test) to the spring benchmark (i.e., post-test)
varied from no increase for Aaron to a 24 WCPM increase (i.e., 87% increase) for Evan.
The frequency of errors varied, decreasing for three students and increasing for two fifth
graders. Placement for the performance level probes resulted in four students (i.e.
Table 5. Pre- and Post-Test Measures.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Letter Names</th>
<th>Letter Sounds</th>
<th>AIMSweb ORF Grade Level</th>
<th>AIMSweb ORF Performance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre RS (%)</td>
<td>Post RS (%)</td>
<td>Pre RS (%)</td>
<td>Post RS (%)</td>
</tr>
<tr>
<td>Michael</td>
<td>13 (81)</td>
<td>16 (100)</td>
<td>6 (38)</td>
<td>15 (94)</td>
</tr>
<tr>
<td>Ellie</td>
<td>16 (100)</td>
<td>16 (100)</td>
<td>6 (38)</td>
<td>15 (94)</td>
</tr>
<tr>
<td>Matthew</td>
<td>14 (88)</td>
<td>16 (100)</td>
<td>1 (6)</td>
<td>16 (100)</td>
</tr>
<tr>
<td>Aaron</td>
<td>16 (100)</td>
<td>16 (100)</td>
<td>11 (50)</td>
<td>22 (100)</td>
</tr>
<tr>
<td>Tim</td>
<td>16 (100)</td>
<td>16 (100)</td>
<td>14 (64)</td>
<td>21 (95)</td>
</tr>
<tr>
<td>Rachel</td>
<td>16 (100)</td>
<td>16 (100)</td>
<td>9 (41)</td>
<td>18 (82)</td>
</tr>
<tr>
<td>Joy</td>
<td>16 (100)</td>
<td>16 (100)</td>
<td>5 (23)</td>
<td>20 (91)</td>
</tr>
<tr>
<td>Evan</td>
<td>16 (100)</td>
<td>16 (100)</td>
<td>19 (86)</td>
<td>22 (100)</td>
</tr>
</tbody>
</table>

*Note. RS = Raw score; ORF = Oral Reading Fluency; WCPM = Words Correct Per Minute; n/a = Not Applicable.*
Aaron, Tim, Rachel, and Evan) reading second grade benchmarks and one student (i.e., Joy) reading the fourth grade benchmarks. All four of the students reading the second grade benchmarks increased their WCPM. The smallest increase was 8 WCPM (i.e., 10% increase) for Rachel with the greatest increase of 30 words (i.e., 136%) for Tim. Frequency of errors decreased for all four students. Joy’s WCPM increased by 22 resulting in a percentage increase of 16%.

**AIMSweb Progress Monitoring**

In addition to the ORF Benchmark probes administered as pre- and post-test measures, additional AIMSweb progress monitoring probes were administered prior to instruction. Winter and Spring Benchmarks were administered as a pre- and post-measure (see Table 6). In addition, probes were administered prior to instructing each new behavior, and post-intervention as a maintenance measure. The kindergartners were administered the kindergarten AIMSweb Measures of Early Literacy probes (i.e., Letter Naming Fluency [LNF], Letter Sound Fluency [LSF], Phoneme Segmentation Fluency [PSF], and Nonsense Word Fluency [NWF]). Fifth graders also completed PSF and NWF AIMSweb probes using the highest grade level norms available (i.e., first grade norms). In addition, Spelling was monitored using two probes: current grade and current performance level. Scores from the AIMSweb progress monitoring probes are listed below with the kindergartner’s results reported first, followed by the results for the fifth grade participants.

**Letter Naming Fluency (LNF).** Scores on the LNF probes demonstrated a variable, yet upward trend in fluent responding. Figure 12 presents the breakdown of
Table 6. *AIMSweb Benchmarks.*

<table>
<thead>
<tr>
<th>Participant</th>
<th>LNF</th>
<th>LSF</th>
<th>PSF</th>
<th>NWF</th>
<th>Spelling Grade Level</th>
<th>Spelling Reading Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WB</td>
<td>SB</td>
<td>WB</td>
<td>SB</td>
<td>WB</td>
<td>SB</td>
</tr>
<tr>
<td>Michael</td>
<td>35</td>
<td>41</td>
<td>8</td>
<td>37</td>
<td>6</td>
<td>26</td>
</tr>
<tr>
<td>Ellie</td>
<td>27</td>
<td>43</td>
<td>3</td>
<td>26</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>Matthew</td>
<td>49</td>
<td>62*</td>
<td>4</td>
<td>24*</td>
<td>4</td>
<td>36*</td>
</tr>
<tr>
<td>Aaron</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>32</td>
<td>49</td>
</tr>
<tr>
<td>Tim</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>35</td>
<td>74</td>
</tr>
<tr>
<td>Rachel</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>Joy</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>39</td>
<td>78</td>
</tr>
<tr>
<td>Evan</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>63</td>
<td>91</td>
</tr>
</tbody>
</table>

*Note. WB = Winter Benchmark; SB = Spring Benchmark; n/a = Not Applicable
*In lieu of Spring Benchmark the last probes administered (K #21) on 4/30/12 were reported*
probes throughout intervention, comparing the results for the kindergartners in this study to the population of kindergartners at the 50\textsuperscript{th} percentile as measured by AIMSweb. Prior to intervention Matthew demonstrated the strongest letter naming skills, correctly naming 49 sounds (i.e., 62\textsuperscript{nd} percentile). His final probe prior to moving was 62 letters correct placing him well above the 50\textsuperscript{th} percentile. Michael improved from 35 to 51 letters correct moving him close to the 50\textsuperscript{th} percentile by the end of intervention. Benchmarks for Ellie improved from 27 to 43 letters correct (i.e., 18\textsuperscript{th} to 29\textsuperscript{th} percentile).

\begin{figure}
\centering
\includegraphics[width=\textwidth]{AIMSweb_Kindergarten_LNF_Comparison}
\caption{AIMSweb Kindergarten LNF Comparison.}
\end{figure}

\textit{Note.} AIMSweb line represents the 50\textsuperscript{th} percentile of kindergarten population.

Figure 12. \textit{AIMSweb Kindergarten LNF Comparison.}
**Letter Sound Fluency.** Winter Benchmark (i.e., pre-intervention) scores were low with a range from 3 to 8 correct letter sounds (i.e., 6th percentile to 13th percentile). Scores remained low until the introduction of letters when a steep increase occurred moving the students closer to the 50th percentile aimline. Michael finished intervention well beyond the 50th percentile; Ellie approached the aimline but ended with a downward trend (see Figure 13).

*Note.* AIMSweb line represents 50th percentile for Kindergarten population.

Figure 13. *AIMSweb Kindergarten LSF Comparison.*
Phoneme Segmentation Fluency (PSF). Winter Benchmarks (i.e., pre-intervention) scores were 0 to 11 phonemes (i.e., 2\textsuperscript{nd} percentile to 24\textsuperscript{th} percentile) segmented correctly in a minute. Upon the introduction of Counters, a steep upward trend began and continued throughout the intervention for all three participants with Spring Benchmarks scores of 63 correct phonemes segmented for Michael and 73 for Ellie (i.e., 82\textsuperscript{nd} and 94\textsuperscript{th} percentiles, respectively); however, both students ended with a lower final maintenance probe (see Figure 14).

PSF scores for the fifth graders were more varied than the kindergartners; however, a similar increase was observed following segmenting instruction (See Table 7).

**Table 7. AIMSweb PSF Progress Monitoring (Fifth Graders).**

<table>
<thead>
<tr>
<th>Student</th>
<th>BL (WB)</th>
<th>Pre-C</th>
<th>Pre-L</th>
<th>Pre-S</th>
<th>Post- (SB)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaron</td>
<td>32</td>
<td>28</td>
<td>39</td>
<td>39</td>
<td>49</td>
<td>57</td>
</tr>
<tr>
<td>Tim</td>
<td>35</td>
<td>38</td>
<td>61</td>
<td>66</td>
<td>74</td>
<td>70</td>
</tr>
<tr>
<td>Rachel</td>
<td>40</td>
<td>44</td>
<td>62</td>
<td>61</td>
<td>70</td>
<td>--</td>
</tr>
<tr>
<td>Joy</td>
<td>39</td>
<td>40</td>
<td>71</td>
<td>79</td>
<td>78</td>
<td>75</td>
</tr>
<tr>
<td>Evan</td>
<td>63</td>
<td>82</td>
<td>95</td>
<td>103</td>
<td>91</td>
<td>91</td>
</tr>
</tbody>
</table>

*Note. BL = Baseline; Pre-C = Pre-Counters; Pre-L = Pre-Letters; Pre-S = Pre-Spelling; M = Maintenance; WB = Winter Benchmark; SB = Spring Benchmark; NS = No Score; --Data not collected*
Note. AIMSweb line represents 50th percentile for Kindergarten population.

Figure 14. AIMSweb Kindergarten PSF Comparison.

**Nonsense Word Fluency.** For the kindergarten participants, Winter Benchmarks (i.e., pre-intervention) scores were 4 to 6 letter sounds correctly named in one minute (i.e., 10th percentile to 12th percentile). Scores increased steadily throughout the intervention. Matthew reached the 50th percentile aimline on his final probe administered on the last day of intervention prior to his unexpected move. Michael and Ellie continued to improve their fluency through maintenance (see Figure 15); however, the most noticeable gain for all three participants was the change from naming individual sounds
Figure 15. AIMSweb Kindergarten NWF Comparison.

Note. AIMSweb line represents 50th percentile for Kindergarten population.

to decoding the whole nonsense word.

A similar pattern for NWF occurred with the fifth graders (see Table 8). All five students steadily increased the number of letter sounds correctly named in one minute throughout the intervention and into maintenance. All five fifth graders also switched from naming individual sounds to decoding whole nonsense words by the end of the intervention.
Table 8. *AIMSweb NSF Progress Monitoring (Fifth Graders).*

<table>
<thead>
<tr>
<th>Student</th>
<th>BL</th>
<th>Pre-C</th>
<th>Pre-L</th>
<th>Pre-S</th>
<th>Post- (SB)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaron</td>
<td>42</td>
<td>42</td>
<td>53</td>
<td>55</td>
<td>64</td>
<td>63</td>
</tr>
<tr>
<td>Tim</td>
<td>38</td>
<td>62</td>
<td>41</td>
<td>54</td>
<td>48</td>
<td>51</td>
</tr>
<tr>
<td>Rachel</td>
<td>42</td>
<td>42</td>
<td>49</td>
<td>60</td>
<td>71</td>
<td>--</td>
</tr>
<tr>
<td>Joy</td>
<td>112</td>
<td>128</td>
<td>206</td>
<td>176</td>
<td>181</td>
<td>181</td>
</tr>
<tr>
<td>Evan</td>
<td>40</td>
<td>61</td>
<td>54</td>
<td>66</td>
<td>48</td>
<td>75</td>
</tr>
</tbody>
</table>

*Note.* BL = Baseline; Pre-C = Pre-Counters; Pre-L = Pre-Letters; Pre-S = Pre-Spelling; M = Maintenance; WB = Winter Benchmark; SB = Spring Benchmark; --Data not collected.

**Spelling.** Data were collected for the fifth grade students using both the *AIMSweb* fifth grade probes (see Table 9), and the probes representing the students’ current reading level (see Table 10). Although individual fifth grade spelling probes demonstrated considerable variability, the mean Correct Letter Sequence (CLS) increased from baseline levels for all 5 students. Comparisons of scores from Winter Baseline (i.e., pre-intervention) to Spring Baseline (i.e., post-intervention) increased for all five students with a range of a 4% increase for Joy to a 35% increase for Aaron.

Despite the improvement in benchmark scores, all five students’ scores remained well below the level expected from a fifth grader. Winter Benchmarks (i.e., pre-intervention) percentiles for correct letter sequences were very similar for four participants (i.e., Aaron, Tim, Rachel, and Evan) with a range in scores from below the
Table 9. AIMSweb Fifth Grade Spelling Progress Monitoring.

<table>
<thead>
<tr>
<th>Participant</th>
<th>BL</th>
<th>Pre-C</th>
<th>Pre-L</th>
<th>Pre-S</th>
<th>Post-S</th>
<th>M</th>
<th>Mean CLS</th>
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<tr>
<td>Aaron</td>
<td>63</td>
<td>67</td>
<td>68</td>
<td>71</td>
<td>85</td>
<td>68</td>
<td>70.3</td>
</tr>
<tr>
<td>Tim</td>
<td>57</td>
<td>67</td>
<td>61</td>
<td>62</td>
<td>76</td>
<td>56</td>
<td>63.2</td>
</tr>
<tr>
<td>Rachel</td>
<td>45</td>
<td>42</td>
<td>47</td>
<td>42</td>
<td>57</td>
<td>--</td>
<td>46.6</td>
</tr>
<tr>
<td>Joy</td>
<td>98</td>
<td>103</td>
<td>87</td>
<td>105</td>
<td>100</td>
<td>107</td>
<td>100.0</td>
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<tr>
<td>Evan</td>
<td>70</td>
<td>73</td>
<td>75</td>
<td>72</td>
<td>84</td>
<td>75</td>
<td>74.8</td>
</tr>
</tbody>
</table>

*Note.* Data are presented as correct letter sequence on spelling probes as listed above. BL = Baseline; Pre-C = Pre-Counters; Pre-L = Pre-Letters; Pre-S = Pre-Spelling; M = Maintenance; WB = Winter Benchmark; SB = Spring Benchmark; CLS = Correct Letter Sequence.

1\textsuperscript{st} percentile for Rachel to the 3\textsuperscript{rd} percentile for Evan. Joy earned the highest Winter Benchmark score with 98 correct letter sequences (i.e., 15\textsuperscript{th} percentile). Spring Benchmark scores were very similar with Joy scoring at the 14\textsuperscript{th} percentile, and the remaining participants with a range from the 1\textsuperscript{st} percentile to the 5\textsuperscript{th} percentile.

Scores were even more variable for the reading equivalent spelling scores than the fifth grade scores. All the students, with the exception of Joy, completed the second grade spelling probes; Joy completed the fourth grade probes. CLS increase for the second grade probes when comparing baseline to mean CLS was a range of 8\% for Evan to 36\% for Aaron. Comparing Winter Baseline to Spring Baseline for second grade scores the CLS range was an increase of 9\% for Evan to a 45\% increase for Rachel. Joy’s spelling did not increase during intervention with a 6\% decrease from Winter Baseline to Spring Baseline, and no change when comparing Winter Baseline to the mean CLS.
Table 10. *AIMSweb Reading Equivalent Spelling Progress Monitoring.*

<table>
<thead>
<tr>
<th>Participant</th>
<th>BL</th>
<th>Pre-C</th>
<th>Pre-L</th>
<th>Pre-S</th>
<th>Post-SB</th>
<th>M</th>
<th>Mean CLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaron</td>
<td>39</td>
<td>67</td>
<td>40</td>
<td>58</td>
<td>53</td>
<td>62</td>
<td>53.2</td>
</tr>
<tr>
<td>Tim</td>
<td>38</td>
<td>62</td>
<td>41</td>
<td>54</td>
<td>48</td>
<td>51</td>
<td>49.0</td>
</tr>
<tr>
<td>Rachel</td>
<td>29</td>
<td>38</td>
<td>27</td>
<td>35</td>
<td>42</td>
<td>--</td>
<td>36.2</td>
</tr>
<tr>
<td>Joy</td>
<td>109</td>
<td>114</td>
<td>108</td>
<td>117</td>
<td>103</td>
<td>101</td>
<td>108.7</td>
</tr>
<tr>
<td>Evan</td>
<td>46</td>
<td>52</td>
<td>40</td>
<td>53</td>
<td>53</td>
<td>55</td>
<td>49.8</td>
</tr>
</tbody>
</table>

*Note.* Data are presented as correct letter sequence on spelling probes as listed above. BL = Baseline; Pre-C = Pre-Counters; Pre-L = Pre-Letters; Pre-S = Pre-Spelling; M = Maintenance; WB = Winter Benchmark; SB = Spring Benchmark; CLS = Correct Letter Sequence.

**Social Validity Results**

Social validity data provide information regarding the relevance and appropriateness of the intervention’s goals, procedures, and outcomes. Social validity data were collected for the kindergartners and the fifth grade participants. Both groups of students were presented the same questions, read aloud by the researcher to circumvent possible reading errors. The kindergartners were asked to check either the smiley face or the frowning face depending on if they agreed or disagreed with the statement. If they were unsure, the students were instructed to put a check in the middle box between the two faces.

The social validity questionnaire for the fifth graders asked the students to check either “yes,” “no,” or “maybe” depending on how they felt about the question. The
questionnaire was scored using a 3-point rating scale (i.e., yes=3, maybe=2, no=1) with a possible total score with a range from 5 (all responses “no”) to 15 (all responses “yes”). A higher score suggests a greater level of treatment acceptability. All five fifth graders completed the questionnaire; only two of the three kindergartners responded as Matthew had already moved when the social validity data were collected.

Individual student total scores ranged from 13 to 15 with a mean of 13.9. Kindergartners’ scores ranged from 13 to 14 (mean 13.5) and fifth grade scores ranged from 13 to 15 with a mean of 14. The cumulative responses of all seven participants are presented in Table 11. Scores for individual questions had a possible range from 7 (i.e., all participants responded “no”) to a maximum of 21 (i.e., all responded “yes”). Points per question ranged from 16 to 21 with a mean of 19.4, and two of the five questions received a 21, suggesting the students were satisfied with the intervention.

Table 11. Student Social Validity Results.

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes (3)</th>
<th>Maybe (2)</th>
<th>No (1)</th>
<th>Total</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like using Word Boxes.</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>19</td>
<td>2.7</td>
</tr>
<tr>
<td>Word Boxes helped me learn to read better.</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>16</td>
<td>2.3</td>
</tr>
<tr>
<td>I can spell more words now.</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>I will sound out words I do not know when reading or writing.</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>I think Word Boxes are a good way for students to learn to sound out words.</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>20</td>
<td>2.7</td>
</tr>
<tr>
<td>Cumulative Mean</td>
<td>5.6</td>
<td>1.2</td>
<td>0.2</td>
<td>19.4</td>
<td>2.7</td>
</tr>
</tbody>
</table>
Chapter 5: Discussion

The purpose of this study was to determine the effects of a word box intervention designed to promote phonemic awareness on the phonological, reading, and spelling skills of two groups of students: (a) three kindergarten at risk emergent readers; and (b) five fifth grade students struggling with reading and spelling (i.e., treatment resisters). Concurrent interventions, utilizing a multiple probe across skills (i.e., counters, letters, and spelling) design were sequentially replicated across students to determine the relationship between the word box intervention and seven dependent variables.

The results of this study suggest the word box intervention was effective in increasing segmenting, letter-grapheme correspondences, and spelling skills for all participants. Specifically, a functional relation was demonstrated for all eight participants individually, and across students in both groups. Increases in skill level maintained for all participants, with maintenance levels at or above intervention levels demonstrated up to two months post-intervention. In addition, social validity data revealed high degrees of satisfaction with the intervention and its outcomes. More detailed discussion of the findings is presented below, organized by research questions. Discussion of limitations, suggestions for future research, and implications for practice follow.
Primary Dependent Variables

What is the effect of the word box intervention on each student’s auditory segmenting skills, as measured by the number of words segmented correctly on 9-word nonsense word probes? The findings demonstrate a functional relation between the word box intervention and participants’ nonsense word segmenting. Intervention scores were well above baseline and maintained post-intervention. This is not surprising given that the segmenting skill required for counters was a prerequisite for the other two skills (i.e., letters and spelling) and therefore was practiced and improved throughout the intervention. This was demonstrated by the near perfect maintenance scores for segmenting with counters observed up to three months after mastering the skill during intervention.

Segmenting with counters proved easier for the kindergarten students than the fifth grade students. For the emergent readers, the primary challenge was learning to hear the individual sounds in words. For the older students, they not only needed to isolate the individual sounds, but also had to correct faulty practices learned in the past, and then relearn how to segment correctly.

Kindergarten participants. The three kindergarten participants demonstrated the ability to isolate initial sounds in some of the words presented during pretesting; however, none of the kindergartners recognized final sounds in words prior to intervention. Segmenting initial and final sounds is a more basic phonemic awareness skill than segmenting (Schuele & Boudreau, 2008), occurring shortly before segmentation on the phonological awareness skills continuum (see Figure 1). Given the
students’ current level of phonemic awareness, segmenting was a very natural progression and all three kindergartners mastered segmenting VC and CVC words within four or five sessions (i.e., approximately 1 ½ hours of instructional time). All three students reached the mastery level (i.e., 8 or 9 correct nonsense words) within three sessions. Ellie’s fourth data point was a significant drop (i.e., from 8 to 4 correct); however, this was not due to lack of skill but rather during the probe Ellie decided she wanted to fill all the boxes with counters, not just the ones needed for the word, and began “playing” with the sounds to fill the box (e.g., for tep she responded, “this could be /t/ /ð/ /p/ /p/, or /t/ /t/ /ð/ /p/, or /t/ /ð/ /ð/ /p/”), demonstrating a phonemic manipulation skill more complex than the task required of her. She correctly completed her next two probes to meet the mastery criteria.

Two particular challenges occurred during segmenting for the kindergartners. First, correctly pronouncing the phonemes took practice for all three participants; each student added a schwa to many of the sounds. This was easily corrected and more pure pronunciations remained throughout the intervention. The second challenge was differentiating the number of phonemes. Over 85% of the words on the word lists were CVC words so it took several repetitions before the kindergartners realized there were only two phonemes in some words. It was very apparent when each student mastered segmenting because he or she would smile and quickly respond with “that one only has two” prior to beginning to segment the word.

Fifth grade participants. Just as the kindergartners struggled to correctly pronounce phonemes, the fifth graders also experienced difficulty; however, their
mispronunciations more significantly affected their ability to segment words. This was most noticeable for Aaron; he often added /ɨ/ (i.e., schwa) to phonemes and then counted it as two separate sounds. It took weeks for Aaron to remove the schwa at the end of phonemes. Early in the intervention Aaron became so frustrated that he began pulling his hair and said that he wanted to quit. Learning the correct pronunciations was important for Aaron because his errors negatively affected his spelling. Aaron’s teacher commented about the extra vowels he added to words, wondering why he did that; Aaron was simply attempting to sound out the words as he was told to do. Aaron eventually learned correct pronunciations; however, about a month after intervention ended Aaron struggled on a segmenting probe (see Figure 5) because the schwa had returned. Aaron realized what was happening and after finishing the probe commented, “I’m adding the /ɨ/ again. I want to redo those words.” The probe was repeated and his score moved from a 6 to his typical maintenance score of 9.

Aaron’s twin brother, Tim, also struggled with counters. His performance was inconsistent, often omitting sounds with no apparent pattern of omission. Tim became frustrated and after the sixth probe Tim’s performance steadily declined. He did not want to continue and was frustrated because he did not want to keep returning to intervention after too many errors on a probe. Tim started making negative comments during probes such as, “I know that’s wrong. I’m going to have to start over.” After Tim’s third consecutive declining probe, the intervention was changed so Tim no longer returned to intervention but rather he was only instructed on his errors, and then another probe was administered. Tim’s attitude and scores steadily improved (see Figure 6).
In contrast to Aaron and Tim, Evan demonstrated much stronger, albeit inconsistent, segmenting skills prior to beginning instruction. Evans’s pre-intervention segmenting ability may not have warranted remediation; however, his difficulty with spelling along with phonemic awareness deficits in other areas qualified him for the intervention. Upon instruction with counters, Evan met mastery within two word lists, but needed to complete all three word lists to meet the mastery criteria.

**What is the effect of the word box intervention on each student’s segmenting of words with the correct phoneme-grapheme representation, as measured by the number of words segmented correctly on 9-word nonsense word probes?** The findings demonstrate a functional relation between the word box intervention and all participants’ ability to correctly segment nonsense words utilizing the correct phoneme-grapheme relationships. This is important because the procedures followed in this study were atypical compared to previous word box interventions (e.g., Blachman et al., 2000; Elkonin, 1973; McCarthy, 2008) in that the typical protocol was to use already established phoneme-grapheme knowledge and then add new graphemes slowly as they were learned. Murray and Lesniak (1999) in their letterbox instruction only taught one new phoneme-grapheme relationship per lesson. Similarly, the procedure prescribed in the phonological awareness curriculum, *Road to the Code* (Blachman et al. 2000), utilizes blank tiles to represent graphemes and these tiles are replaced only when the students have acquired the phoneme-grapheme relationship. Instruction in letter sounds is presented through activities separately from the word box instruction.
In the present study, phoneme-grapheme relationships were demonstrated through modeling using the word box with model-lead-test instruction; there was no additional teaching of phoneme-grapheme relationships separate from the prescribed word box instruction. In addition, each group of students (i.e., the kindergartners and the fifth graders) was instructed with the same word lists and the same phoneme-grapheme correspondences regardless of their presence or absence in the students’ repertoire. For the older students most of the relationships were already established, albeit often confused or mispronounced, so this is consistent with previous research (Joseph, 2004). However, for the kindergartners, the majority of the phoneme-grapheme relationships were unknown. Prior to instruction Michael and Ellie each knew 6 of the 16 phoneme-grapheme relationships (i.e., 38%) to be utilized during instruction and Michael knew only 1 (i.e., 6%). By the end of intervention, they learned all 16.

**Kindergarten participants.** It is difficult to determine the efficiency of acquisition of phoneme-grapheme relationships between this study and the methods used in previous research studies. For this study, it required between 6 and 10 sessions for the kindergartners to reach mastery for Letters (i.e., range: 2 hours–3 hours and 20 minutes of instructional time). Care was taken during this intervention not to overwhelm the students with too much information at one time. The phoneme-grapheme relationships presented to the kindergartners were limited to the initial 16 recommended by Adams et al. (1990). Similar short vowels (i.e., /i/ & /ɛ/) and /ð/ & /ʊ/) were separated, and initial continuous consonants were presented before stop sounds. Despite these efforts, short vowels caused the greatest difficulty; however, this is expected and consistent with
previous research findings given the elusive nature of the short vowels. In fact, Shankweiler and Liberman (1972) found when reading, students made twice as many errors with vowels as they did with initial and final consonants combined.

Difficulty with short vowels was even more problematic when spelling than during Letters instruction. The grapheme cards provided extra support so the student did not have to remember the correct grapheme, but rather only discriminate between the two vowel choices presented with each word (i.e., one correct response and one distractor). This appears to have been an important scaffold for the students.

The biggest benefit of Letters instruction was not the establishment of specific phoneme-grapheme correspondences, but rather the acquisition of the alphabetic principle. This was apparent with Ellie on the third day of instruction with Letters when in the middle of a word she stopped working, and said with excitement in her voice, “Hey, this is like a pattern.” Her “aha moment” was very evident; Ellie had acquired the alphabetic principle! Although the development of the alphabetic principle is likely a more gradual process than this sudden discovery (Gough, 1996), it highlights the importance of understanding the code.

This understanding is in stark contrast to baseline performances where all three kindergartners scrambled the grapheme cards and randomly placed them in the boxes, often beginning with the two corners and then filling in the middle. It is possible that learning the combinations concurrently may have made the alphabetic principle more transparent compared to the more gradual acquisition of phoneme-grapheme correspondences.
**Fifth grade participants.** Research strongly supports introducing letters to phonemic awareness training as soon as the students are ready (Moats, 1990; Shuele & Boudreau 2008). Letters provide a concrete place to attach the phonemes (Hohn & Ehri, 1983). However, for students with poor visual memories, letters can add confusion because older students and adults typically rely heavily on orthography when reading or spelling (Lehtonen & Treiman, 2006). For this reason, nonsense words following the phonetic patterns being taught were used throughout intervention. Although the fifth graders occasionally related the nonsense word to a known word, they quickly responded to segmenting with letters. Three students (i.e., Aaron, Joy, and Evan) completed Letters after only 4 sessions (i.e., 1 hour and 20 minutes of instructional time). Rachel needed considerably more practice (i.e., 10 sessions) because she struggled to remember which graphemes represented the correct vowel combinations, especially differentiating between long and short vowels (e.g., e or ee for /æ/). Although Rachel experienced the greatest difficulty, vowels proved the most challenging of the phoneme-grapheme correspondences for all the fifth graders, similar to the kindergartners, and consistent with previous research findings (Fowler, Shankweiler, & Liberman, 1979; Post, Swank, Hiscock & Fowler, 1999).

What is the effect of the word box intervention on each student’s spelling skills, as measured by the number of words spelled correctly on 9-word nonsense word probes [both populations] and as determined by the AIMSweb measure of Spelling [fifth grade only]? Spelling was an area of difficulty for all the participants in this study. Spelling appears even more closely tied to phonological skills than learning to
read (Nation & Hulme, 1997) so measures of spelling improvement should provide important insight into changes in phonological knowledge and skills.

**Intervention probes.** The findings demonstrate a functional relation between the word box intervention and all participants’ spelling of nonsense words utilizing the phoneme-grapheme correspondences instructed. Although Rachel did not finish intervention, there was an upward trend and change in level after the spelling intervention was initiated.

In addition to comparing performance across skills for each individual, the design utilized for this study also included a comparison of skills across participants. This was done so experimental control could be evidenced even if induction occurred. It was anticipated that explicit instruction in segmenting and letter-sound correspondences would likely result in elevated spelling scores prior to specific instruction in Spelling. A notable change in Spelling baseline levels after Letters instruction occurred for Ellie, Matthew, and Aaron. A slight change in level was evident for Michael and Rachel with continued variable baselines for Tim and Evan. Although Michael’s baselines scores were not significantly higher, his later baselines spellings more closely resembled the correct response (e.g., initial spelling probe for *mef* was *lill* compared to baseline; after Letters Michael spelled *sud* as *sudd*). Joy’s baseline remained at 0. This suggests that about half the students may have generalized their improved phonemic skills into their spellings prior to explicit instruction, all three kindergartners but only one fifth grader. It is probable that this is an example of students without disabilities applying learned skills to novel activities far better than students with disabilities, or possibly the treatment
resisters, who often need explicit instruction to make that transfer (Al Otabiba, 2001). However, Aaron does not fit this pattern because induction occurred for him, and he had been identified with a learning disability.

As mentioned above, vowels proved the most difficult phoneme-grapheme relationships for the students to master. The difficulty experienced during Letters also existed during Spelling despite the previous practice with the same phoneme-grapheme correspondences. Errors on maintenance probes were almost exclusively vowel mistakes. Maintenance data for Spelling were the most varied and lowest of the three skills. In addition, maintenance scores improved over time, especially for Tim, with the highest maintenance score occurring as the final data point for four of the six participants with post-intervention Spelling data. It is possible that this trend could simply be the result of the level of difficulty presented in the final probe (i.e., more of the known vowel patterns were present); however, each student was administered a different probe. Another possibility is the additional time between probes resulted in more practice opportunities and therefore more correct responding. This definitely seemed to be the case for Michael as he struggled to differentiate between /õ/ and /ũ/. With additional practice his maintenance scores increased. Along those same lines, post-testing occurred in close proximity to the final probe for the students entering intervention later, and therefore more practice did occur.

One possible change that could be incorporated to address this issue is to include more vowel practice into the word box intervention. One way this could be accomplished during Letters is after a correct response, the vowel in the presented word could be
replaced with a distractor and then the student reads the new word. Similarly, during Spelling, after a correct response the vowel could be replaced with a different vowel and the student then reads the new word.

**AIMSweb probes.** In addition to the changes in spelling observed during intervention, spelling skills for the fifth graders were also assessed using a secondary measure, the AIMSweb spelling probes. The two-minute timed spelling task was administered pre- and post-intervention and prior to entry into each new skill. AIMSweb spelling word lists from fifth grade were administered to all fifth graders (see Table 8) and then an additional timing was completed with a spelling list at the students’ current reading level (see Table 9), as measured by the Woodcock Tests of Reading Mastery. All students scored at the second grade reading level, with the exception of Joy who was reading at the fourth grade level.

Spelling scores showed considerable variability. Although all students demonstrated an upward trend, scores remained well below the spelling level expected of fifth graders. Four of the participants (i.e., Aaron, Tim, Rachel, and Evan) began intervention with spelling scores from below the 1st percentile to the 3rd percentile. Spring Benchmarks only rose slightly with a range from the 1st to the 5th percentile. Joy’s percentage was virtually unchanged. This suggests that the students did not make much gain relative to their peers; however, they did not fall further behind.

When comparing the fifth grade scores to the reading equivalent scores, the reading equivalent scores for the students performing at the second grade level (i.e., Aaron, Tim, Rachel, and Evan) were more variable and showed greater gain (range 9%–
45% between benchmarks) than their fifth grade performance. This is expected because the second grade words more closely resembled the spelling patterns explicitly taught during intervention. There was still considerable variability however, given that many words presented during the timings did not follow the instructed phonetic patterns.

The most telling aspect of the AIMSweb scores is just how far behind these students still remain. From a positive perspective, it show these students have the potential to make progress; however, to narrow the huge achievement gap compared to their peers, intensive intervention needs to continue. This intervention is just a first-step designed to lay a foundation; however, it will be of little value if intensive remediation is not continued. Torgesen (2000) suggests that in order to significantly reduce the number of students that struggle with literacy, systematic sequential instruction needs to be continued well beyond the year or two of remediation typical in school settings.

**Secondary Dependent Variables**

*What is the effect of the word box intervention on each student’s segmenting fluency, as determined by the AIMSweb measure of Phonemic Segmentation?*

**Fluency (PSF)?** Segmenting was the key skill targeted throughout the word box intervention and significant gains were observed on the students’ ability to fluently segment words into their individual phonemes. Stahl (2004) defines reading fluency as the combination of speed, accuracy and prosody explaining that reading fluency begins by students integrating knowledge of sound-symbol relationships that develop through acquisition of the alphabetic principle. This begins with fluent phoneme segmenting
skills. All eight students improved dramatically in both their speed and accuracy of segmenting as soon as Counters was introduced.

This sudden increase in segmenting skill was clearly observed for all three kindergartners (see Figure 14) upon introducing Counters. Although these students began intervention well below their kindergarten peers, scoring between the 10th and 12th percentiles, all three students were at or above the 50th percentile after Letters instruction and the upward trend continued throughout intervention. Spring Benchmark scores placed Michael and Ellie at the 82nd and 94th percentiles, respectively. It is unclear why both students declined for the final timing, possibly because it was the end of the school year; however, even despite the final decrease the kindergartners demonstrated significant increases in their segmentation fluency and moved from being at risk, to average or above average compared to the kindergarten population.

Because PSF is considered an early literacy skill, it is only normed through first grade so comparisons like those made for the kindergarten students are not possible for the fifth graders. However, analysis of their PSF scores show a steep, ascending trend upon initiating Counters, similar to that observed with the kindergartners. Fluency scores increased from Winter Baseline to Spring Baseline by as much as 111% for Tim. Evan, who began intervention with the strongest segmenting skills of the fifth graders, made the smallest gains but still increased by 44%. Aaron was the only fifth grade participant who continued to increase in fluency after intervention. He also had the greatest length of time between ending intervention and his final PSF timing (i.e., over 2 months). The other fifth graders remained near intervention levels.
What in the effect of the word box intervention on each student’s understanding of the alphabetic principle, as demonstrated by his/her fluency on the AIMSweb measure of Nonsense Word Fluency (NWF)? The Nonsense Word Fluency task is part of the AIMSweb Early Literacy Measures for kindergartners and first graders. NWF is considered a purer measure of decoding skill and phonological processing because it is less affected by students’ vocabularies (Wagner et al., 1999); it is used as the decoding measure on many standardized tests (e.g., Weschler Intelligence Scale for Children-III, Woodcock Tests of Reading Mastery). However, for the AIMSweb NWF task students are given the choice of either decoding the whole word or just saying each individual sound in the CVC nonsense words. Credit is given for each correct phoneme verbalized within the one-minute timing.

All eight participants demonstrated variable yet steady gains in NWF throughout intervention and maintenance. With the exception of Aaron who maintained post-intervention, the other students all continued to increase their word fluency even after intervention ceased. The important accomplishment, however, was not the increase in the number of sounds spoken, but more importantly, all eight students began intervention naming the individual sounds but finished reading the whole nonsense word. Although reading was not explicitly taught during intervention, it appears, for all eight students, they generalized their phonemic knowledge to whole word reading. That was the goal of this intervention.

When first presented with the NWF task prior to intervention, all eight students said they could not read the words and therefore named the sounds. It is exciting that all
of the students had the confidence to decide on their own to read whole words. The directions remained the same each time the task was presented so the students were never explicitly asked to read the words, but rather they made the choice to do so. This is remarkable considering the two groups of students entering intervention, kindergartners lacking decoding skills and fifth graders who found reading very aversive.

What is the effect of the word box intervention on each kindergartner’s letter naming skills, as demonstrated on the AIMSweb measure of Letter Naming Fluency (LNF)? Letter names were not emphasized in this study. In fact, phonemes were emphasized almost to the exclusion of letter names; therefore, significant gains in letter naming fluency would not be expected and the only significant increase in LNF occurred for Matthew. Matthew began intervention at the 62nd percentile for LNF and was well beyond that for his final timing just prior to moving (see Figure 12). Michael and Ellie began below the 50th percentile (i.e., 30th and 18th percentile, respectively). Michael demonstrated a minor relative decrease, while the gap narrowed slightly for Ellie at the end of intervention (i.e., Spring Benchmarks) with scores at the 26th and 29th percentiles, respectively. It was difficult, however, to determine Ellie’s actual letter naming speed because at some point on every trial she stopped naming the letters and interjected a comment about the letter or the letter combinations. When prompted she would return to letter naming.

What is the effect of the word box intervention on each kindergartner’s letter sound identification, as determined by the AIMSweb measure of Letter Sound Fluency (LSF)? All three kindergarten participants entered intervention with limited
letter sound knowledge placing them well below the 50th percentile (range 6th–13th percentile) and in the “at risk” category (see Figure 13). Their scores remained stable until the introduction of letters when phoneme-grapheme relationships were instructed and scores increased dramatically for all three students. Michael continued this trend through the final maintenance timing placing him well above the 50th percentile at the end of the school year. Matthew’s data were following a trajectory similar to Michael; unfortunately the final two timing were not possible because of Matthew’s moving. Ellie’s scores declined for the final two timings. As mentioned above, it was very difficult to accurately measure Ellie’s fluency because her off-task behavior made scores inconsistent and difficult to interpret.

**Pre- and Post-test Measures**

Two standardized measures (i.e., the Comprehensive Tests of Phonological Processing [CTOPP] and the Woodcock Reading Mastery Tests [WRMT-R]), were administered as pre- and post-test measures. The CTOPP was administered in its entirety and the Word Identification and Word Attack subtests of the WRMT-R were utilized in this study. In addition, the AIMSweb Oral Reading Fluency benchmarks were included as a measure of changes in reading fluency.

**What is the effect of the word box intervention on each student’s phonological processing skills, as determined by the Comprehensive Test of Phonological Processing (CTOPP)?** The subtest scores on the CTOPP are combined to yield composite scores in phonological awareness, phonological memory, and rapid naming. These three skills represent the three kinds of phonological processing and a
deficit in one or more of these abilities are the most common cause of reading disabilities (Wagner et al., 1999).

Prior to intervention, all five fifth grade participants demonstrated considerable weakness in phonological awareness with a range in composite scores from below the first percentile (i.e., Aaron and Rachel) to the eighth percentile (Joy and Evan). In addition, they all demonstrated weakness is at least one other phonological processing area. This helps to explain why literacy is such a challenge for these students.

The pre-intervention scores for the kindergartners were considerably higher than the fifth graders; however, kindergartners are not expected to possess strong phonological skills early on so much less is required to obtain a higher score (e.g., even if a kindergartner cannot blend any sounds he earns a score at the 16th percentile because 16% of kindergartners also lack that skill).

Post-test scores revealed significant gains in phonological awareness for all seven participants tested. No post-test data were available for Matthew due to his sudden transfer to a different community and school. Phonological memory and rapid naming were not targeted during this intervention and post-test scores were mixed in both of these areas. For the kindergartners, phonological memory scores decreased slightly for Michael but showed a small increase for Ellie; both students increased in rapid naming speed. Phonological memory scores increased for three fifth graders (i.e., Aaron, Rachel, and Joy) but decreased for two (i.e., Tim and Evan). Rapid naming decreased for three fifth graders; Tim’s score increased, and there was no change for Evan.
The variability in scores may be a combination of inconsistency in the students’ performance along with test measures that are of short duration and could likely vary from day to day. This variability displayed with these skills also help emphasize how significant the increases in phonological awareness were as students’ demonstrated gains of up to three standard deviations. This moved students from significantly below average to the average range, or in the case of the kindergartners, from the average to well above average range. These scores also help to dispute the notion that phonological processing is an innate skill that cannot be changed (Wagner et al., 2003), and supports previous research demonstrating the phonological awareness gains possible when explicit, systematic instruction is implemented with fidelity (Greene 1996; Kitz & Nash, 1992; Swanson et al., 2005).

**What is the effect of the word box intervention on each student’s basic reading skills, as measured by (a) the Word Attack and Word Identification subtests of the Woodcock Reading Mastery Test [both populations] and the (b) AIMSweb measure of Oral Reading Fluency (ORF) [fifth graders only]?** Word reading was not explicitly targeted in this intervention. Students read the word after a correct response; however, students were not required to independently decode words because an auditory prompt was always provided with the word to spell prior to their reading the word.

**Word Identification and Word Attack.** Prior to intervention, none of the three kindergartners could decode any of the nonsense words on the Word Attack subtest and Ellie was the only kindergartner who could read any of the words on the Word Identification subtest, correctly reading four words. Both kindergartners post-tested
demonstrated an increase in word reading ability; however, many of the words on the Word Identification subtest were sight words or included patterns not taught in this intervention so gains were not that strong. In contrast, scores improved significantly on the Word Attack subtest for both students, who began intervention unable to decode a single word, ended at the 79th and 85th percentile for decoding ability post-intervention.

Much smaller gains were observed on both subtests for the fifth graders. This is likely because many of the words on the Word Identification subtest were sight words and both subtests included phonemic patterns not taught as part of this intervention (e.g., /oo/, /igh/, /ie/). Also, when the older students came across words they did not know they were very quick to say they couldn’t read the word or used the first letter to make a guess; this is consistent with their learning history and everyday reading performance.

AIMSweb Oral Reading Fluency probes. Although reading fluency was not targeted during intervention, significant gains were demonstrated for all five fifth graders. Gains were stronger for current reading level (i.e., 2nd grade for everyone except Joy who read at the 4th grade level) compared to the fifth grade benchmarks. This is to be expected given the words in the second grade passages are more likely to include those that could be decoded using the skills taught in this intervention. However, strong gains were made for all participants across both reading levels, with the exception of Aaron who was unchanged on the fifth grade measure. Caution needs to be used when analyzing these results however, because reading fluency was a goal on the students’ IEPs so it is difficult to determine how much of the gain was due to this intervention or possibly intervention
outside of this study. However, Joy did not have an IEP and did not receive additional instruction, and she still demonstrated a 20% increase in oral reading fluency.

**Inter-group Comparison**

Research abounds on phonemic awareness development in the emergent reader; yet, very limited research exists on improving phonemic awareness skills in older, struggling readers. This study sought to compare phonemic awareness acquisitions between these two populations.

**How does the acquisition of phonemic awareness compare between the at risk emergent readers and the older, struggling readers?** Comparisons of emergent readers and older, struggling readers are difficult to make given the varied learning histories of the two populations and the small groups included in this study. The older, struggling reader often possesses more advanced skills in some areas, yet has gaps in prerequisite skills already in the repertoire of the emergent reader (Hock et al., 2009).

These comparisons become even more difficult for this study given the limited number of participants and the disparity in cognitive and phonological processing ability between the two groups of students. Cognitive ability was never measured for the kindergartners; however, it is probable that their cognitive scores may be higher than the fifth graders given that the fifth graders’ cognitive range was from 65 to 88 (i.e., roughly the lowest 20% of the population). Caution must be exercised, however, when analyzing cognitive scores because other factors (e.g., learning history, language skills, cultural background) may negatively impact students’ cognitive scores, resulting in cognitive scores considerably lower than the students’ true learning ability. Regardless of the
difference in cognitive ability, pre-test data also suggested a considerable difference in phonological awareness skills with the kindergartners’ scores well above the fifth graders on a relative basis. Although measures of phonological awareness and reading skills were found to be related independent of overall cognitive ability (Wagner & Torgesen, 1987), these differences certainly make comparisons difficult and should be viewed with extreme caution.

Despite this, certain patterns did emerge between the two groups of students. In particular, the older students entered intervention with a history of learning failure. Although the kindergarten students labeled themselves as “poor readers,” the older students were well aware of their limitations and were at times very quick to respond that they could not perform a certain skill. In fact, Aaron and Tim demonstrated behaviors indicative of wanting to withdraw from the intervention early on because they became frustrated and defeated commenting, “This is useless. I can’t learn anyhow.”

This is in contrast to the younger students who were quicker to pick up the new skills and very excited about what they were learning. For the kindergartners, it was also much easier because they could apply the skills and be successful immediately. The early literacy skills taught during intervention were likely similar to, or pre-requisite for, skills being taught and utilized in the kindergarten classroom. These skills were likely reinforced and practiced during school. For the older students, however, the skills they were developing during intervention were much more basic than the daily work expected in the classroom, and therefore it was more difficult for the fifth graders to see much progress in their day-to-day work. It was not until the fifth graders moved into Spelling
that they really felt positive about the gains they were making. This stresses the importance of providing the older students with instruction at a level that allows them to experience success and therefore not become frustrated. Quirk and Schwanenflugel (2004) stress the importance of providing struggling readers with basic reading skills at the appropriate level, thereby improving motivation and creating the desire to learn more. This requires “buy in” from these students regarding how this intervention will help them in the future. They have experienced past failure and therefore need to be convinced that this intervention will lead to better outcomes than their past experiences. Occasional reminders of the progress the students have made during intervention is also helpful in promoting positive outcomes.

Also, the fifth graders entered intervention with a history of errors so some learning patterns needed to be corrected before students could experience success. This was very evident when attempting to remove the schwa from the end of phonemes. Although present with both groups of students, the older students took considerably more repetitions before experiencing success. Similarly, the fifth graders also possessed faulty visual memories that they tried to rely on when attempting to spell words. Even with the nonsense words, this caused difficulty. It is important, therefore, that interventions, especially those designed for students with learning disabilities, supply ample opportunities for correct responding along with immediate feedback so errors can be minimized (Viel-Ruma, Houchins, & Fredrick, 2007).

In addition, these examples also stress the importance of early intervention and teaching with fidelity so students do not make the errors in the first place. Early
intervention is critical in helping students achieve greater success in reading and other academic areas; it is much more efficient to spend the time necessary to work on prevention than spending the many hours required to remediate students diagnosed with learning disabilities (Heward, 2013). In addition, it is much more advantageous for the students, both in terms of academic success and other school related behaviors (e.g., truancy, completing assignments, class participation).

Social Validity

Assessing social validity is important in determining the appropriateness and significance of an intervention in terms of its goals, procedures, and outcomes (Wolf, 1978). Social validity data help determine the likelihood of the intervention being utilized in the future. It is important that all those involved with the intervention find it practical and beneficial, thereby increasing the chances it will be utilized in the future.

How do the participants and their teachers perceive the word box intervention and its effect on the students’ literacy skills? Students responded to a questionnaire asking about their opinions on the effectiveness of the intervention and how well they liked using word boxes. No formal responses were asked of the teachers and administrators; rather, responses were collected from post-intervention meetings along with comments throughout the intervention.

Participants. Overall, the participants found the intervention beneficial; however, caution must be exercised when interpreting these results because the interventionist read the questions to the participants and was present as each student filled out the questionnaire. It is therefore possible that the results may be inflated because the students
wanted to please the interventionist. However, the responses given by the participants seemed closely aligned with their behaviors and comments during intervention.

The responses to the questionnaire were similar for the kindergartners and the fifth graders. All the students agreed that they could spell more words as a result of the intervention and they would continue to sound out words when reading and spelling. Results were mixed regarding how much the intervention improved their reading skills. One fifth grader, Evan, was unsure how much his reading improved and Ellie, a kindergartner, checked no and said, “I still can’t read very good.”

All of the students reported they like using word boxes, except for Aaron and Tim who checked maybe. They both commented that they “liked part of it but some of it was really hard.” This is understandable considering the frustration they both experienced with counters. All of the students felt words boxes are a good way for students to learn to sound out words, but Michael checked maybe because he said he liked it but he couldn’t answer for other kids because he didn’t know if they would like it or not.

**Teachers.** Although no formal questionnaire was presented to the teachers or administrators, during the post-intervention meetings at both schools the feedback was very positive regarding student acceptability and overall effectiveness of the intervention. The kindergarten teacher reported that the intervention was the “highlight of the students’ day.” Similarly, the fifth grade teachers commented that their students were disappointed on the days they were not picked up for intervention. It is unclear how much the students’ disappointment was due to missing the intervention, or because they were being excused
from a difficult science class. However, Joy gave up her lunch recess throughout the study to participate.

Regarding intervention effectiveness, the fifth grade teachers and the school psychologist were particularly interested in the gains made during the intervention, and excited to add the results to the students’ files. The kindergarten teacher commented that she could see big differences in the students’ skill levels. In particular, she was pleased with the impressive gains Ellie made because Ellie struggled to progress during whole class activities. The elementary school principal commented that she noticed a “real turnaround” in the participants both in terms of academic gains and their desire to pick up books and engage in literacy activities. Although somewhat reluctant about researchers in her school prior to beginning the intervention, the principal invited and encouraged us to continue research at her school next year.

Limitations

In addition to the delimitations discussed in Chapter 1 (i.e., single-subject design, limited number of participants, use of nonsense words), several other limitations exist. In particular, probes were constructed by randomly selecting three words from each of the three word lists for each population. Although random selection is important, this made it impossible to equalize the specific phoneme-grapheme relationships present for each probe and thereby resulting in probes of varying difficulty for different students. For example, Michael struggled to differentiate /ö/ and /ü/. On one 9-word probe, Michael could have encountered three /ö/ and two /ü/ probes, yet another probe may not have contained either of these vowels on any of the words presented. This could lead to
considerable variability on scores. Although this did not seem to present much of a problem during intervention, it did explain some of the variability in maintenance scores, especially for Michael.

Along these same lines, the mastery criteria set for this intervention was not very stringent. To meet mastery criteria students were only required to complete the first three word lists along with two consecutive scores of 8 or 9 on the probes. This allowed some students to move through tiers rapidly, possibly prior to truly mastering the skill especially given the variability in the phoneme-grapheme relationships presented within the probes.

Similarly, the probes were generated from the same word lists used during intervention. This was done because of the limited number of possible VC and VCV nonsense word combinations, especially for the kindergarten participants. This allowed for the possibility of a word used during instruction also being presented as a probe on the same day. Given the large number of words this occurrence was rare, although it did occur on several occasions.

Finally, this intervention occurred over the second semester of the school year. Given the design across participants, students’ entry into intervention was staggered. Therefore, some students did not enter intervention until later in the school year. This resulted in Rachel’s inability to finish the intervention and limited the number of maintenance probes, along with the length of time maintenance data were collected.
Research Implications

The most important finding in this study is that phonemic awareness gains were made with all eight participants, including the older students who entered intervention with very limited phonemic awareness skills. This is consistent with other studies (e.g., Bhat et al., 2003; Guyer & Sabatino, 1989; Swanson et al., 2005) demonstrating that phonemic awareness gains are possible with older, struggling readers and these gains lead to improved literacy skills. This is contrary to Wagner et al. (2003) who purport phonological skills remain relatively coherent and stable over time. This study demonstrated that phonemic awareness skills can be improved, even in older students with limited prior success, and it is important that researchers and practitioners realize the importance of phonemic awareness and focus on research-based practices for students extending beyond the second grade.

Along the same lines, research also suggests (Al Otabiba, 2001; Moats, 1999; Torgesen, 2000) that some students (i.e., treatment resisters) require instruction of increased duration and intensity to experience success. Therefore, further research needs to examine more closely which components were most beneficial and the amount of practice necessary for the more resistant students to experience success.

Further research specific to word box interventions could focus on word box use in different instructional arrangements and with different populations. This could be accomplished with experimental studies utilizing small group and whole class instruction as well as expansion of the population of participants, including adults struggling with literacy.
Mastery of vowels, short vowels in particular, have proven problematic for many students, especially those with learning disabilities. This was certainly the situation during this intervention. Future research could investigate ways to efficiently add additional practice with short vowels into the word box intervention to improve mastery and maintenance with short vowels.

Similarly, it would be enlightening to analyze acquisition of phoneme-grapheme relationships and how best to present this material. This study presented multiple new relationships at once; students seemed to respond well. Previous word box studies focused on practice with phoneme-grapheme relationships learned outside of word box intervention with the word box not used to teach the relationship, but rather to solidify it. It would be interesting to compare the efficiency of acquisition and maintenance of the relationships between the two methods to determine the most effective way teach phoneme-grapheme relationships.

Along the same lines, this study implemented nonsense words to teach the phoneme-grapheme relationships. This was done in an attempt to minimize visual confusion for the older students. Future research could compare the use of nonsense words versus real words in terms of skill acquisition and also generalization of skills to untaught words.

Finally, future research could take a longitudinal look at how to increase the phonemic awareness skills developed in this study and continue to progress students into phonics and more advanced language knowledge. The goal should be to develop an
appropriate curriculum specific to older, struggling readers in an attempt to determine an efficient program that could be used on a large scale for this population.

**Implications for Practitioners**

Clear evidence exists that even beyond elementary school, phonological awareness instruction results in improved performance on phonological awareness and decoding tasks (Guyer & Sabatino, 1989; Royer et al., 2004). However, questions still remain as to the practicality and feasibility of teaching these skills to older, struggling readers given the limited instructional time and these students’ many academic needs.

Word boxes provide teachers with an effective, time efficient way to teach phonemic awareness to both emergent readers and older, struggling readers. The word box with counters provides a concrete means to learn elusive phonemes and the addition of graphemes encourage development of the alphabetic principle. The program can be done individually, with small groups, or even as whole group instruction in only a few minutes per day. This is consistent with the National Reading Panel’s recommendation of brief sessions of phonological awareness training. This also allows for word boxes to be used as a sponge activity when there is a few remaining minutes of instructional time or at the beginning of instruction as a warm-up activity. Word boxes can also be used in a peer tutoring format (Joseph, 2002b) or as a partner activity provided sufficient supervision is available to ensure students are not practicing errors.

Once initial segmentation and phoneme-grapheme relationships have been established, the word box format also allows for teaching more complex combinations, along with extension into phonics, and instructing language rules (e.g., *g* says /j/ when
followed by e, i, or y). The model-lead-test format is an evidence-based practice found to be efficient and effective when implemented with fidelity. Using a familiar format is beneficial because the students are familiar with the routine so no instructional time needs be spent teaching an alternate format.

Another big advantage of word boxes is that they are very economical to create and use. Card stock can be laminated to provide a very durable word box for each student in the group or a classroom. Poker chips work well as counters and grapheme cards can be added as students gain knowledge of sound-symbol relationships. Word boxes can be easily stored in a notebook or desk, and are easily individualized. Students respond positively to the word box instruction, seeming to enjoy using them.

Regardless of the method used to teach phonemic awareness, it is critical that the program is implemented with fidelity. For phonemic awareness instruction this includes teaching “pure” sounds without an added schwa. The difficulty students experience when not taught the correct pronunciations was very evident in this study with the older, struggling readers. Although both the kindergartners and the fifth graders made pronunciation errors at the beginning of intervention, the younger students’ mispronunciations were quickly remediated. However, for the older students this was not the case. It took many, many repetitions to correct, and these errors not only impacted their success with this intervention, but more importantly it severely impacted the students’ school success, especially their ability to read and spell. This serves as an excellent example of the importance of proper instruction. For the skilled learners, they
can often succeed in spite of teacher error; however, for students with disabilities, or treatment resisters, instruction implemented with fidelity is paramount.

Another component of effective instruction is providing sufficient repetitions until mastery is demonstrated. This is extremely important when teaching short vowels. Short vowels are often difficult for students to master, even for more skilled readers. For students with disabilities, short vowels can be exceptionally challenging. It is important that teachers provide sufficient practice opportunities when introducing a new vowel, along with incorporating judicious review and practice with the sounds previously taught.

During this study, although an attempt was made to separate the introduction of similar vowels (e.g., /u/ with /e/, and /o/ with /u/), new phoneme-grapheme relationships were presented quickly and vowel confusion did occur, especially for the emergent readers. In particular, /o/ and /u/ were most frequently confused. In the classroom, providing lots of practice opportunities and following the appropriate scope and sequence (i.e., interspersing vowels with consonants), while emphasizing short vowels can help diminish the confusion. Discrimination activities with previously mastered vowels can later be added to help secure the more difficult phoneme-grapheme combinations. Additionally, it is important not to give up if students struggle to master short vowels. Success will come; it just may require instruction of greater intensity and/or of a longer duration.

During instruction, whether with vowels or any other type of academic task, it is important for teachers to monitor students’ progress to determine if students are mastering the skills being instructed. Frequent data collection is paramount in
determining if a change in instruction is necessary, or perhaps pinpointing those students needing additional practice with a particular skill while determining that others are ready to tackle a new skill. Progress monitoring should be conducted not only for the specific skills taught, but also as a more general measure of academic progress. AIMSweb probes were utilized during this intervention to determine how specific skill development impacted students’ overall literacy skill level. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) are another early literacy progress monitoring measure available to teachers free of charge. Both of these progress monitoring tools provide valuable and necessary information for teachers regarding students' progress of reading skills both on an individual level and also as a comparative basis for creating both short- and long-term reading goals for students and whole classrooms.

Nonsense words were used in this study to teach phoneme-grapheme relationships. This was done in an attempt to minimize the visual confusion older students often experience as they attempt to use their previous visual knowledge to segment and spell words. Although nonsense words are recommended for older students with less successful learning histories, it may have limited the ability of all the students to generalize their knowledge to other words. Therefore, using common phonetic VC and CVC words for instruction with emergent readers seems like the logical choice, and will likely maximize teaching efficiency. Not only will the students learn segmenting and phoneme-grapheme relationships, they will increase the number of known words and perhaps more easily generalize their alphabetic knowledge to other words utilizing similar phonetic patterns.
Developing phonemic awareness is extremely important; yet still only the beginning of the journey toward becoming a fluent reader and writer. Reading and spelling acquisition are very complicated processes, requiring mastery with multiple skills to be successful. Educational programs, especially for treatment resisters must “hold the course,” use systematic, explicit instruction that follows the appropriate scope and sequence through the skills (i.e., phonemic awareness, phonics, fluency, comprehension, vocabulary) needed until students develop those to a degree that allows them to be successful. As suggested by Blachman (1994), we must focus on duration, intensity and timing of treatment, along with the best combination of instructional components to experience success with the most challenging population of learners, treatment resisters.

Conclusion

Skills in reading and writing are critical in today’s society. Development of the alphabetic principle is key in literacy development and is contingent on efficient phonemic awareness skills. Considerable research exists on the development of phonemic awareness in the emergent reader, yet there is a dearth of research regarding its development in older, struggling readers. Therefore, the purpose of this study was to compare the effects of a word box intervention designed to promote phonemic awareness on the phonological, reading, and spelling skills of two groups of students: (a) three kindergarten at risk emergent readers; and (b) five fifth grade students struggling with reading and spelling (i.e., treatment resisters).
The results of this study suggest the word box intervention was effective in increasing segmenting, letter-grapheme correspondences, and spelling skills for all participants. Specifically, a functional relation was demonstrated for all eight participants individually, and across both groups of students. Increases in skill level maintained for all participants, with maintenance levels at or above intervention levels demonstrated up to two-months post-intervention.

The gains made by the students in this intervention were very positive and encouraging; however, the true goal of this intervention was not the immediate improvement of students’ reading, and spelling skills, but rather, the real benefit is derived from developing a foundation that enables students to better understand and utilize the alphabetic system. The desire is for the students to understand the code and use that knowledge henceforth, continuing to develop and grow their understanding of the alphabetic nature of the English language. For the kindergarten participants, hopefully the gains made during this intervention will provide the foundation needed to continue to grow into proficient readers and writers. The challenge is far greater for the fifth grade participants. The gains made for these student will be of little value unless explicit, systematic instruction in letter patterns and phonics continues. This remediation needs be continued with the duration and intensity needed until the basic literacy skills become automatic, a goal that must be reached for all students, including treatment resisters.
References


Appendix A: Principal Permission Letter
Participation in Educational Research

Provided that prior consent has been provided by the parents and approval has been granted by The Ohio State University’s Institutional Review Board, I will allow the researcher(s), Moira Konrad and Susan Keese, to study the effects of word box instruction on the phonemic awareness skills of older students struggling with reading.

I understand this study will involve emerging readers from Northwood Elementary, as well as fifth and sixth grade students with deficits in reading and spelling from Creekview Intermediate. Students who qualify will participate in lessons that will last no longer than 30 minutes and will be delivered in a one-to-one teaching format. Lessons will take place 4 – 5 days per week over a period of 10 to 20 weeks.

I understand that the student’s identity will not be revealed in any publication, document, or any other form of report developed from this project. Additionally, I understand that I may withdraw consent for my school and students’ participation at any time without penalty.

Tim Kannally, Principal
Creekview Intermediate
Marysville Exempted Village School District

Our Mission: To effectively and efficiently provide learning opportunities that challenge all students to realize their maximum potential.
Appendix B: Parental Permission Form
February 2, 2012

Dear Parent/Guardian:

We are writing to you to ask your permission to include your child in a study that he or she might benefit from participating in. Students included in our study need help with their reading and spelling skills.

The purpose of this study is to determine the effectiveness of word boxes in developing students’ ability to break words apart into individual sounds so that they can better read and spell them. The lessons will be taught by an OSU graduate student in a one-to-one teaching format. Your child will not miss any required activities at school.

As part of the process, we would like to look at your student’s educational records, specifically his/her most testing results, and if available, the most recent IEP and evaluation team report (ETR) for achievement test results and goals and objectives in reading and spelling.

To determine if this study is a good fit for your child, a screening session of less than 20 minutes will be completed to determine if he/she meets the eligibility criteria. It is important that only the students who meet eligibility requirements be included so those participating have the best chance of making significant gains. We will only be including eight students in the study, so if more than eight have permission and meet eligibility, we will randomly select eight to participate.

Attached are two copies of Ohio State University’s required parental permission form. We realize that this permission form can be overwhelming, so if you have any questions, please do not hesitate to call or email one of us. If you want your child to participate in this study, you should read the consent form and return a signed copy within a week in the envelope provided and keep the second copy for your records. After the study is completed, we will be happy to share the results with you.

Sincerely,

Moira Konrad, Ph.D.  
Associate Professor  
konrad.14@osu.edu  
614.292.0839

Susan Keesey, M.A.  
Ph.D. Student  
keesey.8@osu.edu  
740.972.3438

Enclosures:
- 2 copies of Parental Permission Form for Child’s Participation in Research
- 1 return envelope
The Ohio State University Parental Permission
For Child’s Participation in Research

Study Title: Effects of Word Box Instruction on Phonemic Awareness Skills of Older, Struggling Readers and Young Children At Risk for Reading Failure

Researcher: Moira Konrad and Susan Keesey

This is a parental permission form for research participation. It contains important information about this study and what to expect if you permit your child to participate.

Your child’s participation is voluntary.

Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to permit your child to participate. If you permit your child to participate, you will be asked to sign this form and will receive a copy of the form. Please be assured that should you decide to not give permission, your relationship with the school and/or your child’s teacher will not be at all affected.

Purpose: The purpose of this study is to examine the effects of using word boxes on students’ knowledge of letter-sound correspondence. This is an important skill to acquire because it will help students sound out unfamiliar words thus expanding their ability to read and correctly spell many more words.

Procedures/Tasks:
1. Each student in the study will take the following pretests with each testing session lasting no more than 20 minutes/day over the course of one or two days:
   a. Comprehensive Test of Phonological Processing, a standardized phonological processing test
   b. Woodcock Reading Mastery Test, a standardized reading test
   d. AIMSweb Spelling – a 3-minutes standardized spelling test, and
   e. Grays Oral Reading Test 4 – a standardized reading test (only administered if students meet minimum criteria)

The purpose of these assessments is to determine the student’s current level of performance.
2. We will review each student’s individualized education program (IEP) and evaluation team report (ETR) for achievement test results and goals and objectives in reading, spelling, and written expression.

3. Each student in the study will participate in one-on-one, 30-minute instruction 4-5 days per week with a graduate student in education from OSU. Each student will progress through three skills designed to improve reading and spelling. Students will receive explicit instruction using word boxes to teach students how to break words into individual sounds, and then using that knowledge to spell and read words. A short test after each skill will be administered to be sure each step is learned before moving on to the next.

4. After the student has mastered all three skills, he/she will take the following posttests with each testing session lasting no more than 30 minutes/day over the course of one or two days:
   a. Comprehensive Test of Phonological Processing, a standardized phonological processing test
   b. Woodcock Reading Mastery Test, a standardized reading test
   d. AIMSweb Spelling – a 3-minutes standardized spelling test, and
   e. Grays Oral Reading Test 4 – a standardized reading test (only administered if students meet minimum criteria)

**Duration:** Each student’s involvement in the study will last approximately 6-20 weeks, depending on how quickly the skills are mastered. Your child may leave the study at any time. If you or your child decides to stop participation in the study, there will be no penalty and neither you nor your child will lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio State University.

**Risks and Benefits:** We do not anticipate any risks associated with your child’s participation; however, students struggling with reading and spelling may find participation in the study challenging. The graduate student will praise and encourage during lessons and will monitor students for any signs of stress and frustration. Students in this study may benefit by improving letter-sound correspondence and thereby may improve their reading and writing skills.

**Confidentiality:** Efforts will be made to keep your child’s study-related information confidential. However, there may be circumstances where this information must be released. For example, personal information regarding your child’s participation in this study may be disclosed if required by state law. Also, your child’s records may be reviewed by the following groups (as applicable to the research):
   • Office for Human Research Protections or other federal, state, or international regulatory agencies;
• The Ohio State University Institutional Review Board or Office of Responsible Research Practices.

Your child’s identity will not be revealed in any publication, document, or any other form of report developed from this project.

**Incentives:** Students will periodically receive small rewards (school supplies, stickers, or a small piece of candy) for participation.

**Participant Rights:** You or your child may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled. If you or your child is a student or employee at Ohio State, your decision will not affect your grades or employment status. Please be assured that should you decide to not give permission, your relationship with the school and/or your child’s teacher will not be at all affected.

If you and your child choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights your child may have as a participant in this study.

An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

**Contacts and Questions:**
For questions, concerns, or complaints about the study, or if you feel you have been harmed by participation, you may contact Susan Keesey at 740-972-3438 or Moira Konrad at 614-292-0839.

For questions about your child’s rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.
Signing the parental permission form

Parent: Should you choose to participate, please return signed form in self-addressed stamped envelope and send through U.S. Mail **within one week.**

I have read (or someone has read to me) this form and I am aware that I am being asked to provide permission for my child to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to permit my child to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

__________________________
Printed name of subject

__________________________  ___________________________
Printed name of person authorized to provide permission for subject  Signature of person authorized to provide permission for subject

__________________________  ___________________
Relationship to the subject  AM/PM  Date and time

Investigator/Research Staff

I have explained the research to the participant or his/her representative before requesting the signature(s) above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

__________________________  ___________________________
Printed name of person obtaining consent  Signature of person obtaining consent

__________________________  ___________________
Date and time  AM/PM  Date and time
Appendix C: Assent Script

Script for Obtaining Student Verbal Assent

• You are being asked to be in a research study. Studies are done to find better ways to teach kids.

• I am going to tell you a little bit about the study and then ask you if you would like to participate. You should ask any questions you have before making up your mind. You can think about it and talk about it with your family or friends before you decide.

• It is okay to say “No” if you don’t want to be in the study. If you say “Yes,” you can change your mind and quit being in the study at any time without getting in trouble.

• If you decide you want to be in the study, an adult will also need to give permission.

• The goal of this study is to help you improve your reading and spelling skills. If you are in this study, I will be doing a 15-minute activity with you three to five days per week. 15 minutes is about as much time as you spend outside at recess. There might be some days during the week that we won’t be able work together because I have other things that I need to do, but I will see you on Monday, Tuesday and Wednesday every week.

• Would you like to participate in the study?
Appendix D: Student Assent

**Student Assent Form**

☐ Yes, I want to be in the study.

☐ No, I do not want to be in the study.

Name ___________________________
Appendix E: Sample Word Lists
<table>
<thead>
<tr>
<th>List 1 – Green</th>
<th>List 2 – Red</th>
<th>List 3 – Blue</th>
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<tbody>
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<tr>
<td>List 1 – Purple</td>
<td>List 2 – Orange</td>
<td>List 3 – Maroon</td>
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<td>shud</td>
<td>slent</td>
<td>fopnoig</td>
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<tr>
<td>taib</td>
<td>traft</td>
<td>nifbub</td>
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<tr>
<td>feep</td>
<td>shlub</td>
<td>ligstum</td>
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<tr>
<td>tish</td>
<td>blamp</td>
<td>fipdest</td>
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<td>chust</td>
<td>feptid</td>
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<tr>
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<td>tremp</td>
<td>nemjupt</td>
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<td>flaif</td>
<td>mubstod</td>
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<td>saif</td>
<td>trisp</td>
<td>supnib</td>
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<tr>
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<td>stroimp</td>
<td>rudsain</td>
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<tr>
<td>feem</td>
<td>drampt</td>
<td>loipstug</td>
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<tr>
<td>shap</td>
<td>grest</td>
<td>sifston</td>
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<tr>
<td>soam</td>
<td>spoam</td>
<td>mumpit</td>
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<tr>
<td>shup</td>
<td>gleep</td>
<td>nisgeed</td>
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</table>
Appendix F: Procedural Integrity Checklist

Student ____________________________

<table>
<thead>
<tr>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Researcher</td>
<td></td>
<td></td>
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<tr>
<td>All required materials are present</td>
<td></td>
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<tr>
<td>Directions are clearly stated (if needed)</td>
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<tr>
<td>Correct modeling is done (if needed)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Researcher pronounces word clearly and correctly</td>
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<tr>
<td>“What is the word?”</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Student repeats word correctly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student repeats each phoneme while completing skill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct error procedure is used (if needed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probe after 4 correct responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Move to appropriate word list</td>
<td></td>
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<td></td>
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</tbody>
</table>
Appendix G: Intervention Scripts
COUNTER SCRIPT

Sue:  Now let’s work on making our sounds pure while we break words into each individual sound. To do this we are going to use counters. Listen to the word and place a counter in a square for each sound you hear. I’m going to be very picky and make sure each sound is pronounced correctly. This will make it much easier when you spell words.

I’ll start. My turn. The word is ____________. (Model by segmenting individual phonemes and place a counter for each).

Let’s try it together.

The word is ____________. What is the word?

Student repeats word. (Correct student until correct response is given).

What are the sounds in _________?

Student places counters in appropriate box receiving assistance as needed for correct responding.

If correct, move on to next example. If incorrect, return to My Turn and repeat. Complete My Turn – Together sequence until student is responding independently and correctly. Then move to independent practice.

The word is ____________. What is the word?

Repeat until student says word correctly.

Tell me the sounds in _________.

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Student moves counters while segmenting word. If correct, move on to next word. If incorrect, model with My Turn and repeat sequence until student responds correctly.

Probe after student makes four consecutive correct responses.
LETTER SCRIPT

Sue:  **Now that you know how to break words apart using counters, let’s do the same thing only this time we’ll use the letters instead of the counters to break the words apart. Just like before, make sure each sound is pronounced correctly. We’ll use the same format.**

**I’ll start. My turn. The word is ____________.** *(Model by segmenting individual phonemes and placing correct grapheme for each phoneme into correct square).*

**Let’s try it together.**

**The word is ____________. What is the word?**

Student repeats word. *(Correct student until correct response is given).*

**What letters make up the sounds in __________?**

Student chooses letters and places them in appropriate box while simultaneously saying each phoneme. Student receives assistance as needed for correct responding.

If correct, move on to next example. If incorrect, return to My Turn and repeat. Complete My Turn – Together sequence until student is responding independently and correctly. Then move to independent practice.

**The word is ____________. What is the word?**

Repeat until student says word correctly.

**What letters make up the sounds in __________?**
Student chooses letters and places them in squares while segmenting each phoneme. If correct, move on to next word. If incorrect, model with My Turn and repeat sequence until student responds correctly.

Probe after student makes four consecutive correct responses.
SPELLING SCRIPT

Sue: Our final step is spelling the nonsense words that we have been working on. You did a great job of spelling the words with the letters, so this is the same thing only you spell without the letters. The same rules apply: each sound goes into its own box. (Model how that works. For older students give example of /sh/ and /oi/). Do you have any questions?

Then let’s get started. My turn. The word is ___________. (Model by writing individual phonemes into the correct squares).

Let’s try it together. You write.

The word is ___________. What is the word?

Student repeats word. (Correct student until correct response is given).

What letters make up the sounds in ________?

Student writes letters in the appropriate box while simultaneously saying each phoneme. Student receives assistance as needed for correct responding. (If kindergartner does not know how to write a particular letter, the interventionist will stop and model how to write the letter).

If correct, move on to next example. If incorrect, return to My Turn and repeat. Complete My Turn – Together sequence until student is responding independently and correctly. Then move to independent practice.

The word is ___________. What is the word?

Repeat until student says word correctly.

What letters make up the sounds in ________?
Student writes letters in correct boxes while saying each phoneme as it is written. If correct, move on to next word. If incorrect, model with My Turn and repeat sequence until student responds correctly.

Probe after student makes four consecutive correct responses.
Appendix H: Social Validity Questionnaires
Social Validity Questionnaire – Kindergarten Students

<table>
<thead>
<tr>
<th>Statement</th>
<th>😊</th>
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<tbody>
<tr>
<td>I liked using word boxes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Word boxes helped me learn to read better.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can spell more words now.</td>
<td></td>
<td></td>
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<tr>
<td>I will sound out words I do not know when I read or write.</td>
<td></td>
<td></td>
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<tr>
<td>I think word boxes are a good way for students to learn to sound out words.</td>
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<td></td>
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<tr>
<td></td>
<td>Yes</td>
<td>Maybe</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
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</tr>
<tr>
<td>I liked using word boxes.</td>
<td></td>
<td></td>
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<tr>
<td>Word boxes helped me learn to read better.</td>
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<td></td>
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<tr>
<td>read or write.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I think word boxes are a good way for students to learn to sound out words.</td>
<td></td>
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</tbody>
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