Examining Early Word Recognition instruction: Synthetic Phonics vs. Analytic Phonics

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ABSTRACT

EXAMINING EARLY WORD RECOGNITION INSTRUCTION:
SYNTHETIC PHONICS VS. ANALYTIC PHONICS

Jenelle Gallagher-Mance, Ed.D.
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Northern Illinois University, 2023
Laurie Elish-Piper, Director

This single subject experimental design study used an adapted alternating treatment design to examine the effects of a synthetic phonics intervention and an analytic phonics intervention on oral reading accuracy, oral reading rate, and letter-sound correspondences among first grade students. Students who were reading at least two levels below guided reading level expectations and scored below the 25th percentile on the AIMSweb R-CBM fluency probe and the Words Their Way Primary Spelling Inventory were selected to participate in the study. Five participants received daily instruction based on a synthetic phonics intervention (systematic directed phonics) or an analytic phonics intervention (word sorts) over a duration of 11 weeks. Participant response to each intervention was measured using the Wilson Assessment of Decoding and Encoding and the AIMSweb fluency probes. Data were collected twice a week and were graphed and analyzed after each session. Visual analysis of graphed displays were examined to compare the effectiveness of the synthetic phonics intervention and the analytic phonics intervention. Trendlines for most participants demonstrated a moderate to high impact on oral reading rate (ORR) and word reading accuracy across conditions. At times, the analytic phonics intervention resulted in some of the highest ORR across conditions, especially when prefaced with synthetic phonics instruction. Findings from the study include the need for
systematic phonics instruction as a precursor to the successful use of analytic phonics instruction. In addition, the combination of both synthetic phonics and analytic phonics instruction supported an increase in oral reading rate and word reading efficiency. Implications for practice include the importance of building a strong foundation in oral language and letter-sound knowledge along with the combination of both synthetic phonics and analytic phonics to offer the most comprehensive instruction for developing word recognition in emerging readers. Future research should include a replication of the study using intermediate students who demonstrate struggles with oral reading fluency, word reading accuracy, and spelling. The addition of a third independent variable such as the combination of both the synthetic phonics and analytic phonics interventions could provide an additional comparison treatment. In addition, the use of longitudinal data collection could determine retention of any gains in oral reading rate, word reading accuracy, and letter-sound correspondences.
NORTHERN ILLINOIS UNIVERSITY
DEKALB, ILLINOIS

EXAMINING EARLY WORD RECOGNITION INSTRUCTION:
SYNTHETIC PHONICS VS. ANALYTIC PHONICS

BY

JENELLE GALLAGHER-MANCE
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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL
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Laurie Elish-Piper
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DEDICATION

To my dearly missed parents, Joseph & Betty Gallagher.

Thank you for teaching me the value of an education and the power of a good book.

Your legacy lives on . . .
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CHAPTER 1
INTRODUCTION

Many students in the U.S. are not reading proficiently, as identified by the National Assessment of Educational Progress’s (NAEP) periodic evaluation of the reading ability of students across the nation and rating of each student’s performance as advanced, proficient, basic, or below basic. According to the NAEP (2019) reading assessment findings, only 35% of fourth-grade students and only 37% of twelfth-grade students performed at the proficient level, indicating a limited capacity to read and comprehend text accurately and a lack of the skills and knowledge needed for proficient work at a grade level. Since partial mastery can be interpreted as below grade level, then 65% of fourth graders and 63% of twelfth graders performed at the basic or below level in 2019 (National Institute of Child Health and Human Development [NICHD], 2019). Based on a reading scale that ranges from 0-500, the average score in 2019 was only 4 points higher than the first reading assessment conducted in 1992. When compared to scores from 2017, fourth-grade student scores in 2019 were 1 point lower. This low and/or stagnant trend of reading proficiency spans the last couple of decades and is represented in over half of fourth and twelfth-grade students who have reading skills classified as basic or below grade-level expectations.

If such a high number of students are already lacking proficient reading skills – particularly in elementary school, then there is a need to further examine reading acquisition
instruction at the emergent level. Reading fluency has been established as a core foundational reading skill (NICHD, 2000; Rasinski et al., 2009; Schwanenflugel et al., 2006) and is defined as the ability to read quickly and without conscious effort (Logan, 1997). Oral reading fluency represents the reader’s orchestration of translating letters into coherent sounds, unitizing sounds into meaningful word components, processing connections between sentences and prior knowledge, and making inferences that support understanding (Fuchs et al., 2001). Early research (Fuchs, et al., 1993) identifies that the most significant growth in the primary grades takes place within the trajectory of oral reading fluency.

Word recognition is a precursor to reading fluency and develops through two processing systems: cue reading (Goodman, 1970; Gough et al., 1992) and cipher reading (Ehri, 2020; Gough et al., 1992). Cue reading is the result of an interaction among the semantic, syntactic, and graphophonic cueing systems. The semantic cueing system represents the meaning-making aspect of the process and supports understanding. The syntactic cueing system refers to the position of the word in the sentence along with its part of speech. This information helps the reader to identify the word based on its placement and function in the sentence. The graphophonic system brings letter-sound knowledge to the interaction or word recognition process. A second processing system that accounts for word recognition relies on cipher reading wherein the reader sounds out or decodes words based on letter-sound relationships. The letter-sound connection becomes firmly rooted in memory. This is a cognitive location also known as the lexicon.

Phonics instruction and the teaching of letters, sounds, and letter combinations are prominent emergent reading skills that lead to the development of word recognition skills, a fundamental early reading construct. The two key approaches to teaching phonics are synthetic
phonics and analytic phonics instruction (Johnston et al., 2012; Appendix D). Synthetic phonics instruction begins with the name and sound for each letter. Students are then taught to segment and blend those sounds together to read words. Synthetic phonics instruction is systematic so each concept can build on previous learning. Synthetic phonics provides explicit teaching that embeds immediate corrective feedback. Alternatively, analytic phonics instruction is based on an inquiry approach that begins with whole words. Students analyze the letter patterns in a series of words and form conclusions. Analytic phonics instruction can also be systematic and explicit, but lessons begin with the whole word rather than at the phonological level as described in synthetic phonics instruction.

Phonics instruction and the teaching of letters, sounds, and letter combinations are substantial emergent reading skills that lead to the development of word recognition skills, a fundamental early reading construct. Two key approaches to teaching phonics are represented by synthetic phonics and analytic phonics instruction. Synthetic phonics instruction promotes the initial blending of individual sounds to form words. Students begin by learning letter names and sounds, followed by the sounding and blending of letters together to read words (Johnston et al., 2012). In analytic phonics instruction, lessons start with whole words or words students can already identify accompanied by follow-up analysis for phonic elements and letter patterns (Johnston et al., 2012).

The debate regarding the best practice for phonics instruction currently continues among literacy professionals (Semingson & Kerns, 2021) and has its roots dating back to the 19th and 20th centuries where the focus was on beginning reading, decoding, and phonics instruction. Horace Mann (1838, as cited in Semingson & Kerns, 2021, p. 158) and John Dewey (1933, as cited in Semingson & Kerns, 2021, p. 158) proposed a whole word approach to teaching reading,
whereas the famous McGuffey Readers embraced a decoding skills-based approach for early readers. Literacy advocate, Jeanne Chall (1967, 1983a, 1996) contributed to the argument about whether instruction should focus on reading as a bottom-up process (reading words from a part to whole) or a top-down process (reading words from whole to part), along with recommendations for teaching phonics. Chall created a model for literacy development that defined six stages of reading development that supported both a code-based approach to teaching reading and a more holistic approach that promoted meaning-making processes (Chall, 1983). *Learning to Read* (Chall, 1967, 1983, 1996) became a seminal work for reading research and practice (Adams, 1990; Moats, 1999) in which Chall proclaimed the importance of letting the research inform practice through evidence-based approaches. A controversy has emerged in the current media regarding the best way to teach early reading skills (MacPhee et al., 2021; Semingson, et al., 2021). Often framed as the reading wars by journalists and the media, the conflict centered on the need for early phonics instruction, and the initial reliance on decoding for word recognition is currently called the science of reading debates (Shanahan, 2020).

In today’s educational sector, many public school districts often choose not to consult empirical research when making district-wide decisions specific to reading instruction. Key stakeholders in the public schools are not always informed about the most appropriate evidence-based practices in reading instruction, and a reduction in school district budgets can limit the selection process for curricular and instructional materials as well as teacher professional development. Change for the sake of change rather than for the sake of improving instructional practices can impede making decisions based on research and what works. The field of education needs additional translational research that takes findings from research and applies those findings to instructional practice in classrooms (MacPhee, Handsfield, Paugh, 2021). Teachers
are seeking to curate a collection of instructional practices that are efficient and highly effective in an educational atmosphere of an infinite number of standards for learning, high stakes testing, teacher accountability, and curricular gaps from previous learning experiences. The science of reading debate needs additional research to provide answers to the following questions: which is more effective for students during early literacy acquisition: synthetic phonics instruction or analytic phonics instruction?

This chapter provides an overview of the study and includes the conceptual framework, the purpose of the research, a statement of the problem, the research questions, definitions of terms specific to the study, and a brief overview of the methodology. See Appendix A for a list of definitions used in this research. An in-depth discussion of the methodology is provided in Chapter 3.

Conceptual Framework of the Study

Several studies provide the theoretical underpinnings for the study. The focus of this study is the relationship between word recognition and reading fluency; therefore, the automaticity theory, information-processing model, lexical quality theory, and word amalgamation theory represent the processes that support this relationship and will be discussed.

Automaticity Theory

LaBerge and Samuels’ (1974) automaticity model of reading is frequently referenced as a framework for undergirding oral reading fluency. Oral reading fluency is one of several chief indicators for evaluating overall reading competence (L.S. Fuchs et al., 2001). For the purposes of this study, automaticity and automaticity will be used interchangeably. Automaticity theory is
described in a two-step decoding process. First, words must be decoded and identified through a process of segmenting sounds for each letter and then blending the sounds into a coherent word. Secondly, meaning is then attached to that word. Oral reading fluency is a complex skill that requires the coordination of many cognitive processes simultaneously. If each component required sustained attention, performance of the complex skill would emerge as inefficient as opposed to a coordinated performance in which each component is performed automatically and efficiently.

LaBerge and Samuels (1974) supported the view that skilled reading reallocates attentional capacity from lower-level word identification processes to the high demands of comprehension functioning (L.S. Fuchs et al., 2001). Lexical processes such as orthographic segmentation (breaking words into syllables) and phonological coding (segmenting and blending sounds to form words) were more accurate constructs for representing the concept of automaticity. In LaBerge and Samuels’s bottom-up serial-stage model of reading, higher level processes are delayed until lower-level processes have been completed. Skilled reading re-routes attention from the lower-level processes of phonological coding and orthographic segmentation to higher level processes of making meaning and comprehension.

Verbal efficiency (Perfetti & Hart, 2002) originally emphasized the importance of speed and automaticity during word processing so cognitive resources were then free to comprehend meaning from a text. Eventually, a precursor to word processing emerged, called the Lexical Quality Hypothesis. Lexical quality refers to linguistic codes stored in the inactive memory that are attached to a linguistic symbol. The degree to which retrieval is effortless and seamless correlates with word recognition efficiency (Perfetti & Hart, 2002). A high-quality code supports rapid and automatic word recognition, while a poor quality code yields flawed comprehension.
Wolf and Katzir-Cohen (2001) parallel Perfetti’s (1985) work by describing efficient underlying systems that free cognitive resources for the reader to then focus on higher level demands during reading, an important need for comprehension.

LaBerge and Samuels (1974) attributed poor reading fluency to problems in word decoding. Poor decoding can also lead to additional difficulties for struggling readers. This poor decoding creates a traffic jam in the brain during which the flow of thought is fully routed to the word recognition process rather than the comprehension of text. High quality lexical representations have fully developed orthographic representations (spelling), phonological representations (one from oral language and one from orthographic mappings), and semantic, or meaningful, information (Perfetti & Hart, 2002; Perfetti, 1992; Seidenberg et al, 2020; Logan, 1997). The lexicon becomes a vast collection of visual information based on the frequency of word exposure along with their common neighbors or words often paired together in text (Dehaene, 2009). Specific visual information that helps the reader identify words is stored in the lexicon. Greater details and comprehensive information about each word in the lexicon leads to improvement in reading fluency. Improvement in fluency can reduce the cognitive load associated with word recognition and allow for increased attention to the comprehension of text (Swanson & O’Connor, 2009). Successful use of the lexicon is based on specific cognitive processes that come from the information-processing model of word identification.

**Information-Processing Model**

The big three processing variables (orthographic, automaticity, and phonological processes) have been documented as providing the underpinnings of fluent and accurate reading (How & Larkin, 2013; McCallum et al., 2006; Moats, 2005; Snow, et al., 2005; O’Brien, 2014;
Schwanenflugel et al., 2006; Swanson & O’Connor, 2009). Gough’s information-processing model (IPM; 1972) represents a sequentially ordered set of translations that further explain the inner workings of the lexicon, a component of the automaticity construct within the word recognition process. The IPM is based on a cognitive theory of learning and explains word identification in a linear model. First, graphemic information, also known as the word, enters the visual system and becomes an icon, which is a symbol coded in the brain. Then a pattern-recognition device identifies the letters of the letter string and character-level representations translate into a phonemic symbol. The phonemic symbol is selected from the code book through the work of the decoder. The phonemic representation of the letter strings is matched with entries in the lexicon. According to Gough (1972), the lexical entries are committed into primary memory where knowledge of syntax and semantics is applied to determine the meaning of the input. This syntactic and semantic context of the word is also represented in an interactive model of reading (Rumelhart, 1985). Finally, sentences are sent to the TPWSGWTAU (the place where sentences go when they have been understood), which becomes the final stopping place for words when reading is complete. Struggling readers appear to find difficulty somewhere between the processing of the graphemic input and the decoder’s access to the code book, which can account for a lack of oral reading fluency among struggling readers. Rumelhart (1985) notes the linear and sequential nature of Gough’s model and the lack of representation for the higher-level meaning-making tasks of word identification. In the model, there is no opportunity for higher-level processing to affect the lower-level input strings. The model strictly represents letter-by-letter, word-by-word analysis of the graphemic input.
However, the information-processing framework alone has not remained sufficient for accurate decoding. The Simple View of Reading (Gough & Tunmer, 1986) purports two systems for successful reading: decoding and comprehension. Even though a reader can pronounce a word accurately, the meaning and understanding i.e., comprehension of the words are derived from the mental lexicon to complete the reading process. The lexicon is a section of the brain in which words and word meanings are stored (Juel et al., 1986; Dehaene, 2009; Perfetti & Hart, 2002). In addition to knowledge of the alphabetic cipher, decoding requires the use of lexical knowledge or the lexicon to achieve the comprehension strand of the Simple View. Readers have direct and immediate access to meanings of words due to use of neurological dual routes; however, words need to be phonologically recoded or converted to letter sounds and
blended together before meaning can be derived. “Both the lexical and phonological pathways operate in parallel and reinforce each other” (Dehaene, p. 26). This second reading pathway, the lexical route, supplements letter-sound decoding and leads to automatic word recognition or reading fluency (Juel, 1986). A process called amalgamation (Ehri, 200) creates lexical or word meanings in memory. Words become transformed groups or packages of letters sealed together in the lexicon, which is further explained through amalgamation theory.

Amalgamation of Word Identities Theory

Continued exploration and definition of the lexicon (Juel et al., 1986; Dehaene, 2009; Perfetti & Hart, 2002) and its role in early literacy acquisition places emphasis on word recognition tasks (Ehri, 2020). Beginning readers learn to read words from memory by amalgamating or bonding word identities together to form individual lexical units in memory. The process of firmly mapping familiar words into memory so they are accessible through automaticity is also called unitization (Ehri & Wilce, 1983). Words that are unitized are consolidated into one unit in memory. Word identities can take the form of orthographic (spellings), phonological (pronunciations), morphological (word roots and affixes), syntactic (grammatical function in sentences), and semantic structures (meanings; Logan, 1997; Perfetti & Hart, 2002; Seidenberg et al, 2020; Yoncheva et al., 2015).

Readers’ competence with spoken language bonds some word identities into the memory (Ehri, 2020). Systematic knowledge of the writing system is established as spoken language maps or imprints words onto the lexicon. In addition, written words are bonded into memory as readers learn word spellings and bond each spelling to the visual word form. The application of letter-sound knowledge during reading and spelling connects letter units to sound units for each
word. The letter-sound units can take the form of grapheme-phoneme units, onset-rimes, syllables, or morphemes and are based on the reader’s knowledge of the writing system. Semantic and syntactic identities are created when readers encounter words in context, such as text and book readings. The readings in context activate word meaning when spellings are seen. Each time a word is read in context, the identity connections are solidified and reinforced in the lexicon. When the word is seen during subsequent readings, the connections in memory are, again, activated. This may explain why time spent reading improves reading for all readers (Allington, 2013).

After words are amalgamated in memory, readers will have the capability to read them as whole units quickly and automatically using the activated identities (Ehri, 2020). The amalgamation of words works for all words, not just high-frequency or irregularly spelled words. Over time, words become recognizable by sight rather than by guessing or decoding words. As students learn the regularities of the writing system through grapheme-phoneme (letter-sound) relations, phoneme segmentation, and decoding skills, graphemes imprint in memory in the form of word spellings. These word identities and word mappings combine to form the lexicon, the cognitive resource for word recognition (Perfetti & Hart, 2002). During text reading, an over-reliance on alternate pathways such as general intelligence, vocabulary, reasoning, or conceptual understanding for word recognition can create a backup in the brain, which leads to disfluent reading (Shaywitz, 2003). The alternate pathways refer to the academic knowledge of the world, word meanings, logical thinking, and understanding that go beyond basic facts. Access to these cognitive resources may be helpful to the reader but an over-reliance on these pathways can cause a delayed response during reading. The sole use of context for word identification takes extra time for cognitive processing, whereas the combination of automaticity, decoding, and
context improves ease of word recognition. Word amalgamation underlies accurate decoding and word recognition for the fluent reader (Ehri, 2020). This supports the process of committing written words into memory rather than relying on incidental associations (Figure 2).

![Diagram](image)

**Figure 2**: Using context takes time. (Shaywitz, 2003)

**Statement of the Problem**

The need for this study arises from several concerns about reading instruction at the elementary level. First, student performance on NAEP (2019) assessments revealed that over half of fourth- and twelfth-grade students in the U.S. have reading skills classified as fundamental or even below grade-level expectations. Reading fluency has been recognized as a key construct for the development of reading abilities and warrants consideration when students are struggling to read [NICHD], 2000; Rasinski et al., 2009; Schwanenflugel et al., 2006). Undergirding reading fluency are the big three processing variables (orthographic, automaticity,
and phonological processes) that support the development of word identification skills (How & Larkin, 2013; McCallum et al., 2006; Moats, 2005; O’Brien, 2014; Schwanenflugel et al., 2006; Swanson & O’Connor, 2009; Snow et al., 2005). Phonological processes are generally established through the teaching of phonics during early literacy acquisition and have an impact on a student’s capacity to read fluently as measured by oral reading accuracy and oral reading rate. Second, if such a high number of students are already lacking proficient reading skills in elementary school, then there is a need to further examine reading acquisition skills at the emergent level. Phonics instruction and the teaching of letters, sounds, and letter combinations are prominent emergent reading skills that lead to the development of word recognition skills, a fundamental early reading construct (Ehri, 2001; Chall, 1996; Juel et al, 1986; McCallum et al, 2006). The two key approaches to teaching phonics are identified as synthetic phonics and analytic phonics instruction. The debate regarding the best practice for phonics instruction continues among literacy professionals (Semingson & Kerns, 2021) who grapple with efficient and effective teaching practices focusing on one key question: Which is more effective—synthetic phonics instruction or analytic phonics instruction?

Purpose of the Research

As student performance on national reading tests remains stagnant starting in the elementary grades, reading professionals seek to increase their knowledge of early reading acquisition and how it transcends into fluent reading, an indicator of successful growth in literacy (L.S. Fuchs, Fuchs, Hamlett, Walz, & Germann, 1993). Children who have efficient word-recognition skills will be able to read connected text fluently and better understand what they read (Schwanenflugel et al., 2006). Word recognition skills build from a foundation in
phonics and phonetic decoding skills and provide a critical foundation in word recognition for later achievement in reading fluency (Juel et al., 1986).

Pedagogical practices for teaching phonics fall into two main categories: synthetic phonics and analytic phonics. Debate continues about which instructional practice has greater impact on students as they improve their reading and reading fluency. The purpose of this research study was to investigate the effects of synthetic and analytic phonics instruction on oral reading accuracy, rate, and letter-sound correspondences to determine their effectiveness for first-grade student reading performances.

Research Question

The following research question was used to determine the most effective way to teach phonics when comparing a synthetic phonics method to an analytical phonics method with first-grade students: What is the effect of synthetic versus analytic phonics instruction on oral reading accuracy, oral reading rate, and letter-sound correspondence knowledge of first-grade students?

Significance of the Study

This study emerged from several experiences the researcher has had as a reading educator over the years. First, performance on NAEP (2019) reading tests demonstrates that the U.S. still needs to improve reading instruction across the grades, especially in elementary school where literacy acquisition begins. Literacy is one of the most important skills taught in U.S. schools. Efficient and effective reading instruction is needed to meet diverse needs within significant time constraints and an expansive curriculum. Educators need to know what works best and has the greatest impact for students.
Second, phonics and word study instruction seem to be lacking in many classrooms and school districts. In a recent district meeting where discussion focused on students’ academic needs, the following comment emerged from one teacher participant, “Kids don’t need phonics. We found the research to prove it.” Statements like this in meetings, on blogs, and in social media groups raise concern among professional educators who are knowledgeable and informed about the research trends rather than a single study taken out of context. Comments such as this support the need for continued professional development for teachers and educational leaders. Teachers with a background in phonics are better prepared to make impactful instructional decisions, analyze student errors, and improve the clarity and language of literacy instruction (International Literacy Association, 2019). Additionally, conclusions from the study may also contribute to shaping the content of teacher preparation programs at the university level to yield high quality teacher candidates for our schools.

Finally, topics such as beginning reading instruction, decoding, phonics, and the science of reading are dominating social media sites, groups, blogs, professional journals, podcasts, and hashtags. Learning to read is not magical. The English language is comprised of 26 letters that represent 44 sounds in our language (International Literacy Association, 2019). Knowledge of letter-sound relationships unlocks about 84% of the English words in print.

Much of the argument has settled on one key question: which is more effective for students during early literacy acquisition--systematic phonics instruction or analytic phonics instruction. Surprisingly, very little research calls for further investigation of the most effective approach for teaching phonics, a core variable in later reading achievement (Chall, 1967; Bradley & Bryant, 1983; Ehri, 2020; Ehri et al, 2001; Ehri & Wilce, 1993; Gough et al, 1992; Juel et al, 1986; McCallum et al, 2006). As school districts look to update curricular materials
and programs for early literacy instruction, increasing knowledge about the importance and kind of phonics instruction best for students will help to pave the way for successful literacy growth and development for all students.

Methodology

The purpose of this research study was to examine the effects of synthetic and analytic phonics instruction on oral reading accuracy, rate, and letter-sound correspondences among first grade students using a within-subject adapted alternating treatments design (AATD; Wolery et al., 1988). Given that educators want to know whether instructional practices are effective and have the potential to result in student growth (Baer et al., 1968), an adapted alternating treatments design was used to compare the effectiveness of a synthetic phonics intervention and an analytic phonics intervention.

The AATD is a variation of the alternating treatments design. AATD is useful for comparing interventions for teaching functional, developmental, or academic behaviors (Ledford & Gast, 2018; Wolery et al., 1988). The treatments (i.e., synthetic and analytic reading interventions) were applied to different but equally difficult independent behaviors (i.e., fluent reading and accurate reading). Independent behaviors are responses that do not change when one behavior is treated. In this study, the dependent behaviors were oral reading rate (ORR; in the form of words correct per minute) and word reading accuracy (the number of errors within each passage) as measured by AIMSweb Reading Curriculum-Based Measurement (AIMSweb R-CBM, 2017) and the Wilson Assessment of Decoding and Encoding (WADE; Wilson, 1998). The WADE was used to measure each participant’s ability to decode words.
Intervention delivery took place in small groups with five students who were performing below grade level expectations in reading. Student performance on the AIMSweb R-CBM (2017) and the real word list from the WADE (Wilson, 1998) were examined two or three days per week to determine the effectiveness of a synthetic phonics intervention in comparison to an analytic phonics intervention.

AATD, a variation of alternating treatments design, was used to compare the effects of two phonics interventions on students’ abilities to read fluently and accurately. This allows for assessment of the relative merits of the two interventions (Wolery et al., 1988) and determined if a behavior change occurred when the intervention was introduced (Ledford & Gast, 2018). In this study, the dependent variables were oral reading rate (ORR; in the form of words correct per minute) and word reading accuracy (the number of words read correctly on a wordlist and the number of errors within each fluency passage) as measured by AIMSweb R-CBM (2017), the WADE (Wilson, 1998), and the Test of Word Reading Efficiency (TOWRE-2; Torgesen et al., 2012). AIMSweb R-CBM was used to measure reading oral reading rate and word reading accuracy. The WADE and the TOWRE-2 measured each participant’s ability to read accurately using knowledge of letter-sound relationships to decode words and nonwords. The Words Their Way (WTW) Primary Spelling Inventory was administered to measure letter-sound correspondences. The AIMSweb fluency probes and the WADE were used to collect data for a primary analysis. The WTW assessment and the TOWRE-2 were used to collect pre/post data and provided the basis for a secondary analysis.

In AATD research, visual analysis of graphic displays are used to document the outcomes of the study and support formative decisions throughout the duration of the study (Ledford & Gast, 2018). Graphic presentation of data provided opportunity for independent analysis and
interpretation of the results of each treatment. Visual analysis was useful for determining whether a study demonstrated experimental control. The researcher remained in continuous contact with the data to ensure the participants were improving. Data points that fell outside of the stability envelope indicated the degree of stability or variability of the data.

Conclusion

Reading and literacy are the most important skills taught in elementary school. Reading fluency, the ability to read words accurately and automatically, undergirds continued literacy growth and achievement. Orthographic and phonological processing along with automaticity combine to create the key ingredients for fluent reading. At the beginning of literacy acquisition for students, teachers’ knowledge of best practices and most impactful methods for developing phonological processing through phonics instruction must rest on research and proven practices. Current debates and conflict among literacy professionals need resolution. When it comes to phonological processes and the teaching of phonics, a deeper understanding of the impact of a synthetic approach and an analytical approach can provide practitioners with essential information for the development of core reading acquisition.

The following chapters present a comprehensive report of the study. Chapter 2 reviews the literature pertaining to reading fluency, orthographic processing, phonological processing, automaticity, word reading efficiency, working memory, oral reading rate, and phonics pedagogy. Chapter 3 provides a complete description of the procedures for intervention implementation and measures used for data collection in the study along with a description of each participant. Chapter 4 reports the results of the study and analysis of the data. The discussion, conclusions, limitations, and implications are addressed in Chapter 5.
CHAPTER 2
LITERATURE REVIEW

Reading fluency has been recognized as a key construct for the development of successful reading abilities (National Institute of Child Health and Human Development [NICHD], 2000; Rasinski et al., 2009; Schwanenflugel et al., 2006). Reading fluency is defined as the ability to read smoothly, accurately, and with expression when activating oral reading (Schwanenflugel et al., 2006). Fluent readers demonstrate the ability to read easily and without conscious effort or interruption (Logan, 1997) as represented in the automaticity theory of reading (LaBerge & Samuels, 1974). By contrast, beginning readers who are dysfluent are identified by their excessively slow and laborious reading, which can interfere with comprehension (Schwanenflugel et al., 2006). For most children, fluent reading develops between first and third grade, when decoding (sounding out unknown words) and word recognition skills develop with automaticity and speed (Chall, 1983; Ehri as cited in Snowling & Hulme, 2005). The automaticity theory of reading proposes that proficient well-developed word-recognition skills underlie fluent reading and successful comprehension of text (LaBerge & Samuels, 1974). Word recognition develops through a series of developmental stages starting with single letter recognition to matching pronunciations with letter groupings to accurate word identification to finally an unconscious retrieval of words from long-term memory (Chall, 1983; Ehri & Wilce, 1983; Logan, 1997). Children who have efficient word-recognition skills are able to read connected text fluently and better understand what they read (Schwanenflugel et al.,
2006). The interaction of established word recognition skills along with reading fluency provide critical support to the real purpose for reading: comprehension (LaBerge & Samuels, 1974; Perfetti & Hart, 2002; Rasinski et al, 2009; Swanson & O’Connor, 2009).

Sight word reading is the ability to accurately identify and pronounce words instantly and automatically (Ehri, 2005). Sight word reading not only includes high frequency words or irregularly spelled words but also includes all words readers can read based on their memory. Growth in reading requires an extensive vocabulary of sight words stored in memory (Ehri, 2005). When readers encounter unknown words, strategies such as decoding (Chall, 1983; Gough et al., 1992; Juel et al., 1986), analogizing (Goswami, 1995) or predicting (Goodman, 1970; Ehri, 1975, 2020) are enacted to identify words. Readers decode when they segment the sounds of a word and then blend the sounds to read and identify the word (Gough et al., 1992; Juel et al., 1986; Chall, 1983). When readers analogize, they look at the whole word and compare it to other known words in order to accurately identify the word (Goswami, 1995). When identifying a word, readers also activate the meaning of a word in memory to support word recognition, which is identified as prediction (Goodman, 1970; Ehri, 1978).

The areas of interest for this early literacy acquisition study include decoding and analogizing as processes in word recognition. To decode or convert letters into their respective sounds of an unknown word, readers need instruction in phonics. Children’s development of phonics and phonetic decoding skills takes place early in the reading acquisition process and provides a critical foundation in word recognition for later literacy achievement in reading fluency (Juel et al., 1986).

Pedagogical practices for teaching phonics appear to fall into two main categories: synthetic phonics and analytic phonics. Synthetic phonics instruction promotes the initial
blending of individual sounds to form words. Students begin by learning letter names and sounds, followed by the sounding and blending (or synthesizing) of letters together to read words (Johnston et al., 2012). In analytic phonics instruction, lessons start with whole words or words students can already identify accompanied by follow-up analysis for phonic elements and letter patterns for word recognition (Johnston et al., 2012).

The purpose of this research study was to further investigate the effects of synthetic and analytic phonics instruction on oral reading rate, word reading accuracy, and letter-sound correspondences among first-grade students. This review of the literature describes the theoretical framework underlying the development of word reading skills in early reading acquisition, the cognitive predictors necessary to establish fluent reading and a brief examination of the role of working memory within the process. Situated within the construct of word recognition, the impact of synthetic and analytic phonics instruction and their connection to letter-sound correspondence, word reading accuracy, and oral reading rate are also discussed.

Word Reading Development

A series of stages represents the development of word reading skills in beginning readers (Chall, 1983; Ehri, 1998, 2005; Gough & Hillinger, 1980). Each stage of development explains one type of word reading that occurs, and mastery of that kind of word reading is required for movement to the next stage (Ehri, 2005). Movement among the stages is not solely systematic and several theories describe each stage as a phase. Key processes and skills are described at each stage. These processes are necessary for readers to move from one phase to the next. These word reading development theories identify what students can expect to learn at each level and provide explanations for why some students do not make progress.
One theory of word reading development consists of four phases (Ehri, 1998, 2005). The phases were created to reflect the kinds of information required for readers to accurately read and spell words. During the first phase, called the pre-alphabetic phase, readers rely on visual cues and context (meaning) cues for word recognition. Letter-sound cues are not yet considered for identifying words. The second phase, called the partial alphabetic phase, finds readers using some letter-sound cues and some visual cues to read and write words, but they cannot fully decode unknown words. The full alphabetic phase takes place when readers have developed complete decoding skills and can analyze and create grapheme-phoneme connections within words to read and spell from memory. Readers who have accumulated accurate spellings in memory and rely on larger letter strings or units to read and spell have progressed into the consolidated alphabetic phase. As each phase represents the development of literacy acquisition, an intersection exists between the phases of growth and the predictors of reading fluency (How & Larkin, 2013; McCallum et al., 2006; Moats, 2005; O'Brien, 2014, Schwanenflugel et al., 2006; Swanson & O’Connor, 2009; Snow, et al., 2005).

Automaticity, as illustrated through rapid word recognition, (LaBerge & Samuels, 1974; Perfetti & Hart, 2002; Wolf & Bowers, 1999), provides a necessary core construct for fluent reading in which automaticity takes place through a two-step decoding process. Words are read in an instant without any slowing for letter-sound application. When decoding is automatic, the reader’s attentional resources become available for other processes and tasks such as text comprehension. Automaticity is a key construct within the word recognition process. The three cognitive abilities of orthographic, automaticity, and phonological processes undergird fluent and accurate reading (How & Larkin, 2013; McCallum et al., 2006). Each of the three processes intersects and impacts beginning word recognition phase theory.
Pre-Alphabetic Phase

Without an established alphabetic system, reading words is difficult for students. The lack of a systematic phonological approach for reading forces beginning readers to seek visual cues for word identification. During the pre-alphabetic phase, children read words by relying on visually salient cues in memory for word identification (Ehri, 2005, 2020; Gough et al., 1992). Early readers see words as a whole and rely on a unique visual cue for word identification. These cues are visually salient by offering some unique shape or letter combination that make them easy to remember. For example, the “oo” in the word pool or the length and shape of the word as in watermelon provide visuographic cues for identification rather than the actual decoding of letters (Share & Gur, 1999). Visuographic cues provide non-phonetic graphic features of the printed word. The reader selects any cue from the word that will help with accurate identification. Pre-alphabetic readers rely on visual cues due to their lack of letter-sound knowledge or the ability to apply letter-sound correspondences to read or spell words.

Pre-alphabetic readers also use visual cues to read words located in their immediate environments, such as stop signs, restaurants, their own name, and friends’ names (Masonheimer, et al., 1984). These readers can read signs common to their environment, such as McDonalds, based on visual characteristics on or around the written words but when asked to identify the letters of the words, pre-alphabetic readers were unable to do so. The word reading of environmental print also comes with additional visual cues such as symbols, colors, and font that provide the context for pre-alphabetic sight word reading (Ehri, 2005). Since pre-alphabetic readers lack letter-sound knowledge, they rely on memorable visual cues for meaningful word identification. This is how the name, pre-alphabetic, takes its place as one of the early stages of
Partial Alphabetic Phase

Movement into the partial-alphabetic phase takes place when readers gain letter knowledge and begin to learn to apply it to read words. This starts the process of creating partial word connections in memory. Letter knowledge is one of the strongest predictors of reading achievement in the early years of literacy acquisition (Adams, 1990; Bond & Dijkstra, 1967; Chall, 1983).

Emergent readers use a process called cue reading to identify their first words (Ehri, 2005; Gough et al., 1992). Since partial-alphabetic readers are in the process of building letter knowledge, these readers begin to identify words based on isolated letters in a word. But as readers grow their letter knowledge and phonics skills, they begin a shift towards cipher reading. The cipher reader uses letter-sound relationships along with a process of matching a spoken word to the word imprinted in memory after repeated exposures.

Phonological processing, or decoding of letters and sounds, takes place when the reader identifies the sound that matches the letter or letter strings (Juel et al, 1986; McCallum et al, 2006). This spelling-sound knowledge, or cipher knowledge, combines with knowledge of a series of spelling rules that aid the reader’s ability to spell and decode words (Juel, et al, 1986). Phonological processing represents one of the strongest indicators of reading achievement when examining the neurological underpinnings of reading. For example, the simple view of reading (Gough & Tunmer, 1986; Juel, et al.,1986) purports two systems -- decoding and comprehension (Juel, 1988) -- as the key critical components of reading.

Decoding is a process by which the reader attaches a sound to a symbol, in this case
sounds to the letters or letter strings, and blends those sounds together to form and identify a word. The process of learning to break the code into individual sounds requires the use of phonemic awareness, one of several components of phonological processing. The ability to rhyme, segment the sounds in a word, blend sounds into speech, and isolate sounds are skills that combine to form phonological processing. Ehri (1992) proposed that the path to becoming a skilled reader (in English) is through the development of solid phonological skills along with efficient phonetic decoding skills that undergird word reading efficiency (WRE).

Decoding relies on knowledge of the spelling-sound correspondences that exist in the English language (Juel et al., 1986). While these correspondences should ideally map a single phoneme onto a single letter, the 26 letters in the English alphabet map onto more than three dozen phonemes based on the influence of other languages (Dehaene, 2009). A reader’s visual processing system eventually comes to recognize these letters as a unit rather than as individual letters called as unitization (Ehri, 2005). Knowledge of letter sound correspondences leads the reader to internalize a series of rules that govern the pronunciation of words and assist with mapping graphemes to phonemes (Dehaene, 2009; Gough et al., 1992; Juel et al., 1986). When the partial alphabetic reader lacks development, it may be largely due to the lack of formal instruction using alphabetic knowledge. Phonics instruction provides the necessary knowledge of letter-sound correspondences that support movement from the partial alphabetic phase to the full alphabetic phase (Ehri, 2005).

**Full Alphabetic Phase**

Readers in the full alphabetic phase can decode unknown words based on letter-sound correspondences (Ehri, 2005). Full alphabetic phase readers create cognitive connections
between graphemes (letters) and phonemes (sounds) and can pronounce words accurately. Sight word learning develops more rapidly and accurately during the full alphabetic phase (Ehri & Wilce, 1987). Full alphabetic knowledge aids in placement of words in memory. Words have a secure place in memory and only a few exposures to new words are required to transition unknown words into familiar words for the reader. Students who had previously seen word spellings recalled words more accurately than those who had not. Phonemic segmentation skill also plays a role and helps to find the assortment of grapheme-phoneme connections that create spellings in memory (Ehri, 1999).

Beginning readers require instruction that incorporates both key features of orthography: letter-sound correspondences and positional letter frequency (O’Brien, 2014). Teaching emergent readers to read and spell words, or decode and encode words in a reciprocal manner, develops the phonological and orthographic processing systems that have been identified as key constructs of a reader’s degree of reading fluency (How & Larkin, 2013; McCallum et al., 2006). In fact, spelling and reading rely on the same mental representation of a word and knowing the spelling of a word allows a fluent reader to decode the same word accurately (Snow et al., 2005)

Orthographic features that contribute to word identification in skilled readers include the consistency of sound-letter correspondence and the positional frequency, or common locations, of letter combinations within a word (O’Brien, 2014; Seidenberg, et al, 2020; Wimmer & Goswami, 1993). Positional frequency knowledge includes the probability of where certain letters appear in words and which letter sequences are most common (O’Brien, 2014). In a study investigating what children know about written language, children from grades one through three were asked to participate in a word likeness choice task in which students were to choose
which of two nonwords appear to be more like real words (O’Brien, 2014). The aim of the study was to determine the point at which understandings of phonological consistency and positional regularity of spellings develop during early literacy acquisition. Less-developed readers were slower to notice letters and shapes that regularly appeared in the same positions due to a lack of cognitive recognition and underlying understanding of the positional frequency information that more proficient readers had naturally developed (O’Brien, 2014).

Poorly established letter-sound knowledge will derail early attempts to blend sounds in a word (Swanson & O’Connor, 2009), which validates the need to teach letter sounds initially in the context of comprehensive early literacy instruction that includes reading, writing, listening, and speaking about meaningful text. A self-teaching mechanism or a self-extending system (Clay, 1991) enables the struggling reader to independently access increasing amounts of text. The self-extending system goes beyond letter-sound knowledge and eventually evolves into the cipher, the internalization of rules for application to related literacy tasks. As readers repeatedly encounter words in context, the lexicon or word storage not only grows but is drawn upon for recall rather than a process of repeated decoding of every word read (Share, 2008). As long as 100 years ago, researchers found that students with phonics training demonstrated a greater advantage with untaught or new words than with taught or previously learned words (Valentine, 1913). As students gained an understanding of the code, the capacity to self-apply or transfer the code to new text reading became more accessible for readers. This process of self-teaching leads to increased automaticity during word recognition and eventually to the development of fluent reading.
Consolidated Alphabetic Phase

Just as the name implies, readers at this phase are consolidating letter sequences such as affixes (prefixes, suffixes) and root words into graphophonemic units. Graphophonemic units are letter strings that represent sounds in the English language. Knowledge of consolidated units supports sight word learning and reduces initial cognitive load for the reader to identify words from memory (Ehri, 2005). Syllabication becomes a key understanding within the consolidated alphabetic phase. Sight word knowledge becomes the anchor for reading longer and more complex words as many single syllable words gain affixes and require syllabication, or breaking words into parts or syllables, to ease word identification.

During the consolidated alphabetic phase, knowledge of letter-sound correspondence is not the single key for accurate decoding. Even though a reader can pronounce a word accurately, the meaning and understanding of the word or words are derived from the mental lexicon to complete the reading process. The lexicon is a section of the brain in which words and word meanings are stored (Dehaene, 2009; Juel et al., 1986; Perfetti & Hart, 2002). Thus, decoding depends on the use of lexical knowledge or the lexicon to achieve the comprehension. Readers have direct and immediate access to meanings of words through neurological dual routes; however, words need to be phonologically recoded or converted to letter sounds and blended together before meaning can be derived. “Both the lexical and phonological pathways operate in parallel and reinforce each other” (Dehaene, p. 26). This additional reading pathway, the lexical route, supplements letter-sound decoding and leads to automatic word recognition (Juel).

Orthographic representations of words, or word spellings mapped into memory, also play a critical role in readers’ ability to read accurately during the consolidated alphabetic phase.
(Ehri, 2020; Gough, et al., 2018; How & Larkin, 2013; Perfetti & Hart, 2002). When letter-sound relationships become automatic, readers become cognitively able to store and maintain word spellings in memory. This process of bonding word spellings to pronunciations in memory is identified as unitization (Coltheart et al., 2001; Ehri, 2020; Ehri & Wilce, 1983) and provides the underpinnings of automatic retrieval during reading fluency tasks. Visual models are formed when letter-sound information bonds spellings to pronunciations and meanings in memory, creating a systematic understanding of speech and how it maps onto written words to solidify the process rather than it being a recurring process of decoding letter-sound relationships every time the word is encountered in print (Ehri, 2020). Grapheme-phoneme connections in the orthographic representation are stored in the lexicon. Repeated exposure to words read in context solidifies the pronunciations in memory and secures efficient placement in the lexicon (Perfetti & Hart, 2002). Spelling knowledge provides an additional cognitive “link” to accurate word recognition (Ehri, 2005). These lexical, phonological, and orthographic systems provide the theoretical foundation for the consolidated alphabetic phase.

**Automaticity**

As mature readers complete the consolidated alphabetic phase and word recognition becomes automatic, word recognition evolves into sight word reading (Ehri, 2005). Automaticity is the identification of the pronunciations and meanings of words without the need for additional decoding and attention. At the beginning stages of automaticity, readers are switching between their attention to decoding words and comprehending text (LaBerge & Samuels, 1974). Later, during the fluent or consolidated alphabetic phase, readers shift their entire attention to making meaning or comprehending the text rather than word identification due to automatic word
recognition. Automaticity supports text comprehension.

The automaticity construct within the context of oral reading fluency takes its place as one of the big three processing variables due to its relationship with improved comprehension (Eason et al., 2013). Several aspects of automaticity have been identified as interrelated constructs believed to complement one another: autonomy, resource use, and speed (Logan, 1985).

Readers who demonstrate a high level of automaticity also maintain a level of independence. An autonomously skilled reader has the ability to initiate a reading task without actively engaging in or attending to it (Schwanenflugel et al., 2006). The reader is drawn to print and inadvertently processes print even when he or she may be intentionally avoiding the text. For example, consider the running script at the bottom of a news story or the closed captioning script on a TV show (Bergen, Grimes, & Potter, 2005), skilled readers cannot help but read the text even when they try to avoid doing so.

Given the importance of speed and automaticity while reading, educators should first examine a student’s word recognition skills (Perfetti & Hart, 2002) to determine whether a reader may experience limited comprehension. Speed and automaticity during word processing rely on the cognitive resources available to comprehend meaning from a text. One particular cognitive resource is the lexicon. Lexical quality refers to linguistic codes (meaning of a word) stored in the inactive memory that are attached to a linguistic symbol such as the letter representation of a word. A high-quality code supports rapid and automatic word recognition, while a poor-quality code yields flawed comprehension. Code quality is a construct of word reading efficiency. Wolf and Katzir-Cohen (2001) parallel Perfetti’s (1985) work by describing efficient underlying systems that free cognitive resources for the reader to focus on higher level
demands during reading. These higher-level demands take the form of reading comprehension, the real purpose of reading (Sabatini, et al., 2018; Swanson & O’Connor, 2009).

**Word Reading Efficiency (WRE)**

A second trait of automaticity is resource use (Logan, 1985). Resource use refers to the cognitive constructs that comprise word reading skills. The degree to which retrieval is effortless and seamless correlates with word recognition efficiency (Perfetti & Hart, 2002). Reading is commonly defined by the ability to read words (Gough, Juel, & Griffith, 1992; Perfetti & Hart). However, there is much more to becoming literate than just the ability to read words. The consolidated alphabetic phase of word identification entails the concept of word reading efficiency (Ehri, 2005). It is the accurate cognitive processing of words that results in successful text comprehension (Perfetti & Hart, 2002). In fact, less skilled comprehenders demonstrated both poor comprehension and poor word reading skills. The notion that many, not all, reading difficulties are caused by poor word identification processes is described by Perfetti and Hart (2002) as the verbal efficiency theory.

Poor decoding can also lead to additional difficulties for struggling readers. LaBerge and Samuels (1974) attributed poor reading fluency to difficulty decoding words, which consequently creates a “traffic jam” in the brain. Essentially, the flow of thought is fully routed to decoding the word rather than comprehending what is being read. Difficulty decoding words demonstrates a lack of high-quality lexical representations that have fully developed orthographic representations (spelling), phonological representations (one from oral language and one from orthographic mappings), and semantic or meaningful information (Logan, 1997; Perfetti, 1992; Perfetti & Hart, 2002; Seidenberg et al, 2020). Word meanings also become a
part of the code required to produce automatic word identification. In fact, the lexicon becomes a vast collection of visual information based on the frequency of word exposure along with their common neighbors or words often paired together in text (Dehaene, 2009). Improvement in reading fluency through an increase in reading rate or automaticity can reduce the cognitive load associated with word recognition and allow for increased attention to the comprehension of text (Swanson & O’Connor, 2009). This is a difficult task for poor readers and requires considerable practice for improvement (O’Connor, et al., 2010).

Ehri and Wilce (1983) designed a study to determine the point at which skilled and unskilled readers develop unitized speeds to read familiar words. Findings indicate that less skilled readers developed unitized speed, or automaticity, with words much slower than grade level counterparts, with full unitization not taking place until fourth grade. Further, younger readers who received additional practice reading familiar words repeatedly were still unable to develop unitized response levels--even by fourth grade. The addition of the grapheme-phoneme connection creates a bond or a seal between word pronunciations in memory and word spelling. This bond establishes direct access from the visual form of the word to the spoken form of the word and may better establish the unitized response levels in the lexicon, an indicator that takes place during the full alphabetic phase of word recognition (Ehri, 2005).

Skilled readers in the consolidated word recognition phase (Ehri, 2005) rely on a well-developed lexicon for accurate word reading (Perfetti & Hart, 2002) and access to successful comprehension. Consequently, the skilled reader is able to practice reading which simultaneously builds the lexicon. This word reading model represents an intersection of the big three processing variables of orthographic, automaticity, and phonological constructs and exists at the core of fluent reading.
Oral Reading Rate (ORR)

Reading rate, or speed of reading, comprises the final element of the automaticity construct. Logan (1997) proposes that an increase in reading rate is the result of improved word recognition of individual words along with recognition of routine letter combinations, which leads to a steady rate of growth on increasingly complex words. In other words, once the foundational skills of phonological processing, letter-sound knowledge, orthographic knowledge, and a degree of automaticity of letters and sounds as during the full alphabetic stage, are established or beginning to emerge, students will begin to see improvement in their reading. The continuous process of reading and rereading text reinforces the cognitive processes required for the automatic recognition of words based on the successful development of the lexicon (Dehaene, 2009; Juel et al., 1986; Perfetti & Hart, 2002). Letter-sound knowledge becomes a segue to a self-teaching mechanism or development of the lexicon necessary for continued growth in early readers (Share & Stanovich, 1995).

While measuring reading comprehension using varying formats, a relationship exists among WRE, ORR, and reading comprehension (Eason et al., 2013). This is like research that suggests a well-established lexicon supports successful comprehension (Perfetti & Hart, 2002). The role of ORR within this relationship may suggest reliance on some level of automaticity (LaBerge & Samuels, 1974) and oral language within word recognition constructs (Eason, et al., 2013). Further clarification of the relationship between WRE and ORR was examined by assessing the reading comprehension and oral language of average readers, poor decoders, and poor comprehenders, ages 10 to 14.

Participants (n=166) were representative of a more average population and to ensure
their general functioning was within the appropriate range (Eason et al. 2013). Students were grouped based on performance using the Reading Comprehension subtest of the SDRT-4, the GMRT-4, DAB, and GORT-4. Fluency measures such as GORT-4 and the Test of Word Reading Efficiency (TOWRE) along with CTOPP Rapid Letter Naming subtest were used to measure reading fluency and automaticity constructs. Language skills were measured using assessments such as the Peabody Picture Vocabulary Test-Third Edition and the vocabulary subtest of the WISC.

Oral language was found to be a predictor of ORR; however, oral language did not contribute to students’ WRE. This demonstrates a link between ORR and oral language rather than for WRE and oral language. The relationship between oral language in vocabulary form and ORR reiterates the importance of semantics in reading comprehension. This finding aligns with the lexical quality hypothesis (Perfetti & Hart, 2002), which identifies the quality of semantic representations (along with phonological and orthographic representations) in word recognition as significant components of reading comprehension.

In another study of struggling readers, an experimental design was used to measure oral reading fluency and the impact on word recognition, decoding, vocabulary, and comprehension (O’Connor et al., 2010). Poor readers (n=123) in grades two or four of a large school district in the southwestern U.S. were screened to determine who met the eligibility criteria for struggling readers (O’ Connor et al., 2010). Struggling readers were those who read 12-45 words per minute on grade-level passages in second grade and as those who read 20-80 words per minute in the fourth grade. Qualifying students were randomly assigned to one to three treatments: practice reading text at their independent reading level (92%-100% word reading accuracy), practice reading text at a difficult reading level (80%-90% word reading accuracy), or a control
Hierarchical linear modeling (HLM) analysis was used to determine significant differences in posttest performance among the treatment conditions (O’Connor, et al., 2010). Findings suggest that students in the treatment condition demonstrated improvement in reading fluency with no significant differences between grade levels or between treatments. The practice in oral reading had no impact on vocabulary or decoding skills, whereas growth in reading fluency did positively impact changes in comprehension. The lack of impact on decoding skills is expected when compared to the readers who struggled in Ehri and Wilce’s (1983) study. Less skilled readers who demonstrated difficulty developing phonetic decoding skills had a greater inclination toward reading words as a whole unit rather than to full unitization at the orthographic level.

Students with adequate WRE but poor ORR may require instruction focused on increasing semantic and orthographic representations rather than learning how to decode (Eason, et al., 2013). A measure of WRE may better capture the specific deficit and provide direction for the focus of intervention. Thus, automaticity occurs when WRE is paired with a sufficient ORR, which allows the reader to use cognitive resources to fully comprehend a text. The interaction of autonomy, cognitive resources, and speed produces automatic fluent reading and is a cornerstone of successful comprehension.

An additional variable impacting the decoding process is auditory memory (McCallum, et al., 2006), which is a significant construct in reading achievement and demonstrates the strongest correlation with decoding. Auditory memory is also one of the most significant predictors of spelling and decoding (McCallum, et al., 2006) must not be overlooked when examining reading accuracy, reading fluency, and performance in reading comprehension.
Working Memory

Working memory (WM) is an additional construct operating within word recognition systems. Orthographic processing, automaticity, and WM create a cognitive interaction to establish fluent reading (McCallum et al., 2006; O’Brien, 2014; Schwanenflugel et al., 2006; Swanson & O’Connor, 2009). Struggling readers tend to demonstrate less capable WM in relation to good readers, and the lack of WM appears to be at the core of individual learning disabilities (Liberman & Liberman, 1992; Liberman & Shankweiler, 1985; Swanson & Siegel, 2001).

The relationship between reading fluency and reading comprehension was examined through investigation of the impact of WM and its capacity to mediate reading fluency on text comprehension within a population of average and below-average readers (Swanson & O’Connor, 2009). Two models of fluency practice were tested to investigate the relationship between WM and reading comprehension for readers who lacked the ability to read fluently. Readers from grades two and four were selected and randomly assigned to a control group or one of two treatment conditions: continuous reading or repeated reading. Since subgroups of students from the same classroom were used for the study, cluster randomization design provided the opportunity to compare subgroups from the same classroom. Hierarchical linear modeling (HLM) analysis was used to determine differences in posttest scores between the conditions.

Findings demonstrated that students with higher WM performed better on text comprehension measures compared to those with lower WM (Swanson & O’Connor, 2009). When the hierarchical linear model separated pretest scores, vocabulary, and word-attack skills,
WM was significantly related to posttest outcomes in text comprehension. There were no significant interactions between fluency conditions and WM on posttest measures of comprehension. In other words, increases in reading fluency did not have an effect on WM. Last, students in the continuous reading condition performed just as well as the fluency group on measures of text comprehension and word identification. Growth in fluency accounted for a significant variance in text comprehension.

However, the study presented problematic results when considering common assumptions related to reading fluency in the context of the struggling reader. First, the belief that fluency is the result of automaticity has been compromised since a direct effect of fluency practice on WM was not detected in the study (Swanson & O’Connor, 2009). Second, WM capacity may have a more generalized impact on word attack skills. WM accounted for differences in reading comprehension separate from reading fluency. According to Swanson and O’Connor, WM plays a larger role in the successful comprehension of a text than simply attributing comprehension to fluent reading.

Difficulties in WM are viewed as secondary to phonological processing problems, making word attack skills more likely than WM to predict performance outcomes (Swanson & O’Connor, 2009). Additional modeling resulted in the combination of WM and word attack measures demonstrated a relationship to fluency, text comprehension, and word identification. The ability to read fluently alone does not translate to improved comprehension. Results of the study confirmed the notion that WM plays an important role within disfluent readers’ text comprehension. “Low level” difficulties such as decoding and word attack skills may often be at the core of “high level” problems in comprehension (Byrne, 2018). Therefore, word-attack skills along with WM were statistically significant for predicting level of performance on reading
comprehension posttests (Swanson & O’Connor, 2009, Perfetti & Lesgold, 1979). A kind of “backtracking” through the cognitive processes underlying word recognition leads to the development of word reading skills during early literacy acquisition. Word attack skills begin with effective phonics instruction. Examination of phonics pedagogy in the literature is necessary to determine practices for phonics instruction supported by empirical evidence.

Phonics Pedagogy

Word accuracy and word reading efficiency play a central role in oral reading fluency and are reflective of the phonological and orthographic processing systems (MacCallum et al., 2006). These are the systems that merge during the consolidated alphabetic phase (Ehri, 2005). One major pathway for developing the phonological and orthographic processing systems is through phonics instruction. But controversy regarding best practices for phonics instruction continues to penetrate the professional landscape. Holistic and implicit practices in which students are immersed in language allow phonics instruction to emerge from exposure to print in comparison to the letter-sound focus in which students receive directed and explicit instruction in a systematic manner during formal reading instruction.

The US National Reading Panel (NRP) recommended the use of phonetic teaching approaches over the use of whole word practices (Ehri et al., 2001; NICHD, 2000). Since word recognition ability accounts for a significant amount of variance in reading comprehension (Juel et al., 1986; Perfetti, 1985), the research continues to examine the core deficits of struggling readers. Difficulties in early reading acquisition are attributed to deficits in core phonological processing (Bradley & Bryant, 1983; Gough & Tunmer, 1986; Hoover & Gough, 1990; Stanovich, 1986). In addition to phonological processing, orthographic processing or spelling
also accounts for variance in word recognition ability (O’Connor & Padeliadu, 2000). Poor spelling is reflective of the orthographic mappings of words into the lexicon, and if initial exposure has been limited or is irrelevant to the student, the orthographic mappings will establish with poor quality.

In English-speaking countries where phonics is taught, phonics instruction seems to start with an analytic methodology in which children are initially taught to read words as a whole rather than by decoding (Johnston et al., 2012). After this initial training with whole words, students receive instruction in phonetic decoding skills, or synthetic phonics, where they are taught to segment and blend sounds into words.

Because instructional approaches differ between synthetic phonics instruction and analytic phonics instruction in terms of impact on early literacy acquisition and initial exposure of content, it is necessary to determine the most effective practice for teaching students letter-sound relationships for word recognition. Is a whole-to-part approach (e.g., analytic phonics instruction) more impactful with emergent readers or does a part-to-whole approach (e.g., synthetic phonics instruction) offer more effectiveness when developing word acquisition and recognition skills in young children? Two key approaches to phonics instruction dominate the instructional landscape: synthetic phonics and analytic phonics. The impact on student achievement in reading has been examined and compared in a wide range of studies to determine the approach that yields the strongest results for student growth in reading.

**Synthetic Phonics vs. Analytic Phonics Instruction**

Synthetic phonics instruction promotes the initial blending of individual sounds to form words. Students begin by learning letter names and sounds, followed by the sounding and
blending of letters together to read words (Johnston et al., 2012). In analytic phonics instruction, lessons start with whole words or words students can already identify accompanied by follow-up analysis for phonic elements and letter patterns.

For the purposes of this study, clarification and definition of the terms synthetic phonics instruction and analytic phonics instruction clarified the focus of the study. The synthetic method can be defined as instruction that starts with the smallest unit of sound, or the phoneme, and builds grapheme-phoneme connections until students can segment and blend, or synthesize, sounds together to form increasingly longer and more complex words. Part to whole sequences dominate synthetic phonics instruction, which is often described as systematic phonics in which grapheme-phoneme correspondences are explicitly taught in a predetermined sequence with initial instruction targeting the smallest grain size of the phoneme (Ehri et al., 2001; Wyse & Goswami, 2008) prior to responding to the meaning of words (Bowers, 2020). A systematic approach contrasts incidental or as-needed instruction, which often parallels whole language methodology (Bowers, 2020). As students encounter new phonic elements in text, instruction then targets phonic units that are smaller or more isolated in presentation. Synthetic phonics teaching is also referred to as systematic phonics instruction, although analytic phonics can also be delivered in a systematic manner.

Analytic phonics instruction starts with the whole word, in that children are initially taught to read words by sight (Johnston et al., 2012). Readers are then taught to recognize letter sounds at the beginning, then at the end, and finally in the middle of words. Word analogies in which readers use the spelling-sound pattern of one word are applied to the pronunciation and spelling of a similar word, such as peak and beak (Goswami, 1995). The use of analogy, including onset and rime, provides a language basis for children to extract letter-sound
relationships. For example, Wylie and Durrell (1970 as cited in Goswami, p. 141) found that “knowledge of just 37 rimes enabled children to read 500 of the most frequently-occurring words.” Analytic phonics instruction targets the use of larger units of letters and sounds for word identification (Ehri et al., 2001). A closer examination of synthetic and analytic phonics practices reveal the trends when considering the impact on student learning.

**Synthetic Phonics**

Research has compared the impact of synthetic phonics instruction on the accuracy of word recognition for the elementary reader. The synthetic phonics approach demonstrated the greatest gains in word reading skills, and students maintained gains on subsequent post-tests (Chall, 1996; Ehri et al., 2001; Johnston & Watson, 2004; Johnstone et al., 2012; O’Connor & Padeliadu, 2000).

Synthetic phonics instruction has also been investigated in related studies throughout the past century (Chall, 1996). A comparison of the look-say method and the phonics method for instruction in both first and second grades provided direction for reading instruction during the early 1900s. During this time, most phonics studies were conducted with first and second-grade students and lacked scientific rigor and limited information regarding longitudinal effects of phonics instruction. When examining word recognition and oral reading rate, the phonics-trained children outperformed the look-say (visual recognition of the whole word) children in both first and second grades on word list reading and silent reading comprehension and vocabulary assessments. At the beginning of formal instruction at school, systematic synthetic phonics achieved early superiority on word recognition and spelling, at least through grade three.

More recent studies rename systematic phonics as synthetic phonics instruction and
continue to determine the effectiveness of synthetic phonics instruction. Ehri et al. (2001) conducted a meta-analysis to examine experimental studies that implemented systematic synthetic phonics instruction to one group of children and another type of unsystematic phonics or no phonics to a control group. Peer-reviewed studies in which reading was measured as an outcome of instruction were used for the meta-analysis. Reading and spelling outcomes were measured based on performance in decoding regularly spelled words, decoding pseudowords, reading real words, spelling words, and comprehending connected text. In particular, studies that targeted students with a reading disability (RD) were examined for the capacity of phonics instruction to prevent reading failure and whether it helped to remediate the reading difficulties among older struggling readers. Effect size was calculated to determine the extent to which the treatment group exceeded the performance of the control group. The impact of phonics instruction was more statistically significant among beginning readers (d=0.55) than among older readers (d=0.27), while effects were very similar for kindergartners (d=0.56) and first graders (d=0.54). Beginning readers demonstrated the greatest impact of early phonics instruction (Ehri et al., 2001).

One particular series of studies from Ehri’s (2001) meta-analysis investigated the longitudinal effects of early phonics instruction on struggling readers (Blachman et al., 1999; Brown & Felton, 1990; Torgesen et al., 1999). Phonics instruction began in kindergarten or first grade and continued for an additional two or three years with four treatment-control comparisons. Mean effect sizes were moderate and their impact was maintained across the grades: kindergarten $d=0.46$; first grade $d=0.54$; second grade $d=0.43$. This demonstrates the value and importance of starting phonics instruction early and continuing it for two to three years (Ehri et al.). In studies targeting second through sixth grade, effect sizes were significant
but smaller. The smaller effect sizes may be the result of the additional time required to correct established reading behaviors in older developed students.

Findings from these studies support the notion that phonics instruction improves reading ability more than the absence of phonics instruction, even among readers who are progressing within a normal range. The exception to these findings relates to older low achieving readers: phonics instruction did not accelerate reading abilities within this subgroup (d=0.15). Additional underlying issues such as WM or cognitive processing speed may also impact the growth of reading for the older low achieving readers and may have played a role in the outcome measure.

Similarly, despite Ehri et al.’s (2001) meta-analysis that demonstrated treatment gains in phonics diminishing over time, Torgesen et al. (1999) found synthetic phonics instruction yielded increasing gains as students grow older. Findings from Torgesen et al. as well as from Johnston and Watson (2004, 2005) align with Johnston et al’s (2012) outcomes that demonstrate increasingly better performance for students who received synthetic phonics instruction early in their schooling. One explanation cited the use of analytic phonics approaches may not provide the degree of intensity and clarity necessary to help struggling readers overcome difficulties with word recognition skills in initial reading instruction. Since analytic phonics instruction begins with the whole word and then analyzes for letter-sound correspondences, this approach tends to lack the repetition and small grain size (the degree of clarity and focus on parts that make up a whole) necessary for providing intensive phonics instruction.

Synthetic phonics proved to have greater effect during early literacy acquisition in a comparison study (Johnston & Watson, 2004). A series of intervention studies in the United Kingdom (UK) explored the effects of synthetic and analytic phonics instruction on word reading ability in young children. In Experiments 1 and 2, three groups of five-year-old children
were studied with one control group and two experimental groups. The analytic phonics group (also deemed the control group in this study), sample size n=109, received training from an analytic phonics program. The analytic + phonological awareness group, sample size n=78, received instruction in analytic phonics and phonological awareness training. The synthetic phonics group, sample size n=117 with a lower socioeconomic status (SES) when compared to the analytic group and the analytic + phonological group, received synthetic phonics instruction.

After pre-testing a series of phonological awareness and literacy tasks such as phoneme segmentation, letter knowledge, emergent reading, real word and nonword reading tests, and a spelling test, students received instruction based on their grouping for 20 minutes a day for 16 weeks. Two series of posttests were administered: one after the initial 16-week period and a second after both analytic phonics groups were taught the synthetic phonics lessons. At the conclusion of the first post-test assessments, all of the children in the analytic phonics and analytic phonics + phonological awareness groups received instruction using the synthetic phonics program (Johnston & Watson, 2004). These studies took place in the United Kingdom, and the education authority expressed concern for ethical issues and sought equitable instruction for all groups. Therefore, all groups received instruction using the synthetic phonics program at the conclusion of the study. By the end of the following school year and 15 months after the end of the program, all of the children were retested with standardized tests of word reading and spelling. Newman Keuls tests were used to compare the means and establish statistical significance. A difference between the groups no longer existed.

Results of the first round of posttesting the same phonological awareness and literacy tasks from prior to instruction demonstrated the synthetic phonics group performed higher than the other two groups. The synthetic phonics group performed better on tests of single word
reading ability, nonword reading, and the ability to spell dictated words more than the other two groups who did not differ from each other. This comes as a surprise since the students in the synthetic phonics group were randomly of lower socioeconomic status and may have experienced a lack of exposure to language and print that could accompany this status.

When tested for spelling, there was no significant difference between the groups, but when analyzed by class, there was a significant difference by subject analysis. The children were not taught individually, but as a class instead of participants as the random variable. Newman Keuls tests showed the synthetic phonics group had higher spelling skills than the analytic phonics and analytics phonics + phonological awareness groups. When examining how many children were more than a year behind according to chronological age in reading, 6 out of 264 (2.2%) fell into this classification and none of the children had been part of the synthetic phonics group. On the test of reading comprehension, there was no significant difference between groups after all groups had received the synthetic phonics portion of instruction (Johnston & Watson, 2004).

When considering the results of the study, the efficacy of the Johnston and Watson (2004) investigation came into question. Wyse and Goswami (2008) presented questions regarding the study design and its lack of parallel content among the treatment conditions. Regardless of the instructional approach, it appears there was inconsistency among the groups as to how many words were taught during the study (Wyse & Goswami). To make accurate comparisons between the student groups, the number of words, letters, sounds, and overall curriculum included in the treatments should remain consistent. In addition, the need to contrast each instructional approach and whether instruction occurred within the context of sight words or began from individual letters and sounds can provide important clarification and better define
the impact of each type of instruction. Since the efficacy of the Johnston and Watson study has come under question, the reported outcomes lack validity, according to Wyse and Goswami (2008). However, it is significant to note that even though the synthetic phonics group was classified as low SES, they outperformed the analytic phonics and analytic phonics + phonological awareness groups, according to the Newman Keuls tests (Johnston & Watson). This finding aligns with a meta-analysis of the effectiveness of systematic phonics instruction (Ehri et al., 2001) in which phonics instruction had the greatest impact on children from low SES backgrounds.

Due to its consistent positive impact on early literacy acquisition, synthetic phonics became the key component of a mandate for school children in the United Kingdom. The Rose Report (Rose, 2006) described this series of mandates for schools. Wyse and Goswami (2008) examined the impact of the Rose Report along with the government recommendation for the use of a synthetic phonics approach for reading instruction in England. Wyse and Goswami’s report included implementation of the Simple View of Reading (Gough & Tunmer, 1986) and recommended that teaching practices incorporate the two processes of word recognition and language comprehension (Wyse & Goswami). The Simple View model supported the parameters of the Rose Report, which included that systematic phonics be taught discretely and in isolation. However, upon further examination of the Rose Report, Wyse and Goswami raised several concerns about the recommendation. The research underlying the recommendation lacked empirical evidence and the use of a randomized control trial methodology that was proposed before creating national educational mandates.

In another study, the positive outcomes for readers who were exposed to synthetic phonics instruction was the focus of a study that investigated reader sensitivity to letter
combinations and position in a word (O’Brien, 2014). Since the structure of the English language is vastly different from many other alphabetic languages (Wyse & Goswami, 2008), it becomes imperative to examine the English language more closely. In English, the phonological organization of syllable structures along with the inconsistent spelling system may indicate the need to use direct instruction that goes beyond the phoneme to become an effective reader. Languages such as German, with a simple consonant-vowel (CV) syllable structure are comprised of words that are configuratively longer in number of letters than in English; however, these longer words are easier to segment into phonemes. The predominant syllable type in English is consonant-vowel-consonant (CVC), which is present in 43% of monosyllabic words, along with consonant-vowel-consonant-consonant (CVCC) syllables comprising 21% of the English language. Even though many German words share the same base word as English, children in Germany learn phonics faster than children learning phonics in English (Frith et al., 1998 as cited in Wyse & Goswami, 2008) due to the ease of the syllabication process in the German language.

Synthetic phonics also demonstrates greater effects on word recognition. The synthetic and analytic phonics approaches were investigated through the immediate and longitudinal effects of two daily tutoring conditions created to teach children (n=12) from four first grade classes in an urban elementary school to read regularly spelled words (O’Connor & Padeliadu, 2000). One condition replicated the synthetic phonics methodology, and the other condition was similar to analytic phonics teaching. The synthetic condition included instruction in blending sounds into words, also known as decoding. In this study, the analytic condition included a gradual introduction of whole words. Both conditions included instruction in letter-sound relationships as well as spelling words from the pre-selected word set.
Findings demonstrated a lack of variance between the treatment conditions (O’Connor & Padeliadu, 2000). However, posttests administered one week later found differences in favor of the synthetic phonics blending treatment on reading and spelling pre-selected words as well as on transfer to words composed of familiar letter sounds. Students who received the synthetic phonics treatment held onto the capacity to segment and blend sounds of a word at a higher success rate than their counterparts who were taught using a whole-word methodology in the study. The role of WM may partially explain the variance between the two treatments (Swanson & O’Connor, 2009). Since WM plays a significant role in the cognitive interactions of the reading process, students who are struggling to read may concurrently struggle with working memory tasks such as word recognition. Students receiving whole-word instruction or the analytic phonics group may have needed strong WM to successfully progress through the analytic phonics treatment.

The addition of systematic synthetic phonics teaching to existing programs such as Reading Recovery (RR; Clay, 1993), yielded different outcomes through the use of experimental design. In contrast to the original RR program for first-grade students, the RR program was modified to include the use of rhyme patterns with students in grades two through five for analyses and application to real and pseudoword reading. Students were explicitly taught to read and write words with rhyme patterns. Children in a control group were taught the same words, but instruction lacked a focus on the rhyme pattern and specific sequence of content. Results favored the students who received targeted rhyme instruction on tests of word and pseudoword reading but not on tests of reading comprehension with an overall effect size of $d=0.37$ (Greaney et al., 1997). The use of larger units of letter strings and analysis at the word level makes this study more analytic rather than a blending of letter sounds or the synthetic phonics
approach. Findings demonstrate that phonics enrichment improves the effectiveness of RR for teaching word reading skills. The addition of intentional and explicit instruction increases the intensity of instruction while developing word reading skills (Ehri et al., 2001).

The complex nature of learning to read in the English language makes it unlikely that the universal adoption of one single method, in this case synthetic phonics, will resolve a nation’s literacy problems (O’Brien, 2014). The irregularities of the orthography in English have led to an increasing use of whole word methods in conjunction with phonics methods that emphasize the analytic teaching of early reading skills in word recognition instruction (Johnston et al, 2012). In fact, it has been suggested that once an early reader has established a foundation in letter-sound correspondence, instruction in analogizing provides additional neural pathways for word recognition (Ehri, 2005) therefore, practices that represent analytic phonics instruction were also examined for their impact on early reading acquisition.

Analytic Phonics

Analytic phonics has been defined in a variety of ways. One definition describes the analytic method as a whole-word approach, or the look-say method, with an emphasis on word families (Johnston et al., 2012) Sounding and blending are not the principal or initial practices in learning to recognize words. Some researchers propose that the analytic method promotes the practice in which students are taught to guess unknown words based on context. Another definition describes a practice in which students are instructed to analyze word parts and attach sounds to read words with a focus on whole to part along with an initial interaction with larger grain sizes or isolated letters and sounds (Ehri et al., 2001; Moustafa & Maldonado-Colon, 1998). Recognition of letter-sound combinations in known words is a significant feature of the
analytic phonics approach along with the teaching of high frequency words without significant phonic analysis (Johnston et al.).

Letter-sound relationships are targeted once the word is identified and understood (Ehri et al., 2001). Children are encouraged to link a current word to another word they may already know as a means for word identification in analytic phonics teaching. Analytic phonics instruction has always addressed the teaching of letters and sounds (Goswami, 1995) and includes systematic teachings that can also be addressed on an as needed basis. Analytic phonics begins during phonological awareness training and instruction, with rime and onset, for children to play with language and build oral language skills. Directed and explicit instruction is the outcome of analytic phonics lessons. Both phonics approaches can include the same scope and sequence of orthographic patterns (Johnston et al., 2012).

As a precursor to whole-word methodology, the psycholinguistic perspective (Goodman, 1970) proposes a process in which readers access the semantic, syntactic, and graphic cues from a text to read accurately and meaningfully. Readers do not improve their capacity to read words accurately by decoding and automaticity but rather through sampling cues from the text in the form of predictions or guesses. These predictions are then confirmed using semantic and syntactic information from the text. Reading is (perhaps, inappropriately) described as a psycholinguistic guessing game that emphasizes the importance of maintaining consistency with semantic and syntactic information rather than graphic cues in the text (Ehri, 2020). Also known as “cue reading,” this approach includes the visual cross-checking of a word by examining the letter strings for a letter-sound match (Gough et al., 1972).

The empirical research that supports analytic phonics is limited. Few studies have been conducted to evaluate the effectiveness of whole-word analytical approaches to word recognition
instruction. In addition to the synthetic phonics practices already described, the Reading Recovery (RR) intervention was examined for its use of analytic phonics instruction (Santa & Hoien, 1999). A modified RR format using an experimental design called for at-risk first-grade students to receive additional word study instruction through word sorting activities. The nature of this study also placed it categorically within analytic phonics instruction.

In this study, the control group received small group-guided reading instruction without any word study instruction. The experimental group received word study activities that consisted of word sorts based on phonograms (e.g. -at as in hat, cat, sat) and spelling instruction in which students wrote letters for the sounds heard in words. Analogy strategies were taught for students to read new words. The treatment group outperformed the control group in reading comprehension ($d=0.73$) as well as word reading ($d=0.93$) (Ehri et al., 2001). This demonstrates the positive impact of analytic phonics on word recognition development and the importance of providing opportunities for meaning making and application within reading instruction.

When analytic phonics instruction was coupled with an element of systematic and explicit instruction, the results demonstrated increased performance on real word and pseudoword reading (Santa & Hoien, 1999). However, performance on comprehension assessments decreased when phonics instruction was isolated from connected and meaningful text. Analytic phonics instruction demonstrated a greater impact when students were initially taught letter-sound relationships in isolation followed by application to real reading experiences. To complete the process of storing words in memory or the mental lexicon and to move students into the consolidated alphabetic phase, students need meaningful and relevant experiences with words (Ehri, 2005; Perfetti, 2002). Words become imprinted or mapped in the lexicon upon repeated exposure to print and spellings during reader engagement with text (Ehri et al., 2001).
Conclusion

Early literacy acquisition requires well-developed word recognition skills that develop through a series of stages of each phases for young readers (Ehri, 1998, 2005; Chall, 1983; Gough & Hillinger, 1980). Each stage reflects the kinds of information and understanding necessary to move to the next stage of word recognition. The pre-alphabetic stage finds readers relying on isolated visual cues in the word for recognition. During the next stage of growth, the partial alphabetic stage, the reader starts to recognize a couple of individual letters in a word and begins to apply decoding (letter-sound recognition) to word recognition tasks. Readers in the full alphabetic phase have created connections between phonemes and graphemes and can pronounce words accurately. The consolidated alphabetic phase is represented by fluent, effortless reading that underlies the successful comprehension of text (LaBerge & Samuels, 1974; Perfetti & Hart, 2002). Children who have efficient word-recognition skills should be able to read connected text fluently and better understand what they read (Schwanenflugel et al., 2006). The big three processing variables (orthographic, automaticity, and phonological processes) have been documented as providing the underpinnings of fluent and accurate reading (How & Larkin, 2013; McCallum et al., 2006; Moats, 2005; O’Brien, 2014; Schwanenflugel et al., 2006; Swanson & O’Connor, 2009; Snow, et al., 2005). Phonological processing, or decoding of letters and sounds, takes place when the reader identifies the sound that matches the letter or letter strings and develops through the pre- and partial alphabetic phases of word recognition (Ehri, 2005; Juel et al, 1986; McCallum et al, 2006). Phonics instruction is a key component of phonological processing and provides essential foundational skills for decoding.
within the full alphabetic phase of word recognition and later reading achievement within the consolidated alphabetic phase (Bradley & Bryant, 1983; Chall, 1967; Ehri, 2005, 2020; Ehri & Wilce, 1993; Ehri et al., 2001; Gough et al., 1992; Juel, 1988; Juel et al, 1986; McCallum et al, 2006).

Debates continue among literacy professionals, especially when it comes to phonics instruction in the elementary context (Semingson & Kerns, 2021). Topics such as beginning reading instruction, decoding, phonics, and the science of reading have dominated social media sites, groups, blogs, professional journals, podcasts, and hashtags. Much of the argument has settled on one key question: which is more effective for students during early literacy acquisition: systematic phonics instruction or analytic phonics instruction? Surprisingly, very little research calls for further investigation of the most effective approach for teaching phonics, a core variable in later reading achievement (Bradley & Bryant, 1983; Chall, 1967; Ehri, 2020; Ehri & Wilce, 1993; Ehri et al, 2001; Gough et al., 1992; Juel et al, 1986; McCallum et al, 2006). Due to limitations in instructional time, teachers of reading need to know the “active ingredients” (Ehri, 2001, p. 432) of reading instruction that will result in the highest levels of literacy for students in the most efficient manner. When it comes to phonological processes and the teaching of phonics, a deeper understanding of the impact of synthetic phonics instruction and analytical phonics instruction will provide practitioners with essential information for the development of core reading practices and acquisition.
CHAPTER 3

METHODOLOGY

Phonics instruction is significant in the process of early reading acquisition, so the effects of synthetic and analytic phonics instruction on oral reading accuracy, rate, and letter-sound correspondences were examined to determine their effectiveness among first grade students. Educators want to know whether instructional practices are effective and have the potential to result in student growth (Baer et al., 1968). Therefore, an adapted alternating treatments design (AATD; Wolery et al., 1988), a form of single subject design (SSD), was used to compare the effectiveness of the two prominent phonics practices: a synthetic phonics intervention and an analytic phonics intervention. Synthetic phonics instruction (Appendix D) promotes the initial blending of individual sounds to form words. Students begin by learning letter names and sounds, followed by the sounding and blending of letters together to read words (Johnston et al., 2012). In analytic phonics instruction, lessons start with whole words or words students can already identify accompanied by follow-up analysis for phonic elements and letter patterns (Johnston et al., 2012).

This chapter includes the following sections: descriptions of the participants, the participant selection process, the experimental design and, the setting as well as the skills selected for instruction, the independent and dependent variables, data collection procedures, procedural fidelity, and data analysis.
Participants

The participants were first-grade students from an elementary school located in a middle-class neighborhood in the suburbs of Chicago. The school serviced a student population of 423 students: 16% were classified as low income with 101 students receiving free or reduced lunch, 14% were identified as students with disabilities, and 3% were English learners. Student demographic data for the school were 72% White, 4% Black, and 18% Hispanic with a 95% student attendance rate. The average class size was 22 students, and 35% of the student population received a proficient rating (met grade level expectations) on the IAR assessment in 2019. Per pupil operational spending in the district was $13,886 in comparison to the state average of $14,700 per pupil spending in 2019 (Illinois Report Card, 2020).

Five students participated in the study. All five attended kindergarten the year before at the same school but due to the pandemic of 2020, the students received core instruction using a hybrid model of delivery (attended school in-person every other day of the school week). Each participant’s school and family history were helpful for understanding how they qualified to participate in the study. (see Appendix B for parent permission letter and Appendix C for participant recruitment script).

Holly comes from a large family and takes her place in the middle of five children along with a late July birthday. Holly started first grade with limited letter-sound knowledge and often restrained from verbally communicating in her classroom and/or interacting with her peers. During kindergarten, she received reading intervention services through a combination of in-person and virtual instruction. In first grade, her core phonics instruction was based on a pilot program featuring analytic phonics instruction.
Shayla was the oldest of three children, and due to changing mask regulations from the 2020 pandemic, she presented a minor speech articulation issue once masks were removed during first grade. With a late July birthday, she started first grade with limited letter-sound knowledge but seemed eager to learn. During kindergarten, she received reading intervention services through a combination of in-person and virtual instruction. In first grade, her core phonics instruction was based on a pilot program featuring analytic phonics instruction.

Wesley was the youngest of two children and demonstrated slow cognitive processing of knowledge during reading intervention lessons. He was screened for speech and language services but did not qualify in first grade. He started first grade with letter-sound knowledge and was able to apply it when reading an early first-grade text, but as the school year progressed, he struggled to accelerate his reading skills and had difficulty with the pacing of reading instruction in the general classroom. During kindergarten, he received reading intervention services through a combination of in-person and virtual instruction. In first grade, his core phonics instruction featured synthetic phonics instruction.

Sandy was the youngest of two children and showed significant growth during first grade. She started first grade with limited letter-sound knowledge and lacked confidence in and motivation for learning. She frequently appealed for help to complete independent assignments in the core classroom. She did not receive reading intervention services during kindergarten. Her core phonics instruction featured synthetic phonics instruction, and her classroom teacher was replaced with a long-term substitute teacher (maternity leave) for three months late in the fall.

Giselle was an only child and started first grade with letter-sound knowledge, which placed her in the first-grade range. She did not qualify for reading intervention services in
kindergarten or beginning first grade but received speech and language services for speech articulation. Giselle was successful at reading increasingly harder first-grade text but often struggled with decoding and encoding. Her core classroom phonics instruction featured the pilot analytic phonics program.

Participant Selection

Since this study took place in a multi-tiered systems of support (MTSS) delivery model. Criterion sampling procedures were used to determine participant selection (Mertens, 2020). The following criteria were used to determine selection of participants for this study: 1) students attending a specific elementary school in the far western suburbs of Chicago, 2) students who qualified for MTSS support services based on local reading assessment scores (Nelly & Smith, 2000) that fell below the 25th percentile, 3) students who were referred to MTSS for reading improvement services by the classroom teacher, and 4) students assigned to one of the first-grade classrooms in the sample elementary school. The students were selected based on performance on local assessments, including the Rigby Benchmark Assessment (Nelly & Smith, 2000; Rigby, 2006), AIMSweb R-CBM fluency probes, and the Words Their Way (WTW) Primary Spelling Inventory (Baer et al., 2007). Scores falling below the 25th percentile on the AIMSweb fluency probes and WTW assessment along with Rigby guided reading levels falling two or more below grade level expectation qualified participants for the study. When the qualifying scores for word accuracy and reading fluency fell below 25th percentile, the students generally needed to develop the same kind of phonetic decoding skills to improve reading accuracy and fluency.

Of the seven participants who qualified for the study, five students received parent consent and were placed into two treatment groups. Due to scheduling conflicts, the three lowest
performing students were placed in one group and the remaining two were placed in the second group, which eliminated some opportunity for equal matching between groups. The design allowed for the use of existing groups in a public school setting. Students who qualified for the intervention but were not able to participate in the study were serviced through placement in another MTSS group scheduled at a different time of day.

Experimental Design

AATD, a variation of alternating treatments design, was used to compare the effects of two phonics interventions on students’ ability to read fluently and accurately (Appendix D). This design allowed for an assessment of the relative merits of the two interventions (Wolery et al., 1988) and determined if a behavior change occurred when the intervention was introduced (Ledford & Gast, 2018). In this study, the dependent variables were oral reading rate (in the form of correct words per minute) and word reading accuracy (the number of words read correctly on a wordlist and the number of errors within each fluency passage) as measured by AIMSweb R-CBM (2017), the WADE (Wilson, 1998), and the Test of Word Reading Efficiency (TOWRE-2; Torgesen et al., 2012). AIMSweb R-CBM (Shin, et al., 1992) was used to measure reading fluency, the WADE and the TOWRE-2 measured each participant’s ability to read accurately using knowledge of letter-sound relationships to decode words and nonwords. The Words Their Way (WTW) Primary Spelling Inventory was administered to measure letter-sound correspondences before and after completion of the study.

Intervention delivery took place in small groups with five students who were performing below grade level expectations in reading. Student performance on the AIMSweb Reading Curriculum-Based Measurement (AIMSweb R-CBM, 2017) and the real word list from the
Wilson Assessment of Decoding and Encoding (WADE; Wilson, 1998) were examined two or three days per week to determine the effectiveness of a synthetic phonics intervention in comparison to an analytic phonics intervention.

Single subject design (SSD) is a quantitative experimental approach that employs a principle known as baseline logic in which participants or the independent variables become their own control (Sidman, 1960, as cited in Ledford & Gast, 2018). Each intervention served as a control. The intervention conditions were rapidly alternated between treatment conditions (Ledford & Gast, 2018; Appendix E). Data are visually presented on a line graph and were analyzed using visual analysis (Barton et al., as cited in Ledford & Gast, 2018). This process helped to identify interventions that were most effective and related to meaningful outcomes.

The students came from one of the three first-grade classrooms in the targeted school. Permission was secured from all key stakeholders, including school district leadership, classroom teachers, parent/guardian (see Appendix B), the students themselves (Appendix C), and the Institutional Review Board (IRB) from Northern Illinois University. Students were assigned to one of two groups, creating three participants in one group and two participants in the other. Each group was then assigned to one of the two instructors for the study. Students remained with the same group and instructor for the duration of the study.

Before the start of the study, any extraneous variables were counterbalanced between the two participant groups. Due to an ongoing pilot program in the district, core phonics instruction in the general classroom differed among the students. One first-grade classroom piloted a new analytic phonics program based on the Fountas and Pinnell Phonics, Spelling, and Word Study, Grade 1 (Fountas & Pinnell, 2018). The program was predominantly composed of phonics lessons that used word sorts and analysis. The other two first-grade classrooms continued a
synthetic phonics program based on Fundations (Wilson, 2012), a program composed of systematic directed phonics lessons in which students were to synthesize and blend sounds together to read words. The synthetic phonics program had been implemented in the district for the past several years. A balance between the two programs was necessary to minimize historical variables among the participants.

A schedule for intervention implementation was established through a randomized sequence (Appendix F). Each intervention condition was listed on six pieces of paper in a container. At the beginning of the study, a drawing took place to determine the intervention condition for each group for each week of the study. Students received one intervention, either the synthetic intervention or the analytic intervention per school day, with their group for 11 weeks.

Setting

The baseline and intervention sessions were conducted in the same building as the students’ classrooms. Sessions lasted 30 minutes and were five days per week. Students received instruction in a small-group meeting room where they were seated at a kidney bean-shaped table facing a whiteboard. The whiteboard had anchor charts displaying visual resources of letters and keywords to help with corresponding sounds. This arrangement minimized distraction from movement in the hallway as students were faced away from the door.

Two teachers delivered instruction for the duration of the study. The first teacher, the researcher of this study, has been a reading specialist for grades K-5 for the past 13 years and specializes in early reading acquisition and corrective reading development for dyslexic readers. The second teacher has been instructing students within the MTSS program as an instructional
assistant for the past 12 years and has been training under the direction of the researcher for the duration. Both teachers had their own small classroom for intervention implementation.

Procedures

Pretests and Baseline Session

The baseline phase during a single case study allows data to be collected when the independent variable is not being implemented. During baseline, the instructor gathers data from one student at a time using four measures, according to the protocols for AIMSweb R-CBM, the phonemic decoding efficiency test from the TOWRE-2, and the WTW Primary Spelling Inventory (Baer et al., 2007). Baseline conditions were established during week one of the small group intervention sessions prior to the formal start of the intervention sessions. The testing sessions took place in the small group meeting room with one student at a time during the three days prior to the first intervention lesson.

After establishment of a baseline condition, the interventions were rapidly introduced in a randomized fashion. At least five lessons were dedicated to the initial condition for each group before visual analysis was conducted. This sequential introduction design permitted a credible demonstration of experimental control due to the repeated introduction and withdrawal of an intervention (Ledford & Gast, 2018). The AATD controlled the sequencing effects and multi treatment interference by alternating sessions when the treatments were given. This counterbalanced design introduced the independent variable at alternating times between the two participant groups.
Instructional Session

The interventions took place every day during the school week as a 30-minute lesson. Students met separately as a group with their assigned instructor one time per day in a small group meeting room. The sequence of interventions each week were determined by random selection at the start of the study. Oral reading fluency and word reading accuracy was measured 2-3 times per week using the AIMSweb R-CBM and reading accuracy was measured two times per week using the WADE wordlist. Data were analyzed to observe a trend of stability. Following a stable trend in data for each group, the next intervention was implemented in the previously established randomized order. Each 30-minute lesson (Appendices G and H), regardless of the intervention condition, consisted of letter-sound practice, word work, reading words, spelling words, and some encoding or writing. The use of a consistent lesson structure between the two conditions minimized the impact of any extraneous variables.

Prior to the beginning of the study, randomization was established by listing each intervention name on six pieces of paper in a container. A drawing took place to determine the intervention condition for each group for each week of the study. Students received one intervention, either the synthetic phonics intervention or the analytic phonics intervention per school day with their assigned group. Due to district testing and other requirements, the duration of the study was 11 weeks.

Following the baseline condition, introduction of the synthetic intervention condition (A) or analytic intervention condition (B) was implemented with each group of students. Group 1’s intervention sequence was A-A-A-B-B-B-B-B-A-A, as determined by randomization procedures. Group 2’s intervention sequence was A-A-A-A-B-B-B-A-B-B-A. Visual inspection
of data determined when an intervention might change. An overview of the design is shown in Table 1.

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Content</th>
<th>Sample Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>Pre-Tests: TOWRE-2 AIMSweb R-CBM WTW Primary Spelling Survey</td>
<td></td>
</tr>
<tr>
<td>1-5</td>
<td>Review consonant-vowel-consonant (CVC) words, bonus letter words, base word + suffix -s, glued sounds: -ang, -ing, -ong, -ung, -ank, -ink, -onk, -unk</td>
<td>pet, mug, kid, toss, well, hams, sheds, sang, lung, sink, honk</td>
</tr>
<tr>
<td>6-20</td>
<td>Consonant blends, digraph blends, closed syllable</td>
<td>best, flap, block, punch, wilt, glass, stuff, grips, stacks</td>
</tr>
<tr>
<td>21-30</td>
<td>Vowel-consonant-e words (VCe), VCe syllable</td>
<td>lime, ape, tide, cube, chase, spoke, rise, kites, grapes</td>
</tr>
<tr>
<td>31-40</td>
<td>R-controlled vowel sounds: ar, or, er, ir, ur</td>
<td>car, bird, burn, her, horn, fern, turn, barn</td>
</tr>
<tr>
<td>41-50</td>
<td>Vowel teams: ai, ay, ee, ea, ey, oi, oy</td>
<td>bait, play, jeep, eat, coin, boy</td>
</tr>
<tr>
<td>51-55</td>
<td>2-syllable words using closed syllables</td>
<td>napkin, dentist, upset, goblin, bathtub, contest</td>
</tr>
<tr>
<td>Post-test</td>
<td>Post-tests: TOWRE-2 AIMSweb R-CBM WTW Primary Spelling Survey</td>
<td></td>
</tr>
</tbody>
</table>

Note. Adapted from Fundations (Wilson, 2012).
Instructional Materials

Instructional materials were based on each program (Appendix G & H) selected for the instructional method. Materials for the synthetic phonics sessions came from the Fundations program and materials for the analytic phonics sessions came from the Phonics, Spelling, and Word Study Lessons, Grade 1 program.

The Fundations program required of a variety of materials to support instruction: alphabet chart with pictures that serve as keywords for each letter and sound, vowel chart with keyword pictures, glued sound chart with keyword pictures, letter formation chart, large letter cards with keyword pictures, small letter cards with no keyword pictures, table-top pocket chart for building words using small alphabet cards, word list books, magnetic letter trays, and a dictation notebook for each student.

The following materials from the Fountas and Pinnell Phonics, Spelling, and Word Study program were used for intervention lessons: cut-apart words for word sorts, a word study notebook and pencil for each student, and an individual white board and marker for each student. The Fundations letter/keyword charts were kept as a reference during the analytic phonics lessons.

Consistent content and curricula were used between the two interventions to maintain the validity of the study. A curricular pacing guide was developed by the researcher, so the participants were learning the same content during the same week regardless of instructional intervention (see Table 1). Content was based on the Fundations scope and sequence. The use of consistent content reduced threats to internal validity.
Due to a current district curriculum review cycle, one of the three general education classrooms was piloting an analytic phonics program in first grade, whereas the other two classrooms were implementing a synthetic phonics program. The Fountas and Pinnell Phonics, Spelling, and Word Study Lessons (Appendix H) is organized by nine areas of word learning: early literacy concepts, phonological awareness, letter knowledge, letter-sound relationships, spelling patterns, high-frequency words, vocabulary, word structure, and word-solving actions. In alignment with an analytic approach in which instruction begins with whole words, the Phonics, Spelling, and Word Study program includes an inquiry approach in that students are encouraged to notice details about letters, sounds, and words through explicit instruction. Professional training for the Phonics, Spelling and Word Study Lessons was provided for the pilot classroom teacher prior to the start of the school year. Due to time constraints and the need to align lesson structure between the two groups, only the word sorts from the Phonics, Spelling and Word Study Lessons were used for the study.

The other first grade classrooms continued instruction using a synthetic phonics program, Fundations (Wilson, 2012; see Appendix G) that had been used in the district for the past 10 years. Fundations provides explicit systematic lessons that focus on the following concepts: word structure, high frequency words, vocabulary, early literacy concepts, phonological awareness, letter knowledge, and letter-sound relationships. Instruction was provided through the use of multisensory structured lessons that began with the smallest unit of sound and then built through the word, sentence, and whole passage level in a systematic manner.
Independent Variables

The independent variables are represented by two instructional intervention packages: synthetic phonics instruction and analytic phonics instruction. Each treatment group was assigned the synthetic phonics intervention or the analytic phonics intervention as the first condition in the AATD sequence. Once a baseline was established, the independent variable (e.g., synthetic or analytic reading instruction) was introduced to each group of students based on the randomization schedule (Appendix F).

The first independent variable, synthetic phonics instruction (Appendix G), represented condition A and taught the initial blending of individual sounds to form words. Students began by learning letter names and sounds, followed by the sounding and blending of letters together to read words (Johnston et al., 2012). In analytic phonics instruction (Appendix H), which was the second independent variable and represented condition B, lessons started with whole words or words students can already identify, accompanied by follow-up analysis for phonic elements and letter patterns (Johnston et al., 2012). Words were analyzed for spelling patterns and word structure.

Each participant received instruction using the same phonics content across the two instructional conditions: synthetic phonics and analytic phonics. Since student groups were counterbalanced to minimize extraneous variables and students performing below the 25th percentile on local assessments generally required nearly the same phonetic content, the use of the same content across both conditions met students’ needs for growth in word recognition skills. The targeted skills fell within the foundational standards of phonics and word recognition from the first grade Common Core Standards (National Governors Association Center for Best
Practices & Council of Chief State School Officers, 2010). The foundational standards are necessary and important components of an effective, comprehensive reading program. Table 1 details the scope and sequence of learning objectives for both conditions as well as sample words that will be used within each condition.

The participants did not miss any core content in the general education classroom. The difference between the class instruction and the intervention sessions existed within the intensity of instruction. Immediate corrective feedback was provided in small groups where lessons were targeted to students’ specific needs within the proposed curricular timeline.

Dependent Variables

In AATD, one variable is manipulated and then the effect is tested for validation or rejection of the effectiveness of the instructional practice (Ledford & Gast, 2018). In the current study, the dependent variables were the oral reading rate, word reading accuracy, and letter-sound correspondence. Oral reading rate was measured by the number of words read correctly using the AIMSweb R-CBM (Pearson, 2017) fluency probe during a one-minute timing. Grade level probes were used for the assessment. Word reading accuracy was measured by the number of errors during the fluency probe, the number of words read correctly on the WADE (Wilson, 1998) wordlist reading assessment, and the score from the Phonemic Decoding Efficiency Test of the TOWRE-2 (Torgesen et al., 1999). Letter-sound correspondence was determined by the score on the WTW Primary Spelling Inventory (Baer, 2008).
AIMSweb Reading Curriculum-Based Measurement (AIMSweb R-CBM)

A measure of oral reading fluency was used to measure the participants’ rate and accuracy. AIMSweb R-CBM is nationally or locally (school or district) normed using percentiles based on a grade level or screening period (fall, winter, or spring). The measurement of oral reading rate serves as an indicator of basic reading competence (Fuchs et al., 2001) and provides data that helped answer the research questions. Fluency probes were administered two times per week to each participant outside of the intervention session. Data were graphed to visually analyze the effects of the intervention.

The national percentile norms are based on large, representative samples of students. Aimsweb R-CBM is a brief, individually administered, standardized test of oral reading for grades 1 (winter) through 12. There are 23 grade-level probes for first-grade students. The same probe was used for all five participants each time the fluency probe was administered to increase reliability. The one-page probe maintains a degree of reliability, or consistency of results over a period of time, as an alternate form of reliability. In other words, different probes yield consistent scores over a short period of time. Cronbach’s alpha for this task at grade 1 was reported to be .96. Reliability presents an important consideration for results to accurately reflect student growth. When a test shows strong prediction with several different criterion measures, there is greater confidence the results can be generalized to other standardized measures of student achievement. The adjusted predictive validity coefficient for grade one oral reading fluency probes in the spring was 0.74. Administration protocols and scoring are located in Appendix I.
Orthographic, or spelling, data were collected using the WTW Primary Spelling Inventory (Baer et al., 2008). Students spelled a series of words in writing that represented key phonetic reading and spelling concepts. Each student’s test was evaluated using the WTW feature guide appropriate to their age-range. Students’ developmental stage was determined by the number of errors within one category or stage of development based on phonetic concepts learned and areas in need of improvement (Baer et al., 2008). Students spelled the same words for both the pre- and post-test. Analysis of the Primary Spelling Inventory using Cronbach’s alpha procedure indicated an overall reliability coefficient of .93, which means the closer to 1.00, the more reliable the instrument (Mertens, 2020). Test-retest reliability estimates for second grade students ranged from a low of .82 in the fall to a high of .93 in the spring. Predictive validity based on reliability and validity analyses resulted in a score of .681 for word analysis by second grade students (Sterbinsky, 2007). The protocol and fidelity checklist for the WTW spelling test are located in Appendix J.

Wilson Assessment of Decoding and Encoding (WADE; Wilson, 1998)

The real word reading test from the WADE was administered as a progress monitoring tool during the intervention phase of the study. The WADE real wordlist is intended to measure fluent decoding of phonetically regular words when presented in isolation. An A wordlist and a B wordlist were assigned to each intervention group to minimize test interference. List A has been designed for elementary students. Since List B is designed for older students with an advanced vocabulary, the list was re-designed by the researcher with words from the Fundations
program so that it would be comparable to List A. Reliability and validity statistics were not available for the WADE. The protocol and fidelity checklist for the WADE are located in Appendix K.

Test of Word Reading Efficiency, Second Edition

The Test of Word Reading Efficiency-Second Edition (TOWRE-2) is a measure of an individual’s ability to identify printed words accurately and fluently (Torgesen et al., 1999). The Phonemic Decoding Efficiency subtest measures the number of pronounceable nonwords presented in vertical lists an individual can accurately decode within 45 seconds. The TOWRE-2 contains four alternate forms, A through D, with 66 items that are equivalent in difficulty. Form B was used as a pre-and post-test in this study. The TOWRE-2 was normed on over 1,700 individuals ranging in age from 6 to 24 years and residing in 12 states and Washington, DC. Over 700 children in the norming sample attended elementary school (through Grade 5) where the TOWRE-2 is expected to be used most frequently. As a measure of instrument reliability, the overall average alternate-form coefficient for Phonemic Decoding Efficiency (PDE) was .92. Analysis for construct-identification validity resulted in a correlation coefficient of .58, a large correlation between the PDE and age. The protocol and fidelity checklist are located in Appendix L.

Data Collection Procedures

The 11-week, or 55-lesson, duration allowed for the collection of multiple data points per condition. Data collection took place before the start of intervention instruction, bi-weekly, and at the conclusion of the 11-week period. Twice per week, the researcher administered the
AIMSweb R-CBM and the WADE Wordlist A or B. The WADE wordlist A was assigned to condition A and wordlist B was assigned to condition B. The wordlists were alternated between interventions to prevent test interference when collecting data points that reflected the influence of the independent variables. The grade level passages from the AIMSweb R-CBM yielded the number of words read correctly and the total number of errors from a one-minute first-grade probe.

Data were collected on alternate days, twice per week, graphed on a regular basis, and analyzed after each session. The collection of continuous data on specific behaviors during the current condition continued for a minimum of three consecutive stable data points. Data were reported as mild, moderate, variable, or stable. Variability could be the result of extraneous events (e.g., health issues, lack of sleep) and indicates the need for additional data in a condition.

**Procedural Fidelity**

Standards for determining the quality of treatment implementation had to be established within the study to maintain a high degree of reliability (Mertens, 2020). Fidelity checks (i.e., procedures that indicate the instructors are implementing the intervention in the same manner and within the same protocol) were necessary to minimize interference with the validity of the study. Prior to the study, the researcher and the MTSS assistant teacher reviewed the implementation protocol using a fidelity checklist (Appendices F & G) presented by the researcher. The second instructor received professional training provided by the researcher, which increased the reliability of the implementation of the independent variable. Reviewers independent of the study conducted observations of the pilot intervention to identify areas in need of improvement based on the fidelity checklist. Lesson components were separated into
two categories: general lesson procedures and lesson procedures. Corrective feedback was provided to the instructor and the official start of the study did not take place until all criteria on the fidelity checklist had been met.

General procedures for the synthetic phonics intervention (condition A) included greeting students as they arrived for the lesson, displaying anchor charts with relevant content and specific to the intervention, monitoring lesson length, providing immediate corrective feedback, discussing goals of the lessons, and questioning students throughout the lesson. Lesson procedures included letter/sound drill, concept instruction, wordlist reading, sound letter drill, spelling words, and dictation.

General procedures for the analytic phonics intervention (condition B) were the same as the synthetic phonics intervention with the addition of completing the task of cutting words apart for the word sort. Lesson procedures for the analytic phonics intervention included reviewing the previous day’s content, reading and explaining one word at a time before sorting, sorting words and then identifying categories, questioning content, and writing sentences with two words. The fidelity score was calculated in the same manner as the synthetic phonics intervention.

Similar procedures for the fidelity checks of data collection procedures took place to get an accurate measure of the oral reading rate, phonetic decoding skills, and developmental spelling. After a review of the fidelity checklist for data collection, observations of data collection procedures were followed by immediate feedback to maintain consistent procedures during data collection.

Continued fidelity checks were carried out by an independent reviewer from the school, who served as a blind secondary observer. Fidelity checks were scheduled to take place to ensure
the fidelity of the study (Ledford & Gast, 2018). The blind secondary observer was trained by the researcher using the implementation and data collection checklists. In addition to the fidelity checks, the results of the blind observer data were compared with the researcher’s data to determine the accuracy and validity of data collection. Approximately 30% of the intervention sessions were examined for fidelity and consistency of instructional practices so all conditions were implemented as planned. This controlled for threats to internal validity.

**Reliability**

Several tasks were completed to ensure the reliability of measurement. Instructor bias, or the likelihood that the data collector had conscious or unconscious beliefs that could impact the accuracy of data collection, was prevented by collecting inter-instructor agreement data and frequently tracking and graphing data (Ledford & Gast, 2018).

Instructor drift, or the tendency of the instructor to abandon the accurate use of definitions (Appendix A) over time, can become problematic due to the long-term use of data collection within SSD. If the instructor inadvertently shifts away from use of consistent definitions or protocols over a long-time span, it could result in an inaccurate process of data collection. Prevention of instructor drift was addressed using regular fidelity checks, continued graphing and analysis of the data, and reviewing accurate definitions and protocols during fidelity discussions on a regular basis. Additional errors were avoided by training instructors according to a specific set of criteria (see Appendices F & G) prior to the start of data collection, as described in the procedural fidelity section.
Internal Validity

High internal validity refers to a study that yields outcomes that are the result of the independent variables, the treatment conditions, and are not the result of extraneous variables. Several threats to internal validity exist within AATD. Student history is one kind of internal validity that could have impacted this study. For example, if students were receiving additional support through speech and language services, the extra time working with related content could also have an impact on student growth.

The 11-week duration of the current study increased the opportunity for threats due to internal validity such as maturation (Ledford & Gast, 2018). When working with young children such as first-graders, maturation alone during a period can positively impact the dependent variables rather than only the intervention. As children cognitively and physically grow and develop over the school year, academic skills can grow and develop independent of instruction. Session fatigue also could also have posed a related threat to internal validity. First-grade participants can grow tired and less attentive as the school day progresses; therefore, session length was kept to 30 minutes and the last hour of the day was avoided for the lessons and data collection.

Testing events can also be a threat to a study, as participants were required to respond to a probe multiple times during progress monitoring events. Probes for the AIMSweb fluency testing were randomized for use to avoid testing interference. Instructors avoided using prompts that lead participants to the correct response. The reinforcement of correct responses through verbal or visual feedback can also pose a testing threat. If errors were made during the assessment, data collection protocol required avoidance of corrective feedback during test
administration. Test sessions were kept to an age-appropriate time-length of 30 minutes to elicit accurate response from participants. The fidelity checklist for data collection addressed these specific concerns to maintain a high level of internal validity. When instructional practices are the outcome of a study with high internal validity, confidence in teaching methods will remain high.

Multi-treatment interference can also present another threat to internal validity (Ledford & Gast, 2018). Prone to occur in demonstration designs, multi-treatment interference is the influence of one experimental condition on another experimental condition. The use of synthetic phonics instruction and analytic phonics instruction as independent variables can present the opportunity for multi-treatment interference. Three types of multi-treatment interference can take place within the study design: carryover effects, sequence effects and rapid alternation effects. Carryover effects are the influence of one treatment condition on the other treatment condition due to the similar nature of each condition. Carryover effects were minimized by establishing the stability of the data points before the implementation of a phase change or a change in treatment. Sequence effects are the influence of one condition on another due to the order in which the conditions were introduced. Randomization of treatments minimized the sequence effects. Rapid alternation effects are the result of rapidly changing conditions. Frequent data collection coupled with randomization of treatments reduced the effects of rapid alternation.

Data Analysis

In AATD research, visual analysis of graphic displays is used to document the outcomes of the study and support formative decisions throughout the duration of the study (Ledford & Gast, 2018). Graphic presentation of data supports independent analysis and interpretation of
results of each treatment. Visual analysis is useful for determining whether a study demonstrates experimental control. The researcher remained in continuous contact with the data to ensure the participants were improving. Communication was the central purpose of the graphic displays. Data points that fell outside of the stability envelope indicated the need for an extension of the treatment condition.

Graphic displays communicate two kinds of information for a study. First, they assist with formative analysis by organizing data during the data collection process. Second, they provide descriptions of behavior in detail over time, which allows readers to explore the relationship between the independent and dependent variables. The participants’ data over time allows the researcher to analyze, in detail, the effect of the intervention on the participant’s behavior. Visual analysis is the key method for displaying and evaluating data; therefore, relevant well-created displays are important.

**Stability Envelopes**

Stability envelopes present one way to quantify stability and were used to estimate the stability of data in level or trend within the two conditions (Ledford & Gast, 2018). The use of stability envelopes ensured consistency in experimental decisions related to data stability. The stability envelope consisted of two parallel boundaries on either side of the median or trend line. For the current study, a range of 30% within the median level was used to constitute data stability. The lines were calculated based on median values, which were less influenced by outlying data values.
Functional Relations

AATD research provides opportunities for analysis of the relationships between variables (Ledford & Gast, 2018). Through examination of all the data, researchers can determine for themselves whether an intervention has a reliable and significant effect on the participants’ behavior. An immediate and abrupt change in the dependent variable that aligns with a condition change provides a clear example of a behavior change. A rapid response establishes a stronger functional relationship between the dependent and independent variables. A stable condition maintains data values that are predictable and consistent or the lack of variability among data points. The multiple iterations of the condition negate the need for the re-introduction of a baseline. When there are at least three demonstrations of effect and when internal validity has been addressed, a functional relationship between the intervention and student’s word accuracy and fluency can be identified based on the established experimental control.

Magnitude of Change

At a glance, one can determine if one intervention is better than the other provided the data paths display little or no overlap. Both researchers and readers of this study can conduct an analysis of the data using graphic representations that are efficient, simple, and detailed. Line graphs detail the time, sessions, and independent and dependent variables as well as display the data over time. The pre-test and post-test scores from the independent variables served as an overall secondary analysis of data. The level and the trends data were compared during the comparison phase of the study. To minimize potential Type I error bias, trend lines were removed for summative analysis and prior to examining graphed data for independent analysis.
Conclusion

An adapted alternating treatments design, a form of single-case research, was used to compare the effectiveness of a synthetic phonics intervention and an analytic phonics intervention. The impact of oral reading rate and word reading accuracy was examined to determine if a synthetic phonics approach produced more gains in oral reading rate and word reading accuracy in comparison to an analytic phonics approach. Five first-grade students who were performing below grade level expectations were selected to participate in the study. Each intervention served as a control and intervention conditions were alternated according to a randomized schedule (Ledford & Gast, 2018). The AIMSweb R-CBM and the WADE real word lists were used to determine a phase change within the study. Data collection took place twice per week and was presented on a line graph for visual analysis. This process helped to identify which intervention is most effective for accelerating growth in oral reading rate and word reading accuracy, two key indicators of later literacy development (LaBerge & Samuels, 1974; Perfetti & Hart, 2002; Rasinski et al., 2009; Swanson & O’Connor, 2009).
CHAPTER 4
RESULTS AND ANALYSIS

An alternating treatment design was used to examine the effects of two phonics interventions on first-grade students’ word reading accuracy, rate, and letter-sound correspondences. Visual analysis was used to determine the presence of a functional relationship across conditions by inspecting the level, trend, stability, and points of non-overlapping data (PND) for oral reading accuracy (ORR) and word reading accuracy. A secondary analysis compared data for word accuracy, oral reading rate, and letter-sound correspondences.

This chapter presents the results of the study in three sections. The first section outlines the procedures for data analyses. The second section reports the results across each condition to determine whether a functional relationship existed between synthetic and analytic phonics instruction on word reading accuracy and ORR. The third section compares data from students’ scores on three reading assessments administered pre- and post-intervention.

Data Analysis

Participants were divided into two groups before the start of the study. Students were assigned to one of two groups, creating three participants in one group and two participants in the other group. The first group included three participants: Holly, Wesley, and Shayla. The second group was composed of two participants: Sandy and Giselle. Each group was then
assigned to one of the two instructors for the study. Students remained with the same group and instructor for the duration of the study.

Prior to the beginning of the study, randomization was established by listing each intervention name on five pieces of paper in a container. A drawing took place to determine the intervention condition for each group for each week of the study. Students received one intervention, either the synthetic phonics intervention or the analytic phonics intervention per school day, with their group for 11 weeks. Due to district testing and other requirements, the duration of the study was 11 weeks. Based on the randomization schedule (Table 2), group 1 received five weeks of the synthetic phonics intervention (condition A) and six weeks of the analytic phonics intervention (condition B). Group 2 received six weeks of the synthetic phonics intervention and five weeks of the analytic phonics intervention.

Data collection took place on alternating days to alleviate test interference and to minimize time away from core instruction. Visual analysis was used to determine the presence of a functional relationship between the two reading interventions. This allowed the researcher to monitor the collected data, while summative visual analysis provided a comparison of means from each dependent variable. In addition, both types of analyses measured the magnitude of change among the data points (Ledford & Gast, 2018). This included visually inspecting changes in data patterns, immediacy of change, amount of overlapping data across adjacent conditions, and consistency of data patterns across similar conditions. Summative analysis was conducted at the completion of the study with an examination of the means of pre/posttest data between the synthetic phonics intervention (condition A) and an analytic phonics intervention (condition B), the independent variables, and word reading accuracy, oral reading rate (ORR), and letter-sound correspondences, the dependent variables.
Table 2

Intervention Randomization Schedule

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Visual Analysis

**Level**

Within condition visual analyses were conducted to identify patterns of response within a single intervention (Ledford & Gast, 2018). Level, trend, and variability/stability were analyzed for indicators related to answering the research questions. Level describes the amount of behavior that occurs on a numerical scale and is specific to each data collection instrument. When considering word reading accuracy measured by the AIMSweb fluency probe, a decline in the number of errors indicates increased accuracy when reading words. When a decline in the
number of errors is stable or consistent, a demonstration of effect is established for that phonics intervention. When word reading accuracy is measured using the WADE wordlist, a consistent increase in the number of words read correctly indicates stability and then establishes a demonstration of effect. When considering ORR as measured by the AIMSweb fluency probe, an increase in the number of words read correctly within one minute indicates a demonstration of effect when the increase is consistent and stable.

**Trend**

Trend was described by the slope and direction of a data series (increasing, decreasing, or remaining the same; Kennedy, 2005 as cited in Ledford & Gast, 2018) along with trend direction, trend magnitude, and trend stability. An increasing trend line indicates a demonstration of effect, which means the phonics intervention is improving the participant’s word reading accuracy on the dependent variable (e.g., WADE, AIMSweb fluency probe for ORR), while a decreasing trend line means the phonics intervention is not improving a participant’s word reading accuracy. However, a decreasing trend line for the number of errors on the AIMSweb fluency probe is an indication that a functional relationship exists between the phonics intervention and word reading accuracy. As fewer errors occur, the reader is reading with greater accuracy.

**Overlapping Data**

Overlap is signified by values of data in one intervention that are in the same range of values of data in the adjacent intervention (Kennedy, 2005 as cited in Ledford & Gast, 2018). Larger separation and smaller proportion of overlap are indicators of a demonstration of effect.
The percentage of non-overlapping data (PND; Scruggs & Mastropieri, 1998 as in Ledford & Gast, 2018) was used to determine level change between two adjacent conditions. The PND was calculated by determining the range of data point values in condition A and then counting the number of data points in condition B that fell outside of this range. Then the number of data points that fell outside the range of condition A were divided by the total number of data points in condition B. The quotient is then multiplied by 100 to yield a percentage. The higher the PND, the more consistent and abrupt the level change between adjacent interventions (Ledford & Gast, 2018). The PND reflects the overlap between interventions and not the size of the level change.

**Variability**

Variability describes changing data points from one data point to the next and is the opposite of stability (Ledford & Gast, 2018). Variability is determined by calculating the stability envelope for each phase. A stability envelope places a quantitative value on the stability or consistency of data values within an intervention. Stability envelopes can support data-informed decisions and can be used to underpin future instructional decisions. Procedures used to calculate the stability envelope begin by determining the median level of all data point values in a condition (Ledford & Gast, 2018). The median level of a data series is the middle data point if all values are ordered from low to high. If the number of data points is even, the median is the average of the two middle values. The median value is then multiplied by 30% (a preselected percentage used to determine level stability; Ledford & Gast, 2018). The product represents the extent of the stability envelope. Data points that fall within a stability envelope demonstrate greater control by the phonics intervention.
A functional relationship was defined by a reliable and consistent change in the
dependent variables (oral reading rate, word reading accuracy). At least three opportunities to
demonstrate a change in behavior, or phase changes, were required to produce potential
demonstrations of effect. Phase changes followed a randomized schedule (Appendix F) and
differed between the two groups of participants. Consistent data patterns across each independent
variable were critical for establishing replicable and predictable patterns of behavior under
specific conditions. The greater the consistency, the more likely the data indicate the presence of
a functional relationship.

Primary Analysis – Group 1

The primary inquiry of the visual analysis data from individual participants was based on
the AIMSweb fluency probes and the WADE word reading assessment. Individual student
graphs depict each dependent variable along with the student’s baseline score, session number,
performance on the AIMSweb assessment, and phase changes between conditions. The solid
vertical lines represent a condition change (condition A, condition B). The dashed vertical lines
represent a phase change. During the randomization of conditions, the same condition was
selected for several consecutive phases. The AIMSweb fluency charts depict the ORR with the
number of words read correctly (the top line on the graph) and the number of errors (i.e., word
reading accuracy) according to testing sessions (the bottom line on the graph). The WADE
assessment results also represent the word reading accuracy.
Group 1 received one day of baseline testing, 31 days of the synthetic phonics intervention, and 22 days of the analytic phonics intervention. Thirteen data points were collected across condition A and 15 were collected across condition B. The students in Group 1, Holly, Wesley, and Shayla, demonstrated changes to word reading accuracy while receiving instruction in both the synthetic and analytic phonics phases. The adjacent condition analysis resulted in consistent level changes among participants upon a phase change.

Holly and Wesley demonstrated several instances of overlapping data in which level changes were the same between two adjacent conditions. One participant’s data (Shayla) resulted in a higher PND, demonstrating the effect from the intervention while receiving both the synthetic and analytic phonics instruction. Over time, Wesley’s results presented an accelerating trend with fewer overlapping data points. Holly’s trendline displayed marginal increase with many points of overlapping data. Shayla’s trendline presented a steady increase, with few overlapping data points, providing evidence of a behavior change.

Holly

**Level (ORR).** Holly demonstrated minimal growth in ORR and began the study with an initial baseline of 4 words per minute on the AIMSweb fluency probes (Figure 3). During the onset of the first synthetic phonics phase, her scores ranged from 4 to 9 wpm. The next data set of scores resulted in a range of 5 to 10 words read correctly per minute. At times, the number of errors was higher than her ORR, demonstrating significantly low ORR.
At session 19 of the analytic phonics intervention phase, Holly’s scores showed an increase from 5 to 14 and increased to 17 words read correctly per minute. As an indicator of increased accuracy, she demonstrated a level change in a series of 5 data points in which her number of errors declined consistently, establishing a functional relationship between the analytic phonics intervention and ORR. During sessions 25 to 28, the next data points resulted in a range of 7 to 14 words read correctly per minute during condition B. Additional data from the analytic phonics phase brought scores ranging from 4 to 12 words read correctly per minute. A level change took place with scores ranging from 4 to 8 wpm. These scores demonstrated stability and established a functional relationship between the analytic phonics intervention and
her reading rate. During sessions 37 to 44 of condition B, Holly’s scores declined and the number of errors increased to surpass the number of words read correctly per minute.

Condition A brought a level change in the number of words per minute along with another decline in the number of errors. Scores ranging from 11 to 15 wpm establish another functional relationship between her synthetic phonics intervention and reading rate.

Trend (ORR). Visual analysis of the trendline displayed a slight incline during the first synthetic phonics phase. After an abrupt decline at session 17, visual analysis revealed a significant incline during sessions 19 through 21 of the analytic phase. After a brief decline, a series of inconsistent trends continued during sessions 26 through 37, with the latter sessions during the analytic phase remaining stable and unchanged. A return to condition A during the second synthetic phonics phase brought an increase in words read per minute followed by a slight decline in number of words read correctly at sessions 49 through 57 at the end of the study. The increase in trend during the study represents some increased reading rate; however, the trendline for the number of errors remained unchanged, with no detection of a functional relationship.

Points of nonoverlapping data (ORR). An adjacent condition analysis resulted in a PND of 29% when comparing the first synthetic phonics phase (condition A) to the analytic phonics phase (condition B). During the second synthetic phonics phase, an adjacent condition analysis resulted in a PND of 25% when comparing the analytic phase to performance during the second synthetic phase. This means fewer data points demonstrated effect and both conditions resulted in nearly equal impact on Holly’s ORR.

Overall, condition A revealed a stability envelope of 2.1 and 27% of the data points remaining within the stability envelope. This means the synthetic phonics intervention resulted
in minimal impact on ORR. Data from condition B resulted in a stability envelope of 2.1 along with 46% of the data maintaining stability for Holly, an indication of a stronger functional relationship between the analytic phonics intervention and ORR when compared to the synthetic phonics intervention and ORR.

**Level (word reading accuracy; AIMSweb).** Holly demonstrated minimal gains in word reading accuracy as demonstrated by her performance on the AIMSweb fluency probes (number of errors). Her baseline score for the number of errors on the AIMSweb fluency probes was 5 (Figure 2). During the first synthetic phonics intervention phase, the number of errors exceeded her number of words read correctly, creating overlap with the ORR. Her range during condition A, sessions 2 through 13, was 5 to 7 errors with a median score of 7 errors, an indication of reduced word reading accuracy. During condition B, she had a range of 2 to 6 errors. This was a consistent decline, creating a level change and a functional relationship during sessions 19 to 28. This resulted in one of the lowest number of errors at session 28. There was a phase change at session 16 and again at sessions 21, 26, 31, 36, and 41; however, the analytic phonics intervention was selected several times in a row during randomization. During sessions 39 through 44 of the analytic phonics phase, Holly’s number of errors established overlapping data with ORR, with the number of errors ranging from 4 to 8 during sessions 29 to 40. An increase in the number of errors represented declining word reading accuracy. The second synthetic phonics phase brought another level change: a decline in the number of errors with a range of 4 to 7 errors during sessions 47 to 57.

**Trend (word reading accuracy; AIMSweb).** When considering the number of errors on the AIMSweb fluency probe, an increasing trend took place during the first synthetic phonics phase. This represented an increase in the number of errors. During condition B, visual analysis
of the trendline for the number of errors remained unchanged, with no detection of a functional relationship. The second phase of condition A resulted in a deceleration of the trendline due to an overall increase in number of errors during the phase.

Points of nonoverlapping data (PND; word reading accuracy; AIMSweb). The adjacent phase analysis on the AIMSweb fluency probes revealed a minimal level change for both the synthetic phonics and analytic phonics interventions, with a PND of 7% from the first synthetic phonics phase to the analytic phonics phase. This means the onset of the analytic phonics intervention (condition B) had a minimal impact on word reading accuracy. When comparing the analytic phase to the second synthetic phase, there was a lack of PND, resulting in no level change or impact as a result of the synthetic phonics intervention (condition A). This means the number of errors did not show a significant decline as the result of the synthetic phonics intervention when measured by the number of errors on the AIMSweb fluency probe.

Overall, a stability envelope of 2.1 was established, resulting in 90% of the number of errors remaining stable during the synthetic phonics intervention. This highly stable data during condition A indicates a greater impact of the synthetic phonics intervention on word reading accuracy. The analytic phonics intervention resulted in a stability envelope of 1.5 with 50% of the errors remaining stable, which means condition B demonstrated a moderate impact on word reading accuracy.

Level (word reading accuracy, WADE). When considering word reading accuracy on the WADE wordlist assessment (Figure 4), the baseline score on the WADE was 10 words read correctly. Holly demonstrated a declining level change at the onset of condition A with a range of scores resulting in 10 to 12 words read correctly.
The onset condition B at session 19 brought an immediate decrease, with a score of 8 words read correctly. This was followed by an increase ranging from 9 to 16 words read correctly at sessions 21 to 30. This level change indicated a demonstration of effect and a functional relationship. As the analytic phase continued during sessions 34 to 40, a level change took place with a range of scores from 12 to 14 words read correctly, which maintained stability within the analytic phonics intervention. Another phase change back to the condition A phase at sessions 42 through 57 brought an immediate decline in word reading accuracy level to a range 13 to 15 words read correctly across several demonstrations of effect, establishing a functional relationship. This indicates the synthetic phonics intervention had a positive effect on word reading accuracy.

Note. Visual analysis for Holly’s word reading accuracy.
Figure 4: Holly WADE word reading accuracy.
Trend (word reading accuracy, WADE). When considering performance on the WADE word reading assessment, the trend line demonstrated a slight increase in word reading accuracy throughout the first synthetic phonics phase, the second analytic phonics phase, and the second synthetic phonics phase. This represents an increase in word reading accuracy. Visual analysis of the trend line during this phase nearly matched the trend based on the error data from the AIMSweb Fluency probes. This demonstrated a minimal increase in word reading accuracy.

Points of nonoverlapping data, (word reading accuracy, WADE). Performance on the WADE word assessment between the first synthetic phase and the analytic phase resulted in a PND of 73%, which indicates that Holly’s word reading accuracy increased during the analytic phonics intervention. The second synthetic phonics phase lacked PND during the adjacent phase analysis. This means a high degree of variability existed among data points, which is an indication that word reading accuracy did not change significantly as the result of the synthetic phonics phase.

When measured by the WADE word reading assessment, condition A resulted in a stability envelope of 3.6, with 69% of the data points remaining stable, whereas, condition B resulted in a stability envelope of 3.9 and 73% of the data points remaining stable. This means the synthetic phonics intervention and the analytic phonics intervention maintained a nearly equal impact on word reading accuracy with a lower degree of variability among the data points.

Wesley

Level (ORR). Wesley increased ORR after participation in the study. During baseline, Wesley read 9 words correct per minute (Figure 5). Upon implementation of the synthetic phonics phase (condition A), Wesley read a total of 12 words per minute (Figure 4), which
demonstrated a change in level. During sessions 6 through 8, Wesley’s words correct per minute rate was inconsistent and lacked stability, with scores ranging from 5 wpm at session 6 to 16 wpm at session 8. At the same time, his word reading accuracy remained stable with accompanying errors of 10 and 11 words at sessions 16 to 18 during the same condition and phase.

Note. Visual analysis for Wesley’s ORR and word reading accuracy. Figure 5: Wesley AIMSweb ORR & word reading accuracy.

The onset of the analytic phonics phase (condition B), sessions 21 through 26, brought stability with scores ranging from 11 to 33 words per minute and an inconsistent decline in number of errors ranging from 7 to 16. This lack of consistency resulted in an inability to identify a functional relationship. The next series of data resulted in scores ranging from 13 to
23 words per minute at sessions 29 through 32. Visual analysis determined that errors remained low for the remaining data points on the AIMSweb fluency probe during this phase, an indication of increased word reading accuracy. Sessions 36 through 43 of the same analytic phonics phase showed stability. Another level change took place with results of 13 to 19 wpm at sessions 38 to 40, which qualified for a functional relationship between the analytic phonics intervention and the reading rate. The last phase of the synthetic phonics intervention (condition A) yielded results ranging from 11 to 29 words per minute with a one-time decrease in errors to 3 at session 48. This failed to demonstrate stability as the number of errors ranged from 8 to 12 during sessions 50 through 57.

**Trend (ORR).** Visual analysis revealed a pronounced incline ORR based on performance on the AIMSweb fluency probes. Session 2 at the start of the synthetic phonics phase resulted in high variability with a mild increase followed by significant decrease at session 6. Session 8 resulted in a large increase followed by a steady decline across sessions 10, 14, and 18. The onset of the analytic phonics phase resulted in a large increase in ORR across sessions 21 through 26, establishing Wesley’s highest ORR during the study. Session 27 resulted in a large magnitude of decline through session 29. Session 32 resulted in another medium increase with some stability of ORR across sessions 36 through 45. The start of the second synthetic phonics phase resulted in a large decline in ORR followed by a series of variability across sessions 48 through 57.

**Points of nonoverlapping data (ORR).** An adjacent conditions analysis resulted in a PND of 54% for condition A when changing to condition B. This higher PND indicates higher and more abrupt level change between the two conditions. An adjacent conditions analysis established a PND equal to 0% when phases changed from the analytic phonics intervention to
the synthetic phonics intervention (condition A) and lacked a demonstration of effect. This lack of PND indicates no behavior change for Wesley’s ORR.

When considering the synthetic phonics intervention, Wesley’s data points resulted in a stability envelope of 4.05, with 38% of the scores falling within the stability envelope. The analytic phonics intervention resulted in a stability envelope of 5.1 and 38% of the scores falling within the stability envelope range of 15 to 19. The nearly equal stability envelopes between conditions A and B demonstrate the same moderate effect for both the synthetic phonics intervention and analytic phonics intervention on ORR.

**Level (word reading accuracy; AIMSweb).** Based on the number of errors from the AIMSweb fluency probe and performance on the WADE wordlist assessment, Wesley demonstrated an increase in oral reading accuracy along with fewer errors across the interventions. Using the AIMSweb fluency probe, baseline was established at 10 errors. The initial phase of the first synthetic phonics intervention (Figure 6) at sessions 1 through 10 yielded a mild decline in the number of errors, ranging from 10 to 7. The number of errors remained stable at sessions 10 to 14, resulting in a range of 7 to 8 errors during the AIMSweb fluency probe. The onset of the analytic phonics phase brought some inconsistent level changes, indicating a decrease in word accuracy, with the number of errors ranging from 7 to 16 during sessions 18 to 27. However, as the number of errors demonstrated an overall increase, so did the words read per minute during this phase. Sessions 30 to 36 showed a level change in the number of errors with scores ranging from 5 to 7 errors, an indicator of a functional relationship between the intervention and oral reading accuracy. Data remained stable at the end of the analytic phonics phase, with a repeated number of 8 errors over three consecutive probes during sessions 38 to 42. This stability of data creates a demonstration of effect for the analytic phonics
intervention. The onset of the final synthetic phonics phase, during sessions 48 through 57, resulted in a significant drop in number of errors, with a score of 3 followed by a rapid level change up to number of errors resulting in a range of 8 to 12 from the fluency probes.

**Trend (word reading accuracy, AIMSweb).** Visual analysis of the trendline based on the AIMSweb number of errors on the fluency probes showed a slight decline in word reading accuracy across the implementation of interventions. During condition A of the first phase, sessions 6 to 10 resulted in a steady decline of number of errors. By session 14 at the end of the first synthetic phonics phase, the number of errors began to increase until session 21, resulting in a lack of word reading accuracy. During sessions 22 to 27 of the analytic phonics phase (condition B), the number of errors experienced high variability and a lack of stability. Starting at session 29 of the analytic phonics phase, a steady decline in number of errors resulted in increased word reading accuracy. This continued until session 38 where the trendline resulted in stability of errors though session 46 of the second synthetic phonics phase. Sessions 48 through 57 resulted in high variability and a lack of stability among the number of errors, indicating a lack of word reading accuracy.

**Points of nonoverlapping data (word reading accuracy; AIMSweb).** When considering the number of errors on the AIMSweb fluency assessment, an adjacent condition analysis going from condition A to condition B resulted in a PND of 14%, indicating fewer consistent and abrupt level changes. When shifting from the analytic phonics intervention to the synthetic phonics intervention, the PND resulted in 0%, indicating no behavior change on word reading accuracy.

Wesley’s data demonstrated stability during the synthetic phonics phase, as demonstrated by 57% of the data points falling within the stability envelope of 2.4. The analytic phonics
intervention resulted in a stability envelope of 2.4 and 54% of the data points falling within the stability envelope. This means that both the synthetic phonics intervention and the analytic phonics intervention resulted in nearly equal effects on word reading accuracy when measured by the number of errors on the AIMSweb fluency assessment.

**Level (word reading accuracy, WADE).** Data collection using the WADE wordlist demonstrated additional functional relationships. Wesley’s baseline data resulted in a score of 12 words read correctly (Figure 6). During the initial introduction of the synthetic phonics intervention, accuracy scores resulting in 11 at sessions 6 through 10, followed by a level change ranging in scores of 15 to 17 words read correctly. Since the baseline data was limited to one data point, a functional relationship cannot be determined during the first phase of the study.

Note. Visual analysis for Wesley’s word reading accuracy.

Figure 6: Wesley’s WADE word reading accuracy.
Between sessions 15 to 20 in the analytic phonics phase, Wesley read 12 to 17 words accurately. A differentiation in response occurred again, with scores ranging from 18 to 20 words read correctly from the WADE wordlist. This accelerating increase means the analytic phonics intervention impacted word reading accuracy. The differentiation of data indicated another functional relationship between the analytic phonics intervention and word reading accuracy.

During the final phase change to the synthetic phonics intervention, sessions 35 through 40, oral reading accuracy scores remained stable with WADE results ranging from 16 to 19 words read correctly establishing an additional functional relationship between intervention and oral reading accuracy.

Trend (word reading accuracy, WADE). Visual analysis of the WADE results contrasted with the AIMSweb fluency probes by revealing a steady incline of growth. Sessions 6 through 10 of the first synthetic phonics phase (condition A) resulted in a decline in word reading accuracy. Session 14 brought an increase in number of words read correctly and maintained stability until the onset of the analytic phonics phase (condition B) in which a single decline in the number of words read correctly took place. Sessions 24 through 27 of the analytic phonics phase resulted in a steady increase of the number of words read correctly. Sessions 29 and 30 brought a decline followed by an increase in the number of words read correctly during sessions 32 through 42, demonstrating stability in word reading accuracy. The onset of the second synthetic phonics phase resulted in a brief decline in the number of words read correctly followed by an increase in words read correctly within the duration of the synthetic phonics intervention. Session 57 resulted in a final decline in the number of words read correctly.

Points of nonoverlapping data (word reading accuracy; WADE). Performance on the WADE during condition A and condition B revealed 43% PND as the result of the adjacent
conditions analysis. This means word reading accuracy changed during the analytic phonics intervention. An adjacent conditions analysis between the analytic and second synthetic phase resulted in 13% PND, indicating fewer level changes with word reading accuracy. When moving from the analytic phonics intervention to the second synthetic phonics intervention, an adjacent conditions analysis resulted in no PND during this phase change. This means there was a clear level change in word reading accuracy upon phase change to condition B.

Overall, the synthetic phonics intervention resulted in a stability envelope of 5.1, with 53% of the data points falling within the stability envelope. The analytic phonics phase resulted in a stability envelope of 4.5 along with 54% of data points maintaining stability. This means that both the synthetic phonics intervention and the analytic phonics intervention resulted in nearly equal effect on the word reading accuracy when measured by the WADE assessment.

Shayla

Level (ORR). Shayla’s ORR demonstrated an increase during the study. With an AIMSweb baseline of 12 wpm (Figure 7), Shayla demonstrated a level change ranging from 14 to 17 wpm during the first synthetics phonics intervention, sessions 2 through 6, along with an abrupt level change ranging from 23 to 25 wpm. After a decline to 10 wpm at session 13, Shayla’s reading rate increased to 27 and 20 wpm at sessions 15 through 18. The analytic phonics phase, sessions 18 through 26, brought a level change with reading rate scores ranging from 20 to 31 words per minute, which indicated a functional relationship between the intervention and reading rate. After a decline in rate to 13 and 15 wpm, the middle and end of the analytic phonics phase scores showed a level change ranging from 24 to 34 wpm and established another functional relationship.
The stability of scores in reading rate was maintained during the last synthetic phonics phase, with reading rate scores ranging from 29 to 50 wpm. This established a functional relationship between the synthetic phonics intervention and ORR.

**Trend (ORR).** Visual analysis revealed a trendline displaying a significant incline representing an increase in Shayla’s reading rate. The onset of the first synthetic phonics phase at session 2 resulted in some minor variability of data that continued for the duration of the phase with large increases and a significant decrease in ORR. Condition A ended at session 18 with another small decrease in ORR. The onset of condition B resulted in some stability of data followed by a large decline in ORR mid-phase at session 29. The second half of the analytic phonics phase resulted in continued variability of data with increasingly higher ORR. The end of
the analytic phonics phase resulted in a large increase in ORR and established a functional relationship at session 42. The onset of the second synthetic phase at session 44 resulted in more variability of data, with one of the last data points representing a large increase in ORR followed by a large decline at the end of the phase.

Points of nonoverlapping data (ORR). When considering the results of the AIMSweb fluency probes, an adjacent conditions analysis between first synthetic phonics intervention (condition A) and the analytic phonics intervention (condition B) resulted in a PND equal to 36%, representing a moderate number of scores with consistent and abrupt level change. An adjacent conditions analysis between the analytic phonics phase and the last synthetic phonics phase resulted in a PND of 57%, indicating the higher scores were the result of a level change. This means the synthetic phonics intervention demonstrated greater effect on ORR when compared to the analytic phonics intervention.

Overall, the stability envelope for the synthetic phonics intervention was established at 7.8 with 43% of the results falling within the stability envelope. This means the synthetic phonics intervention resulted in a moderate impact on ORR. The analytic phonics intervention resulted in a stability envelope of 7.5, indicating 57% of Shayla’s data points remained stable and a slightly greater impact of the analytic phonics intervention on ORR when compared to the synthetic phonics intervention.

Level (word reading accuracy; AIMSweb). Shayla demonstrated increased word reading accuracy across the conditions. The baseline score for the number of errors was 10. During the first synthetic phonics phase (condition A), the error scores resulted in a range of 5 to 7 during sessions 2 to 13, which indicated a functional relationship between the intervention and oral reading accuracy (Figure 7). Error scores remained low in relation to words read correctly,
which demonstrates stability during most of the analytic phonics phase with scores hovering at 4, 5, and 6. Late in the analytic phonics phase (condition B) after a phase change, another level change took place, with errors dropping to 3, 2, and 6, just below the threshold to establish a functional relationship. The onset of the second synthetic phonics (condition A) phase brought a level change with errors ranging from 3, 6, 8, and 9.

**Trend (word reading accuracy; AIMSweb).** Visual analysis of the number of errors on the AIMSweb fluency probe revealed an unchanged (Figure 6) trendline for the number of errors throughout the study. The data points hovered around the trendline, indicating stability yet resulting in a lack of change in word reading accuracy among the two conditions. At session 2 during the first synthetic phonics phase, the number of errors dropped and then remained stable for the duration of the phase. The onset of the analytic phonics phase resulted in continued stability of data with a small decline at sessions 36 through 38 followed by a small incline at session 42. The onset of the second synthetic phonics phase at session 44 resulted in some minor variability and lacked the stability to establish a functional relationship. At session 56, the last data points for during the synthetic phonics phase was nearly equal to the baseline data point.

**Points of nonoverlapping data (word reading accuracy, AIMSweb).** An adjacent conditions analysis of the AIMSweb fluency probe based on the phase change between the first synthetic phonics intervention and the analytic phonics intervention demonstrated a PND equal to 31%, indicating a moderate level change. This means the analytic phonics intervention (condition B) demonstrated some impact on word reading accuracy. The adjacent conditions analysis going from the analytic phonics intervention to the second synthetic phonics intervention (condition A) resulted in a lack of PND. This result demonstrates a lack of impact on word reading accuracy when considering the synthetic phonics intervention.
Overall, the synthetic phonics intervention for Shayla resulted in a stability envelope of 1.8 and 43% of her responses falling within the stability envelope. This indicates that 43% of the number of errors remained stable during the synthetic phonics intervention. The analytic phonics intervention yielded a stability envelope of 1.5 along with 77% of her responses falling within the stability envelope. This indicates that 77% of the number of errors remained stable during the analytic phonics intervention. This significantly high result during condition B indicates an overall greater effect on Shayla’s word reading accuracy when using the analytic phonics intervention.

**Level (word reading accuracy; WADE).** During the WADE assessment at baseline, Shayla read 7 words read correctly (Figure 8). The first phase of the synthetic phonics intervention (condition A) resulted in an abrupt decline followed by an abrupt increase of oral reading accuracy. The results remained stable at a range of 10 to 12 words read accurately at sessions 10 through 15; however, the end of this phase at sessions 18 through 20, resulted in a level change reaching 15 and 19 words read correctly. The onset of the analytic phonics phase brought a series of stable data with results ranging from 16 to 19 words read accurately and was maintained for the duration of sessions 20 through 40. This was an indication of a functional relationship between the analytic phonics intervention and word reading accuracy. The end of this phase resulted in a steady decline of scores, ranging from 12 to 17 words read correctly. The second synthetic phonics phase lacked stability due to scores ranging from 12 to 17 during sessions 42 to 56.
Trend (Word reading accuracy; WADE). The trendline for the WADE took an incline, representing an increase in word reading accuracy. At session 6, the onset of the synthetic phonics phase resulted in an increase in the number of words read accurately. This was followed by a minor decline and then a steady increase for the duration of the phase with the end of the phase, resulting in Shalya’s highest number of words read correctly during the study at session 20. The introduction of the analytic phonics phase at session 22 resulted in a brief decline followed by a variability of increases and decreases in the number of words read accurately with the phase, concluding with a decrease at session 42. The onset of the second synthetic phase at session 44 resulted in a brief decline followed by high variability for the duration of the phase.
Points of nonoverlapping data (WADE). When considering the WADE results, an adjacent conditions analysis of the first synthetic phonics intervention to the analytic phonics intervention yielded a PND equal to 100%, representing a significant level change between conditions. This means the analytic phonics intervention demonstrated a high impact on word reading accuracy. An adjacent conditions analysis between the analytic phonics intervention and the synthetic phonics intervention resulted in a PND equal to 0%, meaning no behavior change took place regarding word reading accuracy.

Overall, the synthetic phonics intervention resulted in 50% of her scores falling within the stability envelope of 3.9. This means the synthetic phonics intervention (condition A) maintained level stability for 50% of the word accuracy data points. The analytic phonics intervention (condition B) resulted in 100% of the scores falling within the stability envelope of 5.4. This means the analytic phonics intervention showed greater stability and effectiveness on word accuracy reading.

Primary Analysis – Group 2

Group 2 received one day of baseline testing and participated in 27 days of the synthetic phonics intervention and 25 days of the analytic phonics intervention. Sandy and Giselle demonstrated reading behavior changes throughout the study, as evidenced by the many abrupt changes to the dependent variable upon intervention change. The adjacent condition analysis demonstrated several consistent responses among the group upon a phase change. Instances of overlapping data in which results were the same between two adjacent interventions were frequent when it came to word reading accuracy on the AIMSweb fluency probe. This was
represented by both Sandy’s and Giselle’s trend lines that remained unchanged with a slight decrease in number of errors over the duration of the study.

WADE data resulted in level changes particularly during the synthetic phonics phase for Sandy. Giselle’s word accuracy during the WADE assessment demonstrated level changes early and then again late in the study during both the synthetic phonics intervention and the analytic phonics intervention. Sandy’s performance during the study resulted in a higher PND as evidenced by the incline in ORR on the AIMSweb fluency probe.

Sandy

Level (ORR). Sandy demonstrated an increase in ORR during the study. With an initial AIMSweb score of 18 wpm (no baseline was established due to absence), reading rate scores ranged from 14 to 30 wpm during the first synthetic phonics intervention, sessions 5 to 10 (Figure 9). This established a level change and a functional relationship between the reading rate and the synthetic phonics intervention. Another level change took place with reading rate scores ranging from 19 to 40 words per minute, establishing a functional relationship between the first synthetic phonics intervention and reading rate.

The first analytic phase brought a level change at sessions 21 to 25, with stable scores ranging from 23 to 48 wpm. The number of errors seemed to increase during this phase. Sessions 27 through 32 resulted in scores ranging from 23 to 55 wpm, creating a lack of level change during this phase. The second synthetic phonics phase, sessions 37 and 39, showed AIMSweb scores of 31 and 63 wpm, respectively. The next scores ranged from 49 to 64 wpm from the second analytic phonics phase, sessions 41 to 55, with errors dropping from 6 to 3. This established a level change during the second analytic phonics phase.
The onset of the first synthetic phonics phase resulted in a small increase in ORR at session 5, followed by a brief decline in the number of words read correctly in one minute. The remaining duration of the phase resulted in variability among increases and decreases in ORR, which resulted in an overall trendline incline through sessions 8 through 19. The onset of the first analytic phonics phase at sessions 23 and 23 resulted in a small decline in ORR, with the number of words read correctly decreasing. The duration of the phase at sessions 25 through 33 resulted in large variability between increases and decreases in ORR. The short return to the second synthetic phonics phase resulted in a medium decline in ORR; however, the number of errors demonstrated a small decline at the same time at sessions 37 and 39. The onset of the third
analytic phonics phase resulted in high variability yet increased ORR and decreased number of errors on the AIMSweb fluency probe during sessions 41 through 55. The last synthetic phonics phase saw a significant decline in ORR along with mild decrease in word reading accuracy. The lack of stability in ORR over the last two phases indicates the possible impact of an extraneous variable outside of one of the two phonics approaches examined in the study.

**Points of nonoverlapping data (ORR).** When considering ORR as measured by the AIMSweb fluency probe, an adjacent conditions analysis between the first synthetic phonics intervention and the first analytic phonics intervention resulted in a PND of 38%, indicating a moderate effect on ORR. A lack of PND between the first analytic phase and the second synthetic phonics phase means the data remained stable with no impact on ORR. An adjacent conditions analysis between the second synthetic phonics phase and the second analytic phonics phase resulted in a PND of 100%. This means condition B resulted in a significant impact on ORR. An adjacent conditions analysis between the second analytic phonics intervention and the last synthetic phonics intervention resulted in a PND of 17%, demonstrating a minimal impact on Sandy’s ORR.

Overall, Sandy’s performance during the synthetic phonics intervention resulted in a stability envelope of 9, resulting in 38% of the data points falling within the stability envelope. This represents a moderate impact of condition I on ORR. The analytic phonics intervention resulted in a stability envelope of 14.55 and 50% of the data points falling within the stability envelope, indicating a moderate impact of condition B on ORR.

**Level (word reading accuracy; AIMSweb).** In the study, Sandy demonstrated the greatest gains during the study when it came to word reading accuracy. She established a baseline of 4 errors on the AIMSweb Fluency probe (Figure 9). The onset of the first synthetic phonics phase,
sessions 5 to 13, resulted in a level change to 3 errors followed by an abrupt increase ranging from 6 to 10 errors, resulting in decreased word accuracy. The next score increased to 13 errors on the fluency probe. This increase also correlated to a significant increase in the ORR on the fluency probe. By the end of this phase, the number of errors decreased to scores ranging from 6 to 9 with the corresponding words per minute remaining high.

The onset of the first analytic phonics phase, sessions 21 to 25, for Sandy brought increased errors ranging from 10 to 18 followed by a significant drop to 8 errors at one point. These scores did not establish a functional relationship and lacked stability when considering the number of errors on the AIMSweb fluency probe. The first analytic phonics phase concluded at session 33 with 7 errors on the fluency probe.

A short return to the second synthetic phonics phase, sessions 37 to 39, brought scores ranging from 8 to 12 with a score of 6 errors at the start of the second analytic phonics phase. This final analytic phonics phase demonstrated decreased scores ranging 3 to 4 at sessions 48 to 55, which established a functional relationship. A final return to the second synthetic phonics intervention at sessions 56 and 57 resulted in a score of 6 errors on the fluency probe with significantly higher scores on the corresponding words per minute.

Trend (word reading accuracy; AIMSweb). Based on the AIMSweb fluency probes, visual analysis resulted in the number of errors showing a slight decline in word reading accuracy toward the end of the study. The onset of the first synthetic phonics phase at session 5 resulted in a minor decrease followed by an immediate increase in the number of errors. The data demonstrated stability through the first half of the phase with some small increases in the number of errors for the duration of the phase resulting in decreased word reading accuracy. The onset of the analytic phonics phase at session 21 resulted in a small increase followed by an
immediate decrease in the number of errors in the AIMSweb fluency probe. Stability was maintained for the duration of the phase yet reflected a lack of improvement in word reading accuracy. A short return to the synthetic phonics phase at sessions 37 and 38 resulted in a small decrease in the number of errors. The onset of the second analytic phonics phase at session 41 resulted in a steady decline in the number of errors for the duration of the study, indicating an increase in word reading accuracy. A short return to the synthetic phonics phase at sessions 56 and 57 resulted in stability of the data when it comes to number of errors and word reading accuracy.

**Points of non-overlapping data (Word reading accuracy; AIMSweb).** When considering the number of errors from the AIMSweb fluency probe, an adjacent conditions analysis between the first synthetic phonics intervention (condition A) and the analytic phonics intervention (condition B) yielded an absence of PND between the two interventions. This means neither intervention resulted in a behavior change in word reading accuracy. An adjacent conditions analysis going from the analytic phonics intervention to the last synthetic phonics intervention yielded an absence of PND at this phase change. This indicates the synthetic phonics intervention lacked any impact on word reading accuracy. An adjacent conditions analysis resulted in a PND of 100% at the phase change from the second synthetic phonics phase to the second analytic phonics phase indicating a decline in the number of errors, an indicator of increased word reading accuracy.

Overall, the stability envelope for word reading accuracy when considering the data from the AIMSweb fluency probes was established at 1.8, with 54% of the results remaining stable during the synthetic phonics intervention. This means condition A resulted in a moderate impact on Sandy’s word reading accuracy. The analytic phonics intervention resulted in a stability
envelope of 2.7 with 14% of the results remaining stable. This means that condition B resulted in a minimal impact on word reading accuracy.

**Level (word reading accuracy; WADE).** Performance on the WADE wordlist indicated growth in oral reading accuracy. Sandy’s baseline score on the WADE was 16 words read correctly (Figure 10). The start of the first synthetic phonics phase at session 7 saw a drop in words read correctly relationship established among scores ranging from 17 to 18. A second functional relationship took place at sessions 16 to 21 with a level change based on scores ranging from 18 to 22. The first analytic phonics phase at sessions 23 to 29 brought a slight decline in word accuracy with a series of results ranging between 15 and 16, presenting another level change and functional relationship between the analytic phonics intervention and word reading accuracy. A final round of scores from this analytic phonics phase during sessions 32 and 33 resulted in a level change with scores ranging from 19 to 20 words read correctly and presented another functional relationship.

The second synthetic phonics phase maintained stability with scores of 19 and 21 words read correctly during sessions 37 and 39. A return to the second analytic phonics intervention during sessions 41 to 55, brought additional stability with a series of scores ranging from 19 to 21 over the next six data points, maintaining a functional relationship. The final synthetic phonics phase concluded the study with a drop to 17 words read correctly during session 56.
Figure 10: Sandy’s WADE word reading accuracy.

**Trend (word reading accuracy; WADE).** Visual analysis of the WADE data resulted in a trendline displaying a mild incline representing a small increase in word reading accuracy. The onset of the first synthetic phonics phase at session 7 resulted in a small decline followed by medium and large increases in word reading accuracy. Sessions 16 through 19 resulted in some of the highest word reading scores for the duration of the study. The onset of the first analytic phonics phase resulted in a small decline in the number of words read correctly. This was followed by stability of scores during sessions 23 through 29. Sessions 31 through 33 saw an increase in word reading accuracy. The onset of the second synthetic phase maintained stability through sessions 37 and 39 and throughout the second analytic phonics phase, ending at session 55. This extensive duration of stability demonstrates the effect of both the synthetic and analytic phonics interventions and marks an increase in word reading accuracy. The third synthetic
phonics phase saw a small decrease in the number of words read correctly as the study concluded.

**Points of nonoverlapping data (word reading accuracy; WADE).** When considering word reading accuracy on the WADE assessment, an adjacent conditions analysis between the first synthetic phonics phase and the first analytic phonics phase resulted in a lack of PND. This means the analytic phonics intervention resulted in a lack of impact on word reading accuracy. The phase change from the analytic phonics phase to the second synthetic phonics phase resulted in a PND equal to 100% with all data points lacking overlap and a pronounced demonstration of effect. This demonstrates an impact of the synthetic phonics intervention on word reading accuracy. The change from the second synthetic phonics phase to the second analytic phonics phase resulted in a lack of PND, resulting in a lack of impact on word reading accuracy. The last analytic phase and the final synthetic phase resulted in an absence in PND, resulting in no effect on word reading accuracy.

Overall, Sandy’s stability envelope on the WADE assessment for the synthetic phonic intervention resulted in 5.25, with 80% of her data points demonstrating effect. This means condition A resulted in a significant impact on word reading accuracy. Data from the analytic phonics intervention resulted in a stability envelope of 5.7, with 92% of her data points falling within the stability envelope. This result is nearly the same between both conditions A and B and indicates a nearly equal impact of Sandy’s word reading accuracy.

**Giselle**

**Level (ORR).** Giselle demonstrated an increase in ORR after participation in the study. Her baseline score of 9 wpm experienced a level change during the first synthetic phonics phase,
sessions 2 to 9, with scores ranging from 27 to 41 wpm (Figure 11) and established a functional relationship between the synthetic phonics intervention and ORR. Another level change took place during sessions 11 to 22, with scores ranging from 37 to 56 wpm. A functional relationship was established. Stability was maintained as phases changed from the first synthetic phonics phase to the first analytic phonics phase. Scores ranged from 44 to 50 wpm during sessions 23 to 27. The middle of the analytic phonics phase brought a decline in ORR, with scores of 35 and 38 wpm at sessions 28 through 30. Sessions 32 through 36 at the end of the analytic phonics phase continued with scores ranging from 44 to 53 wpm, establishing a level change and a functional relationship.

![Figure 11: Giselle’s AIMSweb ORR & word reading accuracy.](image)

**Trend (ORR).** Visual analysis resulted in a mild incline on the trendline, representing an increase in ORR. The onset of the first synthetic phonics phase (condition B) at sessions 2
through 7 brought a large increase in ORR going from 9 wpm to 27 wpm, followed by another increase to 41 wpm, resulting in an increase in the trendline. Variability among data points continued with another large increase in ORR to 56 wpm at session 11, followed by a decline in the trendline when data dropped 37 wpm at session 14. Data remained stable with ORR of 41 and 44 wpm during sessions 20 through 23. The onset of first analytic phonics phase (condition B) maintained stability at sessions 23 through 27 with an ORR of 49 and 50 wpm. This demonstrates the extended impact of the synthetic phonics intervention, even when implementation of the intervention has been withdrawn. Sessions 28 through 30 resulted in a large decrease in ORR, with scores of 38 and 35 wpm, followed by a rebound to an ORR of 44 through 53 wpm throughout the end of the phase. The ORR at session 32 resulted in 53 words per minute, one of the highest ORR during the phase but was also accompanied by the highest number of errors during the study for Giselle. A high ORR is accompanied by a high number of errors indicates a lack of meaning of visual cross checking during reading sessions. The second synthetic phonics phase resulted in stability of the data, with a minor decline from 50 to 47 wpm at session 39. The onset of the second analytic phase resulted in the highest ORR of the study for Giselle, with a score of 67 wpm at session 41. This was followed by a medium decline to 49 and 57 wpm at sessions 43 and 45. Variability of the data continued during the second analytic phase, with ORR ranging from 38 to 55 wpm at the end of the phase. The third synthetic phonics phase resulted in a large decline to 37 wpm, indicating the need for additional directed synthetic phonics instruction for Giselle.

**Points of nonoverlapping data (ORR).** An adjacent conditions analysis between the first synthetic phonics phase and the first analytic phonics phase resulted in a lack of PND, meaning there was a lack of a consistent level change between conditions. An adjacent conditions
analysis resulted in another lack of PND, meaning there was an absence of demonstration of
effect between the first analytic phonics phase and the second synthetic phonics phase. The
adjacent conditions analysis between the second synthetic phonics phase and the second
analytics phonics phase resulted in a PND of 67%. This means a level change took place on
phase change. The adjacent conditions analysis between the second analytic phonics phase and
the third synthetic phonics phase resulted in another lack of PND.

Overall, the stability of scores based on the AIMSweb fluency probes maintained a
functional relationship between the synthetic phonics phase and ORR. The synthetic phonics
intervention established a stability envelope of 11.7, with 73% of the data points falling within
the stability envelope. This represents a high impact on ORR. The analytic phonics intervention
resulted in a stability envelope of 14.7 with 67% of the data points falling within the stability
envelope. This means the analytic phonics intervention also resulted in a high impact on ORR.
Both conditions A and B maintained nearly the same impact on ORR.

Level (word reading accuracy; AIMSweb). Giselle demonstrated improved word reading
accuracy during the duration of the study. Her baseline errors resulted in a score of 4 on the
AIMSweb fluency probe (Figure 11). During the first synthetic phonics phase, sessions 2
through 22, Giselle’s errors maintained stability with scores ranging from 3 to 7 on the fluency
probe, which presented a functional relationship between word accuracy and intervention. The
end of the first synthetic phonics phase brought a decline with error scores of 2 through 5,
establishing another functional relationship along with increased word reading accuracy.

A phase change to the analytic phonics intervention at session 23 brought an increase in
the number of errors ranging from 5 to 8, demonstrating stability. The analytic phonics phase,
sessions 25 to 32, brought an increase in errors ranging from 11 followed by a decline in scores
ranging from 5 to 11. The end of the analytic phase, sessions 33 to 36, resulted in a decline in errors ranging from 1 to 6, establishing a functional relationship between the analytic phonics intervention and word reading accuracy.

A short phase change, at session 39, to the second synthetic phonics intervention phase maintained stability with 2 errors since the number of errors dropped to low levels before the phase change. The second analytic phonics phase change, sessions 41 to 55, brought an increase in errors along with instability, ranging from 2 to 8. The final synthetic phonics phase at session 57 resulted in an error score of 6 along with a decrease in reading rate.

Trend (word reading accuracy; AIMSweb). When considering the number of errors from the AIMSweb fluency data, the trend line remained unchanged, which means Giselle demonstrated no improvement in word reading accuracy. The onset of the first synthetic phonics phase at session 2 resulted in stability of data with little variability for the duration of the phase. The end of the phase at session 22 resulted in a minor decrease in the number of errors from the fluency probe. The onset of the first analytic phonics session resulted in a small increase in the number of errors at sessions 23 and 25. Data remained stable for the next several data points with another increase in number of errors at session 32, meaning a decline in word reading accuracy. The end of the analytic phonics phase resulted in a large decline in the number of errors at session 33, followed by a small increase at the end of the phase. A short return to the synthetic phonics phase resulted in a decline in the number of errors and continued into the second analytic phonics phase indicating increased word reading accuracy. The number of errors remained stable for the duration of the analytic phonics phase, with one increase mid-phase at session 47. The study ended with stability during the last synthetic phonics phase and little increase in word reading accuracy.
Points of nonoverlapping data (word reading accuracy; AIMSweb). An adjacent conditions analysis between the first synthetic phonics phase and the first analytic phonics resulted in a PND of 13%, with few data points demonstrating a behavior change. An adjacent conditions analysis between the first analytic phonics phase to the second synthetic phonics phase resulted in a lack of PND and no behavior change in word reading accuracy during this phase. The phase change from the second synthetic phonics phase to the second analytic phonics phase resulted in another lack of PND due to stability of the data. The second analytic phase change to the last synthetic phonics phase produced a lack of PND as the result of continuously stable data.

Overall, Giselle’s performance during the synthetic phonics phase established a stability envelope of 1.5 along with 64% of the data points remaining stable. This indicates that condition A resulted in a moderate impact on word reading accuracy. The analytic phonics intervention resulted in a stability envelope of 1.5 and yielded 33% of the data points falling within the stability envelope. When comparing the two conditions of the synthetic phonics intervention and the analytic phonics intervention, the synthetic phonics intervention demonstrated greater control upon word reading accuracy for Giselle.

Level (word reading accuracy; WADE). When considering the WADE scores, Giselle established a baseline of 9 words read correctly (Figure 12). At session 1, baseline was established with a score of 9 words read accurately. The first synthetic phonics phase, sessions 2 through 11, produced a level change in the number of words read correctly resulting in scores ranging from 8 to 12. Within the same phase, sessions 14 through 22, resulted in scores ranging from 12 to 16 words read accurately, establishing a functional relationship between synthetic phonics and word reading accurately. The onset of the first analytic phonics phase brought a
level change and stability of eight scores ranging from 10 to 12 words read correctly. A return to the synthetic phonics phase, sessions 25 to 36, brought a level change resulting in a functional relationship between the synthetic phonics phase and word reading accuracy. The second synthetic phonics phase, at session 15, resulted in a score of 15 words read accurately, which remained stable into the second analytic phonics phase, sessions 16 to 20, with scores ranging from 14 to 20 words read correctly. This established another functional relationship between the analytic phonics intervention and word reading accuracy due to lack of overlapping data. A final return to the last synthetic phonics phase, session 57, resulted in a declined level change resulting in 10 words read correctly.

Figure 12: Giselle’s WADE word reading accuracy.
Trend (word reading accuracy; WADE). The trend line presenting on the WADE data also showed a small incline, indicating an increase in word reading accuracy. The onset of the first synthetic phonics (condition B) phase resulted in a small increase in word reading accuracy going from a baseline of 9 words up to 12 words read correctly at sessions 7 through 9. The trendline continued to climb at sessions 14 through 20, with scores at 14 through 16 words read correctly. The end of the first synthetic phase saw variability among the data with a decline in words read correctly with scores ranging from 7 to 12 at sessions 22 and 23. The start of the analytic phonics phase (condition B) saw stability of the data with a small increase in the trend with scores ranging from 10 through 12 for the duration of the phase. This stability of scores lacked any increase in the number of words read correctly, an indication of the minimal impact of the analytic phonics intervention on word reading accuracy. This may indicate the need for Giselle to receive more directed instruction offered by the synthetic phonics intervention. The onset of the second synthetic phonics phase saw a mild increase in words read correctly with a score of 15 words. The start of the second analytic phonics phase saw another increase in the trendline with some variability of scores ranging from 14 to 18 words read correctly. The phase ended with the highest word reading accuracy of 20 words, adding a medium increase to the trendline. The third synthetic phonics phase concluded the study with a significant decrease to 10 words read correctly.

Points of nonoverlapping data (word reading accuracy; WADE). When considering the WADE scores, the adjacent conditions analysis between the first synthetic phonics phase and the first analytic phonics phase lacked PND, meaning there was no behavior change on word reading accuracy. The adjacent conditions analysis between the first analytic phonics phase and the second synthetic phonics phase resulted in a PND equal to 13%. This resulted in a mild impact
of the analytic phonics intervention on word reading accuracy. The adjacent conditions analysis between the second synthetic phonics phase and the second analytic phonics phase resulted in a PND of 67%, reflecting a moderate to high level change in word reading accuracy. The adjacent conditions analysis between the second analytic phonics phase and the third synthetic phonics phase resulted in a lack of PND, an indication of no change in word reading accuracy during condition II.

Overall, the synthetic phonics intervention yielded a stability envelope of 3.6, with 55% of the data points falling within the stability envelope. This represents a moderate impact of condition A on word reading accuracy. The analytic phonics intervention established a stability envelope of 3.6, with 57% of the data points remaining stable. This also represents a moderate impact of condition B on word reading accuracy. When considering the stability envelopes for each condition, the synthetic phonics intervention and the analytic phonics intervention resulted in nearly the same moderate impact on word reading accuracy.

Secondary Analysis

A secondary analysis was conducted to examine group performance using mean calculations of pre/post data of the AIMSweb fluency probe, the Phonemic Decoding Efficiency (PDE) test of the TOWRE-2, the WADE and the WTW Primary Spelling Test. Individual participant means were calculated by finding the sum of all scores and dividing by the total number of scores. Group means were then calculated by finding the sum of individual scores and dividing by number of participants in each group. The percentile rank from the PDE was calculated using scaled scores and grade-based normative tables. Although the alternating treatments design requires the use of visual analysis to draw conclusions about functional
relationships, this secondary analysis was created to support the results of the primary analysis and to provide additional information not detected using the other dependent measures during the primary analysis.

Figure 13: WTW participant letter-sound correspondences pre/post mean.

**Letter-Sound Correspondence**

The Group 1 participants demonstrated growth from pre to posttest letter-sound correspondence (Figure 13). The group mean during the WTW spelling pretest was equal to a score of 30. The group ended the study with a group mean of 40 words spelled correctly. Holly started the study with a WTW Spelling pretest score of 24 and ended the study with a score of 32, showing some growth. Wesley started the study with a WTW spelling score of 32 and ended
the study with a score of 44, demonstrating an increase in letter-sound correspondence. Shayla
demonstrated a pretest score of 34 and a posttest score of 44, resulting in minimal increase in
letter-sound correspondence.

The participants in Group 2 showed declined scores on the WTW Spelling pretest (Figure 12), with Sandy starting the study with a score of 47 and a score of 43 on the posttest. Giselle
started the study with a pretest score of 41 and performed lower, with a score of 34 letter-
correspondence points. Group 2 mean pretest scores from the WTW Spelling test was equal to a
score of 44, with a posttest mean score of 38.5. Giselle demonstrated a significant decline in
spelling performance on the posttest, which seemed to decrease the mean score of Group 2.
Since letter-sound correspondence instruction played a minimal role during intervention lessons,
the collection of spelling data was limited.

The comparison of pre/post spelling test scores demonstrated a correlation between the
phonics interventions and letter-sound correspondences, or spelling, for Group 1 but not for
Group 2. Lesson focus for spelling instruction was minimal for both groups, and both students
from Group 2 declined in spelling performance on the WTW posttest.

**Group 1-word reading accuracy.** When considering word reading accuracy during the
synthetic phonics intervention, the mean number of errors for group 1 from the pretest of
AIMSweb fluency probe was equal to 8.3, whereas the mean number of errors after the synthetic
phonics intervention was equal to 5.76 (Figure 14).
The group’s overall decrease in mean number of errors indicates an increase in word reading accuracy. These changes are similar to the decrease in number of errors that took place at the end of the first synthetic phonics phase and during the second synthetic phonics phase.

Group word reading accuracy during the analytic phonics intervention resulted in a pretest mean score of 7.7 and a posttest mean score of 6.4, establishing a slight increase in word reading accuracy yet a higher number of errors when compared to the synthetic phonics intervention (Figure 13). This correlates to the decreases that took place during the middle of the analytic phase.

Performances on the WADE wordlist (Figure 15) resulted in a group pretest mean of 9.6 words read correctly and a posttest mean of 13.4 words read correctly after implementation of the synthetic phonics intervention. These means correlate with the increases in word reading
accuracy that took place at the end of the first synthetic phonics phase and in the middle of the second synthetic phonics phase.

Figure 15: Group WADE word reading accuracy pre/post mean by intervention.

Post results from the WADE during the analytic phonics intervention resulted in a group mean of 13.4, which was equal to the synthetic phonics post score (Figure 14). Group performance during the analytic phase resulted in significant changes during the middle and end of the analytic phonics phase. These results are nearly equal to the post-synthetic intervention scores for Group 1, an indication of nearly the same effects between the two interventions. Word reading accuracy was measured using the Phonemic Decoding Efficiency (PDE) test from the TOWRE-2 (Figure 16). Raw scores ranged from a mean equal to 3.3 on the pretest to a mean of 6.6 words read correctly on the posttest. Holly read a range of 3 words correctly on the pretest and 11 words correctly on the TOWRE-2, resulting in a national percentile rank of 3% on the
pretest and 23% on the posttest. Wesley’s raw scores ranged from 3 words read correctly on the pretest to 2 words read correctly on the posttest, resulting in a national percentile rank of 3% on the pretest and 1% on the posttest. Shayla’s raw scores ranged from 4 words read correctly, a national percentile rank of 6%, to 7 words read correctly on the posttest, resulting in a national percentile rank of 10% on the posttest. The group mean posttest score along with low posttest percentile ranks demonstrated minimal growth in word reading accuracy which contradicted the results from other data collection instruments.

Figure 16: Participant TOWRE word reading accuracy pre/post percentile rank.
Oral Reading Rate (ORR)

During the synthetic phonics intervention, the oral reading rate was examined using the AIMSweb fluency probes and measured in the number of words per minute. The Group 1 mean at baseline was 8.3, with a synthetic intervention mean score of 16.7 (Figure 17). The increase in ORR was reflected during the middle to the end of the first synthetic phonics phase and beginning and end of the second synthetic phonics phase. Shayla demonstrated the greatest increase from pretest to posttest, an indicator of improved ORR as a result of the synthetic phonics intervention.

When considering ORR, the group mean performance during the analytic phonics intervention resulted in a score equal to 16.5, which is nearly equal to the group mean during the synthetic phonics intervention (Figure 17). The increase in ORR during the beginning of the
analytic phonics phase was reflected in Wesley’s mean intervention scores. The synthetic phonics and analytic phonics interventions were close in mean value, with a 15.3 on the synthetic phonics and 17 on the analytic phonics intervention, demonstrating almost equal effect on ORR. Shayla also had nearly equal scores with a 26.3 wpm during the synthetic phonics phase and 24 wpm during the analytic phonics phase.

Performance on word accuracy instruments (Figure 13) was considered when evaluating the effect of the synthetic phonics intervention. When considering the number of errors on the AIMSweb fluency probe, Group 2 yielded a mean score of 4 errors on the pretest and 5.48 errors on the posttest, indicating a minor increase in errors and a decrease in word accuracy (Figure 15). This increase in number of errors, or decrease in word reading accuracy, was reflected during the middle of the first synthetic phonics phase and the third synthetic phonics phase where the number of errors increased.

When considering the AIMSweb fluency probe during the analytic phonics phases, Group 2 yielded a mean score of 4 errors for the baseline and a mean posttest score of 7.3 errors during the analytic phonics intervention, an indication of a decline in word reading accuracy. This increase was reflected during the first analytic phonics phase in which the number of errors remained stable and even increased. The second analytic phonics phase demonstrated a slight decrease in number of errors, which maintained an unchanged trendline over the phases.

Results on the WADE word accuracy instrument demonstrated mean scores of 12.5 for the baseline and 15 words read correctly based on the synthetic phonics intervention (Figure 15). This was reflected during the middle of the first synthetic phonics phase and the second synthetic phonics phase. During the analytic phonics intervention, word accuracy results using the WADE instrument yielded a group mean score of 15.65 words read correctly. This aligned to participant
performance at the end of the first analytic phonics phase and the end of the second analytic phonics phase. When comparing post-synthetic intervention scores and post-analytic phonics interventions, the results were nearly equal, demonstrating similar effects between the two phonics interventions on word reading accuracy (Figure 17).

Overall, results on the PDE from TOWRE-2 for Group 2 demonstrated a mean raw score of 8.5 on the pretest and a decline to 7.5 on the posttest (Figure 16). Both participants showed a minimum decline, with Sandy resulting in a raw score of 8 words read correctly and a national percentile rank of 21% on the pretest. Sandy’s performance resulted in a raw score of 7 on the posttest, resulting in a national percentile rank of 10% on the posttest. Giselle similarly had a raw score of a 9 on the pretest, resulting in a national percentile rank of 27%. Giselle’s raw score of 8 on the posttest resulted in a national percentile rank of 13% on the posttest. This lack of growth in word reading accuracy is demonstrated by an unchanged trendline throughout the phases of the study.

When considering ORR using the AIMSweb fluency probe, Group 2 resulted in a mean baseline score of 13.5 and a mean post-intervention score of 35.7 words read correctly (Figure 17) during the synthetic phase. This significant increase was reflected during the steady increase of the first synthetic phonics phase.

During the analytic phonics phases, ORR was measured using the AIMSweb fluency probes and resulted in a group mean of 46.9 words read correctly. This significant increase is demonstrated during the middle of the first analytic phonics phase and the beginning of the second analytic phonics phase. However, when compared to Group 1’s post-analytic intervention, these results are significantly higher, demonstrating a correlation between the analytic phonics intervention and ORR for Group 2.
Procedural Fidelity

Fifty-three percent of the intervention sessions were examined for fidelity (Appendix G & H) and consistency of instructional practices so all conditions were implemented as planned and both dependent variables were administered according to their protocols. This increased the credibility of the research study and controls for threats to internal validity. The fidelity score for the synthetic phonics intervention was equal to a mean score of 96%. The fidelity score for the analytic phonics implementation was equal to a mean score of 100%. Procedures were outlined in the Methodology section.

Reviewers independent of the study conducted fidelity checks of intervention implementation using fidelity checklists. Lesson components for both the synthetic and analytic phonics intervention were outlined on separate fidelity checklists for reviewers to ensure each lesson component was implemented during intervention. Fidelity scores were calculated by first tabulating the total number of correct steps in the intervention, subtracting the number of incorrect steps to find the total score. Then the total score was divided by the sum of the total correct and the total incorrect steps and then multiplied by 100. This final score represents the percentage of the intervention that was delivered with fidelity. A procedural score of 80% or above provides an indicator that the intervention or the assessment was administered with a satisfactory level of fidelity. A score below 80% indicates possible threats to internal validity.

A similar procedure was conducted with two of the dependent variables: the AIMSweb fluency probes and the WADE word list. The fidelity score for the AIMSweb fluency probes was equal to a mean score of 94%. The fidelity score for the WADE word list was equal to a mean score 100%.
Reviewers independent of the study conducted fidelity checks of intervention implementation using fidelity checklists. Lesson components for both the AIMSweb fluency probes and the WADE word list were outlined on separate fidelity checklists for reviewers to ensure each lesson component was implemented during intervention. Lesson components were separated into two categories: materials and protocols for implementation.

The materials checklist for the AIMSweb fluency probes included paper copies of the probe for both the examiner and student, a timer, and an examiner clipboard. Implementation protocols included securing a quiet location, scripts for providing directions to student, recording procedures, and scoring procedures. Fidelity scores were calculated using the same procedure as stated above. A procedural score of 80% or above provides an indicator that the intervention or the assessment was administered with a satisfactory level of fidelity. A score below 80% indicates possible threats to internal validity.

Conclusion

An adapted alternating treatments design (AATD) was used with five first-grade students to compare the effects of a synthetic phonics intervention and an analytic phonics intervention on word reading accuracy, oral reading rate, and letter-sound correspondence. Several conclusions emerged from the study. The synthetic phonics intervention provided a foundation for the analytic phonics intervention. The synthetic phonics intervention and the analytic phonics intervention represented nearly equal impact for increasing word reading accuracy and oral reading rate. The analytic intervention yielded a high impact for all five participants and resulted in some of the highest scores in word reading accuracy and oral reading rate during the study.
Further discussion of the results along with conclusions and implications from the study are addressed in Chapter 5.
CHAPTER 5
DISCUSSION AND CONCLUSIONS

The effects of synthetic and analytic phonics instruction on oral reading accuracy, rate, and letter-sound correspondences were examined to determine the impact among first grade students. An adapted alternating treatments design (AATD; Wolery et al., 1988), a form of single subject design (SSD), was used to compare the effectiveness of the two prominent phonics practices (i.e., synthetic and analytic phonics) and understand whether both instructional practices are effective and result in student growth (Baer et al., 1968).

The synthetic phonics intervention developed the students’ capacity to blend individual sounds to form words (Appendix A). Prior to the study, students began by learning letter names and sounds, followed by the sounding and blending of letters together to read words during the study (Johnston et al., 2012). During the analytic phonics instruction, lessons started with a word sort accompanied by follow-up analysis of phonic elements and letter patterns (Johnston et al., 2012). Lessons from each intervention concluded with spelling practice based on the phonetic content of that day.

Data collection included the use of pre and post measurement tools along with formative and summative instruments. AIMSweb Fluency probes (AIMSweb R-CBM), the Test of Word Reading Efficiency-2 (TOWRE-2) and the Words Their Way (WTW) Primary spelling test were administered before and after the study to show overall effectiveness of phonics instruction on word reading accuracy, oral reading fluency, and letter-sound correspondence. During the
alternating treatments study, data was collected on students’ oral reading rate (ORR) and word reading accuracy using the AIMSweb fluency and the WADE word assessment test. These data were analyzed visually to determine the existence of a functional relationship between the independent variables of the synthetic and analytic phonics intervention and the dependent variables of ORR and word reading accuracy. A secondary analysis based on group means and national percentile ranks was used to evaluate growth in ORR and word reading accuracy along with letter-sound correspondence.

Examination of the data revealed several conclusions when comparing the effectiveness of the synthetic phonics and analytic phonics intervention on ORR, word reading accuracy, and letter-sound correspondences for first-grade students. First, the analytic intervention was effective for all five participants and resulted in some of the highest results in ORR and word reading accuracy during the study. Next, student growth in word ORR and reading accuracy using the analytic phonics intervention could be attributed to instruction using the synthetic phonics intervention prior to the start of the analytic phonics intervention. Last, the combination of synthetic phonics instruction and the analytic phonics instruction yielded results that were nearly equal for increasing ORR and word reading accuracy. This chapter addresses the conclusions along with a discussion, implications for instruction, limitations, and directions for future research.

Discussion

The alternating treatments design for both groups of participants yielded an increase in ORR and word reading accuracy for all participants but one. Trendlines for most participants demonstrated a moderate to high impact on ORR and word reading accuracy across conditions.
One participant, who later qualified for special education services in reading, experienced minimal level change across the conditions when measuring ORR and word reading accuracy. All participants demonstrated some level change on word reading accuracy, especially when examining the results of the WADE assessment, but the data lacked a decline when examining the number of errors on the AIMSweb fluency probes. Discussion of the primary analysis is presented first, followed by the secondary analysis using group means based on ORR as measured by the AIMSweb fluency probes, word reading accuracy as measured by the number of errors on the fluency probes, and word reading accuracy as indicated by the number of words read correctly on the WADE assessment. Participant responses to each condition are then explained through theories of word reading development and word reading efficiency.

**Impact of Analytic Phonics Intervention**

**Group 1 – Oral Reading Rate**

The three participants from Group 1 were responsive to the analytic phonics intervention when considering the primary analysis of data. Two participants demonstrated their highest ORR during condition B, the analytic phonics phase. Trendlines during the one participant’s analytic phonics data demonstrated high variability with little stability of scores. Two participants’ scores resulted in stability during part of the analytic phonics phase. Some instances of higher PND during condition B confirm the increased impact of the analytic phonics intervention on ORR. Data from the analytic phonics intervention resulted in a stability envelope of 2.1 along with 46% of the data maintaining stability for Holly, an indication of a
stronger functional relationship between the analytic phonics intervention and ORR when compared to the synthetic phonics intervention and ORR.

These significant level changes may represent the onset of the full alphabetic phase as readers come to decode unknown words based on increased knowledge of letter-sound correspondences (Ehri, 2005). The meaning-based interactions that take place with words during the analytic phonics intervention establish additional connections in the lexicon and later help with word recognition (Juel et al., 1986; Perfetti & Hart, 2002). This suggests the importance of not only providing instruction on word reading accuracy but also word meaning and vocabulary to strengthen neurological connections for words.

The secondary analysis of the AIMSweb data did not support the increased impact of the analytic phonics intervention. Data analysis resulted in a group mean of 16.5 words per minute (wpm). This was nearly equal to the synthetic phonics group mean of 16.7 wpm and indicates a nearly equal impact between the two interventions. Mean calculations within single subject research may not be sensitive enough to detect the impact of the dependent variables of interest (Ledford & Gast, 2018).

Word reading accuracy (AIMSweb). When considering the primary analysis, the AIMSweb fluency probe revealed a level change in word accuracy with some of the lowest number of errors occurring for all three participants. Some instances of higher PND among Group 1 participants indicate a greater behavior change during the analytic phonics intervention. This may be the result of some residual effects of the synthetic phonics intervention carrying over into condition B but could also demonstrate the benefits of meaning-focused instruction when it comes to word reading accuracy. The synthetic phonics intervention represents an intensive fine-grained approach to segmenting and blending sounds that addresses the weak
phonological needs of a struggling early reader. A meta-analysis of studies that implemented systematic and synthetic phonics instruction resulted in beginning readers demonstrating the greatest impact of early phonics instruction (Ehri et al., 2001).

The continual reinforcement of segmenting and blending may have carried over into the analytic phonics phase and resulted in increased word reading accuracy. Multiple pathways in the lexicon are developed through exposure to decoding, pronunciation, spelling, and word meanings. The emphasis on word meanings in conjunction with word analysis creates a stronger pathway and representation of a word in the lexicon (Juel et al., 1986; Perfetti & Hart, 2002). This word meaning emphasis is congruent with the analytic phonics intervention and demonstrates the increased impact of the analytic phonics intervention.

The secondary analysis of the number of errors on the AIMSweb fluency probes resulted in a group mean score of 6.4 errors during the analytic phonics intervention compared to a nearly equal group mean of 6.92 errors during the synthetic phonics intervention. This indicates both the synthetic phonics and the analytic phonics interventions resulted in nearly the same impact on the number of errors in word reading accuracy. The means for number of errors failed to demonstrate a greater effectiveness presented by the analytic phonics intervention. This may be the result of the inability of the means to detect growth within single subject research (Ledford & Gast, 2018).

**Word reading accuracy (WADE).** When considering the primary analysis, participant performance on the WADE resulted overall in a higher rate of stability for all three students. Some of the highest scores occurred during the analytic phonics phase of the study, demonstrating an effect of the intervention. All three participants experienced a significantly higher PND when considering condition B, the analytic phonics intervention. One participant’s
performance resulted in a PND of 100%, meaning all data points in that phase did not overlap with the previous phase. This result was supported by a steady incline on the trendline during the analytic phonics phase, highlighting the impact of the meaning emphasis and efficient word analysis from the intervention. Another participant demonstrated an unchanged trendline, a barely detectable increase in trend across the analytic phonics intervention. Emphasis on meaning during instruction supports the development of the lexicon, a key construct for word recognition within context (Share, 2008). The secondary analysis of the WADE data resulted in a group mean of 13.4 words read correctly during the analytic phonics intervention. This was equal to the synthetic phonics group mean of 13.4 words read correctly and indicates a nearly equal impact between the two interventions. The group mean scores did not support a greater impact on word reading accuracy from the analytic phonics intervention.

**Group 2- Oral Reading Rate (ORR)**

The primary analysis of ORR showed dramatic increases among Group 2 participants with stability among data points collected during the analytic phonics phase. The higher rates of PND indicate an overall increased impact of condition B, with one instance of 100% PND upon phase change to the analytic phonics intervention. This means a significant behavior change took place upon the introduction of the analytic phonics intervention. Upon visual analysis, the analytic phase seemed to carry forth the growth achieved during the early synthetic phase, with consistent level changes among participant performance on the AIMSweb fluency probe. This is reflected in the moderate and significant increases demonstrated on the ORR trendlines. The increased focus on meaning-making during the analytic phonics intervention supported word reading accuracy efforts and led to increased ORR. The increased ORR demonstrates a
continued process of storing words in memory or the mental lexicon as the result of meaningful and relevant experiences with words (Ehri, 2005; Perfetti, 2002).

The secondary analysis of participant performance on the AIMSweb fluency probes resulted in a group mean of 46.9 for the analytic phonics intervention. This is considerably higher than the group mean of 35.7 for the synthetic phonics intervention, indicating an increased effect of condition B.

Word reading accuracy (AIMSweb). Student performance during the analytic phonics intervention showed growth in word reading accuracy for Group 2. A decline in number of errors was demonstrated by one participant during the analytic phase with limited stability. Trendlines showed a barely detectable decline in the number of errors during the second analytic phonics phase, with some stability resulting in a consistent lack of PND for the number of errors on the AIMSweb fluency probes. This indicates a failure for the number of errors to decrease during the analytic phonics intervention. All participants had one instance of 100% PND – one during the synthetic phonics phase and one during the analytic phonics phase. As ORR increased during the final analytic phonics phase, the number of errors started to decrease, demonstrating an inverted relationship between these two variables. The analytic phonics intervention establishes processes of word reading analysis that contribute to word recognition efficiency (WRE; Perfetti & Hart, 2002). The consolidated alphabetic phase reader relies on the establishment of the lexicon for WRE.

The secondary analysis consisted of group means for the number of errors on the AIMSweb fluency probes and resulted in a mean of 7 errors during the analytic phonics intervention. The synthetic phonics intervention resulted in a group mean of 5.8 errors on the
AIMSweb fluency probes. The group means do not support the greater impact of the analytic phonics intervention when compared to the synthetic phonics intervention.

**Word reading accuracy (WADE).** Performance on the WADE assessment yielded similar results, with word accuracy scores showing stability and increase during the analytic phonics intervention phase. When examining behavior changes during the analytic phonics intervention, most scores on the WADE resulted in a lack of PND, meaning the accuracy of word reading performance did not change upon the onset of condition B. However, the trendlines reflect this moderate growth during the analytic phonics phase. An unexpected increase in word reading accuracy at the end of the analytic phonics phase may indicate a minor impact on the number of words read correctly. The focus on meaning-making processes during word recognition contributes to creating high quality lexical representations in the brain. These high-quality representations, in turn, support increased word reading accuracy and ORR (Perfetti & Hart, 2002).

A secondary analysis comparing group means on the WADE resulted in a mean of 16 words read correctly during the analytic phonics intervention and a mean of 15 words read correctly during the synthetic phonics intervention. These nearly equal group means indicate the similar impact of both the synthetic and analytic phonics interventions on word reading accuracy and do not support the notion of a greater impact from condition B.

**Synthetic Phonics Instruction as Precursor**

**Group 1 - Oral reading rate.** When considering the primary analysis, all three participants demonstrated an increase in ORR. Two participants’ scores resulted in a medium to large increase, and one participant demonstrated a small increase in ORR. Condition A demonstrated
high variability for the duration of the phase for all three participants. This is reflected through a lack of PND over the duration of the study. Exposure to the synthetic phonics intervention just prior to the analytic phase resulted in an increasingly higher ORR during the condition B. The first part of the analytic phase resulted in scores continuing to increase for all three participants demonstrating a peak in their ORR. The steady increase over the phase change from the synthetic phonics to the analytic phonics parallels Chall’s (1996) description of a study that compared the look-say (visual recognition of the whole word) and the phonics method during the early 1900s. When examining word recognition and oral reading rate during Chall’s study, the phonics-trained children outperformed the look-say children in both first and second grades on word list reading. In another study, students who were trained to segment and blend sounds of a word (i.e., decode) outperformed their counterparts who were instructed using a whole word methodology (O’Connor & Padeliadu, 2000). The development of word decoding skills increased readers’ word sensitivity to letter combinations and letter positionality in words (O’Brien, 2014). The segmenting and blending presented in the synthetic phonics intervention increased word reading efficiency and led to increased ORR.

The impact of condition A declined at the middle of the analytic phonics phases for all three participants due to the decreasing effects of the synthetic phonics intervention. ORR then took a level change with increases at mid-phase and continued to steadily decline for two of the participants throughout the second part of the analytic phonics phase. This decline reflects the need to continue the synthetic phonics intervention for the long-term. This pattern was also reflected in a study in which students who received a synthetic phonics treatment held onto the capacity to segment and blend sounds of a word at a higher success rate than their counterparts who were taught using a whole-word methodology (O’Connor & Padeliadu, 2000).
One participant’s PND going from the analytic phonics intervention to the synthetic phonics intervention at the end of the study resulted in an increase in ORR, indicating a greater impact of condition A on ORR. The segmenting and blending practices reinforced during the synthetic phonics intervention supported the establishment of the lexical route, a neurological pathway that supplements letter-sound decoding and leads to automatic word recognition (Juel, 1986). This consolidation of letter sequences in the lexicon represents the consolidated alphabetic phase (Ehri, 2005) in which knowledge of consolidated units supports sight word learning and reduces initial cognitive load for the reader to identify words with greater automaticity (LaBerge & Samuels, 1974; Perfetti & Hart, 2002; Wolf & Bowers, 1999). Greater intensity was achieved during the synthetic phonics intervention due to the opportunities for immediate, corrective feedback. Feedback regarding the small grain size (Ehri et al., 2001; Wyse & Goswami, 2008) and nature of the synthetic phonics intervention resulted in increased ORR, especially when synthetic phonics instruction takes place as a precursor to analytic phonics instruction. As these phonological processing systems become efficient, this creates a segue for success during implementation of the analytic phonics instruction.

The secondary analysis of ORR resulted in nearly equal mean scores of 16.7 on the synthetic phonics intervention and 16.5 on the analytic phonics intervention. This indicates that both interventions had an equal effect on ORR as measured by the AIMSweb fluency probe. The nearly equal group means do not align with the notion that the synthetic phonics intervention provided a precursor to the analytic phonics intervention. However, the occurrence of the synthetic phonics intervention prior to the analytic phonics intervention may have established foundational skills for later success with the analytic phonics intervention.
Word reading accuracy (AIMSweb). When considering the primary analysis of the number of errors, several level changes took place across conditions. Condition A resulted in some minor level changes with stability, but a lack of PND for both the synthetic and analytic phonics interventions failed to establish a functional relationship. One instance of a participant’s moderate PND during condition B resulted in some effect of the analytic phonics intervention on the number of errors. Performance during the analytic phonics phase resulted in high variability at the start of the phase and lacked any indication of the synthetic phase as a precursor to condition B performance when considering the adjacent phase analysis. Mid-phase data points became less variable and resulted in a significant drop in the number of errors. A functional relationship was established at the end of the analytic phonics phase with minimal level changes. The synthetic phonics phase saw one brief decline in the number of errors with continued variability of data. The inconsistent declines in the number of errors also represent the need for development of the participants’ phonological processing mechanism during the full alphabetic phase of word reading development (Ehri, 1998, 2005) and takes place when the reader identifies the sound that matches the letter or letter strings (Juel et al, 1986; McCallum et al, 2006). The lack of response to the intervention for one participant indicates the presence of the pre-alphabetic phase of word reading development (Ehri, 1998, 2005) in which the reader uses some letter-sound cues and some visual cues to read and write words but cannot yet fully decode unknown words.

The secondary analysis was based on the number of errors on the AIMSweb fluency probe with group mean scores of 6.92 on the synthetic phonics intervention and 6.4 on the analytic phonics intervention. The nearly equal impact between the synthetic phonics intervention and the analytic phonics intervention does support the role of the synthetic phonics
intervention as a precursor to the analytic phonics intervention. Condition A provides essential phonetic knowledge that is then applied to the work of word analysis in condition B.

**Word reading accuracy (WADE).** The primary analysis using the WADE word reading assessment resulted in an increase in the number of words read correctly for two of the three participants. Condition A saw a steady increase in word reading accuracy that took place as level changes for the duration of the synthetic phonics intervention. These results parallel Ehri’s (2001) meta-analysis, during which the impact of phonics instruction was more statistically significant among beginning readers (d = 0.55) than among older readers (d=0.27) based on performance in decoding regularly spelled words, decoding pseudowords, and reading real words.

The analytic phonics intervention resulted in multiple level changes followed by functional relationships. In addition, participants’ higher PND indicated an increase in word reading accuracy resulting from the analytic phonics intervention. About halfway through the study, one participant who had been the least responsive to the instruction demonstrated a level change from 9 words read accuracy to 13 words during condition B. The interaction with word meaning supports the creation of neural pathways in the lexicon (Perfetti & Hart, 2002; Wolf & Bowers, 1999). To complete the process of storing words in memory or the mental lexicon and to move students into the consolidated alphabetic phase (Ehri, 1998), students need meaningful and relevant experiences with words (Allington, 2013; Ehri, 2005; Perfetti, 2002). The analytic phonics intervention not only included analysis through word sorts but also provided instruction that focused on meaning and application of words in context. The increased level changes frequently took place in the middle of each phase, providing evidence of the residual effects of the previous phonics intervention on the next phase of instruction. Students who received the
synthetic phonics treatment held onto the capacity to segment and blend sounds of a word at a higher success rate than their counterparts who were taught using a whole-word methodology in an earlier study (O’Connor & Padeliadu, 2000). This represents student growth into the full alphabetic phase in that readers are able to decode words based on letter-sound correspondences (Ehri, 2005).

Overall, visual analysis of all three participants’ trendlines revealed a sudden increase in word reading accuracy at the onset of synthetic phonics intervention along with some residual effects well into the analytic phonics phase of the study. Residual effects take place when synthetic phonics knowledge is carried over into the analytic phase and appears to support increased word reading accuracy even when readers are doing analytic word work and reading for meaning. When a reader becomes engaged with the text, words become imprinted or mapped in the lexicon upon repeated exposure to print and spellings (Ehri et al., 2001; Perfetti, 2002), which represents student growth into the full alphabetic phase in that readers are able to decode words based on letter-sound correspondences (Ehri, 2005).

A secondary analysis of the WADE data revealed group mean scores of 13.4 words read correctly on the synthetic phonics intervention and 13.4 words read correctly on the analytic phonics intervention. These equal results indicate the equal impact of both the synthetic phonics and analytic phonics interventions on word reading accuracy for Group 1. As the trendline revealed continued increase in word reading accuracy for two of the three participants, the synthetic phonics intervention took place before and after the analytic phonics phase, establishing core phonetic concepts in preparation for analysis during word identification. The success gained by the analytic phonics intervention could be attributed to the knowledge gained through exposure to the synthetic phonics intervention.
Group 2- Oral reading rate. Primary analysis of the data using the AIMSweb fluency probes resulted in a significant increase in ORR for both participants. High variability along with consistent level changes resulted for the duration of the synthetic phonics phase. The adjacent conditions analysis resulted in stability at the onset of the analytic phonics intervention, which demonstrates the residual effects of the synthetic phonics intervention. Condition B resulted in unchanged ORR for one participant and a consistent decline in ORR for the other. High variability ensued for the duration of the phase, with significant declines mid-phase indicating a fading impact of the synthetic phonics intervention on ORR for participants. Both participants saw their highest ORR of the study along with a decrease in word reading accuracy at the analytic phonics phase. Variability continued over the analytic phonics phase, with some stability for one participant and consistent declines for the duration of the study. One instance of participant PND resulted in 100%, indicating a demonstration of effect during the synthetic phonics intervention.

The secondary analysis of ORR using the AIMSweb fluency probe resulted in a group mean of 16.7 for the synthetic phonics intervention and 16.5 for the analytic phonics intervention. These nearly equal means indicate an equal impact of both the synthetic and analytic phonics intervention when it comes to ORR. The alternating treatments design resulted in use of the synthetic phonics intervention taking place prior to the analytic phonics intervention, allowing for the establishment of core foundational phonics skills before analysis during word identification.

Word reading accuracy (AIMSweb). A primary analysis of the word reading accuracy using the AIMSweb fluency probes demonstrated a small level of increased accuracy for both participants. The synthetic phonics intervention resulted in minor level changes and some
stability of the number of errors, especially when it came to the second synthetic phonics phase. Both participants experienced level change and a decline in the number of errors during the AIMSweb fluency probes. A higher PND took place during analytic phonics intervention, indicating a demonstration of effect that shows the importance of working with words in a meaningful way for students to create neural pathways and cognitive connections between phonemes and meaning (Ehri, 1999; 2005; Juel et al., 1986). Trendlines demonstrated a slight decline in the number of errors through the phases, which represented an increase in word reading accuracy. At times, ORR significantly increased when the number of errors increased. For example, on the AIMSweb fluency probes, one participant went from 35 wpm and 6 errors at session 30 to 53 wpm and 11 errors at session 32. During the next session, the same participant went back down to 45 wpm with 1 error on the AIMSweb fluency probes. As each participant increased fluency, their visual cross-checking decreased, resulting in a higher number of errors. During the word recognition process, visual cross-checking with words stored in the lexicon was failing as participants were still functioning at the partial alphabetic phase (Ehri, 2005; Gough et al., 1992). Work at the partial alphabetic phase results in readers transitioning to cipher reading, a stage at which visual cross-checking takes place more accurately. Also known as “cue reading,” this approach includes the visual cross-checking of a word by examining the letter strings for a letter-sound match (Goodman, 1970; Gough et al., 1972). Emergent readers need to continue development of their visual processing system in which letter strings become a unit rather than remain as individual letters in the lexicon (Ehri, 2005; Juel et al, 1986).

When considering the results, a decline in the number of errors by the end of the study demonstrates the movement of participants from the partial alphabetic phase to the full alphabetic phase where readers are able to decode unknown words based on letter-sound
correspondences (Ehri, 2005). Full alphabetic phase readers create cognitive connections between graphemes (letters) and phonemes (sounds) and can pronounce words accurately. Sight word learning develops more rapidly and accurately during the full alphabetic phase (Ehri & Wilce, 1987). Instruction using the synthetic phonics intervention helped the participants develop full alphabetic knowledge, which aids in placement of words in memory. Words have a secure place in memory that is supported by a developing lexicon and only a few exposures to new words are required to transition unknown words into familiar words for the reader (Dehaene, 2009; Ehri, 1999; 2005; Juel et al., 1986; Perfetti & Hart, 2002). The systematic nature of the synthetic phonics intervention allowed participants to develop mastery by segmenting and blending letter sounds to read words.

The secondary analysis of the number of errors from the AIMSweb fluency probe resulted in a post-group mean of 5.8 errors for the synthetic phonics intervention and a post-mean score of 7 errors for the analytic phonics intervention, indicating the synthetic phonics intervention had a greater impact on word reading accuracy. However, the number of errors was slow to decline until the second synthetic phonics phase for these two participants, indicating the combination of both the synthetic and analytic phonics intervention contributed to the decline in the number of errors. Performance on the number of errors did not support the notion of the synthetic phonics intervention as precursor to growth during the analytic phonics intervention.

Word reading accuracy (WADE). Performance on the WADE assessment also provided a primary analysis of word reading accuracy. Trendlines indicated a moderate growth in word reading accuracy across the conditions, including level changes followed by stability during condition A. Visual analysis confirms increases in word reading accuracy during the synthetic phonics intervention. One PND during condition A resulted in a significant increase in word
reading accuracy. According to the literature, these increases demonstrate the impact of the synthetic phonics intervention as an important precursor to developing a lexicon of words stored in the brain (Dehaene, 2009; Juel et al., 1986; Perfetti & Hart, 2002). As readers repeatedly encounter words in context, the lexicon or word storage not only grows but is drawn on for recall rather than a process of repeated decoding of every word read (Share, 2008). Even as long as 100 years ago, researchers found that students with phonics training demonstrated a greater advantage with untaught or new words than with taught or previously learned words (Valentine, 1913). In this study, word reading accuracy seemed to diminish during the second part of condition B, when the focus on analysis and word meanings were taking place during the analytic phonics phase, which resulted in the need for the increased fine-grained approach offered by the synthetic phonics intervention. Letter knowledge is one of the strongest predictors of reading achievement in the early years of literacy acquisition (Adams, 1990; Bond & Dijkstra, 1967; Chall, 1983). Synthetic phonics instruction is offered as a precursor to word recognition development supports the development of letter knowledge and phonics skills, and the reader begins a shift toward cipher reading. The cipher reader uses letter-sound relationships along with a process of matching a spoken word to the word imprinted in memory after repeated exposures (Ehri, 2005; Gough et al., 1992).

A secondary analysis of the WADE data resulted in post group means of 15 words read correctly for the synthetic phonics intervention and a group mean of 16 words read correctly for the analytic phonics intervention. The nearly equal group means represent a similar impact on word reading accuracy between the synthetic phonics intervention and the analytic phonics intervention. However, placement of the synthetic phonics intervention prior to the analytic
phonics intervention provided the opportunity to establish the foundational knowledge needed to successfully receive the processes of the analytic phonics intervention.

**Combination of Synthetic and Analytic Phonics Intervention**

**Group 1 – ORR.** Oral reading rate, as measured by the AIMSweb fluency probe, resulted in an increase in ORR with two participants’ trend lines demonstrating significant inclines through the combination of both conditions. The synthetic phonics intervention yielded a consistent percentage of points of non-overlapping data (PND), resulting in a functional relationship and a positive effect of the intervention on ORR. Results from this study suggest movement through the partial alphabetic phase (Ehri, 1998, 2005) was evident, as ORR data increased. One participant demonstrated some incline in ORR, resulting in a mild impact of the intervention. This participant remained in the partial alphabetic stage, requiring the need to build letter knowledge and phonological processing skills to move toward cipher reading (Ehri, 2005; Juel at al., 1986; Swanson & O’Connor, 2009). This mild impact may also be the result of other impacting variables such as a learning disability, low language and vocabulary, and the limited exposure to analytic phonics instruction taking place in the general classroom at the start of first grade. This student’s overall difficulty learning to read may have required the intensity and directed nature of the synthetic phonics instruction in the core curriculum to accommodate this deeper difficulty. The analytic phonics intervention resulted in an increase in ORR that continued from the previous phase of the synthetic phonics intervention. This stability was maintained for the first half of the phase but then declined during the second half of the phase. According to the literature, when the partial alphabetic reader lacks development, it may be largely due to the lack of formal instruction using alphabetic knowledge (Ehri, 2005). Students
could benefit from phonics instruction that provides the necessary knowledge of letter-sound correspondences that would support movement from the partial alphabetic phase to the full alphabetic phase (Ehri, 2005). Upward trend lines through both the synthetic and analytic phonics phases demonstrate the increased impact when instruction in phonics is the result of both synthetic phonics and analytic phonics instruction. Visual analysis of condition B notes high variability over the duration of the analytic phonics intervention, which may be an indicator of movement into the full alphabetic phase where sight word learning develops more rapidly and accurately (Ehri & Wilce, 1987). Words have a secure place in memory and only a few exposures to new words are required to transition unknown words into familiar words for the reader.

The secondary analysis resulted in group means of 16.7 words per minute for the synthetic phonics intervention and 16.5 words per minute for the analytic phonics intervention. These near equal group means indicate a near equal impact of both condition A and condition B on ORR and suggest the combination of both the synthetic and analytic phonics interventions resulted in increased ORR.

**Word reading accuracy (AIMSweb).** When examining the number of errors on the AIMSweb fluency probe, trendlines through both conditions saw a minor decline in the number of errors. Isolated declines followed by an increase in the number of errors over the duration of both condition A and condition B resulted in few functional relationships and stable level changes. One participant demonstrated a level change during the analytic phonics intervention but failed to maintain stability. However, the visual analysis of the unchanged trendline indicated no impact of either intervention on the number of errors even though there were
isolated declines in the number of errors on the fluency probe. Despite the small declines, the overall effect of these level changes may not have been enough to affect the trendline.

The lack of decline in the number of errors on the fluency probes indicates the presence of the partial-alphabetic phase of word reading development (Ehri, 2005). When considering the literature, readers begin to move past isolated letter-sound knowledge and identify strings of letters or letter combinations. This shift to letter strings, or cipher knowledge, uses the process of matching a spoken word to the word imprinted in memory after repeated exposures (Juel et al, 1986; McCallum et al, 2006). As the reader’s visual processing system comes to recognize these letters as a unit rather than as individual letters, the process of unitization begins (Ehri & Wilce, 1983). Phonics instruction provides the necessary core knowledge of letter-sound correspondences that support movement from the partial alphabetic phase to the full alphabetic phase (Ehri, 2005).

The secondary analysis resulted in a group mean of 6.92 errors during the synthetic phonics intervention and 6.4 errors on the fluency probes during the analytic phonics intervention. These near equal group means indicated a nearly equal impact of both condition A and condition B on word reading accuracy and support the notion that the combination of both the synthetic and analytic phonics interventions increase word reading accuracy.

**Word reading accuracy (WADE).** When examining the WADE word assessment for word reading accuracy, all three participants demonstrated increased level changes across the synthetic and analytic phonics interventions. Two of the participants showed abrupt level changes followed by stability in word reading accuracy during the synthetic phonics intervention. Stability was continued into condition B along with level changes. The increase in word reading accuracy continued for the duration of the study and was reflected in the increasing
trend lines for two participants. The trendline for one participant reflected a nearly unchanged status, meaning a lack of increase in word reading accuracy. This visual analysis suggests the student needs more time to develop word reading efficiency (Perfetti, 2007; Schwanenflugel et al., 2006) through intensive exposure to word recognition content and by reading more books. As readers grow their letter knowledge and phonics skills, they begin to apply this knowledge to read words. This starts the elaborate process of creating partial word connections in memory. Emergent readers use a process called cue reading to identify their first words (Ehri, 2005; Gough et al., 1992). Steady increases in word reading accuracy were maintained through this phase and provided an indication of the full alphabetic phase of word reading development (Ehri & Wilce, 1987). Full alphabetic phase readers create cognitive connections between graphemes (letters) and phonemes (sounds) and can pronounce words accurately to aid the placement of words in memory (Ehri, 2005). Sight word learning is developing more rapidly and accurately during the full alphabetic phase (Ehri & Wilce, 1987). Full alphabetic knowledge aids in placement of words in memory. As readers increase their volume of reading, a greater number of words find a place in memory (Share, 2008). As students continue to progress through the phases of word reading development, fewer and fewer exposures to print are required to imprint a word in memory.

Secondary analysis of word reading accuracy on the WADE assessment revealed a group mean of 13.4 words read correctly for condition A and an equal group mean of 13.4 words read correctly for condition B. These equal results also provide support to the notion that a combination of synthetic phonics and analytic phonics intervention can impact word reading accuracy.
In addition, all three participants demonstrated growth in letter-sound correspondence, with group mean scores of 30 on the pretest and 40 on the posttest performance of the Words Their Way spelling test (WTW). According to the literature, well-established grapheme-phoneme relationships underpin word recognition development (Ehri, 1999) during the full alphabetic phase of literacy acquisition and there is a need to teach letter sounds in the context of comprehensive early literacy instruction (Swanson & O’Connor, 2009). Even though minimal instructional time was spent during the study on letter-sound correspondence, this measure still captures orthographic processing growth (Moats, 2005) essential to later word recognition development and suggests the importance of establishing a reading-writing relationship within instruction (Shannahan, 2017). According to the literature, teaching emergent readers to read and spell words, or decode and encode words in a reciprocal manner, develops the phonological and orthographic processing systems that have been identified as key constructs of a reader’s degree of reading fluency (How & Larkin, 2013; McCallum et al., 2006).

Group 2- Oral reading rate (ORR). The primary analysis of ORR across the conditions demonstrated moderate and significant increases in ORR for Group 2 participants. Visual analysis revealed level changes followed by stability along with the carry-over from the synthetic phonics intervention to the analytic phonics intervention. Both participants showed movement through the partial alphabetic phase and the full alphabetic phase (Ehri, 1998, 2005), as evidenced by the growth in ORR. According to the literature, ORR was supported by the unitization of words in the lexicon (Ehri, 2005). These results suggest ORR comprises one of the constructs of automaticity and is strengthened by the reading and rereading of text that reinforces the cognitive processes required for automatic recognition of words (Dehaene, 2009; Juel et al., 1986; Perfetti & Hart, 2002). When considering the synthetic phonics phases, the first synthetic
phonics phase yielded the most growth and level change. The additional synthetic phonics phases, in accordance with the randomization schedule, were short, minimizing the opportunity for the intervention to gain traction in the time allotted. Instances of 100% PND going from condition A to condition B and going from condition B to condition A demonstrate the impact of both the synthetic and analytic phonics interventions on ORR.

**Word reading accuracy (AIMSweb).** Visual analysis of the number of errors across both conditions demonstrates level changes and stability. Trend lines show minor declines for the duration of the study. Condition A shows variability across the phases with increases in the number of errors. Condition B also shows variability across the phases with increases and decreases in the number of errors. The analytic phonics intervention demonstrates an instance of 100% PND in which all data points lack any overlap from the synthetic phonics intervention. The adjacent conditions analysis across both conditions frequently lacks PND, which demonstrates a lack of level change.

A secondary analysis comparing group means resulted in a score of 5.8 errors for the synthetic phonics intervention along with a group mean of 7 errors for the analytic phonics intervention. The close value of the means provides additional evidence of the impact of both the synthetic phonics intervention and the analytic phonics intervention on word reading accuracy.

**Word reading accuracy (WADE).** Primary analysis of the WADE assessment for word reading accuracy revealed moderate trend lines across the phases for both conditions. The synthetic phonics intervention demonstrated level changes, followed by instances of stability, whereas the analytic phonics intervention maintained stability with fewer level changes. One instance of PND equal to 100% during the synthetic phonics intervention indicated all data
points exceeded the previous phase of the analytic phonics intervention. Another instance demonstrated a higher PND equal to 67% in which a significant number of data points exceeded the previous phase during the adjacent conditions analysis.

The secondary analysis revealed group means for condition A equal to 15 words read correctly and a group mean equal to 16 words read correctly for condition B. This near equal result indicates the near equal impact of both the synthetic phonics intervention and the analytic phonics intervention on word reading accuracy. In addition, group means for letter-sound correspondence revealed a pretest mean of 44 points and a posttest mean of 38.5 points on the WTW spelling assessment. Letter-sound correspondence showed a decline for both participants from Group 2, with both participants demonstrating less letter-sound correspondence on the post spelling test. This may be attributed to a fidelity issue when administering the post spelling test. The limited time dedicated to orthographic processing during the study may have created a lack of opportunity to strengthen unitization efforts among the participants. According to the literature, work with the grapheme-phoneme connections supports the development of high-quality representations in the lexicon (Perfetti & Hart, 2002) that better establish unitized response levels in that the letters of a word are stuck together in memory, which increases access from the visual form of the word to the spoken form of the word (Ehri, 2005). These results suggest continued development of the orthographic processing system for all three participants.

Implications for Practice

Implications from the study transcend conclusions from research into practice. First, as outlined in Ehri’s (2005) extensive work on early reading acquisition, students need a strong foundation of letter-sound knowledge during their initial encounters with formal reading
instruction to progress through the stages of word reading development. Letter-sound knowledge complements key phonological processes and provides a basis for the development of lexical representations that support word recognition skills and word reading accuracy. Student growth in word reading accuracy and oral reading rate using the analytic phonics intervention could be attributed to instruction of core foundational letter name and letter sound skills using the synthetic phonics intervention prior to the start of the analytic phonics intervention. All participants in this study established letter-sound knowledge through using synthetic phonics instruction, either in the general classroom or intervention.

Second, it is the combination of synthetic phonics and analytic phonics instruction that accelerates accurate word recognition in early readers. Several participants established trend lines that accelerated through each phase of intervention, regardless of synthetic or analytic phonics instruction. Each phonics practice builds on the other approach’s area of weakness. The synthetic phonics intervention is designed to provide clarity, immediate and corrective feedback, and repetition effective for establishing letter-sound knowledge efficiently. The analytic phonics intervention focuses on word analysis and meaning that adds to the neurological word representations created in the lexicon. High quality representations not only build from letter-sound relationships but also from meaningful experiences with words. When high quality representations exist, students are more successful at word reading accuracy (Perfetti & Hart, 2002; Wolf & Katzir-Cohen, 2001). A comprehensive early literacy program (Gallagher-Mance, 1997) needs to incorporate a variety of rich experiences that include letter-sound knowledge and extensive, meaningful experiences with words, lots and lots of words.

Next, the combined use of synthetic phonics along with analytic phonics instruction increases ORR. As a precursor, letter-sound relationships need to be intact along with a degree
of automaticity to increase ORR. The use of both phonics approaches provides a more comprehensive program for developing word reading efficiency while creating word representations in the lexicon. A well-established lexicon supports ORR and the automatic recognition of words. Additional practices such as some repeated reading, working with multisyllabic words, and, most importantly, increasing volume of reading should also be incorporated into a literacy program targeting reading fluency. Continuous reading that provides students with extensive opportunities to read widely and deeply is at the core of any reading improvement program.

Last, for any student to develop effective word reading skills, an oral language base needs to be firmly established. Successful readers need exposure to and multiple opportunities to hear and speak oral language. Listening to language, listening to a variety of text, speaking the language, and talking about books build language and vocabulary necessary for reading acquisition. Educators must continually talk with and read to their students. Minimal exposure to text and language puts all students at a disadvantage for learning to read, especially those who are demonstrating struggles in literacy development. A well-established oral language base provides a foundation from which exposure to words, lots of words, can develop effective ORR and word reading accuracy.

Limitations

Several limitations surfaced during the study. First, the small sample size of participants and the uneven group size limited the generalizability of results to other populations, but single subject design (SSD) offers the opportunity to examine individual responses with depth and detail, which then limits the number of participants. An in-depth portrayal of each students’
responses to the independent variable provides insight into the learning process and can give educators valuable information for instruction that with nuanced adjustments could have an impact on student learning.

Next, the use of only one baseline data point before the start of phase one limited the opportunity to establish baseline stability prior to implementation of the intervention. A longer period of stability would have strengthened the reliability of the participants’ responses to the independent variable. In addition, post study data collection would have provided insight into the maintenance of each dependent variable, an indicator of the continued reliability of the results. The additional use of baseline and post study data collection would have helped to limit the impact of extraneous variables during the study.

Third, the length of the intervention sessions was short. An extended time of 10 minutes during intervention implementation would have allowed additional data collection regarding the impact on letter-sound correspondence, a key indicator of later literacy development. Instructional time spent on letter-sound correspondence would have warranted additional data collection and led to increased opportunities for impact on student growth. Letter-sound correspondence, a form of orthographic processing, enables the lexicon to create multiple representations of a word, which leads to improved word reading accuracy and fluency (Ehri, 2020; Gough, et al., 2018; How & Larkin, 2013; Perfetti & Hart, 2002).

Additionally, the original outline of the study included a timeline of 12 weeks for data collection. Unfortunately, when working with the parameters of a public school district calendar, events such as state and local standardized testing along with special school events impacted the projected timeline, so the study only lasted for a duration of 11 weeks.
Finally, some major local school district restructuring led to a direct impact on the research assistant’s job placement for the following school year. This was devastating news for this individual and led to some ill feelings during implementation of the intervention lessons. However, her participant data does not appear to reflect any impact, so this limitation is considered to be minor in the context of the study.

Suggests for Future Research

The study provides a base for future research. Replication of this study with other elementary populations such as struggling readers from other primary grades and/or intermediate grades along with general education students would continue to add to our understanding of the use of phonics instruction for reading acquisition. The use of experimental design with a control group who received only the synthetic phonics intervention or the analytic phonics intervention could help to isolate and determine the impact of a single approach versus a combination of both a synthetic and analytic phonics intervention on word reading accuracy and fluency. Additionally, SSD studies could continue with each individual participant to gain more longitudinal effects of synthetic and analytic phonics instruction on their literacy growth and development. This information becomes especially useful when working with struggling readers and provides increasingly detailed information about word recognition development for students who experience difficulties learning to read.

Replication of this study could also examine the impact of synthetic and analytic phonics instruction on orthographic mapping and letter-sound correspondence during literacy acquisition. Letter-sound correspondence supports the unitization process and aids the development of word
representations in the lexicon (Coltheart, et al., 2001; Ehri, 2020; Ehri & Wilce, 1983). So often educators support the synthetic phonics approach with young children but lack knowledge about the importance of synthetic and analytic phonics instruction on developing orthographic mapping skills.

Replication efforts could also seek the impact of synthetic and analytic phonics instruction on intermediate students who are struggling with word recognition and fluency. Due to the age of the intermediate student, instruction may proceed into multisyllabic word work, a common weakness that often delays word reading accuracy and fluency in intermediate students. Literacy intervention must address areas of specific need for struggling readers, regardless of the grade level, and target key foundational word accuracy skills.

Undergirding literacy acquisition, oral language proficiency remains. Often practicing educators remain focused on the daily content such as phonics, sight words, and guided reading levels. While those components are important for growth in literacy development, students need to be saturated with rich language coming from high quality read-alouds and conversations about books. Students need daily exposure to text. How can we expect students to decode an unknown word if they have never heard it or lack an understanding of what it means? Interactive read-alouds provide a critical base for the development of oral language and for nonreaders to become readers. Continued research on the importance of these rich read-aloud experiences in all grades is necessary to keep this information at the forefront of conversations when planning any literacy instruction.
Phonics instruction is significant in the process of early reading acquisition. The effects of synthetic and analytic phonics instruction on oral reading accuracy, rate, and letter-sound correspondences were examined to determine their effectiveness for first grade students. An adapted alternating treatments design (AATD; Wolery et al., 1988), a form of single subject design (SSD), was used to compare the effectiveness of two prominent phonics practices: a synthetic phonics intervention and an analytic phonics intervention.

Intervention delivery took place in two small groups with a total of five students who were performing below grade level expectations in reading. Student performance on the AIMSweb Reading Curriculum-Based Measurement (AIMSweb R-CBM, 2017) and the real word list from the Wilson Assessment of Decoding and Encoding (WADE; Wilson, 1998) were examined two to three days per week to determine the effectiveness of a synthetic phonics intervention in comparison to an analytic phonics intervention. Pre and posttest data were collected using AIMSweb R-CBM, the TOWRE-2, and the WTW primary spelling test to compare the means and overall effectiveness of each intervention.

Several conclusions emerged from the study and answer the research question: What is the effect of a synthetic phonics vs. analytic phonics intervention on oral reading accuracy, oral reading rate (ORR), and letter-sound correspondence among first-grade students?

First, the synthetic phonics intervention and the analytic phonics intervention yielded results that were nearly equal for increasing word reading accuracy and oral reading rate. Second, the analytic intervention was effective for all five participants and resulted in some of the highest results in word reading accuracy and oral reading rate during the study. Last, student growth in word reading accuracy and oral reading rate using the analytic phonics intervention...
could be attributed to instruction using the synthetic phonics intervention prior to the start of the analytic phonics intervention.

During the initial literacy acquisition, students need directed phonics instruction such as a synthetic phonics approach to progress through the stages of word reading development. After the initial establishment of letter-sound relationships, the combination of synthetic and analytic phonics instruction yielded the greatest impact when developing word reading accuracy and fluency among elementary students. At the core of literacy acquisition is oral language development. Students must become word experts – what words look like, how words are spelled, what words mean, and how words are structured – to name some specific content knowledge. Rich daily experiences with a variety of quality books and language provide the key ingredient in conjunction with both synthetic and analytic phonics instruction for students to grow oral language skills that segue into literacy acquisition for all students.
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APPENDIX A

DEFINITIONS OF WORDS REFERENCED IN THE STUDY
<table>
<thead>
<tr>
<th>Word</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>segment</td>
<td>break apart the sounds of a word</td>
<td>bench= b-e-n-ch</td>
</tr>
<tr>
<td>blend</td>
<td>push the letter sounds of a word together to read a word</td>
<td>d-r-i-p= drip</td>
</tr>
<tr>
<td>syllable</td>
<td>a push of air or breath when saying a word out loud</td>
<td>bathtub= bath tub= 2 syllables</td>
</tr>
<tr>
<td>consonant</td>
<td>letters of the alphabet that do not include the vowels</td>
<td>c, d, f, g, h, j, k, etc.</td>
</tr>
<tr>
<td>vowel</td>
<td>6 letters of the alphabet; at least one vowel must be present in a real word</td>
<td>a, e, i, o, u, sometimes, y</td>
</tr>
<tr>
<td>digraph</td>
<td>two specific consonants that push together to make one sound</td>
<td>ch, sh, th, ck, wh</td>
</tr>
<tr>
<td>digraph blend</td>
<td>a digraph and an additional consonant</td>
<td>thr= thrust</td>
</tr>
<tr>
<td>vowel team</td>
<td>two letters together in a word that make a vowel sound</td>
<td>ea= meat, ai=bait, ue=blue</td>
</tr>
<tr>
<td>closed syllable</td>
<td>a one-syllable word with one short vowel that has at least one consonant after the vowel</td>
<td>cat= the “t” closes in the vowel so it takes a short vowel sound</td>
</tr>
<tr>
<td>vowel-consonant-e syllable</td>
<td>a one-syllable word with one long vowel that is followed by one consonant and then an “e”</td>
<td>lake= the “k” closes in the vowel but the silent “e” at the end makes it a long vowel sound</td>
</tr>
<tr>
<td>tap (Wilson, 2012)</td>
<td>when a student holds up one hand and presses one finger to the thumb for each sound heard in a word</td>
<td>camp= c (one tap), a (one tap), m (one tap), p (one tap); then tap all fingers at once when the whole word is spoken</td>
</tr>
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APPENDIX B

NORTHERN ILLINOIS UNIVERSITY
PARENT PERMISSION FOR A MINOR TO PARTICIPATE IN A RESEARCH STUDY
Title of Study: Examining Early Word Recognition Instruction: Synthetic Phonics vs. Analytic Phonics

Investigators

<table>
<thead>
<tr>
<th>Name:</th>
<th>Jenelle Mance</th>
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<td>Name:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Name:</td>
<td>Dept:</td>
<td>Phone:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key Information

This is a voluntary research study on how young children learn to read. One way to teach reading is through phonics instruction. Phonics lessons teach students the letters of the alphabet, the sounds those letters make, and how to read and spell accurately using letters. This 12-week study involves students participating in lessons that teach phonics in different ways. The benefits for students include improved reading and spelling skills; there are no reasonable foreseeable risks at this time.

Description of the Study

The purpose of the study is to investigate how phonics instruction impacts oral reading accuracy, oral reading rate, and letter-sound correspondence. If you agree to allow your child/ward to be in this study, your child/ward will be asked to participate in daily phonics lessons with their current RtI intervention teacher and take short reading tests 2-3 times per week.

Lessons will last no longer than 30 minutes a day over a 12-week period. These lessons will take place during their existing small group lesson time. Students will be asked to read words, spell words, and sort words according to letter analysis and meaning.

Risks and Benefits

There are no reasonably foreseeable (or expected) risks.

The benefits of participation are that participants will receive instruction to improve and accelerate growth in core foundational reading skills. Additionally, implications from the study will contribute to the kinds of lessons students receive when they require extra help for reading. Implications will also provide content for teacher preparation programs to help improve the quality of teacher candidates for our schools.
Confidentiality
This study is confidential. The researcher will not be collecting or retaining any information about your child/ward’s identity. The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file.

The researcher will not include any information in any published report that would make it possible to identify your child/ward.

Your Rights
The decision to allow your child/ward to participate in this study is entirely up to you. You may refuse to have your child/ward take part in the study at any time. Your decision will not result in any loss of benefits to which you and/or your child/ward are otherwise entitled. Your child/ward has the right to skip any question or research activity, as well as to withdraw completely from participation at any point during the process. If you choose to withdraw, your child/ward will still receive any extra help that he/she qualifies for according to school district guidelines.

You have the right to ask questions about this research study and to have those questions answered before, during, or after the research. If you have any further questions about the study, at any time feel free to contact the researcher, Jenelle Mance, or by telephone at . The faculty advisor from Northern Illinois University for this study is Dr. Laurie Elish-Piper and she can be contacted at 

If you have any questions about your child/ward’s rights as a research participant that have not been answered by the investigator or if you have any problems or concerns that occur as a result of your child/ward’s participation, you may contact the Office of Research Compliance, Integrity, and Safety at (815)753-8588. If you have any problems or concerns that occur as a result of your child/ward’s participation, you can report them to the Office of Research Compliance at the number above.

Northern Illinois University policy does not provide medical treatment or compensation for treatment of injuries that may occur as a result of participation in research activities. The preceding information shall not be construed as a waiver of any legal rights or redress which the participants may have.

Future Use of the Research Data
After removing all identifying information from your child’s/ward’s data, the information could be used for future research studies or distributed to another investigator for future research studies without additional permission from you.
Disclosure of Research Results to Participants

Testing results will be graphed and shared with students so they can see a picture of their performance in reading during the study.

Your signature below indicates that you have agreed to allow your child/ward to volunteer as a research participant for this study, and that you have read and understood the information provided above. You will be given a signed and dated copy of this form to keep, along with any other printed materials deemed necessary by the study investigators.

_____________________________________________           _____________________
Participant’s Signature      Date
APPENDIX C

SCRIPT TO INVITE A MINOR TO PARTICIPATE IN STUDY
As you all may remember, I am still going to college and taking classes. I am working to become a doctor of teachers. When I’m finished, you can call me Dr. Mance. I will not be a doctor you can go to when you get sick but rather a Doctor of Education, an expert at teaching kids. One of my classes requires me to do some research like a scientist would do. I would like to research more about how kids learn to read. I am wondering if you would be willing to be the kids in my research study. We will continue our lessons every day, as usual. If you are willing, I would like to send a letter home to your parents/family to be sure it is ok with them that you are a participant in my research. I will also call your families on the phone to answer any questions they may have. If your family says it’s ok for you to do this, there is a letter that your parents will need to sign, and you can bring it back to school.
<table>
<thead>
<tr>
<th>Synthetic Phonics</th>
<th>Concept</th>
<th>Analytic Phonics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Letter/Sound Cards</td>
<td>Letter name/Letter sound</td>
<td>Letter Sorts (sort letters by shape, lines, etc.; put words into categories by the letters or sounds of letters)</td>
</tr>
<tr>
<td>Segmenting &amp; blending sounds</td>
<td>Word recognition</td>
<td>Analyzing letter patterns (words with same vowel sound or grouping of letters)</td>
</tr>
<tr>
<td>Definition- a selection of lesson words are defined by instructor and put into sentences by students</td>
<td>Vocabulary/Word meaning</td>
<td>Word sorts (put words into categories of meaning)</td>
</tr>
<tr>
<td>6 syllable types/syllabication (closed syllable, i.e. stop; vowel-consonant-e syllable, i.e. lake; open syllable, i.e. we)</td>
<td>Word structure</td>
<td>Word structure (stand has two blends and one short vowel)</td>
</tr>
<tr>
<td>Kinesthetic/Tactile - build words using magnetic letter tray</td>
<td>Spelling</td>
<td>Word sorts- manipulate word cards into groupings on a chart or on paper</td>
</tr>
</tbody>
</table>
APPENDIX E

A & B CONDITION SUMMARY INCLUDING BASELINE, CONTENT, AND DATA COLLECTION
<table>
<thead>
<tr>
<th>Lessons</th>
<th>Group 1 Condition</th>
<th>Group 2 Condition</th>
<th>Content (Wilson, 2012)</th>
<th>Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Test</td>
<td>Baseline/ Pre-Testing</td>
<td>Baseline/ Pre-Testing</td>
<td>None</td>
<td>TOWRE-2 AIMSweb R-CBM WTW Primary Spelling Survey</td>
</tr>
<tr>
<td>1-5</td>
<td>A- Synthetic Intervention</td>
<td>A- Synthetic Intervention</td>
<td>Review CVC words, base word + suffix -s, bonus letter words, glued sounds</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>6-10</td>
<td>A- Synthetic Intervention</td>
<td>A- Synthetic Intervention</td>
<td>Consonant blends, digraph blends, closed syllable</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>11-15</td>
<td>A- Synthetic Intervention</td>
<td>A- Synthetic Intervention</td>
<td>Consonant blends, digraph blends, closed syllable</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>16-20</td>
<td>B- Analytic Intervention</td>
<td>A- Synthetic Intervention</td>
<td>Consonant blends, digraph blends, closed syllable</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>21-25</td>
<td>B- Analytic Intervention</td>
<td>B- Analytic Intervention</td>
<td>Vowel-consonant-e words (VCe), VCe syllable</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>Week 26-30</td>
<td>B- Analytic Intervention</td>
<td>B- Analytic Intervention</td>
<td>Vowel-consonant-e words (VCe), VCe syllable</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>Week 31-35</td>
<td>B- Analytic Intervention</td>
<td>B- Analytic Intervention</td>
<td>R-controlled vowel sounds: ar, or, er, ir, ur</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>Week 36-40</td>
<td>B- Analytic Intervention</td>
<td>A- Synthetic Intervention</td>
<td>R-controlled vowel sounds: ar, or, er, ir, ur</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>Week 41-45</td>
<td>A-Synthetic Intervention</td>
<td>B-Analytic Intervention</td>
<td>Vowel teams: ai, ay, ee, ea, ey, oi, oy</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>Week 46-50</td>
<td>A-Synthetic Intervention</td>
<td>B-Analytic Intervention</td>
<td>Vowel teams: ai, ay, ee, ea, ey, oi, oy</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic WADE B List-Analytic</td>
</tr>
<tr>
<td>Week 51-55</td>
<td>A-Synthetic Intervention</td>
<td>B-Analytic Intervention</td>
<td>2-syllable words using closed syllables</td>
<td>AIMSweb R-CBM-2x WADE A List-Synthetic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Post-Test</td>
<td>Post-Testing</td>
<td>Post-Testing</td>
<td>None</td>
<td>TOWRE-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AIMSweb R-CBM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>WTW Primary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Spelling Survey</td>
</tr>
</tbody>
</table>
APPENDIX F

RANDOMIZATION OF INTERVENTIONS
<table>
<thead>
<tr>
<th>Week</th>
<th>Mance Intervention</th>
<th>Bartholomew Intervention</th>
<th>Notes/start</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>synthetic</td>
<td>synthetic</td>
<td>2/16/22</td>
</tr>
<tr>
<td>2</td>
<td>synthetic</td>
<td>synthetic</td>
<td>2/28/22</td>
</tr>
<tr>
<td>3</td>
<td>synthetic</td>
<td>synthetic</td>
<td>3/7/22</td>
</tr>
<tr>
<td>4</td>
<td>analytic</td>
<td>synthetic</td>
<td>3/14/22</td>
</tr>
<tr>
<td>5</td>
<td>analytic</td>
<td>analytic</td>
<td>3/21/22</td>
</tr>
<tr>
<td>6</td>
<td>analytic</td>
<td>analytic</td>
<td>4/4/22</td>
</tr>
<tr>
<td>7</td>
<td>analytic</td>
<td>analytic</td>
<td>4/11/22</td>
</tr>
<tr>
<td>8</td>
<td>analytic</td>
<td>synthetic</td>
<td>4/19/22</td>
</tr>
<tr>
<td>9</td>
<td>synthetic</td>
<td>analytic</td>
<td>4/25/22</td>
</tr>
<tr>
<td>10</td>
<td>synthetic</td>
<td>analytic</td>
<td>5/2/22</td>
</tr>
<tr>
<td>11</td>
<td>synthetic</td>
<td>analytic</td>
<td>5/9/22</td>
</tr>
<tr>
<td>12</td>
<td>synthetic</td>
<td>synthetic</td>
<td>5/16/22</td>
</tr>
</tbody>
</table>
APPENDIX G

CONDITION A: SYNTHETIC PHONICS IMPLEMENTATION FIDELITY CHECKLIST
The synthetic phonics intervention will be comprised of the following components:

a.) Letter/Sound Review- Establish quick and automatic letter names and associated letter sounds

b.) Teach Concepts for Reading- teach word structure by presenting 3 words in segmented form and practice decoding words with specific letter patterns

c.) Wordlist Reading- Establish independent application and automaticity of single-word decoding skills; students should read 6-8 words. Chart progress to determine lesson progression

d.) Sound/Letter Review- Establish quick and automatic letter sounds and associated letter names using magnetic letter trays

e.) Teach Concepts for Spelling- Establish process to spell 3 words by breaking them into parts such as word elements, syllables, sounds using magnetic letter trays

f.) Written Dictation- Develop independent spelling skills with word structure elements using student dictation book and pencil; students are to spell 3 sounds, 2 words, 1 dictated sentence

Materials: letter sound cards, table-top pocket chart, wordlist reading books, magnetic letter trays with array of letters (1 for each student), digraphs, glued sounds, closed syllable exceptions, dictation book and pencil for each student
### Synthetic Phonics Implementation Fidelity Checklist

<table>
<thead>
<tr>
<th>Date</th>
<th>Lesson #</th>
<th>Instructor</th>
<th>Peer Reviewer</th>
<th>Substep</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>General Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Greet students</strong></td>
</tr>
<tr>
<td><strong>Keyword, Glued Sounds, Vowel Sounds charts displayed</strong></td>
</tr>
<tr>
<td><strong>Tabletop chart displayed</strong></td>
</tr>
<tr>
<td><strong>Materials: small sound cards, large sound cards, pocket chart, dictation books, pencils available</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesson Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesson Steps and Description</strong></td>
</tr>
<tr>
<td>1. Letter/Sound Drill- Display each letter card at a time; students are to identify letter name then letter sound. Rotate among students in the group.</td>
</tr>
<tr>
<td>2. Teach concepts/Build words- Using letter cards, build one word at a time for a total of 3 words. Invite one student at a time to read the word. Tap out sounds, if needed. Words should review previous concepts and teach the new concept.</td>
</tr>
<tr>
<td>3. Wordlist Reading- Distribute Wordlist books. Assign a different list of 6-8</td>
</tr>
</tbody>
</table>
words to each student. Listen to each student and provide immediate, corrective feedback. No

4. Sound/Letter Drill- Distribute letter trays. Instructor provides the sound and the student is to repeat the sound. Student is to then identify the letter and point to the letter or letters on the letter tray. Rotate among students. Instructor should give all vowel sounds, a couple of digraphs & glued sounds & closed syllable exceptions. Yes

No

5. Spell Words- Invite students to build 3 words on a letter tray as the instructor gives one word at a time. Instructor says word aloud and then students repeat the word. Then students tap the word to spell the word. Yes

No

6. Dictation- Distribute Dictation Books. Invite students to put the date at the top. Instructor then dictates 3 sounds, 2 words, and 1 sentence for students to spell. Instructor will lead students to proofread the sentence for spelling and punctuation. Yes

No

<table>
<thead>
<tr>
<th>Implementation Fidelity Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total correct steps (a):</td>
</tr>
<tr>
<td>Total incorrect steps (b):</td>
</tr>
<tr>
<td>Total a/(a+b)*100:</td>
</tr>
</tbody>
</table>

Score Interpretation:

< 80% = greater threat to internal validity

>80% = low threat to internal validity
APPENDIX H

CONDITION B: ANALYTIC PHONICS IMPLEMENTATION FIDELITY CHECKLIST
The analytic phonics protocol will be comprised of the following key components for an open word sort:

a.) Display 6-8 words that contain targeted phonetic concepts.

b.) Invite students to find ways to sort words together based on letter/sound combinations.

c.) Ask one student at a time to select a word and begin a sort on a table-top chart. Talk about each word in detail including spelling, letter-sound relationships, and meanings.

d.) Students then write each word in a word study notebook on a sorting grid.

d.) Use a highlighter to color and highlight letters that match the targeted phonetic concept.

e.) Continue talking about one word at a time and sort into categories/groups.

f.) Using their word study notebook, dictate 2 words for students to spell; then invite students to select one word from the word sort and write a sentence using that word. Invite volunteers to share their sentences with the group.

**Analytic Phonics Implementation Fidelity Checklist**

<table>
<thead>
<tr>
<th>Date</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson #</td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td></td>
</tr>
<tr>
<td>Peer Reviewer</td>
<td></td>
</tr>
<tr>
<td>Substep</td>
<td></td>
</tr>
</tbody>
</table>
General Procedures

<table>
<thead>
<tr>
<th>Greet students</th>
<th>Yes</th>
<th>No</th>
<th>NA</th>
<th>Session runs 30 minutes</th>
<th>Yes</th>
<th>No</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elmo projector available</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>Immediate, corrective feedback provided</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Words cut apart in ziplock bags</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td><em>I Can</em> statements displayed and discussed</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Materials: large letter cards, pocket chart, notebooks, pencils available</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>Instructor questioned students at different intervals throughout the lesson</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
</tbody>
</table>

Lesson Procedures

<table>
<thead>
<tr>
<th>Lesson Steps and Description</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Connect to previous learning by reviewing yesterday’s lesson concept.</td>
<td>Yes No</td>
</tr>
<tr>
<td>2. Display words and ask for students to read one word at a time and explain its meaning. Continue with several other words.</td>
<td>Yes No</td>
</tr>
<tr>
<td>3. Put 6-8 words on a pocket chart and invite students to sort words. Ask students to identify categories.</td>
<td>Yes No</td>
</tr>
<tr>
<td>4. Distribute student word sorts and invite students to work as a team to complete the sort.</td>
<td>Yes No</td>
</tr>
<tr>
<td>5. Discuss the sort with the following questions: Why did you sort these words in that way? What are you noticing about these words? What does this word mean? Is there a different way to sort these words?</td>
<td>Yes No</td>
</tr>
<tr>
<td>6. Writing- Distribute Word Study Notebooks. Invite students to put the date at the top. Invite students to spell 2 dictated words and then student can pick one word and write it in a sentence. Remind students to use capitalization and punctuation. Share sentences aloud.</td>
<td>Yes No</td>
</tr>
<tr>
<td>Implementation Fidelity Score</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--</td>
</tr>
<tr>
<td>Total correct steps (a):</td>
<td></td>
</tr>
<tr>
<td>Total incorrect steps (b):</td>
<td></td>
</tr>
<tr>
<td>Total $\frac{a}{a+b}\times100$:</td>
<td></td>
</tr>
</tbody>
</table>

**Score Interpretation:**

- $< 80\%$ = greater threat to internal validity
- $> 80\%$ = low threat to internal validity
APPENDIX I

PROTOCOL/FIDELITY CHECKLIST FOR AIMSWEB R-CBM DATA COLLECTION
### AIMSweb R-CBM

<table>
<thead>
<tr>
<th>Date</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe #</td>
<td></td>
</tr>
<tr>
<td>Student Name</td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td></td>
</tr>
<tr>
<td>Peer Reviewer</td>
<td></td>
</tr>
</tbody>
</table>

#### Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Secured</th>
</tr>
</thead>
<tbody>
<tr>
<td>paper copy of R-CBM Protocol</td>
<td>Yes</td>
</tr>
<tr>
<td>paper copy of the probe to be read by student</td>
<td>Yes</td>
</tr>
<tr>
<td>corresponding Examiner’s Copy for use during scoring- the Examiner’s</td>
<td>Yes</td>
</tr>
<tr>
<td>copy has a number at the end of each line, indicating the cumulative</td>
<td></td>
</tr>
<tr>
<td>number of words</td>
<td>No</td>
</tr>
<tr>
<td>timer or clock</td>
<td>Yes</td>
</tr>
<tr>
<td>pencil or pen for scoring</td>
<td>Yes</td>
</tr>
<tr>
<td>a clipboard for Examiner’s copy so student cannot see Examiner’s</td>
<td>Yes</td>
</tr>
<tr>
<td>markings during the administration of the probe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

#### AIMSweb R-CBM Administration

<table>
<thead>
<tr>
<th>Task</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure a quiet testing area away from distractions. Sit across from</td>
<td>Yes</td>
</tr>
<tr>
<td>the student, not beside the student.</td>
<td>No</td>
</tr>
<tr>
<td>Record student’s name and date on Examiner’s Copy.</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>
**Emphasize Words Read Correctly (WRC):** Tell student: *I am listening for your best reading* and start timer for 1 minute.

Yes  
No

**3-Second Rule:** If a student stops or struggles with a word for 3 seconds, tell the student the word and mark it as incorrect. You want enough time to observe if the student is using a strategy for unfamiliar words, but not so long that the student gets frustrated or gives up.

Yes  
N/A  
No

**Long Pause:** Tell student, *Keep reading* or *Next word . . .*

Yes  
N/A  
No

**Discontinue Rule:** During screening only, if the passage is so hard that the student reads fewer than 10 words correctly in 1 minute, do not administer any other passages; use the score from the passage(s) already administered.

Yes  
N/A  
No

**Speed reading:** If a student is speed reading and making many errors because she or he is trying to read very quickly, interrupt the student and say: *This is not a speed reading test. Begin again, and be sure to do your best reading.*

Yes  
N/A  
No

** Interruption:** If something disrupts testing, discontinue the passage and administer another. Substitute a progress monitoring passage for a screening passage.

Yes  
N/A  
No

**Prepare for scoring the probe.**

Yes  
N/A  
No

**AIMSweb R-CBM Scoring**

<table>
<thead>
<tr>
<th>Description</th>
<th>Action</th>
<th>Action</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of words read (a)- Use number guides on examiner copy to determine total number of words read</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>Total number of errors (b)- Count total number of errors- substitutions, omissions, insertions, mispronunciations, reversals</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>Total: a-b= Words Read Correctly in 1 minute</td>
<td>Yes</td>
<td>N/A</td>
<td>No</td>
</tr>
</tbody>
</table>

**Implementation Fidelity Score**
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total correct steps (a) :</td>
<td></td>
</tr>
<tr>
<td>Total incorrect steps (b):</td>
<td></td>
</tr>
<tr>
<td>Total ( \frac{a}{(a+b)\times100} ):</td>
<td></td>
</tr>
</tbody>
</table>

Score Interpretation:

- \(< 80\% = greater threat to internal validity\)
- \(\geq 80\% = low threat to internal validity\)
APPENDIX J

PROTOCOL/FIDELITY CHECKLIST FOR WORDS THEIR WAY PRIMARY SPELLING TEST
## Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lined paper with numbers 1-20 on left margin for each student</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Pencil for each student</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

## General Directions for Administering the Inventory

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say the following introduction: <em>I am going to ask you to spell some words. Spell them as best you can. Some words may be easy to spell and some may be harder to spell. When you do not know how to spell a word, spell it the best you can.</em></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Call each word out loud and repeat it. Say each word naturally without emphasizing sounds or syllables.</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Use the word in a sentence. Sample sentences are available on the scoring instrument.</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Be sure students know the exact word and are writing it next to the correct number.</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Collect all papers when inventory is complete.</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

## Primary Spelling Inventory Word List

<table>
<thead>
<tr>
<th>Word</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. fan</td>
<td></td>
</tr>
<tr>
<td>2. pet</td>
<td></td>
</tr>
<tr>
<td>3. dig</td>
<td></td>
</tr>
<tr>
<td>4. rob</td>
<td></td>
</tr>
<tr>
<td>5. hope</td>
<td></td>
</tr>
<tr>
<td>6. wait</td>
<td></td>
</tr>
<tr>
<td>7. gum</td>
<td></td>
</tr>
<tr>
<td>8. sled</td>
<td></td>
</tr>
<tr>
<td>9. stick</td>
<td></td>
</tr>
<tr>
<td>10. shine</td>
<td></td>
</tr>
<tr>
<td>11. dream</td>
<td></td>
</tr>
</tbody>
</table>
### Scoring

1. Use a copy of the Feature Guide for each student. Draw a line under the last word called if you called fewer than the total number and adjust the possible total points at the bottom of each feature column.  

<table>
<thead>
<tr>
<th>yes</th>
<th>no</th>
</tr>
</thead>
</table>

2. Score the words by checking off the features spelled correctly that are listed in the cells to the left of each word. Put a check in the correct column if spelled correctly. Give speller credit for the letters that are correct.  

<table>
<thead>
<tr>
<th>yes</th>
<th>no</th>
</tr>
</thead>
</table>

3. Add the number of checks under each feature and across each word.  

<table>
<thead>
<tr>
<th>yes</th>
<th>no</th>
</tr>
</thead>
</table>

4. To determine stage of development, note where students first made two or more errors under the stages listed in the shaded box.  

<table>
<thead>
<tr>
<th>yes</th>
<th>no</th>
</tr>
</thead>
</table>

5. Implementation Fidelity Score  

<table>
<thead>
<tr>
<th>yes</th>
<th>no</th>
</tr>
</thead>
</table>

Total correct steps (a):  

Total incorrect steps (b):  

Total \( \frac{a}{(a+b)} \times 100 \):
Score Interpretation:

< 80% = greater threat to internal validity

> 80% = low threat to internal validity
APPENDIX K

PROTOCOL/FIDELITY CHECKLIST FOR THE WILSON ASSESSMENT OF DECODING AND ENCODING (WADE)
Wilson Assessment of Decoding and Encoding (WADE)

<table>
<thead>
<tr>
<th>Date</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe #</td>
<td></td>
</tr>
<tr>
<td>Student Name</td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td></td>
</tr>
<tr>
<td>Peer Reviewer</td>
<td></td>
</tr>
</tbody>
</table>

**Materials**

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td>pencil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>student list of words</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>recording form for test administrator</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

**General Directions for Administering the Reading Test/WADE**

<table>
<thead>
<tr>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Place the list of words in front of the student.</td>
<td></td>
</tr>
<tr>
<td>2. Invite the student to read the list aloud.</td>
<td></td>
</tr>
<tr>
<td>3. Explain to the students the following: <em>I want to see how many of these words you can read. Begin at the top and read going downward. When you come to a word you don’t know, just move on to the next word.</em></td>
<td>yes</td>
</tr>
<tr>
<td>4. Put a plus sign (+) next to each word read correctly. Record any substitutions on the recording sheet.</td>
<td>yes</td>
</tr>
<tr>
<td>5. If reading the words is difficult for the student, <strong>stop the test after 5 consecutive errors</strong>.</td>
<td>yes</td>
</tr>
<tr>
<td>6. Invite the student to try to read any of the remaining words.</td>
<td>yes</td>
</tr>
</tbody>
</table>
### Reading Test List A

<table>
<thead>
<tr>
<th>List 1</th>
<th>List 2</th>
<th>List 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. cap</td>
<td>1. junk</td>
<td>1. mascot</td>
</tr>
<tr>
<td>2. luck</td>
<td>2. bang</td>
<td>2. punish</td>
</tr>
<tr>
<td>3. bib</td>
<td>3. chomp</td>
<td>3. contest</td>
</tr>
<tr>
<td>4. hog</td>
<td>4. fresh</td>
<td>4. children</td>
</tr>
<tr>
<td>5. pet</td>
<td>5. send</td>
<td>5. wingspan</td>
</tr>
<tr>
<td>6. shell</td>
<td>6. crunch</td>
<td>6. pumpkins</td>
</tr>
<tr>
<td>7. fall</td>
<td>7. thrill</td>
<td>7. inspect</td>
</tr>
<tr>
<td>8. tan</td>
<td>8. bold</td>
<td>8. fantastic</td>
</tr>
<tr>
<td>9. quits</td>
<td>9. squint</td>
<td>9. athletic</td>
</tr>
<tr>
<td>10. chops</td>
<td>10. spring</td>
<td>10. distracted</td>
</tr>
</tbody>
</table>

All test items administered: yes

### Reading Test List B

<table>
<thead>
<tr>
<th>List 1</th>
<th>List 2</th>
<th>List 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. bat</td>
<td>1. dunk</td>
<td>1. napkin</td>
</tr>
<tr>
<td>2. sock</td>
<td>2. sang</td>
<td>2. publish</td>
</tr>
<tr>
<td>3. big</td>
<td>3. thump</td>
<td>3. dentist</td>
</tr>
<tr>
<td>4. fox</td>
<td>4. flash</td>
<td>4. publish</td>
</tr>
<tr>
<td>5. peg</td>
<td>5. rest</td>
<td>5. cobweb</td>
</tr>
<tr>
<td>6. shop</td>
<td>6. bench</td>
<td>6. goblins</td>
</tr>
<tr>
<td>7. mall</td>
<td>7. shrug</td>
<td>7. expect</td>
</tr>
<tr>
<td>8. van</td>
<td>8. mild</td>
<td>8. basketball</td>
</tr>
<tr>
<td>10. chats</td>
<td>10. strong</td>
<td>10. disrupted</td>
</tr>
</tbody>
</table>

All test items were administered: yes
### Scoring

1. Count all of the plus signs and record as the total score.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

### Implementation Fidelity Score

- Total correct steps (a):
- Total incorrect steps (b):
- Total a/(a+b)*100:

### Score Interpretation:

- < 80% = greater threat to internal validity
- >80% = low threat to internal validity
APPENDIX L

PROTOCOL/FIDELITY CHECKLIST FOR TEST OF WORD READING EFFICIENCY,
SECOND EDITION (TOWRE-2)
### Test of Word Reading Efficiency, Second Edition (TOWRE-2)

<table>
<thead>
<tr>
<th>Date</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe #</td>
<td></td>
</tr>
<tr>
<td>Student Name</td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td></td>
</tr>
<tr>
<td>Peer Reviewer</td>
<td></td>
</tr>
</tbody>
</table>

#### Materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>Secured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes/No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Phonemic Decoding Efficiency cards to be read by student</td>
<td>Yes/No</td>
</tr>
<tr>
<td>corresponding record booklet for use during scoring</td>
<td>Yes/No</td>
</tr>
<tr>
<td>timer or clock</td>
<td>Yes/No</td>
</tr>
<tr>
<td>pencil or pen for scoring</td>
<td>Yes/No</td>
</tr>
<tr>
<td>a clipboard for Examiner’s copy so student cannot see Examiner’s markings</td>
<td>Yes/No</td>
</tr>
<tr>
<td>during test administration</td>
<td></td>
</tr>
</tbody>
</table>

#### Administration

<table>
<thead>
<tr>
<th>Administration</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure a quiet testing area away from distractions. Sit across from the</td>
<td>Yes/No</td>
</tr>
<tr>
<td>student, not beside the student.</td>
<td></td>
</tr>
<tr>
<td>Record student’s name and date on record booklet and complete</td>
<td>Yes/No</td>
</tr>
<tr>
<td>relevant information.</td>
<td></td>
</tr>
<tr>
<td>Say to student: *I want you to read some words for me. These words are</td>
<td>Yes/No</td>
</tr>
<tr>
<td>made-up, silly words. Just tell me how they sound. Let’s start with this</td>
<td></td>
</tr>
<tr>
<td>practice list. Begin at the top and read down the list as fast as you</td>
<td></td>
</tr>
</tbody>
</table>
can. If you come to a word you cannot read, skip it and go to the next word. Use your finger to keep your place if you want to.

| Practice Word List: Invite student to read the made-up words on the practice list from top to bottom, without jumping around. If student is unable to read any words on this list, discontinue test. If examinee simply pronounces each letter sound separately, say, *Try to blend the sounds together to make a made-up word.* | Yes | N/A | No |
| Test List: Say to student-*Now you will read some longer lists of made-up words. The made-up words start pretty easy, but they get harder as you go along. Read as many of them as you can until I tell you to stop. Read going down the list. If you come to a word you can’t read, skip it and go on to the next one. Display the nonword list and point to the upper left corner. You may begin.* | Yes | N/A | No |
| Give the student 45 seconds to read as many nonwords as they can. After 45 seconds, tell the examinee to stop, and draw a line after the last word read. | Yes | N/A | No |
| Long Pause during word reading: After 3 seconds, tell student, *Keep reading or Next word . . .* | Yes | N/A | No |
| Discontinue Rule: If examinee finishes all the nonwords before the time is up, note the time required to read all the nonwords. If examinee stops reading nonwords before the time is up and indicates that he or she cannot read any more nonwords, ask the examinee to look over the whole list to see if there are any more nonwords he or she can read. If he/she is unable to pronounce no more nonwords, stop testing. | Yes | N/A | No |
| Mark all the nonwords the examinee pronounces incorrectly on the record booklet and draw a line after the examinee’s last nonword. | Yes | N/A | No |

TOWRE Scoring

| Total number of words pronounced correctly in 45 seconds: | yes | no |
| Total number of errors- If examinee skips a word or is told to go on to next word, count as an error. | yes | no |
| Consult test administration guide for | yes |
acceptable pronunciation alternatives for vowels. | no  
---|---
Implementation Fidelity Score |  
Total correct steps (a) : |  
Total incorrect steps (b) : |  
Total a/(a+b)*100: |  

Score Interpretation:

< 80% = greater threat to internal validity

>80% = low threat to internal validity