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The Effects of Morpheme and Prosody Instruction on Middle School Spelling

Margaret Anne Dornay
Seattle Pacific University

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Margaret A. Dornay

Seattle Pacific University

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by

Margaret A. Dornay

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Approved by _____

Dr. William Nagy, Chairperson of the Dissertation Committee

_____

Dr. Nyaradzo Mvududu, Dissertation Committee Member

_____

Dr. Scott Beers, Dissertation Committee Member

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Abstract

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by

Margaret A. Dornay

Seattle Pacific University Dissertation Chair: Dr. William Nagy

A single case design was used to investigate the impact of two types of instruction on middle school students' spelling. Phase 1 emphasized morphology awareness instruction (MAI) and phase 2 employed the addition of prosody awareness instruction (PAI). In order to compare the effects of MAI and PAI, spelling scores were gathered from eight students over a 12-week period. The children attended two 30-minute sessions each week. Two of the participants were high performing students, three were typical learners, and three students were experiencing pronounced difficulties in all areas of literacy. The scores of seven out of eight participants indicated a positive response to both phases with the majority of high scores falling in the prosody phase. The effect size (ES) of the overall improvement across the eight students was measured using Tau-U. The ES for morphology the morphology condition compared to baseline was .793, $p < .001$. The ES for prosody compared to morphology was for prosody compared to morphology was .810, $p < .001$. Instruction in prosody awareness seems to hold promise as one avenue for rapidly building spelling consciousness in students with diverse learning profiles.

Key terms: *spelling, morphology awareness, prosody awareness*

Chapter 1: Introduction

Background

The first chapter supplies background information relevant to the current study. A statement of the problem, the purpose of the study, the research questions, and the significance of the study are also discussed.

Reading, writing, spelling, and vocabulary are four closely allied subjects (Wolter & Dilworth, 2014). Achievement in one tends to support achievement in the other three (Carlisle, 2010; Cunningham, 1998; Kearns, 2015). Of these four subjects, spelling is often overlooked. Some educators even maintain that school time should not be wasted on spelling because today's students can rely on computer software to do the job (Reed, 2012). Certainly the click of a mouse can swiftly locate the typographical errors in a final draft. However, knowledge of spell-check programs does little to advance the many sub-components students need for broad literacy development (Henry, 2010). In contrast, the building up of reliable spelling skills can do much more than contribute to the tidy appearance of a finished paper. Confident spelling has been shown to support the growth of additional academic skills that are fundamental to success in school and beyond—skills such as fluent writing, competent decoding, and clear oral communication (Berninger, Vaughn, et al., 2002; Carlisle & Stone, 2005; Ehri, 2000; Snow, Griffin, & Burns, 2007).

Presently, educators are not in possession of a reliable formula for supporting student success in spelling, nor is there an agreed-upon model regarding the precise way in which spelling interfaces with other aspects of literacy development (Cervetti, Hiebert, Pearson, & McClung, 2015; Gordon et al., 2015; Holliman et al. 2014; Kearns, 2015).

The present study explored the impact of two types of spelling instruction that differ in emphases: morphology awareness instruction (MAI) and prosody awareness instruction (PAI). The study investigates the contribution of both types of instruction to literacy development, especially as regards the development of children's ability to recall the correct letter sequence (CLS) of words.

Specialized Terminology

Investigators working in morphology and prosody research have developed an abundance of specialized vocabulary in order to report and discuss their findings. While most of these terms have agreed-upon meanings, a few remain ambiguous. The reader is referred to a table of orthographic terms in Appendix A for the particular definitions of terms as they are used in this dissertation. Because *morpheme awareness* is often referred to in the literature as *morphology awareness*, *morphological awareness*, and sometimes, just *morphology*, the same variable terminology will be used throughout the present study.

Spelling and Morpheme Awareness

"Morphological awareness is the manipulation of units of meaning called morphemes" (Goodwin & Ahn, 2010, p. 4). Morphemes are the smallest units of meaning in a language (Henry, 2010). Morphemes can serve as freestanding words (e.g., *walk*) or they can be "bound" to other morphemes (e.g., *-ing* in *walking*) (Carlisle, 2010). Research has identified a number of ways in which morphology instruction promotes literacy (Bowers, Kirby, & Deacon, 2010; Nagy, Carlisle, & Goodwin, 2014). For instance, knowledge of morphemes plays a role in learning to read: a recent study reported that "morphological decomposition of words was found to constitute a central

process of skilled reading" (Bar-Kochva, 2016, p. 163; see also Verhoeven & Perfetti, 2003). Additional studies have confirmed that morphological awareness contributes not only to general reading measures but also to components of reading such as decoding and comprehension (Goodwin & Ahn, 2010). Another reason morphological instruction supports literacy is that morphology plays a central role in the growth of schoolchildren's vocabulary: "large numbers of the words that they have to learn at school are derived (with the help of derivational morphemes) from other words" (Nunes & Bryant, 2006, p. 9).

In many instances, an *implicit* understanding of morphemes is sufficient to encourage the growth of reading and spelling skills as well as the expansion of vocabulary (Bowers, 2012). But studies have shown that *explicit* instruction in morphemic awareness can provide additional positive impact, particularly in the area of spelling (Bowers, 2012; Diliberto, Beattie, Flowers, Algozzine, 2008). In English, as in many other languages, the correspondence between letters and morphemes in a word is often more apparent than the correspondence between roots and pronunciation (Nunes & Bryant, 2006; Venezky, 1980). Many roots change in pronunciation when combined with an affix. For example, it is clear that "muscle" and "muscular" share the same root morpheme even though the pronunciation of that root sounds dissimilar when the two words are spoken aloud. When children are made aware of these stable relationships through explicit instruction, it can be an immense aid to their spelling (Nagy & Anderson, 1995).

Spelling and Prosody Awareness

A number of researchers have established that awareness of phonological segments such as phonemes and rhymes is a strong predictor of reading ability (Goswami & Bryant, 1990; Muter, Hulme, Snowling, & Taylor, 1998; Ziegler & Goswami, 2005). In addition to phonological awareness, recent studies indicate that sensitivity to speech prosody may also be a predictor of literacy development (Clin, Wade-Woolley, & Heggie, 2009; Holliman, 2014; Holliman, Wood, & Sheehy, 2008; Whalley & Hansen, 2006; Wood, 2006).

According to Pierrehumbert (2003), "prosody is a term used in linguistic theory to cover all aspects of grouping, rhythm, and prominence in spoken language, from sub-parts of the syllable up through the organization of words in the phrase" (p. 121).

Based on a study of two groups of English-speaking children, Wood (2006) concluded that "metrical stress sensitivity could account for variance in spelling ability after phonological awareness has been taken into account and after vocabulary has been taken into account" (p. 1). This finding suggested that stress sensitivity may influence spelling development in a way that is independent of its contribution to phonological representations.

Stress assignment across the syllables in a word or phrase produces various rhythmic patterns. For example, contrast the strong-weak stress pattern of the noun *REcord* with the weak-strong stress pattern of the verb *reCORD*. Particularly during silent reading, struggling students may fail to process stress patterns that are critical for identifying words and their functions in a sentence. A simple procedure, such as the

clapping of multisyllabic words, can foster greater attention to stress patterns. This in turn may support word recognition, pronunciation, comprehension, and spelling.

Problem Statement

A substantial body of research indicates a correlation between morphological awareness and literacy development (Berninger,Vaughn, et al., 2002; Carlisle, 2010; Henry, 2010). Recent research also indicates a correlation between language skills and performance on measures of prosody performance (Taub & Lazarus, 2012). However, few studies focus on the potential of morphology awareness instruction (MAI) as a specific technique to improve children's spelling (Bowers, 2012; Nunes & Bryant, 2006) and even fewer sources of information are available regarding the effectiveness of prosody awareness instruction (PAI) as a spelling intervention (Wood, 2006).

As schoolchildren move into the middle grades, they face the challenge of reading, comprehending, and spelling multisyllabic words (Adams, 2011; Cunningham, 1998). Compared to spelling, reading can seem less demanding. Reading or decoding is a receptive language process. When reading, the student has something to start with—the letters on the page. Because of the systematic correspondence between spoken and written forms of words, the letters readily convey meaning. Spelling, in contrast, is a productive language process: the speller hears sounds and must translate them to symbols by writing or by speaking letter names. Spelling demands more from the student while providing fewer prompts in the form of visual cues (Henry, 2010, p. 6). For this reason, among others, spelling is thought to be one of the more challenging areas for students with learning disabilities while "improving spelling outcomes for these students is of high importance" (Williams, Walker, Vaughn, & Wanzek, 2016, p. 1). However, for all

students, poor spelling can have negative impacts on writing (Berninger,Vaughn, et al., 2002). *The Nation's Report Card: Writing 2011* indicated that only 3% of eighth graders performed at the *Advanced* level. This left 24% of students performing at the *Proficient* level and the largest percentage, 54% percent of eighth graders, performing only at the *Basic* level in writing (National Center for Education Statistics, 2011). Today, spelling remains a national concern (Bowers, 2012). In spite of much effort and experimentation on the part of educators, many children are unprepared to meet the challenges associated with multisyllabic words (Joshi, Treiman, Carreker, & Moats, 2008). There is a need to investigate the potential of new research findings as aids to the development of spelling achievement.

For many schoolchildren, accuracy in spelling becomes more problematic as the number of encounters with longer words increases from grade to grade (Cunningham, 1998; Wolter & Dilworth, 2014). A review of the research indicates that morphological awareness has the potential to positively impact spelling, as well as word reading, comprehension, and vocabulary (Bowers, 2012; Carlisle, 2010). There is also growing evidence that prosodic skills play a broad role in literacy development (Whalley & Hansen, 2006) as well as a specific role in spelling development (Wood, 2006). However, insights involving morphemes and prosody have not yet been adequately harnessed in the service of spelling instruction. An investigation into the impact of morpheme awareness and prosody awareness on the ability of students to recall the correct letter sequence (CLS) of words could make a valuable contribution to the literature regarding future steps in spelling research.

Purpose of the Study

The purpose of this study is to examine the impacts of two spelling interventions (MAI and PAI) on the spelling scores of middle school students. It may be the case that positive and differential effects on children's spelling can be identified by offering individual students both types of instruction in a sequential format. If MAI and PAI are introduced to students at staggered intervals, spelling scores can be used to register any measurable improvement that appears to directly follow the initiation of a particular instructional approach (Byiers, Reichle, & Symons, 2012; Kratochwill et al., 2010). The first instructional phase of the study emphasized MAI. The second instructional phase emphasized PAI. Because the effectiveness of the former has been relatively well established (Bowers, 2012), the present study has as its main focus, the role of prosody awareness instruction (PAI).

Research Questions

1. Can measurable change be detected in the weekly spelling scores of middle school students following the introduction of MAI?
2. Can measurable change be detected in the weekly spelling scores of middle school students following the *addition* of PAI to MAI?

Structure of the Study

The present study is based on a single-case design (SCD). The plan includes eight participants ages 11 to 13. Observations of each student were made under three conditions: baseline, morphology awareness instruction (MAI), and prosody awareness instruction (PAI). Each participant constitutes an individual unit of analysis. A single-case design (alternatively called a single-subject design) "is one that involves the intense

study of one individual" (Gall, Gall, & Borg, 2007, pp. 415–416). Thus numerous data points (spelling test scores) were collected over 12 weeks, across three conditions, for each of the eight participants. In order to compare the discrete impacts of morphology and prosody instruction, a pool of carefully balanced spelling tests were developed. These lists were matched for number of words and word frequency ($U = 1$) as well as word length and total number of letters per list. To further control for internal validity, the introductions of MAI and PAI were staggered across the study. This randomization of start times for each condition helps to strengthen the relationship between student spelling scores and specific interventions (Kratochwill et al., 2013).

Hypothesis

In this study, the independent variable is the method of instruction (baseline, MAI, and PAI). The scores of the weekly spelling tests constitute the dependent variable. The null hypothesis in this investigation is that one or both instructional interventions will show no measurable effects on weekly spelling scores.

Significance of the Study

Although MAI is gradually gaining recognition as a powerful tool in literacy education, there is as yet little research on the value of PAI as an aid to spelling. In the current study, the specific and explicit teaching of both instructional methods in sequence represents a new application of research findings to the challenge of improving student retention of letter strings for correct spelling. By validating or invalidating PAI as a viable technique to improve spelling, this study holds out the possibility of contributing to the body of knowledge presently emerging around the potential of prosody training to enhance academic achievement. In addition to issues of academic interest, the study also

touches upon issues of social significance. These additional considerations are unpredictable and often rest on variables outside the formal research design. One of these variables is perceived need. Teachers as well as students stand to profit from improved methods of spelling instruction. According to surveys, many teachers report the need for more and better teaching techniques to use in teaching spelling (Fresch, 2007; see also Johnston, 2000; Moats, 2005; Schlagal, 2002, 2007). If it can be shown that PAI has the potential to enhance CLS, teachers who are looking for new ways to improve student spelling can be encouraged to incorporate prosody awareness techniques into their particular settings.

Unlike teachers, students may not be in a position to vocalize their need for more effective spelling approaches, even though advancement in spelling could benefit them in numerous ways. Studies show that low-progress spellers experience social pressure as a consequence of poor spelling (Joshi, Treiman, Carreker, & Moats, 2008). If prosody demonstrates potential to support the spelling ability of struggling students, this would contribute to the study's social significance.

Content of the Following Chapters

Subsequent sections of this dissertation are divided into four chapters: Literature Review, Research Methods, Results and Interpretation, and Discussion. The Literature Review includes an overview of spelling instruction and the theoretical underpinnings of morphology instruction as it applies to spelling achievement. The Literature Review also includes a summary of the scant but growing body of information involving prosody's relationship to spelling. The Research Methods chapter outlines the research design, participants, methodology, and analyses used to conduct the study. The Results and

Interpretation chapter summarizes the findings and provides possible interpretations. In the light of hindsight, the final chapter discusses results together with suggestions regarding application of findings and refinements for future research.

Chapter 2: Literature Review

Spelling

The following chapter provides an overview of pertinent literature regarding spelling and its relationship to literacy as a whole. Specifically, the focus will be on research that relates to the teaching of spelling at the grade school level. Approaches to spelling instruction, as well as the theories that underlie spelling instruction, will be discussed—most particularly, approaches that build on the foundations of morphology awareness and prosody awareness.

Francine R. Johnston (2000) interviewed 42 teachers, Grades 2 to 5, concerning their practices and beliefs about spelling instruction and found lack of agreement on a number of issues. Close to half of the teachers reported that they had received no directives as to how spelling should be taught (52%). Some had received directions that were confusing or simply too general: "consider spelling primarily as a function of editing" (Johnston, 2000, p. 144). Most respondents (74%) expressed the belief that today's students spell worse than students did in the past (Johnston, 2000). The study concluded that the elementary teachers were "largely dissatisfied with the spelling ability of their students" (Johnston, 2000, p. 143). Teachers were also dissatisfied with the current spelling instruction "but appeared to lack the knowledge and resources needed to teach spelling more effectively" (p. 143).

In 2007, attitudes regarding spelling instruction were addressed in a national survey. A total of 355 teachers responded from across the United States (Fresch, 2007). Teacher concerns seemed to be very similar to those identified earlier by Johnston (2000). Responders most often reported that a traditional memorization model was used

in their classrooms, but they expressed frustration with the results. Typically, there were complaints that students did well on the Friday test but failed to adequately display spelling knowledge in written work. It appears that there is little consensus among teachers regarding best practice in spelling instruction. However, there is considerable agreement that more needs to be done to help students improve spelling ability.

Spelling supports many components of literacy. Competent spelling is an important skill for a variety of reasons, but a particularly salient reason is that there is social pressure associated with accurate spelling. The ability to spell correctly is taken for granted in a literate society (Scott & Brown, 2001). Furthermore, spelling is conspicuous, and people are not reluctant to pass judgment on poor spellers (Smith, 2012). According to the National Commission on Writing for America's Families, Schools, and Colleges (2005), poor spelling on an employment application is very likely to be the difference between acceptance and rejection of an applicant. Poor spelling is presumed by many to correlate with unintelligent or careless behavior (Alber & Walshe, 2004).

Spelling supports writing. For schoolchildren, spelling is an important attribute of individual work, especially work that will be shared with others. Misspelled words make text more difficult to read (Graham et al., 2008) and can influence readers and graders to undervalue the quality of a writer's message (Marshall & Powers, 1969). In a recent meta-analysis, Graham, Harris, and Hebert (2011) found that papers with misspelled words were scored by teachers more harshly for quality of ideas than were the same papers when they were free of spelling errors. According to Berninger (1999), spelling difficulties can interfere with other aspects of the composing process. For example, consciously thinking about how to spell a word while writing, may tax

children's working memory, leading them to forget ideas they have not yet committed to paper (Graham, Harris, & Fink-Chorzempa, 2002).

While research reveals that poor spelling can have negative impacts on other components of literacy, research also indicates that the spelling-literacy connection can be exploited for its positive contribution (Henry, 2010). The effect of supplemental spelling instruction on spelling ability and on reading and writing scores, was examined by Graham et al. (2002). Second-grade children experiencing difficulties learning to spell, participated in 48 spelling classes of 20 minutes each. The goal of the intervention was to enhance spelling achievement and investigate the impact of spelling on a range of literacy skills. Compared to controls, students in the spelling condition made greater improvement on norm-referenced spelling measures, a writing-fluency test, and a reading word-attack measure. Six months after the instruction, students in the spelling treatment maintained their advantage in spelling (Graham et al., 2002).

Academic achievement rests in large part upon written expression (Christenson, Thurlow, Ysseldyke, & McVicar, 1989) and failure to rapidly and accurately recall spellings may interfere with the composing process (Berninger, 1999; Graham et al., 2002). Since spelling is intimately related to written expression, spelling should be recognized as a key component in a student's academic program (Wanzek et al., 2006). When a large part of student effort is devoted to thinking about how to spell words, written work suffers (Singer & Bashir, 1999). Students who spell poorly write fewer words (Ehri, 1989) and tend to receive lower grades (Joshi et al., 2008). Uncertainty about spelling negatively influences children's writing vocabulary, as they are less likely

to attempt to include words they cannot spell (Graham et al., 2002; Graham & Santangelo, 2014).

Poor spelling can influence teacher perceptions about a child's competence as a writer (Graham, Harris, Fink-Chorzempa, & MacArthur, 2003). Juel (1988) found that 29% of the variance in first-grade children's writing scores could be attributed to spelling performance.

Spelling difficulties produce a ripple effect that extends beyond the immediate challenge of composing text. Detrimental impacts include poor writing fluency, poor writing quality (Scott & Brown, 2001), and in some cases, poor self-image (Graham & Santangelo, 2014). McCutchen (1988) and others (Berninger, 1999) contended that transcription skills, such as spelling, shape how children go about the process of writing. When transcription skills become too cognitively demanding, other essential writing processes are compromised. Thus, poor spellers often fail to employ all of the writing strands pertinent to text production. In cases where planning and revising are side-lined, writing quality diminishes. Due to inability to recall the correct letter sequence of individual words, would-be authors are reduced to listing disconnected information, leaving little creative energy available for attending to rhetorical goals or text organization (Bereiter & Scardamalia, 2013).

For children who have considerable difficulty learning to spell, the consequences may be severe. Such students may develop a mindset that writing for them is simply not possible, "leading to arrested writing development" (Graham & Santangelo, 2014, p. 1704; see also Berninger, Mizokawa, & Bragg, 1991).

Spelling supports reading. Although some students exhibit spelling difficulties while managing to excel in other literacy skills, such is not usually the case. According to an expanding body of research, there is a known reciprocal relationship between spelling and reading (Graham et al., 2002; Graham & Santangelo, 2014; Santoro, Coyne, & Simmons, 2006; Weiser & Mathes, 2011). Children who enter first grade knowing many letter names and sounds perform significantly better in spelling and reading (Roberts & Meiring, 2006). It seems that a common source of word knowledge underlies both processes (Templeton, 1991). Some have even proposed that spelling is the foundation of reading (Venezky, 1980). Specifically, Venezky (1999) determined that early educational records (from the 16th through the 19th centuries) demonstrated belief in a strong tie between spelling and reading. For example, a common teaching technique in centuries past, was to ask students to read and spell new words simultaneously. It appears that generations of educators correctly intuited that encoding and decoding skills are complimentary (Venezky, 1999).

Today, the symbiotic relationship between spelling and reading is increasingly supported by research. Studies show that learning to spell and learning to read rely on similar underlying knowledge and therefore, learning how to spell helps children better understand reading (Ehri, 2000). Learning about spelling enhances reading development by shaping children's knowledge of phonemic awareness, strengthening their grasp of the alphabetic principle, and making sight words easier to remember (Ehri & Wilce, 1987; Moats, 2005). "The arguments for including spelling instruction as a major component of the reading and language program are strong," Adams (1990, p. 404) concluded in her book, *Beginning to read: Thinking and learning about print*. She warned that spelling

instruction is of "paramount importance" (p. 416) and that "skillful reading depends critically on the deep and thorough acquisition of spellings and spelling-sound relationships" (p. 421). Since Adams' claims in the 1990s, evidence for the spelling-reading connection has continued to mount. Uhry and Shepherd (1993) found that first graders who received spelling instruction improved their ability to decode familiar words. O'Connor and Jenkins (1995) confirmed that children progress faster in reading and spelling when they receive spelling instruction in early grades. Ehri (1997) discovered high correlations across grade levels, suggesting that spelling and word reading use similar processes. Okyere, Heron, and Goddard (1997) found that spelling instruction enhanced students' ability to read words that reflected the same patterns presented in their spelling words. Berninger et al. (1998) found that spelling instruction improved word recognition for struggling second-grade spellers. Ehri (2000) identified six individual studies highlighting correlations from .68 to .86, indicating strong relationships between spelling and reading. A meta-analysis by Graham and Hebert (2011) provided additional support for this assumption by showing that spelling instruction enhanced children's word reading skills ($d = 0.62$).

Two recent syntheses (Wanzek et al., 2006; Weiser & Mathes, 2011) and one meta-analysis (Graham & Santangelo, 2014) further explored the relationship between spelling and reading. Weiser and Mathes (2011) examined the impact of encoding instruction on reading and spelling performance for at-risk elementary students and older students with learning disabilities (LD). Their findings suggested that instruction in encoding increases students' knowledge of the alphabetic principle, promotes the development of phonemic awareness, and encourages growth in reading and spelling.

Graham and Santangelo (2014) investigated whether spelling instruction in any language made students better spellers, readers, and writers. Their meta-analysis included studies of spelling interventions for students with and without disabilities in kindergarten through 12th grade. Results highlighted "the effectiveness of formal spelling instruction for increasing spelling performance, phonological awareness, reading performance, and spelling while writing" (Williams et al., 2016, p. 2).

Thus, theorists have long contended that instruction in spelling can positively impact reading performance (Graham & Santangelo, 2014; Weiser & Mathes, 2011). Simply put, spelling instruction focuses attention on the correct letter sequence in words, which is critical in both spelling and sight word reading. It follows that supporting proficiency in spelling actually supports reading (Moats, 2005). Therefore, researchers such as Snow, Burns, and Griffin (1998) concluded that "effective reading instruction should include components of spelling such as spelling-sound relationships, the orthographic system, and morphological components of words" (p. 8).

Spelling supports speech and vocabulary. Spelling's pivotal role in literacy is not limited to reading and writing. Speech and vocabulary development are also thought to share cognitive space with spelling. Spelling involves the capturing of sounds in print. In turn, "print exerts a formative influence on speech" (Ehri, 1987, p. 28). According to Ehri (1987), "learning to read and spell are major events influencing the course of spoken language development" (p. 28). The orthographic structure of words supplies pronunciation cues that reinforce speech patterns. Particularly in children with speech and hearing problems, spelling can enhance pronunciation and thus contribute to better communication. An example from personal experience: a student with atypical

development was observed to frequently leave off the last sound in words ending with a hard "g." Pronunciation improved dramatically when the child was asked to spell the word before saying it out loud. Even children displaying typical development will often modify their pronunciation of particular words once they see those words in print. Another personal example: a first-grade boy was surprised to discover that truck began with "t" instead of "ch" and that the first syllable of imagination was "im" instead of "in."

Spelling is also related to vocabulary development. Rosenthal and Ehri (2008) conducted a study to investigate the value of orthography in vocabulary learning: "The question of interest was whether elementary students (Grades 2 and 5) would better learn and remember the pronunciations and meanings of new words when they were exposed to spellings of the words than when they practiced only spoken forms of the words" (p. 177). Findings supported the former hypothesis. Strong orthographic knowledge was shown to benefit vocabulary learning for both second graders and fifth graders. It seems that "phonological memory may be less important than orthographic knowledge for explaining good-poor reader differences in learning the pronunciations of new vocabulary words" when they are visually presented (Rosenthal & Ehri, 2008, p. 187). The researchers theorized that when new vocabulary words are read rather than simply heard, "orthographic processes lessen dependence on phonological working memory for storing new vocabulary" (p. 187).

Nagy and Anderson (1984) pointed out that the number of words with which students should become familiar is simply too great to allow teaching all the words via a direct-instruction model. However, the immensity of the task is not a reason to forgo the

teaching of vocabulary. Rather, the situation challenges educators to use extreme care in choosing words for spelling and vocabulary instruction. If the selected words represent higher-order processes and patterns, they can become "instructional means to conceptual ends" (Templeton, 1989, p. 250). Words thoughtfully chosen can stand in as "types of derivational processes and patterns that apply to literally tens of thousands of words" (p. 250).

To summarize, a case can be made for the benefits of a combined spelling-vocabulary approach to learning (Templeton, 1989). Since the spelling of words represents both sound and meaning, instruction can profitably address the structure of words and the nuance of vocabulary in a unified format (Templeton, 1991, p. 185). Because the orthographic system of English tends to support meaning over pronunciation, "direct and systematic instruction aimed at exploring 'spelling/meaning connections' may be the key to facilitating vocabulary development" (Templeton, 1989, p. 243).

Spelling can be challenging to students. Some educators have claimed that spelling, like speech, develops naturally as a side effect of a print-rich environment (Bean & Bouffler, 1987; Wilde, 1990), but others have protested that the parallel between learning to spell and learning to talk is not as compelling as some might hope (Ehry, 1987; Read, 1975). Experience teaches that most everyone learns to talk without formal instruction. But many children as well as adults continue to find spelling mysterious and difficult even after years of print exposure (Henry, 2010).

Although reading and spelling are closely related (Graham et al., 2002), the actual process of spelling (encoding) is often more challenging for students than reading

(decoding). This can be accounted for by the fact that encoding is a production task rather than a recognition task (Henry, 2010; Williams et al., 2016).

English spelling is one of the more difficult literacy skills (Wanzek et al., 2006), in part, because many sounds in English words can be represented by more than one letter or group of letters. Unlike transparent languages (such as Hungarian, Finnish, and Italian), English spelling is not based on a one-to-one phonetic correspondence but rather supposes a multi-faceted knowledge of letters, sounds, and syllable patterns (Bear & Templeton, 1998). While English orthography is generally systematic, "the tactical and procedural rules capturing this regularity range from simple to complex, vary in the number of words they can be applied to, and do not capture all correct spellings" (Graham & Santangelo, 2014, p. 1705; see also Cummings, 1988).

Competent English spelling is a multifaceted skill that rests on overlapping layers of knowledge, such as alphabetic understanding, pattern understanding, and meaning (Bear, Invernizzi, Templeton, & Johnston, 2008), as well as phonological awareness, morphological awareness, semantics, and orthographic knowledge (Moats, 2000).

To persuade educators and researchers of the importance of spelling as a critical skill, it is necessary to acknowledge that students with significant spelling difficulties cannot resolve their problems with spell-check computer programs. These programs are primarily designed to identify typos, which will help adequate spellers only. Spell-checker technology does not eliminate the need to proofread (Scott & Brown, 2001) because spell-check programs fail to respond to context, word definitions, and grossly misspelled words. Studies show that spell-check programs sufficiently correct errors only 25-80% of the time (Joshi et al., 2008), which cannot aid the truly poor speller.

According to the U.S. Department of Education (2015), "students with learning disabilities (LD) account for 37% of students receiving special education services in public schools." While these students struggle across many different content areas, acquisition and mastery of specific spelling skills can be especially difficult (Fletcher, Lyon, Fuchs, & Barnes, 2006; Vaughn, Bos & Schumm, 2011). Poor or beginning spellers need considerable practice in order to retain correct letter strings in words (Graham, 1983). Allen and Ager (1965) supported this contention. Study results indicated "that spelling is an independent skill and that transfer effects from other curriculum areas should not be expected" (Graham, 1983, p. 560).

History of spelling instruction. Since the 19th century, many educators have remained convinced that "learning to spell depends on simple memorization of a list of unrelated words" (Reed, 2012, p. 10; see also Schlagal, 2007). Early spelling books provided as many as 50 words a week for students to learn by heart (Hanna, Hodges, & Hanna, 1971). The words were not related by function or pattern. It was not until the 1930s that educators began to organize spelling lists around words most frequently used in reading and writing (Rinsland, 1945; Thorndike, 1921). This was also a time when various study methods were developed as aids to the memorization process. The Say, Cover, Write, and Check method is still recommended in many spelling texts, and the use of pre-tests and self-correction activities initiated at this time, have now become standard (Henry, 2010; Horn, 1947; Reid & Hieronymos, 1963).

Throughout the 1900s, there were attempts to organize spelling words to promote orthographic generalizations; but more recently, researchers have turned away from questions about what words to teach and how to teach them. Instead they have focused

their attention on the developmental aspects of how learners acquire orthographic knowledge (Henderson, 1990; Henderson & Beers, 1980; Read, 1975; Schlagal, 1992; Templeton & Bear, 2013). Various stage theories regarding spelling have been proposed. It seems reasonable to conclude that teachers can improve student learning by matching instruction to the individual's level of knowledge—that is, through instructional groupings that conform to particular levels of development (Schlagal & Trathen, 1998; Vygotsky, 1987). Following this reasoning, many educators began recommending a spelling curriculum completely individualized and based solely on the words students misspell in their writing (Bean & Bouffler, 1987; Wilde, 1990). This hyper-individualized approach envisions no need for spelling books or formal spelling classes.

Thus, not only has educational history witnessed a variety of approaches to spelling, there has even been disagreement on whether formal spelling instruction is necessary (Krashen, 1989, 2002). Because some scholars considered the English writing system hopelessly inconsistent, they concluded that spelling should not be directly or formally taught, as "such instruction is neither effective nor efficient" (Graham & Santangelo, 2014, p. 1734). Spelling was deemed too irregular and unpredictable to make instruction profitable (Simonsen & Gunter, 2001).

Although some educators were convinced that formal spelling instruction was too challenging for children, others maintained that it was superfluous, noting that children were capable of learning to spell without systematic instruction. According to this view, spelling need not be "taught" because it is naturally "caught" as an indirect result of other literacy activities such as reading and writing (Bean & Bouffler, 1987; Edelsky, 1990; Krashen, 1989; Wilde, 1990). Proponents of this approach embraced the concept that

"skills develop best when rooted in natural, meaningful contexts" (Bean & Bouffler, 1987; Wilde, 1990). They maintained that drill is counterproductive and that true spelling ability is the result of rich involvement with written language.

Effectiveness of formal spelling instruction. While some children appear to acquire decoding and encoding skills on their own without being formally taught (Ehri & Wilce, 1987), the majority do not. Past studies, as well as recent research, present compelling evidence for a number of benefits that accrue to some type of formal spelling instruction in the schools. Beginning in the 1920s, a large number of studies have shown that adequate spelling performance requires formal spelling instruction (Bosman & de Groot, 1992; Devonshire & Fluck, 2010; Graham, 1999, 2000; Wanzek et al., 2006). It has been repeatedly demonstrated that students who learn to spell words from lists, consistently outperform students learning words from context (Horn, 1967; Horn & Otto, 1954; McKee, 1939). There is considerable evidence that the study of spelling words apart from context plays a critical role in the development of spelling achievement (Adams, 1990; Beck, McKeown, & Omanson, 1987).

Laudable efforts to make instruction more meaningful—"to render it genuine, purposeful, and authentic"—should not eliminate the systematic and sequenced study of word structure (Templeton, 1991, p. 198). Incidental teaching of spelling "at the point of need" should be exercised at every opportunity, but "a considerable body of recent research supports the practice of teaching spelling words out of context" (Templeton, 1991, p. 186). Results from Weiser and Mathes (2011) and Graham and Santangelo (2014) confirmed that in order to improve spelling skills, students need explicit and

formal instruction in spelling strategies and multiple opportunities to practice with new words (Sayeski, 2011; Wanzek et al., 2006; Williams et al., 2016).

Educators who do not expect students to develop "spelling consciousness," educators who do not aid students in honing their ability to memorize letter sequences and pronounce words correctly—such educators, no matter how well intentioned, may be depriving their students of the most direct route to spelling achievement (Templeton, 1991).

The search for best practice in spelling instruction. In summary, the English spelling system is complex, hence it is challenging to learn and challenging to teach. However, literacy is essential to successful functioning in our society and "learning to read and spell words is a central part of becoming literate" (Ehri, 1987, p. 5). Though at times spelling has been marginalized in education, the theories and findings just discussed present a compelling case for the inclusion of formal spelling instruction in the schools (Reed, 2012).

However, not all teachers feel prepared to develop and deliver an effective spelling program for their students. Some classroom teachers report that they have not received instruction themselves in how to teach spelling (Johnston, 2000). Occasionally the curriculum supplied to the teacher is lacking in adequate support materials (Fresch, 2007; Johnston, 2000). Sometimes the school schedule fails to include a dedicated time for the subject of spelling (Fresch, 2007). This laissez-faire attitude implies the belief that the majority of students will become competent spellers without focused instruction.

But most students do not come to an adequate understanding of the English writing system on their own. Ample studies demonstrate that there are measurable

benefits associated with systematic instruction in spelling throughout elementary school and even beyond. Young children in particular profit from timely and organized spelling support (Graham, 1999; Graham et al., 2002; Moats, 2005; Santoro et al., 2006). O'Connor and Jenkins (1995) reported that children progress faster in reading and spelling when they receive focused spelling instruction in the early grades. Ineffective first-grade instruction can lead to poor performance for the rest of the child's school career (La Paro & Pianta, 2000). Academic intervention is essential for those students performing below benchmarks, as spelling problems in the early years of schooling tend to persist throughout the elementary years if left untreated (Juel, 1988; Scott & Brown, 2001).

The need for effective spelling support is not limited to students in the lower grades. Recently, "an examination of students' spelling development found significant monthly growth in grades three to seven but no significant growth in grades eight to twelve," suggesting a more pronounced lack of spelling instruction for adolescents compared to younger students (Foorman & Petscher, 2010). It is unfortunate that just as middle-school students are encountering a growing number of multisyllabic words in their schooling, formal spelling instruction is sometimes abandoned.

Students identified with dyslexia constitute a particular population in need of spelling help. Students with learning disabilities often exhibit reading and spelling problems in combination. Williams et al. (2016) conducted an investigation into the effects of reading and spelling interventions on spelling outcomes for students with LD in kindergarten through 12th grade. A systematic search identified 10 studies for inclusion in the synthesis. One study used a treatment-comparison design with a control group

(Darch, Eaves, Crowe, Simmons, & Conniff, 2006), while the remainder of the studies used single-case designs to demonstrate experimental control. “Participants in all studies increased their spelling accuracy for words directly taught and practiced in the interventions” (Williams et al., 2016, p. 9).

Because of the demonstrated spelling-literacy connection, it is not unrealistic to expect improvement in several related areas when students are provided with systematic spelling instruction. As mentioned previously, comprehensive spelling can positively impact pronunciation, vocabulary, reading, and writing. Considering the potential benefits of a well-designed spelling program, some have called for a new type of spelling instruction that will intentionally build upon the overlap of interacting literacy skills (Templeton, 1991, p. 198). What characteristics should define this new type of spelling? “Research suggests the answer is not to be found in a single approach” (Reed, 2012). The complexities of our language cannot be captured with a one-dimensional strategy. Henry (1988) noted the various “layers” of English and proposed that spelling instruction be organized to correspond accordingly. Certainly, some of those layers would need to explore languages of origin: Anglo-Saxon, Latin, and Greek. More basic layers of spelling instruction would need to attend to letter-sound correspondences, syllable patterns, and morpheme patterns. Perhaps the most foundational layers would investigate the functions of sound and symbol for essential but overlooked factors that play a role in spelling.

With this framework in mind, the next section of Chapter 2 will focus on the effects of morphology awareness instruction (MAI) on spelling. The morphological structure of the English language fosters the process of capturing spoken sounds in

written symbols. A body of research indicates that morphology awareness should play a role in spelling instruction. Chapter 2 will end with a discussion of the possible effects of prosody awareness instruction (PAI) on spelling. Prosody pertains to sound in language. The potential of prosody instruction as an aid to spelling is the focus of this study.

Morphology

Becoming literate means "learning how to use the conventional forms of printed language to obtain meaning from words" (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001, p. 34). It follows that children receiving literacy instruction need to be informed regarding how the English writing system works (Rayner et al., 2001). This instruction, if it is to reflect evidence-based research, will present reading and writing as "two sides of the same coin" (Ehri, 2000). This instruction will be systematic. It will be firmly anchored in the orthography of the English language. And it will acknowledge the foundational role of morphology. Frost, Kugler, Deutsch, and Forster (2005) went so far as to claim that the principles of organization and processing of words in alphabetic orthographies "are primarily determined by the language's morphological characteristics" (p. 1293).

The English writing system. English is a morpho-phonemic language with an alphabetic writing system in which the pronunciation of morphemes (bases and affixes) regularly shifts across words (Chomsky & Halle, 1968; Venezky, 1999). Some experts have claimed that English spelling maps a limited set of 40-some phonemes (or discrete sounds) onto approximately 170 graphemes (letters or letter combinations) (Henry, 2010). Other experts protested that the 170 figure is too low—estimates over the 1,000 mark are not unheard of (Henry, 2010). Thus, inconsistencies in the representation of

individual phonemes have provoked abundant discussion (Borgwaldt, Hellwig, & de Groot, 2004, 2005; Frost & Ziegler, 2007).

It is apparent that once a student can spell according to phonics spelling rules, there will yet be additional challenges for the writer of English. "At some point, readers and spellers must graduate from a phonetic understanding of spellings to a morphemic understanding" (Ehri, 1987, p. 6). The spelling of many English words does not conform to expectations, though it may be more predictable than first appears. The source of this inconsistency is to be found in the morpho-phonemic structure of the English language (Frost, 2012). Words that seem "irregular" based on phonemic spelling rules can be understood as quite systematic when considered from another perspective. That other perspective allows for discrepancies in grapheme-phoneme correspondence in order to preserve meaning relationships in derived words (Henry, 1993).

Despite changes in pronunciation over time, base words that are related in *meaning* often retain common *spelling patterns* (Chomsky, 1970; Henry, 2010). For example, the spelling of the morphemes in each of the following pairs does not change although the corresponding sounds represented by the letters *do* change: *logic-logician*, *digress-digression*, *final-finality* (Templeton, 1989). The internal orthographic representation of the stem in these derivationally related words remains constant while the pronunciation fluctuates (Templeton, 1989).

Some silent consonants in derivationally related words constitute additional evidence of morpheme preservation (Venezky, 2004). For example, the word *sign* retains the *g* of the morpheme because it is actually pronounced in the derived forms *signal*, *signature*, *signify*, and *significance*. Children who are taught to look for layered meanings

embedded in multisyllabic words will find themselves growing in their ability to retain those words for fluent reading and reliable spelling. An investigation of elementary students revealed that children "making morphological or meaning connections" when spelling had higher scores than those who used other retrieval strategies (Reed, 2012, p. 19; see also Devonshire & Fluck, 2010).

Optimization of information. The English language is distinctive in that morphological variations are characterized by extensive phonological variations. As Pinker (2015) observed, "English words notoriously do not always reflect their sound [in writing]; often they reflect morphological structure instead" (p. 45).

Thus, the addition of affixes frequently alters the way a particular morpheme is pronounced (*heal*/*health*, *courage*/*courageous*). Occasionally, individuals and groups have called for the reform of English spelling. But the suggestion that English spelling should be "made consistent" stems from a lack of appreciation for the way English has developed over time (Frost, 2012). If we were to overhaul our writing system in pursuit of more consistent letter-sound relationships, we would be in danger of losing a great deal of information that is made available to the reader through the preservation of visual commonalities among words that are related in meaning. For example, which pairing reflects more information about meaning relationships—*compete* and *competition*, or *compete* and *computishun*?

According to Frost (2012), the evolution of the English writing system could have taken either of two paths:

> The first was to follow closely the phonological forms of the language and convey to the reader the different pronunciations of morphological variations. The second

> was to represent the morphological (and thereby semantic) information, irrespective of phonological form. Not surprisingly, the writing system of English has taken the second path of morphophonemic spelling. English orthography has evolved to be the most inconsistent writing system of the Indo-European linguistic family. (p. 269)

Despite inconsistencies, English provides an optimization of information by "providing *maximal* morphological (hence semantic) cues along with relatively impoverished phonological notations, using *minimal* orthographic symbols" (Frost, 2012). This has immediate implications for lexical structure and lexical processing, which in turn impacts spelling.

Predictability of spelling. Spelling is perceived by many students as one of the more challenging literacy skills (Moats, 2000; Schlagal & Trathen, 1998). The willingness of children to invest effort in accurate spelling, may depend on whether they perceive English phoneme-spelling correspondence as "generally predictable or as hopelessly irregular" (Berninger, Vaughn, et al., 2002). Decades ago, Venezky (1970) explained that "the present orthography is not merely a letter-to-sound system riddled with imperfections, but instead, a more complex and more regular relationship wherein phoneme and morpheme share leading roles" (p. 11).

While information regarding the morphological nature of English has long been available, it has not readily filtered down to teachers and their students (Schlagal, 2002, 2007). Seminal work conducted by researchers such as Chomsky and Halle (1968), Chomsky (1970), and Venezky (1970) revealed that the English writing system is more regular than its reputation would suggest. Students' attitudes toward spelling may depend

on whether or not their instructors are explicitly aware of meaning-morpheme correspondences. A further critical element is whether or not instructors are familiar with effective ways to teach this information to children who may have differing instructional needs (Bowers, Kirby, & Deacon, 2010).

Children need to be encouraged to look for orthographic similarities among words that are semantically related (Templeton, 2011), but for a number of reasons, knowledge of morphology is not sufficiently exploited in elementary classrooms. One of the primary explanations may be a lack of reliable knowledge on the part of teachers themselves as to how morphology works (Templeton, 2011); see also Moats & Smith, 1992). Specifically, because morphology—the underlying meaning structure of words—is foundational to the English writing system, teachers and students who do not have a grasp of morphology are not fully equipped to make sense of how the writing system works.

Components of morphology. Linguists have identified three broad components of morphology: compounding, inflectional morphology, and derivational morphology. Compounding is the familiar process of combining separate words to form a single compound word, as in *hummingbird*, *quicksilver*, *soybean*, and *playground*. In English, inflectional morphology includes verb tense and number, as in *jump*/*jumped*. It also includes possession—*boy's*, *boys'*—and comparatives and superlatives—*large*, *larger*, *largest*. Derivational morphology combines a relatively small number of affixes and bases to form hundreds, even thousands, of words (Henry, 2010).

Morphology research. Recent meta-analyses have documented that morphological instruction positively impacts children's spelling as well as other related literacy skills (Bowers, et al., 2010; Carlisle, 2010; Goodwin & Ahn, 2010, 2013; Reed,

2008). Nunes and Bryant (2006) argued that morphological insights can demystify many peculiarities in English spelling (see also Moats, 2005; Nagy & Scott, 2000). It is proposed that morphologically-based instruction improves students' ability to reproduce the written substructures of words in order to spell accurately (McCutchen, Stull, Herrera, Lotas, & Evans, 2014) and to more efficiently recall letter strings in words (Treiman & Kessler, 2006).

Additional research has suggested roles for morphological awareness that "extend beyond spelling to include aspects of text generation as well" (McCutchen & Stull, 2015, p. 274). For example, Berninger, Nagy, and Beers (2011) found that measures of children's morphological awareness predicted sentence generation. In addition to increasing fluency and expanding vocabulary, "morphological knowledge may also assist young writers with word *construction* as they try to approximate the syntax and required lexical form that are characteristic of the academic register" (McCutchen & Stull, 2015, p. 274).

Students' morphological knowledge has been found to play a critical role in promoting vocabulary development (Templeton, 2011) and facilitating syntactic awareness (Berninger, Abbott, Nagy, & Carlisle, 2010; Bowers et al., 2010). Considering that approximately 60% of the new words a student encounters in textbooks are made up of word parts that can assist the reader in inferring meaning, "it is hard to overstate the importance of morphology in vocabulary growth" (Nagy & Scott, 2000, p. 275). Nagy and Anderson (1984) claimed that "knowledge of word-formation processes opens up vast amounts of vocabulary to the reader" (p. 314). "The prevalence of morphologically complex words increases in texts as students progress through the elementary years"

(Katz & Carlisle, 2009, p. 326). Consequently, the value of morphological knowledge expands as children mature.

It is sometimes thought that morphological concepts may not be appropriate for elementary students or for older students who have learning delays. Recent meta-analyses of morphological instruction, however, show particular benefits in literacy outcomes for both younger schoolchildren and less able students. Bowers et al. (2010) conducted statistical meta-analyses of 22 studies and found positive effects overall with largest effects for less able students. Evidence from other studies (Abbott & Berninger, 1999; Henry, 1988; Lovett, Lacerenza, & Borden, 200; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003;) has suggested that there is "value in teaching elementary and middle school students with reading disabilities how to use MA [morphology] to decode and understand unfamiliar words in texts" (Katz & Carlisle, 2009, p. 326). More than a few researchers and educators have expressed concern that morphology instruction is underutilized in special education despite its instructional value for literacy achievement (Berninger et al., 2010; Bowers et al., 2010; Henry, 2010).

Benefits of morphemic spelling. Phonemic spelling is based on encoding units of sound, while morphemic spelling involves the meaningful units of language: prefixes, roots, and suffixes. Among educators and researchers, there has been, over recent decades, an increased focus on the role of morphology and on the significance of the various levels of morphological awareness among students (Bowers et al., 2010; Carlisle, 2010; Nunes & Bryant, 2006).

Morphemic awareness can be considered an analytic skill that involves inferences about word structure and meaning (Anglin, Miller, & Wakefield, 1993; Nagy &

Anderson, 1984). As students advance in morphological understanding, they may rely less on the use of phonological resources (Juel, 1988). As for the benefits of morphological analysis, the familiarity and redundancy of word parts can serve as memory aids and facilitate language learning by reducing memory load. When compared to the challenges of processing each multisyllabic word as a unique pictograph, the study of morphological structure offers a more efficient approach. To take advantage of these benefits, what is needed is an awareness that words are sometimes made up of smaller recognizable units, which can serve as clues to decode a complex word and infer its meaning. The established benefits of morphological instruction are today encouraging teachers to find a more prominent place for morphology in the classroom (Bowers et al., 2010).

Theories of literacy development have typically envisioned a stage-like process as students move through the grades (Bear & Templeton, 1998; Moats, 2000). The assumption is that children acquire metalinguistic skills in a stair-step fashion, with one skill building upon another. Not a few theories place the contributions of morphological awareness as a later occurring phenomenon. While logic no doubt supports a sequential acquisition of concepts, another factor to consider is the quality of instruction experienced by the children. Morphology instruction that is brief, sporadic, one-dimensional, and conceptually isolated from other skills may have little impact on students, regardless of their age. Morphology instruction that is ongoing, systematic, and consciously connected to other literacy skills can be expected to have more positive impact. For example, young children might not profit from a lecture on morphology, but they may derive a great deal of measurable benefit from identifying morphemes in words

through writing and sorting activities. Those who have investigated such instructional applications (Berninger et al., 2010; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009; Walker & Hauerwas, 2006) provided evidence that morphological awareness supports spelling, word recognition, and reading comprehension abilities relatively early in development. These early and strong contributions made by morphological awareness, together with orthographic awareness, "support a theoretical stance that development is best characterized as interrelated growth in various metalinguistic skills across time" (Apel, Wilson-Fowler, Brimo, & Perrin, 2012, p. 1300; see also Apel & Masterson, 2001). Given the recognized effects of morphological knowledge on literacy skills—including spelling ability—current literature has suggested that "the systematic and sequential instruction of morphology is needed during the elementary years of schooling" (Senechal & Kearnan, 2007, p. 1).

Literature Review (Prosody)

Searching for precursor skill. Numerous studies have been conducted over the last three decades with the goal of investigating the role of phonological awareness in literacy instruction (Bradley & Bryant, 1983). The result is that explicit instruction in sound-symbol correspondence is today considered an essential part of best practice (National Reading Panel, 2000). A smaller, but growing, number of studies have centered on morphological awareness as the logical next step (Bowers, 2012; Deacon, Conrad, & Pacton, 2008; Kirby et al., 2012; Nagy, Berninger, & Abbott, 2006; Nagy et al., 2003). Despite efforts to harness this research in the interests of literacy and learning, too many children are still not reaching high standards in reading, writing, and spelling. Educators continue to look for ways to address the needs of "treatment resisters" (Bhide, Power, &

Goswami, 2013; Bowers, 2012; Fuchs & Fuchs, 2006; Torgesen, 2000) and those students who fall victim to "fourth-grade slump" (Chall & Jacobs, 1983; Wanzek, Wexler, Vaughn, & Ciullo, 2010). To aid in the search for more effective literacy instruction, researchers have begun to focus greater attention on precursor skills which are thought to underlie literacy development. The hope is that a better understanding of foundational skills—those skills which develop prior to formal literacy instruction—will provide clues regarding why some students experience reading delays. It may be that screening for these precursor skills will help in the early identification and remediation of reading difficulties.

Two dimensions of phonology. Phonological awareness is a commonly used umbrella term that refers to the ability to perceive and manipulate sound structures in spoken language (Veenendaal, Groen, & Verhoeven, 2015). This awareness involves sound units of various sizes. For example, syllables, phonemes, and rimes fall into different grain-size categories (Wade-Woolley, 2016; Wood, 2006). However, the influence of phonology is not limited to the sub lexical units of speech. There are two dimensions of phonology—segmental and suprasegmental. Segmental phonology (phonological awareness) has impacted literacy instruction for decades (Del Campo, Buchanan, Abbott, & Berninger, 2015; Goswami, 2000; Hatcher, Snowling, & Griffiths, 2002), but suprasegmental phonology (prosody) has only recently become the focus of literacy research (Veenendaal et al., 2015). A key difference between prosody and other aspects of phonology is the breadth of effect that prosody has on spoken language. Whereas our current concepts of phonological awareness usually focus on variation at the sub lexical level, prosody encompasses the suprasegmental dimension of language.

Prosody is comprised of three components: lexical stress, intonation, and phrasing (Breen & Clifton, 2011), all of which are expressed through frequency, duration, and intensity (Clin et al., 2009). Syllable duration, intensity, and frequency are auditory indexes that mark stress. A stress pattern is created by the relative distribution of these markers across an utterance, "giving the perception of strong (longer, louder, and higher in pitch) or weak (shorter, quieter, and lower in pitch) syllables" (Clin et al., 2009, p. 198). "Awareness of these suprasegmental features is considered prosodic sensitivity" (Clin et al., 2009). Within prosodic sensitivity there is the sensitivity to meter, the alternation of stressed and unstressed syllables, and attention to rhythm which refers to the way syllables are distributed in time (Whalley & Hansen, 2006).

Stress is computed at various levels of the prosodic hierarchy (Chen & Wang, 2011). For example, it may be applied across an utterance or localized within a single word. The way in which stress is allocated is "language specific" (Clin et al., 2009, p. 198). Researchers have long agreed that "conscious knowledge of the phonology of one's own language is one of the most potent ingredients for later success at reading and spelling in English" (Wade-Woolley, 2016, p. 371). In fact, the reading disabilities literature displays a remarkable consensus that phonological awareness is a recognized "dimension of linguistic competence predictive of reading acquisition and reading failure" (Lovett et al., 2000, p. 458).

Thus, phonological awareness and prosodic awareness are both phonological processes but they operate at different levels, the former at the level of the individual sound segment and the latter at the suprasegmental level across utterances. Both have been shown to be related to word reading in young readers (Wade-Woolley, 2016;

Whalley & Hansen, 2006). In particular, phonological awareness has demonstrated a predictive power in children's literacy by setting the stage for the acquisition of the alphabetic principle (Adams, 1990).

Prosodic sensitivities and reading difficulties. Although the relationship between phonological awareness and reading is well documented (Goswami, 2000; Hatcher et al., 2002), the reason why "some children fail to acquire phonological awareness despite years of explicit tuition in the alphabetic principle" is less well understood (Wood, 2006, p. 270). It has been proposed that further investigation of underlying prosodic skills might contribute needed insight. In a 1998 study, Wood and Terrell suggested that "skills which develop in early infancy to facilitate speech perception (i.e., awareness of rhythm) may have an impact upon later phonological development and literacy" (p. 397). To explore this relationship further, 30 primary school children identified as poor readers were matched with controls and subjected to a task battery (rapid speech perception, rhythmic awareness, rhyme detection, and phoneme deletion). Wood and Terrell (1998) concluded that young poor readers demonstrate relative insensitivity to the prosodic cues of rhythm and stress at the phrasal level.

Additional studies confirm that children with reading difficulties exhibit problems processing the rhythm of speech (Holliman, Wood, & Sheehy, 2012). A study conducted by Goswami et al. (2002) measured sensitivity to the rhythmic properties (nonlinguistic tasks) in speech and found that children with dyslexia were significantly less sensitive to these auditory characteristics than their non-dyslexic counterparts. It was also determined

that speech rhythm sensitivity was better developed in children who started to read at a young age and less so in children with dyslexia (Goswami et al., 2002).

Wood and Terrell (1998) found that children with reading difficulties scored significantly lower than age-matched controls on word recognition tasks and sensitivity to meter. Moreover, the children's relative insensitivity to speech rhythm remained a significant predictor after differences in vocabulary were controlled for (Wood & Terrell, 1998). Later, Wood (2006) revisited these data to find that performance on the rhythmic sensitivity measure was associated with phonological awareness after both age and vocabulary had been accounted for.

Prosody, or suprasegmental phonology, involves the "melody of spoken language," which includes awareness of speech rhythm and perception and production of stress placement and word boundaries. This sensitivity refers to the awareness of suprasegmental phonology or the acoustic properties of speech that convey information beyond the sound segments of words (Breen & Clifton, 2011). When prosodic skills are well developed, the ground is laid for progress in literacy; when prosodic skills are weak and underdeveloped, progress in literacy is compromised. Reading difficulties are often found together with phonological processing deficits (Vellutino & Fletcher, 2005).

Properties and functions of prosody. It appears that prosody is critical to the acquisition of language. "For example, prosodic cues help segment the speech stream into phrases, words, and syllables, inform syntactic structure, and emphasize salient information to facilitate understanding" (Whalley & Hansen, 2006, p. 2).

According to Bolinger (1978), "the first universal property of prosody is the interface between prosodic and syntactic breaks" (p. 480). Prosodic boundaries reliably

inform parsing decisions, particularly at the phrase level, providing reliable cues for chunking spoken language into comprehensible syntactic units such as phrases and sentences (Cutler, Dahan, & van Donselaar, 1997). The retrieval of spoken words from the mental lexicon is facilitated by the word's prosodic structure, "providing a template or means for accessing lexical representations" (Lindfield, Wingfield, & Goodglass, 1999). Chunking by prosodic means also allows listeners to reduce their memory load by aiding the retention of an utterance until more abstract and complex syntactic and semantic processes occur (Speer, Crowder, & Thomas, 1993).

An additional property of prosody is the highlighting of prominent information (Bolinger, 1978). Prosody denotes whether a particular string of words is meant as a question, a statement, a sarcastic comment, or an exclamation (Speer et al., 1993). Prosody finds application over speech segments at many levels from the lexical level to the utterance level. At the utterance level, prosody has many functions: it can convey playfulness, emphasis, and a variety of emotions. It can even convey meaning that directly contradicts the words being spoken.

The prosodic stress pattern of alternating strong and weak syllables provides a functional tool to separate words in speech "because strong syllables generally are assumed to mark the beginning of lexical words such as nouns and verbs" (Whalley & Hansen, 2006, p. 2). Approximately 85% of English lexical words begin with a strong syllable (Cutler & Carter, 1987). Multisyllabic words may also have secondary or tertiary stress. This variety of stress patterns may play a role in word storage.

The developmental course of prosody. The important role played by prosody in oral language development begins early in life. Attention to discrete segments in the

speech stream enables initial word learning (Cutler & Mehler, 1993; Cutler & Norris, 1988; Demuth, 1996). Researchers have hypothesized that infants use prosodic information to initiate the process of segmenting the stream of continuous speech into meaningful units.

Correlations between prosodic features and grammatical structures provides information about syntax and morphology to early learners (Steedman, 1996). Theories of phonological development have suggested that basic auditory processing of acoustic information related to prosody such as frequency, duration, and amplitude modulation "set the foundation for the establishment of representation at each level of the phonological tier, from segment to intonational phrase" (Goswami, 2015; Goswami et al., 2013). Quality representations, especially at the lower levels, are necessary for successful reading acquisition as well as the development of other literacy skills (Perfetti, 2007; Perfetti & Hart, 2002).

Cutler and Mehler (1993) proposed that infants enter the world equipped with a periodicity bias that directs the developing child's attention to the rhythmic properties of their first language. "Prosodic cues are utilized by newborns, infants, and children, to 'bootstrap' their acquisition of language" (Cutler & Mehler, 1993, p. 3). Among these prosodic cues, vowel sounds are one of the first speech elements to attract infants (Cutler & Mehler, 1993). Cutler and Otake (1994) pointed out that infants acquire language-specific vowel prototypes at about six months of age, which is well before the development of consonantal phonology (Kuhl, Williams, Lacerda, Stevens, & Lindblom, 2006; Werker & Polka, 1993).

In a 1999 study by Jusczyk, Houston, and Newsome, English-learning infants appeared to have word segmentation abilities that conform to predominant stress patterns by age 7.5 months. By 10.5 months of age, infants have sensitivity to other acoustic information such as statistical regularities, allophonic cues, and phonotactic patterns that help facilitate understanding of word boundaries (Jusczyk & Aslin, 1995; Jusczyk, Hohne, & Bauman, 1999). A number of researchers have agreed that infants are particularly sensitive to metrical stress and are able to utilize it as the basis of their initial attempts to segment fluent speech into individual words (Cutler & Mehler, 1993; Jusczyk, Hohne, et al., 1999). This finding may be able to explain the phenomenon of baby-talk. When communicating with infants, it is not unusual for adults to spontaneously employ speech with exaggerated prosodic features. In general, babies appear to respond to this musical speech with close attention. The role of prosodic sensitivity in language development could shed light on this speech peculiarity. It seems that infants are born equipped with specific skills that aid them in cracking the code of their mother tongue while adults harbor a complimentary tendency to assist in the process by employing stilted language. When adults converse with infants, they generally emphasize content words and mark syntactic boundaries, thus facilitating infant access to language (Werker, Pegg, & McLeod, 1994). It might be the case that the phenomenon of baby-talk provides further evidence of the foundational role of prosody in early speech development.

Over the last two decades a literature has been developing that recognizes an expansive role for prosody in literacy development (Goswami et al., 2002; Goswami, Gerson & Astruc, 2010; Holliman, Wood, & Sheehy, 2008, 2010, 2012; Leong, V.,

Hämäläinen, Soltész, & Goswami, 2011, Schwanenflugel, Hamilton, Kuhn, Wisenbaker, & Stahl, 2004; Whalley & Hansen, 2006). While a relationship between prosody and spoken word recognition has for some time been assumed, research has uncovered evidence of additional connections between prosody and the entire family of literacy subskills. A link is proposed between prosody and text decoding (Wood, Wade-Woolley, & Holliman, 2009). Prosody appears to play an important role in children's reading development, including comprehension (Whalley & Hansen, 2006).

Perfetti, Zhang, and Berent (1992) explained that there is extensive evidence for the notion that "contact with printed words in any writing system automatically arouses phonological properties associated with the words" (p. 227). In addition, Harris and Perfetti (2016) found further evidence that the phonology activated during reading is multi-layered: "suprasegmental layers of phonology affect not only word recognition broadly, but orthographic processes specifically" (Harris & Perfetti, 2016, p. 227).

Today researchers and educators are alert to many of the factors that influence children's reading of words, such as orthography (Arciuli, Monaghan, & Seva, 2010), morphology (Kearns, 2015), and phonological awareness (comprised of syllable, rime, & phoneme awareness). However, it appears that studies in suprasegmental phonology may be able to give added value to current practice (Bhide et al., 2013).

To test whether phonemic and prosodic awareness are differentially related to the reading of long and short words, Wade-Woolley and Heggie (2015) conducted a study with 110 children in Grades 4 and 5. Prosodic awareness was assessed by a task that asked participants to identify the syllable bearing primary stress in a spoken word (Wade-Woolley & Heggie, 2015). It was found that both phonemic and prosodic awareness were

significantly correlated with all reading outcomes. Although the largest role was played by phonemic awareness, the results of the study showed that both phonemic and prosodic awareness made independent contributions to short word reading and multisyllabic word reading (Wade-Woolley & Heggie, 2015).

The conclusion was that phonemic and prosodic awareness are complementary but not redundant processes. When non-word monosyllable reading was accounted for in the model, only prosodic awareness maintained a predictive relationship with multisyllabic word reading, contributing a small but significant amount of unique variance. This is likely due to the fact that multisyllabic words place additional demands on readers. Big words call for correct syllabification (Perry, Ziegler, & Zorzi, 2010), stress assignment, and vowel reduction (Arciuli et al., 2010; Seva, Monahan, & Arciuli, 2009), all of which are outside the scope of segmental phonology (Wade-Woolley, 2016). Only prosodic awareness survived control for simple decoding ability in the reading of long words, suggesting that "suprasegmental phonology gives added value to our understanding of reading multisyllabic words" (Wade-Woolley, 2016; Wade-Woolley & Heggie, 2015).

Prosody and decoding. Literacy skills do not develop apart from spoken language. In fact, oral and written language are intimately connected (Whalley & Hansen, 2006). Numerous studies have demonstrated an association between competence on spoken word recognition tasks and reading attainment (Metsala, 1997; Wood, 2006; Wood & Terrell, 1998).

Prosody plays an important role in listening comprehension and consequently is also important in reading comprehension (Whalley & Hansen, 2006). This assumption supports the contention that silent reading triggers a phonological response (Perfetti et al.,

1992). Even the silent reader is actually pronouncing words internally during the reading process. We see evidence of this phenomenon when a young, precocious reader attempts to exercise an expanding vocabulary in the service of oral speech. The child has gleaned the meaning of a new word from silent reading but has never heard the word spoken aloud. When the child tries out the new word in public, listeners are not infrequently jolted (and perhaps entertained) by a distorted pronunciation.

Prosody and reading comprehension. Although the link between phonological processing skills and reading development has been well documented, fewer studies have investigated the influence of both segmental and suprasegmental phonology on reading comprehension (Veenendaal et al., 2015). Learning to read starts with acquiring the alphabetic principle, "but the ultimate goal of reading acquisition is to learn to comprehend written text" (Veenendaal, Groen, & Verhoeven, 2016, p. 55).

Goswami et al. (2010) showed that prosodic and phonological awareness skills made independent contributions to reading outcomes in a group of dyslexic children with reduced sensitivity to both prosodic structure and phonological awareness. Whalley and Hansen (2006) found that in fourth-grade students, prosodic sensitivity (a compound word task distinguishing between a compound word, such as *high-chair*, and two words, such as *high* and *chair*) contributed to word reading, whereas a reiterative, phrase-level task contributed to reading comprehension when non-speech rhythmic awareness and phonological awareness were accounted for. In this reiterative speech task, students listened to a spoken title of a film or book followed by two "DEEdee" sentences, which contained no phonemic or semantic information, as all syllables were replaced with *dee*. The DEEdee sentence that corresponded most to the prosodic pattern of the original

sentence was the target. Miller and Schwanenflugel (2006) reported a significant contribution of pitch variations to reading comprehension after controlling for word decoding. Thus, there is "a growing body of empirical support from studies demonstrating the role of prosody in English reading comprehension" (Choi, Tong, & Cain, 2016, p. 70).

Among the expanding number of studies that examine segmental and suprasegmental phonology, some have had longitudinal designs. Holliman et al, (2010) conducted a longitudinal study that showed that speech rhythm sensitivity in five- to eight-year-old children predicted reading comprehension one year later. The results indicated that after controlling for age, vocabulary, and phonological awareness, a prosodic word-level task that manipulated stress placement (*carROT* instead of *CARot*) was related to word reading but not to reading comprehension (Holliman et al., 2010).

Miller and Schwaneneflugel (2006) examined the influence of suprasegmental phonology in relation to early reading. There were strong-to-moderate correlations between prosodic features and word-reading skills from first to second grade, and both contributed to reading comprehension outcomes in third grade. Although the contribution of word-reading skill was taken into account, phonological awareness was not included in the study.

In a related longitudinal study, Miller and Schwanenflugel (2008) further demonstrated that different prosodic parameters such as pauses and intonation significantly predicted reading comprehension development in native English readers. Veenendaal et al. (2015) showed that text-reading prosody not only is related to reading comprehension but also predicts it one year later. Employing a longitudinal design, the

performance of 99 Dutch primary students on phonological awareness (segmental phonology) and text-reading prosody (suprasegmental phonology) in Grades 4 and 5, as well as reading comprehension in Grade 6, was examined. A key finding in this study was the contribution of suprasegmental phonology to reading comprehension, in addition to segmental phonology (Veenendaal et al., 2015).

Literacy challenges in a stress-timed language. Metrical challenges in a stress-timed language. Metrical stress is of particular interest with respect to spoken English, as English is a stress-timed language: over 90% of English words contain more than one syllable and, therefore, show lexical stress (Cutler & Carter, 1987). In English, polysyllabic words each contain one syllable with primary lexical stress. Which syllable this is, varies from word to word: *STUdent* is trochaic with stress in the first syllable, *inSTRUCT* is iambic with stress in the second syllable (Quam & Swingley, 2014). In stress-timed languages approximately the same amount of time elapses between strong syllables (Wood, 2006), although vowels in strong syllables tend to be longer in duration, louder, and higher in pitch than weak syllables (Kochanski, Grabe, Coleman, & Rosner, 2005). "Strong syllables tend to contain a fully articulated vowel while weak syllables are often 'reduced' (e.g., the first vowel in the word 'today' is reduced, as it is pronounced 't'day'" (Wood, 2006, p. 271).

Lexical stress in English is a type of prosody used to distinguish meaning. For instance, lexical stress is often associated with a word's grammatical category, with 94% of bisyllabic nouns having strong-weak (SW) stress and 69% -76% of bisyllabic verbs having (WS) stress (Kelly & Bock, 1988). It has been shown that infants are more likely to map a novel iambic word onto an action and a novel trochaic word onto an object

(Curtin, Campbell, & Hufnagle, 2012). Many words in English can be changed from nouns to verbs by simply transposing lexical stress: *OBject* to *obJECT*; *CUMbat* to *ComBAT*; *IMport* to *imPORT*.

In English, there are three lexical stress patterns: the strong-weak (SW), or trochaic; the weak-strong (WS), or iambic; and the strong-strong (SS) pattern, or spondaic, which is relatively rare. Van Rees, Ballard, McCabe, Macdonald-D'Silva, and Arciuli, (2012) pointed out that children tend to produce the SW stress pattern earlier in development and with more ease than the WS pattern. This preference for SW lexical stress in English appears to impact children's speech patterns and reading development (van Reese et al., 2012).

Clin et al. (2009) found that "derivational processes that drive shifts in lexical stress are more challenging for students than those that do not" and that prosodic sensitivity and morphological awareness both make independent explanatory contributions to reading ability (p. 207). As base words are combined with affixes to create new words, pronunciation is affected. This factor adds to the challenge of reading and may also impact spelling. If the skills associated with speech perception promote the development of phonemic awareness, then measures of spoken word recognition might significantly correlate with reading and with spelling attainment (Wood & Terrell, 1998). In order to further explore the interaction between stress and speech articulation, researchers conducted the first study (with typically developing preschoolers) to show that patterns of lexical stress can be explicitly taught using the principles of motor learning (PML) (van Reese et al., 2012, p. 198).

Defining the relationship between prosody and spelling. Chiat (1983) has observed that, in speech, identification of phonemes appears to be easier in stressed as opposed to unstressed syllables. What holds for spoken language may carry over to written language. The brief auditory duration of weak syllables challenges students who are seeking to recognize spoken words and to map phonological representations of those spoken words onto an alphabetic system (Wood, 2006). Because of the variation in how reduced vowels are represented orthographically (Wood, 2006), weak syllables have the potential to undermine spelling accuracy.

The possibility of a connection between prosody and spelling has prompted a number of studies. Wood (2006) claimed that "metrical stress sensitivity could account for independent variance in the children's spelling scores after phonological awareness had been taken into account" and, in a separate analysis, "after vocabulary had been taken into account" (pp. 270, 283). This suggested that beyond the variance that metrical stress sensitivity shares with segmental phonological awareness and lexical knowledge, it is independently associated with the children's ability to spell accurately (Wood, 2006).

However, in a more recent study, Holliman et al. (2016) used hierarchical regression analyses to examine the independent contribution of prosodic sensitivity to both word reading and spelling. Ninety-three English-speaking children were assessed for prosodic sensitivity, vocabulary knowledge, and phonological and morphological awareness along with word reading and spelling. The aim of the study was to investigate whether prosodic sensitivity could explain unique variance in word reading and spelling after controlling for other more established predictors (Holliman et al., 2016). The

findings: “prosodic sensitivity was able to explain unique variance in word reading, but was unable to make an independent contribution to spelling” (Holliman et al., 2016, p. 2).

A notable finding in Holliman et al. (2016) is the direct role of prosodic sensitivity in reading not predicted by previous models. While the study did not find a direct relationship between prosody and spelling, this may be due to fact that the research participants were beginning readers. Future replications of the study could involve older readers and consequently use a spelling test containing more multisyllabic words. On page 11 of Holliman et al. (2016), we find a possible explanation for why the relationship between prosody and spelling might have escaped notice: “the children in this sample were unable to spell the multisyllabic words presented in the test.” Since prosody sensitivity is bound up with lexical stress, and since accented syllables come into play in longer words, the relationship between prosody and spelling might have encountered a floor effect.

Holliman et al. (2016) claimed that “no consensus has yet emerged” regarding precise mechanisms by which prosody might influence the network of skills that contribute to literacy competence (p. 2). As confirmation of various theories regarding prosody and literacy awaits future research findings, current literature has suggested that while a direct pathway has not yet been uncovered, “the likely role of prosodic sensitivity in word reading and in spelling may be via other mediating variables” (Holliman et al., 2016, p. 3).

Literacy instruction and metalinguistic theories. “Metalinguistic awareness is the ability to reflect on and manipulate the structural features of language” (Nagy & Anderson, 1995, p. 2). One way of conceptualizing the effects of MAI and PAI is through

the lens of various metalinguistic theories. Perfetti's lexical quality hypothesis (LQH) offered an explanation for the process by which word retrieval could become automated (Perfetti, 2007; Perfetti & Hart, 2002; Perfetti & Stafura, 2014). The LQH stated that the quality of word representations, such as knowledge about word structure and meaning, affects reading comprehension and other representation that determine lexical quality: orthography, phonology, grammar, and meaning. The binding of these four features together is so significant that it constitutes a fifth essential feature. Perfetti (2011) also emphasized the role of morphology in determining lexical access: "In the case of a morphemically complex word, knowledge of a constituent low lexical quality may sometimes rely on morpheme knowledge to make up for weaknesses in other aspects of lexical knowledge"(p. 158). Bowers (2012) took this to mean that morphological awareness instruction could act as a "binding" agent bringing together orthography, phonology, grammar, and meaning (p. 151). It may be that prosody serves some of the same functions with an even wider scope than morphology. Consider that a sarcastic comment may depend more on prosody than any specific word feature to communicate meaning. Another example: Whalley and Hansen (2006) stripped all phonemes from words and found that children could still identify those words simply by attending to suprasegmental prosodic features (Veenendaal et al., 2015, p. 56). According to the LQH, the quality of lexical representations is related to the specificity and redundancy of orthographic, phonological and semantic constituents of word representations and their interconnections. In describing the LQH, Perfetti (2007) present four features of lexical

Nagy's (2007) metalinguistic hypothesis is similar to Perfetti's (2007) and has added to our fund of ideas about word knowledge. Nagy (2007) observed that "some of

the correlation between vocabulary knowledge and reading comprehension can be accounted for by appealing to the relationship of each of these with a third construct" (p. 54). This observation has implications for literacy instruction given that the third construct—metalinguistic awareness—is "demonstrably teachable (e.g., National Reading Panel, 2000)" (p. 52). Thus, Nagy and Anderson (1995) pointed out that success in literacy development is not reserved to students who spontaneously "catch on" to the subtleties of decoding and encoding English. The quality of instruction can be determinative: "it is the youngest, least advantaged, least able children who will benefit most from instruction that helps them become aware of the structure of their writing system and its relationship to their spoken language" (Nagy & Anderson, 1995, p. 6).

Implicit versus explicit spelling instruction. The theories and findings investigated thus far present a compelling argument in favor of some type of formal spelling instruction in the schools. It is further indicated that this instruction should be more than incidental. "An important aspect of any teaching is to take the implicit and make it explicit for students" (Scott & Nagy, 2004, p. 111). For example, first graders directly taught the six syllable types outperformed their peers who received implicit phonics instruction on measures of reading and spelling (Blachman, Tangel, Ball, Black, & McGraw, 1999). Explicit instruction is important for older and less able students as well. "Explicit instruction in morphological structure significantly improves the spelling ability of adolescents identified with dyslexia as compared to students matched by age and by initial spelling performances" (Tsesmeli & Seymour, 2009). Researchers has emphasized that a growing knowledge of morphology, through direct and explicit

instruction in common roots and affixes, leads to improvements in spelling accuracy (Henry, 1993; Nunes, Bryant, & Olsson, 2003).

In a deep orthography such as English, "the achievement of full competence in spelling requires the coordination of a number of distinct categories of knowledge" (Tsesmeli & Seymour, 2009, p. 4). These categories encompass morphological structure, orthographic conventions, and lexigraphic memory. They include phonological awareness in both its segmental and suprasegmetal aspects. While some students will be able to independently tap into this knowledge, others may need explicit instruction in order to develop adequate spelling skills (Bradley & Bryant, 1983).

Explicit instruction cannot be accomplished simply by telling students the information they need to know. Various strategies must be used that encourage students to take up the information as a permanent part of their own linguistic equipment. Here, repetition is essential. Our culture presently frowns on *kill and drill* approaches. This does not mean that teachers can simply skip the drill. Rather, it means that teachers must provide sufficient practice for students to develop automaticity without simultaneously killing the students' confidence and creativity.

Summary

In summary, researchers today are exploring an array of strategies for teaching spelling that are supported by a growing number studies. While many questions remain, educators are not without guidelines. Research findings support a systematic approach to spelling that acknowledges the complexity but also the order of the English writing system. These findings call for an understanding of children's developmental patterns and individual learning abilities. There is strong evidence for the benefits of phonological awareness

instruction. There is strong evidence for the benefits of morphology awareness instruction. There is scant, but promising evidence for benefits traceable to prosody awareness instruction. For these reasons, further investigation of prosody in relation to spelling appears warranted.

Chapter two opened with a discussion of educational issues related to spelling—the history of spelling and its impact on students, teachers, and the larger community. Then two areas of research were explored: morphology and prosody. It was found that both play pivotal roles in literacy development with specific implications for the learning and teaching of spelling. Particular importance was attached to the value of morphology awareness instruction (MAI) and prosody awareness instruction (PAI) in making spelling knowledge an explicit component of student literacy development. Although recent studies show that phonemic awareness training and morphological awareness training are powerful predictors of spelling success, it may be the case that other avenues for effective instruction remain relatively unexplored. Perhaps PAI can provide added value above and beyond MAI. Prosody instruction may have the potential to bring students to a greater sensitivity to the way in which vowels function, especially vowels in weak syllables. And, if as already stated, explicit approaches are more effective than implicit approaches, then prosody awareness techniques may prove to be useful additions to a well-structured spelling program. Chapter two closed with the proposition that the use of prosodic instructional techniques for promoting spelling achievement has not been fully explored. The present study is formulated to compare the effects of MAI and PAI on the spelling accuracy of middle school students.

Chapter 3: Method

For convenient reference, the research questions that guide this study are restated:

1. Can measurable change be detected in the weekly spelling scores of middle-school students following the introduction of MAI?
2. Can measurable change be detected in the weekly spelling scores of middle-school students following the *addition* of PAI to MAI?

The questions above prompted the investigation of elementary spelling achievement in response to two conditions over a 12-week period. The framework for the study is a single-case design (SCD) employing staggered interventions across multiple baselines. Chapter 3 begins with a description of the design. Next, details regarding participants, instrumentation, and procedures are supplied. The chapter closes with a discussion of data analyses.

Single-Case Design (SCD)

Today, a major goal in the field of education is the documentation of treatments that have an unequivocal and causal relationship with significant learning outcomes (Cannon, Guardino, Antia, & Luckner, 2016; Kilgus, Riley-Tillman, & Kratochwill, 2016). Agreement is strong that randomized control trials provide this rigor (Moeller, Dattilo, & Rusch, 2015; Plavnick & Ferreri, 2013; Wendel, Cawthon, Ge, & Beretvas, 2015). Single-case experimental designs, by contrast, forego the statistical power of a large sample size. However, single-case design has a rich history in other disciplines, such as psychology and medicine, and is increasingly being utilized in the field of education, in part because of its ability to deal with small samples and "highly contextualized treatments" (Crumbacher, 2013, p. 112; see also Byiers et al., 2012).

According to Cannon et al. (2016), SCD can play a role in systematic research that "documents and replicates functional and causal relationships between independent and dependent variables" (Cannon, 2016, p. 442; see also Kazdin, 2011; Kratochwill et al., 2010, 2013). Professional guidelines regarding SCD research call for this causal relationship to be demonstrated across participants, behaviors, events, or settings "on at least three occasions" (Tate et al., 2016, p. 379; see also Horner et al., 2005; Kratochwill et al., 2010, 2013; Vannest & Ninci, 2015). Tate et al. (2016) further explained that the criterion of three or more demonstrations "helps control for the confounding effect of extraneous variables that may adversely affect internal validity and allows a functional cause and effect relationship to be established between the independent and dependent variables" (p. 379).

The present study analyzes data gathered from eight participants, three of whom had been reported by their parents and teachers to be experiencing slow progress in literacy skills. Thus, children who are struggling with one or more sub-components of literacy are a significant focus of this study. Children with learning disabilities (LD) represent a fraction of the general student population. However, their learning difficulties can be traced to a wide range of etiologies. As a consequence, the formation of matched groups with sufficient numbers of students in control and treatment conditions becomes problematic. The low incidence and heterogeneity of the LD population tends to restrict the range of options available for conducting evidence-based research with potential for targeting their particular needs.

For these reasons among others, educational researchers have recently witnessed "increased recognition of the importance of the SCD for estimating the effectiveness of

interventions for low-incidence populations" (Wendel et al., 2015, p. 103; see also Kratochwill et al., 2013; Shadish & Sullivan, 2011). SCD utilizes an experimental process in which treatment access is systematically manipulated by a researcher, performance is monitored over time, and the units of interest serve as their own control (Horner et al., 2005: Kratochwill et al., 2010; Segool, Brinkman, & Carlson, 2007). Thus, with the participation of small groups, or even individuals, SCD research can investigate causal relationships.

SCD research constitutes an important addition or alternative to large-group studies for a number of reasons. Because it is relatively inexpensive, it is well-suited for defining new interventions prior to investment in more costly group design comparisons (Horner, Swaminathan, Sugai, & Smolkowski, 2012). "It allows for individual differences associated with participants" (Plavnick & Ferreri, 2013, p. 550). It does not require researchers to withhold treatment from a control group (Horner et al, 2005). A particular strength of SCD research is the possibility of strong internal validity that allows documentation of experimental control through systematic and direct replication (Gast & Spriggs, 2010; Kazdin, 2011; Kratochwill et al., 2013). Because the goal of the present study is to identify instructional support that is effective for both typical and atypical students, SCD is a good fit for this project.

Multiple-Baseline SCDs

Two common SCDs, withdrawal and multiple baselines, are structured so that the change in outcome measures is repeated over conditions or participants. In single-case studies that employ a multiple-baseline design, there is no requirement for the withdrawal of the intervention. This makes the use of SCD research practical in situations, such as

this study, where targeted behaviors are not expected to return to baseline (Byiers et al., 2012). For example, once a student has learned a new technique for encoding words, it is not desirable, or reasonable, to expect the student to unlearn the technique.

The present study introduces two instructional interventions at staggered intervals. Wendel et al. (2015) maintained that "staggering the introduction of an intervention across cases allows for more stringent analysis of outcomes among different participants, behaviors, or settings" (p. 105). The staggered onset of treatment can address various threats to internal validity such as history, regression to the mean, maturation, and instrumentation (Kratochwill et al., 2010). If a baseline is first established and if changes in performance occur only after the implementation of treatment, "then one can have confidence that the treatment/intervention is causing the behavior change" (Crumbacher, 2013, p. 46).

Guidelines for Evaluation of Quantitative Data in SCD Research

Because SCD is increasingly recognized as a legitimate experimental methodology through which to collect causal evidence (Kratochwill et al., 2013), there has been a corresponding interest in design and design standards within the SCD literature (Kilgus et al., 2016; Maggin, Briesch, Chafouleas, Ferguson, & Clark, 2014; Smith, 2012). As a variety of methods continue to proliferate (Horner et al., 2005), the U.S. Department of Education's Institute of Education Sciences (IES) has taken an interest in providing a clearinghouse that describes interventions with potential to yield positive academic and behavioral outcomes for children: the What Works Clearinghouse (WWC), developed in 2002, has been active in promulgating a network of standards, guidelines, and criteria specific to single-case research (Kratochwill et al., 2010). In

particular, the WWC has developed criteria for judging whether designs can reasonably make a causal argument about the impact of a treatment by considering different design features and visual analyses (Crumbacher, 2013; Kratochwill et al., 2010). Several aspects of the present study are reflective of WWC guidelines.

Participants

During the fall quarter of 2016, eight middle-school students, ages 11 to 13, participated in the spelling research study. Two children were identified by their parents and teachers as having above-average language skills. One had uneven language skills and four were struggling in one or more areas of language development, including spelling (see Appendix B Participant Characteristics).

An Upper-Level Spelling Inventory (USI) (Bear et al., 2008) was administered by the experimenter to all participants prior to initiation of intervention. Table 1 illustrates the marked differences in spelling scores among the eight participants.

Table 1

Characteristics of the participants, including their grade level, gender, ethnicity, type of schooling, and Upper-Level Spelling Inventory (USI) score

Student	Name	Age	Gr.[a]	M/F	Ethn.[b]	Disability	School	USI[c]
A	Sophia	11	6	F	C		Home	60
B	Kevin	13	8	M	C	LD	Home	57
C	Scarlett	11	5	F	C	IEP	Public	42
D	Mia	12	6	F	C	IEP	Public	38
E	Hailey	11	6	F	C		Private	89
F	Pedro	13	7	M	C		Public	89
G	William	11	5	M	C	ADHD	Home	30
H	Robert	12	8	M	C	LD	Private	90

Note. C = Caucasian; IEP = Individual Education Program, for a child requiring special education; LD = learning disability; USI = Upper-level Spelling Inventory.
[a]Grade level.
[b]Ethnicity.
[c]Score out of a maximum of 99.

Setting and Structure

The study was conducted at a Montessori-based learning center located in the Pacific Northwest. Students were recruited through a notice posted on the message board at the center. In response to the notice, parents enrolled their children in the research study. Children and parents signed consent forms (Appendix C). The study was granted IRB approval under exempt review (see Appendix D).

Six of the students were scheduled to receive instruction in groups of two because their scores on the USI were close and because these students were deemed likely to

share similar strengths and weaknesses in spelling ability. Two students were not paired because their profiles did not match any other participant.

Measures

The dependent variable (DV) consists of scores derived from matched spelling tests. The independent variable (IV) includes a baseline and two instructional phases: morphology awareness instruction (MAI) and prosody awareness instruction (PAI). The study design dictated the need for carefully constructed spelling lists with particular characteristics. Each list needed to provide enough easy words for low-progress students to register measurable results. Each list also needed to provide enough challenging words so that high-achieving students would not readily encounter a ceiling. However, if the lists became unwieldy, students could easily be overwhelmed with too many words. Scheduling was an additional factor: time devoted to administration of the spelling tests would infringe on instruction time. Because the instructional phases planned for the study were of short duration, the tool for assessing progress needed to be fine-grained and sensitive to small changes in skill acquisition.

Matched Spelling Lists

In order to assemble lists that corresponded to these requirements, a pool of words were selected from *The Educator's Word Frequency Guide* (Zeno, Ivens, Millard, & Duvvuri, 1995). All words in the tests had a frequency of $U = 1$ (i.e., occurring once in a million words of text). This means that while students are likely to encounter the words at some point, they are unlikely to have much, if any, previous experience with them.

These words were randomly placed into lists. Each list had the same number of words and the words were matched for letter length. Thus, each list contained the same

number of letters (see Appendix E for steps used to create the spelling lists; see Appendix F for two samples lists).

Test Administration and Scoring Metrics

For each test session, students were supplied with numbered and lined paper. Spelling words are pronounced clearly by the tester. In order to reduce audio distractions, a contextual sentence was supplied only when necessary to differentiate the requested word from another word with similar pronunciation (e.g., "Smell the *rose*" might be used to differentiate from "The children stood in *rows*"). Words were pronounced a second time at student request. The spelling test was not timed. When students were ready for the next word, they each executed a silent, pre-determined signal.

The most common spelling metric for scoring spelling tests is the number of words spelled correctly (WSC). A drawback to this method is that it may fail to detect incremental progress over the brief span of an instructional phase. Researchers have experimented with alternative spelling metrics in the hope of capturing slight improvements inside of short time-frames. These alternate scoring methods attend, in varying degrees, to spellings that are partially correct (Hosp & Hosp, 2003; Masterson & Apel, 2010, 2013). One such method gives credit for each correct letter sequence (CLS).

CLS is time-consuming for the teacher, but it offers many benefits. During the scoring process, teacher attention is directed toward each student's many small achievements. Teachers can also become more aware of consistent mistakes that indicate a need for the re-teaching of specific spelling patterns.

Longitudinal studies have compared CLS with WSC in Grades 1 to 4. Both metrics were able to capture weekly growth (Fuchs, Fuchs, Hamlett, Walz, & Germann,

1993), although CLS appeared to be a more sensitive measure of spelling progress than WSC because it yielded a higher slope coefficient and was more likely to capture small changes in student spelling over a relatively short period of time (Deno, 1985).

Test-retest reliability is offered by Shinn (1989) and Shinn and Shinn (2002). Marston (1989) documented strong reliability for administration of parallel spelling forms one week apart (CLS = .83). More recently, researchers investigated four spelling metrics (including CLS) across two studies with kindergarten students (Ritchey, Coker, & McCraw, 2010). In both studies, there were strong correlations among the scores from the different spelling metrics.

A particular advantage of CLS is its ability to assess partial spelling skills. Floor effects can be expected when working with LD students (Ritchey et al., 2010). Allowing for partial or incomplete spelling has the potential to eliminate such floor effects. Teachers are better able to track student progress and students are often motivated more by scores that focus on number of correct choices rather than number of errors. Because of its sensitivity and flexibility, CLS is the spelling score metric used in this study. (For details on scoring procedures, see Hosp & Hosp, 2003; Shinn & Shinn, 2002).

Procedures

The current study followed each participant across a 12-week period. Students attended 30-minute sessions twice each week. The sessions were spaced so that each spelling test was administered one week after the preparatory lesson for that particular list of words. In most cases, make-up lessons were provided for missed sessions.

Pre-Baseline Assessment of Participants

As part of the pre-baseline assessment, a parent-teacher conference was arranged. At the conference, the student's present learning situation and past learning history were discussed. Scheduling was then determined and parents were invited to ask questions about the research study.

The Upper-Level Spelling Inventory (USI) was administered to each student (Bear et al., 2008). The USI can be used with students in upper elementary, middle, high school, and postsecondary classrooms. The 31 words in the inventory are ordered by difficulty and provide samples of word patterns that are understood to build upon one another (Bear et al., 2008). USI scores can help determine developmental spelling stages and pair compatible students in order to plan for pertinent instruction.

Baseline

Studies based on multiple-baseline designs are stronger or weaker depending on whether or not a reliable baseline is first established (Kratochwill et al., 2010). The basic premise of each design is to first establish a baseline condition in which behavior occurs in a steady and predictable manner over extended observations (Cannon et al., 2016).

"Comparison of an individual's performance of the target behavior during baseline to his or her performance during the intervention condition determines the effectiveness of the intervention" (Tankersley, Harjusola-Webb, & Landrum, 2008, p. 85). The present study recorded six or more data points in order to establish a stable condition before introducing the first intervention phase (Kratochwill et al., 2013).

Instructional Phases

Eight children attended two 30-minute sessions per week over a 12-week period. Training combined oral instruction with written materials, the aim being to train students in the morphological structure of derived words and to make explicit the links between morphological and orthographic structure. The intervention was targeted at *derived words* because derived word are typically long, low in frequency and abstract in meaning (Nagy & Anderson, 1984), and create significant difficulties in spelling (Carlisle, 1987; Kemp, 2006; Tsesmeli & Seymour, 2006). Each session included a similar sequence of activities. The first few minutes of class were devoted to administration of the spelling test. The rest of the session focused on preparation for the following week's test. The emphasis of the preparation in first-phase sessions was morpheme awareness (first condition); in second-phase sessions, it was prosody awareness (second condition). In all sessions, children worked with blocks, cards, and other manipulatives. Students used whiteboards and hand signs to respond to questions and to demonstrate an understanding of various concepts.

For both MAI and PAI, the following schedule was observed. First, words on the new spelling list that students could already spell were identified and set aside. Then, the more challenging words were systematically analyzed with a goal toward retention of letter strings based on within-word patterns. To encourage phonological analysis of a word, children were asked to identify any multi-letter phonograms in the word by underlining them. Students then circled prefixes and suffixes. Using several gross motor-techniques, students counted the number of vowel sounds (syllables), responded to questions about the six syllable types, and rehearsed the encoding and decoding of word

parts. Children participated in sorting games and were helped to categorize words with similar characteristics: double consonants, *-able*/*-ible* endings; Latin/Greek bases; etc. The last few minutes of each class were devoted to brainstorming ways to make the spellings "conscious" and reliable. Students were encouraged to discover ways to "carry the words with them in their mind." Students were asked to share ways in which they had put new words to use during the previous week.

Thus, each instructional session moved in the direction of phoneme first and spelling unit second "because spelling is a phoneme-to-spelling translation process" (Berninger, Vaughn, et al., 2002, p. 295). After working with phonemes, attention was directed to morphemes and syllables, and finally to whole words. The primary teaching approach was direct instruction. However, many opportunities were created for students to articulate their insights. Emphasis was placed on student-generated solutions regarding how to retain the spelling patterns in words. There was particular recognition of individual student progress from week to week. For example, two to three minutes were devoted each session to going over the challenging words that each student got right on the previous test. No time was devoted to discussing spelling errors. Students became acquainted with the graphing of their spelling scores; for children who were accustomed to experiencing very little progress in spelling, the graphs provided visual proof that they were able to improve (see Appendix G for typical questions used in the MAI and PAI conditions).

Data Analysis

Because all spelling lists utilized in this study had an identical number of words as well as an identical number of letters in each word, the highest possible score was the

same for every test. Thus, a graph was constructed for each student with a possible correct letter score (CLS) of 185. Scores were recorded directly on the graph, making it easy to track individual patterns across the phases of the study.

Visual analysis has long been the first, and sometimes the only, level of analysis available to the SCD researcher. Barry Parsonson and Donald Baer (2015) contended that the immediacy of the relationship between visual analysis and graphing can be understood as a particular strength of SCD research: "In representing the actual data measured, graphs can and do transform those data as minimally as possible" (Parsonson & Baer, 2015, p. 16).

However, today visual analysis is complemented by numerous strategies that offer a more systematic approach to the evaluation of quantitative data in SCD research (Lenz, 2012), including a growing number of computational methods proposed for calculating effect size (ES). Although consensus regarding the application of ES measures to single-case studies has not yet emerged (Parker, Vannest, & Davis, 2011), researchers are looking for ways to incorporate SCD findings into meta-analyses. This will require the creation of a standardized metric. While none of the new ES metrics appear to be ideally suited to SCD research, the WWC does not recommend employing visual analysis alone (Kratochwill et al., 2010, 2013). Combining visual analysis with ES is thought to enhance objectivity, precision, certainty, and general acceptability (Parker, Vannest, & Brown, 2009).

A commonly used ES measure for SCD studies is the Percentage of Non-Overlapping Data (PND) (Scruggs & Mastropieri, 2001). The PND is directly aligned with visual analysis (Parker & Vannest, 2012) and thus intuitively accessible. PND was

among the first ES measures proposed for SCD research (Scruggs, Mastropieri, & Casto, 1987) and was for several decades, the most frequently applied index (Parker & Hagan-Buke, & Vannest, 2007; Scruggs & Mastropieri, 2013). However, PND was followed by numerous other statistical approaches and today, "the literature suggests using multiple ES metrics for comparative purposes" (Kratcochwill et al., 2010; Maggin, Chafouleas, Goddard, & Johnson, 2011). Considering the extensive use of PND over the last three decades, PND will be the initial method of computing effect size for this study.

To further explore and interpret the data gathered in the present study, one of the newer ES metrics, Tau-U, will also be employed in addition to PND. Tau-U is a nonparametric statistical analysis of effect size which "offers a more complete index of change between phases than do other frequently used non-overlap measures such as Non-Overlap of All Pairs (NAP, Parker et al., 2009) and Percentage of Non-Overlapping Data (PND, Scruggs et al., 1987). The originators of Tau-U have maintained that it is "nonparametric, distribution-free, and suitable for data with any distribution shape" (Parker & Vannest, 2012, p. 259). They also stated that "it has strong statistical power (at least 91-95% that of OLS regression)," making it suitable for short series. According to Parker and Vannest (2012), Tau-U is capable of controlling for baseline trend (see Appendix H, Questions Regarding Tau-U).

In the interests of conservative reporting of Tau-U statistics, there is an argument for always adjusting for trend. James Pustejovsky (http://jepusto.github.io/Tau-U) gives the numerator of the Tau-U calculation as S_P-S_B, where S_P is Kendall's S for the comparison and S_B is Kendall's S for the baseline trend. However, it should be noted that if one always corrects for trend, it is possible to have a Tau-U over 100%. For these and

other reasons, the originators of Tau-U recommend making an adjustment only when significant baseline trend exists (Parker & Vannest, 2012). The researcher will follow Parker & Vannest's line, with an alpha level of .05.

As presented in Appendices H and J, the interpretation of both PND scores and Tau-U scores is somewhat similar. For PND, a score greater than 90% is considered highly effective, 70% to 90% is fairly effective, 50% to 70% is of questionable effectiveness, and a PND of <50% or lower reflects an unreliable or ineffective treatment (Scruggs, Mastropieri, Cook, & Escobar, 1986; Scruggs & Mastropieri, 1998). For Tau-U, a score greater than 92% is large or strong effect, 66% to 92% is medium to high effect, and 65% or lower constitutes weak or small effect (Parker & Vannest, 2009; Rispoli et al., 2013).

Chapter 4: Results and Interpretation

The investigator collected spelling scores from eight students over a period of 12 weeks. The data were graphed to allow for visual analyses. The primary focus of interest was the amount of change between two instructional phases: morphology awareness instruction (MAI) and prosody awareness instruction (PAI). A secondary interest was the amount of change between the MAI condition and the baseline.

Table 2

PND and Tau-U *Statistics for Students A Through H*

	PND		Tau-U			
Student	Base-Morp.[a]	Morp.-Pros.[b]	Base.[c]	Morp.[d]	Base-Morp.[e]	Morp.-Pros.[f]
A	.5	.867	-.667	.056	.583	.956***
B	.5	.867	0	.357	.438	.917***
C	.875	.917	-.333	.929**	.917**	.698**
D	.5	.929	.467	.75**	.813*	.795**
E	1	.813	-.067	-.333	1**	.866**
F	1	.75	.467	-.607*	.979**	.922***
G	.714	1	.472	.333	.921**	1***
H	.889	0	.512*	.083	.657*	.254

[a]PND for morphology compared to baseline (expressed as a decimal). [b]PND for prosody compared to morphology. [c]Tau-U of the baseline trend. [d]Tau-U of the morphology trend. [e]Tau-U for morphology compared to baseline (adjusted when the baseline trend is statistically significant). [f]Tau-U for prosody compared to morphology (also adjusted). *$p < .05$. **$p < .01$. ***$p < .001$.

Table 2 is a summary of the results of the study. The table illustrates that six out of eight participants showed a significant improvement, when moving from baseline to

morphology. It also indicates that seven out of the eight showed a significant improvement moving from morphology to prosody.

Results and Interpretation: Individual Graphs

To explore and interpret the results of each student's individual graph, a three-step process was employed. First, the data were visually analyzed. Next, the PND was calculated. The final step was to obtain Tau-U statistics by using the web-based calculator offered by the SCR research group (see Table 2 for a summary of the PND and Tau-U statistics; see also http://www.singlecaseresearch.org/calculators/Tau-U for the SCR research group calculator).

Seven of the eight students in the study indicated a positive response to instructional intervention relative to baseline. The number of correct letter sequences (CLS) achieved by individual students can be found in Figures 1 to 8. To support visual analysis of the graphs, the percent of non-overlapping data (PND) was calculated for the main focus of interest by adding the number of intervention points that exceed the highest baseline data point and then dividing the sum by the total number of points in the intervention (Table 2; see also Scruggs et al., 1987). The secondary interest was explored in the same manner: the PND was calculated by comparing data collected during the first intervention phase with the baseline. It should be noted that the PND scores were calculated as a proportion rather than as a formal percentage. In order to obtain a more useful effect size (ES) for each participant, Tau-U calculations were done using the scores of each individual student (see Appendix I, Tables I1 to I8). Although PND is a commonly used index for SCD research, newer and more versatile methods of calculating effect size are becoming available (Kratochwill et al., 2013). The Tau-U statistic is a non-

parametric measure of correlation based on Kendall's Tau and the Mann-Whitney test (Parker, Vannest, & Davis, 2011; Parker, Vannest, Davis, & Sauber, 2011; Parker & Vannest, 2012). The Tau-U shows particular promise for SCD application (see Appendix H for questions about Tau-U).

Student A (Sophia)**.** Visual analysis of Sophia's spelling scores suggests a downward trend in the baseline followed by improvement over the remainder of the 12-week course. The PND score comparing morphology to baseline is .5. The comparable Tau-U statistic is .583, $p = .105$, showing no significant spelling improvement. Prosody, compared to morphology, has a PND of .867, Tau-U = .956, $p < .001$, indicating strong improvement.

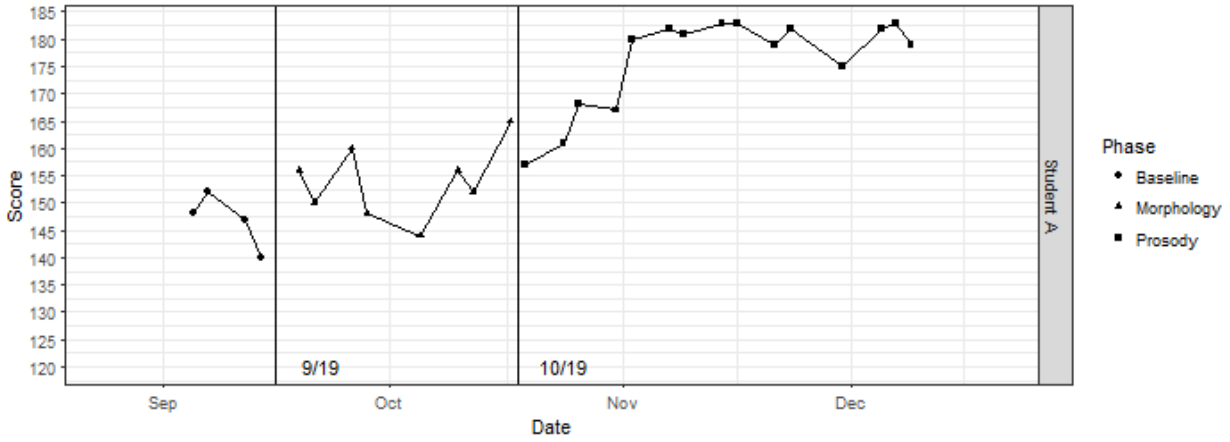

Figure 1. The CLS scores of Student A (Sophia).

It appears that after the introduction of prosody, Sophia not only improved, but her scores became more stable—fewer pronounced swings as seen previously in the morphology phase.

Student B (Kevin)**.** In Figure 2, the baseline displays scores that are all within five points except for a low outlier at 115. This outlier can be interpreted as a side-effect of Kevin not knowing how to take the test and follow the directions. Across the first

intervention phase, this student displays an erratic pattern. If the pattern could be projected into the prosody phase, one might expect a continued distribution of scores between 135 and 162 with perhaps a small positive slope. However, that is not what occurs. Rather than a duplication of the same pattern, the introduction of PAI in the second instructional phase is accompanied by an overall improvement. It could also be noted that there is evidence of increasing stability in the prosody condition. Additionally, it appears from the graph that Kevin encountered a ceiling.

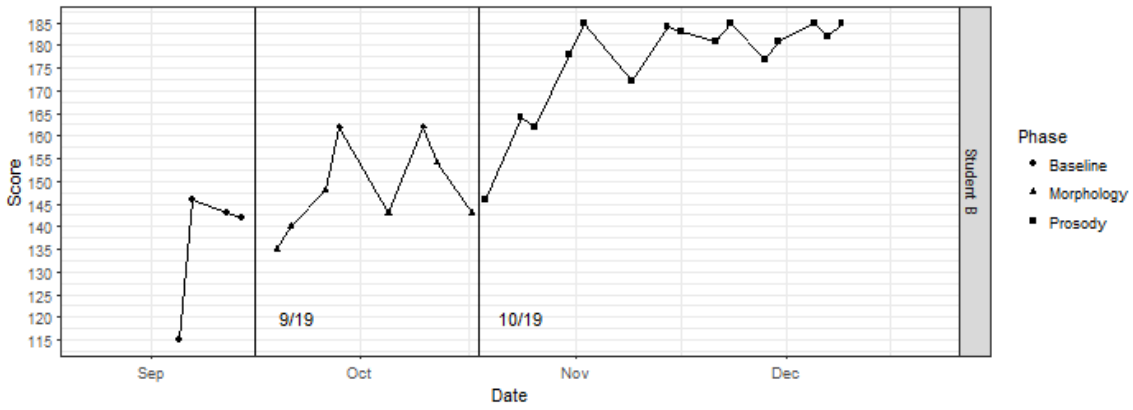

Figure 2. The CLS Scores of Student B (Kevin).

As an adjunct to visual analysis, PND scores were calculated. The PND between morphology and baseline is .5, Tau-U = .438, p = .235, suggesting no improvement as a result of the morphology intervention. However, the PND between prosody and morphology is .867, Tau-U = .917, $p < .001$, offering strong support for the possibility that PAI was instrumental in raising spelling scores.

Student C (Scarlett)**.** This student began the course with low scores. This could partly reflect the challenge of getting acquainted with a new situation. It could also signal the fact that Scarlett had not consciously developed specific tools to use when confronted with the task of spelling unfamiliar words—and so she simply guessed at spellings

without resorting to a particular strategy. According to baseline scores, there was no improvement until the introduction of morphology. The PND for morphology compared to baseline was .875, Tau-U = .917, p = .005, which indicates a strong effect. The PND for prosody to morphology was .917, Tau-U = .698, p = .001.

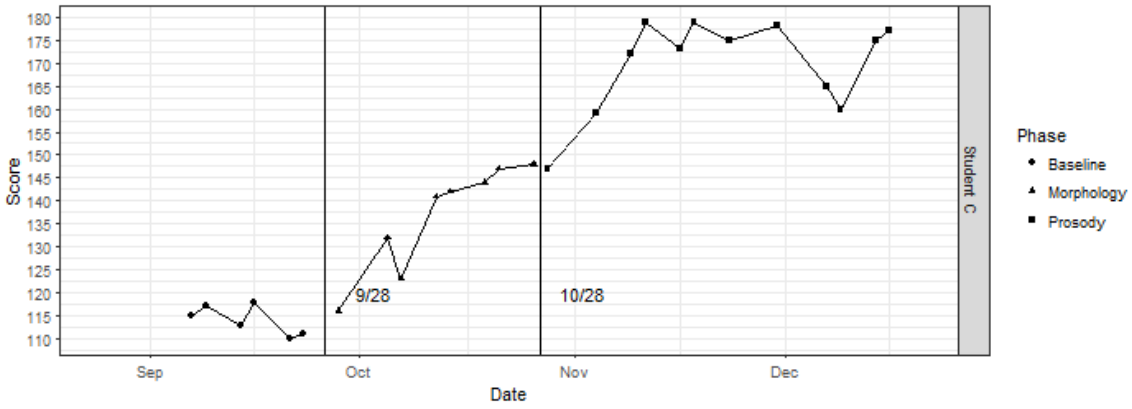

Figure 3. The CLS Scores of Student C (Scarlett).

When considering the prosody phase compared with morphology, one would want to take into account the strong trend already evident in the morphology condition, Tau-U = .929, p = .001. The Tau-U for prosody, compared to morphology, reflects an adjustment for this trend. The adjusted score of .698 indicates some effect but is lower than the comparable PND score.

Student D (Mia)**.** The morphology-to-baseline PND for Mia is .5 and thus on the surface does not reveal an effect. The equivalent Tau-U is .813, p = .01. The discrepancy between PND and Tau-U can be traced to Mia's relatively high score on the fourth session of the baseline phase. This score was higher than half the scores in the morphology condition, which has a disproportionate impact on the PND score. In this instance, visual analysis seems to be more reliable than PND. By simply looking at the graph, one would assume that the introduction of morphology is accompanied by

improvement, compared to baseline; but the PND does not reflect this observation. In contrast to PND calculations, the Tau-U output considers all the baseline scores, not just the highest one.

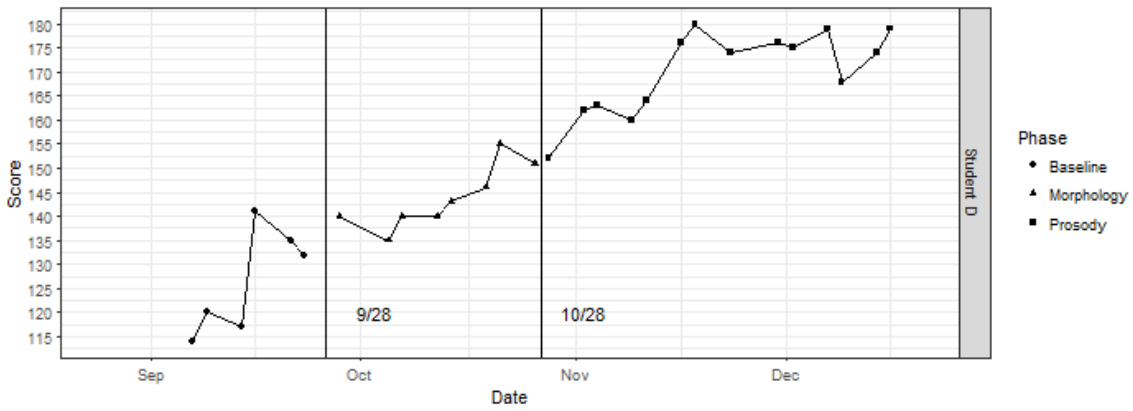

Figure 4. The CLS Scores of Student D (Mia).

The prosody-to-morphology PND is .929 which seems to indicate a strong effect for prosody instruction. The equivalent Tau-U is lower, at .794 (p = .002). This is because the morphology condition exhibits a statistically significant trend, Tau-U = .75, p = .009, which is controlled for in the calculations for this statistic. Scarlett and Mia (Students C & D) are sisters, close in age. The trajectory of their charts looks somewhat similar. This could reflect their backgrounds or the fact that they tended to discuss the spelling words before and after class and vie with one another to remember specific words from the spelling lists.

Student E (Hailey)**.** The PND score comparing morphology to baseline was 1, and so was the equivalent Tau-U, p = .003. This shows that there was no overlapping data. The PND comparing prosody to morphology was .813, Tau-U = .866, p = .001.

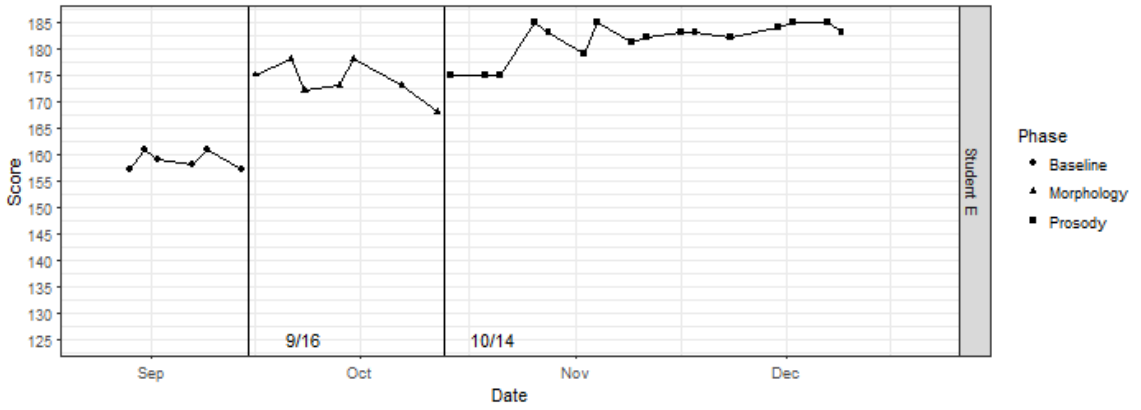

Figure 5. The CLS Scores of Student E (Hailey).

Although Hailey's Upper-Level Spelling Inventory score and her class demeanor suggest a student with strong spelling capabilities and considerable motivation for learning, the baseline data do not illustrate movement. Wolery, Dunlap, and Ledford (2011) reiterated that "a minimum of three data points is required to determine a trend" while more than three points can be considered a "stable pattern" (p. 106). Hailey's stable pattern in the baseline condition does not change until the introduction of MAI. This might be explained by the fact that Hailey was accustomed to relying on her excellent visual memory to spell words she had previously seen in her schoolwork and reading; but the study presented unfamiliar words in each weekly spelling test. It seems that in spite of a strong academic profile, Hailey had not developed tools for inferring the spellings of words that she had never seen in print. The graph illustrates that Hailey was quick to make use of the new tools she encountered in the morphology and prosody interventions.

Student F (Pedro)**.** As shown in Table 1, Hailey and Pedro received the same high score on the Upper-Level Spelling Inventory (UPI). Therefore, it was decided that they would attend sessions together, which proved to be a productive arrangement. They are both eager learners and a friendly competition developed. Since both have excellent

visual memories, they had not encountered the need to try other approaches to spelling. At first, oral spelling responses and phonological processing tasks were difficult for both students. But the challenge soon faded in the wake of strong motivation.

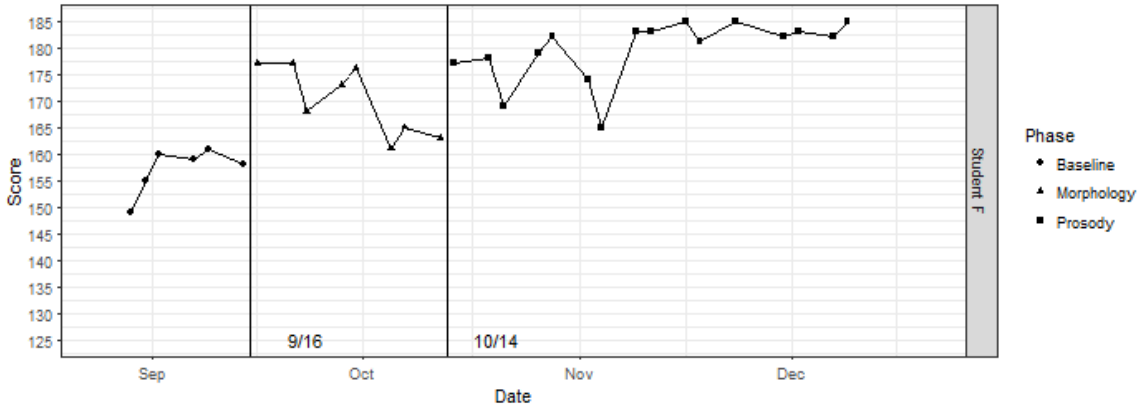

Figure 6. The CLS Scores of Student F (Pedro).

Visual analysis of Pedro's chart shows no overlap between morphology and baseline. Therefore, the PND score is 1 and the Tau-U is similar at .979, $p = .002$. There is a significant negative trend in the morphology condition, Tau-U = -.607, $p = .035$. Since both Pedro and Hailey became sick during the morphology phase, this could have contributed to this trend.

The PND for prosody, compared with morphology, is .75, Tau-U = .922, $p < .001$. The negative trend of morphology is overcome, and there is a clear improvement in CLS scores.

Student G (William)**.** According to his mother, William was hospitalized for some time after birth due to prematurity and other health issues. He has always been homeschooled and did not read until he was eight years old. William has been treated for anxiety and he currently takes medication for ADHD. William's attention during the first few sessions was intermittent and he frequently sprang from his chair to pace the room.

As can be ascertained from the chart, William's weekly test scores were erratic. However, morphology scores appear to be associated with an improvement over baseline. The improvement continues on into the prosody phase and somewhat stabilizes by the end of the course.

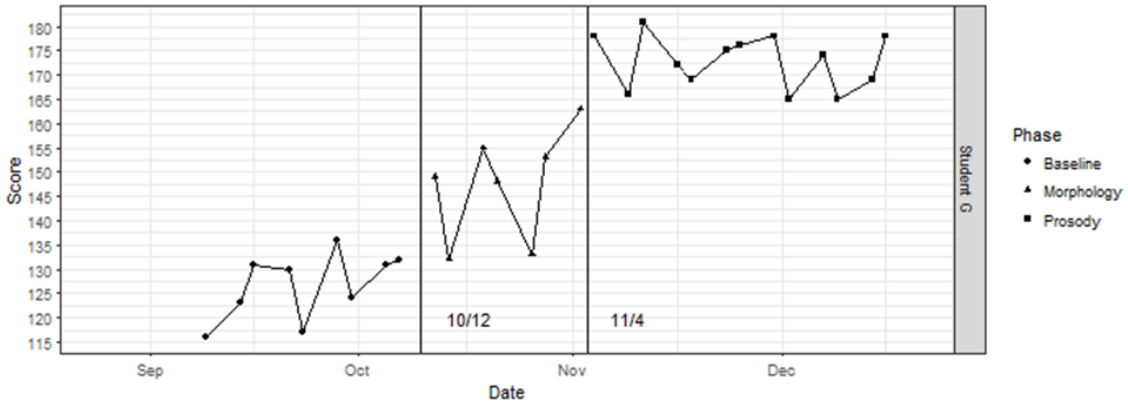

Figure 7. The CLS Scores of Student G (William).

The PND score comparing morphology to baseline is .714, Tau-U = .921, p = .002. For the prosody-to-morphology comparison, both the PND and Tau-U ($p < .001$) return a score of 1 as there is no overlap. Before the study, William's mother stated that he was continually asking her how to spell words whenever he tried to do written assignments. After the study, William's mother was happy to report that he was now "teaching his younger brother to spell."

Student H (Robert)**.** Robert, as the graph indicates, began with higher scores than most of the other students. Although Robert exhibited the characteristics of dyslexia in the primary grades, he has received literacy tutoring for several years and this may account for his relatively high starting point—and minimal response to intervention. Robert's PND score comparing morphology to baseline is .889, Tau-U = .657, p = .01. The difference between the PND score and the Tau-U is caused by the fact that Robert's

baseline scores have a positive trend, Tau-U = .515, p = .02. Robert was the only one of the eight students to have a statistically significant trend in the baseline, in his case positive. It should be noted that he also had the highest number of baseline sessions, which, in relative terms, increased the power of the calculations used to test for a significant trend.

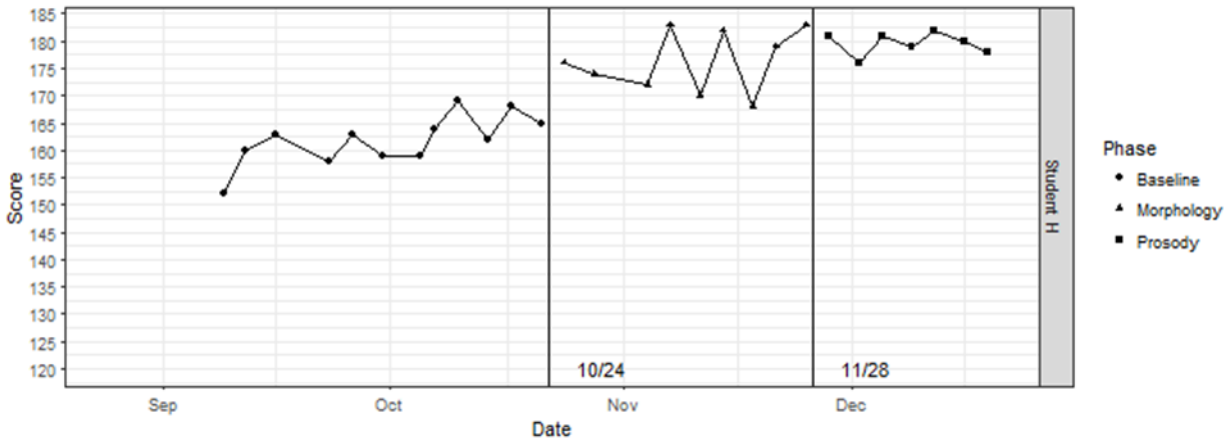

Figure 8. The CLS Scores of Student H (Robert).

Comparing prosody to morphology, we get a PND of 0 because the highest morphology score determines the percent of overlap, and Robert's highest score was in the morphology phase. The Tau-U score comparing prosody to morphology is .254, p = .397. Although the response to prosody is not statistically significant, visual analysis of the chart does indicate improved stability in spelling scores during the prosody phase.

Data for the Eight Participants Combined

In single-case design (SCD), each participant constitutes an independent unit of interest. While there are many positive aspects to SCD research—convenience, low cost, no need for a matched control group—it might appear that when a series of SCD studies comes to an end, the investigator is left with a number of disassociated results. How is one to draw conclusions from scattered and unrelated data? And when one does draw

conclusions, how are they to be evaluated? One way to strengthen conclusions based on SCD research is to pre-plan for staggered interventions across participants, rather than using a universal start time for each phase. In Figure 9, the various start times are indicated by the phase boundaries. Wolery et al. (2011) explained that "each time the experimental conditions change, an opportunity exists to determine whether the manipulation is associated with consistent changes in the data pattern" (p. 105). The literature has commonly recommended three as the minimum number of baselines to be introduced in a time-lagged fashion, but "four or five baselines provide the opportunity for additional replications" (p. 105). Figure 9 illustrates five different sequences across eight participants.

Weighted averages**.** A study is more valuable if it can contribute to the research community in a way that allows for replication and participation in meta-analyses. The present study provides PND scores for all participants; but adding PNDs across replications can lead to inaccurate conclusions (Parker, Vannest, & Davis, 2011; Wolery, Busick, Reichow, & Barton, 2010). However, Tau-U scores were also obtained for each participant. Tau-U is a more flexible ES index that can facilitate the summarizing of SCD studies.

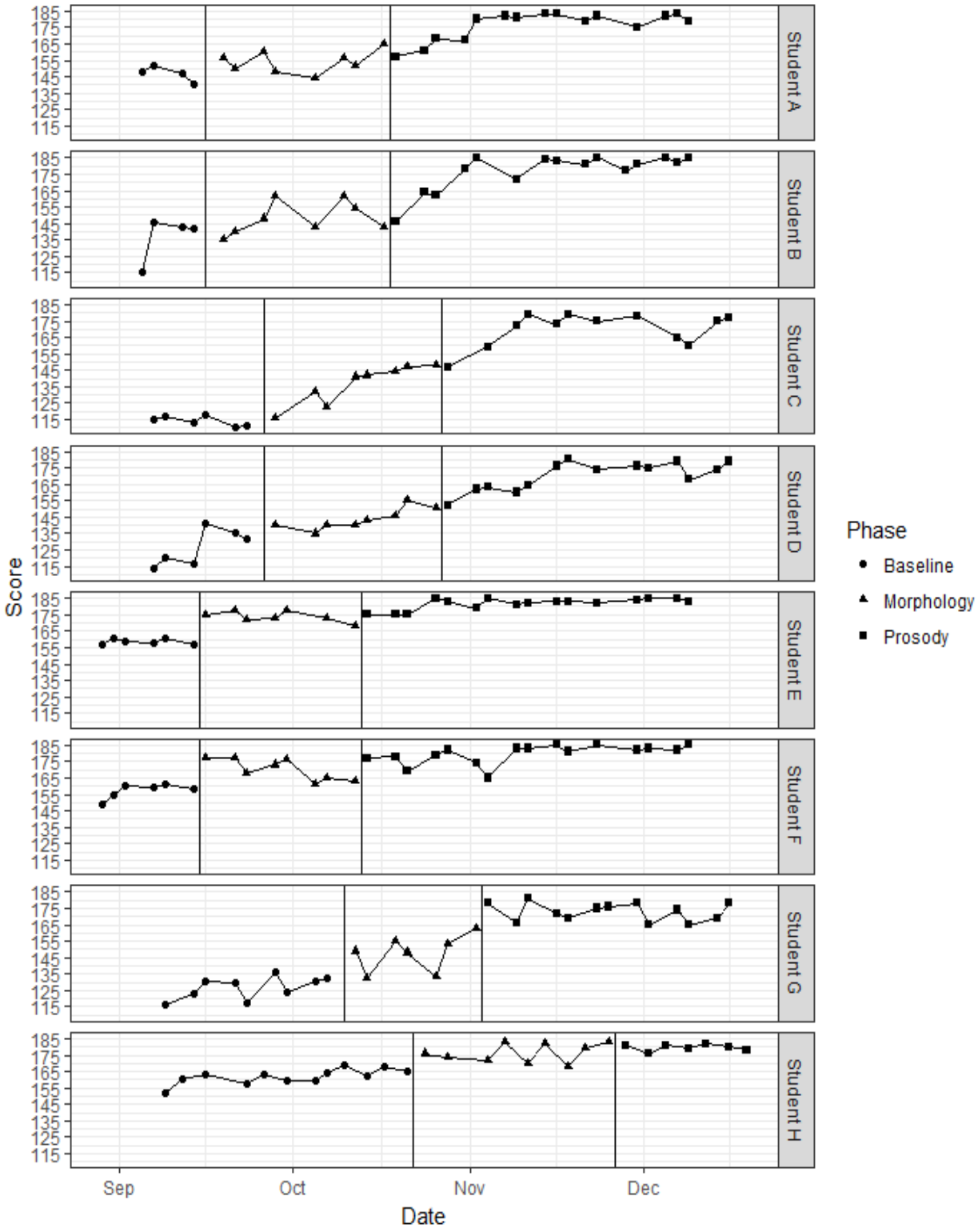

Figure 9. Students A through H, showing staggered start times for morphology and prosody awareness conditions.

Scores for the eight participants were entered into the web-based calculator (http://www.singlecaseresearch.org.) offered by the SCR research group. The Tau-U weighted average for morphology-to-baseline is .793, 95% CI [.568, 1], $p < .001$. The Tau-U for prosody-to-morphology is .810, 95% CI [.625, 1], $p < .001$. In order to compare these results with a more conservative figure, the weighted averages were calculated again, controlling for baseline trend in all cases, not just those cases that showed statistical significance (see James E. Pustejovsky's response to Parker, Vannest, Davis, & Sauber, 2011, at http://jepusto.github.io/Tau-U). The recalculated statistic for morphology compared to baseline is .749, 95% CI [.523, .974], $p < .001$. The recalculated statistic for prosody compared to morphology is .791, 95% CI [.605, .976], $p < .001$. As two measures of effect size were used, PND and Tau-U, the researcher investigated their relationship with a Pearson's correlation. The morphology condition compared to baseline was $r(6) = .702$, $p = .052$; prosody compared to morphology was $r(6) = .887$, $p = .003$.

Chapter 5: Discussion

The purpose of this study was to investigate the potential of prosody awareness instruction as a spelling aid. Seven of the eight participants in the study demonstrated a significant rise in spelling scores in response to prosody intervention. Despite these positive results, there are several limitations to the study. The number of participants is small, casting doubt on the possibility of generalization to other populations. Also, the structure of the study leaves room for questions about which factors might actually be responsible for the improvement in student spelling scores. While the increase in scores coincides with the implementation of MAI and PAI, there is the possibility that the observed changes may have been due to factors other than the independent variable.

For example, maturation always plays a role in children's academic progress. In this case, the short duration of the study makes maturation a less-than-satisfying explanation. It is unlikely that a selected group of dissimilar students would demonstrate marked spelling improvement inside a single quarter simply as a result of growth and development.

Researcher Bias as a Threat to Validity

Though additional statistical analyses have become commonplace in the last 30 years, visual analyses have remained the principal means by which SCD data is evaluated (Horner et al., 2012). For this reason, some have suggested that SCD research might be disproportionately prone to experimenter effects (Fisher, Kelley, & Lomas, 2003). At first it may seem that researcher bias would not play a role in a study that rests on a simple scoring system such as WSC or CLS. However, a researcher who has a strong interest in a particular strategy may favor that strategy over another while working with

study participants. In turn, the students may respond to the teacher's selective enthusiasm. Consciously or unconsciously, the investigator can unduly influence the outcome of a study. This is especially true when results rest on the visual interpretation of only one individual. A possible corrective would be to employ two or more instructors to take turns teaching the sessions. The scoring and statistical analysis procedures could also constitute a source of bias. To protect against this threat, the scoring and data calculations could be turned over to individuals unconnected with the outcome of the research.

Effects of MAI

The potential of prosody awareness instruction as a spelling intervention was the main focus of this study, but the effects of morphology instruction were also a consideration. However, in this study, the PND and Tau-U scores comparing morphology to baseline cannot support strong conclusions about the effectiveness of morphology as an intervention. Part of the reason is that the morphology-to-baseline calculations are not comparing like to like. The comparison is focused on the challenge of spelling *taught* words versus the challenge of spelling *untaught* words. Thus, two educational approaches were not compared. Rather the comparison was between morphology intervention and no intervention. If one wished to undertake a closer examination of morphology instruction as a spelling aid, a future study could be done in which morphology is compared to another type of spelling method, such as the traditional Cover-Copy-Compare method.

Effects of PAI

The present study does not effectively isolate the effects of PAI from other possible contributors, such as the power of one-on-one teaching, the implementation of motivational techniques, and of course, the carryover from MAI. It cannot be ruled out

that high scores in the last phase were simply the result of the continued benefits of morphological knowledge acquired in the previous phase. A more clear-cut investigation of prosody could be done by replicating some aspects of the present study while ruling out other instructional techniques unrelated to prosody. For example, during the present study, students were encouraged to explore various memorization strategies in order to be successful at holding on to the correct letter strings in words over the course of a week. But this admixture does not allow us to conclude that prosody is a uniquely effective spelling intervention. It may be that some other strand of the lesson was in some way responsible for spelling improvement. A future study would want to eliminate as many confounding factors as possible. Another way to get a clearer picture of prosody's effectiveness would be to conduct a similar study but lengthen the morphology phase. The goal would be to see if the same effects could be duplicated within the same timeframe but without the addition of prosody.

Limitations of Spelling Lists

The effect of prosody instruction relative to morphology instruction cannot be adjudicated without a reliable metric. Therefore, much care was taken in devising the matching spelling lists used in this study. But this is an area that could use additional improvement. For example, it was found that some lists had more compound words than other lists. The investigator as well as the students noticed that compound words tended to be easier to spell and that overall student scores seemed to dip and fall relative to the number of compound words. Not only are compound words "easier," but some vowel combinations are "harder." In conclusion, although the lists were randomized by

computer, further refinement could be done by having experienced teachers hand-adjust the balance of hard and easy words.

Another limitation of the spelling lists has to do with the wide range of student ability in the present study. A list of 18 words was too long for the struggling students and not long enough for the more able students. The high performing students also asked for more difficult words. Similar studies in the future might prove more fruitful if the participants were first carefully assessed for spelling ability, then grouped with others who shared similar scores, and finally supplied with lists that are more precisely designed to fit each particular group of students**.**

Implications for Practice

It is well known that motivation is a strong predictor of academic success. Both MAI and PAI offered the students tools that encouraged them to grow in competence and thus confidence. As the students acquired more strategies to help them unlock the spelling of words, they were motivated to put forth more effort. A reinforcement cycle was created that probably had much to do with student progress.

For these reasons, the methods used in this study might profitably be put to use in a number of ways. Firstly, it must be remembered that the structure of the study was not designed to improve spelling across the board but only to recall taught words over the course of a week. According to Marcia Henry (2010), "most children, even those with reading and language problems, do well on the Friday test" (p. 12). The "Friday test," of course, refers to the traditional quiz that follows a week of exposure to the test words (including, in many cases, a pretest on Wednesday or Thursday).

It is true that expectations for the current study were quite different from expectations for a typical classroom routine. For one thing, most of the words on the study list were unusually difficult; for another thing, the students did not take home a printed list of the words. Instead, they were encouraged to "take home the list in your mind."

But the point is that the goal of learning taught words for a quiz is a narrow and achievable goal. Progress toward the goal can be made visible. Over the course of the study, the students had access to their graphs and could see their improvement. This was another motivational factor.

Noting that a group of very dissimilar students developed measurable skill in retaining taught words over the course of a week, and also noting that a significant side effect was student enthusiasm, it might be productive to apply some of the techniques used in the present study to a larger group situation, such as an entire classroom. An approach that quickly engages and motivates students would be a good choice to employ at the beginning of the school year. After a few weeks of building spelling momentum, the teacher could then switch back to the standard curriculum or continue to use the new techniques with the addition of a very carefully composed set of word lists and an expanded set of objectives. Long-term goals for an entire school year should not be limited to the retention of letter strings in taught words. More properly, year-long goals would need to take in all aspects of word study.

Pull-out classes could prove to be another area of productive application. Individuals or small groups of students who are underperforming could be given intense morphology and prosody instruction in order to strengthen their decoding and encoding

skills. The pull-out classes should also incorporate the motivational techniques and memorization strategies that proved helpful in the current study. Once students reach pre-determined benchmarks, they could be returned to regular classes armed with new skills and new confidence.

Perhaps the most obvious application of the present findings is to be found in tutoring situations. Teachers in such situations would have little need to modify or adapt the procedures used in the current study, as they were designed for one-on-one or small-group work. A positive aspect of tutoring situations is that they lend themselves to continuing SCD research and further exploration of MAI and PAI.

Personal Reflections

Morphology. Carlisle and Feldman (1995) described morphological awareness as the "conscious awareness of the morphemic structure of words and the ability to reflect on and manipulate that structure" (p. 194). This consciousness is exactly what is missing for many children who struggle with encoding and decoding multisyllabic words. During the first instructional component of the present study, I noted several ways that morpheme awareness strategies helped students break down multisyllabic words into chunks that were more manageable and more meaningful to them (these steps are detailed in Appendix G).

An important element of morphological study is its direct relationship with vocabulary development. The present study had a narrow focus—improved retention for letter strings in words. Consequently, no attention was given to vocabulary during the instructional phases. However, the baseline phase offered an opportunity to explore the morphological matrix (www.realspelling.com) which originated in the work of Chomsky

(1970) and has lately been made more popular by Peter Neil Bowers (2012). The matrix and accompanying word sum sparked student interest and demonstrated great potential as tools for building word consciousness and expanding vocabulary. In an ideal spelling program, attention to vocabulary would be integrated with other word-study components.

The three study participants who seemed to have learning difficulties were very motivated to work with the matrix. The two participants who already had excellent word skills were even more motivated.

Prosody. I have found it enlightening to question good spellers as to how they go about recalling the correct letter string in words. For some, the process is so unconscious they have no words to explain it. Others state that they can "see" the letters in their mind. A surprising number of students have told me they "say" the word first. By this they really mean that they exaggerate the pronunciation in a way that reflects how the word is spelled. For example, many people subvocalize the "p" in pneumonia as they write the word. This prosodic approach appears to be one of the more powerful techniques to help poor spellers. Spalding and DesRoches (1986) called this strategy "think-to-spell" and decades ago recommended it for primary children learning to read and write in English. I found it helpful for older students as well, especially students with learning disabilities and I dubbed it *over-pronunciation* to distinguish it from correct pronunciation. Ehri (1987) occasionally referred to this exaggerated spelling as *careful* pronunciation.

It came as a surprise to find that Drake and Ehri (1984) conducted a study to compare the effects of careful pronunciation versus typical pronunciation on spelling scores. Forty-two students were supplied with words divided into syllables. The control group pronounced spellings conventionally according the dictionary while the

experimental group was taught to pronounce words closer to the manner in which they are spelled. Words with schwa vowels and silent letters were over-pronounced by the experimental group. “For example, the word ‘chocolate’ was pronounced ‘choc-o-late.’ The medial silent O was pronounced as a long vowel, and the shwa vowel “u” in “lut” was pronounced as it is spelled, with a long A sound, ‘late’” (Drake & Ehri, 1984, p. 23). The results of this study confirmed that subjects who used the exaggerated pronunciation remembered letter strings better than those who relied only on the correct pronunciation (Drake & Ehri, 1984).

The power of muscle memory or the power of repetition? In the present study, hand signs were introduced to communicate student knowledge of the six syllable types. Having used this approach mainly with preschoolers, I was at first concerned that older students would find this somewhat childish. Without exception, all the students showed a preference for using various large motor movements as instructional components rather than verbal explanation or worksheets. Over many years and numerous students, I have noted a very strong connection between active movement and secure learning. Regarding the power of teaching through large muscle movement, ‘neuromyths’ abound (Organisation for Economic Co-operation and Development [OECD], 2002). Whether cognitive neuroscience will uncover a causal relationship between large muscle activity and ‘natural cognition’ (Strauss, 2003; Strauss, Ziv, & Stein, 2002) remains to be seen (Goswami, 2004). In the meantime, a very simple explanation is at hand: children prefer movement. What has most impressed me about signing is the amount of repetition that students are willing, I might even say, eager, to undertake. For example, students in this study tired rather quickly when asked to explain their reasons for labeling syllable types

in words. However, there was marked improvement in student endurance for addressing exactly the same labeling process using hand signs. In fact, as the instructor, I would find myself pushing to go to the next step, while a student wanted to sign each word on the list instead of every other word. This was particularly true in sessions attended by two students. I was very willing to have students take turns, each executing the hand signs for different words. But the students wanted turns on every single word. It seems that children have more stamina for repetition associated with large muscle movement, than for repetition involving fill-in-the-blank work sheets. What I saw happening in this study was a lot of drill, perhaps more than students would happily endure under other circumstances. I believe this appetite for repetition can be traced to the characteristics of prosody.

It seems that for some students—especially those who have spelling difficulties—instruction must be precise, palatable, and most of all, plentiful. Prosody awareness instruction (PAI) corresponds to these requirements. Because PAI tends toward inclusivity and explicitness, it can offer students a more precise method for storing letter sequences in words. Prosody has to do with sound in language. If children are silently filling in work sheets, a large component of language is missing. PAI lends itself to palatable learning due to the fact that it is a familiar and foundational part of everyone's learning repertoire from birth. Much research has supported the idea that prosodic sensitivity is a front-loaded capacity and plays a basic role in learning to understand and to speak one's first language. PAI provides plentiful opportunities for learning because of the ease in which prosody can become an add-on to other techniques. When students are involved in a written spelling test, it takes just a fraction of a second for them to

pronounce the word before writing it. For some students this will make a critical difference in their score. If students are identifying syllable types in a long word from left to right, they can give the appropriate hand signs and simultaneously *over-pronounce* each syllable. Children find this procedure interesting, the teacher receives immediate feedback, and it is more efficient to accomplish two tasks at once.

Prosody and sub-lexical stress. There seems to be a connection between poor spelling and poor pronunciation. Once students become more attuned to stress patterns in words, they are more likely to pronounce words correctly; spelling also improves. In the first session of the present study, I asked each student to read a short passage out loud. All but three of the students stumbled over the word *consonant*. No comment was made at the time but later I asked each student to spell *consonant*. The students who were unable to spell the word were the same ones who had mispronounced it in their reading. We briefly drew a *con* a *son* and an *ant.* We also explored the word by clapping strong and weak syllables. Both the spelling and the pronunciation became more secure.

If students are to decode and encode a multisyllabic word correctly, there are many things they must attend to: number and placement of letters, grapheme-phoneme correspondence, number and stress pattern of syllables. Some children can rely on their nondeclarative or implicit memory to process all the needed information. Others will need to be shown how to break down these challenges into smaller steps. Prosody awareness techniques are useful tools for this purpose. For example, in this study, I initiated the steps in word-analysis by pronouncing the whole word. Then I asked students to find the vowels by placing their hands beneath their chin as they said the word. Next, students counted out the syllables with their dominant hand by tapping the

non-dominant arm. Finally, they clapped the weak and strong syllables. At this point, students printed the word on their white board, identified the multi-letter phonograms, circled affixes, marked syllables and explored weak syllables for schwa sounds. Each student came up with their own sign for the schwa. Discussion of syllable stress helped students determine "how to over-pronounce this word." The process ended each time with students indicating syllable types with the use of hand signs accompanied by their "think-to-spell" choice of pronunciation.

Schwa spellings and prosodic awareness. Perhaps the most obvious benefit of prosody awareness activities for spelling is that they can help students become independent in conquering the spelling of vowels. Vowel sounds in unaccented syllables tend to be reduced in multisyllabic English words. Since any vowel letter (or vowel combination) can take on the schwa sound, it is not surprising that schwa spellings are among the most challenging to remember (Drake & Ehri, 1984). PAI helps students build skill in identifying schwas and recalling the accurate spelling of schwa syllables. Toward the end of the study, I was impressed to see students in the prosody condition work their way through all the word-analysis steps without prompting.

Connection between morphology and prosody. When planning the initial outline of the present study, I found it very difficult to determine exactly what should constitute instruction in morphology awareness and what should constitute instruction in prosody awareness. Many morphological relationships between words are often clouded by phonological changes. Even wordsmiths find it challenging to unravel the unique contributions of morphological and prosodic awareness when it comes to understanding word structure and meaning.

In the present study, strategies introduced in the PAI condition hinged on students responding to directions. But creating a set of directions assumes that students will be familiar with the vocabulary used in those directions. Morphology is the ideal discipline for learning word-study terminology (phonogram, consonant, syllable, schwa, etc.) (Henry, 2010). Therefore, it seemed practical to plan PAI to follow MAI. In some respects this is counterintuitive because prosody researchers often work with infants while morphology researchers do not usually work with children until they are at least of school age or older. However, it seems that at each stage, morphology and prosody are both vital components of language development. Bhide et al. (2013) theorized that "morphological and suprasegmental phonological information can be viewed as representational properties, or features, which need to be bound together to create fully specified words in the lexicon (p. 106; see also Perfetti, 2007). Thus, many activities in the second instructional phase of the study were intentionally designed to maximize retention for spelling by combining aspects of prosody together with morphology. Morphology, when limited to a lecture format, can become a dry subject for children. In contrast, prosody lends itself to supporting morphology through the addition of movement. Prosody is associated particularly with rhythmic motor activities such as marching, singing, and clapping. A growing number of researchers are investigating potential aids to literacy development that are attuned to the aspects of prosody. For example, van Rees et al. (2012) found that principles of motor learning (PML) can be used to train children to assign lexical stress to orthographically biased pseudowords (pp. 197-206). It may be the case that the study of morphology, without attention to prosody, can detract from the benefits that morphology has to offer and vice versa. The challenge

is not “which should have preference?”, but rather, “how can we maximize the potential of a balanced combination of both?”

A second look at study variables. When a tutoring program does *not* go well and students fail to make adequate progress toward specified goals, it is imperative to recheck the soundness of the goals and search for roadblocks that could be standing in the way. This takes time and effort but it must be done—children are at a standstill and it is vital that students continually move forward in their learning.

When a tutoring program *does* go well and students make adequate progress, it is tempting to assume that one or more obvious components of the program are responsible for success. There is little pressure to dig deeper and uncover all the factors that might have contributed to forward momentum. Thus significant elements in a learning situation can be easily overlooked.

In the main, the participants in the present study exhibited measurable progress toward improved retention for the correct letter sequences in words (CLS). While it would be comfortable to conclude that morphology awareness instruction (MAI) and prosody plus morphology instruction (PAI) were responsible for the bulk of the improvement, it may be the case that other components of the program should also be considered.

In the initial weeks of the study, I used the baseline sessions to assess student strengths and weaknesses that could possibly impact later spelling scores. Examples: letter reversals, poor word pronunciation, illegible handwriting, inability to concentrate, and extreme lack of confidence. While it was not possible to address all these challenges

in such a short time, I did find many ways to reduce some of the negative impacts these difficulties could have had on the spelling tests given during instructional phases.

An age match. The present study seemed to exhibit a good fit between the material to be learned and the ages of the students (11 to 13). Just as young people enjoy sports (soccer, tennis, long-distance running) because they feel a growing sense of physical power (improved wind, ball control, and stride) the study participants began to enjoy a growing sense of power over words. Partly due to the individual graphs, there was a game-like feel to the project. Students could look at the climbing numbers on the graph and interpret them as concrete proof that they were able to teach themselves how to recall the proper spelling of multisyllabic words. They began to expect their scores to improve each week.

Middle school students have a great deal of endurance—as long as they are not made to encounter repeated defeat. In fact, students at this age like a challenge if it leads to a feeling of achievement. The participants were old enough to stand up to much repetition and they were young enough to join in gross motor activities without feeling inhibited. They were old enough to know that effort on their part was directly connected to achievement but young enough to say, "I can't remember the word you just said, could you say it again?" If a similar program was planned for high school students, it might need to be more rule-based and perhaps employ symbols on response cards rather than hand signs. A program for lower elementary students would need to reduce the number of list words, the amount of repetition, and the pace of each session.

Memory aids. It should be noted that it is not unusual for the majority of students in a class to get good scores on their weekly spelling tests (Henry, 2010). Even students

with specific learning disabilities can often get passing scores on the typical Friday test (Henry, 2010). The fact that participants in the present study were able to reproduce the correct letter sequence in a list of multisyllabic words is not particularly exceptional. However, it *is* exceptional that each list was very long (18 words), students were expected to juggle two lists during a week (36 words), many of the words were totally unfamiliar, and there was no take-home materials or trial test during the middle of the week as is usually the case with traditional weekly spelling tests.

From the start, I was concerned that retention over the span of a week would be the biggest hurdle. Several memory-enhancing strategies were used during the sessions (repetition, color, mnemonics, etc.). Participants were told that the spelling words needed to be filed carefully in their lexicon and taken out for inspection during the week. I put the responsibility on the students: "Since you cannot take the list home, you must carry it with you in your mind—how are you going to make sure it stays there?" This sparked their creativity. Some came up with sound associations and some, meaning associations. We searched for word relatives, small words inside the big word, and words that had similar spellings. We categorized the words (how many words on the list have double consonants? How many end in "able"? Can you name them? Can you write them? Can you spell them?).

With the introduction of each new spelling list, I randomly targeted one of the long words on the list and presented something interesting about it. I also indicated that I would be surprised if they could remember how to spell it for a whole week: "most students your age cannot spell this word—even some grownups do not know how to spell this word." This approach usually resulted in most of the students retaining the spelling

of that particular word and consequently gaining 14 CLS points on the next test that might otherwise have been lost.

When it was time to take a spelling test, I showed the students that recalling last week's questions, would bring back their memory for the spelling of the words they had previously worked on. I asked, "Did you use one of the list words in your school work during the week?" and "Did you spell the 'hard word' for someone in your family?" and "Did we study any words with double consonants?" Very often, the light would go on before we even began the test, and students would declare that they could remember many of the words from the previous week's study.

Motivation. There was much evidence that study participants were not just cooperative but actually enthusiastic about coming to the sessions and applying themselves to the project. Some students occasionally asked to continue a particular session beyond the 30 minutes designated. When the 12 weeks were up, several students inquired if there would be another study in the near future.

Motivation is a pivotal factor in any goal-oriented endeavor and I believe that spelling scores would have been very different if the participants were attending sessions only because their parents had signed them up. Several factors worked together to sustain motivation throughout the 12 weeks—and these factors tended to reinforce one-another. To aid the circle of positive energy, I decided that children would not correct their own or each-others' work. The practice of students correcting their own work is mentioned by many researchers as one of the more powerful tools to reinforce spelling and I find it very productive in many situations. However, I decided to avoid this technique for several reasons. Because many of the participants showed spelling weaknesses (USI), I

concluded that they were unlikely to profit from being exposed to their own or others' misspelled words. Only two out of the eight participants were confident about their spelling ability. Most of the students were already diffident about their spelling skills so pointing out their mistakes could have had additional detrimental effects. A very obvious reason to forgo student-correction of spelling tests was that the study was designed to focus on the quite narrow target of improving the spelling of *taught* words rather than spelling in general. Thus, revisiting past spelling tests was not deemed to be a good use of time. Instead, all class activities were oriented toward learning to spell words on the forthcoming test.

Because of the difficulty of the target words, the high number of words to learn each week, and the short amount of time available at each session, it made sense to employ the most productive and reliable strategies during each session. For example, students used paper and pencil to take each spelling test, but for the rest of the session, they were given dry erase boards to use. Based on personal experience, I have found that most children will work for longer periods and in a more productive manner with erase boards than with paper and pencil. This is especially true of students who exhibit dysgraphia, or who simply have poor handwriting. Erase boards can be used just like response cards and in this way, more than one student can answer questions at a time. Therefore, all participants can be equally engaged. Color also seems to aid memory: "print the spelling word in black, underline the phonograms in purple, circle affixes in green, and put a red mark on any schwas you find."

Perhaps the most powerful motivational element was the fact that the participants realized they were part of something important. The impression that came across was not

that the teacher was helping the students learn to spell but rather, that the students were helping the teacher to accomplish a study. Students could consult their rising graphs each week and see concrete proof that they were able to teach themselves how to recall the proper spelling of multisyllabic words. This promoted greater attention during the sessions which led to higher scores, which fueled greater confidence and the circle of reinforcement was again repeated.

Overall, the study proved to be productive for the participants and enjoyable for the teacher. Parents reported that their children were positive about the program itself and that the students were also becoming more positive about spelling. One parent sat in on some of the sessions so she could continue at home with some of the strategies used in class. Several parents mentioned that they saw carryover effects from learning *taught* words to spelling in a more general sense.

Summary of Chapter Five

The present study resulted in positive effects for two instructional conditions. For the majority of participants, both MAI and PAI were associated with improvement in spelling performance. When asked about spelling, many teachers have revealed that they are frustrated and challenged by the subject, and that they are often disappointed with the results of their efforts (Fresch, 2007). Thus, both teachers and students could benefit from improved spelling approaches. If spelling techniques exist that appear to be efficient, effective, and confidence-building, they should be further explored. The present study tends to confirm the wisdom of including morphology as a vital component of an effective spelling program. The present study also adds to the existing, yet relatively limited, literature supporting the potential benefits of prosody instruction for the purposes

of enhancing spelling skills. If future research continues to support the importance of prosody awareness instruction (PAI), then perhaps it should join morphology awareness instruction (MAI) as a team player in the spelling teacher's toolkit.

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Appendix A

Table of Orthographic Terms

Affix
A meaningful part of a word attached before or after a root or base word; a category that includes prefixes and suffixes.

Allophone
A predictable phonetic variant of a phoneme, such as nasalized vowels.

Allophonic variation
Speech segments vary in sound quality depending on context. The letters that come before or after a particular speech sound can modify the way in which it is pronounced.

Prosody, prosaic
Prosodic features of speech are "generally taken to include length, accent, stress, tone, and intonation" among other things (Fox, 2002). The Greek (*prosodia),* from which it is derived, can be interpreted as "song sung to music." In linguistic contexts, the word refers to "such characteristics of utterances as stress and intonation" (Fox, 2002).

Alphabetic principle
The assumption that letters and letter combinations represent phonemes in an orthography.

Automaticity
Fluent performance without conscious attention.

Base word
A free morpheme, usually of Anglo-Saxon origin, to which affixes can be added. A base is the morpheme that carries the main kernel of meaning in any word. Every word is either a base, or a base with at least one other morpheme fixed to it. The terms *base* and *root* are often used interchangeably. *Base* is used by Bowers et al. "because it is specifically morphological, whereas *root* also refers to word origin (etymology)".

Bound morpheme
A morpheme, usually of Latin origin in English, which cannot stand alone but rather is used to form a family of words with related meanings. A bound root has meaning only in combination with a prefix and/or a suffix.

Derivational morpheme
Morphemes, added to roots or bases to form new words that may or may not change the grammatical category of a word.

Euphony
Ease of pronunciation.

Free morpheme
A morpheme that can stand alone in word formation.

Grapheme
A letter or letter combination that spells a single phoneme; in English, a grapheme may be one, two, three, or four letters, such as *e*, *ei*, *igh*, or *eigh*.

Lexical quality
Reichle and Perfetti (2003) define the lexical quality of representations as 'the degree to which the orthographic, phonological, and semantic features that collectively define a given word are both well represented and well interlocked in the reader's memory' (p.321). LQH is used. Ehri refers to the same concept/construct with the term 'amalgamation theory.'

Morpheme
The smallest meaningful unit of language.

Morphological knowledge
"Morphological knowledge is an umbrella term that includes both implicit and explicit knowledge about oral or written morphological features of words that can influence the processing of lexical items during language based activities" (Bowers, 2012). The term morphological awareness is usually reserved for that type of knowledge about morphological structure that rises to the level of conscious awareness. Hence the definition of Carlisle (1995): Mophological awareness is "awareness of morphemic structures of words and the ability to reflect on and manipulate that structure (Carlisle, 1995, p. 194). Morphological processing can include less conscious or implicit processing of morphological information" (e.g., Deacon, Parrila, & Kirby, 2008).

Morphology
The study of meaningful units of language and how they are combined in word formation.

Morphophonemic
Pertaining to rules or aspects of language that specify the pronunciation of morphemes; pertaining to a writing system that spells meaningful units (morphemes) instead of surface phonetic details in speech; a characteristic of English orthography.

Multisyllabic
Having more than one syllable.

Neutral (derivational) suffix
A suffix that does not change the base form or root to which it is added
.
Nonneutral (derivational) suffix

A suffix that changes the pronunciation and / or spelling of the base word or root to which it is added.

Opaque orthography
Writing system in which the relationship between sound and symbol is somewhat obscure, irregular, or influenced by morpheme structure; also called a *deep orthography*.

Orthograhic morphological family
Any word that shares a common written base is a member of the same orthographic morphological family. Any word that can be included in a matrix is by definition part of the same orthographic morphological family.

Peak
The part of the syllable, usually the vowel, that carries the most vocal energy; also called the *nucleus.*

Phone
A phonetic realization of a phoneme; the speech sound that is actually produced in spoken words.
Phoneme: A speech sound that combines with others in a language system to make words.
Phoneme Awareness: The conscious awareness that words are made up of segments of our own speech that are represented with letters in an alphabetic orthography; also called *phonemic awareness.*

Phoneme blending
The act of assembling single speech sounds into a whole word.

Phoneme deletion
The act of leaving out a sound in a word in order to make a new word.

Phoneme discrimination
The ability to distinguish words that differ only in one phoneme.

Phoneme identification
The act of showing, by pointing to a picture, object, or symbol, which speech sound is in the beginning, middle, or end of a word.

Phoneme segmentation
The act of separating a word into its component speech sounds.

Phonological awareness
Metalinguistic awareness of all levels of the speech sound system, including word boundaries, stress patterns, syllables, onset-rime units, and phonemes; a more encompassing term than *phoneme awareness.*

Phonological retrieval
Retrieval of the phonological form of a word from long-term memory; refers to the mental act of formulating and pronouncing the word.

Phonological Working Memory (PWM)
Temporary storage of speech codes in memory that allows meanings of language to be extracted and stored in longer term memory.

Pragmatics
The system of rules and conventions for using language and related gestures in social contexts; the study of that rule system.

Prosody
Prosody (or suprasegmental phonology) refers to intonation patterns, stress placement, and rhythm in spoken language.

Rapid Automatic Naming (RAN)
The task of naming a repeating sequence of objects, colors, numbers, or letters under timed conditions; also known as *rapid serial naming.*

Rime
A linguistic term for the part of a syllable that includes the vowel and what follows it; different from the language play activity of *rhyming.*

Root
Although this word is used as both a morphological and etymological term in this dissertation, it will refer only to the latter. The root is the historical origin of a word.

Schwa
A non-distinct vowel found in unstressed syllables in English.

Stem
A morphological term for an already complex word to which another morpheme is being added. For example, enjoy is the stem of enjoyment. The word enjoy cannot be called a base as it is already complex. The term "stem" allows us to refer to complex word structures during morphological analysis and synthesis.

Stressed
Accented syllable articulated with greater loudness, duration, or pitch.

Suffix
A morpheme, added to a root or base word that modifies its meaning and often changes the word's part of speech.

Suprasegmental
Prosodic features such as tone, utterance length, and stress.

Syllable boundary
Division between adjacent syllables, which is not always the same in speech as in print.

Word sum
A tool for linguistic analysis of complex words into their constituent morphemes. Orthographic word sums reveal the underlying full form of the written morphemes of a word including any surface spelling changes that may occur due to suffixing conventions. The synthetic word sum shows the constituent morphemes on the left side of the rewrite arrow and synthesizes those elements into the surface orthographic representation on the right. Analytic word sums start with a complex word on the left of the rewrite arrow which is analyzed into the complete written forms of the constituent morphemes including suffixing changes which are marked on the right. (Moats, 2000; Bowers, 2012)

Appendix B

Description of Participants

Student A (Sophia)

Sophia was age 11 at the time of the study. She has always been homeschooled. Sophia seems to fall in the average range for reading, writing, and spelling.

Student B (Kevin)

Kevin was 13 at the time of the study. He has always been homeschooled but he is enrolled in three classes at Mercer Island high school for the fall of 2017. Kevin is personable, athletic, polite, and curious about the world, but he avoids reading. He exhibits noticeable difficulty in extracting meaning from grade-level text. When reading out loud, Kevin tends to mispronounce multisyllabic words and finds it hard to extract meaning from long sentences. For several years, Kevin has been taking online classes that are adjusted to his learning difficulties.

Student C (Scarlett)

Scarlett was 11 at the time of the study. Scarlett struggled with reading and writing from an early age. She has been receiving support in reading, writing and math since she enrolled in the Mercer Island school district in 2015. This is what her IEP says concerning writing/spelling goals: "[Scarlett] writes with a clear sequence and good ideas. She frequently writes with words she can confidently spell sometimes choosing vocabulary below grade level which contributes to a higher number of correct sequences. Spelling of grade level vocabulary and use of basic punctuation is inconsistent and not yet automatic. Continued growth in application of spelling rules will improve spelling confidence and accuracy and give Anna access to vocabulary words she knows but avoids using in her writing."

Student D (Mia)

Mia was 12 at the time of the study. This information is taken from Mia's IEP: Based on Mia's evaluation in the fall of 2016, "her school performance continues to be adversely impacted by a specific learning disability in the area of reading. While she has made strong progress over the past three years, she continues to demonstrate deficits in both encoding (spelling) and decoding (word reading) which impacts her ability to clearly convey her ideas in writing and to read fluently and accurately. [Mia] requires specially designed instruction in the area of reading, as well as classroom accommodations such as the ability to look over her tests again before final grading, in order to make progress in the general curriculum."

Student E (Hailey)

Hailey was 11 at the time of the study. In the last few years, she has experienced a combination of homeschool, public school, and private school. As a preschooler, Hailey was quick to learn to read and she has continued to read extensively. She is an eager and organized student. After being exposed to a word a few times, Hailey is able to recall the spelling.

Student F (Pedro)

Pedro was 13 at the time of the study. He reads widely, has an unusually well-developed writing and speaking vocabulary, and has always attended public school. Pedro's mother states that he recently tested at 99% in language when taking a test for the school's gifted program.

Students G (William)

William was 11 at the time of the study. William has displayed health and anxiety issues since birth. He has always been homeschooled and is presently under the care of a Dr. Grant. William's parents state that he is taking ADHD medication which seems to be helpful. It is presumed by William's parents that, if he were to attend public school, he would qualify for an IEP.

William began the present study with the understanding that it was a trial experience and he could withdraw at any time. For the first couple weeks, William was relatively expressionless and did not make any eye contact. He showed extreme sensitivity to noise and jumped up frequently to check into things that the teacher did not hear or notice. After a few sessions, he became engaged in the learning process. There were fewer trips to the window. Finally, there were some smiles. William's mother relates that she has seen many positive effects as a result of William's spelling sessions. William shows increased interest and independence in word study. And for the first time, William has volunteered to join a group activity—cub scouts.

Student H (Robert)

Robert was 12 at the time of the study. Robert homeschooled until this year when, for the first time, he enrolled in a small private school where he is an A student. Although Robert showed signs of unusual intellectual ability at an early age, he had a very difficult time learning to read. At the age of 8 he was still not able to decode 3-letter phonetic words. In fact he evidenced a physical avoidance of text. With effort on the part of the family, Robert himself, and a tutor, Robert learned to read. He now reads extensively and is extremely interested in literature, history, and languages other than English. He can marshal his arguments well orally, but his hand-written work still evidences strange spelling, missing words, and cramped printing. Robert will probably always need to plan extra time for revision of his written work. If Robert were to undergo evaluation at some point for the purposes of support services in college, it might be the case that he would be considered a "compensated dyslexic."

Appendix C

Letters to Parents and Participants

INFORMED CONSENT

The Effects of Morpheme & Prosody Instruction on Elementary Spelling Achievement

Engaging the culture, changing the world®

Seattle Pacific UNIVERSITY

IRB Approval – IRB # 161706004

Principal Investigator: Margaret Dornay 206.232.2323 adribooks2@gmail.com

Faculty Sponsor: Dr. William Nagy 206.281.2253 wnagy@spu.edu

PURPOSE

Your child is invited to take part in a research study. The purpose of this research is to explore ways to make spelling instruction more effective. Students ages 11 –13 are being asked to take part in this study because as children move into the upper grades, they are challenged with a growing number of "big words" in their reading, writing, and spelling.

PROCEDURES

The study will take place at Vivarium Children's House. Principal investigator, Margaret Dornay is looking at ways students can learn more about words by considering morphology (parts of words) and prosody (stress in words). Sessions will be twice a week and consist of a quiz followed by activities and games designed to prepare for the next quiz that will be given the following week. Sessions will last 30 minutes each and will commence the first week of January 2017 and end inside of 12 weeks.

RISKS and DISCOMFORTS

While the spelling class is not associated with any known risk, parents and students are free to withdraw at any point in the study.

BENEFITS

Participants will be exposed to word study techniques that can better equip them to read, pronounce, and remember specific letter sequences of vocabulary words in their future school work. Those who join the class can also feel confident that each student is making an individual contribution to spelling research.

PARTICIPATION AND ALTERNATIVES TO PARTICIPATION

Parents are free to decide that their child's data is not to be used in the study.

CONFIDENTIALITY

The information in the student records will be kept confidential. Data will be stored securely at Seattle Pacific University and will be made available only to persons conducting the study. While de-identified data may be used in future research by the Principal Investigator, no reference will be made in oral or written reports that could link data to individual students.

SUBJECT RIGHTS

If you have questions or concerns at any time about the study, you may contact the Principal Investigator, Margaret Dornay, at 206. 232. 2323. If you have questions about your rights as a participant, contact the SPU Institutional Review Board Chair at 206-281-2201 or IRB@SPU.edu .

CONSENT

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in this research project and agree to participate in this study. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities.

I have read the above information and agree to participate in this study. I have received a copy of this form.

Parent's name (print) _____	**Researcher's name (print)** _____
Parent's signature _____	**Researcher's signature** _____
Date _____	**Date** _____

Copies to: Participant Principal Investigator

Engaging the culture, changing the world®

Seattle Pacific UNIVERSITY

INFORMED CONSENT

Title of the Study: Effects of Morpheme & Prosody Instuction

Principal Investigator: Margaret Dornay 206.232.2323
adribooks2@gmail.com

IRB Approval – IRB # 161706004

What Is The Study About?

Besides teaching at Vivarium Children's House, I go to school at Seattle Pacific University (SPU). I am asking 12 of my spelling students help me with a project I am doing for school at SPU. The project is about how children learn to spell. You have been asked to help because you are in grades 4 - 8. The upper grades are a time when many school textbooks start to include more and more long words. These words may be difficult to read and remember. You have taken many spelling tests. I could use the scores you got on your tests to make my project better.

What Are You Being Asked To Do?

I am asking your permission to put your spelling scores in my written report. The report will not include your name. It will not include your spelling test papers. It will not include anything you have written. It will simply include the scores you got on your spelling tests during the fall quarter, 2016 or winter quarter, 2017. Only scores from tests taken at Vivarium Children's House will be used.

Are There Any Risks To Me?

There are no likely risks. However, you are free to decide that you do not want your scores included in the written report.

Are There Any Benefits to Me?

One reason to think about giving permission to use your scores, is because your information may help others to discover better ways to teach spelling.

More Questions?
First you will want to talk to your parents about any questions you have. If you still have questions, you can call Margaret Dornay at 206.232.2323.

For questions about your rights as a research participant, you should contact the Seattle Pacific University Institutional Review Board Chair at 206.281.2201 or IRB@spu.edu.

If you do want to be in the study, please sign your name.

Participant's Name (please print):_____

Participant's Signature:_____ Date:_____

PI's Name (please print):_____

PI's Signature:_____
Date:_____

Copies to: Participant Principal Investigator

Appendix D

IRB

Seattle Pacific
UNIVERSITY
Engaging the culture, changing the world

School of Education

3307 Third Avenue West, Suite 202
Seattle, Washington 98119-1950

206 281 2214 phone
206 281 2756 fax

www.spu.edu

November 18, 2016

Subject: IRB Approval – IRB # 161706004 (Exempt Review)

Dear Ms. Dornay and Dr. Nagy:

Your research project "*The Effects of Morpheme and Prosody Instruction on Elementary Spelling Achievement,*" has been approved. This study was approved under exempt review as it met the following criteria.

3. ___x_ Research uses survey or interview procedures or observations (including observations by participants) of public behavior AND at least one of the following conditions exist:
   a. __x_ Human participants cannot be identified directly or through identifiers code or numbers
   OR
   b. __x__ The participants' responses or the observations recorded, if they became known outside research, cannot reasonably place the participant at risk of criminal or civil liability or be damaging to the participant's financial standing or employment
   OR
   c. __x__ The research does not deal with sensitive aspects of the participant's own behavior, such as illegal conduct, drug use, sexual behavior, or use of alcohol

Your approval is in effective until what time any methods of the study change substantively. When that occurs, you will need to renew your IRB application. Your study has been assigned IRB number: **IRB # 161706004.**

To complete your documents please add the IRB # to your study's written recruitment material and invitation to participate in the research project.

Use your study number in any further communication regarding this study.

This is the only documentation that you will receive regarding your study's approval. Please print it out and add to your study's documentation.

Best Wishes in the Completion of your Research

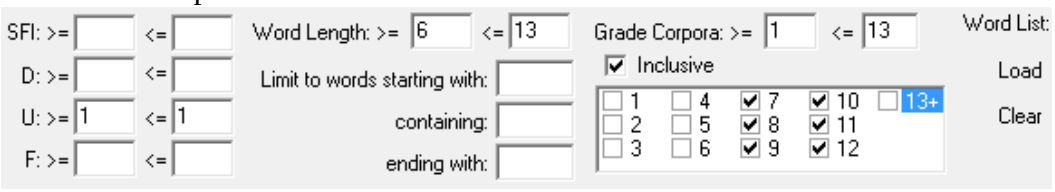
Sincerely,

John B. Bond, Ed.D.
SOE IRB Coordinator
Professor of Educational Leadership

Appendix E

Steps to Create Matched Spelling Lists

Words were extracted from the Educator's Word Frequency Guide (WFG), Version 2.2. Word frequency was restricted to U = 1. The aim was to create twenty lists of words, with a length between 6 and 13 letters, using the R statistics program and its randomization processes. The defaults were as follows:



Each list will contain 1 word of length 6, 3 each of words with lengths of between 6 and 10 letters, two each of words between 11 and 12 letters, and a single thirteen letter word, for a total of 18 words.

The extraction involved the following steps:

1. Extraction of all words from the WFG which had between 6 and 13 letters, a grade corpora between 1 and 13, with the boxes 7 through to 12, and inclusive checked. This extracted 4003 words, in a csv file.
2. The file was imported into the statistics program R. A new file was created, with two columns, one with the word, one with the word count.
3. Any word containing a punctuation mark or a digit was removed from the list. This reduced the words in the list to 3765. Further reductions were made. To eliminate plurals, words ending in men and s were removed, with the exception of -us, -ss, christmas, and diabetes. Additionally, words ending in -ing and -ed were removed. The word bureaus was removed, and also labour, because of its British spelling. Moslem was also removed.
4. Various words were removed manually. These were mainly proper words, but also included words that had a British spelling. The total number of words removed was 321.
5. The resultant list had 1622 words.
6. Eight lists were created, of words of lengths 6 through to 13 letters. The lengths of the lists were as follows: 6 letters, 343, 7 letters, 337, 8 letters, 262, 9 letters, 265, 10 letters, 204, 11 letters, 119, 12 letters, 54, 13 letters, 38.
7. As 20 tests had to be created, of 18 words each, it was necessary to select 360 words. The 360 words were selected randomly. Each test had 1 word of length 6, 3 words each of the lengths 7 through to 10, 2 words each of 11 through to 12, and a single word that had 13 letters. So 20 words were collected of length 6, 60 words were collected from 6 through to 10, 40 from 11 and 12, 20 from 13. A seed was stated prior to creation of each randomized list, which for simplicity's sake had the same number as the number of letters, with set.seed(6) for the six letter words, and set.seed(7) for the seven letter words. The randomization procedure was as follows:

```
> set.seed(6)
> six1 <- sample(six,20,replace=FALSE)
> set.seed(7)
> seven1 <- sample(seven,60,replace=FALSE)
> set.seed(8)
> eight1 <- sample(eight,60,replace=FALSE)
> set.seed(9)
> nine1 <- sample(nine,60,replace=FALSE)
> set.seed(10)
> ten1 <- sample(ten,60,replace=FALSE)
> set.seed(11)
> eleven1 <- sample(eleven,40,replace=FALSE)
> set.seed(12)
> twelve1 <- sample(twelve,40,replace=FALSE)
> set.seed(13)
> thirteen1 <- sample(thirteen,20,replace=FALSE)
```

8. Once the randomized lists had been created, words from the lists were allocated to the 20 tests. This was done by dividing the lists by 20, and each of the 20 parts were allocated serially. So the randomized list of 6 letter words, which contained 20 letters, had the first letter going to Test 1, the second letter to Test 2, and so on. The code is in Appendix B.
9. The order of each list was randomized. The seed was 100 plus the list number. For example, the list for Test 5 was created as follows:

```
set.seed(105);
test5 <- sample(list5,18,replace=FALSE);
write.table(test5, "test5.txt", sep="\t");
```

Supplemental words

Having created 20 word lists, it was found that another 10 lists were required. There were not a sufficient number of 12 letter words to create this list, so extra words were added to the pool. Using WFG, with same parameters, all 13 letter regular plurals were taken, and the s dropped to create 12 letter singulars. Words that already appeared in the existing list were dropped. The words added to the pool were acquaintance, commissioner, disagreement, entrepreneur, handkerchief, invertebrate, presentation, superstition, and veterinarian. The words were simply appended to the list of 1626 words in the pool, with the 360 words used subtracted. So, 1626 minus 360 is 1266, and then 9 extra 12 letter words were added, to make a pool of 1275 words.

An additional 23 words, supplemental to Appendix A, were deleted from the 1275 word pool, three of which had British spelling: guatemala, christendom, buddhist, grande, vancouver, neighbourhood, warsaw, behaviour, asiatic, semiarid, buddhism, orlando, undersea, cambium, antislavery, protozoa, defence, gothic, bradley, walden, passover, baleen, and seacoast. The ten additional lists were then created using the same method,

and random number seeds, as before. Proper names and adjectives were removed from the list.

Appendix F

Two Samples of the Thirty Matched Spelling Lists

Test 1

1 seawater
2 outcry
3 enrollment
4 deceptive
5 canteen
6 elaborately
7 designate
8 respondent
9 multicellular
10 insecure
11 bewilderment
12 aesthetic
13 accelerator
14 diminish
15 wrestle
16 intestinal
17 haggard
18 praiseworthy

Test 2

1 pedestrian
2 impulsive
3 cottontail
4 congregation
5 beeswax
6 follower
7 birthplace
8 soberly
9 adventurous
10 contemplation
11 deduction
12 passport
13 radiance
14 disdain
15 thunderstorm
16 chameleon

17 loudspeaker
18 upheld

Appendix G

MAI Activities / PAI Activities / Memory Support

Goal: Conscious and Correct Pronunciation of the Target Word (see *Inner Voice* below*).*

- Teacher: "The word is '*forgetfulness.'* Say the word in your mind."
- Student(s): (Student silently pronounces the word.)
- Teacher: "Say the word aloud."
- Student(s): "forgetfulness."

Goal: Encode and Decode Parts of the Word (see *Glass Analysis* below).

- Teacher: "In the word 'forgetfulness,' what letters make the 'for' sound?"
- Students: (Students spell f/o/r.)
- Teacher: What letters make "the 'or' sound?

  The 'et' sound? The 'get' sound?

  What letters make the 'forget' sound?

  What letters make the 'ful' sound?

  The 'forgetful' sound?

  What letters make the 'ess' sound? The 'ness' sound?

  What letters make the 'fulness' sound"

  What letters make the 'getfulness' sound?

- Teacher: "In the word 'forgetfulness,' what sound does f/o/r make?"
- Students(s): (Students says the word *for*).

  What sound does o/r make?

  What sound does e/t make?

The g/e/t? The f/o/r/g/e/t?

What sound does f/u/l/ make?

What sound does g/e/t/f/u/l make?

What sound does e/s/s make? n/e/s/s?

- "If I took off the f/o/r, what sound would be left?
- "If I took off the "ness" sound, what sound would be left?
- "What is the whole word?"

Goal: Use Erase Boards to Identify Phonograms and Affixes (see *Response Cards* below).

- Teacher: "Are there any multi-letter phonograms?"
- Student(s): (Students mark their boards and show their work.)

Circle the prefix. Circle the suffix.

Place a red dot between syllables.

PAI Activities

Goal: Use Large Muscle Activities to Identify Schwas

- "Place your hand under your chin and count the vowels."
- "Show me the syllables on your arm."
- "Clap the number of syllables."
- "Clap the stress pattern in the word. Box the strong syllable."
- "Look for schwas in the weak syllables."
- "Mark the schwas on your boards."

Goal: Guide Students toward a Helpful Over-pronunciation of the Word

- "How is this word pronounced?"
- "How should we pronounce this word in order to spell it?"
- "Show me the signs for all the syllables in this word."
- Students(s): (Students identify syllables by sign and *over-pronounce* the word.)

Memory Support

Goal: Help Students Activate Memory Strategies

- Teacher: "How could we categorize these words?"

  Are there compound words?

  What about double consonants?

  Which words end in 'able' and which in 'ible?'

- Do you see any small words inside the big word?
- Do you still remember how to spell the hard word we learned at the beginning of class?
- Which family member would like to hear you spell these words during the week?

Glass-Analysis

Little transfer learning takes place from word to word, if the student who knows the spelling of "get," is unable to see the "get" in "forgetfulness." Many students who struggle with spelling, show an inability to analyze words into recognizable parts. While most students can make these kinds of connections unconsciously, some students need to develop a conscious morphological awareness of words by being walked through a guided process which they can then make their own. Glass-analysis is not a method to teach the reading or spelling of particular words. Rather it is a way for students to develop independence in breaking words into useful and manageable parts. It also allows the teacher to identify students' decoding weaknesses. It is fast-paced and promotes student confidence.

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Inner Voice

Just as L2 learners may find that their inner voice is unreliable in helping them rehearse for public articulations in the new language, dyslexic students also appear to lose the prosody of spoken words and invert or leave out syllables in words they have just heard even though they are speaking in their first language. This happens internally, before students attempt to pronounce the specified words out loud. If the spelling word is

"consonant" and the student pronounces it internally as "con-sno-nant," the student will very likely spell it incorrectly. Some students need to be helped to make use of their inner voice and become responsible for checking it carefully before attempting to spell words.

Breen and Clifton (2010) conclude that the inner voice contains suprasegmental information, "information about the metrical structure of words." If the spelling word is "practically" and the student pronounces it internally as "practicly," again the word will likely be spelled wrong. Not only should students with spelling difficulties learn to attend to the inner voice, students should learn to train the inner voice to *over-pronounce* words that are challenging to spell (Drake & Ehri, 1984; Ehri, 1987).

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Tomlinson, B. (2013). *Developing materials for language teaching.* Bloomsbury Publishing.

Response Cards

When each student has a white board, this can be used to answer the teacher's questions in the manner of a response card (Lambert, Cartledge, Heward, & Lo, 2006). Strategies such as response cards encourage students to take an active role in their own instruction. Students do not need to be called upon. Most importantly for this study, students are repeatedly thinking about how to spell words, then producing the words on their boards, then making a visual connection with the finished word, and also receiving approval and guidance immediately from the teacher regarding the response they have just executed. Students benefit from continual engagement and the teacher benefits from observing student learning in real time.

References

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Appendix H

Questions about Tau-U

What are some characteristics of Tau-U**?**

- Tau-U is a "new family of indices hat can combine nonoverlap with trend and permit control of undesirable positive Phase A trend" (Parker, Vannest, Davis, & Sauber, 2011, p. 296).
- Tau-U is a non-parametric statistic that is based on the Kendall's Rank Correlation. It focuses on the proportion of pairs that are complementary. Like the Mann-Whitney test, it follows the S sampling distribution.
- The Tau-U calculation is not compromised by ceiling effects as is PND and other nonoverlap methods. It performs well in the presence of autocorrelation (Parker et al., p. 295-296).

How is Tau-U **calculated? (Simplest** Tau-U **non-overlap only)**

- When comparing Phase A (baseline) with Phase B (intervention), Tau-U counts pairs of scores; the simple case Tau U score is the proportion of pairs which are concordant. Concordance is defined as each case where the intervention side of the pair is higher than the baseline side. As an example, consider three baseline scores (100, 95, 110) and four treatment scores (100, 109, 120, 130). When each baseline data point is compared with each treatment data point, there are twelve pairs (n baseline x n treatment): 100-100, 100-109, 100-120, 100-130, 95-100, 95-109, 95-120, 95-130, 110-100, 110-109,110-120, and 110-130. In 9 of the pairs the intervention side is higher; in 2 of the pairs the intervention side is lower.

Subtracting 2 from 9 leaves 7. Since 7 of the 12 pairs are concordant, the Tau-U score is 7/12, which is .583.

- Evaluating Tau-U scores: For Tau-U, a score greater than 92% is large or strong effect, 66% to 92% is medium to high effect, and 65% or lower constitutes weak or small effect (Parker & Vannest, 2009; Rispoli et al., 2013).

Draw-backs to Tau-U**?**

- It is relatively new and thus does not have an established history like PND.
- For a strong criticism of Tau-U, go to http://jepusto.github.io/Tau-U

Appendix I

Tables of Tau-U Statistics for each of the Eight Participants

Table I1

Tau-U *Statistics for Student A (Sophia)*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Ab	-0.6667	8.6667	2.9439	0.4907	-1.3587	0.1742
1	Am	0.0556	92	9.5917	0.2664	0.2085	0.8348
phase:							
	Ab vs						
2	Am	0.5833	168	12.9615	0.36	1.6202	0.1052
	Am vs						
3	Ap	0.9556	1125	33.541	0.2485	3.846	0.0001

Table I2

Tau-U *Statistics for Student B*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Bb	0	8.6667	2.9439	0.4907	0	1
1	Bm	0.3571	65.3333	8.0829	0.2887	1.2372	0.2160
phase:							
	Bb vs	0.4375	138.667	11.7757	0.3680	1.1889	0.2345
2	Bm						
	Bm vs	0.9167	960	30.9839	0.2582	3.5502	0.0004
4	Bp						

Table I3

Tau-U *Statistics for Student C (Scarlett)*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Cb	-0.333	28.33	5.323	0.355	-.9393	0.348
1	Cm	0.929	65.333	8.083	0.289	3.217	0.0013
phase:							
	Cb vs						
2	Cm	0.917	240	15.492	0.323	2.84	0.005
	Cm vs						
3	Cp[a]	0.698	672	35.923	0.27	2.585	0.0097

[a] *As morphology has a statistically significant trend, an adjustment was made.*

Table I4

Tau-U *Statistics for Student D*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Db	0.4667	28.3333	5.3229	0.3549	1.3151	0.1885
1	Dm	0.75	65.3333	8.0829	0.2887	2.5981	0.0094
phase:							
	Db vs						
2	Dm	0.8125	240	15.4919	0.3227	2.5174	0.0118
	Dm vs						
4	Dp[a]	0.7946	858.667	29.303	0.2616	3.0372	0.0024

[a]*As morphology has a statistically significant trend, an adjustment was made.*

Table I5

Tau-U *Statistics for Student E*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Eb	-0.0667	28.3333	5.3229	0.3549	-0.1879	0.851
1	Em	-0.3333	48.3333	6.6583	0.3171	-1.0513	0.2931
phase:							
	Eb vs						
2	Em	1	196	14	0.3333	3	0.0027
	Em vs						
3	Ep	0.8661	896	29.9333	0.2673	3.2405	0.0012

Table I6

Tau-U *Statistics for Student F*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Fb	0.4667	28.3333	5.3229	0.3549	1.3151	0.1885
1	Fm	-0.6071	65.3333	8.0829	0.2887	-2.1032	0.0354
phase:							
	Fb vs						
2	Fm	0.9792	240	15.4919	0.3227	3.0338	0.0024
	Fm vs						
4	Fp[a]	0.9219	1066.667	32.6599	0.2552	3.613	0.0003

[a] *As morphology has a statistically significant trend, an adjustment was made.*

Table I7

Tau-U *Statistics for Student G*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Gb	0.4722	92	9.5917	0.2664	1.7724	0.0763
1	Gm	0.3333	44.3333	6.6583	0.3171	1.0513	0.2931
phase:							
	Gb vs						
2	Gm	0.9206	357	18.8944	0.2999	3.0697	0.0021
	Gm vs						
3	Gp	1	637	25.2389	0.2774	3.6056	0.0003

Table I8

Tau-U *Statistics for Student H*

id	Label	TAU	VARs	*SD*	*SE*	*Z*	*P* Value
trend:							
0	Hb	0.5152	212.6667	14.5831	0.2210	2.3315	0.0197
1	Hm	0.0833	92	9.5917	0.2664	0.3128	0.7545
phase:							
	Hb vs						
4	Hm[a]	0.6574	792	28.1425	0.2606	2.5229	0.0116
	Hm vs						
3	Hp	0.2540	357	18.8944	0.2999	0.8468	0.3971

[a] *As the baseline has a statistically significant trend, an adjustment was made.*

Appendix J

Questions about Percent of Non-overlapping Data (PND)

What are some characteristics of PND?

- PND is the oldest of the overlap methods (Scruggs, & Mastropieri, 1998; Scruggs, Mastropieri, & Casto, 1987).
- Used extensively, easily calculated, PND does not assume data are independent.
- Does not make other assumptions necessary in regression methods.
- Interpreted as: The percentage of Phase B data exceeding the single highest Phase A datum point.

How is PND calculated?

- Identify the intended change.
- Count the number of data points in Phase B (the intervention) that are higher than the maximum point in Phase A (baseline). If Phase A has data points 70, 80, 75, and 90, while Phase B displays scores 85, 90, 100, 105, and 120, three scores in Phase B will be over the maximum Phase A score.
- Calculate the finale PND score as the number of scores in Phase B that are over the Phase A maximum, divided by the total scores in Phase B. In the example just given, three Phase B scores are over the maximum. Since there are a total of five scores in this phase, the PND score is 3 divided by 5, which is 0.6 or 60%.
- A PND score greater than 90% is considered highly effective, 70% to 90% is fairly effective, 50% to 70% is of questionable effectiveness, and a PND of <50% or lower reflects an unreliable or ineffective treatment (Scruggs, Mastropieri, Cook, & Escobar, 1986; Scruggs & Mastropieri, 1998).

Draw-backs to PND? (Brian Reichow & Mark Wolery, 2010; Kratochwill et al., 2010, 2013).

- PND is compromised by a baseline data point at floor or ceiling. This means that a single outlier in the baseline could disrupt a comparison because the maximum score in the baseline is used to work out PND. If Phase A had scores 120, 80, 75, and 90 while Phase B had 100,110, 115, and 120, the score of 120 in Phase A would mean that the PND was zero.
- PND is compromised by trends in data within conditions.
- PND is compromised by the number of data points in the intervention condition.
- PND does not measure magnitude of difference.
- PND is compromised by variability in the baseline condition, because it relies on the most extreme datum point in the baseline, perhaps the one that is least representative of the data pattern
- PND does not address critical issues of consistent replications.
- Adding the PNDs across replications can lead to inaccurate conclusions.