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### Effects of Daily Spaced Versus Massed Practice on Spelling Word Retention Among Struggling Spellers

Melissa Engel  
*Minnesota State University, Mankato*

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Effects of Daily Spaced Versus Massed Practice on Spelling Word Retention Among Struggling  
Spellers

Melissa Engel, M. S.

A Dissertation Submitted in Partial Fulfillment of the  
Requirement of for the Degree of  
Doctor of Psychology  
in  
School Psychology

Minnesota State University, Mankato

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Effects of Daily Spaced Versus Massed Practice on Spelling Word Retention Among

Struggling Spellers

Melissa Engel, M.S

This dissertation has been examined and approved by the following members of the student's committee.

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Shawna Petersen-Brown, Ph.D., Advisor	School Psychology
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Carlos J. Panahon, Ph.D., Committee Member	School Psychology
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Kevin Filter, Ph.D., Committee Member	School Psychology
---------------------------------------	-------------------

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Dana Wagner, Ph.D., Committee Member	Special Education
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# EFFECTS OF DAILY SPACED VERSUS MASSED PRACTICE ON SPELLING WORD RETENTING AMONG STRUGGLING SPELLERS

MELISSA ENGEL, M.S.

A DISSERTATION SUBMITTED IN PARTIAL FULLFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF  
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MINNESOTA STATE UNIVERSITY, MANKATO  
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MAY 2022

## ABSTRACT

Although extensive research has documented the benefits of spaced practice, very little of that research has been conducted in schools, and even less has included students with disabilities or with academic deficits. The purpose of this study was to compare spaced and massed practice on students with an educational disability in a school setting. Three students identified as having a specific learning disability (SLD) and receiving special education services in written language participated in this study, which used an alternating treatment design. Students learned 10 lists of 6 spelling words, each list over the course of three days. Students were introduced to each word, then practiced the words using cover-copy-compare each day. Spaced and massed practice were randomly counterbalanced across lists. Spaced practice included 3 daily sessions with up to 2 opportunities to practice each word (up to 5 min each), while massed practice included 1 daily session with up to 6 opportunities to practice each word (up to 15 min). Students participated in a pretest, immediate posttest, and 5-day retention assessment for each list. The effectiveness of spaced and massed practice was measured in words spelled correct (WSC) and percent change in correct letter sequences (CLS). Small effect sizes in favor of spaced practice in spelling with two of the three students with disabilities, although they were not significantly different than zero. Visual analyses were ambiguous. These results do not suggest an added benefit to implementing spaced practice to improve retention of spelling words among students with an SLD. Variability in the results suggest that other variables may have impacted the results.

## Effects of Daily Spaced Versus Massed Practice on Spelling Word Retention Among Struggling Spellers

Spelling is an important skill; it impacts student's reading, writing skills, and communication skills (Graham et al., 2002). Competent spellers apply these skills to reading and writing as they apply knowledge of how words are spelled to effectively comprehend and deliver a message. Likewise, spelling is impacted by reading, writing, and communication skills. For example, spelling skills are influenced by phonemic awareness, knowledge of grapheme–phoneme correspondences, communication, and reading (Caravolas et al., 2001). Researchers have found correlations between spelling and reading achievement ranging from .5 to .9, which illustrates the relationship between spelling and reading (Caravolas et al., 2001; Graham et al., 2002; Graham & Santangelo, 2014; McLaughlin et al., 2013). Spelling deficits are also common; approximately one third of children with a specific learning disability have difficulties in written communication and spelling (McLaughlin et al., 2013). Given the impact of spelling skills on literacy and written expression, and the significant relationship between these things, interventions to address spelling deficits are an important area of investigation.

### **Importance of Spelling Skills and Their Relationship to Literacy Achievement**

Spelling is an important skill because it impacts writing abilities, reading abilities, and overall academic achievement. Researchers have found that poor spelling impacts the writing process due to the increased cognitive resources allocated to spelling individual words rather than the writing process (Graham et al., 2002; McLaughlin et al., 2013). In other words, when too much attention is focused on how to spell individual words, working memory capacity is depleted. This impacts planning, sentence composition, and content development (Graham et al.,

2008). Children with spelling deficits tend to also use simpler vocabulary when they write, which affects writing quality (Graham et al., 2002, McLaughlin et al., 2013).

Spelling and reading deficits are also reciprocally linked (Graham et al., 2002). Early research in this area identified strong causal relationships in which phonemic awareness (identifying and manipulating sounds in oral language) predicted spelling achievement (Torn  us, 1982; Wagner et al., 1994). Children who cannot accurately and fluently analyze the smaller sounds that make up spoken words will have difficulty learning the correspondences between those sounds and letters or letter combinations (Cunningham, 1990). Researchers have found that phonological segmentation ability at the beginning of first grade predicted growth rate and end-of-year ability in both reading and spelling (Foorman, et al., 1991). Other research has connected explicit phonemic awareness instruction to improved spelling achievement in the first several years of formal schooling (Burns & Richgels, 1989; Ellis & Cataldo, 1990). These findings were confirmed by the National Reading Panel (2000). In addition, direct, systematic instruction in letter-sound correspondences is associated with increased growth and level of achievement in both reading and spelling (Foorman et al., 1991). Finally, word recognition and spelling skills were found to have a reciprocal predictive relationship (Foorman et al., 1991).

Spelling instruction also impacts reading skills. Spelling instruction at the whole-word and letter-pattern level is associated with better phonemic awareness, phonics, and word recognition skills (Graham et al., 2008). A meta-analysis of spelling instruction supported the moderate impact of spelling instruction on word recognition ( $d = 0.62$ ; Graham et al., 2011). When an individual has difficulty spelling, they often have difficulty expressing themselves through writing, which then is reflected through their schoolwork across content areas (Graham et al., 2002, McLaughlin et al., 2013). Graham et al. (2011) found that teachers' evaluation of the

quality of ideas within a writing sample was negatively impacted by misspelled words. Specifically, in a paper with 3-13% of words misspelled, ratings of content quality dropped by 0.38 standard deviations compared to the same paper without spelling errors.

### **The Development of Spelling Skills**

The reciprocal relationships between reading, writing, and spelling skills are well documented. In addition, the impact of explicit spelling instruction on broader academic achievement in spelling has also been investigated. An understanding of how and when spelling skills develop is also needed to inform effective instruction and intervention. A review of theory and empirical research suggests that explicit spelling instruction is necessary for the successful development of spelling skills. Templeton (2020) found through an analysis of spelling development theories that children do not learn how to spell simply through exposure to literacy materials (i.e., by reading). Graham et al. (2008) found positive effects of formal spelling instruction for students in kindergarten through tenth grade compared to students with no formal instruction.

Although explicit instruction is important to development of spelling skills, development of spelling skills begins before explicit instruction. First, a foundation is formed through exposure to oral and printed language. Children learn to speak and comprehend oral language through exposure beginning at birth. During the preschool years (i.e., ages 3-5), children begin to recognize letters and understand that printed words have meaning. Language and writing skills that develop during the preschool years establish readiness for formal spelling instruction.

Formal spelling instruction begins in elementary school. During this time, children progress through several stages of learning how to read and write. Williams et al. (2016) suggested that there are three progressive stages that describe the development of spelling skills:



alphabetic, pattern, and meaning. The alphabetic stage involves a child's progression through learning letter-sound relationships. The pattern stage begins when the child begins to recognize patterns in print and can identify groups of letters. The third stage, meaning, is when students begin to decode and text becomes meaningful to them. The three progressive layers of learning are founded in years of previous research, much of which focused on typical errors children make when reading and spelling: errors in matching letters and sounds, errors in letter patterns, and errors in comprehension (Henderson, 1981; Henderson & Beers, 1980; Templeton, 2011; Templeton & Bear, 1992).

**Alphabetic stage.** Within the alphabetic stage, students are beginning to learn about the alphabet and identifying individual letters. They are also learning letter-sound correspondences and other basic phonics skills. These young elementary-aged children use these skills along with phonological awareness and oral language skills to sound out words. Attempts at spelling are done phonetically and often contain errors (Bruck & Treiman, 1990; Williams et. al. 2016). At this stage, most errors in spelling reflect immature segmentation strategies and a lack of awareness of more complex phonics rules (Bruck & Treiman, 1990). For example, a student's attempt to spell "car" may look like "CR" as the student focuses on individual letter sounds. In the alphabetic stage, children also learn the effect of replacing letters in a word with different letters. For example, replacing the first letter in the word "hat" can make the words "cat" or "mat". Overall, in this stage, children learn how to recognize sounds in words and produce letters to make those sounds in the correct sequence.

**Pattern stage.** As students begin to recognize letter patterns in words and move away from individual letters, they move into the pattern stage. Children discover that there are common letter patterns in words and that sometimes the sound a letter pattern makes is not the

same as the combination of each individual letter sound. For example, the letter “t” makes a /t/ sound on its own and the letter “h” makes a /h/ sound on its own; however, when combined as “th” the letters make a different sound, /th/. Students in this stage begin understanding letter combinations as well as how vowels interact and move past CVC patterns to more complex patterns, (Adamson et al., 2005). In general, students become more accurate and fluent spellers in this stage as their focus transitions to patterns within words that recur in the language and do not always follow basic letter-sound correspondences.

**Meaning stage.** The meaning stage focuses on the connection between whole words and their meaning. Students in this stage begin to comprehend and write whole words and sentences. Once students can comprehend whole words and sentences, they also use information from surrounding text and the environment to identify unknown words (Williams et al. 2016). For example, once students recognize letters and patterns and comprehend whole words, they can read simple directions or use resources around the classroom to copy a word they want to use. Overall, the meaning stage builds upon previously developed skills so that children can spell words in sequence to communicate a message, just as they are able to comprehend the text they read.

As students progress through these stages, misconceptions or errors that were learned in early stages may carry forward to later stages. These misconceptions or errors may impact the successful development of more advanced spelling skills (Williams et al., 2016). For example, students who do not master letter patterns in vowels may make more frequent errors in spelling words with vowel pairs, or a student who fails to master letter identification may make frequent errors in their spelling overall.

### **Best Practices for Spelling Instruction**

Since spelling achievement is important for written communication and also influences achievement in other academic areas, it is important identify and implement evidence-based spelling instruction and interventions. First and foremost, effective spelling instruction should be formal as opposed to informal. In November 2012, the National Council of Teachers of English (NCTE) and the International Reading Association (IRA) reaffirmed the Standards for English Language Arts (NCTE, 2012). The standards include specific reference to students needing to master language conventions including spelling and punctuation (Westwood, 2014). This emphasis is supported by research. For example, Graham and Santangelo (2014) completed a meta-analysis of research on spelling instruction and consistently found that formal instruction in spelling has positive effects on spelling accuracy that are maintained over time, as compared to informal spelling instruction ( $ES = 0.54$ ). Furthermore, formal instruction in spelling is also associated with an increase in the student's writing abilities ( $ES = 0.70$ ).

Adams (1990) provided an analysis of formal spelling instruction that clarifies its impact on reading and writing skills. Adams found that when students study how words are spelled, their examination of how sounds and letters fit together provides cues about the phonemic structure of the word. Explicitly teaching spelling enhances children's ability to read words correctly as it benefits their knowledge of alphabetic principle and decoding strategies. In contrast, passively learning to spell words by reading, studying words, or practicing writing is insufficient. Instruction and practice with feedback are needed so that children can progress through stages of spelling development described previously (Templeton & Gehsmann, 2014).

In addition to being formal, spelling instruction should also be explicit. Bear and Templeton (1998) studied the development of word knowledge and emphasized the importance of explicit instruction, stating that with any curriculum that encourages critical thinking,

“analysis is very difficult and counterproductive if students don't first know what they're looking at” (p. 230). Explicitly teaching students letter and sound patterns in reading and writing has a direct impact on spelling achievement and overall written expression (Darch, et al., 2006; Joshi et al., 2009; Moats, 2005; Templeton & Morris, 2001).

Explicit instruction increases accuracy and fluency and is considered best practice across domains of literacy (i.e., reading, writing, and spelling). Explicit instruction is intentional; objectives are clearly stated within the curriculum and are directly communicated to the learner (Kemper et al., 2012). Explicit instruction in spelling is also carefully sequenced to build on prior knowledge, with spelling strategies directly stated and practiced. Frequent (i.e., weekly) assessments are used to monitor the acquisition, maintenance, and application of spelling rules, patterns, and exceptions to facilitate successful development of subsequent skills (Kemper et al., 2012; Wanzek et al., 2006).

Accuracy is extremely important in spelling (Westwood, 2014). Therefore, spelling instruction must include elements that support the accurate application of letter spelling rules and strategies (Allred, 1977; Henderson, 1990; Loomer et al., 1990; Moats, 2005; Schlagel, 2007). Explicit instruction includes elements of systematic practice that promote accurate application of spelling patterns or rules, such as word drill in which students practice spelling each individual word repeatedly with feedback mechanisms to support learning. Explicit instruction has been found to provide strong and consistent support for improving spelling accuracy as compared to incidental approaches ( $ES = 0.43$ ; Graham & Santangelo, 2014). Students with learning disabilities show a particular need for explicit instruction in learning to spell accurately, suggesting that elements of explicit instruction are a particularly important aspect of spelling instruction for these students (Berninger et al., 2002; Good et al., 1998; Graham, 2000).

Third, spelling instruction should be integrated into the broader literacy curriculum, with explicit connections made between writing and reading. As noted previously, explicit instruction with repeated practice is important. However, common practice methods such as drill promote memorization, which affords little opportunity to develop spelling strategies, manipulate word concepts, or apply critical thinking skills (James, 1899/1958). Children benefit from explicit demonstrations of the connection between phonics and spelling within a comprehensive literacy program. Comprehensive literacy programs teach students processes and strategies to examine the words they read and write. These methods promote application of rules and strategies to new words students encounter in reading and writing.

In addition to connecting reading and written language through a comprehensive literacy curriculum, it is also suggested that spelling instruction be applied to additional subjects to increase comprehension to further promote generalization of spelling rules and strategies (Bear & Templeton, 1998). For example, the introduction of new vocabulary words in a science curriculum may also include spelling practice. These extensions provide additional opportunities for students to develop their reading, spelling, and written language abilities within subject-specific content and vocabulary.

### **Cover, Copy, Compare as an Evidence-Based Spelling Intervention**

A well documented strategy used in spelling, among other academic areas, is Cover, Copy, Compare (CCC). CCC facilitates practice of skills that benefit from memorization or recall, including spelling words, and is consistent with best practices in spelling instruction. Since CCC is a method for implementing systematic practice, it should be used to complement instruction within the broader literacy curriculum. CCC is a cost- and resource-efficient evidence-based intervention used to improve the academic skills of struggling students. CCC has

been successfully implemented for spelling with elementary and high school students (Zielinski et al. 2012) and students with disabilities (Cieslar et al. 2008; Hochstetler et al. 2013; Konrad & Joseph, 2013; McNeish et al., 1992; Nies & Belfiore 2006; Zielinski et al. 2012).

In CCC, the student first reviews a model of a correctly spelled word, then covers the word and writes it from memory. After writing the word, the student uncovers the model and compares it to their attempt (Skinner et al., 1997). If the student wrote the word correctly on the first attempt, they repeat the process with the next word. If they wrote the word incorrectly, they study the model again, then cover it again and make a second attempt to spell it. This process repeats until the student spells the word correctly; then, they move on to the next word. CCC is a self-managed intervention which integrates immediate corrective feedback and self-correction. It is an intervention that can be used for whole classrooms or students with more intensive needs due since it is self-managed and has been found to be acceptable to students in the research (Jaspers et al. 2012; McNeish et al., 1992).

CCC is consistent with the implementation of best practices in spelling instruction. CCC is a formal intervention that includes explicit instruction. CCC emphasizes spelling words accuracy, as they must spell each word accurately before moving to the next word. Accordingly, it includes features that support accuracy, including modeling, immediate error correction, and feedback. The intervention can also be structured to provide as many opportunities to respond as students need.

An extensive body of literature, including meta-analyses, has documented CCC's effectiveness in several academic domains including math facts and spelling (Joseph et al., 2012; Williams et. al. 2018). Williams et al.' (2018) meta-analysis of several spelling interventions found that explicit instruction, multiple opportunities for practice, and immediate corrective

feedback were important components of the spelling interventions studied, with CCC being effective across research studies involving students with learning disabilities.

Several individual studies have investigated CCC's effectiveness in spelling with students with learning disabilities. Murphy et al. (1990) researched the effects of CCC with nine students in the intermediate grades identified as having a learning disability. An ABAB research design was used to compare traditional spelling instruction to CCC practice. Performance varied for individual students across conditions, but overall, spelling accuracy was 10% greater in the CCC condition compared to traditional spelling instruction. McNeish et al. (1992) studied the effects of CCC on spelling accuracy with five middle school students with learning disabilities. When measuring retention, four of the five participants showed an increase in the average percentage of words spelled correctly. Not only did the students retain more spelling words with CCC compared to baseline, they also perceived CCC to be more effective and particularly liked the self-correction aspect. Jaspers et al. (2012) used an alternating treatment design to evaluate the effectiveness of three spelling interventions; CCC, CCC plus sentence definition, and a control phase. Each day, six first grade students participated in one of the three treatment phases followed by an assessment of spelling accuracy. Like other studies, researchers also found significant increases in accuracy while using CCC. Jaspers et al. (2012) did not observe a benefit to 2-day retention, which the authors suggested may have been due to insufficient opportunities to practice (mastery was defined as correctly spelling a word in two sessions). Zielinski et al. (2012) also studied the effects of CCC among three students with learning disabilities using a multiple baseline design. CCC was effective for all three students. During the baseline phase, the students' spelling accuracy ranged from 10% to 60%. During CCC implementation, students' accuracy ranged from 55% to 100%. Hochstetler et al. (2013) completed similar research with

three middle school students identified as having a learning disability or other health impairment. Like previous research, the researchers found significant improvements in spelling accuracy using the CCC intervention.

### **Spaced Practice for Effective and Efficient Spelling Instruction**

Explicit instruction is a best practice in spelling instruction, and implementation of sufficient opportunities respond is consistent with explicit instruction and supports accuracy in spelling. However, providing sufficient opportunities to practice takes time. One survey of elementary school teachers indicated that teachers provide about 90 min of spelling instruction per week, more than the recommended 60-75 min per week (Graham et al., 2008). However, these data were highly variable, and 10% of respondents indicated they spent 20 min or less each week teaching spelling. Given the wide variability in time dedicated to spelling instruction, it is important to identify effective and efficient methods for teaching and practicing spelling. Spaced practice, as opposed to massed practice, may provide a method for maximizing the benefit of a fixed number of opportunities to practice within a fixed amount of time.

The benefits of spaced practice were first investigated by Ebbinghaus in the 1890s, and Ebbinghaus was soon joined by additional researchers (Ebbinghaus, 1885/1964; Jost, 1897). Since then, the benefits of spaced practice as opposed to massed practice have been well documented. Massed practice refers to learning or practicing information or a skill all at once (with no delay between practice opportunities) whereas spaced practice refers to learning or practicing information or a skill multiple times across a specified period. More recently, spaced practice was defined as practicing information with a lag in between practice opportunities, with the lag referring to how practice is distributed, either in time (i.e., seconds, minutes, days) or number of items (i.e., 1 or more items in between practice opportunities; Cepeda et al., 2006).



Ebbinghaus (1885/1964) was the first to document the benefit of distributing learning events across time, rather than all at once, on memory. Since then, the topic of massed versus spaced distribution of practice has become one of the mainstays of learning and memory research. At this time, spaced practice has been applied in a wide range of domains. For example, spaced practice has been applied to the timing and placements of advertisements (Schmidt & Eisend, 2015) and the delivery of treatments (Foa et al., 1980). It is important to understand the effectiveness of spaced practice and potential causal mechanisms of spacing practice.

### **The Effectiveness of Spaced Practice**

Given the extensive research on spaced practice, there have also been several meta-analyses documenting its effects. Meta-analyses have identified effects ranging from moderate ( $r = .34$ , Janiszewski et al., 2003;  $ES = 0.46$ , Donovan & Radosevich, 1999) to large ( $ES = 0.74$ ; Latimier et al., 2020). Meta-analyses have examined significant moderators and the relationship between lag time and optimal retention interval. Of the meta-analyses reviewed, all cited the magnitude of the lag as an important influence of the effect of spaced practice. The lag refers to the amount of space between practice opportunities, which is measured by either items or time (Cepeda et al., 2006). Interestingly, the relationship between effect sizes and lag time is typically found to be an inverse-U, such that very short or very long lags produce the smallest effect sizes (Cepeda et al., 2008; Janiszewski et al., 2003). In addition, longer lag times tend to provide the greatest benefit at longer retention intervals, while shorter lag times tend to provide the greatest benefit at shorter retention intervals. Another general finding emerging from meta-analyses is that verbally-mediated information shows the greatest benefit of spaced practice, while benefits observed for procedures that are not verbally mediated are more modest (Donovan & Radosevich, 1999).

In a meta-analysis of the spaced practice literature, Donovan and Radosevich (1999) looked at 63 articles that used a wide range of tasks in spaced and massed practice. They examined the effects of several moderators: methodological rigor, mental requirements, overall complexity practice distribution, and retention interval. Overall, Donovan and Radosevich (1999) found that increasingly distributed practice resulted in larger effect sizes for verbal tasks like free recall, foreign language, and verbal discrimination, but the tasks also showed an inverse-U function, in that longer than usual lags produced smaller effect sizes. In contrast, increased lags produced smaller effect sizes for skills like typing, gymnastics, and music performance. In memory tasks the optimal spacing “gap” is greater when the delay between practice and final test is longer (Cepeda et al., 2008). In 2003, Janiszewski et al. completed a meta-analysis of 97 research studies focusing on verbal learning and the spacing effect. Moderators of the analysis included repetition and memory, pictorial/verbal stimuli, stimulus meaning, and stimulus complexity. One of the moderators showing significant effect sizes was the lag time. Of the studies reviewed by Janiszewski et al., (2003), most studies (61%) found a positive relationship between lag time and retention, although a variety of relationships were found. In 2006, Cepeda et al. completed an extensive meta-analysis of 184 articles on the effects of spacing and lag. Researchers found the longer the retention interval was the bigger effect it produced. When retention intervals were short, such as less than a minute, massed intervals produced better results ( $ES = 1.7$ ) versus when intervals were longer such as 30 days, spaced intervals produced greater benefits ( $ES = 8.8$ ). In 2020, Latimier et al., completed a meta-analysis of 29 studies to research the benefits of spaced practice on retention. In this meta-analysis, moderators included: setting, education level, type of material stimulus, design, training, final assessment types, feedback, retention interval, number of exposures for a given

item, type of spacing schedule, and time of retrieval. Of the 29 studies reviewed, results produced a strong overall weighted mean effect size indicating a large advantage of spaced retrieval practice over massed retrieval practice, ( $ES=0.74$ ). These meta-analyses indicated the effectiveness of practice opportunities spaced apart over small and large periods of time. However, these meta-analyses have been based on the broader body of research, which primarily includes adult participants in laboratory settings.

### **Causal Mechanisms of Spaced Practice**

The idea behind spaced practice was discovered from research attempting to better understand memory (Ebbinghaus, 1885/1964; Jost, 1897). Memory research has found that just learning something once isn't enough to commit the information to long term memory. Instead, the material needs to be reviewed over time so that recall of the information becomes easier as it's committed from short-term to long term memory. Janiszewski et al. (2003) evaluated five potential causal mechanisms that may explain why spaced practice may work better for retaining information compared to massed practice: attention, rehearsal, encoding variable, retrieval, and reconstruction.

The attention hypothesis suggests that a person will pay less attention to a task or materials that is familiar to them (i.e., practiced in a massed fashion; Janiszewski et al., 2003; Melton, 1970; Underwood et al., 1974; Zimmerman, 1973). The rehearsal hypothesis suggests that spaced practice is better than massed practice because spaced provides more opportunities for rehearsal. After the initial session, subsequent practice sessions serve as reminders of previously learned information making the information more likely to be retained due to the repeated exposure and more opportunities to practice (Cepeda et al., 2006, Janiszewski et al., 2003).

The encoding variability hypothesis refers to how information is encoded and the difference between information being presented massed or spaced (Benjamin & Tullis, 2010). The idea behind encoding variability favoring spaced practice is that information presented in a spaced fashion provides more opportunities for the learner to make connections and to encode additional information pertaining to the content or the encoding situation. This variability increases the likelihood of retaining the information.

The retrieval hypothesis suggests that when exposed to the same information for a second time, the learner is automatically reminded of prior exposure (Janiszewski et al., 2003). This spaced practice method gives the learner a chance to almost forget before reviewing the material again. When the brain has almost forgotten, it takes effort to recall that information and is more likely to make it into the long-term memory (Latimier et al., 2021). Reconstruction hypothesis predicts the spacing effect is dependent on the degree to which the information or the stimulus is reconstructed during subsequent practice opportunities (Janiszewski et al., 2003). This assumes that when a person repeats an event, that the event is reconstructed with one's memory as opposed to creating a whole new memory. By spacing practice of information, learners are reconstructing and solidifying memories each time they review or practice the information.

Janiszewski et al. (2003) found the strongest support for the reconstruction hypothesis, followed by the retrieval hypothesis. The attention and rehearsal hypotheses garnered the least amount of support in this analysis. It seems likely that the act of having to reconstruct a representation information when practice is spaced, in addition to the effort of retrieving previously stored information, are promising explanations for the effectiveness of spaced practice.

In general, a significant body of research documents the effectiveness of spaced practice for supporting retention of information and skills. However, much of the research conducted in this area is conducted with adults in laboratory settings. At this time, there is a small but growing body of research documenting the effectiveness of spaced practice with children in schools.

### **The Effectiveness of Spaced Practice Implemented with Students in Schools**

A growing body of research has documented the benefits of implementing spaced practice with children in schools. This is particularly important given the need to maximize both effectiveness and efficiency of instruction and practice opportunities. Several studies have applied spaced practice to enhance spelling achievement. Fisherman et al. (1968) found positive effects of spaced practice in spelling using computer assisted drills. The 29 participants practiced spelling words in both massed and spaced formats, with nine practice opportunities provided for each word. Students showed significantly greater accuracy on words learned through spaced practice on two assessments 10 and 20 days after the practice concluded. Gettinger et al. (1982) also studied the effects of spaced practice (in addition to training for transfer and a reduced number of spelling words) on spelling achievement with students with learning disabilities as compared to traditional spelling instruction. Practice opportunities were spaced apart by one to two days. They found significant differences between groups (81% accuracy at posttest in the treatment group compared to 61% accuracy in the control group). Rea and Modigliani (1985) studied the effects of spaced practice on both spelling and multiplication facts with a group of forty-four third grade students. Students were split into two groups depending on ability level then those groups were divided equally into one spaced practice and one massed practice group. This study found significant gains in spelling and math abilities when spaced practice (average of 70 percent correct), as opposed to massed practice (average of 53 percent correct), was used

regardless of ability level. Generally, a small body of research appears to support the use of spaced practice to learn spelling words. However, the research appears to be limited, and there are no known studies completed within the past 30 years in this area.

There are some recent examples of evaluating spaced practice in the schools to other areas, specifically math and vocabulary. Sobel et al. (2011) studied the effects of massed versus spaced practice with vocabulary. This study used a within subjects design and included 39 fifth graders practicing vocabulary words using spaced (two practice sessions one week apart) and massed practice (two practice sessions one min apart). Researchers measured retention after five weeks. Students remembered almost three times as many vocabulary words in the spaced practice condition compared to the massed condition. Petersen-Brown et al. (2019) used a quasi-experimental design to examine the effects of spaced and massed practice of math vocabulary words for third and fourth grade students. Results suggested that students showed greater retention through spaced practice compared to massed practice, with a moderate effect size observed ( $ES = 0.63$ ).

Wang et al. (2014) researched whether spacing of practice influences training and transfer of 115 fifth grade children who received working memory training based on a “running span” task in mathematics. Overall, participants in all four training groups improved but the only training group to show significant improvement also had the greatest amount of spacing (20 days). Coddington et al. (2019) studied the effects of a CCC intervention on math fluency in spaced or massed practice and studied the impact of varying the number of opportunities to respond. The authors found no benefit of spaced practice, although practice sessions were only spaced apart by several minutes.

Powell et al. (2020) researched the effects of massed and spaced practice on math fact fluency. This study looked at the effects of providing one 4-min math fact practice session per day versus four 1-min math fact practice sessions. Spaced practice groups were also split into short-spaced, 10 minutes, and long-spaced, 3 hours, to investigate the role of spacing practice across the day. Three classes of third grade students were assigned to three groups using information from previous assessments to ensure equal ability across groups. They found that the group of students within the long spaced practice group grew at a significantly higher rate,  $t(41) = 2.304, p = .026$ , when measuring digits correct compared to students in the massed practice group. Students in the short spaced also grew at a higher rate compared to the massed group, however results were not significant in this case. These results suggest that spaced practice over a longer amount of time can support retention and increases in fact fluency compared to massed or short spaced sessions.

In general, the school-based research on spaced practice supports its effectiveness. Researchers have specifically identified benefits of spaced practice when practice opportunities are spaced apart across a school day (Powell et al., 2020) and up to one week apart (Petersen-Brown et al., 2019; Sobel et al., 2011), and with retention intervals ranging from one week (Powell et al., 2020) to five weeks (Sobel et al., 2011). Results from Coddington et al. (2019) study suggested that shorter spacing intervals (in this case, several minutes) and shorter retention intervals (in this case, one day) may not be sufficient to observe benefits of spacing in all subject areas. In addition, some researchers have found specific benefits of spaced practice to support struggling students (Rea & Modigliani, 1985) and students with disabilities (Gettinger et al., 1982).

### **Purpose and Research Question**

Spelling has been shown to be an important skill as well as influential in the development of other literacy skills (Graham et al., 2002). However, time is a limited resource in schools, and prior survey research indicates that teachers on average do not spend the suggested amount of time on writing and spelling instruction (Graham et al., 2008). Therefore, it is important to identify ways to maximize the effectiveness and efficiency of spelling instruction. Explicit interventions such as CCC may be particularly appropriate ways for facilitating spelling practice. In addition, spaced practice, as opposed to massed practice, has been shown to enhance learning and retention of information and skills (Cepeda et al., 2006, Janiszewski et al., 2003), but the research with children in schools is lacking. A small number of studies have established the effectiveness of spaced practice on spelling instruction (Fisherman et al., 1968; Rea & Modigliani, 1985); one specifically found a promising impact on students with disabilities (Gettinger et al., 1982). More recent research has continued to establish the effectiveness of spaced practice in schools in other academic areas such as math fact fluency (Powell et al.; 2020) and vocabulary (Petersen-Brown et al., 2019; Sobel et al., 2011).

The purpose of this study was to investigate the effects of spaced practice, as compared to massed practice, on immediate and delayed spelling accuracy for students with learning disabilities. Using an alternating treatment design, students with disabilities and identified spelling deficits participated in the CCC intervention using spelling words from their identified learning level of curriculum. The students alternate between massed practice and spaced practice lists, and retention was monitored using posttests after each list.

### **Research Question**

1. To what extent does spacing practice opportunities throughout the school day increase immediate and delayed retention as compared to massed practice opportunities?



## **Method**

### **Participants and Setting**

Three fourth grade students at an elementary school in a rural area of southern Minnesota participated in the research study. Two participants were male and one was female. To be considered for participation in the study, students had to meet several criteria: (1) enrolled in the 4<sup>th</sup> grade, (2) currently receiving special education services under the Specific Learning Disability category, and (3) receiving special education services in spelling. Three students at the school met these criteria, and informed parental consent and student assent were obtained for all three students.

At the time of the study, Student A was a 10-year-old male who qualified for special education services under the Specific Learning Disability category. Student A received services in written language, reading, and math, in addition to services to improve fine motor skills and visual motor integration. Student A also had several relevant diagnoses, including ADHD and two eye conditions (Lenticular Astigmatism and Strabismus). Student A receives several accommodations, including dictating what he has written to an adult given his visual and fine motor deficits. Thus, he was provided with this accommodation throughout the study during assessment and intervention sessions: he spelled a word, then spelled it aloud to the interventionist, then the interventionist wrote out the dictated spelling alongside his initial written response. Student B was a 9-year-old male who qualified for special education services under the Specific Learning Disability category. Student B received special education services in written language, math, and reading. Student C was a 10-year-old female who qualified for special education services under the Specific Learning Disabilities category. Student C received services in written language, math, and reading, in addition to fine motor skills. Student C also

had a diagnosis of ADHD. Students B and Student C had several documented accommodations for testing and instruction, but none were provided during the study as they did not pertain to spelling or the CCC intervention.

Participants engaged in study procedures during their scheduled time in the special education resource room and during their unstructured work time (i.e., study hall). Students at the site typically participate in writing instruction, including spelling, in the special education resource room for approximately 20 min daily. During this time, students worked in small groups of 2 to 5 students with either the special education teacher or a paraprofessional. When implementing study procedures, participants were in a quiet space in the school with minimal distractions including in the special education resource room, fourth grade hallway, and an empty classroom. Students were seated at a small table with the interventionist in a group of 1 to 3, which only included study participants.

Interventionists for the study included two paraprofessionals and two special education teachers. Multiple interventionists were trained to ensure continuity in case of illness or quarantine during the COVID-19 pandemic. In fact, three interventionists tested positive for COVID during the study. The two primary interventionists were paraprofessionals working in fourth grade with the identified participants, and two special education teachers primarily implemented procedures as needed, when the paraprofessionals were unavailable. The first paraprofessional was female, had earned an associate's degree, and had worked as a paraprofessional for 10 years at the time of the study. The second paraprofessional was female, had earned an associate's degree, and had been working as a paraprofessional for less than 1 year at the time of the study. The first special education teacher was female. She had earned a bachelor's degree in education, had licenses in Emotional Behavioral Disorder and Specific

Learning Disabilities, and had 21 total years of teaching experience at the time of the study (11 years in special education). She was the case manager for the participants in this study. The second special education teacher was female, had earned a Master's degree in Education and was licensed in Emotional or Behavioral Disorders. This teacher had 32 total years of teaching experience at the time of the study (14 years in special education).

### **Research Design**

An alternating treatment design was used to answer the research question. For each treatment alternation, the order of massed and spaced practice in adjacent pairs of lists (e.g., lists one and two, lists three and four) was determined randomly, by flipping a coin. Students one and two were at the same instructional level, so opposing practice procedures were used for each list (i.e., if student one used spaced practice for list one, student two used massed practice for that list). Massed and spaced practice were each implemented for five lists; 10 total lists were learned and practiced. Each list included six spelling words, and each list was practiced for three consecutive school days. Prior to beginning practice on each list, participants completed a pretest including 10 to 15 words. Six words that had been spelled incorrectly on the pretest were randomly selected to be learned and practiced. Students were then introduced to the words and correct spelling using brief and scripted explicit instruction. During the three-day practice phase for each list, students practiced words daily using either spaced or massed practice as determined by the random process described above. Lists selected for spaced practice were practiced in three sessions on all three days, and each session concluded when students practiced each word two times or 5 minutes elapsed, whichever was sooner. Words selected for massed practice were practiced in one session on all three days, and the session concluded when students practiced each word six times or 15 minutes had elapsed, whichever was sooner. After all practice sessions

were complete, participants took an immediate posttest. Participants also took a delayed retention test on the same list of words 3 to 5 days later.

### **Dependent Variables and Measures**

Measures used in the current study included words spelled correctly (WSC) on immediate and delayed retention posttests, change in the percent of correct letter sequences (CLS) from pretest to immediate posttest, and change in the percent of CLS from pretest to delayed retention posttest.

For each of the 10 spelling lists, participants completed a pretest (implemented prior to any practice sessions) and a posttest (implemented immediately following the final practice session for that list). Participants also completed a delayed retention posttest 3 to 5 days after practice on the last had concluded, which was typically the date of the immediate posttest for the next list.

All assessments were scored using both words spelled correctly (WSC) and correct letter sequences (CLS). WSC was calculated as a word spelled with all correct letters in the correct order with no additional letters added (Shinn & Shinn, 2002). A CLS is a pair of letters correctly placed in order within a word. A CLS does not refer to just one correct letter, but to a pair of letters and/or spaces is in the correct sequence. For example, if the word “cactus” were spelled correctly, it would appear as “^c^a^c^t^u^s^” with each carat (^) indicating a correct sequence, resulting in seven CLS. Reliability estimates for WSC and CLS in written expression are moderate to high (Shinn, 1989). Correlations of WSC and criterion measures have been found to range between .45 and .92 (Marston, 1989). While WSC is generally accepted in education as an accurate measurement of spelling, CLS is more sensitive and can provide more data and WSC alone.

Since only unknown words were selected to be learned and practiced, WSC on the immediate and delayed retention posttests was used as one dependent variable. The change in percent CLS was used as a second dependent variable (since the initial percent CLS varied by list). Specifically, the percent CLS on the pretest was subtracted from the percent CLS on the immediate posttest, and percent CLS on the pretest was subtracted from the percent CLS on the delayed posttest.

## **Materials**

Materials included consent and assent forms, weekly spelling pretests and posttests, second and third grade level spelling lists, session scripts and CCC materials. Interventionists used pens to record data and students were provided pencils or used their own.

**Consent and assent forms.** Parent consent and student assent forms were given to parents and students eligible for the research study (see samples in Appendix A and Appendix B). Prior to any data collection, parent consent forms were distributed to parents, either by providing the form directly to the parent (for one student) or sending the form home with students after parents were notified the form would be distributed (for two students). Student assent was obtained by the researcher after parent consent had been obtained and prior to the start of any sessions with the interventionist.

**Spelling list.** Spelling lists were obtained from the second and third grade reading curriculum that both general education and special education students use. These grade levels were selected to match each individual students' ability level, with students one and two working from the second-grade curriculum and student three working from the third-grade curriculum. Ten word lists, each including 10 to 15 words, were taken directly from upcoming spelling lists within the curriculum. The participants had not yet learned or practiced any of the spelling words

on any of the included lists. Six words that were spelled incorrectly on the pretest for inclusion on the list and were learned and studied. The spelling words included in the second and third grade curriculum include single and multisyllabic words following a variety of letter patterns. The first unit in the second-grade curriculum contained single and multisyllabic words with long-e sounds (e.g., keep, lady); the second unit contains single and multisyllabic words with long -i (e.g., right, dry). In the first list of the third-grade curriculum contained single and multisyllabic words with the /oi/ sound (e.g., voyage, join); and the second unit contained multisyllabic words with the /ow/ sound (e.g., about, meow). Spelling lists were developed to minimize carryover across weeks and conditions. Lists that included themes that did not include a variety of letter patterns were removed with approval and guidance from the special education case manager to establish equal difficulty across word lists. Lists that were removed included lists that focused on words with a plural ending (e.g., plants, babies), words ending in -ing (e.g., pushing), or past tense words (e.g., crashed), because similar word patterns had been taught earlier in the curriculum.

**Session scripts.** Session scripts were developed for the initial introduction to a list of spelling words, for CCC sessions, and for testing sessions. A sample script for introducing participants to a word list is included in Appendix C. A script for CCC sessions is included in Appendix D. Finally, a sample script for spelling assessments is provided in Appendix E, which was used for the pretest, immediate posttest, and delayed retention test for each word list.

**CCC materials.** Daily CCC materials include three pages of six spelling words with two opportunities to practice each word on each page. Each CCC page used for spaced practice includes the list of six words listed vertically two times on one page with three lines to the right

of each word, the first for the first attempt, and the second and third lines available for correction if needed.

When one session of massed practice was implemented, all three pages of CCC materials were provided in the one daily session (see Appendix F for a sample of second grade CCC materials). When three sessions of spaced practice were implemented, one page of CCC materials were provided in each daily session (see Appendix G for a sample of third grade CCC materials). However, intervention materials used by participants included the spelling words printed neatly by the researcher and photocopied. This strategy ensured an efficient transition from the pretest to practice sessions for each list. Three sets of these materials were made for each list, one on each of three treatment days. A timer was used to time sessions to ensure that massed practice sessions were no more than 15 minutes and spaced practice sessions were no more than 5 minutes each.

**Pretest and posttest.** Prior to beginning practice sessions for each list, students were given a pretest containing 10 to 15 words from a spelling list in the curriculum. Posttests contained six to twelve words given at the end of the lists after CCC sessions were complete (beginning with the second spelling list, two six-word posttests were given in one session to include both the immediate and delayed retention posttests). The interventionist was provided a script for each spelling test as well as a checklist to ensure all steps in the pretest and posttest sessions were complete. The spelling test scripts included the spelling word, followed by a sentence using the word. The scripting, including the sentences, were provided within the spelling curriculum.

### **Acceptability Survey**

Student participants completed a survey at the completion of the study indicating their perceived acceptability and effectiveness of the intervention procedures. Students completed the Kids Intervention Profile (KIP; Eckert et al., 2017; see Appendix J). The KIP includes 8 questions, each on a 5-point Likert scale with 1 being not at all, and 5 being very, very much or much, much more. Points along the scale were accompanied by boxes of varying magnitudes, from small to large, to help young participants comprehend the descriptors. Questions on the KIP were modified to ask about the spelling intervention specifically. The KIP contained questions asking if participants liked or disliked the intervention and how they felt the intervention impacted their progress in spelling. Following the completion of the survey, students were verbally asked if they preferred spaced or massed practice for spelling words.

## **Procedures**

**Consent.** IRB approval was obtained from Minnesota State University, Mankato prior to the start of the study. Approval from the school administrator was granted prior to identification of potential participants. When potential participants were identified, parent consent was obtained followed by student assent.

**Interventionist training.** Three of the interventionists (the first paraprofessional and both special education teachers) were trained together by the researcher in a 20-min session before school started for the day. The second paraprofessional was trained on another day in a similar session because of the onset of illness in the first paraprofessional. All interventionists were trained in how to implement CCC procedures, administer spelling tests, and provide behavioral support to maintain student engagement with the task. First, the researcher showed the interventionists all materials for the study and how to create new packets for the students for each set of new words. The researcher explained the schedules to follow when implementing



massed and spaced practice, highlighting the differences between each. Then, the researcher modeled the spelling test script, the spelling introduction script, and the CCC session script. In modeling the scripts and sessions, the researcher sat down around a table and administered a pre-test followed by CCC practice sessions for massed and spaced practice to the interventionists, followed by each interventionist copying the model and administering a pre-test and CCC practice session with the researcher. To ensure accuracy and provide feedback, the researcher observed the first three sessions for each interventionist where 100% adherence to protocols were recorded for all four interventionists.

**Treatment phase procedures.** Spaced and massed practice were implemented in randomly counterbalanced fashion by spelling list. Prior to implementing practice procedures for a given list, a pretest was administered by an interventionist. The pretest was administered to students individually or as a pair using a script. The second grade curriculum used by student one and student two consisted mainly of 10 word pretests while student three working from the third grade curriculum received 15 word pretests in all 10 lists. From each 10- to 15-word pretest, six words spelled incorrectly as measured by WSC were randomly selected to be included on the spelling word list. This procedure was repeated for all spelling lists. At the start of the first session of the new list, the interventionist introduced each word using a scripted introduction to facilitate initial learning of all six spelling words for that list (see sample in appendix C).

During spaced practice sessions held on three days of the week, students used CCC to practice the list of six words with two opportunities to practice each word (or for a maximum of 5 minutes) three times each day for three days a week. Spaced sessions were held at least 1 hr apart but were scheduled to be 1 hour and 5 hours apart. During massed practice sessions, also three days a week, students used CCC to practice a different list of six words with up to six

opportunities for practice (or for a maximum of 15 minutes) one time a day on three days of the week.

**Posttest and retention procedures.** Following the final practice session of the week in both conditions, students were administered an immediate posttest. Students also took a delayed retention posttest three to five days after the final practice session. Starting with the second spelling list, the delayed retention posttest typically occurred at the same time as the immediate posttest for the next list. Interventionists administered the posttests using the script referenced previously.

### **Implementation Fidelity and Interscorer Agreement**

Implementation fidelity was evaluated by reviewing session artifacts, including completed logs (see Appendix H) and CCC worksheets, and through direct observation of 36% of sessions, including 30% of sessions that included the initial introduction to the spelling list. The interventionist kept a log of all sessions for all participants, including the date, time, length of time it took to complete the task and number of sessions completed during that time (see Appendix I for sample).

All pretest and posttest assessments were scored for WSC and percent CLS by the researcher and a research assistant to ensure scoring procedures were applied correctly. The research assistant was a school psychology graduate student who was familiar in scoring procedures for WSC and CLS. Interscorer agreement was calculated using agreements over agreements plus disagreements for both WSC and CLS. Agreement was 100% across participants and conditions for both WSC and CLS.

### **Data Analysis**

Each spelling pretest, immediate posttest, and delayed retention posttest was scored using CLS and WSC. Percent CLS was calculated for the pretest, immediate posttest, and delayed retention posttest. The change score was reported as the dependent variable and was calculated as change in percent CLS from pretest to immediate posttest and change in percent CLS from pretest to delayed retention posttest. To calculate the change in percent CLS, percent CLS posttest and retention test scores were subtracted from their pretest percent CLS.

Visual analysis of WSC and change in percent CLS was examined across massed and spaced practice for both immediate and delayed retention posttests. Visual analyses focused on differences in level, trend, and variability in the data for massed versus spaced practice.

Kendall's baseline corrected Tau was calculated to estimate the effectiveness of spaced practice compared to massed practice (positive effect sizes favored spaced practice). Kendall's baseline corrected Tau is a non-parametric effect size which controls for trends in comparison phase data such as the alternating treatment design (Tarlow, 2016). Standard error of Tau ( $SETau$ ) was also reported. Parameters for interpretation of results identified a range of 0 to .2 as a small effect size, .2 to .6 a moderate effect size, .6 to .8 a large effect size, and .8 to 1 a very large effect size (Vannest & Ninci, 2015).

## **Results**

Descriptive statistics and baselines corrected Tau effect sizes for each student and treatment are shown in Table 1. Results are also depicted in time series graphs in Figures 1 through 12. For each student, two graphs displays results in change in percent CLS, one for posttest and one for retention. Two graphs displays results in WSC, one for posttest and one for retention.

**Table 1***Results of percent change in CLS and WSC across conditions*

			Change in % CLS from pretest			Tau	WSC			Tau
			Min	Max	Mean		Min	Max	Mean	
Student 1	Spaced	Posttest	-23%	+70%	+26%	.121	0	6	3	.285
		Retention	-6%	+43%	+16%	-.447	0	3	1.2	-.263
	Massed	Posttest	+3%	+47%	+27%		0	2	1.4	
		Retention	+13%	+53%	+28%		1	3	1.8	
Student 2	Spaced	Posttest	+3%	+43%	+23%	.566	1	4	2.8	.559
		Retention	+10%	+37%	+22%	.388	1	3	2	.500
	Massed	Posttest	-10%	+36%	+6%		0	3	1.2	
		Retention	-7%	+36%	+10%		0	3	0.8	
Student 3	Spaced	Posttest	+20%	+57%	+43%	.328	4	6	4.8	.068
		Retention	+25%	+57%	+42%	.507	4	6	4.6	.135
	Massed	Posttest	+11%	+34%	+29%		3	6	4.6	
		Retention	+7%	+40%	+25%		2	6	3.8	

*Note.* Tau effect sizes compare spaced to massed practice, where spaced is the treatment

condition. Positive effect sizes favor spaced practice.

\* indicates a Tau effect size that is significant at the  $p < .05$  level.

### **Student One**

Student one was a 10 year old male in fourth grade and receiving special education services under the category of Specific Learning Disabilities. Student one's performance was evaluated, focusing on level, trend, and variability of performance in each condition. Visually, Student one's change in percent CLS was variable in both spaced and massed practice conditions (see Figure 1 and Figure 2); this is also supported by descriptive data. Due to this variability, Student one's overall level of performance across conditions was difficult to determine. In fact, Student one showed the greatest range of performance within the spaced practice condition. For example, on spaced practice immediate posttest assessments, Student one's performance ranged from a 23% loss in CLS to a 70% gain CLS (a range of 93% CLS) with a mean of 26% gain in

CLS. On spaced practice delayed retention tests, Student one's performance ranged from a 6% loss in CLS to a 43% gain in CLS (a range of 49% CLS) with a mean of a 16% gain in CLS. Student one's performance in massed practice posttests ranged from a 3% gain in CLS to a 47% gain in CLS with a mean of a 27% CLS gain. Student one's performance in massed practice delayed retention tests ranged from a 13% gain in CLS to a 53% CLS gain with a mean of 28% CLS gain. Tau scores calculated from change scores using percent CLS for spaced practice produced small or negative effect sizes that were not significantly different from .00,  $Tau = .121$ ,  $p = .753$  ( $SETau = .444$ ) for posttests and  $Tau = -.447$ ,  $p = .144$  ( $SETau = .400$ ) for delayed retention tests.  $SETau$

Student one's WSC graph also indicates variability across spaced and massed practice conditions (see Figure 3 and Figure 4); this is also supported by the descriptive data. Once again, the overall level of performance across conditions was difficult to determine due to significant variability. The graph appears to demonstrate more consistent performance in massed practice and more variability in spaced practice. On spaced practice posttest assessments, Student one's performance ranged from 0 WSC to 6 WSC with a mean of 3 WSC. On spaced practice delayed retention tests, Student one's performance ranged from 0 WSC to 3 WSC with a mean of 1.2 WSC. Student one's performance in massed practice posttests ranged from 0 WSC to 2 WSC with a mean of 1.4 WSC. Student one's performance in massed practice delayed retention tests ranged from 1 WSC to 3 WSC with a mean of 1.8 WSC. Tau scores calculated from WSC, comparing spaced practice to massed practice were small and not significant from .00,  $Tau = .285$ ,  $p = .395$  ( $SETau = .429$ ) on posttests and  $Tau = -.263$ ,  $p = .451$  ( $SETau = .431$ ) on delayed retention tests.

## **Student Two**

Student two's performance was evaluated, also focusing on level, trend, and variability of performance in each condition. Based on visual analyses of the change in percent CLS posttest, and WSC posttest and delayed retention graphs, as shown in Figures 6-8, there was an initial difference in level favoring spaced practice, although there was a positive trend shown in the massed condition. The level of performance was similar across conditions by the conclusion of the study. Student 2's performance appears to have been more variable in the massed practice condition based on change in percent CLS. On spaced practice immediate posttest assessments, Student two's performance ranged from a 3% gain in CLS to a 43% gain CLS with a mean of 23% gain in CLS. On spaced practice delayed retention tests, Student two's performance ranged from a 10% gain in CLS to a 37% gain in CLS with a mean of a 22% gain in CLS. Student two's performance in massed practice posttests ranged from a 10% loss in CLS to a 36% gain in CLS with a mean of a 6% CLS gain. Student two's performance in massed practice delayed retention tests ranged from a 7% loss in CLS to a 36% CLS gain with a mean of 10% CLS gain. Tau scores calculated from change in percent CLS, comparing spaced practice to massed practice were small to moderate and not significantly different from .00,  $Tau = .566, p = 0.06$  ( $SETau = .369$ ) for posttests and  $Tau = .388, p = .210$  ( $SETau = .412$ ) for delayed retention tests.

Student two's WSC graphs, as shown in Figure 7 and Figure 8, led to similar conclusions in that the level of performance was initially higher in the spaced practice condition. However, performance in massed practice showed a positive trend, and performance was similar across conditions by the end of the study. On spaced practice posttest assessments, Student two's performance ranged from 1 WSC to 4 WSC with a mean of 2.8 WSC. On spaced practice delayed retention tests, Student two's performance ranged 1 WSC to 3 WSC with a mean of 2 WSC. Student two's performance in massed practice post-tests ranged from 0 WSC to 2 WSC

with a mean of 1.2 WSC. Student two's performance in massed practice delayed retention tests ranged from 1 WSC to 3 WSC with a mean of 0.8 WSC. Tau scores calculated from change in WSC, comparing spaced practice to massed practice were moderate, but not significantly different from .00,  $Tau = .559$ ,  $p = .083$  ( $SETau = .371$ ) on posttests and  $Tau = .500$ ,  $p = .129$  ( $SETau = 0.387$ ) on delayed retention tests.

### **Student Three**

Student three's performance was evaluated, focusing on level, trend, and variability of performance in each condition. Visually, Student three's CLS graphs, as shown in Figure 9 and Figure 10, exhibited a downward slope overall. The level of the data is higher in the spaced practice condition overall; in other words, Student three's performance in spaced practice appears to have resulted in greater CLS gains compared to massed practice. On spaced practice immediate posttest assessments, Student three's performance ranged from a 20% gain in CLS to a 57% gain CLS with a mean of 43% gain in CLS. On spaced practice delayed retention tests, Student three's performance ranged from a 24% gain in CLS to a 57% gain in CLS with a mean of a 42% gain in CLS. Student two's performance in massed practice ranged from a 7% gain in CLS to a 40% gain in CLS with a mean of 26% CLS gain. Student three's performance in massed practice posttests ranged from a 11% loss in CLS to a 34% gain in CLS with a mean of a 29% CLS gain. Student three's performance in massed practice delayed retention tests ranged from a 7% gain in CLS to a 40% CLS gain with a mean of 25% CLS gain. Tau scores calculated from change in percent CLS, comparing spaced practice to massed practice were small and not significant from .00,  $Tau = .328$ ,  $p = .296$  ( $SETau = 0.296$ ) for immediate posttests and  $Tau = .507$ ,  $p = .095$  ( $SETau = 0.095$ ) for delayed retention tests.

As shown in Figure 11 and Figure 12, student three's WSC graphs also shows a negative slope over the course of the study. There is less differentiation in Student three's performance between massed and spaced practice as indicated by WSC compared to change in percent CLS. On spaced practice posttest assessments, Student three's performance ranged from 4 WSC to 6 WSC with a mean of 4.8 WSC. On spaced practice delayed retention tests, Student three's performance ranged 4 WSC to 6 WSC with a mean of 4.6 WSC. Student three's performance in massed practice post-tests ranged from 3 WSC to 6 WSC with a mean of 4.6 WSC. Student three's performance in massed practice delayed retention tests ranged from 2 WSC to 6 WSC with a mean of 3.8 WSC. Tau scores calculated from change in WSC, comparing spaced practice to massed practice were small and not significant from .00,  $Tau = .068$ ,  $p = .913$  ( $SETau = 0.913$ ) on post tests and  $Tau = .135$ ,  $p = .742$  ( $SETau = 0.742$ ) on delayed retention tests.

### **Survey results**

Student participants completed a survey at the end of study to gain information from stakeholders on their experience and like or dislike for the CCC intervention and spaced vs massed practice schedules. Student one reported he very, very much (5) likes practicing spelling, practicing spelling using CCC worksheets, wished he could practice more, helped his spelling, and improved his spelling. Student one also reported he sometimes (3) didn't want to participate, and that his spelling has not gotten worse (1) with the practice. Student two reported he very, very much (5) likes practicing spelling, it helped his spelling, and improved his spelling. Student two also reports he likes CCC worksheets a lot (4) and sometimes (3) wished he could do more. Student two reports that he has never (1) not wanted to participate, and his spelling and not gotten worse with the practice. Student three reports she believes the practice helped her spelling very, very much (5) and likes the CCC worksheets a lot (4). She also reported her spelling has



improved a lot (4). Student three reports she sometimes (3) didn't want to participate and that she has never (1) wished do practice more and does not think her spelling has gotten worse with the practice. Overall, the students reported enjoyment of the intervention, with students sometimes enjoying it more than others. When asked if they enjoyed spaced or massed practice better; student one reported enjoying spaced practice more, students two and three reported they preferred spaced practice.

### **Fidelity and Interscorer Agreement**

The researcher observed 36% of intervention sessions. In the sessions observed an average of 92% of steps were followed (ranging from 85% to 100% of steps followed). Specifically, 50% of spelling word introductions were observed with 88% of steps followed on average. In addition, 50% of CCC sessions were observed with 88% of steps followed on average, and 40% of assessment sessions were observed with 86% of steps followed on average.

Interscorer agreement was calculated for 90% of immediate and delayed retention tests. Overall interscorer agreement was 100%. Examination of materials produced from participants revealed that all opportunities for practice were completed by all three participants. Interventionists kept consistent records of sessions throughout the study, with only two sessions missing information (specifically, the exact start and end time for one student).

### **Discussion**

A significant body of research has documented the effectiveness of spaced practice for supporting retention of information and skills (Cepeda et al., 2008; Powell et al., 2020; Sobel et al., 2011). Promising causal mechanisms for spaced practice include reconstruction and retrieval (Janiszewski et al., 2003). The retrieval and reconstruction hypotheses suggest that spaced practice challenges an individual to reconstruct and retrieve previously learned information,

which leads to greater retention. In meta-analyses of the spaced practice literature, Donovan and Radosevich (1999), Janiszewski et al. (2003), Cepeda et al. (2006), and Latimier et al. (2020) all found moderate and statistically significant effects in favor of spaced practice over massed practice. The research reviewed in these analyses is varied, including a variety of tasks, lag times, and retention intervals. However, the broader body of research primarily includes adult participants in laboratory settings. A much smaller body of literature investigates educationally relevant research on spaced practice. This research focuses on universal student populations (Petersen-Brown et al., 2019; Powell et al., 2020; Sobel et al., 2011). Several studies have been completed in schools with students with disabilities. This research supports the use of spaced practice for students with disabilities specifically, although no known research has been completed in this area recently (Gettinger et al, 1982; Rea & Modigliani, 1985).

The purpose of this study was to compare retention of spelling words when using spaced versus massed practice with students with a specific learning disability. CCC was the intervention used in this study because it allows for practice of skills that require memorization or recall, including spelling words, and it is consistent with best practices in spelling instruction. CCC is a cost- and resource-efficient evidence-based intervention used to improve academic skills. CCC has been successfully implemented for spelling with elementary and high school students (Zielinski et al. 2012) and students with disabilities (Cieslar et al. 2008; Hochstetler et al. 2013; Konrad & Joseph, 2013; McNeish et al., 1992; Nies & Belfiore, 2006; Zielinski et al. 2012).

In the current study, three students identified as having a learning disability and receiving special education services in written language participated in CCC practice sessions using an alternating treatment design in which spaced and massed practice were implemented in randomly

counterbalanced fashion, one for each spelling list. Students learned 10 lists of six spelling words, each list over the course of three days. Students were introduced to each word, then practiced the words daily using CCC. Spaced practice included three daily sessions with up to two opportunities to practice each word (up to five min each), while massed practice included one daily session with up to six opportunities to practice each word (up to 15 min). Students participated in a pretest, immediate posttest, and five-day retention assessment for each list. The effectiveness of spaced and massed practice was measured WSC and change in percent CLS. Overall results were ambiguous. Visual analyses indicated a high degree of variability across students and overlap between conditions, indicating that there was not a significant difference in retention of spelling words in massed and spaced practice conditions. Effect size analyses generally favored spaced practice, but these effect sizes were small to moderate and not statistically significant. These ambiguous results suggest that factors outside of spacing of practice, including attendance, motivation, and behavioral concerns, may have impacted the results. These ambiguous findings may also indicate that the conditions were not different enough in ways that have a significant impact on spelling word retention.

Student one's performance indicates that massed practice may have been slightly more effective, whereas results indicated that spaced practice may have been slightly more effective for students two and three. Considerable variability in the data was also observed. Factors unrelated to the intervention itself may have impacted study results, as observed by the researcher and interventionists. Student one experienced some refusal behaviors, particularly during the middle of the study. This period coincided with changes in interventionists and longer school breaks. Refusal behaviors were observed throughout the school day. During CCC sessions, Student one was observed to peek at words prior to attempting to spell them, argue with

interventionists when reminded of correct CCC procedures, put little effort into his work, and refuse to participate until presented with another task. Interventionists provided encouragement, reminded the student that his participation was voluntary, reminded the student of appropriate session behavior, and redirected him back to task when distracted. Despite observed behavioral challenges, results from the acceptability survey indicated that student one enjoyed CCC practice and believed practicing with the worksheets helped him learn to spell better. Student one specifically indicated a preference for massed practice for two reasons: he perceived the repetition was helpful and preferred to miss the activity scheduled at the same time as massed practice. It is possible that for students with behavioral challenges, the increased transitions required in spaced practice may be particularly challenging.

Student two's results indicate that spaced practice was slightly more effective, although there was an increasing trend, particularly in the massed practice condition. Effect size estimates were moderate for Student two although not statistically significant. The researcher and interventionists did not observe specific environmental or behavioral variables that may have impacted his performance. On the acceptability survey, Student two indicated that he enjoyed CCC practice. He indicated a slight preference for spaced practice because the worksheets were shorter. Student two indicated his spelling has improved after participating in CCC.

Student three's results suggest an almost complete overlap between spaced and massed practice (although the level of performance in spaced practice was better at the start of the study in change in percent CLS), as well as a negative trend in both conditions. At the start of the study, her performance was favorable. However, her performance declined throughout the study. In this case, sporadic attendance is a factor which may have impacted the results. Student three was absent at times for unknown reasons and at other times due to COVID-19. After periods of

absence, Student three showed difficulty in demonstrating knowledge and skills across subject areas and some functional skills (i.e., fine motor). Student three indicated that she liked practicing spelling a lot and that she believed her spelling improved a lot. Student three reported she sometimes didn't want to participate. Student three indicated a slight preference for spaced practice because the worksheets were completed quickly; it was difficult for Student three to maintain focus to complete massed practice sessions. Student three expressed a desire to continue using CCC and is currently using the intervention to practice spelling words at school. Spaced practice may be helpful for students who struggle to maintain attention over longer periods, although the results of this study do not specifically support this.

### **Limitations**

The results of this study should be interpreted within the context of its limitations. The first limitation is that consistent attendance of interventionists and participants (specifically, Student three) was impacted by the COVID-19 pandemic. Throughout the study, all interventionists and participants were absent from school due to being identified as a close contact of someone with COVID-19 and/or awaiting test results for COVID-19. In addition, three interventionists and one participant were absent for an extended period after testing positive for COVID-19. Beyond COVID-19-related absences, Student three experienced pervasive absences during the second half of the study. Not only did this impact her academic and functional skills broadly, it also impacted data collection in that it caused delays and delayed retention tests were at times implemented more than five days after practice concluded. However, delayed retention tests were completed a maximum of 8 days after practice concluded for a given list. In general, absences and inconsistency in interventionists seemed to impact the motivation and behaviors of participants.

Interfering behaviors were also a limitation within this study, particularly for Student one. Student one exhibited refusal behaviors at times and did not implement CCC procedures correctly at times. Although Student one agreed to continue participation, these behaviors may have impacted intervention results. Ultimately, it is difficult to estimate the magnitude of the impact of these factors, although it certainly impacts conclusions that can be drawn.

Potential variation in difficulty of spelling lists is also a limitation. Some attempts were made to equate difficulty of lists within participants, including skipping lists that included previously taught concepts. Spelling lists were drawn directly from the school curriculum, and lists are not necessarily constructed to ensure equal difficulty across lists. Relatedly, students may have had unpredictable or variable exposure to spelling words previously or during instruction in other content areas, due to the spiraling nature of the spelling curriculum and its integration with the literacy curriculum. Some variability is observed in the length of spelling lists, from 10 to 15 words (although all lists used in the current study included six spelling words). This variation created a difference in the number of words available for inclusion in spelling lists. Spelling lists also varied in the total number of CLS. CLS totals ranged from 30 to 53 and were not controlled for when assigning lists to massed or spaced conditions. It is possible that lists with more CLS may have been more difficult for participants to learn.

CCC also may not be the ideal intervention to use to compare massed versus spaced practice; it also may not be the ideal intervention to use to support retention of spelling words among students with disabilities. Though CCC incorporates several best practices in spelling instruction including explicit instruction with an emphasis on accuracy, it is lacking in other best practices including formal instruction and integration into the broader curriculum. Students received explicit instruction on the sounds in each word and how to spell the word, but the

instruction occurred once during the first practice session for each list. This instruction, although explicit, is perhaps not considered formal due to its brevity. The instruction was also not embedded into the broader curriculum as spelling lists were selected from future lists to ensure the words would be unknown.

## **Implications**

The findings of this study have implications for research and practice. The results of this study were ambiguous, which suggests that spaced practice did not have a significant impact on students' retention of spelling words or that other factors had a greater impact on students' performance. However, given the extensive body of research that supports spaced practice, it is important that more research is conducted in this area to identify how and under what circumstances spaced practice should be implemented for students with disabilities in the school setting.

This study expanded on the research of spaced and massed practice in schools and with students with disabilities. More specifically, it expanded the research on spaced practice in spelling interventions for students with learning disabilities. This study does not definitively support the application of spaced practice in these areas. However, additional research in this area is needed, specifically with students with disabilities with a range of needs and in a range of content areas.

This study suggests that spaced practice may not make a significant contribution to the learning of students with disabilities. However, past research supports its implementation with students in schools. Therefore, it may be beneficial in specific situations, although educators should carefully monitor its effectiveness given the tentative support for this practice, especially for students with disabilities. This study suggests that spaced practice is perceived to be

acceptable, feasible, and effective to the interventionists and participants included in this study. Therefore, although time in school is limited and scheduling needed instructional activities is difficult at times, this study suggests that it is possible to integrate spaced practice over the course of a school day. However, this study suggests that it may not be indicated for some students, such as those who struggle with transitions.

### **Conclusion**

The results of this study extended the current research on spaced and massed practice in the school setting and for students with learning disabilities. Spaced practice has the potential to maximize the effectiveness of time spent in instruction. In other words, it may help educators to make more efficient use of instructional time while supporting increased retention for students. This study contributed to a small body of research investigating the impact of spaced practice on the spelling achievement of students with disabilities. Results varied for each student, but results were ambiguous overall. Although spaced practice may be a useful tool to implement in schools, other factors (e.g., managing challenging behavior, attendance, consistency of interventionists) may have a greater impact on student performance. Further research on the use of spaced practice for students with disabilities may continue to shed light on the role of spaced practice to enhance learning for students with disabilities.



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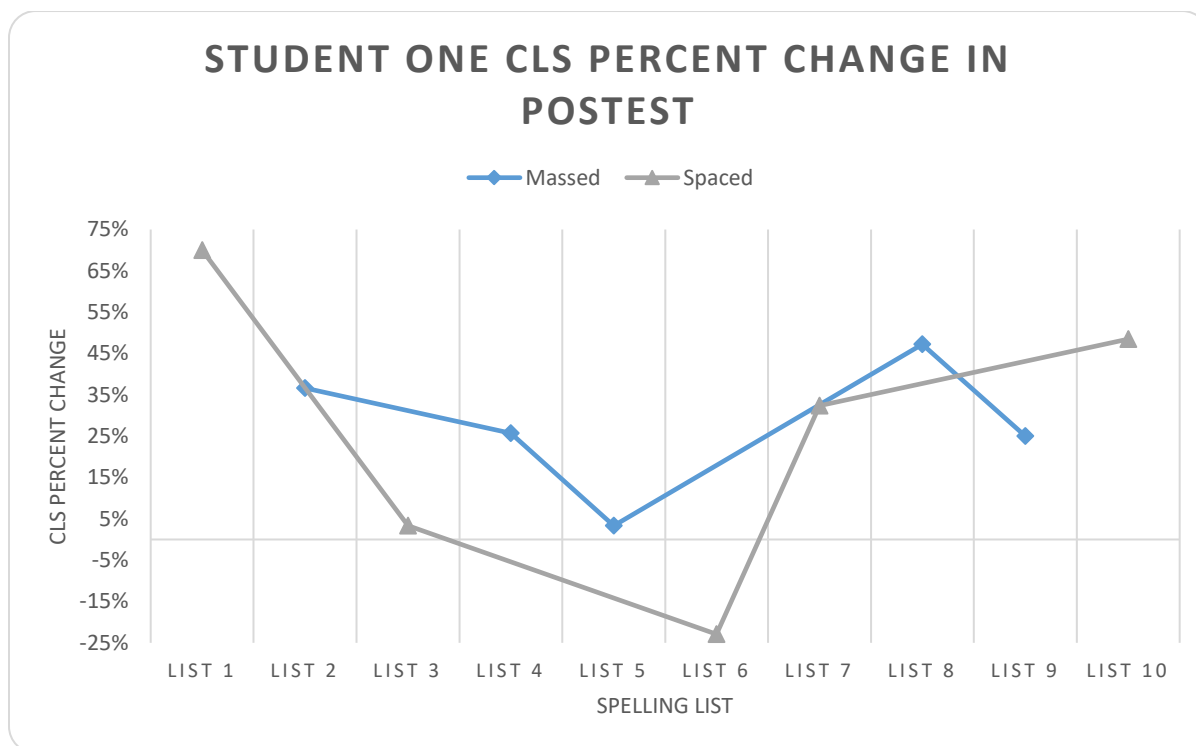


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## Figures and Appendices

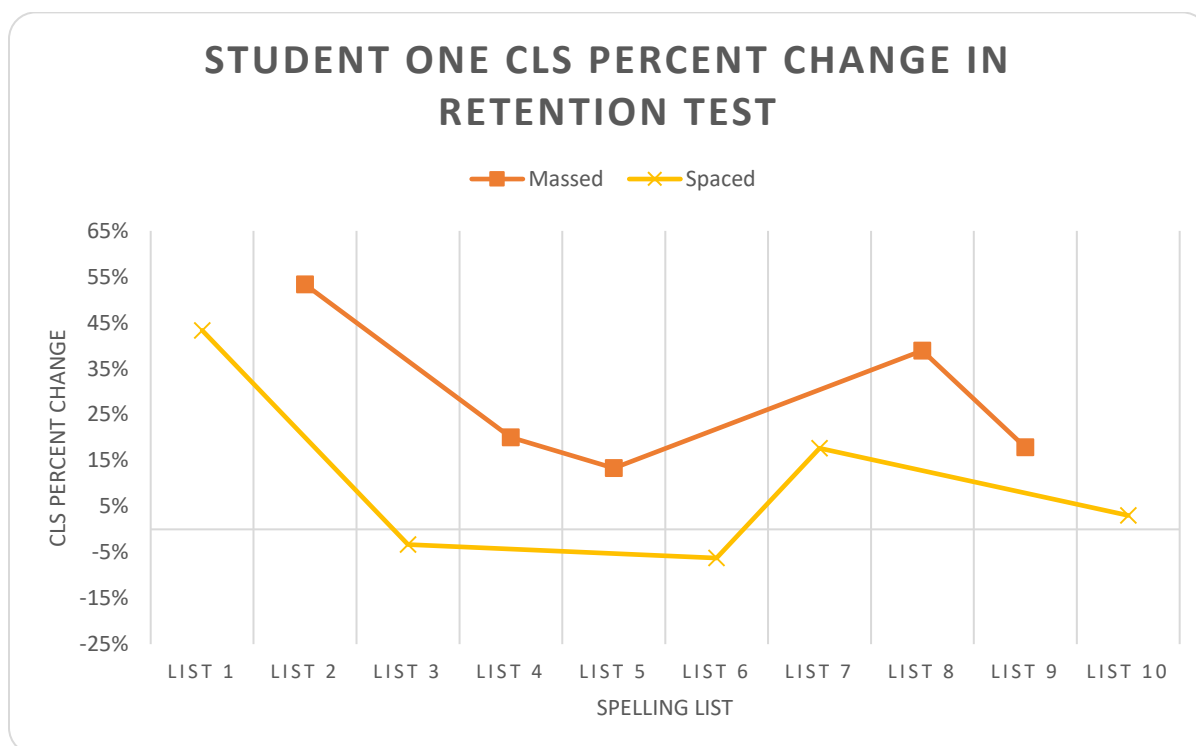
**Figure 1**

*Student One Correct Letter Sequence (CLS) Change Score Massed vs Spaced Practice Posttest*



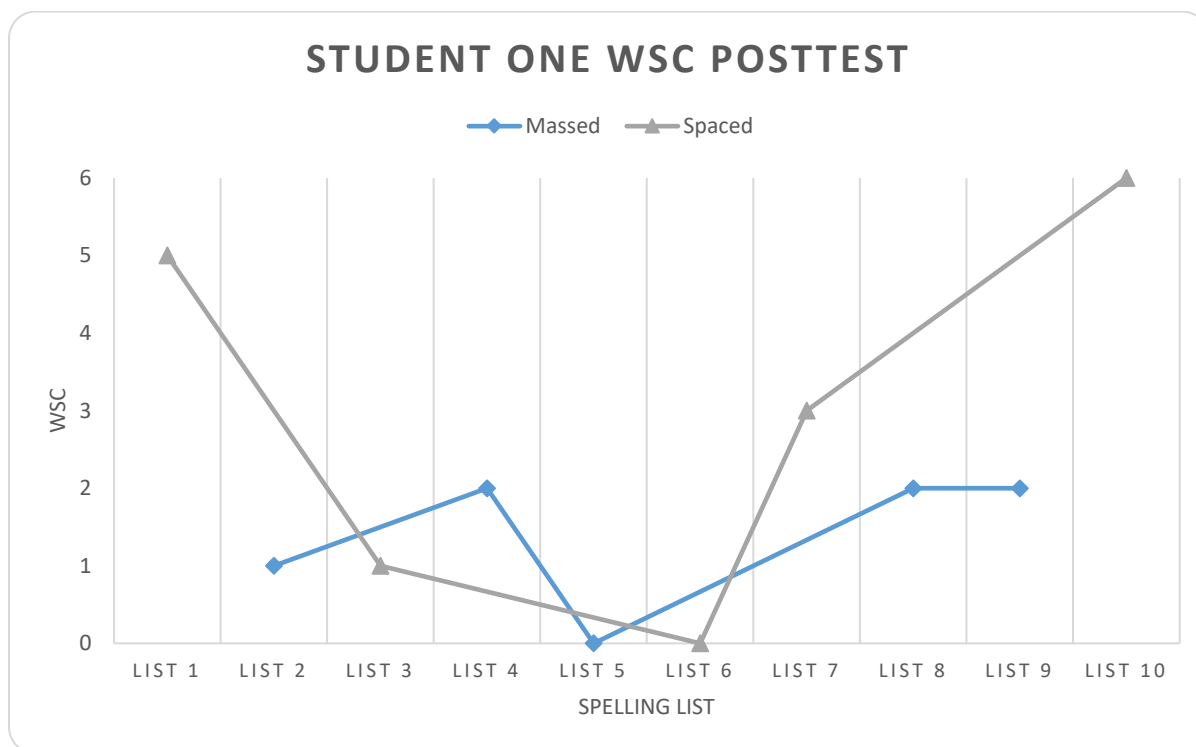
**Figure 2**

*Student One Correct Letter Sequence (CLS) Change Score Massed vs Spaced Practice Delayed Retention Test*



**Figure 3**

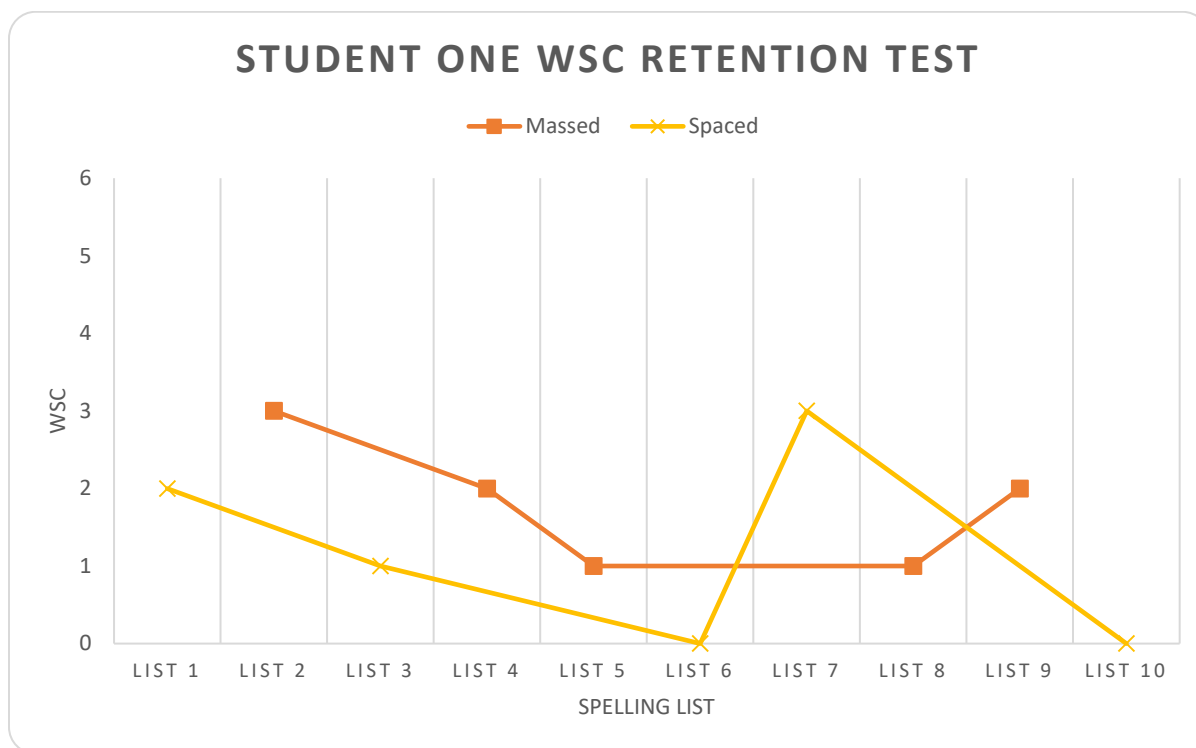
*Student One Words Spelled Correct (WSC) Change Score Massed vs Spaced Practice Posttest*



**Figure 4**

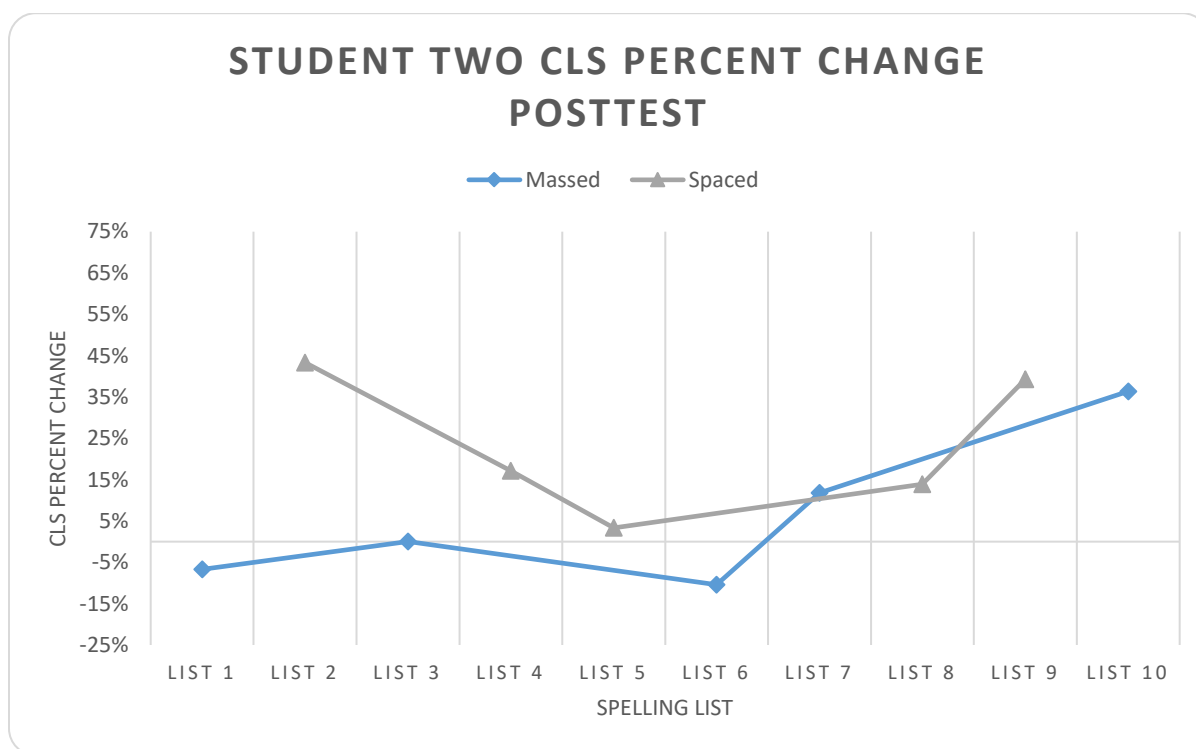
*Student One Words Spelled Correct (WSC) Change Score Massed vs Spaced Practice Delayed*

*Retention Test*



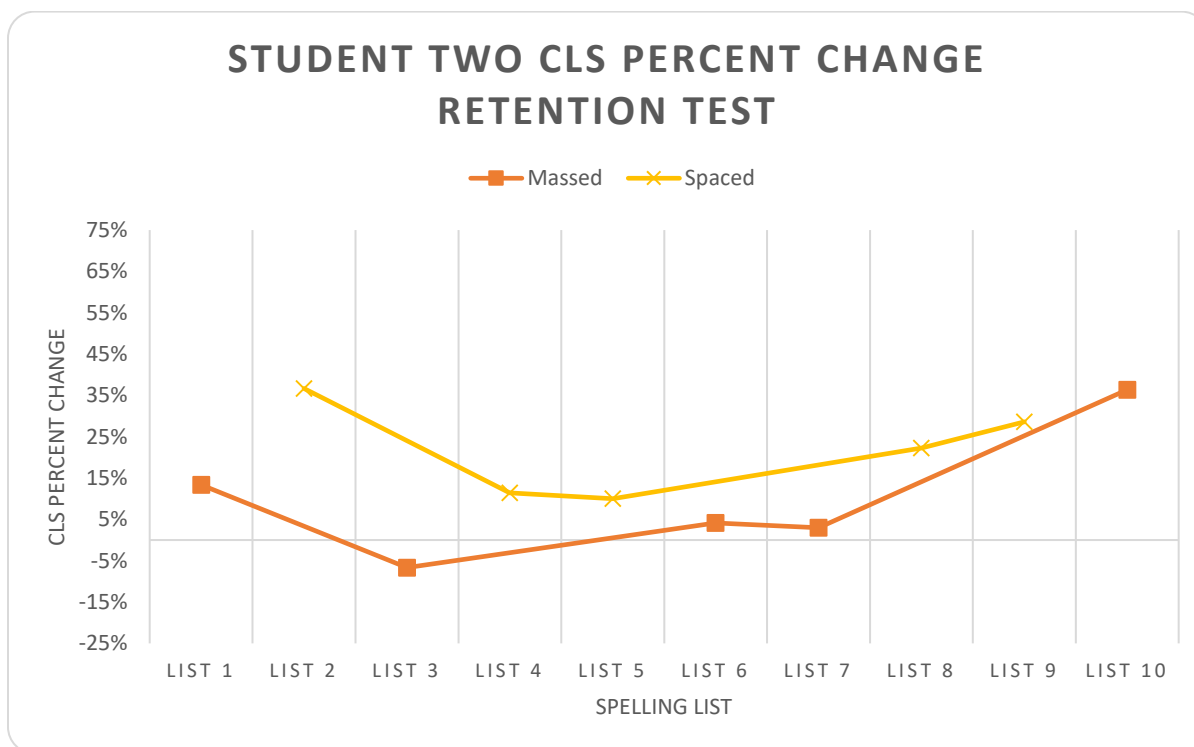
**Figure 5**

*Student Two Correct Letter Sequence (CLS) Change Score Massed vs Spaced Practice Posttest*



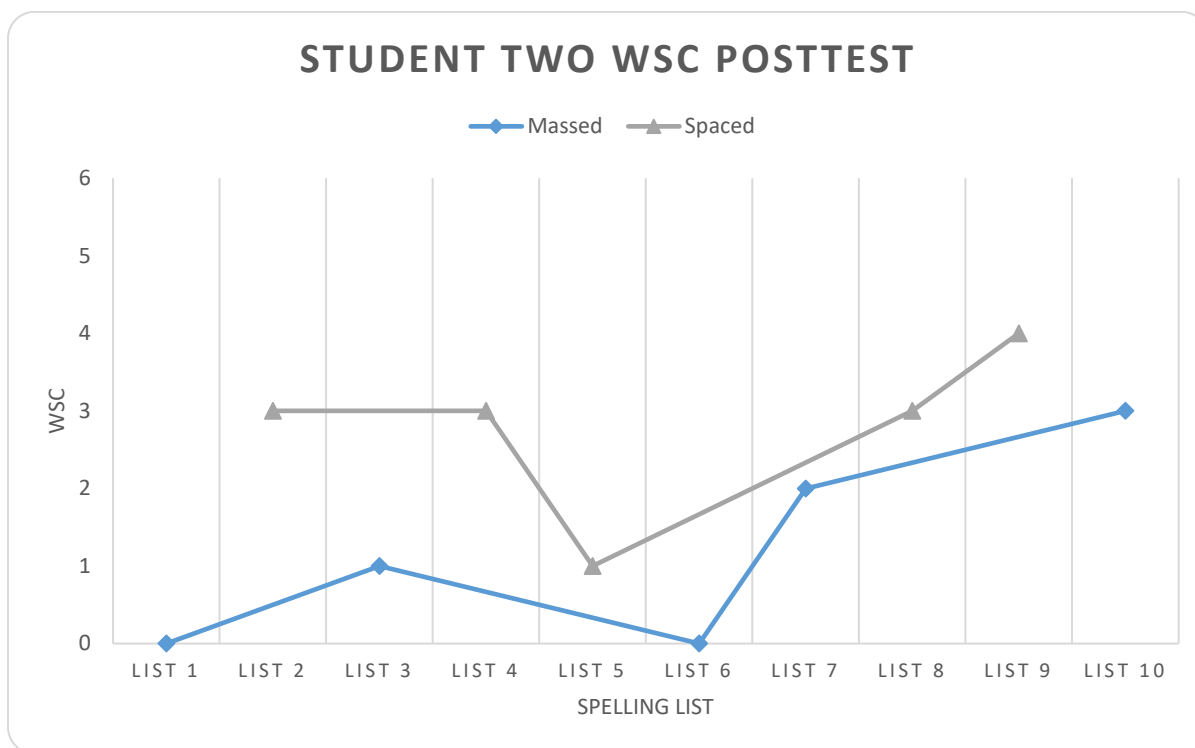
**Figure 6**

*Student Two Correct Letter Sequence (CLS) Change Score Massed vs Spaced Practice Delayed Retention Test*



**Figure 7**

*Student Two Words Spelled Correct (WSC) Change Score Massed vs Spaced Practice Posttest*

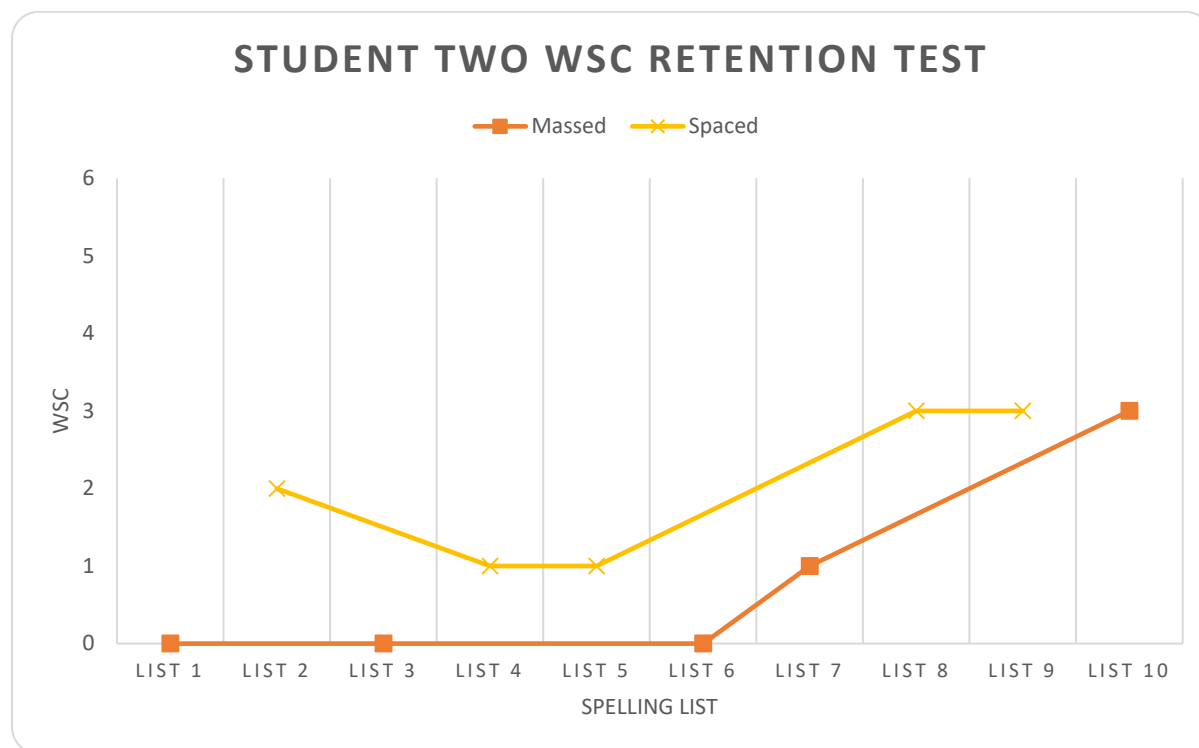




**Figure 8**

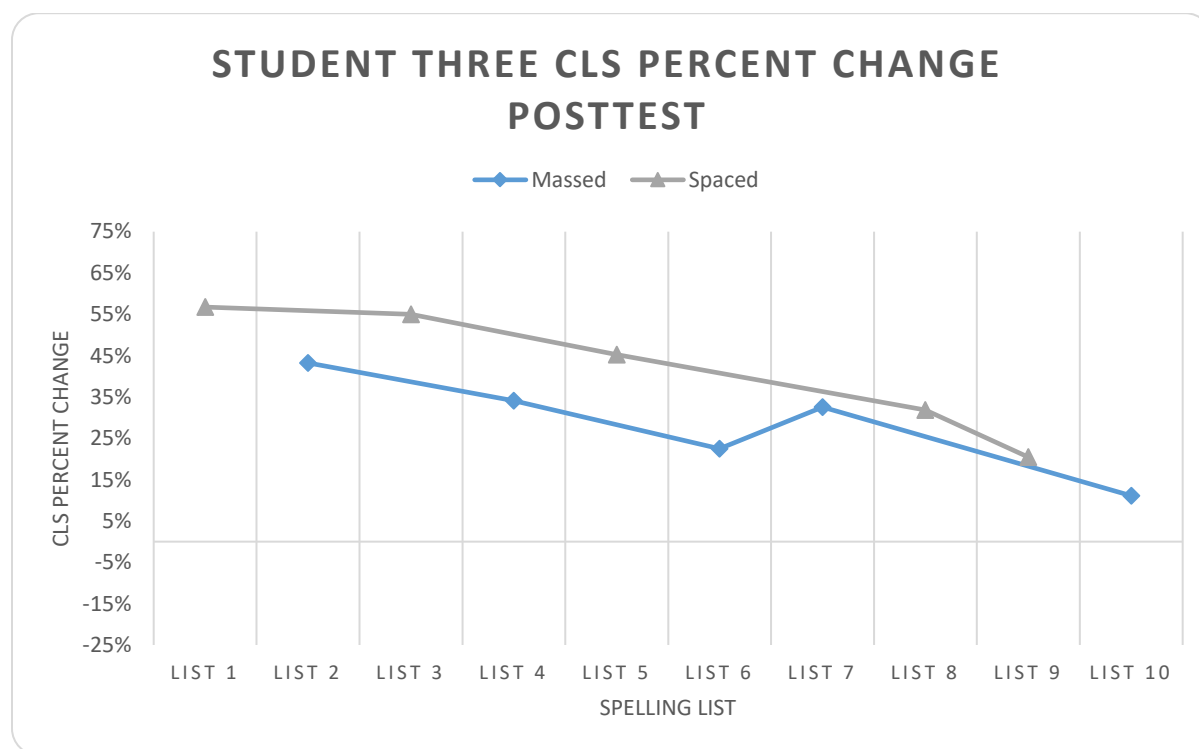
*Student Two Words Spelled Correct (WSC) Change Score Massed vs Spaced Practice Delayed*

*Retention Test*



**Figure 9**

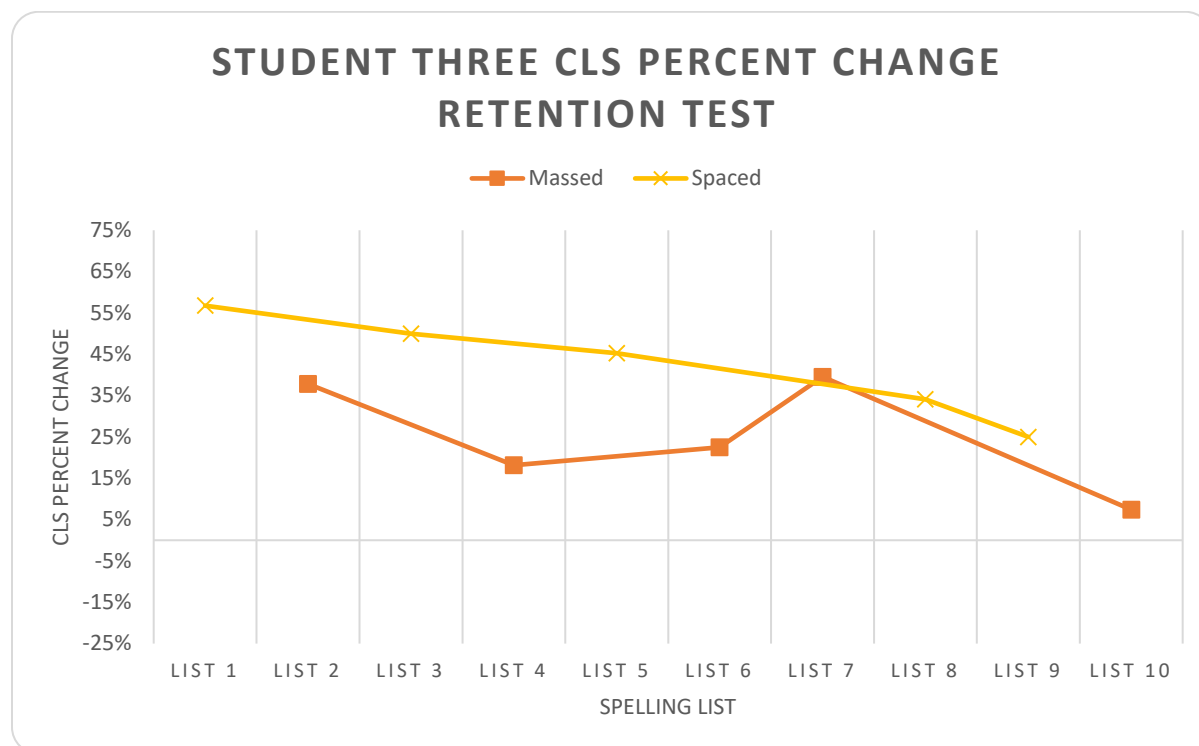
*Student Three Correct Letter Sequence (CLS) Change Score Massed vs Spaced Practice Posttest*



**Figure 10**

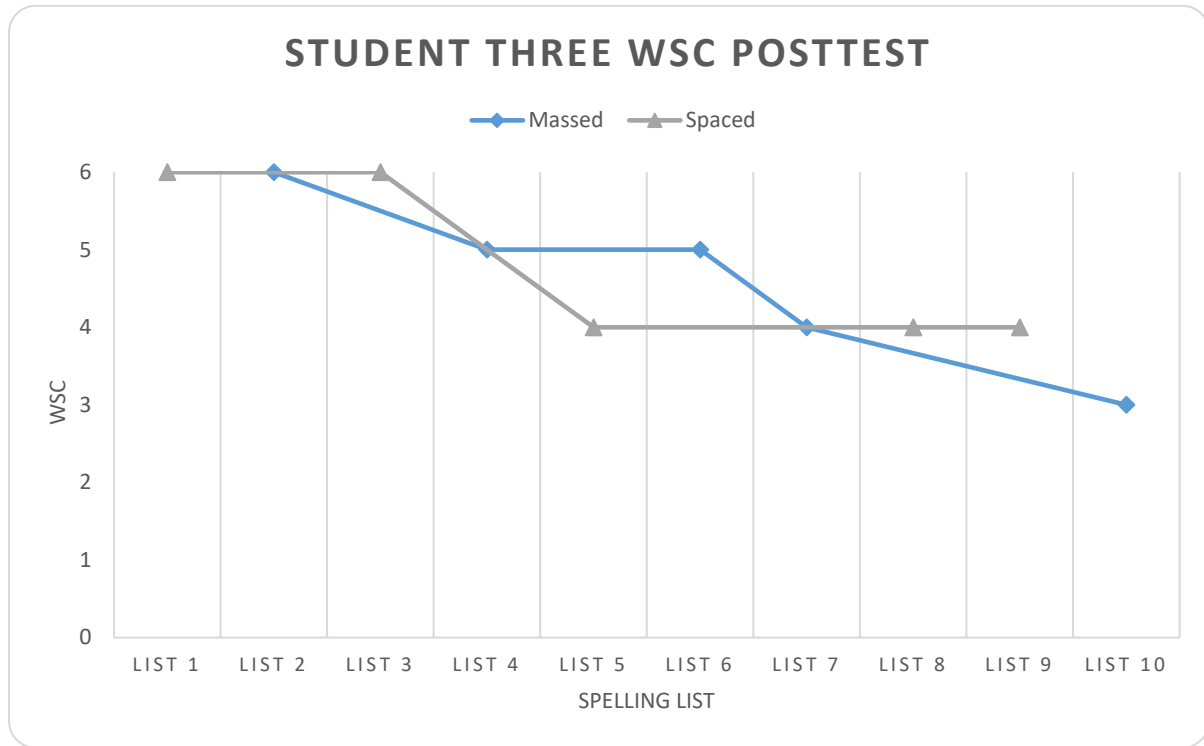
*Student Three Correct Letter Sequence (CLS) Change Score Massed vs Spaced Practice Delayed*

*Retention Test*



**Figure 11**

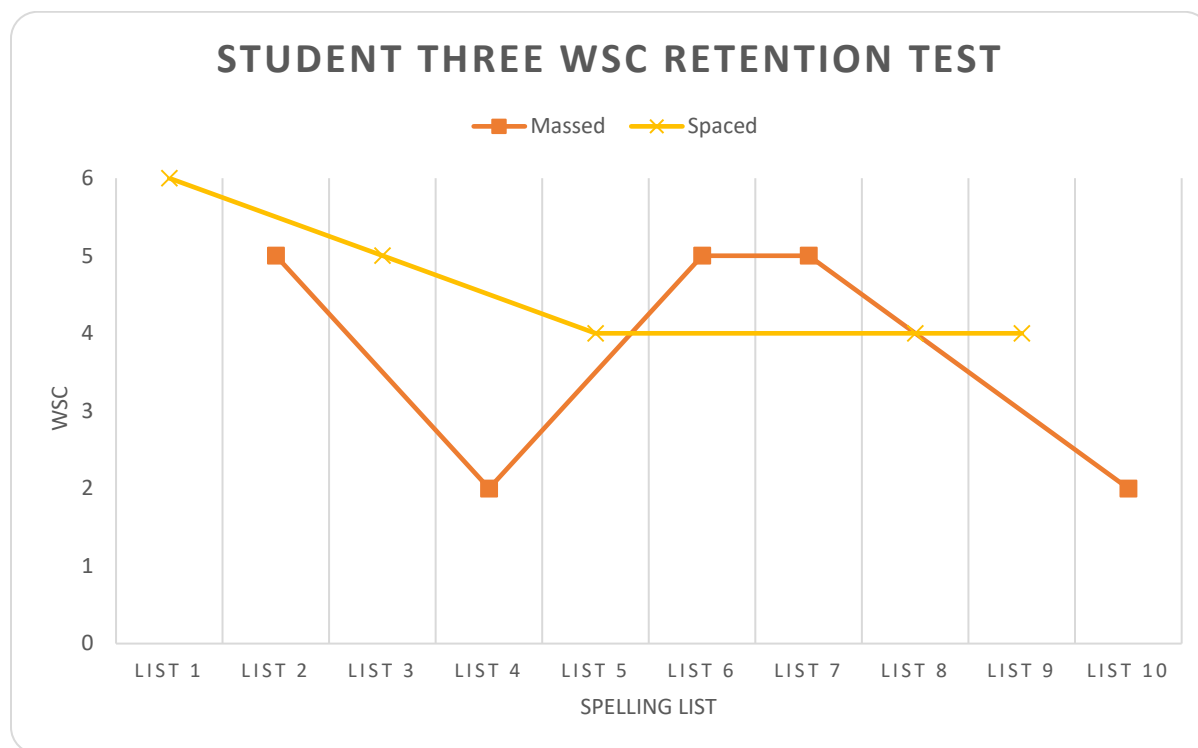
*Student Three Words Spelled Correct (WSC) Change Score Massed vs Spaced Practice Posttest*



**Figure 12**

*Student Three Words Spelled Correct (WSC) Change Score Massed vs Spaced Practice Delayed*

*Retention Test*



## Appendix A Parent Consent Form

Dear Parent or Guardian:

Your child is invited to be in a research project being completed by a small number of students in fourth grade by Melissa Engel, School Psychology Doctoral Candidate at Minnesota State University, Mankato. Melissa Engel is studying the best methods to improve spelling accuracy. Participation in this project is voluntary and you may choose if your child participates or not.

**Procedures:** If you provide consent for your child to be in the study, they will complete several activities over 7 weeks in the area of spelling during their special education services time in written language. Participants will take a spelling test which will take about 5 to 15 minutes. During the week your child would practice some of those spelling words in a single longer session and in three shorter sessions. At the end of each week, participants will again be given a brief test. Sessions will range from 5 to 15 minutes, or about 30 minutes total each day. They would use worksheets to practice the words and would study each word, cover it up, and then write it from memory. Participants will complete this work for five weeks, and 1 week later be given a post-test with half of the words they learned.

**Confidentiality:** Only researchers involved with this study, Melissa Engel, her University Advisor, and one student researcher, will be able to see the records of this study. Student names will be removed from spelling tests before they are scored, and only Melissa Engel can access the record connecting each student to their results. Your child's teachers will not receive information about how your child did.

**Voluntary Participation, Risks, and Benefits:** Participation in this project is voluntary, and you and your child have the right to stop at any time. If you would like your child to no longer participate in the research, contact me at the email address or phone number below. Your child may stop participating at any time by telling their teacher, me, or a graduate student researcher. Your decision whether or not to participate will not affect your relationship with Minnesota State University, Mankato, and refusal to participate will involve no penalty or loss of benefits. There are minimal risks to your child. They may not enjoy the activities, but this risk is not greater than for other classroom activities. By participating in this study, the student could learn how to spell up to 40 words. There are no other benefits to participation.

**Contacts:** If you have any questions about this research study, contact Shawna Petersen-Brown at (507) 389-1353, shawna.petersen-brown@mnsu.edu. If you have any questions about participants' rights and for research-related injuries, please contact the Administrator of the Institutional Review Board, at (507) 389-1242.

If you want your child to be in this study, please sign and return one copy of the form. You have a right to keep the second copy of this consent form. Your signature means that you have read this form, are at least 18 years old, and have received a copy of this form to keep.

Print your name: \_\_\_\_\_ Sign your name: \_\_\_\_\_

Print your child's name: \_\_\_\_\_ Date: \_\_\_\_\_

## Appendix B

### Child Assent Form

In order for children to participate in this project, each student must provide oral assent to participate prior to the start of the first session. Therefore, each student must orally indicate that they are willing to participate in the project before you can begin working with the student. Please read the following script to the child and document whether the student assent has been obtained.

#### Directions:

*I am interested in learning more about how children learn to spell. I would like you to learn and practice new spelling words over the next month or two months. First, I will give you a spelling test. Then I will show you a way to practice spelling words, and you will practice your spelling words three days a week. At the end of each week, you will complete another spelling test. When our practice weeks are over, you will take another spelling test on the words you practiced. I want to make sure that it is okay with you. It is totally up to you if you want to do this.*

*If you want to rest or stop completely when we work together, you can tell me or your teacher, and you will not get into any trouble. In fact, if you don't want to work with me at all, you don't have to. Also, if you have any questions about what you'll be doing, just ask me, your teacher, or your grown up, and we'll try to answer them.*

*If you would like to help me, please say yes. Do you have any questions for me, your teacher, or grown up at home? You may ask us at any time.*

*Would it be okay if we worked together in the area of spelling?"*

1. Please circle the child's response to the question:

**Yes**

**No**

**I don't know**

**No response**

2. Please provide the following information:

**Child's Name:** \_\_\_\_\_

**Date:** \_\_\_\_\_

## Appendix C

### Sample Spelling Introduction Script

1. **Introduction:** *We are going to learn to spell some words today! These are words you might see in a book or use in your own writing. Knowing how to spell words can help you read and write better.*
2. **Read and review words:** *Now we will read each word together and identify the sounds and letters that make up the word. Follow along with your finger as we read each word.*
  - a. *Point to the first word. The word is package. Let's say the sounds, /p/ /a/ /ck/ /a/ /j/. "package" is spelled "p" "a" "c" "k" "a" "g" "e".*
  - b. *Point to the next word. The word is attitude. Let's say the sounds, /a/ /t/ /i/ /t/ /oo/ /d/. "Attitude" is spelled "a" "t" "t" "i" "t" "u" "d" "e".*
  - c. *Point to the next word. The word is "alligator". Let's say the sounds, /a/ /l/ /i/ /g/ /A/ /t/ /r/. "Alligator" is spelled "a" "l" "l" "i" "g" "a" "t" "o" "r".*
  - d. *Point to the next word. The word is "dwell". Let's say the sounds, /d/ /w/ /e/ /l/. "Dwell" is spelled "d" "w" "e" "l" "l".*
  - e. *Point to the next word. The word is "spend". Let's say the sounds, /s/ /p/ /e/ /n/ /d/. "Spend" is spelled "s" "p" "e" "n" "d".*
  - f. *Point to the next word. The word is "festive". Let's say the sounds /f/ /e/ /s/ /t/ /i/ /v/. "Festive" is spelled "f" "e" "s" "t" "i" "v" "e".*
3. **Collect materials and return to folder.** *Excuse students back to their routine.*



## Appendix D

### Cover, Cover, Compare intervention script

1. **Introduce cover-copy-compare:** *Now it's time to practice writing our words. I have a special set of papers that will help you practice your words, and we use our papers in a special way.*  
*The steps are: study, cover, spell, and check. Study, cover, spell, and check. Your turn.*  
*(wait for response) Good! Study, cover, spell, and check.*  
*Let's get ready. Use your blank paper to cover all of the words except the first one. Good job!*
  - a. *First, you'll study. Look at how the first word is spelled and try to remember it in your head. When you are ready, use your blank paper to cover the word.*
  - b. *Now, spell the word in the first line.*
  - c. *Next, uncover the word and check it. Did you spell it correctly? If you spelled it correctly, you can move down to the next word. If you spelled it incorrectly, cross it out. Either way, you'll repeat the steps: study, cover, spell, and check. If you forget, the words "study, cover, spell, and check" are at the top of your pages.*  
**(Step 1 may be eliminated when students show independence in initiating CCC).**
2. **Give instructions:** *Please practice your words all the way to the end of the page, then move on to the next page (show with sample). I'll be here to help and answer questions, and if you aren't finished when time runs out, that's ok. Remember: study, cover, spell, and check!*
3. **Start stopwatch:** Start timer or stop watch to monitor time.
4. **Support:** Provides support for task completion and behavioral engagement
5. **Session end times:** Spaced practice sessions end after 5 minutes. Massed practice sessions end after 15 minutes.

## Appendix E

## Spelling test script

1. Hand out blank spelling test paper to students
2. Read each word and sentence slowly, do not move on until students have written their answers.
  - a. *Package. When the package arrived, Danny hurried to open it. Package.*
  - b. *Attitude. If you have a positive attitude, the challenges you face will not seem so bad. Attitude.*
  - c. *Alligator. I saw an alligator sitting out on the golf course last Saturday! Alligator.*
  - d. *Dwell. Stephan tries not to dwell on negative thoughts. Dwell.*
  - e. *Spend. Our neighbors spend three weeks at the seashore every August. Spend.*
  - f. *Festive. Those balloons and colorful streamers make the room look festive for the party. Festive.*
3. Collect spelling tests and return to folder. Excuse students back to their routine.

## Appendix F

*Cover, Copy, Compare worksheet – massed practice worksheet x3*

## Cover, Copy, Compare

1.free \_\_\_\_\_

2.read \_\_\_\_\_

3.beak \_\_\_\_\_

4.baby \_\_\_\_\_

5.lady \_\_\_\_\_

6.only \_\_\_\_\_

1.free \_\_\_\_\_

2.read \_\_\_\_\_

3.beak \_\_\_\_\_

4.baby \_\_\_\_\_

5.lady \_\_\_\_\_

6.only \_\_\_\_\_

1.free \_\_\_\_\_

2.read \_\_\_\_\_

3.beak \_\_\_\_\_

4.baby \_\_\_\_\_

5.lady \_\_\_\_\_

6.only \_\_\_\_\_

1.free \_\_\_\_\_

2.read \_\_\_\_\_

3.beak \_\_\_\_\_

4.baby \_\_\_\_\_

5.lady \_\_\_\_\_

6.only \_\_\_\_\_

1.free \_\_\_\_\_

2.read \_\_\_\_\_

3.beak \_\_\_\_\_

4.baby \_\_\_\_\_

5.lady \_\_\_\_\_

6.only \_\_\_\_\_

1.free \_\_\_\_\_

2.read \_\_\_\_\_

3.beak \_\_\_\_\_

4.baby \_\_\_\_\_

5.lady \_\_\_\_\_

6.only \_\_\_\_\_

## Appendix G

*Cover, Copy, Compare worksheet – spaced practice worksheet*

## Cover, Copy, Compare

1.noise \_\_\_\_\_

2.broil \_\_\_\_\_

3.soil \_\_\_\_\_

4.loyal \_\_\_\_\_

5.avoid \_\_\_\_\_

6.voyage \_\_\_\_\_

1.noise \_\_\_\_\_

2.broil \_\_\_\_\_

3.soil \_\_\_\_\_

4.loyal \_\_\_\_\_

5.avoid \_\_\_\_\_

6.voyage \_\_\_\_\_

## Appendix H

## Pre-test Checklist

Step	Yes	No
1. Records if student(s) are present or absent		
2. Distributes paper for the spelling pretest to students		
3. Reads from the script provided for the test		
4. Collect tests then distribute list of spelling words		
5. Reads from script to introduce the spelling words		
6. Ensures students are following along and pointing to the spelling words in introduction		
7. Returns materials to folder		
TOTAL NUMBER OF STEPS FOLLOWED		

## CCC Daily Intervention Fidelity Checklist

Step	Session 1	Session 2	Session 3
Records if student(s) are present or absent			
Distributes CCC worksheet for the sessions			
Starts stop-watch when work begins			
Provides support for task completion and behavioral engagement			
Records time when session is complete			
Records opportunities to practice completed for each student			
Returns completed CCC worksheet to folder			

## Posttest Checklist

Step	Yes	No
1. Records if student(s) are present or absent		
2. Distributes paper for the spelling test to students		
3. Reads from the script provided for the test		
4. Ensures students are actively engaged in completing the test		
7. Returns materials to folder		
TOTAL NUMBER OF STEPS FOLLOWED		

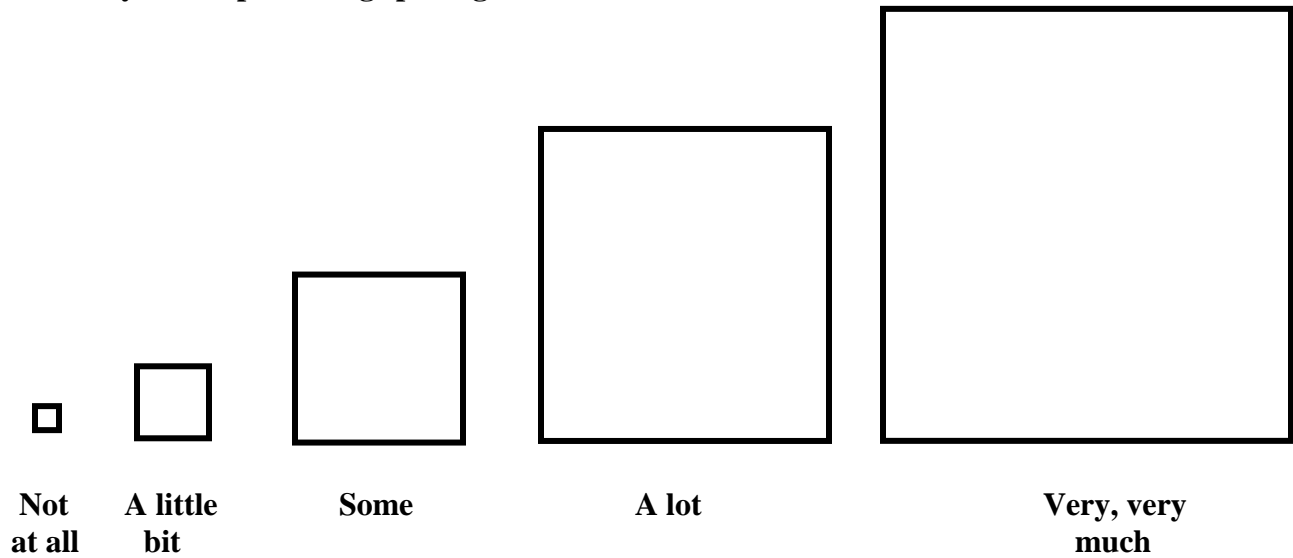
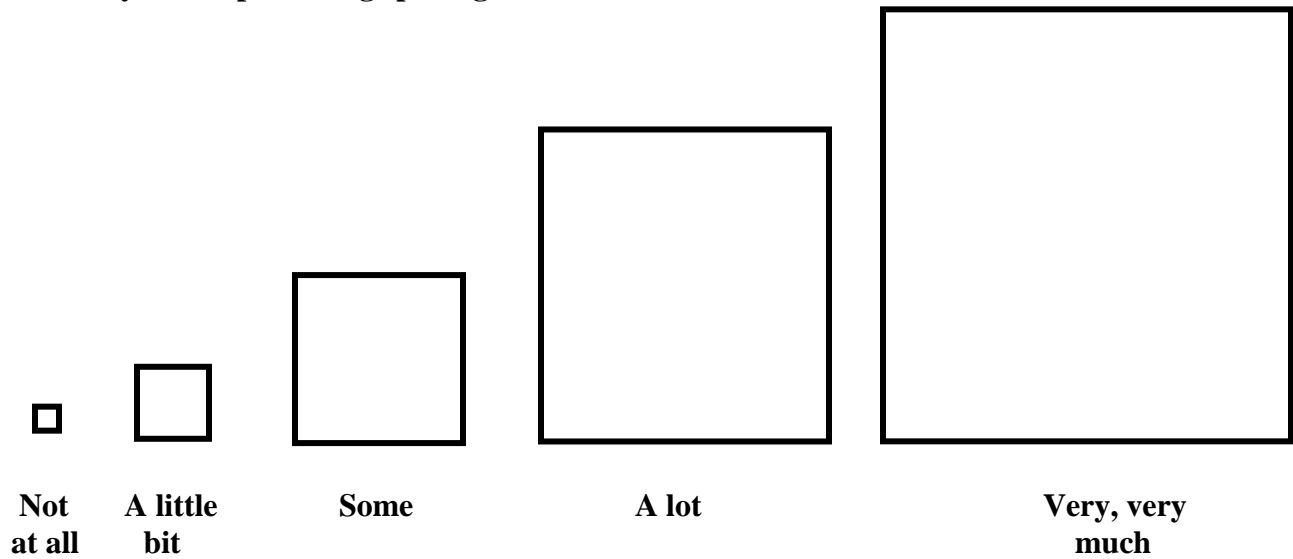
## Appendix I

## Block 1 Day 1

	1		2		3	
8:10	Spelling & CCC intro	Attendance: Y      N	Spelling & CCC intro	Attendance: Y      N		
	CCC 5 min	Time:	CCC 15 min	Time:		
8:20		Opportunities completed:	CCC 15 min	Opportunities completed:	Spelling & CCC intro	Attendance: Y      N
					CCC 5 min.	Time:
						Opportunities completed:
9:20	CCC 5 min.	Attendance: Y      N			CCC 5 min	Attendance: Y      N
		Time:				Time:
		Opportunities completed:				Opportunities completed:
2:20	CCC 5 min	Attendance: Y      N			CCC 5 min	Attendance: Y      N
		Time:				Time:
		Opportunities completed:				Opportunities completed:

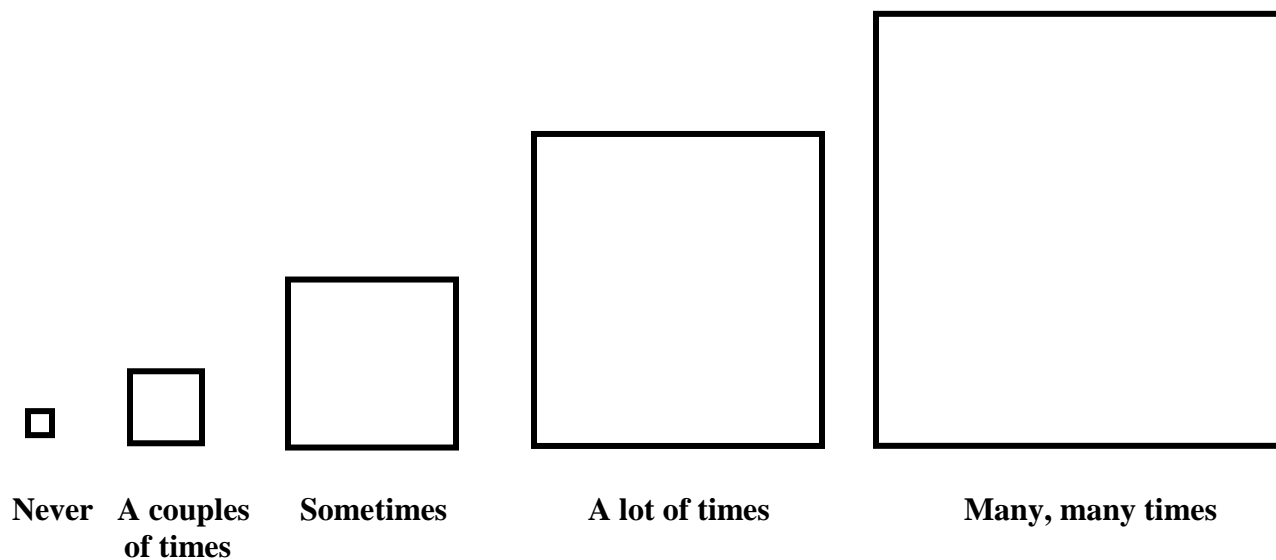


## Appendix J

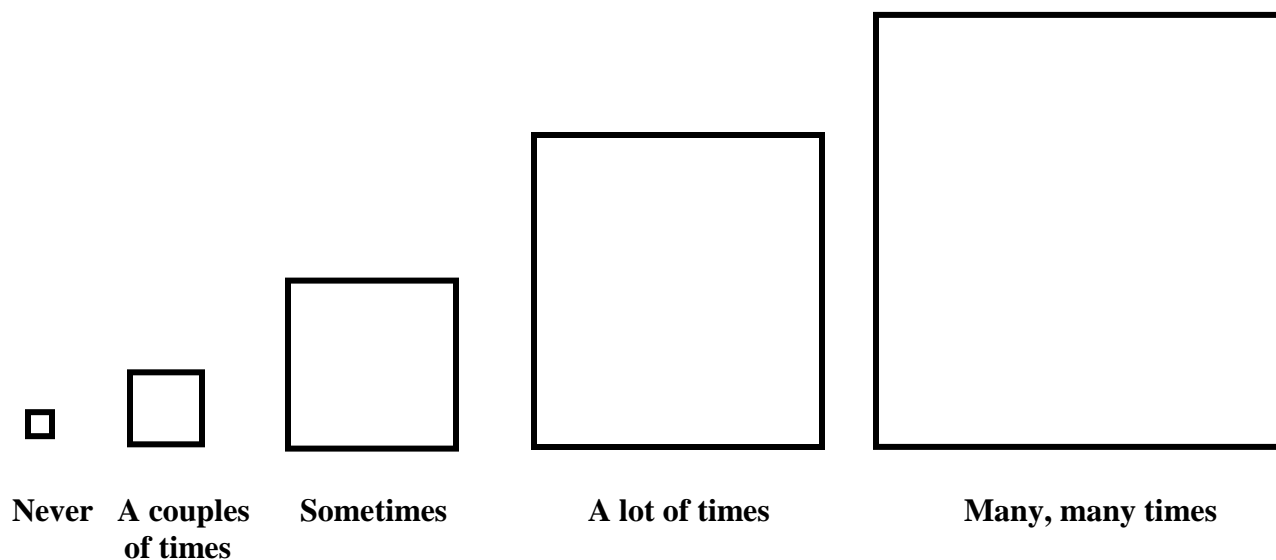
**KIDS INTERVENTION PROFILE (KIP)****Question # 1****How much do you like practicing spelling words?****Question # 2****How much do you like practicing spelling words on worksheets?**

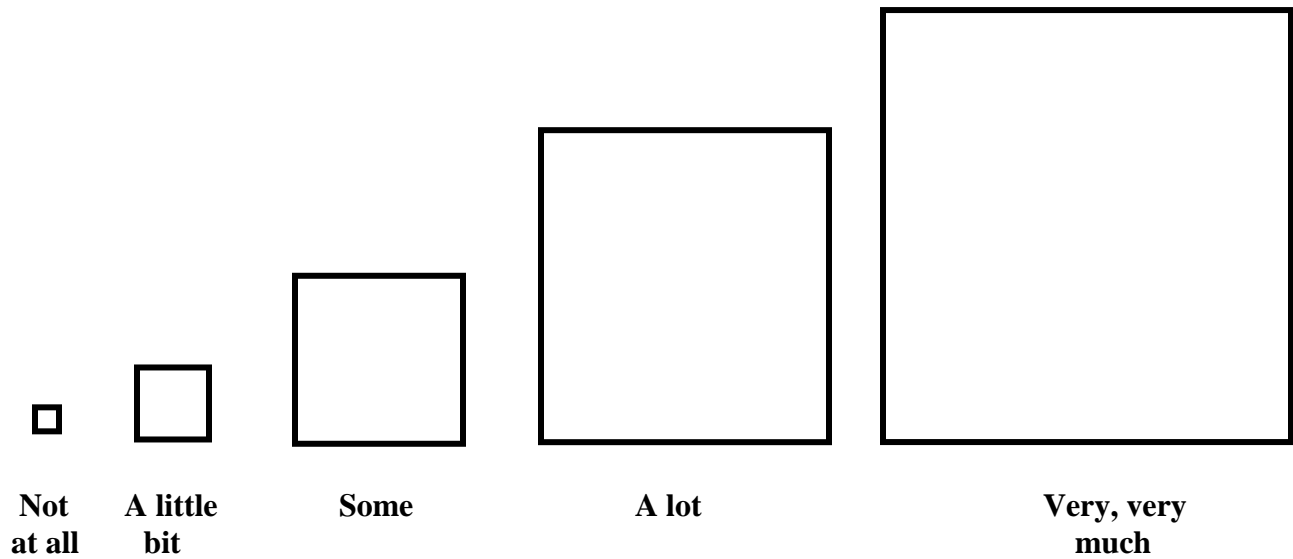
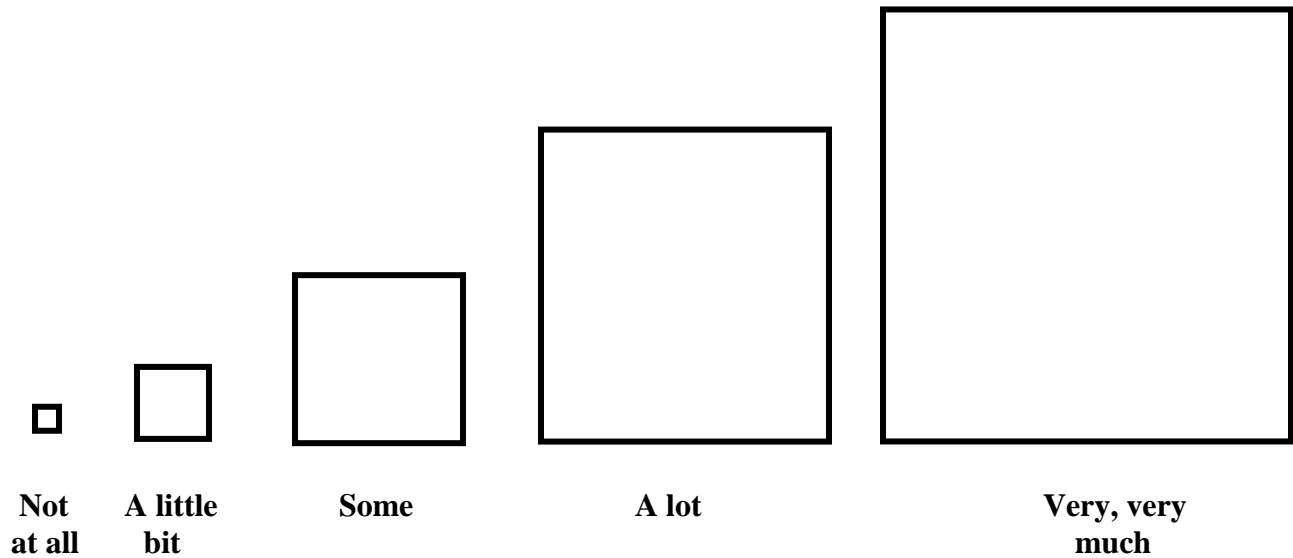
**Question # 3**

**Were there times when you didn't want to practice spelling words on worksheets?**

**Question # 4**

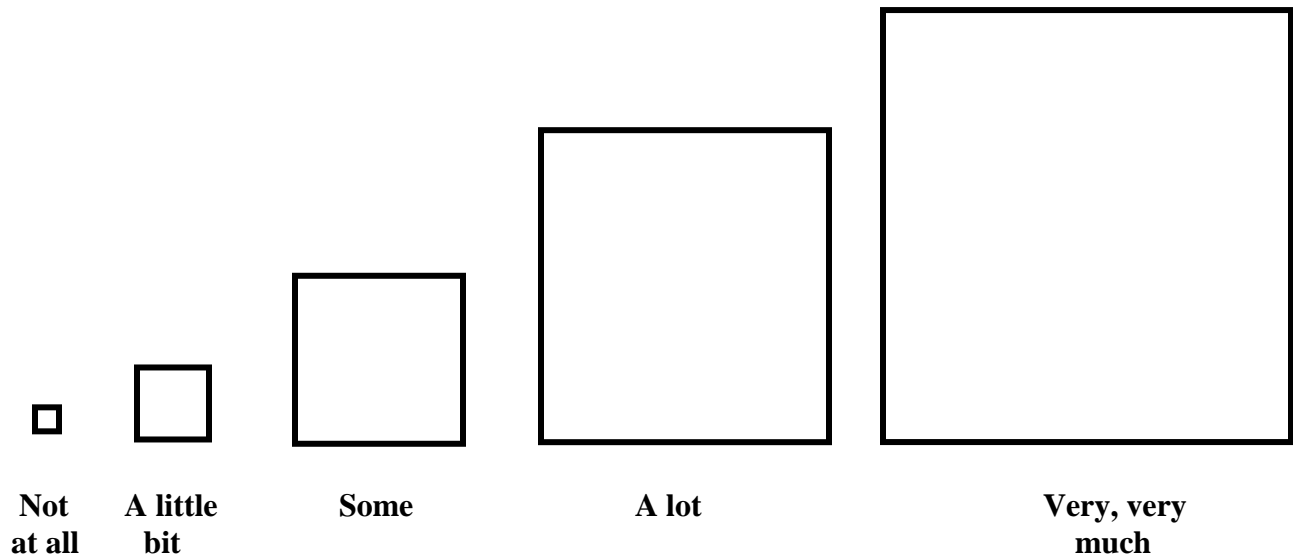
**Were there any times when you wished you could work more on practicing spelling words on worksheets?**



**Question # 5****How much do you like practicing spelling words on worksheets?****Question # 6****How much do you think it helps you when you practice spelling words using worksheets?**

**Question # 7**

**Do you think your spelling has improved from practicing on worksheets?**

**Question # 8**

**Do you think your spelling has gotten worse from practicing using worksheets?**

