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Spelling, Spaced Retrieval, and Vocabulary

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Abstract

An individual's knowledge of spelling, also known as orthographic knowledge, is comprised of three parts: phonology, morphology, and memory. While specific spelling instruction has been shown to be beneficial for students, spelling is often underemphasized in current curricula, and the instruction that does exist often emphasizes just one component of spelling rather than balancing all three. This case study explored the use of Spaced Retrieval training as an enhancement to traditional Semantic and Vocabulary instruction, examining whether this combination of methods would increase the participant's percentage of words correct on a 40 word spelling test. Spaced Retrieval served as a systematic memory component of instruction, combined with the phonology and morphology included in the traditional spelling instruction methods. During four intervention sessions, the participant studied 80 words which comprised four 20-word units, each of which focused on a particular English spelling rule. The words in each unit were taught using both traditional rule base instruction and Spaced Retrieval. While the participant's 40 word pre-test/post-test comparison improvement by only one correct word, examination of his post-test errors suggested a preliminary understanding of the target spelling rules, and his approach to spelling (i.e. editing, conscious application of rules) was observed to improve significantly by the end of the study. The participant also showed retention of words learned by Spaced Retrieval up to twelve days after his first intervention session.

Spelling, Spaced Retrieval, and Vocabulary

The act of spelling is an intricate process that requires writers to associate their knowledge of a language's phonemes with its graphemes to produce accurate results (Apel, 2011). This process is further complicated by the number of rules that must be applied as words become more morphologically complex (Bourassa & Trieman, 2008), as well as the vast array of irregular spellings that must essentially be memorized to be used (Apel, 2011). These three elements: phonology, morphology, and memory, are coordinated by a skilled speller to allow for correct visual representations of their language. Unfortunately, spelling instruction is difficult for teachers, particularly when a number of researchers are of the opinion that explicit spelling instruction is unnecessary and that students can learn what orthographic knowledge they need through reading instruction. When teachers do teach spelling, they focus a great deal on phonology at the expense of the other two components (Morris, Blanton, Blanton, & Perney, 1995). This study examined a new technique for teaching spelling that contains an explicit memory component, the use of Spaced Retrieval training, combined with more traditional Semantic and Vocabulary instruction to incorporate the phonological and morphological aspects as well.

The Process of Spelling

Phonological Component

The first component of spelling involves knowledge of the phonology of a language. Apel (2011) refers to this as Orthographic Pattern Knowledge, or how spoken language must be represented in writing. One component of Orthographic Pattern Knowledge is alphabetic knowledge, or simple sound-letter correspondence. However, other patterns must also be

learned, as many phonemes are represented by digraphs (i.e. *ch* or *th*), and other phonemes may be represented in multiple ways (i.e. the /I/ sound in *fish*, *women*, and *symbol*; Apel, 2011).

Another conception of the phonological component is the phonological route of spelling, one half of the “dual route” model of spelling described by Bosman and Van Orden (1997). The phonological route is a simple phoneme-to-grapheme converter which is challenged by more complex orthographic patterns. This route, therefore, is responsible for children’s phonologically “accurate” misspellings, such as WIMEN for *women*. The second route, the lexical route, relies more on memory than phonological knowledge and will be discussed more fully below.

Morphological Component

Beyond phonology, morphological knowledge also plays a role in English spelling due to the morphological consistency of the language. Many English words preserve morphological meaning and spelling as more complex words are formed from roots, even if the phonology of a word changes (Arndt & Foorman, 2010, Bourassa & Treiman, 2008). Words such as *sign/signal* and *music/musician* exemplify this morphological consistency and fall in Bourassa and Trieman’s category of “Phonological Change.” Young spellers who successfully employ their morphological knowledge toward spelling will produce correct spellings of the morphologically complex *signal* and *musician*, even though the phonology of these words is different from their roots, *sign* and *music*. Exceptions to this rule fall into three other categories. “No Change” words such as *warm/warmth* retain both the spelling and phonology in the morphologically complex word. A few “orthographic change” words actually change the spelling but retain the phonology, as in *happy/happiness*. “Both change” words, such as *explain/explanation* require both the phonology and the orthography to change when the new morpheme is added. Spellers with some

degree of morphological knowledge often erroneously produce EXPLANATION, which would follow the common phonological change pattern (Bourassa & Trieman, 2008).

These categorical changes support that, while morphological knowledge is important for spelling, the large number of options for handling morphologically complex words can be confusing for young spellers. Arndt and Foorman (2010) found that morphological errors, including omission or misspelling of prefixes or suffixes, as well as improperly modified root words, were the most common misspellings among second graders. Clearly, while phonological and morphological knowledge are crucial to successful spelling, the large number of errors still possible necessitates another component to the spelling process if correct standard spellings are to be consistently produced.

Memory Component

The third major component of spelling is the role of memory. According to Apel (2011), spellers form and store Mental Graphemic Representations (MGRs), stored representations or “mental images” of words and word parts that allow the speller to produce the correct graphemes in a word without processing each phoneme or morpheme individually. Analogously, Bosman and Van Orden’s (1997) dual routes model is completed by the lexical route, which produces whole-word spellings. This lexical route is said to be responsible for any non-phonetic misspellings produced, such as a transposition of graphemes (WAMRTH for *warmth*, for example).

Several theories have been presented as to how the brain stores and retrieves these MGRs, as well as stored orthographic patterns. One example is Baddeley’s (2003) view of a four part short-term or “working memory,” where information may be stored and manipulated for a short amount of time, but will be lost in a matter of seconds if not rehearsed and refreshed. The

first part of Baddeley's working memory is the phonological loop, which is an oral language device used for matching names to objects and situations (Berringer & Abbott, 2010). The phonological loop itself is believed to have two subcomponents. The first is a temporary storage system that temporarily holds phonological information, and the second is a subvocal rehearsal system, which the individual uses to mentally rehearse information in order to retain it longer. Not surprisingly, the phonological loop is believed to be the most crucial for learning to read and spell new words, because it allows for phonological connections to visual input, such as a series of graphemes (Baddeley, 2003). The second component in Baddeley's model is the visiospatial "scratch pad," in which spatial, visual, and kinetic information are consolidated into a usable whole and temporarily stored. This component probably has little to do with reading or spelling, except possibly facilitating accurate eye movement across a page of text (Baddeley, 2003). The third component is a central executive, which facilitates attention to and inhibition of relevant or irrelevant information. This component is believed to be a major factor in determining an individual's working memory span (Baddeley, 2003). Lastly, the episodic buffer combines information from various other sources into usable chunks or episodes in memory (Baddeley, 2003).

Another theory, the Triple Word Form theory discussed by Berringer and Abbott (2010), suggests that working memory contains three units for processing words: phonological, morphological, and orthographic. Coding, analyzing, and coordinating these units is necessary for both reading and writing. They also suggest that because the morphological unit is utilized in both spoken and written language, it may play a role in integrating the other two units, though further research is needed to confirm this.

The Importance of Spelling Instruction

A young student's orthographic knowledge plays a unique role in their learning of other aspects of language. Overall, the relationship between reading and spelling tends to be asymmetrical. In short, most readers can read significantly more words than they can readily spell (Arndt & Foorman, 2010; Bosman & Van Orden, 1997). In spite of this, the correlation between the two skills tends to be fairly high, leading some to claim that spelling and reading are actually one process. Others claim that different processes are at work: an individual reads by "ear" and spells by "eye" (Bosman and Van Orden, 1997). In any case, reading and spelling are certainly linked. However, teaching reading without explicit spelling instruction is not enough to optimize a student's orthographic knowledge, and may hinder their reading ability and vocabulary as well. Arndt and Foorman (2010) claim that, due to the morphological consistency of English discussed above, increased knowledge of spelling can actually improve both literacy and vocabulary beyond pure reading instruction. If children learn to recognize and spell root words, prefixes, and suffixes, they will more easily read and comprehend novel words that they encounter which contain those word parts. A study done by Rosenthal and Ehri in 2008 found that orthography is linked to both literacy and phonology. When second graders were presented with a novel pictured item, they were more likely to correctly pronounce and define the item later in the memory task if the item's name was printed below the picture than when no written name was given. This effect proved true even though the researcher did not draw the children's attention to the written name. Clearly, learning orthography explicitly is extremely advantageous for students.

Traditional and Current Spelling Instruction Methods

Professional Views

Though research has revealed so many complex components within the process of spelling, both researchers and teachers are divided as to how to make spelling instruction reflect these concepts. Researchers generally are divided in two groups: traditionalists and reformers. Traditionalists support the continued use of the spelling textbooks that teachers have used for decades. They believe that, when used correctly, these textbooks allow students to internalize the orthographic patterns in the approximately 3000 words they study from second to eighth grades (Morris, et al., 1995). Reformers believe that these textbooks are outdated, and that students would learn better through incidental teaching. They suggest that teachers give ample opportunities for reading and writing, and that they should correct student's spelling errors as they occur, rather than requiring rote memorization of a weekly list.

A study by Schlagal (2002) found that teachers' viewpoints and practices tend to fall into three categories. The Basal Speller group aligns most with the traditionalist research group. They agree that the use of weekly spelling lists helps students internalize orthographic patterns, and they support the use of textbooks because these books provide a progressive series of developmentally appropriate words. The incidental group is in agreement with the reformist researchers, believing that spelling is best taught through mini lessons and editing workshops within writing activities, rather than as a subject of its own. Lastly, some teachers fall into a third group, the developmental word study group. These teachers agree with the basal speller group that spelling should be systematically taught, but also see the value of an individualized component, as supported by the incidental group. Developmental word study teachers assign lists of words based on individuals' or small groups' skill levels and needs. Each has a target set of

orthographic patterns to learn, and the teacher's instruction is tailored to promote growth and monitor individual progress through the school year.

Instructional Practices

In 1995, a typical weekly unit in a spelling textbook included the following:

Day 1: The teacher introduces words and emphasizes the pattern highlighted by the unit (affixes, long/short vowels, etc; Morris et al., 1995). Some books recommend a pretest of the words as well, but because it is listed as optional, many teachers will skip this step (Schlagal, 2002).

Days 2-4: Teachers lead students through practice of words through alphabetizing, proofreading activities, dictionary skills, fill-in-the-blanks, etc (Morris et al., 1995). Many of these activities are more Language Arts related, and very little evidence exists that they help with actual orthographic knowledge at all. These activities neither support memorization of spelling words nor generalization of the orthographic patterns they contain (Johnson, 2001).

Day 5: The teacher gives a spelling test on the unit words (Morris et al., 1995).

Throughout this sample routine, the recommended teacher instruction in the book focuses almost solely on the phonological component of spelling, to the exclusion of any others, encouraging teachers to point out sounds in the words but not necessarily how these sounds were affected by morphological changes (Morris et al., 1995). Research also indicates that a practice method of giving a pretest of the words at the beginning of the week, then having students write missed words correctly three times, can be very effective in encouraging students to memorize the words and also learn the patterns within them (Schlagal, 2002). Unfortunately, study methods like this tend to be mentioned only in passing in spelling books, if at all, and are therefore underemphasized by teachers (Morris et al., 1995), hindering the memory component of spelling.

Given the obvious flaws in instructional practices based on spelling textbooks, one might be relieved to learn that the recent trend has been a slight progression away from spelling textbooks. Morris and colleagues in 1995 found that the observed teachers showed a 99% adherence to the textbook's instructions and activities. By 2001, however, Johnson found that only 50% of teachers interviewed used spelling textbooks at all, and only 29% used them exclusively. Unfortunately, spelling instruction beyond textbooks is no more solid or researched-based than instruction from the books. Fifty-two percent of teachers surveyed by Johnson (2001) were given no instructions whatsoever by their school system how to actually teach spelling, and those who were specifically told not to use spelling textbooks were not given a clear alternative. Many of these teachers have turned to an "alternative approach," in which they still used a traditional weekly spelling list, but they invented the lists themselves. The words were either drawn from content areas from other subjects the students were studying, or students were allowed to choose words themselves from a long list developed by the class. Some teachers also used a slightly more developmental approach and compiled lists based on each student's errors. In any case, the resulting word lists rarely shared any orthographic patterns, causing students to rely solely on the memory component of spelling and not allowing for any generalization of phonology or morphology to words within or beyond the list (Johnson, 2001). Practices like this require students to simply memorize a list of challenging, low-frequency spelling words (such as "leprechaun" and "constitution") that will not greatly aid them in their daily writing or in developing their orthographic knowledge (Schlagal, 2002). Overall, current instructional practices still ignore research-based practices such as a weekly pretest of the words or practice methods, and teachers rarely provide sufficient opportunities for students to perceive and manipulate various orthographic patterns to understand how they work (i.e. contrasting "hop"

and “hope” or “cut” and “cute” to explore the vowel-consonant-silent –e pattern; Schlagal, 2002).

Student Performance

When using spelling textbooks organized by grade level, students seem to benefit most if they already have some knowledge of their “grade level” lists. In fact, when Morris and colleagues (1995) examined the results of a beginning-of-the-year pretest, students correctly spelled an average of 40-50% of grade-level words for the grade they had just entered. As the year progressed, many students excelled on the weekly tests, scoring above 90%. However, by the end of the year, they could still only spell an average of 74% of words from their spelling textbook correctly on a posttest, and only 68% of “transfer words,” words not explicitly taught but containing similar sounds and orthographic patterns. This indicates that some generalization of patterns was occurring, but not nearly enough for children to become fully competent spellers by the time their formal spelling instruction ends in 8th grade (Morris et al., 1995). Most teachers who support the use of a textbook note the importance of learning orthographic patterns. Unfortunately, teachers who stick too closely to the textbook “script” find themselves only briefly drawing students’ attention to these patterns, and almost never assigning activities that would allow the students to examine and manipulate these patterns in order to better understand them (Morris et al., 1995).

The main argument many researchers and teachers have against spelling textbooks is that they do not offer a range of instructional levels for various levels of spelling performance. When student errors are examined, however, low-performing spellers tend to make the same types of errors (phonological, orthographic image, orthographic, transposition, and morphological) as grade-level spellers, they just make them more frequently (Arndt & Foorman, 2010). This

indicates, then, that lower-performing spellers are typically not disordered but simply delayed. In other words, these spellers are performing at a lower “spelling instructional level” and may not have sufficient spelling knowledge to benefit from grade-level instruction. A clear sign of this is a student who does well on Friday tests but forgets the words by the unit review test, or who does not spell their explicitly-taught spelling words correctly in their own writing. The issue may not be that spelling textbooks are not effective, however. One possibility is that these students are being taught above their current instructional level and therefore are not able to retain words from week to week (Schlagal, 2002). For these students, teachers can still use formal spelling instruction and spelling textbooks, but the appropriate action would be to give them a lower-difficulty spelling list from a lower grade level spelling textbook. Many teachers have assumed that the memory load was simply too great for low-performing students and have therefore assigned an abbreviated version of the same list used by the rest of the class. Unfortunately, this only addresses the memory component, and does not help these students develop the phonological and morphological knowledge necessary to catch up to their classmates (Johnson, 2001).

Spaced Retrieval and Spelling

Description of Spaced Retrieval Training

Traditional spelling instruction focuses a great deal on semantic aspects of words, but it does not typically employ a systematic, truly intentional memory component that would reflect the large role that memory plays in the spelling process. Research suggests that working memory may not be a fixed ability, but may be subject to improvement through changes in the student’s environment and method of learning (Berninger & Abbot, 2010). The current study is based on the idea that Spaced Retrieval training may be an appropriate instructional change and provide an

answer to the imbalance of semantics and memory in most spelling curricula. Spaced Retrieval training is a training procedure characterized by gradually expanded delays between trials (Hochhalter, Bakke, Holub, & Overmier, 2008). In other words, participants are told the target information and asked to repeat it (0 second delay). If the participant repeats the information successfully, the researcher will wait a set amount of time, such as 10 seconds, and ask for another recall. After each correct response, the researcher will wait for predetermined, progressively longer intervals (i.e. 30 seconds, 1 minute, 3 minutes, etc.) before asking for the target information. If the participant gives an incorrect response, the researcher will provide the correct information and ask the participant to repeat it again (Hochhalter et al, 2008). This technique has been shown to be effective in elderly participants with various memory impairments, including Alzheimer's disease (Hochhalter et al, 2008, Cherry & Simmons-D'Gerolamo, 2005), anomia, Parkinson's disease, cerebral vascular accidents, and alcohol-induced dementia (Hochhalter et al, 2008).

Variations of Spaced Retrieval

Different variations on this type of memory task have been explored by researchers. The expanding delays that characterize Spaced Retrieval seem to be significant: in Hochhalter and colleagues' study, 8 of the 10 participants learned the target information with Spaced Retrieval, but none learned information effectively with Uniform Retrieval training, which held the between-trial delay constant (Hochhalter et al., 2008). Adjustments to traditional Spaced Retrieval may also be helpful, depending on the population. For example, Hochhalter and colleagues implemented what they referred to as "Adjusted Spaced Retrieval Training" (ASRT). In this method, the between-trial delay depended upon the correctness of the response. For example, using the time intervals stated above, if a participant responded correctly after the 30

second delay, the delay would increase to 1 minute before the next response. However, if the participant responded incorrectly, the time before the next response decreased to 10 seconds. In other words, the researcher would take a step backward instead of a step forward. Hochhalter and colleagues (2008) stated that this might have been even more effective if the time intervals were adjusted according to each individual's performance, instead of being restricted to forward and backward steps within set intervals, but further research would be needed to prove this claim.

Cherry and Simmons-D'Gerolamo (2005) explored the effectiveness of object orientation tasks before commencing Spaced Retrieval training to aid memory of object names. Researchers would engage participants in casual conversation about the target objects in front of them before beginning any training. They found that the object orientation group achieved longer duration intervals between correct responses than participants who did not participate in orientation tasks.

Effectiveness

The effects of Spaced Retrieval seem to benefit participants long-term. In a study by Cherry and Simmons-D'Gerolamo (2005) on patients with Alzheimer's disease, participants who had previously received Spaced Retrieval training one year prior outperformed participants who were receiving the training for the first time. The more experienced participants had fewer failed attempts and attained longer retention durations in the study than the other participants that had never experienced spaced retrieval before.

While Spaced Retrieval training has been shown to be effective in helping adult patients with memory loss (i.e. Alzheimer's disease), at the time of writing this technique had not been used for children with spelling impairment. This study, therefore, is a case study that will examine how enhancing the memory component of spelling through Spaced Retrieval, combined

with traditional Semantic/Vocabulary instruction of orthographic patterns and word meaning, can improve the spelling performance of the participant.

Research Questions and Hypotheses

Research Question: Will Spaced Retrieval training, combined with traditional semantic spelling instruction, improve the percentage of words spelled correctly by one participant on a forty word spelling test?

Hypothesis: The participant's spelling performance should improve, given that the memory component of spelling is being addressed through Spaced Retrieval training, in addition to the phonological and morphological components through the traditional methods.

Methods

Participant

The participant for this study was Reggie¹. He was 12 years, 4 months old and in the spring of his 6th grade year. Reggie had been in therapy for his writing and spelling difficulties for 6 months. His clinician had introduced him to Spaced Retrieval training briefly before formal therapy began as a study technique for his school spelling tests, but he had not used it frequently, as he did not have any remaining spelling tests for the year. At the beginning of the study, Reggie's largest difficulty seemed to be remembering basic spelling rules and understanding when to apply them. He also paid little attention to editing or self-correction. His receptive and expressive verbal language skills assessed both through standardized testing (see Materials section) and through candid conversation were age-appropriate or better.

Materials

Several standardized tests were administered to Reggie to ensure that his difficulty with spelling was not a result of broader language impairment. The nature of the study also required

¹ Name has been changed to protect the participant's privacy.

Reggie to have at least age-appropriate short term memory capacity, as well as a 2nd grade level of spelling or higher, which was verified in standard assessment as well. The majority of the following standardized tests were administered in the first 60 minute session, but due to time constraints, the OWLS Listening Comprehension subtest was given at the beginning of the second session.

Reggie's receptive vocabulary ability was assessed using the *Peabody Picture Vocabulary Test - Fourth Edition* (PPVT-4; Dunn & Dunn, 2007). Based on the instructions in the PPVT-4 manual, he was instructed to identify the picture that best represented a target word from a page containing four colored pictures. A raw score, standard score, and percentile rank were calculated using the PPVT-4 administration manual. Scores are contained in Table 1.

Two subtests of the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner, Torgesen, & Rashotte, 1999) were given to Reggie. The Elision subtest assessed his current phonological processing ability, and also his working memory capacity. Reggie was asked to repeat a word, and then asked to mentally remove a specific sound from each word and say the new word that was created. The instructions for one test item, for example, read, "Say *bold*. Now say *bold* without saying /b/." The correct response from the participant would be "old." Next, the Memory for Digits subtest was administered to ensure that Reggie possessed the short-term memory skills to perform the Spaced Retrieval task within the study. Series of numbers, gradually increasing from two digits to eight digits, were presented by a prerecorded voice, and Reggie was asked to repeat the numbers in the order he heard them. For each subtest, a raw score, standard score, and percentile rank were obtained from the CTOPP administration manual. The scores for both subtests are contained in Table 1.

The Listening Comprehension and Oral Expression subtests of the *Oral and Written Language Scales* (OWLS; Carrow-Woolfolk, 1995) were also administered. The Listening Comprehension subtest is very similar to the PPVT-4 in procedure, but explores listening comprehension as a whole, rather than isolating receptive vocabulary skills. Reggie was asked to identify which of four pictures on each page best represented the target word, and the scores obtained provided another measure of his receptive language ability. The Oral Expression test required Reggie to respond verbally to a series of verbal and visual stimuli; he was asked to answer questions, complete sentences, and generate sentences in a correct and logical manner. Raw scores, standard scores and percentile ranks for each subtest are contained in Table 1.

The *Test of Written Spelling - Fourth Edition* (TWS-4; Larsen, Hammill, & Moats, 1999), form A, was also administered to Reggie to ensure that his current spelling level was above a 2nd grade level. The investigator read the target word (e.g., *bed*), followed by the target word in a short sentence (e.g., *She slept on a **bed***) to make certain that Reggie understood what the word was, as well as giving him an opportunity to hear it again. Reggie was instructed to spell the target word on the provided testing form. A raw score, standard score, and percentile rank was calculated using the TWS-4 administration manual. Reggie's scores for the TWS-4 are contained in Table 1.

Test	Purpose of Test for this Study	Standard Score	Percentile
Peabody Picture Vocabulary Test-4 (PPVT-4)	To ensure age-appropriate receptive language skills	119	90
Comprehensive Test of Phonological Processing (CTOPP)-Elision Subtest	To ensure age-appropriate phonological processing and working memory	10	50
CTOPP-Memory for Digits Subtest	To ensure adequate memory skills to participate in Spaced Retrieval.	12	75
Oral and Written Language Scales (OWLS)-Listening Comprehension Subtest	To ensure age-appropriate listening comprehension	115	(unavailable)
OWLS-Oral Expression Subtest	To ensure age-appropriate expressive language skills	101	53
Test of Written Spelling-4 (TWS-4)	To ensure at least a 2 nd grade spelling level (criteria for study participation)	90	26

Grade Equivalent: 5.0

Table 1: Summary of Standardized Tests and Scores

Procedures

To begin intervention with Reggie, a 40 word pre-test with words from Masterson and Apel's SPELL program (2000) was used to establish a baseline. This word list is included in Appendix A. The errors made on this test, combined with the errors made on the TWS-4, became the basis for the intervention sessions. Over the next two weeks, Reggie studied four units, each addressing a particular spelling rule that he had not applied or had applied incorrectly during pre-testing. Each unit consisted of a 20 word list created by the investigator. It should be noted that

the last two units were given on the same day in an extended two-hour session, due to time constraints on data collection. Lists for each unit are included in Appendix B. When applicable, the investigator attempted to use variations of the rule so the participant would see when and how the rule should be used with various words.

The first unit addressed the *double consonant plus -ed* rule, differentiating between words with the double consonant (e.g. “whipped”) and words without (e.g. “ordered”). During pretesting, Reggie applied this rule inconsistently, and occasionally on words where it was not needed, such as BITTING for *biting*. The second unit addressed various spellings of the *shun* sound (i.e. -tion, -sion, and -cian) and when they were to be used. This unit contained words such as “attraction,” “division,” and “musician.” Reggie was aware that these series of graphemes represented the “shun” sound, but he often used the incorrect one on target words, producing spellings such as MAGISION for *magician*. The third unit focused on when to change *y* to *i* before suffixes, distinguishing words like “happiest” from those like “obeyed.” Reggie knew this rule even before intervention began, but he would occasionally over-generalize it and produce spellings such as TAXPAIER for *taxpayer*. Lastly, the fourth unit emphasized the helpfulness of applying knowledge of *root words* to help spell complex words such as “disloyal” and “interstate.” During pretesting, Reggie would occasionally spell words without giving consideration to what the words meant or their roots, causing him to produce spellings such as STERD for *stirred*.

After pre-testing, each intervention session followed a similar pattern. Reggie would take a pre-test on 10 of the words from the unit list for that day. After the test, the investigator showed Reggie his errors, but did not explain the spelling rule or give any semantic instruction. Spaced Retrieval was then performed with the same 10 words, regardless of correctness on the pre-test,

in two groups of five words each. Reggie would write all five words, fold the paper over so that he could not see them, and wait the designated amount of time until his next trial. Between-trial delays were increased from 30 seconds to 1 minute to 3 minutes assuming all five words in the set were spelled correctly each time. An error on any of the five words resulted in returning to the 30 second interval, working back up to 3 minutes. During between-trial delays, Reggie was allowed to discuss movies, video games, and other topics of interest to him, but he was not permitted to discuss the words, pre-test, or target spelling rule. Once Reggie spelled all five words in the set correctly - following a three minute delay - the process was repeated with the other five words, until all 10 words from the pretest had been successfully spelled using Spaced Retrieval. An example of a completed Spaced Retrieval set can be seen in Figure 1.

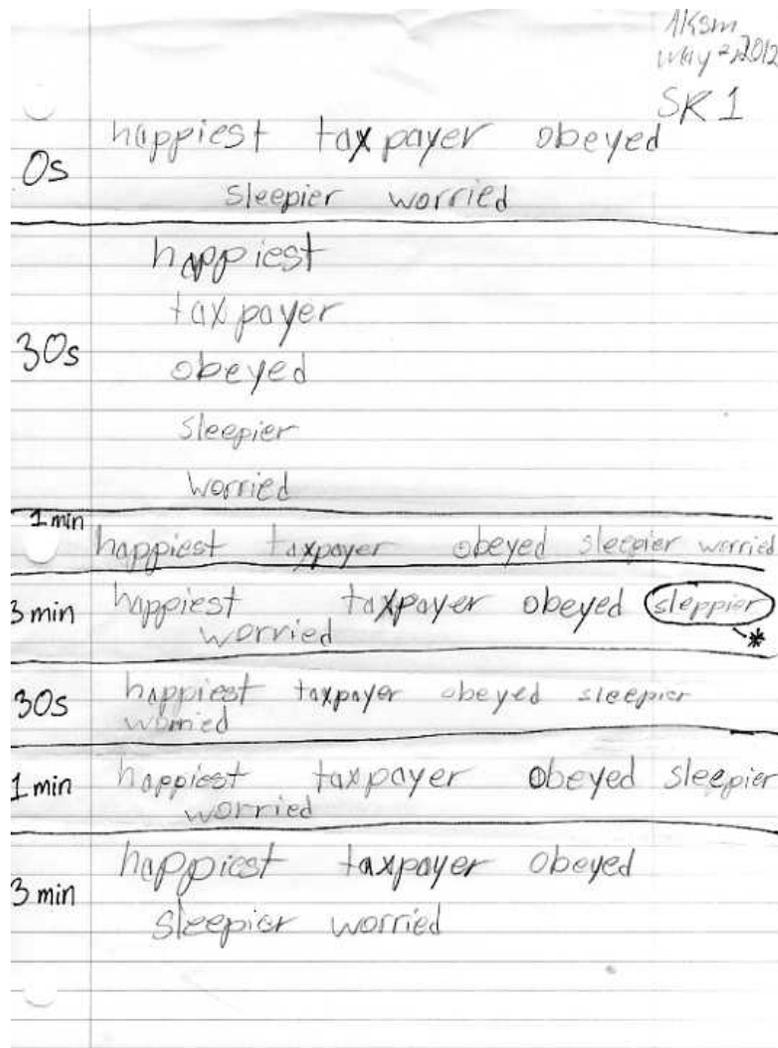


Figure 1: Completed Spaced Retrieval set. Note the error in the word *sleepier* after the first three minute delay that resulted in returning to a 30 second delay.

After Spaced Retrieval training, Reggie and the investigator discussed the target spelling rule for the day, comprising the Semantic/Vocabulary component of his instruction. For two of the sessions, Reggie was given a handout with the target rule (as explained on http://www.spellmasters.com.au/spelling_basics.asp, 2012) to offer him a visual representation of the rule as well as a verbal explanation. The handouts are included in Appendix C and D. Only two were used because the investigator had not found website at the time of first session, and no

true “rule” existed for the use of root words, so a handout was deemed unnecessary for the fourth unit.

At the end of each intervention session or targeted rule, Reggie took a 20 word post-test which included the 10 original spelling words plus 10 more to look for generalization of the target spelling rule. For the second and subsequent sessions, Reggie also completed a spelling test containing all of the Spaced Retrieval trained words completed up to that point in the study, presented in a random order. This allowed investigator to examine between-session retention of these words.

During Reggie’s last session in the study, he was tested on all 40 Spaced Retrieval trained words, with words from all four units intermixed and presented in a random order. Reggie also completed the 40 words from SPELL again, in order to see if he would improve in the number of correctly spelled words. The investigator examined his post-intervention productions for retention of trained words, generalization of target rules onto SPELL words, and improvement in areas such as editing, self-identification of errors, and conscious application of spelling rules. Specific comparisons of Reggie’s pre- and post-test performance are discussed below.

Results

Overall Pre- and Post-Test Analysis

On the 40 word SPELL pre-test, Reggie spelled 27 out of 40 words correctly. During the test, he was observed to pay little attention to editing and rarely went back and checked or corrected words, even if he verbalized that a word looked “wrong.” Many of his errors were transpositions such as MACTH for *match*, which most likely occurred from not paying sufficient attention to the task. Other errors, however, such as EXTENTION for *extension*, were phonetically accurate attempts that showed a need for practice and for explanation of spelling rules.

After intervention, Reggie's scores showed only a slight improvement, as he spelled 28 words correctly. Interestingly, however, he made different errors on the post-test than the pre-test. He was observed to apply many of the rules discussed during intervention correctly on words that he missed on the pre-test. For example Reggie correctly doubled the "p" in *stopped*, which he did not do on the pre-test. Some of his post-test errors seemed to indicate an overuse of the rules that were targeted in intervention, such as producing CRYs for *cries*, a word he spelled correctly on the pre-test. The investigator speculated that this was influenced by the Spaced Retrieval word "flying," although this cannot be confirmed. Many of the words Reggie produced incorrectly in both the pre- and post-tests were at least closer to the correct spelling the second time, and showed an increased awareness of the target rules. For example, on the pre-test, Reggie wrote DISCRIPtan for the target word *description*. On the post-test, he produced DISCREPTION, which is still an error, but shows a greater awareness for the "shun" sound rules targeted in his intervention.

More significant than the test results (i.e., the number of words correctly spelled), is the observation that Reggie paid so much more attention to his spelling during the post-test. Specifically, Reggie was noted to request more time between each word to check his work, and was observed going back to previous words to make changes when he felt he needed to. Without being instructed, he also made marks next to words that he believed he missed spelled before finishing the post-test. In this way, he self-identified 50% of his errors on the SPELL post-test voluntarily, something that he did not even attempt on the pre-test.

Spaced Retrieval Pre- and Post-Test Analysis

Within each unit, Reggie scored at or near 100% on every post-test for the words he practiced with Spaced Retrieval training that session; regardless of his score on the pre-test.

Spaced Retrieval, therefore, was an effective way of teaching spelling, at least for a specific 10 words and an approximately 30 minute recall time. Reggie achieved 100% correct on the generalization words only once, but he consistently earned a higher percentage correct on the generalization words than he earned on the corresponding pre-test, suggesting that Reggie had some understanding of the rule addressed and may have been starting to internalize it. His level of success in generalizing the spelling pattern may have been influenced by his previous familiarity with the targeted rule. For example, Reggie made a comment about the *y to i* rule during that unit's pre-test, before Spaced Retrieval or Semantic instruction had occurred. He clearly had learned the rule before and had at least some understanding of its application, which is signified by his high level of success in that unit (Unit 3). Reggie's scores for each unit in percent correct are summarized in Figure 2.

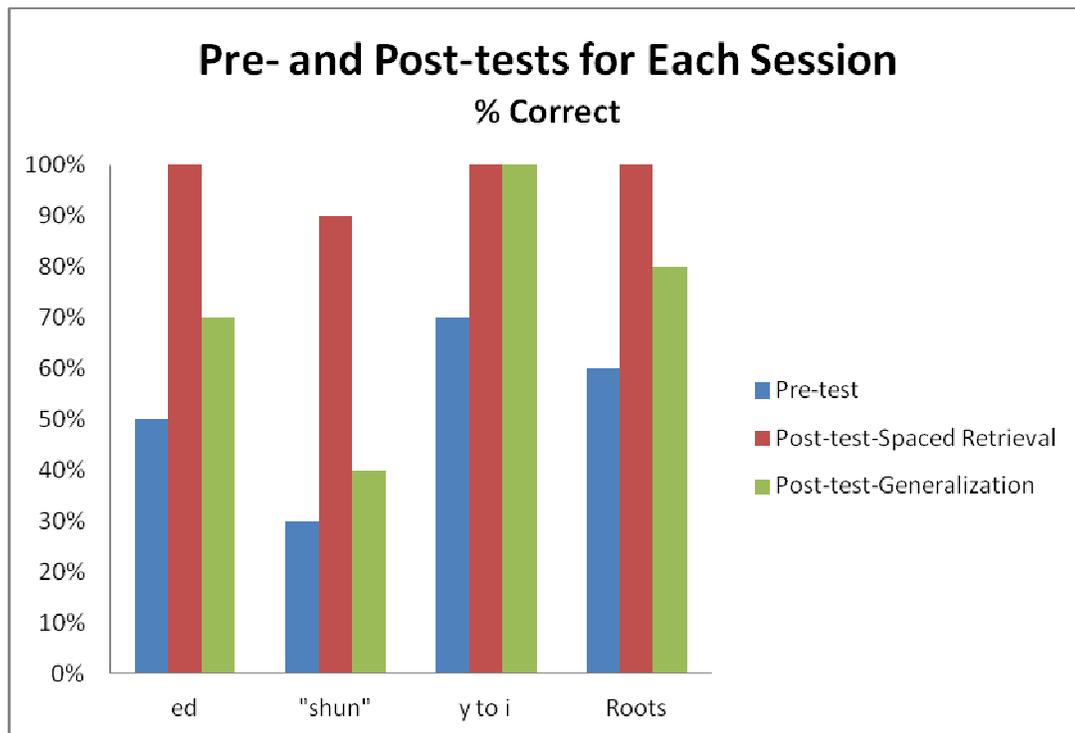


Figure 2: Percent Correct for Pre- and Post-Tests in Each Unit

Retention of Words practiced during Spaced Retrieval

As mentioned previously, at the beginning of the second session and in subsequent sessions Reggie was retested on the Spaced Retrieval words from all previous sessions. These words were presented in a randomized order, so that his memory for the spelling of each individual word was being assessed, and not his memorization of the list as a whole. His retention ranged from 80-100%, and did not seem to be strongly affected by time. In fact, his lowest retention score (80%) was earned after only a five day delay, the shortest he was tested on. Due to time limitations, the longest retention rate measured was 12 days after the first unit, at which time Reggie was still able to produce all 10 of the -ed unit words correctly without assistance. Reggie's performance on retests for each unit at various time intervals is summarized in Figure 3.

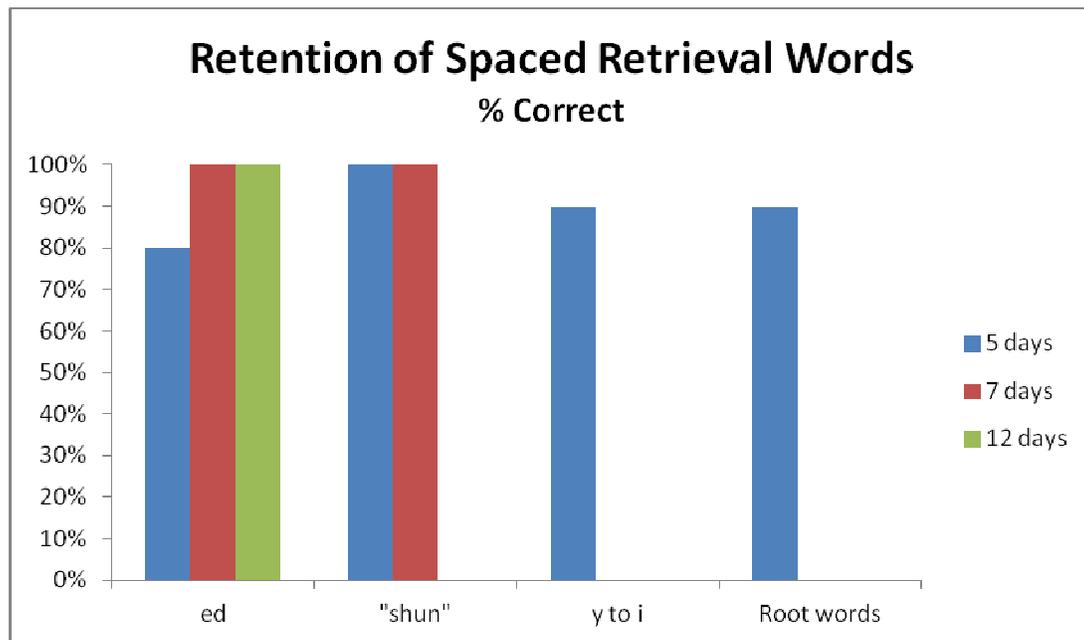


Figure 3: Percent Correct on Retention Testing for Each Unit at Various Time Intervals

Discussion

Overall Observations

The original hypothesis that Spaced Retrieval training would significantly increase Reggie's performance on a 40 word spelling test proved to be essentially false. Reggie only spelled one additional word correctly on the post-test than he did on the pre-test. However, the study still yielded interesting results. Spaced Retrieval training clearly helped Reggie to learn the 40 words that were specifically practiced using that method and to retain the majority of them at least up to 12 days later. Spaced Retrieval, combined with explicit discussion of spelling rules, provided some improvement of words not explicitly practiced, specifically the 10 generalization words in each unit. The retention of these generalizations was not as great as the retention of the practiced words, however, as evidenced by the very slight improvement on the 40 word SPELL post-test. A closer examination of Reggie's post-test errors, however, indicate a greater understanding of the spelling rules the words contained and show that these words could potentially be learned with further practice. This process also offered an unforeseen benefit to the participant. The greatest improvement in Reggie through the course of the study was in his approach to spelling, particularly his use of editing. Though this observation cannot be quantitatively measured, and the investigator did not attempt to do so, these are valuable skills that could potentially facilitate improvement in Reggie's future spelling ability beyond the scope of this study.

Limitations

One limitation of this study was the time constraint. The participant was only available for approximately two weeks to complete all testing and data collection, and therefore measures such as retention of Spaced Retrieval words could not be explored to any great extent. As

mentioned previously, investigator also had to hold two of the sessions in one day, which prevented all sessions from being perfectly uniform. However, the longer session did not have any effect on the participant's enthusiasm or willingness to work, so the results are most likely still demonstrative of how he would have performed across two separate 60 minute sessions.

Clearly, as this is a case study, Reggie's results may not be typical of all students using Spaced Retrieval to enhance Semantic and Vocabulary instruction. Further research is needed to determine whether these techniques would benefit other students with spelling difficulties in the same way, or to a lesser or greater extent. These results also cannot be used to determine whether a program like this would be of any benefit to those with broader language impairment (e.g., expressive or receptive delays) or with diagnosed conditions such as dyslexia.

Future Directives

Given the results of Reggie's brief intervention, continuation with a combined Spaced Retrieval and Semantic/Vocabulary spelling instruction program could potentially be very beneficial. His post-test errors indicated that a growing understanding of the targeted spelling patterns was developing, and with more experience and practice he would probably fully master them. This technique could also be used to address other common rules that he might struggle with, such as "i" before "e," that were not assessed in this study's pre-testing.

While the program was beneficial for one participant, larger-scale research would give a much greater indication as to the potential of Spaced Retrieval as a viable spelling instruction method for a full student population. The structure of this study also made the task of disentangling the effects of Spaced Retrieval from the effects of Semantic instruction nearly impossible, so further evidence should be collected to determine which is more effective, or if their results are optimized in tandem.

Lastly, Spaced Retrieval should be attempted with various populations of students to discover if the benefits extend to those with language impairments beyond their spelling. If the results of these studies are sufficiently positive, Spaced Retrieval could prove to be the missing piece in current spelling instruction methods.

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Appendix A
40 Word Spelling Test (Pre- and Post-test; Masterson and Apel, 2000)

- | | |
|-------------|-----------------|
| 1. ear | 21. Babies |
| 2. keep | 22. Stirred |
| 3. trick | 23. Biting |
| 4. lung | 24. Fried |
| 5. match | 25. Shipping |
| 6. tune | 26. Poison |
| 7. honey | 27. Repair |
| 8. press | 28. Continue |
| 9. flight | 29. Skeleton |
| 10. nurse | 30. Magician |
| 11. sound | 31. Signal |
| 12. bottle | 32. Description |
| 13. bowl | 33. Lawyer |
| 14. comb | 34. Extension |
| 15. pause | 35. Sailor |
| 16. caught | 36. Location |
| 17. cries | 37. Eruption |
| 18. stopped | 38. Prisoner |
| 19. bunches | 39. Argument |
| 20. sorted | 40. Community |

Appendix B
Unit Lists: Spaced Retrieval and Generalization Words
***-word used for Spaced Retrieval Training**

Unit 1: -ed

1. scrubbed*
2. stunned
3. ordered*
4. totaled*
5. whipped*
6. jogged*
7. cleared
8. bored
9. drummed*
10. dropped
11. flapped
12. quizzed*
13. printed*
14. skinned
15. plugged
16. owned
17. bothered*
18. searched
19. knocked*
20. nailed

**Unit 2: “shun”
endings**

1. vision*
2. explosion
3. submission*
4. collision*
5. decision
6. erosion
7. division*
8. expression
9. musician*
10. technician
11. clinician
12. politician*
13. vacation
14. location*
15. frustration
16. subtraction*
17. rotation
18. attraction*
19. completion
20. production*

Unit 3: “y” to “i” rule

1. happiest*
2. played
3. cried
4. employer
5. taxpayer*
6. sleeper*
7. obeyed*
8. annoyed
9. cities
10. prettiest
11. spying
12. dismays*
13. copied
14. angrier
15. worried*
16. cowboys*
17. hurried*
18. preyed
19. berries*
20. flying*

Appendix B
(cont.)**Unit 4: Root Words**

1. teacher*
2. election
3. careless*
4. settlement
5. tenderness
6. package*
7. marker
8. quickly*
9. muscular*
10. wonderful
11. unknown
12. mistreat
13. telephone*
14. insecure
15. disloyal*
16. abnormal*
17. pretest
18. supernatural*
19. resize
20. interstate*

Appendix C
“shun” Rule Handout (Spellmasters Australia, 2012)

The "shun" sound

The sounds at the end of musician and condition sound alike but...

- cian always means a person, where...
- tion or sion are never used for people.

How do you tell whether to use *tion* or *sion*?

Rule: If the root word ends in "t", use -tion.

Examples: complete/completion

Rule: If the root word ends in "s" or "d", use sion.

Examples: extend/extension, suppress/suppression

Rule: If the sound of the last syllable is the "heavy" sound of /zhun/ rather than the light sound, /shun/, use "s".

Examples: confusion, vision, adhesion

Exceptions: The ending, -mit becomes -mission: permit/permission, omit/omission, submit/submission, commit/commission

Appendix D
“y” to “i” Rule Handout (Spellmasters Australia, 2012)

"y" endings

Rule: If the word has a consonant before the "y", and when adding –ed, –er, or –est after "y", change the "y" to "i".

Examples: ugly/ugliest, fly/flier, carry/carried

Rule: If the word has a vowel before the "y", or when adding –ing, keep the "y".

Examples: employ/employed, annoy/annoying, carry/carrying

Rule: If a noun has a consonant before the “y”, make it plural by changing “y” to “i” and adding –es. If a noun has a vowel before “y”, keep the “y” and add -s

Examples: cherry/cherries, Monday/Mondays