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A Spelling Pronunciation Strategy Helps College Students Remember How To Spell Difficult Words

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A SPELLING PRONUNICATION STRATEGY HELPS COLLEGE STUDENTS REMEMBER HOW TO SPELL DIFFICULT WORDS

by

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Abstract

A SPELLING PRONUNICATION STRATEGY HELPS COLLEGE STUDENTS REMEMBER HOW TO SPELL DIFFICULT WORDS

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Drake and Ehri (1984) showed that children could utilize a spelling pronunciation strategy in order to remember spellings of words. One purpose of the current study was to determine whether college students could also benefit from a spelling pronunciation strategy in remembering spellings of 20 commonly misspelled words. The second aim of the study was to examine the contribution of decoding skill, exposure to print and vocabulary knowledge in explaining variance in general spelling ability of college students. Based on Share's (1995) self-teaching hypothesis, each of these predictors was expected to explain unique variance in the ability to remember the spellings of words.

College students (*N*= 42) who were native speakers of English were recruited from an urban college. The mean age of participants was 22.5 (*SD* =7.87). There were 31 females and 11 males. The majority, 13 of them, were freshman who had not decided on their majors. An experimental design with pretest and posttest was adopted in order to measure the effects of a spelling pronunciation strategy. Half of the participants were trained to learn spellings of words by applying a spelling pronunciation strategy whereas the other half practiced reading the words. Results of immediate and delayed posttests showed a significant main effect of treatment. Participants who were trained by a spelling pronunciation strategy produced significantly more

correct words, letters, silent letters, letters that represent schwa vowels, and double letters than the participants who practiced reading words ($p < .001$). Although there were no significant differences between the groups on the number of correctly spelled words on pretest, on posttest the participants who were trained by a spelling pronunciation strategy on average spelled 5.3 more words correctly than the participants who practiced reading words.

Hierarchical regression analyses showed that decoding and exposure to print explained significant variance in spelling ability if entered into the regression before vocabulary knowledge. However, when vocabulary was entered first, exposure to print and decoding did not explain significant additional variance in the model. One reason is that vocabulary shared substantial variance with decoding and exposure to print. When hierarchical regression analyses were conducted with vocabulary knowledge as the predicted variable and decoding and exposure to print as the predictors, results showed that both decoding and exposure to print explained significant unique variance not explained by the other predictor. Together they explained 37% of the variance in vocabulary knowledge. In turn the three predictors explained 42% of the variance in spelling ability.

These findings carry implications for spelling instruction. Students of every age can benefit by being taught how to create spellings pronunciations of complex words in order to remember how to spell the words. Limitations and directions for future research are discussed.

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Chapter 1

Introduction

Poor spelling skill in college students has been a concern and a topic of research for more than a century. However, there is little research about ways to improve undergraduates' spelling skills. There has been a movement centered on the content of students' writing rather than mechanical aspects of writing. Researchers and educators have focused on communication aspects of writing rather than mechanical aspects such as spelling and grammar (Schalagal, 2007). However, studies have shown that spelling is important. Kreiner, Schnakenberg, Green, Costello, and McClin (2002) in three experiments demonstrated that perceptions of readers about the author's writing ability are greatly affected by the presence of spelling errors in an essay. The negative effect of presence of spelling errors is not limited to the perception of writing abilities. When readers try to read an essay with spelling errors, their attention is diverted from the message to deciphering the misspelled words (Martin & Ranson, 1990). Spelling skills affect writing processes as well. When writers avoid using a word because it is hard to spell, they may end up using a word that is less precise or otherwise inappropriate. As a result, poor spelling may indirectly influence the message that the author tries to convey. Writing time may be used more productively when spelling skills are strong. Thinking about a substitute word for a word that is hard to spell, or continuously referring to dictionaries and spell checkers can be time consuming, and these activities can draw attention away from the messages that authors wish to convey. Furthermore, misspellings on resumes and cover letters have been described as a "knock-out" factor for initial evaluations of job applicants (Martin & Ranson, 1990).

Only a few studies have focused on the spelling skills of college students. These studies show that college students have spelling difficulties. A study with a sample of 439 college

students majoring in business was conducted by Martin and Ranson (1990). In this study, they used two word lists. One included the words that people use in daily life, whereas the second list included the words that business professionals would include in their written communications. Both lists of the words were extracted from a high school spelling scale. General words that were correctly spelled by at least 97% of the students were *pair, spirit, nomination, formula*, and *interesting*. Only 56.5% of the sample correctly spelled *pneumonia*; whereas the proportion of the students who spelled *endeavor, commissioner* and *recollection* were 65.4%, 74.5%, and 83.6%, respectively. Business words that were correctly spelled by at least 97% of the subjects were *agency*, *traffic*, *profitable, specification*, and *produced*. On the other hand only 35.8 correctly spelled *questionnaire*. Spelling *satisfactorily*, *inconvenience*, and *recommendation* seemed to be hard for the sample as well (spelled correctly by 56%, 67%, and 70.2 % of the sample, respectively).

Although professors expect to see the correct spelling on students' papers, teaching correct spelling is almost never an explicit objective of the college curriculum (Ormrod, 1986). It must, therefore, be assumed that college students learn spellings of the words incidentally through reading and writing. However, three experiments conducted by Ormrod showed that this is not really the case. The first experiment showed that good spellers compared to less skilled spellers learned faster when they were exposed to new words in isolation. As the length of the word increased the number of the repetitions required to learn a word increased as well. The second experiment was designed to create a more natural condition; new words were presented within the context of reading passages. The participants were told to read passages and answer comprehension questions at the end. One group (intentional) was told that they would be tested on the spellings of the words while the other group (incidental) was not told about the spelling

test before reading the passages. The participants read six passages only once and took a comprehension test about the content of the passages. There was no significant difference in comprehension test results between the groups. The participants were also grouped according to their spelling ability as poor spellers and good spellers. Compared to the poor spellers, the good spellers learned significantly more correct spellings through reading passages. Whether the participants were told that they would be tested for spellings also made a significant difference: the intentional group generated significantly more correct spellings than the incidental group. However, the mean number of new words learned in the second experiment (2.43 out of 12) was very small.

In another experiment, Ormrod (1986) tested whether exposing students to the words more frequently would make a difference. In the reading passages that the students were tested for comprehension, some new words appeared twice while some appeared six times. Also instead of a dictation test, a recognition test was used in the hope of increasing the number of correct spellings. Overall students performed better on this recognition test. Although there were no significant differences in reading comprehension scores of the groups, there were significant differences in the spelling scores of the groups. Good spellers performed significantly better than poor spellers. The intentional group learned significantly more correct spellings than the incidental group. There was also an interaction between spelling ability and learning condition. Good spellers spelled more words when they were told that they would be tested than when not told (Mean gain = 1.76 words spelled correctly) whereas poor speller were not affected by what they were told (Mean gain = .03 words spelled correctly).

Also, how many times a word appeared in the text had a significant effect on the number of the correct spellings that the subjects learned through the readings: For the words that

appeared twice the average of the correct spellings produced was 3.66; whereas for the words that appeared six times the mean was .66 higher (4.32). The authors pointed out that even though the difference was significant, the increase in number of correct spellings was not proportional to the number of repetitions. This suggests that simply exposing college students to the spellings of words numerous times does not insure that spellings will be remembered that much better. In the third experiment, even when subjects were told to learn spellings of the words and even with six repetitions of each word, on average, they learned the spellings of 6 out of 8 words even though the test for spelling was a recognition test rather than a dictation test. It appears that there is a maximum limit to the number of the word spellings that one can learn through reading. These experiments clearly show that besides encouraging students to read often, effective spelling strategies should be taught.

Nowadays, technology and innovations provide students with many resources while working on compositions. Computers have spell-checkers and cell phones have apps to deal with misspelled words. However, society has placed increasing value on accurate spelling; spelling difficult words is perceived as a sign of a good education. Students are not able to use spell checkers in traditional in-class essay exams that are hand written. Not knowing how to spell the words for a piece of writing is not just a source of embarrassment, but also is a limitation since the thought process is interrupted with concerns about the mechanical aspects of the writing.

Spelling is still an important skill for one to be successful in academic life, to feel confident in writing, and to be successful professionally. Employers, sometimes, do not call job seekers for an interview because they have misspellings in their resumes (Schramm, & Dortch, 1991). Unfortunately, after the elementary school years, students often do not receive very much help in school for their spelling difficulties. Difficulties may arise as consequence of poor

spelling skill. Another reason for the difficulty is the fact that some words are very hard to spell due to the complexity inherent in these words' orthographic representations. A word that has such complexity, *accommodation,* was misspelled by 84% of the sample in a study with 50 college students (Trucker, 2011).

There are not that many strategies or solutions offered to help adults with spelling difficulties. Strategy instruction has been found to help children in learning to spell. In Drake and Ehri's (1984) study careful pronunciations of words that optimized the match between letters and sounds helped fourth graders to remember the spellings of the words. The effect was greater with weaker spellers. Perhaps, a big part of the difficulty with the spellings of words is the existence of many silent letters in English. Ehri and Wilce (1982) examined second and fourth graders' memory for silent and pronounced letters in familiar spellings of words. Pronounced letters were recognized somewhat more accurately than silent letters. However, silent letters were detected more rapidly in words than pronounced letters were. The researchers suggest that silent letters may be flagged as exceptions in long-term memory when spellings are learned.

The purpose of the proposed study was to examine in college students the benefit of studying commonly misspelled words by creating spelling pronunciations to remember how to spell the words. This was a modified replication of a study of Drake and Ehri (1984). One way for pupils to remember the spellings of words is to optimize the match between letters in the spellings and sounds in a spelling pronunciation that modifies sounds to accommodate letters. For example, *excellent* would be pronounced as /ex/-/cel/-/lent/ with short E sounds replacing schwa vowels. The spelling pronunciation strategy involves pronouncing words that have irregularities in their spellings in a way that transforms the irregular spellings into regularized pronunciations. For example, in the word *Wednesday* the letters D and second E are silent; they

do not correspond to a sound in the standard pronunciation of the word. The spelling pronunciation of this word would be /wed/-/nes/-/dey/. This spelling pronunciation in which the match between letters and sounds is optimized can help pupils in creating the links between phonemes and graphemes. Therefore, this strategy was expected to help pupils store and remember the spellings of words.

The first aim of the proposed study was to determine whether college students could benefit from the spelling pronunciation strategy just as the fourth grade students did in Drake and Ehri's (1984) study. The second aim of the study was to determine if utilizing the regularities of the alphabetical system to create spelling pronunciations was especially beneficial with commonly misspelled words. Drake and Ehri's (1984) study has been criticized because students in the control condition were exposed to phonetic misspellings and some researchers have claimed that this caused the control condition to misspell words making it hard to see if spelling pronunciations improved spelling. In the current study the control group was exposed to correct spellings rather than phonetic misspellings. The third aim of the study was to contribute to the line of research that has examined the influence of decoding, vocabulary and exposure to print as measured by the Author Recognition Test (ART) on the spelling ability of college students.

An experimental research design was adopted. The dependent variable was the number of correct spellings that were learned. The independent variables were strategy instruction with two levels (spelling pronunciations vs. word reading) and spelling ability (good vs. poor).

The hypotheses of the study were:

1. Students who apply a spelling pronunciation strategy in learning the spellings of words will remember the spellings of more words than control students who practice reading the spellings of

the words. Strategy students will remember more silent letters, more letters symbolizing schwa vowels and more doubled letters than control students who practice reading the words.

2. Better spellers will benefit more from the application of a pronunciation strategy than poorer spellers, so the difference in performance between the strategy and control groups will be greater for better spellers than for poorer spellers.

3. Several predictor variables will each explain unique variance in students' spelling ability, including exposure to print as measured by ART, vocabulary knowledge, and decoding skill.

Chapter 2

Literature Review

Spelling Strategy Use

Ehri (1984) suggested that one way for pupils to remember the spellings of words is to optimize the match between letters in the spellings and sounds in a spelling pronunciation that modifies sounds to accommodate letters. For example, *excellent* would be pronounced as /ex/-/cel/-/lent/ with short E sounds replacing schwa vowels.

To test the effectiveness of this approach Drake and Ehri (1984) conducted an experiment. Their sample consisted of 42 fourth-grade students. The participants were matched according to spellings ability which was based on their scores on the Mann-Suiter Developmental Spelling Inventory (1975). Members of the matched pairs were randomly assigned, one to the phonetic training group, one to the conventional training group. The phonetic training group was taught to decode the phonetic spellings of words whereas the conventional training group was taught to convert standard pronunciations into careful spelling pronunciations to optimize the match between letters and sounds. During study trials, the participants pronounced 20 words in one of two ways before they copied the standard spellings. Participants who carefully pronounced conventional spellings spelled more words correctly, remembered more correct letters, and remembered silent letters and letters symbolizing schwa vowels more accurately than participants who pronounced phonetic spellings. On the other hand, the groups did not differ significantly in their memory for double letters.

In Drake and Ehri's (1984) study participants were also grouped based on their spelling ability as measured by their scores on the Mann-Suiter Inventory. Analyses of performance as a function of spelling ability revealed main effects on the number of correctly spelled words, total

correct letters in spellings, correctly spelled schwa vowels, correctly spelled silent letters and double letters. High-ability spellers tended to outperform average spellers who in turn outperformed low-ability spellers. Spelling ability interacted with training condition in three of analyses: number of total letters correct, number of schwa letters correct, and number of silent letters correct. The two methods of studying spellings created much larger differences in low-ability spellers than in average and high-ability spellers. Low ability spellers benefited much more from a careful pronunciation strategy than average and good spellers. This was evident in their memory for correct letters, schwa letters, and silent letters. The results of this study support the idea that the spelling pronunciation strategy is helpful. However, the study has been criticized because the control condition was exposed to phonetic misspellings and some researchers have claimed that this caused the control condition to misspell words making it hard to see if spelling pronunciation improved spelling. In the current study the control group will be exposed to correct spellings rather than phonetic misspellings.

One of the few studies that examined spelling skills of college students in terms of their strategy use was conducted by Holmes and Malone (2004). They investigated the spelling skills of unexpectedly poor spellers. What they meant by unexpectedly poor spellers was the adults with good reading skills but poor spelling skills. The stimuli of the study consisted of words that require word specific spelling knowledge rather than words that can be spelled by general rules and patterns of grapheme-phoneme connections, by analogy to the other words, or by using morphological knowledge. They tried to understand the strategies that are used by adult readers to spell these hard words.

The participants were 163 college students, 17 to 27 years old. All were native speakers of English. They were pretested with 56 multisyllabic words. Based on their pretest scores,

participants were ranked. The 26 participants with higher scores were chosen for the skilled spellers group while the 26 participants from lower end were chosen for the less skilled group. The groups did not differ significantly in word recognition that was measured by a multiple-choice test which required students to choose the correct meaning of the written words. The treatment involved a think aloud procedure. Students were shown ten of the words that they misspelled during the pretest. Each word was presented on a card for 30 seconds, and students were told to think aloud while studying the spelling of the word. Then students were asked to read all 56 of the pretest words that were listed on a paper. Lastly, students were asked to spell the 10 words that they studied.

When tape recordings of think alouds were transcribed and analyzed, it was seen that there were differences between the strategies that were used by skilled and less skilled spellers. Also, the extent to which the use of these strategies resulted in the correct spellings of the words was different for skilled and less skilled spellers. Overall for both groups, having the students study the previously misspelled words for 30 seconds (while thinking aloud) resulted in significantly more correct spellings (average of 8.3 for skilled spellers and 6.2 for less skilled spellers). Both skilled and less skilled spellers used many strategies (letter rehearsal, over-pronunciation, comparison, morphological analysis, word analogy, and visualization) and often they combined several strategies for studying the spelling of a specific word. Letter rehearsal was used by both of the groups most often and the degree to which it resulted in correct spelling was not significantly different for the skilled and less skilled spellers. Skilled spellers used over-pronunciation more effectively than less skilled spellers. The less skilled group used the over-pronunciation strategy more often. However, their success in using the strategy in terms of generating the correct spellings was really low (47% of times that the weaker speller used this

strategy they ended up with the correct spelling; whereas the skilled group ended up with correct spelling every time (100%) that they used the strategy). The authors suggested that perhaps the less skilled spellers created incorrect/less effective over-pronunciations or they could not remember the over-pronunciation that they created during the study trial when they were asked to spell the word.

Another strategy that distinguished the skilled and less skilled groups was comparison. Here, the comparison strategy was identified whenever the participant made a reference to their incorrect spelling. For example, while studying *supersede* if student said "S-E-D; I thought it was a C." the strategy that the student used would be categorized as comparison. Use of comparison strategy alone led to correct spellings 91% of the times for skilled group, while only 50% of the times this was true for the less skilled. Perhaps the less skilled group was forgetting what letters to be replaced in their incorrect misspellings. When over-pronunciation and comparison were used together or in combination with other strategies such as letter rehearsal, the less skilled group did not differ significantly from the skilled group in the number of correct spellings that they wrote.

Based on these findings, the authors (Holmes and Malone, 2004) wanted to investigate more closely why the over-pronunciation and comparison strategies were not used more effectively by less skilled spellers. Therefore, a second experiment was conducted. The participants were 78 college students, between the ages of 18 and 20, and all were native speakers of English. The participants were asked to spell 50 words. After their attempt to spell, they read aloud the printed list of the same words. In another session, the participants were trained for spellings of the ten words that they misspelled in the previous testing and they were tested with a symbol memory and a letter memory task. The words that were chosen for training

were the ones that the participants misspelled just by one or two letters, for example, SUPERCEDE for *supersede*. Half of the participants were trained with the comparison strategy whereas the others were trained with over-pronunciation. It is not stated whether the participants were randomly assigned to the groups, but there were no significant differences in pretest scores between the two groups. For training a computer was used. When students pressed the space bar, the correct spelling and their own misspelling of the target word appeared on the screen. For over-pronunciation strategy, students would create a sentence that included over-pronunciation of the word. For example, they would say, "I should spell *separate* as sep-are-ate." For the comparison strategy, for example, they would say, "There is an A, not an E in the middle of *separate*." After creating the sentence for the correct spelling, they would press the space bar again and this time only the correct spelling would stay on the screen for 30 seconds. During this time, students would keep rehearsing the sentence that they created for remembering the correct spelling. After studying the target words this way, participants were tested for their memory of the spellings of the words.

The symbol memory task was created by 20 distinct sequences of 3-6 meaningless shapes, while the letter memory task included 20 distinct sequences of consonant upper case letters. Sequences of items briefly appeared on the computer screen, and students were asked to repeat the same sequence with cards displaying the printed symbols (to test visual memory) or letters (to test verbal memory) as soon as the stimuli disappeared from the screen. Also, the memory task was presented either simultaneously (all 3-6 letters or symbols appeared on the screen at once) or sequentially.

Between the two strategy groups there were no significant differences in immediate or delayed posttest spelling scores. Both groups learned an average of 8 words that were misspelled

during the pretest. Both skilled and less skilled spellers profited similarly from the training. It seems that less skilled spellers benefited from guided strategy instruction rather than from their unstructured way of studying that was revealed by think alouds that were examined in the previous experiment.

When word recognition scores were partialed out, there were only two significant correlations between the type of training and the type of memory. Sequential visual memory was correlated significantly with the spelling scores of the students who used the comparison strategy and sequential verbal memory was correlated significantly with spelling scores of the students who used the over-pronunciation strategy. Perhaps the type of training affected the students' performance on the memory task, because they were given the memory task right after the training. However, the authors suggest that this result is reasonable since creating over-pronunciations require retrieval of phonemes that corresponds to the graphemes appearing on the screen, which is very similar to the requirement of the verbal memory task. The authors also point out that the correlation between the comparison groups' spelling scores and sequential symbol memory was quite small, and perhaps it was inflated since students often used verbal expressions to remember the sequence of the symbols.

Holmes and Malone's (2004) study provides us with an important finding that there are strategies that can be taught, and both skilled and less skilled spellers can benefit from the strategies that are taught. Since it is more likely that poor spellers have poor phonological memory it makes sense to provide them with a well-structured strategy that can strengthen their memory. However, the findings of the first experiment were based on a think aloud procedure which has its own pitfalls. In the second experiment it is hard to distinguish the strategies of

over-pronunciation and comparison since the participants in both groups saw both correct spelling and misspelling of the words simultaneously.

Also, exposing students to incorrect spellings may affect their mental representations of the words. In three experiments, Brown (1988) demonstrated that exposure to incorrect spellings may increase the likelihood that students misspell the words after seeing the misspellings even though they spelled the words correctly before seeing them. In the first experiment, between the completion of two spelling tests on the same words, experimental group participants intentionally generated misspellings of half of the words, while the control group performed a neutral task. According to some, producing incorrect spellings may help the mental representation of the word to become more stable and, therefore, may help learning correct spellings. In this view, there is only one correct mental representation of the word and the presence of alternatives should help with differentiating the correct version more definitely. The posttest dictation test proved otherwise. Those who produced incorrect spellings made more switches from correct (in pretest) to incorrect (in posttest). The negative effect of generating misspellings was evident in within subject analyses as well. For the words that the participants produced incorrect spellings, there was a significantly higher rate of correct to incorrect switches from pretest to posttest than for the words that were not included in the intervening task of generating incorrect spellings.

Not only producing incorrect spellings, but also brief exposure to incorrect spellings showed a negative effect. In the second experiment of Brown's (1988) study, all participants received two successive spelling tests, with an interpolated task between the two. All participants received a dictation test first; half of the participants received a recognition test second, and the other half received another dictation test. After the initial dictation test, participants in the control

group were given a puzzle to work on for seven minutes. The experimental group participants were shown the two most frequent misspellings of each word from the dictation test and rated on a 5-point scale on how closely it resembled the correct spellings (as 1=almost identical, 2=very close, 3=somewhat similar, 4=not very similar, 5=very different).

The results of this experiment clearly showed that every kind of exposure to incorrect spelling deteriorated students' memory for correct spelling. The experimental group who rated misspellings in between the two tests had significantly more correct to incorrect switches than the control group participants who were not exposed to misspellings. The participants who were given a recognition test had a higher proportion of correct to incorrect switches than the participants who were given a dictation test.

When Brown (1988) asked the students what kinds of words they mostly had trouble with, 57% of them said that they had difficulty with the words that they had multiple versions of in mind and they would get confused about which one was correct. Apparently, having multiple mental versions of the words causes difficulty and confusion in producing correct spellings. Therefore, while teaching spelling, any type of exposure to incorrect spelling must be avoided as much as possible.

Fresch (2008) was another researcher interested in college students' spelling issues. Fresch tested the spelling ability of 17 undergraduate college students enrolled in a teacher preparation program. She tested students with 25 words that appeared in the course reading material such as *efficacy*, *metacognition* and *illegible*. These words require knowledge of word features that are usually acquired by mature spellers. The students were also required to complete a survey with 8 questions that assessed their perceptions of themselves as spellers, and the strategies that they would use when they need to spell an unknown word. The mean number of

correctly spelled words was 14.5 out of 25 words with a range of eight to 18 correct. Fresch (2008) claimed that the students who received the lowest scores were the ones who wrote that they would use sounding out as a strategy when they try to spell an unknown word. The only word that was spelled by all 17 students correctly was *designation* and the author claimed that it may be that this word contained predictable letter-sound correspondences. Also a majority of students (16 out of 20) spelled correctly the words *earring*, *bombard*, *metacognition*, and *their*. Only four of the students wrote the word *commiserate* correctly. The most common error was omission of the second "m." The survey question "how did you learn to spell?" was answered by 59% of students as "sounding out words," by 29% of the students as "memorizing for spelling tests." The student who had the highest score noted that reading a lot helped her in learning to spell. For another survey question, "What advice were you given when you needed help with spelling?" students responded more often "sounding out" and less often "looking it up in a dictionary". Some students expressed how frustrating it could be to find the word in a dictionary if its spelling is not known. The third survey question asked students if they were still using the advice given, all but 18% of them said they had kept using the same strategy. The 18% said that now, instead, they used spell checkers.

Fresch (2008) points out an important pitfall of spell checkers. One must sound out the word in some way so that the computer can offer some options based on the participant's attempt. Fresch entered some of the students' incorrect spellings in Microsoft Word to see what suggested corrections would appear. For example, one participant spelled *irascible* as URAZIABLE, and the spell check offered *erasable, unreliable, reliable, eradicable, trainable, risible, resizable*, and *graspable*. The spell check could not give any spelling suggestion at all for the misspelling of *epahcacey* (intended to spell efficacy).

This study clearly shows that many college students struggle with spellings of some words that appear in their reading materials. Usually the strategies that they learned from adults (sounding out, looking it up in a dictionary) and the strategies they adopted themselves (using spell checks) are not enough to cope with this difficulty. Clearly they need to be taught more effective strategies. Holmes and Malone's (2004) findings support the idea that it is not too late to teach spelling strategies to students in college. However, their training method included exposing participants to incorrect spellings which has shown to have negative effects (Brown, 1988). In the current study, we tested the effect of the spelling pronunciation strategy on remembering correct spellings of words in college students. This strategy has been shown to help fourth graders to remember correct spellings. The strategy does not require participants to be exposed to incorrect spellings.

Overview of the Processes Involved in Spelling Words from Memory

It is crucial to review the theories that explain the processes involved in remembering and writing the spelling of a word from memory because in the proposed study we will try to understand the role of print exposure, vocabulary, and decoding in remembering spellings of words from memory. There are four major theories of spelling. Dual-route theory and connectionist theory attempt to explain the processes involved in spelling. Stage theory and constructivist theory of spelling attempt to explain how spelling develops over time (Sawyer & Joyce, 2006).

Dual-Route Theory. According to dual-route theory, there are two major routes in which individuals store and retrieve information that is pertinent to word spellings (Coltheart, 1978). The phonological route comprises learning and remembering the correspondences between phonemes and graphemes. The orthographic route leads to direct access of whole words in a

mental dictionary. Dual-route models attempt to explain how the two independent routes contribute to correct spelling. In these models words with regular spellings are assumed to require the use of the phonological route. On the other hand, words that require the use of the lexical route (orthographic route) are those with irregular spellings. However, the model does not assume a stable status for irregularity: Through experience with the written language, those words which were initially accessed through the phonological route can subsequently be accessed directly through the lexical route (Sawyer & Joyce, 2006).

The Constructivist Theory. According to the constructivist theory, writing skills, including spelling, develop naturally in a way that is quite similar to oral communication. Based on this view, students develop their spelling skills by writing their messages and by reading messages written by others. Within this perspective, correct spelling is expected to evolve through purposeful attention to the words that the pupil is motivated to learn, and through repeated exposure to frequently used words encountered when reading different types of text (Sawyer & Joyce, 2006). Contrary to the constructivist view, in a review of literature on spelling instruction that included samples of students ranging from first grade to college, Graham (2000) concluded that for the students to develop in their spelling skills, incidental learning should be combined with direct instruction. Scott (2000), in her review, concluded that poor spellers benefit most from intense, systematic and individualized instruction.

Stage or Phase Models of Spelling. According to Frith (1980, 1985) children's literacy development follows three phases and competency in each phase is essential for acquisition of literacy skills. During the first logographic phase, children use visual cues and symbols to read and spell such as drawing a heart and reading it as "I love you." They may recognize words by the features of the letters. During the alphabetical phase, they start to use phonological coding. In

this phase their learning should be supported by activities that are relevant to rhyming, blending and segmentation of phonemes of words. Usually at this phase reading and spelling involve one-to-one matching between letters and sounds. In the third orthographic phase, children integrate their phonological and orthographic knowledge. Consolidated patterns of grapheme-phoneme correspondences become part of the generalized knowledge that is operational in representing words in written language (Sawyer & Joyce, 2006).

Henderson (1985) proposed a similar developmental model which includes five stages. In the first stage, preliterate, children's writing is characterized by squiggles or random marks. In the second stage, letter name, children gain some understanding of phoneme-grapheme correspondences. Their spelling reflects their knowledge of letter names and phonemic awareness. During the third stage, within-word pattern, children use letter clusters rather than single letters to represent phonemes and their spelling reflects an understanding of the orthographic system. Their spelling reflects knowledge of short and long vowels. During the fourth stage, syllable juncture, children learn how words' spellings are affected by inflectional endings that are added to roots. For example they learn that when the past tense ending *–ed* is added to a word like *hop,* it becomes *hopped* rather than *hoped*. In the fifth stage, derivational constancy, children learn how the meanings of words (especially for those have similar morphemes and roots) affect their spellings. For example the words *confess* and *confession* are spelled similarly because they are related in meaning, despite the fact that their roots include different phonemes.

Connectionist Theory. This theory, as opposed to dual route theory, claims that the phonological route and orthographic route are connected, and they interact (Seidenberg & McClelland, 1989). Ehri (2000) used the term *amalgam* in explaining such connections:

> When readers see and pronounce words, their knowledge of alphabetic system is activated and computes connection between graphemes in the spellings and phonemes detected in the pronunciation of the words. Repetition of this process a few times bonds the spellings of the word to its pronunciation and meaning in memory, forming an amalgam (p.22).

According to Ehri (1997) spelling and reading share similar processes and pupils use similar skills and knowledge whether they read or write words. Two sources that help with spelling are systematic knowledge and word specific knowledge.

Systematic knowledge is acquired through instruction as well as reading and writing experiences. Systematic knowledge includes information about how graphemes represent the phonemes; this includes not only single phonemes but also larger units such as syllables and morphemes that are gained by being exposed to letter patterns that recur across the words. When necessary, choosing the appropriate option among multiple alternatives such as C, CK, K and CH to represent /k/ in a specific word is also considered systematic knowledge. Information about the morphemes (roots, prefixes, suffixes, etc.) and information about the origins of the words that guide the pupils when they try to spell a word is also considered systematic knowledge (Ehri, 1997).

On the other hand, word specific knowledge consists of information about the spellings of individual words. This information is gained through experiences with reading and writing and it is held in long term memory. In the process of gaining word specific spellings knowledge of the alphabetic system plays a mnemonic role. Because English has a deep orthographic system as opposed to more shallow/transparent systems, when pupils try to spell a word, there are many options to represent the phonemes in the words. For example, it is the connection forming

process between the phonemes and the graphemes of the word “telephone” that takes place through several exposures to this word that enables the pupils to remember the spelling of “TELEPHONE” not “TELLAFOAN or TELUFOWN” (Ehri, 1997).

The connection forming process plays a role in learning to spell irregularly spelled words as well. The majority of the letters in irregularly spelled words are consistent with grapheme-phoneme conventions. To remember the letters or letter groups that do not follow the conventions, for example, if they appear to be silent or not representing any phonemes of the words, pupils may flag them as silent in memory, or they may create spelling pronunciations that include the silent letters, for example LISTEN as “lis-ten” (Ehri, 1997).

Words that include graphemes that do not follow the conventional system in representing the phonemes, phonemes that can be represented with many options to choose, graphemes that do not have correlates in sound (double letters, silent letters), spelling patterns that do not recur in more than a few words, schwa vowels that can be represented with any letters and letter combinations are the most troublesome words for the pupils to learn the correct spellings (Ehri, 1997).

In the current study, college students were taught spellings of some challenging words by adopting spelling pronunciations in which the words’ conventional pronunciations were altered slightly to symbolize letters that do not map directly onto sounds and hence are hard to remember. The hard parts are the letters that represent the schwa sounds, double letters and silent letters. In the spelling pronunciation strategy, we can use a mnemonic to remember the silent letters. Although in normal pronunciations a silent letter does not have a corresponding phoneme, in the spelling pronunciation extra phonemes are created and embedded in pronunciations. For example, in *fluorescent*, U is silent and therefore pupils often forget this

letter. In a spelling pronunciation we can say *flu* (sounded as the word flu), *or* (sounded as the word or), and the rest of the word is sounded the same as the original. The mnemonic of "flu" can help the pupil to remember that the first syllable of *fluorescent* includes a silent U. Similarly, the letters that represent the schwa sounds can be remembered with this strategy. For example, often pupils spell the word *accommodate* as ACCOMADATE. By stretching the syllable and assigning the phoneme /o/ to this schwa in the spelling pronunciation, they can remember that it is spelled with an O rather than an A. Another issue with double letters can be observed with *accommodate*. To remember that this word has double m's the word can be segmented right between the two m's (ac-com-mo-date) and the phoneme /m/ can represent the letter M in each segment.

Self-Teaching Hypothesis and Exposure to Print

Share's (1995) self-teaching hypothesis has been utilized to describe the learning of word-specific orthographic information that occurs while children independently read text that includes new words. However, it can be argued that a similar process occurs when adults encounter new words while reading text. According to the self-teaching hypothesis, children utilize their knowledge of phonemic awareness (specifically blending) and alphabetical knowledge (grapheme-phoneme correspondences) when they encounter new words while reading text. In this way they decode words. If a child successfully decodes words, this results not only in accurately reading of the words, but also in learning orthographic information about the words. After several times encountering the same words, children develop word specific orthographic representations of the words in memory which in turn help children to read the words by sight and spell the words more proficiently.

Share (1995) conducted experiments that support the self-teaching hypothesis. In one of these experiments, second graders were asked to read aloud stories that contained pseudo-words naming of places, peoples, plants, etc. Three days after reading the stories, children identified target spellings more often, named them more quickly, and spelled them more accurately than alternate homophonic spellings. Four exposures were sufficient to learn significant orthographic learning. This result provides evidence for the argument that when pupils encounter a word that they do not know they use their alphabetical knowledge. Accurate phonemic representation of the word while seeing the orthographic representation of the word permits the connections to occur between graphemes and phonemes and these grapheme-phoneme connections provides the glue for the orthographic representation of the word to be built in memory. It is likely that adults also use similar processes in learning new orthographic information. The fact that Share (1995) proposes an item-based perspective rather than a stage-based perspective goes along with this idea. Most adults are already fluent readers and spellers but when they encounter an unfamiliar word, they decode the word rather than read it by sight. Share's self-teaching hypothesis and ideas that are relevant to this issue are compatible with the hypothesis of the current study that exposure to print would be a strong predictor of spelling skills of adults. Share acknowledges that besides proficiency in decoding, it is also important how frequently pupils encounter the words. Avid readers are more likely to encounter more new words and learn the meanings and spellings of these words.

To benefit from the self-teaching hypothesis, pupils need to engage in reading activity, so that they get exposed to a variety of words numerous times. People engage in reading in different ways and in different amounts. Some read everyday, some read less frequently, some read easy texts, some read sophisticated books, etc. Even those who have similar reading levels as assessed

by reading comprehension ability differ in the degree that they engage in reading activities (Stanovich & West, 1989).

It has been an interest of researchers to understand the consequences of differential print exposure. For this reason a variety of questionnaire and interview methods have been used. However, these types of methods are confounded by social desirability. People are likely to report more reading than actually takes place (Zill & Wingle, 1990). People can be asked to keep a diary and record the times that they engage in reading activities. This can be more reliable than interview and questionnaire methods (Carp & Carp, 1981). However, the diary method is complicated. It requires extensive and long-term cooperation of participants. For these reasons Stanovich and West (1989) developed a measure of print exposure. This measure can yield estimates of relative differences in print exposure in just 5-10-minutes. It is easy for the participants to respond and it is relatively immune from contamination from socially desirable responses (West, Stanovich, & Mitchell, 1993). The Author Recognition Test (ART) and the Magazine Recognition Test (MRT) were developed to measure print exposure levels of adults (Stanovich & West, 1989). These tests use a detection logic; real author and magazine names are embedded among foils. The participants are asked to look at the list of names and check the names known to be authors on the ART and the titles known to be magazines on the MRT. Response biases are controlled by correcting the number of items checked based on the number of foils checked.

To examine validity of ART and MRT as measures of amount of reading practice Stanovich and West (1989) conducted an experiment. The participants were 61 undergraduate students. They were given the Experimental Spelling Test (EST) which was developed by Fischer et al. (1985), the spelling subtest of Wide Range Achievement Test (WRAT-S), the

Reading and Media Habits Questionnaire (RMHQ), ART and MRT. The RMHQ contained 6 multiple choice items. Participants were required to rate the extent to which they read for pleasure (ranging from almost never to everyday), read books in addition to those were assigned as part of course requirements (ranging from none to more than 40), whether they owned a library card (ranging from none to two), whether they bought magazines, visited bookstores, and read newspapers. The responses on these six questions were summed up to compute a composite index of print exposure. Furthermore, there were three open-ended items that required participants to name the magazines that they subscribed to, to name the last bookstore they had visited, and to name two favorite authors. The questionnaire included four items that pertained to TV-watching habits. Two multiple choice items asked the participants how much TV they watched per day, and how much TV they had watched per day before entering college. Responses to these two questions were summed up to compute a composite index of TV exposure. Furthermore two open ended questions required participants to list the names of TV programs that they watched on regular basis and also name their favorite programs.

Correlational analyses revealed that ART was a much stronger measure compared to other measures in predicting orthographic processing. The correlation between EST-Critical segment errors and ART was -.43 (correlation was negative because the scores were number of errors rather than corrects). ART scores were highly correlated with WRAT critical error scores as well (-.46). Correlations between spelling scores and the Reading Habits composite and MRT were much smaller and nonsignificant. On the other hand, scores of the questionnaire item that asked the participants to name their two favorite authors were correlated significantly with spelling ability (-.36 for WRAT critical segment errors, and -.34 for EST-critical segment errors). Furthermore, Stanovich and West noted that the less predictable the spelling of the

segments of the words was, the greater was the association between performance on spelling and the ART and the favorite author question. Results of analyses revealed that ART is the strongest predictor of spelling scores and therefore in the proposed study ART will be used as a measure of exposure to print in predicting spelling scores.

Reading Words to Learn Their Spellings

In the current study the control group practiced reading the words to learn spellings while the treatment group applied a spelling pronunciation strategy in order to remember spellings of words. We expected that the control group would learn spellings of words by reading them because reading and spelling share similar processes and transfer effects have been found from reading to spelling. For both reading and writing words, pupils need to have knowledge of grapheme-phoneme connections and phonemic awareness skills. When they read they need to blend the phonemes to pronounce the word that they are reading, whereas when they spell a word they need to segment the phonemes of the words. As a result of similar processes involved in reading and spelling words, it was expected that transfer would occur. When pupils read words they are exposed to orthographic representations of the words, and this should in turn help them remember how to spell these words.

In a study by Gilbert (1935), high school and college students were asked to spell a set of words. Then they read passages that included some of these words. On a posttest, the participants' spellings improved more on the words that appeared in the passages than on words that were not included in the passages.

Several other studies show that reading words improves memory for spelling. In Ormrod's (1986) study, college students were required to read passages that contained pseudo-words. They learned the spellings of 2.8 out of 8 words. Dixon and Kaminska (1997) showed

that spellings of words could be improved by exposure to correct spellings of those words, but also worsened by exposure to incorrect spellings. Transfer effects of reading to spelling were evident in spellings of second graders (Ehri,1980). After practicing reading nonwords, second graders spelled these nonwords more often with the orthographic representations that they read despite the fact alternative orthographic representations were possible.

Transfer effects of reading to spelling were evident in Ehri and Wilce's (1986) study with second graders as well. Pupils who read words that included medial flaps spelled with either T or D remembered these letters better than students who did not read the words. The children who did not read but only heard the words more often wrote flaps in the spellings with D. Although all of these words included medial flaps that sounded close to /d/, participants who read the words transferred the orthographic information when they spelled these words.

Differences and Similarities between Good and Poor Spellers

Several spelling studies compared performance of good and poor spellers. It is crucial to include them in this review of literature since one of the aims of the current study was to understand what causes students to have difficulty in spelling.

In Fischer, Shankweiller and Liberman's (1985) study the participants were 38 college students. Good and poor spellers were determined based on the results of the EST (Experimental Spelling Test). The EST includes 120 words divided into three levels. Level-1 words can be spelled mostly by applying knowledge of grapheme-phoneme correspondences. Level-2 words require orthographic and morphemic knowledge, such as differential effects of adding –ed suffix to roots; *thinned* requires doubling the final consonant of the root but *chained* does not. Level-3 words include words that require word-specific knowledge such as *Fahrenheit* and *gnaw*. Good spellers were those who scored at least one standard deviation higher than the mean score and

poor spellers were those scoring at least one standard deviation lower than the mean score. There was no significant difference between poor spellers and good spellers in vocabulary as measured by Wechsler Adult Intelligence Scale (WAIS) Vocabulary Subtest (Wechsler, 1958). However, oral reading and comprehension scores of the two groups as measured by WRAT (Wide Range Achievement Test, Jastak et al., 1965) subtests of oral reading and comprehension were significantly different.

Regardless of the level of the word (i.e. Level 1 to Level 3 reflects increasing complexity in orthographic representation) good spellers performed significantly better than poor spellers. Poor spellers appeared to have difficulty at all levels: grapheme-phoneme correspondences, common orthographic rules, morphophonemic relationships, and word-specific knowledge. The largest difference on performances of the groups occurred in Level-2 words. Fischer et al. reasoned that if spelling ability is mainly dependent on memory then the biggest difference would occur in Level-3 words which comprised words that had segments requiring word-specific spelling knowledge.

In Holmes and Ng's (1993) study with a sample of Australian college students, good and poor spellers were distinguished based on a revised test of the spelling subtest of the English Skills Assessment Test (Australian Council for Educational Research, 1982). This test was a recognition test in which participants were presented with a set of 4 alternatives. Good spellers made fewer than 18% errors and poor spellers made at least 50% errors. Vocabulary was measured by the Advanced Vocabulary Test of the Kit of Reference Tests for Cognitive Factors (Educational Testing Service, Princeton, NJ, 1963). Vocabulary scores of poor spellers were significantly lower than that of good spellers. Holmes and Ng reasoned that this finding conflicts with Fisher et al.(1985) study finding no significant difference in vocabulary knowledge of good

and poor spellers because the WAIS-R may not be as sensitive as the test they used in assessing vocabulary differences among highly educated participants.

Holmes and Ng (1993) also administered an Australian version of Author Recognition Test (ART) that they designed for the study. Poor spellers did not list significantly fewer favorite authors than good spellers. However, poor spellers recognized significantly fewer authors than good spellers. The groups did not differ significantly on their scores of the Reading Habits Questionnaire. This result supports Stanovich and West's (1989) claim that people answer questionnaires based on social desirability and usually overestimate their reading habits.

Several experiments that Holmes and Ng (1993) conducted revealed that poor spellers read less frequently for leisure than good spellers. Furthermore poor spellers had more restricted vocabularies than the good spellers. On the other hand, the groups did not differ significantly in their performances on tasks tapping visual-spatial reasoning.

In Holmes and Ng's (1993) experiments the largest gap between spelling scores of good and poor spellers occurred in Level-3 words that required word-specific knowledge. However, in Fischer et al.'s (1985) study participants' performance on Level-2 words that required morpho-phonemic knowledge distinguished good spellers from poor spellers more than the other levels. Holmes and Ng claimed that their results did not totally replicate Fischer et al.'s because in that study word-length was not precisely controlled.

To understand why poor spellers had difficulty in word-specific spellings, Holmes and Ng (1993) administered lexical decision tasks. Good and poor spellers performed similarly in lexical decision tasks with high frequency words, regardless of item length and spelling regularity. However, poor spellers took significantly more time and misclassified significantly more of the low frequency words as nonwords than good spellers, regardless of spelling

regularity. Holmes and Ng reasoned that their findings indicate that poor spellers do not always completely analyze and remember all the letters in words and so base their identification decisions on inadequate information.

Frith (1980-1985) claimed that poor spellers attempt to recognize words using only partial cues rather than the full letter sequence. Holmes and Ng's (1993) lexical decision task results support this idea. Based on this, it can be argued that poor spellers do not learn the spellings of words as well as good spellers because poor spellers do not map all of the links that occur between graphemes and phonemes. Instead they predict the word when they read based on partial grapheme-phoneme connections and the context.

Another explanation could be that especially for the words with complex spellings reading them only once is not adequate to acquire full representations of the words in memory. The more the person is exposed to words the more likely that full representations are formed. Perhaps one of the reasons for poor spelling ability is the lack of reading experiences despite adequate reading ability. Therefore, the proposed study will include ART (Author Recognition Test) as a predictor of spelling skills of college students in order to clarify the relationship between reading experience and spelling.

In Burt and Butterworth's (1996) study with a sample of Australian college students WRAT-R (revised version of 1984) was used to classify the students as good and poor spellers. Good spellers' scores ranged from 42.8 to 46.2 and poor spellers' scores ranged from 32.4 to 35.9. Both groups were also administered EST (Fischer et al.,1985). The largest difference between the performances of good and poor spellers occurred in Level-3 words of EST. However, they did not conclude that spelling heavily depended on memory. Rather they reasoned that the spellings of opaque words are not totally arbitrary. They can be seen as more

regular by those who study different languages. Level-3 words included *bourgeois* and *connoisseur* which have French origins. Similarly, *kaleidoscope* and *pyorrhea* have Greek origins and *subpoena* and *annihilate* are borrowed from Latin. They also noted that 51% of their sample had studied French and/or German for at least two years. They also emphasized that orthographic transparency varies along a continuum rather than reflects distinct categories. They pointed out that a large difference between good and poor spellers on low transparency words does not necessarily support a major role for rote learning in spelling.

Many words that are borrowed from other languages such as French, Greek and Latin do not follow regularities of the English spelling system. It would not be wrong to argue that these types of words are very hard and knowledge of grapho-phonemic connections and orthographic rules are often inadequate to spell these words correctly. However, it would be wrong to claim that good spellers are better than poor spellers in spelling these words because they have better memories than poor spellers. Fischer, Shankweiler and Liberman (1985) have shown that poor spellers do not perform significantly worse than good spellers on tests that measure visual memory. Rather inferior performance of poor spellers may be the result of insufficient exposure to these types of words. More than 50% of the participants of Burt and Butterworth (1996) had studied French or German. Studying those languages may have provided the students with more reading experience with these types of words and more opportunities to build grapheme-phonemic connections while reading them. Therefore, Burt and Butterworth's results support the current study's expectation that those who read more frequently as indexed by ART will be more skilled at spelling. One way to remember irregular spellings is to create mnemonics to recode the graphemes of the words that do not follow the regular system in order to remember those unusual

graphemes. In the current study spelling pronunciations were utilized as mnemonics to remember the spellings of commonly misspelled words.

Burt and Butterworth (1996) also examined the interactions between spelling ability, word frequency and the regularity of word spellings. According to the Dual Route model, once a word is mastered it should be remembered as a whole, not in parts. Therefore, regardless of the extent to which the word's spelling contains irregularities, if used frequently pupils should be able to spell it correctly. Poor spellers made 29% errors on opaque words (which were the words that least follow the regularities of the English spelling system) whereas good spellers achieved a performance that is near ceiling regardless of orthographic transparency in the words' spellings. If spelling is learned by rote memorization or by visual memory then poor spellers should not have failed to spell the words like *necessary*, *restaurant*, and *vehicle* which are used frequently.

Burt and Butterworth (1996) observed that good spellers consistently outperformed poor spellers regardless of the extent to which words have transparency in their spellings and how frequently they are used. ANOVA's showed that all 3 variables had significant effects (ability, transparency and frequency) on spelling the words correctly. The interaction of spelling ability with item frequency reflected a greater effect of frequency on poor spellers than good spellers. However, frequency had a reliable effect on both groups. The interaction of spelling with orthographic transparency revealed that good and poor spellers differed more on medium and low transparency words (29%and 31%, respectively) than they did on highly regular words (9%). Nevertheless, good and poor spellers differed significantly at each level of orthographic transparency, and the effect of transparency was significant within each group of spellers.

Familiar words were easier than unfamiliar words, and the effects of spelling ability and transparency were smaller for familiar than unfamiliar words. The effect of transparency observed by Fischer et al. (1985) was replicated for both familiar and unfamiliar words.

Both groups (poor spellers and good spellers) had the lowest accuracy in their spellings when items were low in frequency and transparency. Burt and Butterworth (1996) reasoned that performance on these idiosyncratic words might reflect differential exposure to the words. They pointed out studies indicating that good spellers engage in more recreational reading (Burt and Furry, 1995; Holmes and Ng, 1993; Stanovich and West, 1989) and because of this, they may have more learning opportunities with these words.

Burt and Butterworth's (1996) findings are consistent with the view that orthographic structure and spelling-sound correspondences are important in spelling all words, regardless of familiarity (as measured by frequency). Kreiner (1992) claimed that spelling of familiar words is affected by polygraphy, a measure of difficulty in deciding which graphemes to use to represent a phoneme. Burt and Butterworth's findings support the idea that frequently used words have no special status in lexical memory; rather transparency in their spelling has an effect on accuracy.

Burt and Butterworth (1996) also administered a spelling acquisition task with nonwords to test the idea that good spellers are superior in linguistic sensitivity (knowledge and use of structural regularities of English). With this task good and poor spellers were given equal opportunity to learn spellings. This way they tried to eliminate the effect of differential exposure to words. Furthermore, to observe the effects of phonological processes, the items varied in terms of pronounceability (for example high: diskangle, medium: dispeign, low: dysthoegm). A second list of items included highly pronounceable nonwords which were very long (e.g. pelanduarity) to test the effect of orthography alone since the other items varied in orthographic

and phonological complexity. Since these words are long, participants would not be able to memorize them and instead would be forced to phonologically recode the words.

The performance of good spellers on these pseudowords was consistently superior to that of poor spellers. Based on this result, Burt and Butterworth (1996), claim that spelling ability among college students does not simply reflect good spellers' greater familiarity with the words. Rather it seems that good spellers and poor spellers differ in the skills that are operative in the acquisition of the spellings of unfamiliar words. Furthermore, similar performance was observed in both tasks of recalling and recognizing spellings. This indicates that the groups differed in the learning processes more than in retrieval processes. Pronunceability had a substantial effect on memory performance, particularly recall, in both groups of spellers. The long pseudowords sharply differentiated the two groups of spellers in recall, significantly more than that observed on short pronounceable items. This result is consistent with the expectation that under limited study time, good spellers would make better use of phonological information available in the long pseudowords than poor spellers.

In another experiment Burt and Butterworth (1996) tested Frith's (1980) argument that poor spellers use only partial cues when reading words. Participants were required to read sentences with confusable words such as *ingenious* and *ingenuous* on a computer screen, they were then asked to choose the one in the preceding sentence (the word was on right or left of the screen, and the alternative word was on the other side of the screen). There were also control groups of words which were either1- similar in orthography but not in meaning, (e.g. aroma-coma), 2-related in meaning but orthographically dissimilar (e.g. present-gift), or 3-unrelated. The participants also had taken a dictation task with WRAT-R and EST-Level 2 words and

Vocabulary in which participants were asked to write brief definitions of the 28 confusable words.

Good spellers were significantly better at discriminating correctly between words that they had read in a sentence and orthographically similar words that would have been semantically and syntactically acceptable in the sentence. However, when the words were orthographically dissimilar, poor spellers were not reliably different from good spellers. These results confirm the hypothesis of Frith (1980). Also, in Holmes and Ng's (1993) study with college students, poor spellers showed a deficit in lexical decision tasks that were indicative of reliance on partial analysis of letter sequences.

Performance of the good spellers on the vocabulary test was significantly better than performance of the poor spellers: Out of 56 possible points, good spellers scored 24.8 and poor spellers scored 14.1 ($p<.01$). The correlation between vocabulary and spelling scores was .51 and the correlation between reading accuracy and spelling scores was .35. Although vocabulary was strongly related to spelling ability, it was weakly correlated with reading accuracy of test items (.16).

The low performance of poor spellers in lexical decision tasks that were administered in the preceding studies may indicate that their poor spelling could be a result of only partial analysis of grapheme-phoneme connections. Perhaps for poor spellers, reading frequency does not make a big difference since they do not fully analyze the words while reading them anyway; they may use partial grapheme-phoneme connections combined with the context in the text to read words. For example, they may encounter the word *restaurant*, and read it in context but never pay attention to the two letters "AU" that represent the second vowel of this word.

However, another plausible explanation for this observation is that those who read more widely encounter many words that have a similar vowel such as *Austin, August, author, fault, haul, Paul, sauce, sausage, applause, Australia.* Encountering numerous words that contain the same pattern numerous times may help readers to fully analyze orthographic representations of words. As a result we can argue that those who read frequently encounter many words that have similar orthographic representations and this greater exposure to patterns contributes to their systematic alphabetical knowledge. Those two seemingly opposing ideas were tested in the current study by predicting spelling scores from decoding scores and the ART scores. If spelling is greatly affected by paying attention to all parts of the words while reading, a greater proportion of variance in spelling scores should be predicted by decoding. On the other hand, if spelling is greatly affected by print exposure, a larger proportion of variance in spelling scores should be predicted by ART.

Another researcher, Beech (2002) examined the relationships between reading, spelling, and knowledge of grapheme-phoneme connections. The sample was composed of 110 undergraduate students in theUK. A silent reading test (reading vocabulary) consisted of 84 real words and 42 foils. The participants were required to identify the real words. It was taken as a measure of reading vocabulary. The spelling test was a component test, for example, an incomplete word “ac_modate” had to be completed (76 items). Participants completed a semantic link test in which they chose the word, out of four options, that was semantically related to the target word. Another measure of the study, the meaning judgment test, required the participants to judge whether pairs of words were similar in meaning. The participants were also administered an Author Recognition Test (ART) as a measure of print exposure. Good spellers scored significantly higher than poor spellers on ART, silent reading and meaning judgment

tasks. Similarly good readers scored significantly higher than poor readers on the ART, semantic link and spelling components tasks. These results confirm that reading and spelling skills are highly interrelated and exposure to print is relevant to both reading and spelling.

Burt and Fury (2000) also examined the differences between good and poor spellers. The spelling measure was a dictation task and included WRAT Level-2 words and Level 2 words of EST. These words required knowledge of morphophonemic, affixation, and derivational spellings. The reading accuracy task required subjects to read sentences that included 20 confusable word pairs such as *evaluation/evacuation* and indicate which word was read in the preceding sentence. Participants were administered the comprehension subpart of the Nelson Denny Reading Test, and the 1st minute of reading passages of this test was used as a reading rate measure. Participants also took the Nelson Denny Vocabulary Test and ART (Stanovich & Cunningham, 1992). Good and poor spellers were classified based on one standard below and above the mean on the WRAT.

Results showed that accuracy in reading confusable words was positively correlated with spelling ability (r = .39). Poor and good spellers were significantly different in reading accuracy. Reading rate and spelling scores were correlated moderately. Vocabulary had statistically significant correlations with spelling, reading comprehension, reading rate and ART. Burt and Fury reason that vocabulary is related to spelling as both reading and writing are related to reading experience. ART was significantly correlated with all literacy measures, including accuracy on reading confusable words. The correlation between ART and EST was .24, which although significant, was lower than the correlation between ART and WRAT-R (r = .43). Most errors in EST were attributable to deficiencies in morphophonemic knowledge. Therefore, Burt and Fury concluded that reading experience may not be an important source of sophistication in

the use of morphophonemic knowledge. They reason that spelling depends on the quality of the individual's learning about the orthography of words, rather than efficiency of memory access procedures or the knowledge and application of rules. The results of the aforementioned studies reveal that poor speller even at the college level do not effectively attend to the spellings of the words while reading them. They need to be taught how to effectively process the links between graphemes and the phonemes of words with challenging spellings so that they can remember them. The spelling pronunciation strategy that was taught in the current study was expected to help students attend all graphemes of the words by mapping them onto phonemes in memory.

Decoding Skill, Exposure to Print and Vocabulary as Predictors of Spelling Ability

Decoding skill. According to the self-teaching hypothesis (Jorm & Share, 1983; Share, 1995), knowledge about words' spellings is acquired largely by applying a decoding process to read words. Engagement in the process of decoding of words provides an opportunity to learn their spellings. In this view decoding is considered to be critical in learning how words are spelled because it draws attention to the order and identity of letters and how they map phonological representations. Consistent with this view, strong association has been found between children's success on decoding and orthographic learning (Share, 1999). Those who had higher levels of success in decoding had higher levels of orthographic learning (Share & Shaley, 2004).

Furthermore, decoding and spelling skill have been found to be highly correlated in children (Dreyer, Shankweiler, & Luke, 1993; Stage & Wagner, 1992). In Shankweiler, Lundquist, Dreyer and Dickinson's (1996) study with high school students as well, significant correlations were found between decoding and spelling skill. The correlation coefficient for real word decoding and spelling was .68, and the correlation coefficient between nonwords and

spelling was .70. In regression analyses predicting spelling, decoding along with phonemic awareness and morphological awareness explained significant unique variance in spelling.

It was one of the goals of the present study to determine whether these two code-related skills retain their close association in college students who are experienced in reading and spelling and whether decoding retains its power to account for individual differences in spelling. Consistent with our expectation that decoding still would be a strong predictor of spelling, Stanovich and West (1989) found strong correlations between the decoding and spelling skills of college students. Correlation coefficients for real word decoding and several measures of spelling ranged from .28 to .37 and correlation coefficients for nonword decoding and several measures of spelling ranged from .45 to .52. Similarly in Allyn and Burt's (1998) study with college students, WRAT-R spelling scores were highly correlated with nonword decoding (r =.65, p<.01).

According to Ehri's (2005) theory of sight word reading, spellings of specific words are linked to their pronunciations in memory. Students use their knowledge of the alphabetic system to create these connections. When readers encounter a new written word and recognize its pronunciation and meaning, they use their alphabetic knowledge to compute connections between graphemes and phonemes. Reading the word just several times serves to bond the spelling to its pronunciation along with its other identities in memory. In this view, decoding skill is critical for the links created between pronunciations and spellings of words. Therefore, we included decoding as a predictor of spelling ability.

Since college students can already read most words by sight, nonword reading tasks are commonly used in measuring decoding skill. Another type of task that is often used with mature readers is a lexical decision task in which participants are asked to discriminate a real word from

a nonword. In this task, nonword spellings are created by changing the spelling of real words by slightly changing sequences of one or more letters. This task implicitly forces the participants to attend to all grapheme-phoneme connections of the words. Since college students are proficient readers, it is hard to capture variation in their decoding skills. Perhaps for this reason, studies that examined differences between good spellers and poor spellers with college students used lexical decision tasks rather than decoding tasks. Although lexical decision tasks are different than decoding in many ways, they are similar wherein both of them require participants to attend to all letters with their precise sequences. In Holmes and Ng's (1993) study, poor spellers took significantly more time and misclassified more of the low frequency words as nonwords than good spellers. This finding supports Frith's (1980-1985) claim that poor spellers recognize words using only partial cues rather than full letter sequence.

Exposure to print. The rationale for including exposure to print as a predictor of spelling ability is based on the self teaching hypothesis. Share (1995) in several experiments demonstrated that students learn orthographic representations of words through reading. After several exposures to spellings of words in text, children chose the spellings of words they had read in the stories rather than their homonyms. Experimental studies showed that reading words in context help students to remember their spellings (Gilbert, 1935; Ormrod, 1986; Dixon & Kaminska, 1997). Further evidence for the relationship between spelling and exposure to print is provided by correlational studies. Exposure to print measure of ART was found to be a strong predictor of spelling as demonstrated by high correlations between several measures of spelling and ART in college students (Stanovich and West, 1989). Correlations ranged from .34 to .46 as different measures of spelling were included in the study. Burt (2006) in a study with college students also found a strong correlation between ART and spelling ($r = .42$, $p<.01$). Similarly

Stanovich and Cunnigham (1992) in their study with 300 college students found a strong correlation between ART scores and spelling scores as well (r = .51, p<.01). In Holmes and Ng's (1993) study, poor spellers scored significantly lower than good spellers on ART.
In another study with 110 college students in the UK as well, poor spellers scored significantly lower than good spellers on ART (Beech, 2002)

Vocabulary. We included vocabulary knowledge as a predictor variable for general spelling skill because most of the extant research and theories of word learning confirm this relationship. According to Ehri's (1992) sight word learning theory, orthographic representations of words are stored in long term memory as consolidated units along with their pronunciations and meanings. Subsequently when readers encounter the spellings of these words while reading text, the meanings of the words are activated automatically. Therefore it is reasonable to expect a positive correlation between spelling skill and vocabulary knowledge.

When students read a variety of texts they encounter unfamiliar words whose spellings and meanings are unknown. They may use the context to infer meanings or use other ways such as looking the words up in a dictionary to learn their meanings. Since learning meanings and spellings of new words this way is expected to be supported by the same source, which is exposure to print, we expected to detect a strong relationship between spelling and vocabulary knowledge.

Support for this relationship comes from studies that compare performances of good spellers and poor spellers on vocabulary tests. In several studies good spellers were found to have significantly higher vocabulary scores than poor spellers (Holmes & Ng, 1993; Burt & Furry, 2000; Burt & Butterworth, 1996). However, in Fischer, Schankweiler and Liberman's (1985) study, good spellers did not perform reliably better than poor spellers on the Vocabulary

subtest of the Wechsler Adult Intelligence Scale (Wechsler, 1958). As discussed in the previous section of the literature review, this may have happened because of measurement issues.

In our pilot study we found a very high correlation between spelling and vocabulary (r = .70, p<.01). However, our sample included many bilingual students, and that may have affected the correlation. Further support for the relationship between spelling and vocabulary comes from a correlational study. Stanovich and Cunningham (1992) found a high correlation (r = .59, p< .01) between vocabulary and spelling. In sum, based on theory and previous research reviewed above, we expected that three variables, decoding skill, exposure to print, and vocabulary knowledge, would be found to explain significant unique variance in the spelling skills of college students.

Chapter 3

Pilot Study, Rationale and Hypotheses

Pilot Study

In a pilot study, college students (n=33) were asked to spell some words that are commonly misspelled. They received training on the words that they misspelled with one or another strategy. There were three strategies: Creating spelling pronunciations (PRON), flagging hard to spell parts of the words (FLAG) and looking at the correct spellings of the words carefully (LOOK). PRON group was trained to pronounce the words in a special way in order to optimize the match between the graphemes in the words' spellings and phonemes to create a spelling pronunciation. The FLAG group was trained to underline the hard parts that cause difficulty in remembering how to spell the words, such as silent letters, doubled letters, letters that represent the schwa sounds, and unusual or unexpected parts. Participants in the LOOK group were instructed to look at the spellings of words carefully in order to remember how they were spelled. Participants studied the words three times and were tested for their memory of spellings after each study period.

In addition, participants were administered a dictation task of 28 spelling words which were taken from the Boder Test of Spelling Patterns (Boder & Jarrico, 1982). The word correct scores of this test were used to compare the three groups in order to ensure that they did not differ significantly in their general spelling ability. The Nelson Denny Vocabulary Test (Brown, Fishco, & Hanna, 1993) was given to measure the subjects' general vocabulary level. The test consists of 80 multiple choice items. Participants were given 15 minutes to complete this test. The Colorado Assessment of Decoding, Revision II (Word Detectives Test) was given to

measure nonword decoding skill. Participants were asked to underline the incorrectly spelled but phonologically accurate spellings of familiar English words (e.g.,*lun*, *fep*, *kat*). Students were given 5 minutes to complete the 40 items. The number of correct responses was used in the analyses. Participants also took a silent letters test that was designed for the study. It required the participants to circle the silent letters in each word. The test had 24 items and the number of correctly circled silent letters was used in the analyses. In addition, the participants filled out a questionnaire regarding their own assessment of their spelling skill.

The data of only 24 subjects who studied exactly16 words were included in the analyses since inclusion of the subjects who studied fewer words could mislead our results. Our sample was very diverse with students coming from a variety of majors and speaking a range of languages. Although the differences between the groups on the pretest measures were not significant, to lessen random error we used Nelson Denny Vocabulary Test scores as a covariate in analyzing the effect of treatment on the number of correct spellings that were learned throughout the trials. Table 1 displays descriptive statistics of the 24 participants:

Table 1

Characteristics and Means, Standard Deviations, and Test Statistics for Participants in Three Experimental Conditions (Maximum score=16)

Characteristics and Tests	Experimental Conditions PRON(*N*=9) *M(SD)*		FLAG(N=7) *M(SD)*		LOOK(*N*=8) *M (SD)*		Test Stat.		*p*
Age	21.13	(2.70)	20.23	(3.50)	19.50	(1.31)	*F*:	.78	.47
Bilinguals (*N*)	5		5		7		$\chi 2$:	.35	.35
Modified Boder spelling test	18.11	(2.09)	17.43	(4.12)	13.88	(6.51)	*F*:	2.05	.15
Nonword decoding test	29.67	(6.73)	32.00	(5.97)	30.39	(7.01)	*F*:	.25	.78
Silent letters test	23.89	(1.83)	24.86	(3.44)	22.13	(4.97)	*F*:	1.13	.34
Nelson Denny Vocabulary	47.00	(12.22)	53.00	(11.5)	50.00	(14.9)	*F*:	.42	.66

ANCOVAs were conducted with Nelson Denny Test of Vocabulary scores as the covariate to examine differential effects of the three types of training on the number of correctly spelled words on Trials 1 and 2 and on the delayed test. Table 2 below shows the means and standard deviations for the three experimental conditions for each trial and delayed test.

Table 2

Adjusted Mean Number of Correct Spellings for Experimental Conditions

		Trial 1	Trial 2	Week-delay
Training type	*N*	*M(SD)*	*M(SD)*	*M(SD)*
PRON	9	8.03(2.19)	10.77(2.28)	9.67(2.61)
FLAG	7	5.71(2.17)	9.77(2.28)	7.78(2.60)
LOOK	8	5.60(2.15)	7.71(2.26)	8.06(2.58)

On the first test trial, the type of training showed a main effect on the number of correct spellings only at the margin of statistical significance, $F(2,20) = 3.35$, $p = .055$. Simple contrast tests showed that PRON training resulted in significantly more correct spellings than the FLAG training ($p = .049$), and the LOOK training ($p = .031$) after controlling for Nelson Denny Vocabulary Test scores.

On the second test trial, the type of training showed a significant main effect, $F(2,20) = 3.95$, $p = .036$. Simple contrast tests showed that there were no significant differences between the PRON and FLAG treatments on the number of correctly spelled words. The difference in the number of the correctly spelled words between PRON and LOOK was significant though. The PRON group produced significantly more correct spellings than the LOOK group ($p = .012$).

For the delayed test, the training type did not reveal a significant difference among the three groups on the number of correctly spelled words after controlling for Nelson Denny Vocabulary test scores, $F(2,20) = 1.27$, $p > .05$.

Error analyses revealed that the PRON and FLAG conditions were more effective in improving parts of the spellings that included silent letters, schwa sounds, and unusual or unexpected letters. However, the LOOK condition appeared to be more effective in lessening double letter errors.

An important finding was that the majority of students, despite the availability of many technological tools that help with spelling errors, reported in the questionnaire that they did care about spelling a word correctly from memory.

Rationale and Hypotheses

The proposed study expanded upon and improved features of the pilot study. One limitation was that individual participants studied different words. This happened because we wanted to make sure that each participant studied the words they misspelled. We did not want to waste their time by instructing them with the words that they already knew. This situation created two problems. One was that we ended up excluding nine of the participants' data since they studied fewer than 16 words. We included only 24 participants who studied exactly 16 words. This resulted in small and unequal numbers of participants across conditions to include in the data analyses to determine if the three strategies were equally effective.

The second limitation was that since participants studied different words, we could not be confident in our results since the words could not be judged to be equally difficult across conditions. For example, the spelling of *separate* can be easily learned since most participants have difficulty in remembering only that the middle vowel is represented with an A, not an E.

However, another study word, *rhinoceros* is much more challenging as it has several problematic parts such as the silent H, C sounding /s/, and letter O representing the schwa. To resolve this issue that was observed in the pilot study, in the current study we taught the same words that we expected to be challenging to all of the participants.

Another limitation of the pilot study was that we did not have a true control group in order to attribute the amount of learning to the strategies that we taught. We planned the "just looking at the correct spelling" as the control condition. We thought that the participants in this condition would just be passively exposed to the words. However, it turned out that many subjects in this condition spontaneously used a strategy or a combination of strategies to improve their spellings of the words over trials. In the current study, we included a control group who just read the words. This ensured that the participants in the control condition were equally exposed to spellings of the words and reduced the likelihood of spelling strategy use.

There were some issues with the strategy of flagging hard parts of the words. The experimenter observed that the training time was not adequate to teach the elements that were part of this strategy. The participants had a hard time understanding the concept of schwa vowels. Some participants examined the words for long periods of time and could not decide which parts were hard. This longer waiting sometimes resulted in participants' engaging in other strategies such as creating spelling pronunciations or thinking about their misspelling and comparing them to the correct spelling. Therefore, in the current study we did not teach this flagging strategy.

The pilot study included participants who spoke many different languages, and the age that they started to learn English as a language varied as well. To make sure that the learning of correct spellings was because of strategy instruction rather than other factors involving

knowledge and use of language in this study, we included only native speakers of English as participants.

Furthermore, in our pilot study we observed a significant correlation between vocabulary scores (as measured by the vocabulary subtest of Nelson Denny Reading Test) and spelling scores of the participants. Text reading has been found to contribute not only to spelling ability but also to vocabulary knowledge. If vocabulary and spelling both improve through reading of words in text then there should be a high positive correlation between vocabulary and spelling scores of people. However, extant research has mixed results on this. In a study by Fischer, Schankweiler and Liberman (1985) good spellers did not perform reliably better than poor spellers on the Vocabulary subtest of the Wechsler Adult Intelligence Scale (Wechsler, 1958). However, Stanovich and Cunningham (1992) found a high correlation (r = .59) between vocabulary and a spelling composite score. They measured vocabulary with a subset of 20 items from the Vocabulary subtest of the Nelson-Denny Reading Test (Brown et al., 1981). The spelling composite score was obtained by combining the scores on a dictation task with WRAT (Spelling subtest of Wide Range Achievement Test) and the Experimental Spelling Test (Fischer et al., 1985) and scores on a spelling recognition test with words taken from the Peabody Individual Achievement Test (Dunn & Markwardt, 1970).

In Holmes and Ng's (1993) study, the mean vocabulary score of poor spellers was significantly lower than that of the good spellers. In their study the spelling measure was a recognition task (spelling subtest of the English Skills Assessment Test; Australian Council for Educational Research, 1982) and the Vocabulary was measured by the Advanced Vocabulary Test of the Kit of Reference Tests for Cognitive Factors (Educational Testing Service, Princeton, NJ, 1963). Similarly Burt and Furry (2000) found a significant difference between good and poor

spellers in vocabulary scores, and a significant correlation between the participants spelling scores and vocabulary scores, although their vocabulary measure was not a standardized test.

In our pilot study we found a higher correlation between spelling and vocabulary (r = .70). However, our sample included many bilingual students, and that may have affected the correlation. In the present study we measured exposure to print as indexed by the Author Recognition Test (ART), vocabulary, and decoding skills to examine correlations with the spelling scores of the participants. The purpose was to increase our understanding of how learning word meanings and spellings through exposure to print are interrelated.

The first aim of the current study was to determine whether college level students can benefit as much from the spelling pronunciation strategy as the fourth grade students in Drake and Ehri's (1984) study. The second aim of the study was to determine if utilizing the regularities of the alphabetical system to create spelling pronunciations is especially beneficial with commonly misspelled words. Drake and Ehri's (1984) study has been criticized because the control condition was exposed to phonetic misspellings and some researchers have claimed that this caused the control condition to misspell words making it hard to see if spelling pronunciation improved spelling. In the current study the control group was exposed to correct spellings rather than phonetic misspellings. The second aim of the study was to examine the contribution of decoding, vocabulary and exposure to print (as measured by the Author Recognition Test) to the spelling ability of college students.

An experimental research design was adopted. The dependent variable was the number of correct spellings that were learned. The independent variables were strategy instruction with two levels (spelling pronunciations vs. word reading) and spelling ability (good vs. poor).

The hypotheses tested were:

1. Students who apply a spelling pronunciation strategy in learning the spellings of words will remember the spellings of more words than control students who practice reading the spellings of the words. Strategy students will remember more silent letters, letters symbolizing schwa vowels, and doubled letters than control students who practice reading the words.
2. Better spellers will benefit more from the application of a pronunciation strategy than poorer spellers, so the difference in performance between the strategy and control groups should be greater for better spellers than for poorer spellers. This is expected because better spellers should be more skilled at mapping graphemes onto phonemes to remember spelling pronunciations.
3. Several predictor variables will each explain unique variance in students' spelling ability, including exposure to print as measured by ART, vocabulary knowledge, and decoding skill.

Chapter 4

Method

Participants

College students who were native speakers of English were recruited for the study through a research participation pool in the psychology department of a college located in an urban city. There were 21 students (16 females and 5 males) in the treatment condition and 21 students (15 females and 6 males) in the control condition, mean age 22 years 7 months. The majority, 13 of them, were freshmen who had not decided on their majors yet. There were 11 students who were majors in psychology; three students who were majors in speech and communication sciences and three students who were majors in chemistry. The rest of the students came from a variety of majors.

Procedures

The study was conducted in two sessions. The first session included pretests. The second session included the treatment and control training procedures and the posttests. The first session lasted 55 to 75 minutes. The second session lasted 45 to 65 minutes. The time interval between first session and second session was one week. The experimenter met with each student individually. After reading and signing consent forms, the participants were administered several pretests during the first session. The order of administration of the pretests is the same as the order listed below.

Pretests

Spelling Dictation Pretest. This test was given to measure the participants' knowledge of the spellings of the 20 training words (see Appendix E) before the training so that the gains through the training in experimental and control conditions could be compared. The words were

presented in the same order listed in Table 3. In selecting the 20 target words we considered words that would be difficult for most of the participants in order to lessen previous knowledge about the spellings of the words that could interfere with the effects of the treatment. Most of the words were selected from the list of commonly misspelled words that were collected by Oxford Dictionaries (http://www.oxforddictionaries.com/words/common-misspellings). We included 12 of these words that most of the participants misspelled in our pilot study (*Fluorescent, Fahrenheit, millennium, occurrence, liaison, rhinoceros, idiosyncrasy, irresistible, hierarchical, privilege, accommodation, and questionnaire*). Two words (*chauvinism* and *lieutenant)* were taken from the list of words in the Boder Test of Spelling Patterns (Boder & Jarrico,1982). These two words as well were misspelled by majority of the pilot study participants. The other six words were taken from the stimuli that were used in previous research examining spelling skills of college students (Holmes & Ng, 1993; Burt & Butterworth, 1996).

The experimenter told each participant that she would like the participant to write down some words. She played a recording of each word that was supplied by a smartpen. This recording included each individual word followed by a sentence to clarify meaning. For example, *Fluorescent. Fluorescent light bulbs save energy*. After hearing the word and the sentence the participant wrote down the word on a numbered sheet. The experimenter continued with the next word when the participant finished writing each word. Scored was the numbers of correctly spelled words. The split-half reliability of this measure (odd-even, Spearman-Brown corrected) was .86.

Modified Spelling Component Test. This test was used as a general spelling skill measure. The Spelling Component Test (Coren, 1989) is composed of 76 words with one or more letters missing. Participants are required to insert the missing letters in the blank spaces.

For example participants were required to insert "i" on the short line of "exper__ment" to complete the word *experiment*. The words of this test were selected from lists of the words most frequently misspelled by college students. The original test is timed at 10 minutes. It is reported to have high reliability. In order to ensure that participants would recognize each word's identity, we modified the test by including brief definitions of all of the words right next to the partially spelled words. Furthermore, we extended the time to 20 minutes to ensure that the participants would have adequate time to read all of the items and their definitions. Five items were not included since the same words were included in the Spelling Dictation task. The split-half reliability of this measure (odd-even, Spearman-Brown corrected) was .92 (see Appendix C)

Author Recognition Test (ART). A newer version of ART (Acheson, Wells, & MacDonald, 2008) was administered to measure differential exposure to print of the participants. ART was originally designed by Stanovich and West (1989). In the ART pupils indicate whether they are familiar with particular popular authors by putting check marks next to the author names. Print exposure score is calculated by subtracting the number of foil names that are marked from the number of correct real names marked. The ART was created this way to prevent the pupils from checking names they do not know or from guessing. The ART has been shown to be a valid measure in gauging print exposure: It has been shown to have convergent validity with daily activity diaries (Allen, Cipielewski, & Stanovich, 1992). It has been shown to be a good predictor of reading behavior in natural settings (West, Stanovich, & Mitchell, 1993). The split-half reliability of this measure (odd-even, Spearman-Brown corrected) was .86.

In calculating the reliability analysis for ART, correct items were scored as +1, incorrect items were scored as -1, and the items that were not checked were scored as 0. The newer version of ART (Acheson, Wells, & MacDonald, 2008) that we used in the present study

included 65 real author names and 65 foils. The participants were asked to read the instructions and complete the task which required them to put a check mark next to the names that they knew for sure that were authors. Instructions also included warning that there would be a penalty for guessing so they should check only the names they were absolutely certain were authors. One example for real author name was *J.R.R. Tolkien* whereas an example of a foil name was *Seamus Huneven.*

Word Detective Test. (The Colorado Assessment of Decoding, Revision II; Scarborough et al., 2008). This test was administered to measure the decoding skill of participants who were asked to underline the phonologically accurate but incorrect spelling of a familiar English spoken word selected from three non-word spellings (e.g., *lun, fep, kat*). The participants were told that there were three misspelled words in each box. However, when they try to read these misspelled words one of them would sound like a real word. Participants practiced the test with three sample items. They were told that on the back of the page there were 40 boxes each including three misspellings and they needed to choose the one that sounded like a real word, just like they did with the practice items. Students were given five minutes to complete the 40 items. The number of correct responses was used in the analyses. The split-half reliability of this measure (odd-even, Spearman-Brown corrected) was .94.

The Nelson Denny Vocabulary Test. (Brown, Fishco, & Hanna, 1993). This test was given to measure the participants' general vocabulary level. The test consists of 80-multiple choice-items, each with five response options. The participants were told that this was a vocabulary test that required them to find the best option that completed the sentence and circle the letter that was in front of that choice. For example, A *chef* works with A. bricks, B. music, D. clothes, D. food, E. statues. Before beginning with actual test items, all participants practiced

with the three practice items successfully. Participants were given 15 minutes. The number of correct responses was used in the analyses. The split-half reliability of this measure (odd-even, Spearman-Brown corrected) was .85.

Pretest Questionnaire. The participants filled out a questionnaire pertaining to their perceptions of their spelling abilities and use of strategies. The questionnaire had items that required participants to rate their difficulty in remembering spellings of words, their confidence in their spelling skills, how important they thought spelling was, and how effective they thought use of spellcheckers was. They were also asked to write the strategies that they use in order to remember spellings of words (see Appendix D).

Training

The experimenter met with individual students a week following the first session. During the second session, the training procedure was followed by an immediate spelling posttest, then the PPVT test, then the delayed spelling posttest. The participants were randomly assigned to either the treatment or the control condition. Both groups were trained on the same words in the same order listed in Table 3. The first step of training was the same for both the experimental and the control conditions. The participants read aloud 20 sentences that included the training words which were underlined. The goal was to familiarize the participant with the 20 training words. Mispronunciations were corrected and recorded. Also after reading each sentence, the participants rated their familiarity with each of the target words. The meaning of "familiarity" was not specified, so it could have referred to spelling or memory or both. Ratings ranged from 4 (high) to 0 (low). These ratings were used to test whether the groups differed in terms of familiarity with the study words. For the treatment group, this was followed with the training steps that are explained below.

The spelling pronunciation training. The strategy training group was taught to read the words by assigning spelling pronunciations. The spelling pronunciations of the study words were created by dividing the words into either syllable or grapheme-phoneme segments so that the segments symbolized sounds in a way consistent with the writing system. For example the first segment of *Fahrenheit*, FAH was pronounced as /fah/. When possible, words were divided into commonly known words with simple spellings. For example, the last two segments of *Fahrenheit*, HE-IT were pronounced the same as *he* and *it*. Table 3 displays the segmentation of each word and how the segments were pronounced.

To give an overview of the steps in spelling pronunciation training, in Step 1, students read the 20 sentences and rated their familiarity with the underlined target words. In Step 2, they viewed the target words segmented into the parts shown in Table 3 and were taught how to create a spelling pronunciation by pronouncing these parts. In Step 3, they were shown the segmented spellings again and asked to recall how the parts were pronounced. Errors were corrected. In Step 4, they were shown the spellings of words as wholes and asked to recall the spelling pronunciations.

Table 3

Target Words Segmented into Written Units and Assigned Spelling Pronunciations by Students in the Spelling Pronunciation Condition

Written Segments	Spelling Pronunciations
Flu-or-e-scent	FLU-OR-ɛ-SCENT
Fah-ren-he-it	fæh-rɛn-HE-IT
Mil-len-ni-um	mɪl-lɛn-KNEE-ʌm
Oc-cur-rence	ɑk -CURE-rɛns
R-hi-no-ce-ros	r-HI-NO-SAY-ros
Ac-com-mo-date	ɑk-kɑm-MOW-DATE
Ir-resist-ible	ɪr-RESIST-ɪbəl
Hi-er-arch-ical	HI-ɜr-ARC-ɪkəl
Priv-il-ege	PrɪV-ɪl- ɪdʒ
Question-naire	QUESTION-nAIR
Idio-syn-crasy	ɪdio-SIN-kræsi
Lia-is-on	liə -IS-ON
Mane-u-ver	MANE-u-vɛr
P-neu-mo-nia	P-NEW-MOW-niə
Bou-quet	bo-kwɛt
Sil-hou-ette	sɪl- HO-ɛt
Bure-au-cracy	bɜre-ɑʊ-kræsi
Chau-vin-ism	tʃɑʊ-vɪn-ɪzm
Im-pec-cable	ɪm-pɛk-CABLE
Lie-u-ten-ant	LIE-u-TEN-ANT

Note. The segments whose pronunciations are real English words are written in capital letters. The IPA symbols that are used in the table: æ (hat), ɛ (left), ɪ (ship), ɔ (saw), ɑ (pot), ʌ (up), ɜr (her), ə (sofa), i (sheep), u (shoot), u: (new), o (show), ɑʊ (mouth), dʒ (joke), and tʃ (cheese).

More specifically, in the second step, the experimenter showed the spellings of the 20 words segmented into pronounceable parts with dashes between the parts and demonstrated how to read the spelling pronunciations of the words. In order to make sure that each participant heard exactly the same pronunciation for each segment, a smart pen was utilized. A native speaker of English who has clear diction pronounced each word, spoke the accompanying sentence and spoke each segment of the spelling pronunciation. These utterances were recorded on a smart

pen which has the capacity to play any given part of the recording at any given time when requested by touching the page with the pen. This was enabled by underlining the specific segments of the word while recording was done. After the experimenter played the recordings for each word and pointed to the line that was drawn with the smart pen that contained the recording of the word, the participant read the word in the same way. Errors were corrected and recorded.

In the third step, the experimenter asked the participants to read the 20 segmented words and recall their spelling pronunciations. Participants were required to use the same spelling pronunciations that they were taught in the second step. Errors were corrected and recorded.

In the fourth step, the participants were asked to segment the 20 words printed without dashes between segments and read the words with their spelling pronunciations. The experimenter demonstrated how to show the segments by drawing a vertical line with a pencil between FLU and OR in fluorescent. Following this demonstration, participants segmented each word, read the word and pronounced each segment with its spelling pronunciation. Errors were corrected and recorded.

On average the 2nd, 3rd and 4th steps of the treatment training lasted a total of 19 minutes, ranging from 15 minutes to 27 minutes. The first step of the training was not timed.

The control condition training. After students read the sentences and rated their familiarity with the target words, the experimenter showed the spellings and demonstrated the normal pronunciation of the 20 words. The participant read each word aloud with normal pronunciation. Errors were corrected and recorded. In the third and fourth steps, the experimenter asked the participant to read the 20 words. Errors were corrected and recorded. To compensate

for the longer time that was spent on training in the treatment condition, the control group read the list of words two more times.

On average, the 2nd, 3rd and 4th steps of the control training lasted a total of 10 minutes, ranging from 8 to 12 minutes. The first step of the training was not timed.

Posttests

Immediate Spelling Dictation Posttest. The training was followed by the posttest in which the participants listened to each word followed by a sentence that clarified the meaning of the word and they were asked to spell the word. This task was just like the Spelling Dictation Pretest except that the order of the words was changed from that used in the pretest. The same scoring criteria were used as in the pretest. This time, the purpose was to measure the spelling gains that resulted from the two types of training.

Peabody Picture Vocabulary Test (PPVT). This measure was used in order to measure receptive (listening) vocabulary. The PPVT-IV (Dunn, & Dunn, 1959) is a norm-referenced, wide-range test containing 228 test items grouped into 19 sets of 12 items each. The items sets are arranged in order of increasing difficulty. Each item consists of four colored illustrations arranged on a page called a Picture Plate. For each Picture Plate shown, the participants were asked to select the picture that best represented the meaning of the stimulus word. Each stimulus was pronounced by a native speaker of English who has clear diction. The pronunciations were recorded on a smart pen. Participants heard a recording of each stimulus word while they were shown each Picture Plate. Form A was used in the present study. Set 14 was used as a starting point as it is labeled as "Start Ages 19-Adult." The experimenter said, "You will hear a word now and I would like you to choose the picture that shows that word. Please ask me to repeat the

recording if you need to hear the word again." The split-half reliability of this measure (odd-even, Spearman-Brown corrected) was .88.

This vocabulary test was administered at the time of the posttests despite the fact that the other tests measuring general abilities, including spelling, decoding, exposure to print and vocabulary, were given as pretests. It was necessary to administer this test during the posttests because the pretest session was too long whereas there was extra time during the posttest session. Also administering this test during posttest created a delay between the two spelling dictation tasks that tested participants' memory for spellings of the 20 target words.

Delayed Spelling Dictation Posttest. This task was just like the Immediate Spelling Dictation Posttest. The scores on this test were used a measure of delayed memory for spellings. The length of delay was 15 to 20 minutes with the administration of PPVT intervening. The participants listened to each word followed by a sentence that clarified the meaning of the word and they were asked to spell the word. Test-retest reliability of this measure was .98 which was obtained by computing the correlation of the scores of this test at two different times (immediate and delayed).

Posttest Questionnaire. The treatment group was asked to rate the effectiveness of the spelling pronunciation strategy, while the control group was asked to rate the effectiveness of reading words in order to remember their spellings. Furthermore, participants were asked to convey any comments about the study (see Appendix D).

Chapter 5

Results

Characteristics of Participants

First, the comparability of students in the treatment and the control conditions was examined. Independent *t*-tests were run to determine whether the groups differed on pretest measures. None of the tests showed a significant difference indicating that the groups had very similar characteristics. Table 4 displays descriptive statistics for the two groups:

Table 4

Characteristics, Means, Standard Deviations, and Test Statistics for the Participants in the Two Experimental Conditions on the Pretests

	Experimental Conditions					
	Treatment		Control		Test	
Characteristics and Tests	*M*	*(SD)*	*M*	*(SD)*	Stat.	*p*
Age (years)	22.43	(8.10)	22.66	(7.70)	-.10	.92
Sex	16 Females, 5 Males		15 Females, 6 Males		.12	.73
Target Words						
Correct Spellings (Max 20)	3.90	(3.12)	4.38	(4.03)	.47	.64
Correct letters (Max 202)	177.00	(12.32)	173.19	(18.12)	.79	.44
Correct silent letters (Max 22)	14.14	(3.00)	14.29	(3.72)	-.14	.89
Correct letters representing schwa sounds (Max24)	15.60	(3.54)	16.00	(3.60)	-.35	.73
Correct double letters (Max 10)	6.00	(1.32)	5.48	(1.97)	.92	.36
Score on Author Recognition Test (Max 65)	11.38	(7.45)	12.00	(8.10)	-.26	.80
Peabody Picture Vocabulary Test	201.62	(10.47)	202.43	(8.93)	-.27	.80
Modified Spelling Component Test (Max 71)	42.33	(9.40)	39.62	(11.03)	.86	.40
Word Detectives Test (Max 40)	34.81	(6.71)	31.24	(6.51)	1.75	.09
Nelson Denny Vocabulary Test (Max 80)	55.57	(10.94)	54.05	(10.00)	.47	.64
Total Familiarity Rating (Max 80)	70.33	(8.20)	69.38	(8.29)	.38	.71

Note. Statistical test for Sex variable $X^2(1)$; for all other variables independent samples $t(40)$. All test scores are raw scores.

The mean age of the participants was 22.55 (*SD* = 7.87). As indicated by several pretests that have norms, this group of students was observed to have average skills that were the focus of the present study. For example, the norm on the Spelling Component Test (Coren, 1988) was obtained by testing 702 college students and yielded a mean of 45.1 words correct (*SD* = 11.96). Students in the present study had a mean score of 40.98 (*SD* = 10.21) on this test. Five points below the norm was observed probably because we excluded five items on the test. On the PPVT-IV (Dunn, & Dunn, 1959) our sample's raw score was 202 (*SD* = 9.70). This corresponds to a standard score of 99 which is considered as average based on the norms. However, on the Nelson Denny vocabulary test, participants scored substantially below the mean of the normative sample, *M* (ND) = 54.81, *SD* = 10.47 vs. *M* (norm) = 64.52, *SD* = 11.46. Why this discrepancy occurred is not clear.

On the ART, our sample had a mean of 11.69 (*SD* = 7.73). However in Acheson, Wells, and MacDonald (2008) the mean score of 99 participants on ART was 22.7 (*SD* = 10.8). One reason could be that current students may be reading less than students in 2008 in general. Another reason could be that by chance students who do not engage in reading much as indexed by ART were heavily represented in the present sample. Another reason could be that the participants of Acheson, Wells, and MacDonald (2008) by chance were made up of individuals who read a lot more than average. The discrepancy in abilities of that study and our sample could be seen more clearly with the following information reported by Acheson et al.(2008). In that study participants' ACT reading scores were above the national average. Whereas their participants obtained an average of 28.3, the national average for this test in 2003 was 20.5. Superior reading ability may explain their higher scores on the ART than our sample.

Effects of Treatment

Our hypothesis was that students who applied a spelling pronunciation strategy in learning the words would remember the spellings of more words than control students who practiced reading the words. Spelling pronunciation strategy students were expected to remember more silent letters, more letters symbolizing schwa vowels, and more doubled letters than control students. Also it was expected that good spellers would benefit more from the application of a pronunciation strategy than poorer spellers.

To test our hypotheses, first we distinguished the good and poor spellers. When the performance of the participants on the number of words spelled correctly on the Spelling Dictation Pretest was examined, a bimodal distribution was observed. Figure 1 displays this bimodal distribution. Therefore, it was appropriate to classify the participants as good and poor spellers based on their performance on this pretest. The participants who had fewer than six correct words were classified as poor spellers and the participants who produced 6 or more correct words were classified as good spellers. This resulted in 17 good spellers and 25 poor spellers.

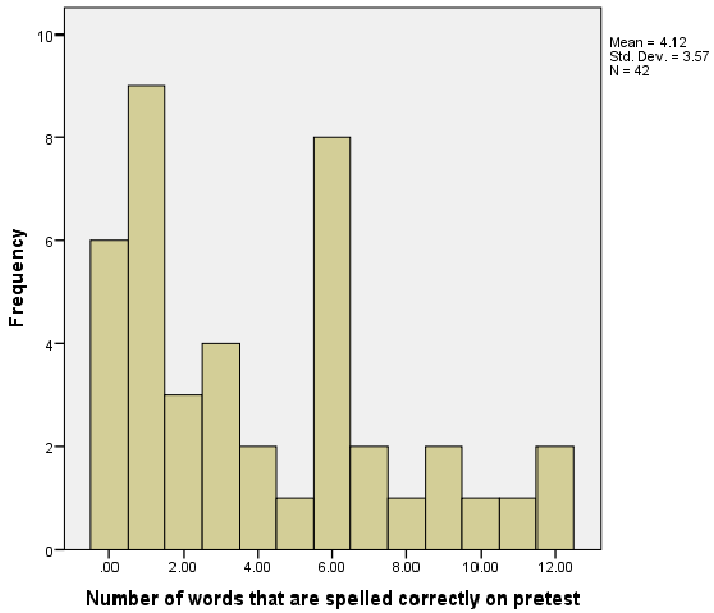

Figure 1. Bimodal distribution of word correct scores on Spelling Dictation Pretest

Performances on posttests was examined by several ANOVAs. Training condition (treatment vs. control), spelling ability (poor vs. good spellers), and time of posttest (immediate vs. delayed) were entered as independent variables. The latter was a repeated measure. Scores on several dependent variables were examined. Specifically they were the number of correctly spelled words, the number of total correct letters, the number of correct silent letters, the number of correct letters representing the schwa sounds, and the number of correct double letters. Table 5 shows means and standard deviations. Table 6 shows results of the ANOVAs.

Table 5

Posttest Means and Standard Deviations on the Spelling Posttests

Dependent Variables	Spelling Conditions			
	Treatment *M(SD)*	Control *M(SD)*	Overall *M(SD)*	Effect Size *d*
Spelling Words Correctly (Max 20)				
Good Spellers	16.50(2.58)	12.35(3.57)	14.06(3.76)	1.34
Poor Spellers	9.96(4.90)	3.55(2.24)	7.14(5.07)	1.69
Spelling Letters Correctly (Max 202)				
Good Spellers	199.00(2.87)	195.75(3.75)	197.09(3.70)	0.98
Poor Spellers	191.39(6.54)	178.77(9.60)	185.84(10.12)	1.54
Spelling Silent Letters (Max 22)				
Good Spellers	21.29(1.35)	18.75(1.93)	19.79(2.11)	1.53
Poor Spellers	18.21(3.03)	13.82(2.19)	16.28(3.46)	1.67
Spelling Schwa Vowels (Max 24)				
Good Spellers	22.64(1.65)	21.00(1.83)	21.68(1.90)	0.95
Poor Spellers	19.61(2.24)	15.45(4.11)	17.78(3.77)	1.23
Spelling Double Letters (Max 10)				
Good Spellers	8.50(1.04)	8.55(1.01)	8.53(0.99)	-0.05
Poor Spellers	7.86(1.20)	6.05(0.72)	7.06(1.36)	1.83

Note. There were 7 good spellers and 14 poor spellers in the treatment group and 10 good spellers and 11 poor spellers in the control group.

Table 6

Results of the ANOVAs

Dependent Variables	*df*	*MS*	*F*	*p*	Partial Eta Squared
Spelling Words Correctly					
Treatment	1	551.34	20.22	<.001**	.35
Spelling Ability	1	1161.53	42.61	<.001**	.53
TxS	1	25.41	.93	.34	.02
Error	38	27.26			
Test Point	1	.23	.34	.56	.01
TPxT	1	2.5	3.81	.06	.09
TPxS	1	.00	.00	1.00	.00
TPxTxS	1	1.23	1.87	.18	.05
Error	38	.66			
Spelling Letters					
Treatment	1	1243.16	14.29	<.001**	.27
Spelling Ability	1	2983.22	34.28	<.001**	.47
TxS	1	433.37	4.98	.03*	.12
Error	38	87.02			
Test Point	1	.61	.11	.75	.00
TPxT	1	.93	.16	.69	.00
TPxS	1	1.06	.18	.67	.01
TPxTxS	1	23.47	4.06	.05	.10
Error	38	5.78			
Spelling Silent Letters					
Treatment	1	237.17	21.25	<.001**	.36
Spelling Ability	1	316.15	28.33	<.001**	.43
TxS	1	17.08	1.53	.22	.04
Error	38	11.16			
Test Point	1	.47	.65	.43	.02
TPxT	1	.82	1.15	.29	.03
TPxS	1	.13	.19	.67	.01
TPxTxS	1	.35	.48	.49	.01
Error	38	.72			

Table 6 continued

Dependent Variables	*df*	*MS*	*F*	*p*	Partial Eta Squared
Spelling Schwa Vowels					
Treatment	1	165.78	11.22	.002**	.23
Spelling Ability	1	363.46	24.60	<.001**	.39
TxS	1	31.09	2.11	.16	.05
Error	38	14.77			
Test Point	1	1.30	1.89	.18	.05
TPxT	1	.01	.01	.97	
TPxS	1	.40	.58	.45	.02
TPxTxS	1	2.04	2.95	.09	.07
Error	38	.69			
Spelling Double Letters					
Treatment	1	15.32	7.34	.01**	.16
Spelling Ability	1	48.90	23.42	<.001**	.38
TxS	1	17.11	8.19	.01**	.18
Error	38	2.09			
Test Point	1	.39	1.72	.20	.04
TPxT	1	.42	1.83	.18	.05
TPxS	1	.01	.05	.83	
TPxTxS	1	.28	1.24	.27	.03
Error	38	.23			

*$p < .05$. ** $p < .01$.

As shown in Table 6, the analyses of words spelled correctly revealed that there was a significant effect for the type of training and a significant effect of spelling ability. However, the interaction between spelling ability and the type of training was not significant. Time of testing was not significant as well. Participants performed similarly on the two posttests. The participants who were in the spelling pronunciation treatment condition spelled correctly on average 5.3 more words than control students who were trained by reading the words. Good spellers spelled correctly on average 7.7 more words than poor spellers (see Table 5).

Similar patterns of performance were observed on the dependent variable of total correct letters. The analysis revealed that there were significant main effects for the type of training and

for spelling ability. The interaction between spelling ability and the type of training was significant as well (see Table 6). Poor spellers benefited more than good spellers from the spelling pronunciation strategy. Time of testing did not show a significant effect. Participants showed similar performance on the two posttests. The participants who were classified as poor spellers in the treatment condition spelled on average 11 to 13 more letters correctly on posttests compared to the poor spellers in the control group. However, the participants who were classified as good spellers in the treatment group spelled only 2-4 more letters correctly on the posttests compared to good spellers in the control group. One reason is that good spellers were performing close to ceiling on this measure. Disregarding spelling ability, the participants who were in the treatment condition and were trained to produce spelling pronunciations spelled correctly on average 7.9 more correct letters than control participants who were trained by reading the words. Good spellers' spellings' included 12.3 more correct letters than the spellings of poor spellers (see Table 5).

Comparison of the mean percentage of letters and words spelled correctly in Table 5 reveals that it was harder to spell words correctly than to recall correct letters. Among the groups of good and poor spellers in the treatment and control groups, the percentage of letters written correctly ranged from 89% (poor control spellers) to 99% (good treatment spellers). However, the percentage of words spelled correctly ranged from 18% (poor control spellers) to 83% (good treatment spellers). This indicates that the difficulty spelling whole words arose from the misspelling of a limited number of letters within words, perhaps only one letter in the case of good spellers in the treatment group who misspelled a mean of 3.5 words and 3 letters. The disparity between words and letters correct was greatest among poor spellers in the treatment and control groups. Treatment poor spellers spelled 95% of the letters correctly and 50% of the

words correctly whereas poor spellers in the control group spelled 89% of the letters correctly but only 18% of the words correctly. Clearly the latter group was having great difficulty remembering a few of the letters in most of the words. This underscores the special benefit of the spelling pronunciation treatment in boosting poor spellers' memory for the complete spellings of these difficult words.

Results of the ANOVA were similar for recall of silent letters. Good spellers performed better than poor spellers and the treatment group performed better than the control group (see Table 5). The main effect of training condition was significant. The main effect of spelling ability was significant as well (see Table 6). There was no significant interaction between the training condition and spelling ability. Time of testing was not significant as well. The groups showed similar performance on the two posttests.

Similar performance of the groups was observed for the letters that represent the schwa sounds. In the ANOVA there were significant main effects of training condition and spelling ability on the recall of letters that represented the schwa sounds (see Table 6). The participants in the treatment condition spelled more correct schwa letters across posttests than controls. Good spellers correctly spelled more schwa letters than the poor spellers (see Table 5). No significant interaction was observed. Time of testing was not significant as well.

Similar performance of the groups was observed for double letters. In the ANOVA there were significant main effects of training and spelling ability plus a significant interaction between training and spelling ability (see Table 6). The participants who were trained with spelling pronunciations spelled more double letters correctly than the participants who were trained by reading the words (see Table 5). There was no significant main effect and no significant interactions involving time of testing. As evident in Table 5, good spellers in the

treatment and control groups spelled about the same number of double letters correctly. However, poor spellers in the treatment condition spelled correctly two more doublets on average than poor spellers in the control group on the posttests. As shown in Table 5, the effect size for good spellers was close to zero whereas the effect size was very large for poor spellers, *d* = 1.83. This shows that the spelling pronunciation strategy benefited poor spellers but not good spellers. One reason is that good spellers in both treatment and control groups were recalling double letters almost perfectly, leaving little room for any difference.

Despite the fact that there were fewer good spellers and more poor spellers in the treatment group than in the control group, the treatment group still outperformed the control group on the spelling outcomes. This attests to the strength of the spelling pronunciation strategy.

One point to be noted is that poor spellers who received spelling pronunciation strategy training performed almost as well as good spellers in the control condition on some of the measures. As evident in Table 5, mean scores were similar in spelling letters correctly (*M* = 191 vs. 196, respectively), in spelling silent letters (*M* = 18 vs. 19), spelling schwa vowels (*M* = 20 vs. 21), and spelling double letters (*M* = 7.9 vs. 8.6). This suggests that the spelling strategy exerted a strong impact on poor spellers. It was expected that good spellers might benefit more than poor spellers from a spelling pronunciation strategy. However, effect sizes in Table 5 suggest that poor spellers benefited equally if not more from this strategy than good spellers. On every posttest, the effect size for poor spellers was larger than that for good spellers. This indicates that poor spellers did not have difficulty applying this strategy to remember the spellings of words.

Spellings of Individual Words

Table 7 displays the percentage of the participants who correctly spelled each word on the pretest and immediate posttest. *Idiosyncrasy* and *millennium* were the most difficult words. On the pretest the former was spelled correctly by none of the students and the latter was spelled correctly by only one participant. *Impeccable* and *bouquet* were the least difficult words. On the pretest the former was spelled correctly by 50% of the participants and the latter was spelled correctly by 64% of the participants.

One question of interest was whether the main effect of treatment detected with participants as the unit of analysis would also be evident with words as the unit of analysis. Table 7 reveals these results. In a comparison of the proportions of students gaining from pretest to posttest in spelling each word correctly in the treatment and control groups, it is apparent that all but one word showed greater improvement in the treatment than in the control group. This shows that the spelling pronunciations strategy was more effective than the word reading strategy in improving students' knowledge of the spellings of most of these difficult to spell words.

In Table 7, it is apparent that for many words the magnitude of the gains favoring the treatment over the control group was sizeable. For all but two words, differences were 10% or greater. For six words, the differences exceeded 30%, ranging from 33% to 48%. Interestingly all of the latter words contained silent vowel letters or a silent letter H or P, and these silent letters were not regularized by being embedded in common multi-letter spelling patterns. These findings support Ehri's (1997) claim that the hardest letters to retain in memory are those that do not map onto sounds in conventional pronunciations of the spellings. This is why a spelling pronunciation is especially effective.

Table 7

Mean Familiarity Rating (MFR) for Each Word and Percentage of Participants Who Spelled the Words Correctly Before and After Training

		Treatment ($N = 21$)			Control ($N = 21$)			Difference in Gains
Word	MFR	Pre %	Post %	Gain %	Pre %	Post %	Gain %	Treatment-Control
Idiosyncrasy	2.64	0	52	52	0	38	38	14
Millennium	3.76	0	19	19	5	14	10	9
Liaison	2.83	5	67	62	10	38	29	33
Occurrence	3.76	5	48	43	19	38	19	24
Rhinoceros	3.40	10	52	43	5	33	29	14
Accommodate	3.76	10	38	29	5	33	29	0
Irresistible	3.86	10	43	33	5	14	10	23
Privilege	3.88	10	38	29	14	24	10	19
Chauvinism	2.43	10	57	48	14	33	19	29
Fahrenheit	3.88	14	62	48	14	14	0	48
Fluorescent	3.83	14	48	33	24	24	0	33
Hierarchical	2.83	14	67	52	24	52	29	23
Bureaucracy	3.45	19	48	29	14	24	10	19
Maneuver	3.62	19	57	38	29	48	19	19
Silhouette	3.55	29	81	52	19	33	14	33
Lieutenant	3.76	33	76	43	43	52	10	33
Questionnaire	3.86	38	81	43	33	67	33	10
Pneumonia	3.60	38	86	48	38	52	14	34
Impeccable	3.29	48	86	38	52	81	29	9
Bouquet	3.71	62	90	29	67	71	5	24
M	3.49	19.40	59.80	40.55	21.70	39.15	17.80	22.50

Note. Familiarity ratings ranged from 4 (high) to 0 (low).

In Table 5, comparison of treatment effect sizes separately for good and poor spellers reveals that poor spellers may have benefited more from the treatment than good spellers. In Table 6, the significant interactions between treatment and spelling ability on two spelling measures, total letters correct and double letters correct, occurred because poor spellers made greater gains from pretest to posttest than good spellers. Inspection of mean performance in Table 5 suggests the reason for this. Ceiling effects limited the gains that were possible to observe among good spellers. In other words, good spellers could not improve as much as poor

spellers because they knew more spellings than the poor spellers before the study began. In order to examine this possibility, in Table 8 performance on pretest, posttest and gains were tabulated for each word for good spellers and poor spellers separately.

As evident in Table 8, there were six words that 71%-86% of the good spellers in the treatment group spelled correctly on the pretest and 14 words that fewer than 50% spelled correctly. To determine whether poor spellers made greater gains as a result of the spelling pronunciation treatment than good spellers, we compared the percentages of good and poor spellers in treatment and control groups who improved from pretest to posttest across the 14 harder to spell words. Comparison of the mean percentages of good spellers showing improvement revealed 54% (SD = .20) among treatment students versus 28% (SD = .18) among control students. Comparison of the mean percentages of poor spellers showing improvement revealed 34% (SD = .12) among treatment students versus 9% (SD = .13) among controls. Calculation of the difference in each case reveals that almost the same mean percentage of good and poor spellers in the treatment group outperformed good and poor spellers in the control group. On average 26% of the good spellers in the treatment spelled more words correctly than good spellers in the control group. Similarly, on average 25% of the poor spellers in the treatment group spelled more words correctly than poor spellers in the control group. This indicates that the spelling pronunciation treatment benefited good and poor spellers to the same extent in learning to spell these 14 words.

Table 8
The Percentage of the Participants who Spelled Each Word Correctly by Training Condition and Spelling Ability (N=42)

	Treatment						Control					
	Good Spellers(N=7)			Poor Spellers(N=14)			Good Spellers(N=10)			Poor Spellers(N=11)		
Word	Pre %	Post %	Gain %	Pre %	Post %	Gain %	Pre %	Post %	Gain %	Pre %	Post %	Gain %
Fluorescent	29	71	42	0	36	36	50	40	-10	0	9	9
Fahrenheit	43	100	57	0	43	43	30	30	0	0	0	0
Millennium	0	14	14	0	22	22	10	30	20	0	0	0
Occurrence	14	57	43	0	43	43	40	60	20	0	18	18
Rhinoceros	29	71	42	0	43	43	10	70	60	0	0	0
Accommodate	0	57	57	14	29	15	10	50	40	0	18	18
Irresistible	14	71	57	7	29	22	10	40	30	0	0	0
Hierarchical	14	86	72	14	57	43	50	90	40	0	18	18
Privilege	29	71	42	0	22	22	20	50	30	9	0	-9
Idiosyncrasy	0	100	100	0	29	29	0	30	30	0	45	45
Liaison	0	71	71	7	64	57	20	70	50	0	9	9
Maneuver	29	86	57	14	43	29	50	80	30	9	18	9
Bureaucracy	43	86	43	7	29	22	30	50	20	0	0	0
Chauvinism	29	86	57	0	43	43	30	60	30	0	9	9
Questionnaire	86	100	14	14	71	57	80	100	20	0	36	36
Pneumonia	86	86	0	14	86	72	70	80	10	9	27	18
Bouquet	86	100	14	50	86	36	90	90	0	9	54	45
Silhouette	71	100	29	7	71	64	30	60	30	0	9	9
Impeccable	86	100	14	29	79	50	90	100	10	18	64	46
Lieutenant	71	100	29	7	71	64	80	90	10	9	18	9
M	37.95	80.65	42.70	9.20	49.80	40.60	40.0	63.50	23.50	3.15	17.60	14.45

Students were asked to rate their general familiarity with the words. Since familiarity may also be a factor influencing participants' performance learning the spellings of words, we computed the average rating for each individual word. As can be seen in Table 7, the lowest familiarity ratings were for *chauvinism* and *idiosyncrasy* whereas the highest familiarity ratings were for *privilege* and *Fahrenheit*.

Calculation of the correlation between mean familiarity ratings and the percentages of students who learned to spell words they could not spell on the pretest summed across all the groups revealed a negative relationship, $r = -.67$, $p < .001$, indicating that more familiar words showed a smaller percentage of students learning to spell those words than less familiar words.

This was not because more familiar words were easier to spell as indicated by a low correlation between familiarity ratings and pretest scores, $r = .22$, $p = .34$. The latter finding also suggests that students' familiarity ratings were not based on their familiarity with the words' spellings but rather on their familiarity with the words' meanings.

Performance during Training

The experimenter recorded pronunciation and segmentation errors that participants made during the study. If a participant made any error in pronouncing any part of a word this was scored as one error. If a participant made any error in pronouncing a segment this was scored as one error. Similarly, for each segment that was divided incorrectly one error score for segmentation was added. These sums were added over all errors occurring during Steps 2-4 and a total error score was obtained.

The spelling pronunciation group made on average 18.2 (SD =11) total errors that included errors in pronouncing the words, segmenting and pronouncing the segments. The control group made on average 3.6 (SD =4.7) total errors pronouncing the words when they read them. This difference was confirmed to be significant, $t(40)= 5.50$, $p<.01$. Most of the errors in the treatment group occurred because some of the participants could not remember the exact places where the segments were to be divided. In the control group, pronunciation errors happened often with longer words such as *hierarchical*. Participants either did not pronounce the syllable of /ki/ at all or pronounced it as /ti/.

As expected the treatment group spent more time in training than the control group. Time spent practicing spelling pronunciations on average was about 19 minutes with a standard deviation of about 3 minutes. The control group who practiced reading the words as wholes spent

on average about 10 minutes with the standard deviation of about one minute. This difference was confirmed to be significant, $t(40) = 11.94$, $p < .01$.

The treatment group made the majority of errors on the fourth step of the training in which they needed to remember on their own how to divide the words into segments and produce the correct spelling pronunciation for each segment. This should not be taken as evidence that the participants were not learning the strategy. During training a faded scaffolding approach was used. As the training trials progressed the experimenter gradually diminished the support that was provided to the participant. During the fourth step there was almost no support and therefore participants made more errors. During the second step, treatment participants made on average 1.24 errors (*SD* = 1.45) in pronouncing the segments. During the third step the number of errors increased to on average 2.19 errors (*SD* = 1.75). During the final step, participants made on average 5.57 errors (*SD* = 4.09) in dividing the words into the segments and 6.29 errors (*SD* = 4.55) in pronouncing the segments. Considering the fact that participants needed to remember 67 segments and their unique pronunciations, these errors should not be taken as failure to learn the strategy. Obviously, trying to learn 20 words that have complex spellings all at once created cognitive load for participants. A question of interest was whether the errors in producing spelling pronunciations and dividing spellings into segments were related to learning the spellings. To examine this, we calculated the correlations that are displayed in Table 9.

Table 9
Correlations between Errors Pronouncing Segments, Errors Dividing Segments and Number of Words Spelled Correctly on Pretest and Posttests by Spelling Pronunciation Strategy Participants (N=21)

	1	2	3	4	5	6	7
1. Pronouncing Segments – Step 2		-.216	.364	.293	-.103	-.532*	-.511*
2. Pronouncing Segments – Step 3			.319	.388	-.105	-.289	-.289
3.Dividing Segments – Step 4				.962**	-.228	-.748**	-.704**
4. Pronouncing Segments – Step 4					-.124	-.665**	-.590**
5.Pretest Spelling Correct						.503*	.598**
6.Posttest Spelling Correct							.959**
7.Delayed Posttest Spelling Correct							

*p<.05; **p<.01

As can be seen in Table 9, the success of participants in remembering correct spellings was greatly dependent on the tasks of the fourth step in the strategy. Remembering how to divide the segments in the correct places and giving those segments the correct pronunciations showed the highest correlations with the number of correctly remembered spellings on the immediate and delayed posttests.

Questionnaire Results

Prior to training, participants were asked several questions. One question asked them to identify strategies they generally use to remember the spellings of words. To determine whether knowing about the spelling pronunciation strategy would exert an effect on whether students benefited from the strategy during training, we ran *t* tests comparing the performance of students who claimed to know the spelling pronunciation strategy (N =14) with those who said that they did not know the strategy (N =7). It should be noted here that the participants may not have known exactly what a spelling pronunciation strategy is. Answers from participants and observations of the experimenter suggest that the participants' concept of a spelling pronunciation strategy was limited to dividing words into segments or syllables. The performance of these two groups did not differ either on the pretest or the posttest. On the pretest, the group who claimed to know the spelling pronunciation strategy spelled correctly on

average 3.4 words (*SD* =3.3) and the group who claimed not to know the strategy spelled on average 4.9 words (*SD* =2.7) correctly. On the posttest, the first group increased the words correct to on average 11 words (*SD* =5.2) and the latter group increased the words correct to 13.4 (*SD* =5.1). This suggests that students who claimed to know the strategy did not use it effectively in learning the words.

Also prior to training, the participants were asked to rate their perception of their difficulty in spelling on a scale of one to ten where higher numbers would correspond to greater difficulty in spelling. Participants' ratings ranged from one to seven with a mean of 2.93 and standard deviation of 1.69. They were asked to rate the degree to which they believed that spellchecks affect their spelling skills. Their ratings for this item ranged between -5 (negative effect) to +10 (positive effect) with a mean of 5.17 (*SD* =4). This indicates that the majority of students believed that spell checks have a positive effect on their spelling skills. The majority of them, 37 out of 42, marked positive ratings, while only a few marked numbers indicating a negative effect of spell checkers.

Prior to training we asked the participants to rate how important they think spelling is. On a scale of one to ten, the average rating was 8.3 (*SD* =2.2). The majority of the participants (34) marked the ratings of 7, 8, 9 or 10 while only a few marked the ratings of 2, 4, 5 or 6. This indicates that most students regarded spelling words correctly as important.

At the end of the posttests, participants were asked to rate how effective their training method was in helping them to learn the spellings of words. The participants in both conditions thought that their training method was effective. The participants in the treatment condition rated the question of "How effective is the spelling pronunciation strategy?" on average about 8 (*SD* =1.6), while the control group participants rated the question of "How effective is reading words

for remembering their spellings?" similarly with a mean of 8.3 (*SD* =1.7). The treatment group's rating for the effectiveness of the strategy ranged four to ten while the control group's ratings for the effectiveness of reading ranged five to ten. This indicates that both treatment and control groups believed that the spelling practice they received improved their ability to spell words. Inspection of the numbers of students who showed improvement verified that almost all did spell more words correctly on the posttest than on the pretest, with only two showing either no improvement (one control student) or a drop of one word (one treatment student).

It seems that students care about knowing correct spellings of words. Their perceptions about the effectiveness of reading words or applying a spelling pronunciation strategy in order to learn correct spellings of the words were accurate although their ratings did not reflect the treatment differences in gains that we observed on the outcome spelling measures.

Predictors of General Spelling Ability

Table 10 presents the correlations between general spelling ability as measured by MSCT scores, vocabulary as measured by the Nelson Denny and PPVT tests, decoding as measured by the Word Detective test, exposure to print as measured by the ART test, number of words spelled correctly following the experimental treatments, and gains from pretest to posttest. In the interpretation of correlations, it should be noted that unlike the pretest spelling scores, the posttest spelling scores have been influenced not only by students' spelling ability but also by their response to one of the two treatment conditions and so are less interpretable.

Table 10
Correlations (N=42)

Measure	1	2	3	4	5	6	7	8
1.Modified Spelling Component Test (General spelling)								
2.Nelson Denny (Written vocabulary)	.53**							
3. PPVT (Spoken Vocabulary)	.52**	.51**						
4.Word Detective (Decoding)	.35*	.31*	.23					
5.Author Recognition Test (Print Exposure)	.43**	.39*	.50**	-.03				
6.Correctly Spelled Words (Pretest)	.79**	.45**	.60**	.22	.40**			
7.Correctly Spelled Words (Posttest[a])	.70**	.39**	.39*	.50**	.13	.67**		
8.Gain scores	.28	.15	.02	.48**	-.17	.06	.78**	
M	40.98	54.81	202.00	33.03	11.69	4.14	9.94	5.79
SD	10.21	10.47	9.70	6.61	7.73	3.58	5.69	4.23

Note. M=mean; *SD*=standard deviation.

[a] Posttest scores were computed by averaging immediate and delayed posttest scores.

*p<.05; **p<.01.

The highest correlations were observed between different measures of spelling with *r*s ranging from .67 to .79, indicating that spelling ability is one construct. The next highest correlations were between MSCT spelling and Nelson Denny Vocabulary (r = .53) and between MSCT spelling and PPVT vocabulary (r = .52). The two vocabulary tests were strongly correlated, r = .51, but not as strong as the spelling tests, perhaps because one was an oral test (PPVT) and one was written (ND). Given this difference, it is surprising that the correlations between each test and the MSCT spelling test were almost identical. One would expect spelling ability to explain more variance in a written vocabulary test than an oral vocabulary test.

It is also surprising that the word detective decoding test was not more strongly correlated with the spelling measures that were uninfluenced by the treatments, with *r*s ranging from .22

(spelling pretest) to .35 (MSCT). Other studies have found very strong correlations between reading words and spelling words, with *r*s above .70 (Ehri, 1997). Low correlations may have occurred because scores on the decoding test were high and showed limited variability (see Table 4). However, the decoding test was significantly correlated with the spelling posttest ($r = .50$) and with gain scores from pretest to posttest ($r = .48$). This suggests that decoding skill contributed to students' memory for the spellings of treatment words possibly because this skill was recruited to execute the spelling pronunciation strategy.

Hierarchical regression analyses were conducted to examine the contribution of several predictors to MSCI spelling performance. Questions of interest were whether vocabulary knowledge, decoding skill and exposure to print (ART) explained variance in spelling, and whether each explained unique variance not explained by the other two predictors. A composite vocabulary score was created by converting raw scores on the Nelson Denny and PPVT tests to *z*-scores and summing the two scores. The three predictors were entered in all possible orders in several hierarchical regression models to examine the amount of variance in spelling performance explained by these variables. Results are shown in Table 11.

The amount of variance in spelling performance explained by each variable when entered in Step 1 of the regression analysis shows that all were significant predictors. From Table 11, it is apparent that vocabulary explained the most variance (see Model 1), $r^2 = 36\%$, followed by exposure to print (see Model 3), $r^2 = 18\%$, and decoding (see Model 2), $r^2 = 12\%$.

The amount of significant unique variance in spelling explained by the predictors was determined by entering each of the variables into the regression analysis as the third step after the other two had been entered. Results shown in Table 11 reveal that only vocabulary knowledge explained significant unique variance (see Model 2), 11%, whereas the other two explained only

3%-4% unique variance, values which were not significant (see Models 1 and 4). In addition, when vocabulary was entered in Step 1, neither of the other two predictors explained any significant additional variance (see Models 1 and 5).

Only two of the models resulted in predictors that each added significant variance when entered into the model (see Model 2 and Model 3). These models involved entering decoding or print exposure either first or second and then vocabulary third. Together the three variables explained 43% of the variance in spelling ability.

Table 11
Hierarchical Regression Analyses Predicting MSCT Spelling Scores

Models	Entry Steps	R^2	R^2 Change	*ß*	*F* Change	*p*
1	1 Composite Vocabulary	.36	.36	.60[a**]	22.85	<.01**
	2 Decoding	.39	.03	.55[a**], .18[b]	1.89	.18
	3 Exposure to Print (ART)	.43	.03	.42[a**], .23[b], .22[c]	2.25	.14
2	1 Decoding	.12	.12	.35[b*]	5.63	.02*
	2 Exposure to Print (ART)	.32	.19	.37[b**], .44[c**]	11.05	<.01**
	3 Composite Vocabulary	.43	.11	.42[a**], .23[b], .22[c]	7.29	.01**
3	1 Exposure to Print (ART)	.18	.18	.43[c**]	9.00	<.01**
	2 Decoding	.32	.13	.44[c**], .37[b**]	7.61	<.01**
	3 Composite Vocabulary	.43	.11	.42[a**], .23[b], .22[c]	7.29	.01**
4	1 Exposure to Print (ART)	.18	.18	.43[c**]	9.00	<.01**
	2 Composite Vocabulary	.38	.20	.16[c], .52[a**]	12.58	<.01**
	3 Decoding	.43	.04	.42[a**], .23[b], .22[c]	2.93	.10
5	1 Composite Vocabulary	.36	.36	.60[a**]	22.85	<.01**
	2 Exposure to Print (ART)	.38	.02	.52[a**], .16[c]	1.21	.28
	3 Decoding	.43	.04	.42[a**], .23[b], .22[c]	2.93	.10
6	1 Decoding	.12	.12	.35[b*]	5.63	.02*
	2 Composite Vocabulary	.39	.27	.18[b], .55[a**]	17.32	<.01**
	3 Exposure to Print (ART)	.43	.03	.42[a**], .23[b], .22[c]	2.25	.14

Note. *p<.05. **p<.01
[a] Standardized beta coefficient for Composite Vocabulary
[b] Standardized beta coefficient for Decoding
[c] Standardized beta coefficient for Exposure to Print (ART)

A second possibility was suggested by these findings. Although decoding and print exposure did not explain significant unique variance in spelling, they might make an indirect contribution to spelling by explaining variance in vocabulary knowledge which in turn

contributes to spelling ability. To address this question, two hierarchical regressions were conducted, one in which decoding was entered in Step 1 and print exposure in Step 2, and another reversing the order of entry of the predictors. Results are reported in Table 12 where it is apparent that both predictors explained significant unique variance in vocabulary knowledge not explained by the other predictor, with exposure to print explaining 26% unique variance, and decoding explaining 11% unique variance. Combined, the two variables explained 37% of the variance in vocabulary knowledge. It is interesting to note that print exposure and decoding shared little if any variance, as shown by a very low correlation between them close to zero (r = -.03, see Table 10). This indicates that their contributions in explaining vocabulary knowledge are independent of each other.

Table 12
Hierarchical Regression Analyses Predicting Composite Vocabulary Scores

Models	Entry Steps	R^2	R^2 Change	*ß*	*F* Change	*p*
1	1 Decoding	.10	.10	.31[a*]	4.32	.04*
	2 Exposure to Print (ART)	.37	.27	.33[a*], .52[b**]	17.04	<.01**
2	1 Exposure to Print (ART)	.26	.26	.51[b**]	14.34	<.01**
	2 Decoding	.37	.11	.52[b**], .33[a*]	6.71	.01*

Note. *p<.05. **p<.01
[a] Standardized beta coefficient for Decoding
[b] Standardized beta coefficient for Exposure to Print (ART)

Chapter 6

Discussion

The results confirm that college students indeed have difficulty in spelling irregularly spelled words. On average students spelled about four words correctly out of 20 words on the pretest. *Idiosyncrasy, millennium, rhinoceros, accommodate, irresistible* and *liaison* were the most difficult words. They were spelled correctly by 0 to 7 percent of the students. On the other hand *pneumonia, lieutenant, impeccable* and *bouquet* were easier. They were spelled correctly by 38 to 64 percent of the students. Why would *idiosyncrasy* be spelled not even by a single participant correctly while *bouquet* was spelled correctly by 27 participants? Obviously *bouquet* is a lot shorter than *idiosyncrasy;* it has fewer syllables and letters. Trying to remember spellings of longer words would result in larger memory loads than shorter words and therefore should be harder to remember. Obviously, there are other factors such as complexity in the word's spelling and familiarity with the words. The mean familiarity rating for *idiosyncrasy* was 2.64, whereas for *bouquet* the mean familiarity rating was 3.71, which is higher.

Our hypothesis was that students who applied a spelling pronunciation strategy in learning spellings of words would remember the correct spellings of more words than the control group who practiced reading the words. Strategy students were expected to remember more silent letters, more letters representing the schwa vowels, and more double letters than the control group. Also, it was expected that good spellers would benefit more from the application of the pronunciation strategy than poor spellers. Our results were in accord with some but not all of these hypotheses.

Consistent with our expectations, the spelling pronunciation group spelled more words correctly than the control group. Also good spellers spelled more words correctly than the poor

spellers. However, contrary to our expectation, good spellers did not benefit more from the pronunciation strategy than poor spellers. Rather poor spellers in the strategy group made equal if not larger gains than the good spellers. Although the interaction between spelling ability and strategy condition was not significant on the number of correctly spelled words, the effect sizes favored the poor spellers (see Table 5). This finding parallels the results of Drake and Ehri (1984) in which poor spellers benefited more from the spelling pronunciation strategy. One explanation may be that because good spellers knew more spellings on the pretest, they had less room to improve on the posttest. When pre-to posttest gains were examined on 14 words that fewer students spelled correctly on the pretest, it was seen that about the same percentages of good and poor spellers improved from pre- to posttest in the strategy group.

We expected good spellers to benefit more from the spelling pronunciation strategy than poor spellers. This contrasts with Drake and Ehri's (1984) finding that poor spellers benefited more from the strategy. The reason for the difference was that we expected good spellers to possess and make better use of their knowledge of spelling patterns while applying the strategy than poor spellers. In Drake and Ehri's study, spellings produced by poor spellers in the control group may have been depressed since they were exposed to phonetic misspellings of the words. This may have created a bigger gap between poor spellers than between good spellers in the treatment and control groups. Exposure to incorrect spellings has been found to erode memory for correct spellings (Brown, 1988; Dixon & Kaminska, 1997). Participants in our study were not exposed to misspellings.

Because good spellers possess superior knowledge of spelling patterns and decoding skill than the poor spellers, the good spellers were expected to make better use of the spelling pronunciation strategy to remember spellings. However, the results indicate that one does not

need to be a good speller or possess extensive knowledge of spelling patterns to use the pronunciation strategy effectively. This may in fact be a strength of this strategy. As long as one knows regular grapheme-phoneme correspondences, he or she can benefit from the strategy.

Of course, there could be other explanations why poor spellers would benefit as much if not more from the strategy. One possibility is that good spellers already knew more of the spellings than poor spellers as shown on the pretest so the remaining spellings that they stood to learn were more complex and harder to remember than the ones that the poor spellers stood to learn. To test this assumption, we cross tabulated the words that the students improved their spellings from pretest to posttest, with strategy condition and spelling ability. As seen in Table 8 the highest gains from pretest to posttest for good spellers in the treatment condition were for *idiosyncrasy, hierarchical* and *liaison* whereas the highest gains for the poor spellers in the strategy group were for *pneumonia, silhouette* and *lieutenant*. The poor spellers may have benefited more from the strategy because the spellings they needed to learn were easier than the ones that the good spellers needed to learn. *Idiosyncrasy, hierarchical* and *liaison* have more complex spellings than *pneumonia, silhouette,* and *lieutenant*. Furthermore, the spellings that good spellers learned were less familiar than the spellings learned by poor spellers. For example, *idiosyncrasy* had a mean familiarity rating of 2.64 whereas *pneumonia* had a mean familiarity rating of 3.60. Future research should include words with equal complexity and familiarity ratings in order to see more clearly whether poor spellers benefit more from the spelling pronunciation strategy.

Another explanation could be that good spellers are independent learners. They already have a repertoire of strategies and they use them flexibly and effectively. However, poor spellers either do not know appropriate strategies or do not know how to use them effectively (Holmes,

& Malone, 2004). As a result, poor spellers benefited more from the spelling pronunciation strategy in the present study because instruction was highly structured and student responses were scaffolded. Similarly, in Rosenthal and Ehri's (2010) study, students with low abilities benefited more from a highly structured and guided mode of text reading. In their study, students in the pronunciation strategy condition, upon encountering an unfamiliar word in text, read the word out loud whereas students in the control condition put a checkmark next to the word as they read the word silently. Having the students read out loud forced them to decode the words rather than use the context to guess or skip the words. Guessing or skipping unfamiliar words are ineffective ways that low ability readers are known to use. Students who read the words out loud remembered the meanings and spellings of the words better, and the effect sizes were larger for poor readers. Likewise, in the present study, poor spellers were forced to pay attention to all grapheme-phoneme connections in the strategy condition. This is probably not something they would do independently. This may explain why effect sizes were larger for poor spellers.

The effect of the spelling pronunciation strategy in boosting recall of spellings was observed not only on the number of words correctly spelled, but also on the number of correct letters, silent letters, letters representing the schwa sounds, and double letters. This was despite equivalent performance of the strategy and control groups' spellings of the same words on the pretest. Whereas the interaction between treatment group and spelling ability on the number of correctly spelled words was not significant, the interaction between treatment and spelling ability on the number of correctly spelled letters was significant. Poor spellers benefited more from the spelling pronunciation strategy in remembering correct letters than good spellers. Similarly, poor spellers appeared to benefit more from the spelling pronunciation strategy in remembering silent letters and letters that represent schwa vowels as revealed by somewhat larger effect sizes

favoring the poor spellers compared to the good spellers (see Table 5). One explanation is that ceiling effects limited improvement among good spellers on these measures.

A significant interaction between spelling ability and training condition was also detected in the analysis of recall of double letters. Poor spellers benefited more from the spelling pronunciation strategy in remembering double letters than controls whereas there was no treatment effect among good spellers. In Drake and Ehri's (1984) study, the spelling pronunciation strategy group did not recall more correct double letters than the comparison group who practiced by reading phonetic misspellings of the words. Our results are in conflict with Drake and Ehri's findings. One explanation could be the fact that the training that was given to Drake and Ehri's comparison group was different from the training that was provided to the control group in the current study. In the previous study, both the spelling pronunciation and the phonetic spelling groups not only read the words but also copied the correct spellings. This practice of copying the spellings may have limited the effect of the treatment conditions. Perhaps copying the words increased attention to the presence of double letters in both groups. Another possible explanation is that in the previous study there were only six double letters while in our study there were ten double letters. Having a more limited number of double letters may have rendered the comparison insensitive to a difference.

Another reason could be that in Drake and Ehri's (1984) study, participants in the spelling pronunciation group were not required to actively divide spellings into segments, but in the current study participants were required to divide the words into segments exactly the way the experimenter divided the segments. For those words that have double letters, the experimenter divided the segments in a way that put each letter of doublets into different

neighboring segments. Perhaps, these differences in the application of the strategy made the participants of this study more aware of the double letters.

Another explanation could involve developmental differences favoring college students over 4th graders in reading, spelling, and memory for words. College students know many more words with double letters than 4th graders. Future research should adopt the strategy instruction used here that provided more explicit spelling-sound mapping procedures and examine its effectiveness with participants of different grade levels to examine this issue further.

In their discussion of the results, Drake and Ehri (1984) noted that although the spelling pronunciation group performed better on the spelling posttest than the group who read phonetic misspellings, their results did not reveal how much a careful pronunciation strategy facilitates memory for spellings relative to a "neutral" study method. They suggested that answering this question would be the next step in this line of research. In the current study we measured the effect of the spelling pronunciation strategy on college students' memory for spellings of 20 mostly irregularly spelled words. We are confident that the superiority of the spelling pronunciation group in the number of correctly spelled words, total correct letters, silent letters, letters representing the schwa vowels and double letters can be attributed to the effect of the spelling pronunciation strategy. The participants in the control condition were exposed to correct spellings rather than the misspellings seen by Drake and Ehri's controls. Furthermore, the control group was equally exposed to and engaged with the target words as much as the treatment group.

The treatment group's training took longer because participants needed more time to remember where to draw the lines to divide the segments. However, this inequality in time spent was compensated by providing the control group with two more exposures to spellings. The treatment group, in total, read each word as a whole three times and read each word divided into

segments three times as well. In contrast, the control group read each word twice in each step totaling 12 times. Therefore, we are confident that the benefit of the spelling pronunciation strategy was not simply attributable to exposure to the words as the control group in fact was exposed more times than the treatment group. Furthermore, we are confident that the superior improvement of the treatment group resulted from the spelling pronunciation strategy. Unlike other studies in which participants simply repeated what the computer or the experimenter spoke, our participants were forced to match graphemes and phonemes when they divided spellings into segments and to pronounce the segments themselves, two steps which are considered the most essential part of the strategy.

Discussion of Regression Analyses

In order to examine the relationships between exposure to print, vocabulary and decoding as predictors of spelling ability, regression analyses were utilized. For self-teaching to take place, pupils need to be exposed to words in and out of text. Exposure to print is a crucial component of orthographic learning. Therefore, we expected that our measure of students' knowledge of authors would explain significant variance in general spelling skill (MSCT). In order to learn spellings, pupils also need to match graphemes in spellings of words to phonemes in their pronunciations. In other words, they need to decode unfamiliar words. Therefore, we expected that decoding skill would also make a significant contribution in explaining variance in general spelling skill. For self-teaching to take place, pupils need to actually read unfamiliar words upon encountering them in text rather than guessing them. In addition if they use the context or other methods such as looking up meaning in a dictionary, they would be actively engaged in learning the three identities of unfamiliar vocabulary words (phonologic, orthographic and semantic identities). This would increase the likelihood that the words would become sight words and

their spellings would be secured in memory. Therefore, we expected that vocabulary knowledge would make a significant contribution in explaining students' knowledge of the spellings of more advanced words such as these on the MSCT spelling test.

Table 11 displays the results of hierarchical regression analyses in which decoding skill, ART, and vocabulary were utilized to predict MSCT general spelling. Decoding skill, exposure to print and composite vocabulary together explained 43% percent of variance in MSCT spelling scores. However, coefficients for decoding skill and ART did not reach to significance. This might have happened because decoding skill and ART were not making direct but rather indirect contributions to MSCT general spelling through their relationship to vocabulary knowledge. To test this, we conducted regression analyses with composite vocabulary as the dependent variable and ART and decoding skill as predictor variables. This model predicted 37% of variance in composite vocabulary scores. Both, ART and decoding skill were found to be significant contributors to vocabulary knowledge.

Our hypothesis was that decoding skill, ART and vocabulary would make significant contributions in explaining variance in MSCT general spelling scores. Although decoding and ART added significant variance in explaining MSCT general spelling scores in the third step of Model 2 and Model 3 (see Table 11) that included all three predictor variables, only the coefficient of vocabulary remained significant. This finding may have several explanations. Perhaps among college students the only variable that contributes to MSCT general spelling is vocabulary. Decoding skill and ART could be making their contribution to MSCT indirectly by contributing to vocabulary. When we tested this explanation by conduction a regression analysis that included vocabulary as the dependent variable and decoding skill and ART as the predictor

variables 37% of variance in vocabulary was predicted. Therefore, it is likely that decoding skill and ART contribute to MSCT general spelling through vocabulary.

Another reason why decoding skill and print exposure were not significant predictors could be that our measures were not sensitive enough to capture sufficient variance in decoding skill and exposure to print. Also, it may be that we were not able to measure the contribution of print exposure because our sample's scores on the ART were low. Our sample had a mean of 11.69 (*SD* = 7.73) on ART. However in Acheson, Wells, and MacDonald (2008) the mean score of 99 participants on ART was 22.7 (*SD* = 10.8). Perhaps by chance our sample included mostly infrequent readers and we ended up with truncated data which does not offer much variance for prediction in a regression analyses. Future research should include a sample that is varied in its ART scores in order to examine which of the possible explanations stated above is really the case.

Linear relationships between decoding, print exposure, vocabulary and spelling were studied concurrently in the present study. However, it is likely that the relationships are not totally linear, but spiral. Students who read more will be more exposed to spellings of words and contexts that expose the meanings of these words. Therefore, students who read more will have a greater repertoire of vocabulary. This will make them more confident in reading materials that contain more sophisticated words. This in turn will create more opportunities to learn new words. In order to ensure that our students benefit from this snowball effect, we need to provide them with appropriate instruction that equips them with strong decoding skills. Besides that we need to introduce them to books that they will enjoy reading in order to instill love for reading so that they will become independent readers and learners.

Relevant Theories and Previous Research

The findings of this study support connectionist theory. According to this theory, phonological and orthographic representations of words are connected in memory when written words are learned. According to Ehri (1997) learning to spell shares similar processes with the processes involved in reading and pupils use similar skills and knowledge whether they read or write words. Two sources that help with spelling are systematic knowledge of the writing system and word specific knowledge. Systematic knowledge is acquired through instruction as well as reading and writing experiences. Systematic knowledge includes information about how graphemes represent the phonemes; this includes not only single phonemes but also larger units such as syllables and morphemes that are gained by being exposed to letter patterns that recur across the words. When necessary, choosing the appropriate spelling option among the multiple alternatives, such as choosing C, CK, K or CH to represent /k/ in a specific word, also involves using systematic knowledge. Information about the spellings of morphemes (roots, prefixes, and suffixes) and information about the origins of words that guide pupils when they try to spell a word are also considered types of systematic knowledge (Ehri, 1997).

On the other hand, word specific knowledge consists of information about the spellings of individual words. This information is gained through experiences with reading and writing and is held in long term memory. In the process of gaining word specific spellings, knowledge of the alphabetic system plays a mnemonic role. Because English has a deep orthographic system as opposed to more shallow/transparent systems, when pupils try to spell a word there are many options to represent the phonemes in the words. For example, it is the connection forming process between the phonemes and the graphemes of the word “telephone” that takes place

through several exposures to this word that enables the pupils to remember the spelling of "TELEPHONE," not "TELLAFOAN or TELUFOWN" (Ehri, 1997).

The connection forming process plays a role in learning to spell irregularly spelled words as well. The majority of the letters in irregularly spelled words are consistent with grapheme-phoneme conventions. To remember the letters/letter groups that do not follow the conventions, for example, if they appear to be extra/silent/not representing any phonemes of the words, pupils may flag them as silent in memory, or they may create spelling pronunciations that include the silent letters, for example LISTEN as "lis-ten" (Ehri, 1997).

Words may include graphemes that do not follow the conventional system in representing phonemes. These may be graphemes that do not have correlates in sound (double letters, silent letters), or spelling patterns that do not recur in more than few words, or schwa vowels that can be represented with any letter or letter combination. These are the most troublesome parts of spellings for pupils to remember (Ehri, 1997). All of the words that were taught in the present study had at least one of those elements that made them hard to spell correctly and most of them were complicated by having combinations of double letters, silent letter, and schwa issues. For example the word *occurrence* includes double letters, schwas and a silent letter. In the current study, comparison of correct spellings of whole words and individual letters revealed that the difficulty was centered on failing to remember only one or two letters that depressed scores in spelling whole words. Presumably these were the difficult-to-remember letters. It is no surprise that these types of words are called *spelling demons* (Cahen, Craun, & Johnson, 1971). In our study there was one word that was especially demonic, that not even one participant spelled correctly (*idiosyncrasy*) before training was provided. Our study supports Ehri's (1997) suggestion that spelling pronunciations are helpful in learning to spell words that include letters

whose sound mapping are ambiguous or absent. Grapheme-phonemic connections not only help in learning to read and spell regularly spelled words, but also help in remembering irregularly spelled words by providing a mnemonic to remember the letters and letter chunks that do not follow the regular conventions.

Based on the connectionist view, reading words also helps pupils learn how words are spelled. In the current study, good spellers in the control group improved in their ability to spell words after they practiced reading them. However for struggling readers and spellers, simply reading words may not be enough to remember all of letters of the words in correct sequence. In the present study, poor spellers in the control group spelled very few words on the posttest after they practiced reading them (see Table 5).

Bhattacharya and Ehri (2004) conducted a study examining a spelling pronunciation strategy taught to adolescents who were struggling readers. Students were randomly assigned to one of three conditions. The first group practiced reading 100 multisyllabic words by analyzing grapho-syllabic units in the words. Adolescents were instructed to divide the words into syllables by ensuring that each syllable had its own vowel. They were also taught to pronounce schwa vowels according to spellings, such as pronouncing /ish/ not /ush/ in *finish*. They were taught to match the spellings of each syllable with its pronunciation by pointing to the syllable while pronouncing that specific syllable. This spelling pronunciation procedure resembled that used in the current study. The second group practiced reading whole words. There was also a third group that received no instruction. In comparison to the whole word reading group and the control group, the grapho-syllabic analysis group performed significantly better in spelling practiced words and decoding pseudo-words that were not practiced. Although recall was weaker, the whole word group did remember how to spell words they had read better than the no treatment

control group, showing some benefit of reading on spelling. Results provide support for the claim that struggling readers learn fewer spellings of words by simply being exposed to them. They benefit strongly by being taught to analyze the words in terms of matching graphemic units to phonemic units.

Results of the present study do not provide full support to the Dual-Route Theory. According to this theory, phonological and orthographic routes are independent and irregularly spelled words are accessed through the orthographic route (Coltheart, 1978). Our study shows that words with irregular spellings can be regularized by optimizing the match between phonemes and graphemes and this activity functions as a mnemonic for remembering irregularly spelled parts of the words. Therefore, it does not appear to be the case that the phonological and orthographic routes are necessarily independent. Rather they interact at least when they are forced to interact which happens when the spelling pronunciation strategy is applied.

The results of this study do not provide full support for the Constructivist Theory of spelling. In this theory it is assumed that spelling skills evolve naturally. With this perspective, correct spelling is expected to evolve through purposeful attention to the words that pupils are motivated to learn and repeatedly encounter when reading different types of text (Sawyer & Joyce, 2006). Results of our study show clearly that reading is not enough to remember spellings of words with irregular spellings. The control group who read the words 12 times, remembered on average only 8 out of 20 words whereas the group who used a spelling pronunciation strategy remembered the correct spellings of about 13 words. If students' repertoire of the words they can spell arises only from the words they can read or write spontaneously, this may result in a more severe form of the poor getting poorer in their spelling ability (Mathew Effect; Stanovich, 1986). It is supported by correlational studies showing that those who read more based on print

exposure measures such as the Author Recognition Test were the ones who also performed better on spelling tasks (Stanovich & West, 1989). Those who read a lot and hence are exposed to many words with varied spelling patterns may be able to learn the correct spellings of words naturally. However, poor spellers likely are intimidated by difficult words. They may not try to use them in their writings and they may avoid reading books that include more sophisticated vocabularies. As a result, we cannot expect low achieving students to learn spellings of words that are highly irregular such as those in this study without instruction. Students should be provided with methods and tools to tackle the hard task of remembering correct spellings for these challenging words. They should be provided with effective strategies such as a spelling pronunciation strategy. Graham's (2000) review on spelling instruction that included samples of students ranging from first grade to college concluded that incidental learning should be accompanied by instruction. Moreover, instruction should include methods that are proven to be effective such as the spelling pronunciation strategy studied here.

The results of this study are parallel with the findings of Ormrod (1986). Ormrod showed that reading words may not be adequate for remembering their spellings. Participants were exposed to new words that were embedded in passages that students read. The words that appeared six times were remembered better than those appearing two times. On a recognition test students who read the words twice selected the correct spellings on average 3.66 times whereas those who read words six times were able to identify the correct spellings on average 4.32 times out of 8 words. The new words were not real words like those in our study but rather pseudo words. Our study shows that for real words as well, simply reading words may not be adequate for learning their spellings. The group who read the words 12 times spelled correctly about 8 words whereas the group who studied the words with the spelling pronunciation strategy spelled

correctly about 13 words on the posttest. Further support on the importance of instructing students and providing them with effective strategies comes from a recent study. The meta-analysis conducted by Graham and Tanya (2014) demonstrated strong and consistent support for teaching spelling rather than leaving it just to nature or to incidental learning.

In contrast to findings of Holmes and Malone (2004), in the present study we uncovered some evidence that poor spellers benefited more from the spelling pronunciation strategy than good spellers. This inconsistency is most likely due to differences in data collection techniques. In the present study we pursued an experimental design in which the training method was manipulated. However, in Holmes and Malone's study the experimenters used a think aloud method in order to examine what strategies were used, how they were used, and how effective they were. Furthermore, when the students were directed to spend 30 seconds studying the words they misspelled by just one incorrect letter, differences between good spellers and poor spellers in the gains from the strategy were similar. This contrasts with our finding that poor spellers benefited more from the spelling pronunciation strategy. This might be due to methodological differences as well. In Holmes and Malone's (2004) study, every participant studied only the words that they misspelled during the pretest. Therefore, all of the participants did not study exactly the same words. Perhaps, this obscured differences in the gains of good and poor spellers that resulted from the use of the strategies. Furthermore, the participants studied the words while thinking aloud and they were exposed to their own misspellings of the words. Thinking aloud may have affected the participants' learning. Also, exposure to incorrect spellings may have affected the results.

In order to benefit from a spelling pronunciation strategy it should be applied with words that have irregular spellings. If a word's spelling is mostly regular, then the word's standard

pronunciation already reflects its spelling. There were researchers who measured the effects of a spelling pronunciation strategy in languages other than English. These languages differed in the extent to which their orthographies are deep or shallow. For example Thaler, Landerl and Reitsma (2008) had German children who were in third grade practice a spelling pronunciation strategy. They did not find the strategy to be more effective than standard pronunciation of the words. One reason maybe the fact that the spelling pronunciation strategy provides a mnemonic that helps students to remember the graphemes that do not correspond to phonemes (i.e., silent and double letters) or uncommon graphemic patterns, for example, "heit" in Fahrenheit that is not spelled as 'height." German orthography is a lot more transparent than English. The words that they taught to third graders, for example, *ruhren, sehr,* and *sohn,* all have a silent /h/ but in the rest of the word there is almost perfect grapheme-phoneme matching. Obviously, the spelling pronunciation differs little from the standard pronunciation for these words, hence limiting the advantage of a spelling pronunciation strategy. This is what Thaler, Landerl and Reitsma found. Spelling pronunciation did not show a measurable effect compared to the normal pronunciation in the German language.

In another study, Landerl, Thaler and Reitsma (2008) investigated the effects of a spelling pronunciation strategy in German children who were in fifth grade. Both the spelling pronunciation group and the control group received a 10-session computerized training in which they were taught the spellings of 30 words that were borrowed from other languages and therefore had irregular spellings. The spelling pronunciation treatment required participants to pronounce the words with spelling pronunciations whereas the control condition heard and pronounced words only in their standard pronunciations. Both groups, after their attempt to spell the words, were exposed to their incorrect spellings and the standard spellings, and students were

given a chance to compare them. Furthermore, the program gave them feedback if their spelling was correct or incorrect. The spelling pronunciation group outperformed the control group systematically on all training days. The poor spellers in the control condition had the lowest number of correct spellings and good spellers in the spelling pronunciation condition showed the best spelling performance. The good spellers in the control condition profited more from the training than the poor spellers in the spelling pronunciation condition. This seems to be in conflict with the results of Drake and Ehri's (1984) study and also with the findings of the present study. However, there are several reasons that may explain these conflicting results. German has a relatively transparent spelling system. It is likely that German children, whether they are taught are not, are prone to use a spelling pronunciation strategy spontaneously since most of the words in German are spelled regularly. In addition the children practiced the same words over10 sessions extending over 10 days, so much more practice was provided than in the current study. Furthermore, children whether they were in the spelling pronunciation or control condition were shown both the correct spellings and incorrect spellings. This allowed the participants to use not only a spelling pronunciation or normal pronunciation strategy to learn the spellings but also a comparison strategy.

Educational Implications

This study supports the view that students should be provided with strategies and interventions in order to overcome their difficulties with spelling irregularly spelled words. Simple exposure and practice reading words enabled students in our control group improve in the number of correct spellings on average from 4.4 words to about 8 words. In contrast, the strategy treatment group increased the number of correct spellings from about 4 words to 13 words. It appears that for irregularly spelled words, standard word pronunciation does not ensure that a

student will amalgamate all graphemes of words with their phonemes as described by Ehri's word learning theory (Ehri, 2005). However, consistent with Ehri's theory, the overpronunciation of a word so that the pronunciation closely matches its spelling appears to be an effective strategy. This strategy enables students to encode a word's spelling in at least two different ways, auditorially as well as orthographically. This increases the possibility for correct spellings to be remembered (Ormrod & Jenkens, 1988).

The findings of this study can be taken as one more piece of evidence against the view that spelling need not be taught because pupils will learn through reading and writing naturally without explicit instruction. Educators should teach the spelling pronunciation strategy to their students. This strategy is not only effective in terms of increasing students' ability in learning spellings, but also it is cost effective. It does not require any specific tool or skill, neither for the teachers to teach nor for students to learn the strategy. As long as students know which letter makes which sound in words and as long as they do not have a learning problem that limits their ability to detect the phonemes in words, they can learn and use the strategy effectively. It is also cost effective in terms of the time that needs to be devoted in order to teach this strategy. It takes only several minutes to teach and practice the strategy. It should be noted here though that during this study, students were guided by the experimenter. They did not apply the strategy independently. Whether the same result would be obtained without guidance is a topic of the future research.

Regrettably college professors are under pressure to cover a curriculum that leaves no room for helping students with their difficulties in spelling. However, they often complain that they have to mark so many misspellings in students' writings. By doing so they are not only wasting their time but causing aversive effects on students' knowledge of the spellings that are

marked. By marking those spellings they are drawing students' attention to misspellings of words. Brown (1988) in several experiments showed that exposing students to misspellings causes alternative orthographic representations to compete with the correct spellings of the words and therefore causes confusion in students in deciding which way to be the correct spelling of the word.

My suggestion to those professors is that instead of wasting their time on marking misspellings and complaining about marking so many misspellings in students' writings, they should spend several minutes discussing with students why they might have difficulty with their spellings. Besides referring students to the writing centers that many colleges provide in order to get help with their spelling difficulties, they might also demonstrate use of the spelling pronunciation strategy with several words that students misspelled and show them how spelling pronunciations can serve as mnemonic in remembering correct spellings.

If spelling difficulties are observed in writings of one or two students, individualized instruction should be provided for the words that those students misspelled in their writings. However, if more than just a few students are having this difficulty, professors can make a list of the words that are misspelled by most of the students and spend several minutes showing students how these words might be pronounced in order to remember their spellings. Students should be encouraged to come up with their own spelling pronunciations, and feedback should be provided so that students can apply the strategy independently as well.

If professors have no time at all for helping students with their spellings, then they should refer them to the writing centers. Tutors in the writing centers should be knowledgeable about effective strategies. They should demonstrate how to use effective strategies and provide students with practice and feedback. Students usually take a draft of their typed assignment to the

writing centers. If students express that they have difficulty with spelling, I suggest that tutors ask those students to bring several examples of handwritten papers. Tutors can select several words that are misspelled in these writings and show students how to create spelling pronunciations. Students can practice and receive feedback for several other words as well.

In courses identified as writing intensive, professors are obligated to incorporate instruction of writing besides covering the content of the courses. In these courses, writing is used as a tool to enhance students learning of the content of the course. These courses provide students with many opportunities of writing and revising their written assignments. If professors of writing intensive courses observe that students have difficulty in their spellings, I suggest that they introduce the spelling pronunciation strategy to them. It takes little time to introduce the strategy, and it is likely to help them. In writing intensive courses, focus is mainly on expressing learning of the content and ideas through writing. However, if students have difficulty spelling, the mental energy that should be devoted to thinking about the content and big ideas will be limited by the need to think about how to spell words. In many writing intensive courses students are provided with free writing exercises in which they are told to just write down their ideas without worrying about mechanical errors. Although these exercises do provide students with an opportunity to use all of their mental energy on the content and expressing their ideas, we cannot be sure that this eliminates their worry about misspelling words and about what their professors are going to think when they see those misspelled words. My suggestion is that free writings should be utilized but accompanied by instruction in the misspelled words that commonly occur in many students' papers. A spelling pronunciation strategy can be taught to students in order to lessen future spelling errors in students' writings.

Due to the availability of spell checkers, people might think that spelling is not that important. However, thinking about how words are spelled takes mental energy of students. Writing fluency requires that words can be written automatically. Therefore the more students know correct spellings of words and less uncertainty about correct spellings, the more they can devote their attention to the ideas and write more fluently.

Spelling is important given its relationship to vocabulary. In their answer to the questionnaire item "Why do you think spelling is important?" majority of students expressed that if they misspell words they can be confused with the homonyms of these words and therefore cause confusion in readers and hence they would have difficulty in conveying their message in writing. This shows that students implicitly recognize the relationship between spelling and vocabulary. It is important to teach spelling as it contributes to vocabulary learning. Another implication of this study is that students should be encouraged to read a variety of reading materials. The more varied the material they read, the more different words they will encounter and the more likely they will be to learn vocabulary meanings and their spellings. As we expected, general spelling ability as measured by MSCT was significantly correlated with vocabulary measures, with the exposure to print measure, and with the decoding skill measure. Vocabulary measures showed higher correlations with the general spelling measure than the decoding skill measure. This was what we expected. Furthermore, regression analyses revealed that there is a strong relationship between vocabulary and spelling.

When students read different texts they are more likely to be exposed to new vocabulary words. With these exposures they are not only more likely to learn meanings of the new vocabulary words but also the spellings of those new vocabulary words. Therefore, there should be high correlations between exposure to print, vocabulary and spelling measures and this is

what we found. This finding is parallel to the findings of several researchers (Stanovich & Cunningham, 1992; Holmes & Ng, 1993; Burt, & Furry, 2000). However, Fischer, Shankweiler and Liberman (1985) did not find a significant difference in vocabulary scores of good spellers and poor spellers. Unfortunately, all of the previous research was done with different measures of vocabulary and spelling. Therefore, it is difficult to known whether differences in the results are attributable to differences in measurement. Our study indicates that among college students, exposure to print is a good predictor of spelling and vocabulary. Both vocabulary and spelling reflect the extent to which students engage in reading a variety of texts.

We are confident that the strong relationship that we found between vocabulary and spelling skill is not by chance or because of measurement issues because we had two different measures of vocabulary and both tests had very similar correlations with our spelling measure. On the PPVT, participants' performance was not dependent on knowing the spellings of words. They choose the picture that matched the word that they heard. In Nelson Denny vocabulary test, participants choose the best written option that completed the sentence. Despite this major difference, these two vocabulary tests had almost the same correlation with the MSCT spelling test (ND and MSCT r =.53; PPVT and MSCT r = .52). When we found a high correlation between vocabulary (ND) and spelling skill in our pilot study, we thought that this might have been observed because in ND the test takers needed to recognize words from their spellings. However present finding show that the same relationship can be observed with an oral vocabulary test as well. In taking the PPVT, participants do not see the spellings of words, yet the same relationship was observed. This supports the view that greater exposure to print leads to more vocabulary learning. This includes learning meanings of new vocabulary words as well as learning their spellings. This is evidence that the self-teaching hypothesis (Share, 1995) applies

to not only children but also to college students. Adults as well, when they encounter a new word while reading text use decoding and their existing orthographic knowledge to learn spellings of these new words.

Limitations and Directions for Future Research

In this study we were able to show that a spelling pronunciation strategy could be used effectively to teach spellings of mostly irregularly spelled words to college students. The results may not be generalizable to other grade levels. However, we cannot find a reason why other grades would not benefit similarly from the strategy. As long as participants of any age know the correspondences between phonemes and graphemes they should be able to use the strategy. Obviously, at younger ages, working memory is more limited than that of college students. However, we do not expect that this would play a role since the participants practiced the spelling pronunciations of each word right after the experimenter and therefore they did not have a lot to load into their working memories.

The study was taught and practiced with individual students. Teachers and instructors may not have enough time to devote to individual students. If taught to groups of students, similar results still may be obtained. In the present study, individual students were taught in order to control the learning conditions and reduce effects of extraneous variables. One concern was that if students read the spelling pronunciations after the teacher's demonstration we could not be sure that the students were actually matching graphemes to phonemes. They might have just repeated what the teacher said without really examining the phoneme-grapheme correspondences in each segment of the words. An alternative approach might be to have students come up with their own spelling pronunciations after the teacher demonstrated and scaffolded the strategy. We did not do this in this study, because we wanted to measure the effect

of the strategy in a highly controlled manner. However, other approaches remain for future research.

Participants' performance on the delayed test did not differ significantly from their performance on the immediate test that required them to recall spellings of words. Both the treatment group and the control group remembered almost the same number of correct spellings on immediate and delayed posttests. However, the delayed test was administered only 15 to 20 minutes after the immediate test. Therefore, based on the results of this study we cannot determine whether the effects of reading the words with their spelling pronunciations or normal pronunciations would have a lasting effect on memory. We cannot determine how long students' memory for spellings of words created by spelling pronunciations would erode. Likewise, we cannot be sure if there would be a difference between the two groups (i.e., spelling pronunciation and normal pronunciation groups) in terms of durability of the effects. Answers to these questions would require data collection extending over a longer period of time. In this study we recruited our participants through a research participation pool that allowed us to meet with individual students for only two sessions. Therefore, we were not able to test participants' memory for the spellings of words after a prolonged time.

In the present study participants studied 20 difficult to spell words. The treatment group practiced spelling pronunciations of words that were prescribed by the experimenter. After they practiced reading the segmented words during the last step, they were asked to divide the words into the segments that they had practiced during the 2nd and 3rd steps of the strategy. We cannot be sure if participants would be able to apply the strategy by themselves. The instruction of the study was implicit. They were not explicitly taught how to divide the words into segments and sound out the segments in order to create spelling pronunciations. They were not asked to apply

the strategy to words that were not practiced. Therefore, we do not know if the strategy and its beneficial effect would generalize to words other than the 20 words that were studied. These questions remain to be answered in future research.

In the present study we applied a prescribed procedure because we did not want to leave participants open to engaging in other strategies. This allowed us to determine whether pronouncing the words in a way that emphasized their spellings contributed to participants' memory for spellings beyond that produced by reading the words with just their normal pronunciations. If college students had been allowed to examine words and decide how to sound out the silent letters, schwas and double letters to create spelling pronunciations, they might have examined the words in other ways as well, for example, by using analogies, by comparison or letter rehearsal. We did observe this in our pilot study. College students have a wide range of strategies in their repertoires. As observed in the pilot study, when we asked students to create spelling pronunciations for words or flag hard parts of the words, they engaged in other strategies as well. Still they had difficulty remembering correct spellings of words. This underscores the need for finding the strategies that really work. Teachers should teach students only the strategies that are proven to be effective. Perhaps future research on the effectiveness of spelling strategies should utilize children who do not know any strategies to avoid this problem.

Some students may have a hard time in applying the spelling pronunciation strategy if it is not prescribed. Mature readers may have a hard time in understanding what a silent letter, or schwa vowel is since they are fluent readers and they are prone to see the words as whole units rather than divided into segments and letters. During the pilot study, the experimenter observed that several participants had a hard time understanding the concept of schwa letters. Some participants had a hard time in pronouncing the words in a way that was close to its spelling.

They had a hard time in deviating from the normal pronunciations of the words. Some of their spelling pronunciations were almost the same as their normal pronunciations of the words. During the pilot study, demonstration was provided for only two words and participants practiced and received feedback for only three words. Perhaps if more detailed instruction, demonstration of the strategy with larger number of words, and practice with feedback with a larger number of words were provided, participants would be more successful in applying the strategy. The experimenter observed that for some participants in order for them to apply the strategy independently, extensive instruction and feedback very likely would be necessary. However, in our pilot study there were students who applied the strategy successfully after demonstration of the strategy on a few words. This shows that the extent to which this spelling pronunciation strategy could be learned and applied independently depends on individual characteristics of participants. These possibilities should be examined in future research.

One concern about the spelling pronunciation strategy is that teaching students to pronounce words in a way that deviates from their normal pronunciations might cause confusion about the normal pronunciations of the words and might cause difficulty in reading them and recognizing their meanings when they are encountered in text. Block and Duke (2015) cautioned teachers not to "mispronounce" a word to help children with its spelling. However, they admitted that schwas are the most difficult sound to spell in the entire orthographic system and they did not identify an alternative way that would help children remember the schwa letters. They suggested helping students with this difficulty by showing correct spellings. Showing correct spellings helps students remember correct spellings but it may not be enough for poor spellers to remember the correct spellings. As explained in the studies comparing good spellers' to poor spellers' skills, it is evident that poor spellers do not attend to all details of spellings by just being

exposed to the correct spellings (see literature review, differences and similarities between good and poor spellers). This was also evident in the present study where poor spellers who simply read correct spellings were the ones who made the least gains compared to the other groups.

Block and Duke (2015) did not explain why exactly they did not want students to learn spelling pronunciations. One concern could be that students might get confused about which way to pronounce the words when reading them. Our suggestion is that spelling pronunciations should always accompany normal pronunciations and teachers should be clear about which one is the normal pronunciation and which one is the spelling pronunciation. In our study, participants were required to read the whole word with their normal pronunciation before reading segmented words with their normal pronunciations. Participants were required to read the words with their normal pronunciations at each step of the strategy before reading them with their spelling pronunciations. In the present study we did not observe students having confusion between normal and spelling pronunciations of the words. Indeed some of the participants who did not know pronunciations of the words improved their pronunciations during the 3rd and 4th steps of the training. Therefore, if spelling pronunciations are provided along with their normal pronunciations we do not expect students to be confused about which way to pronounce words. However, our study was with mature students. With younger students we suggest that before teaching the words' spelling pronunciations, children should have the words in their oral vocabulary.

In the present study our participants consisted of all native speakers of English. Therefore, we do not know whether nonnative speakers would use spelling pronunciation effectively in order to learn correct spellings and whether this would be superior to reading the words with their normal pronunciations. In our pilot study we had nonnative speakers and we did

not observe any striking difference between native and nonnative speakers in their application of the spelling pronunciation strategy and their improvements in spelling the target words by applying the strategy. However, due to the small sample size, we were not able to do statistical analyses comparing performance of native and nonnative speakers of English. Future research with larger sample sizes can examine this issue.

Nonnative speakers are not a homogenous group. They speak different languages, and orthographies of these languages differ in terms of how transparent or complex they are. Some languages such as Spanish, Turkish and Finnish have more transparency in their orthographies and their alphabet is similar to the English alphabet. However some other languages such as Arabic, Hebrew and Chinese have totally different writing systems. Whether differences in the first language of nonnative speakers would influence the effectiveness of the spelling pronunciation strategy applied to English words needs to be addressed in future research.

Appendix A

Consent Form

CITY UNIVERSITY OF NEW YORK
Graduate Center
Educational Psychology Program

CONSENT TO PARTICIPATE IN A RESEARCH PROJECT

Project Title: College Students' Spelling Skills

Principal Investigator: Turkan Ocal
Graduate Student
Graduate Center
365 5th Ave 3204
212-817-8294
New York, NY, 10016
201-428-8711

Faculty Advisor: Linnea Ehri
Distinguished Professor
Graduate Center
365 5th Ave 3204.01
New York, NY, 10016
212-817-8294

Site where study is to be conducted: In any available room of Brooklyn College, Psychology Department

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Introduction/Purpose: You are invited to participate in a research study. The study is conducted under the direction of Turkan Ocal, a graduate student in Educational Psychology Program at The Graduate Center/City University of New York. The purpose of this research study is to find out which strategies help college students remember the correct spellings of commonly misspelled words. The study may help us to understand better the learning processes involved in spelling. The results of this study may aid in finding ways to help struggling spellers at the college level. The study sessions will be audio recorded to examine how strategies are used by each individual.

Procedures: Approximately *40* individuals are expected to participate in this study. Each participant will participate in two sessions. The time commitment of each participant is expected to be *about two hours*. Each session will take place about one hour. There will be a one week interval between the two sessions. Each session will take place in at the student's campus.

Possible Discomforts and Risks: The risks from participating in this study are no more than that of encountered in everyday life. Your participation in this study may involve a minimal amount of stress since the words that are going to be spelled are commonly misspelled even by some skilled readers and you may feel embarrassment about your spelling skills. To minimize these risks you will be reminded that you will not be judged, graded or penalized for your

misspellings. If you are greatly upset as a result of this study you should talk to me right away and contact the counseling services on your campus.

Benefits: There are direct and indirect benefits. Participating in the study may increase general knowledge of reading and spelling processes. Through the study, you will get a chance to learn the spellings of words that are hard for you.

Voluntary Participation: Your participation in this study is voluntary, and you may decide not to participate without prejudice, penalty, or loss of benefits to which you are otherwise entitled. If you decide to leave the study, please contact the principal investigator Turkan Ocal to inform them of your decision.

Financial Considerations: Participation in this study will involve no cost to the subject. For your participation in this study you will earn two research participation credits after completing both of the sessions as described by the experimenter.

Confidentiality: The data obtained from you will be collected via audio and digital records and written tests. The collected data will be accessible to Turkan Ocal (Principal Investigator) and her advisor, Linnea Ehri. The researcher will protect your confidentiality by securely storing the data during screening, and by coding the data once the study is completed. The collected data will be stored as deidentified codes. The consent forms and coding system will be kept in separate locked cabinets. Once the study is complete audio records will be transformed to text. After notes are taken on how subject used the strategy the recordings will be erased. If subject utters other than strategy/misspelled words etc. (any personal expression) it will not be transformed to the text material at all.

Contact Questions/Persons: If you have any questions about the research now or in the future, you should contact the Principal Investigator, Turkan Ocal, (201)428-8711, tocal@gc.cuny.edu or her advisor Dr. Linnea Ehri at 212-817-8294 or lehri@gc.cuny.edu. If you have any questions concerning your rights as a participant in this study, you may contact Graduate Center/City University of New York HRPP Administrator Kay Powell, (212)81 7-7525, kpowell@gc.cuny.edu.

Statement of Consent:

"I have read the above description of this research and I understand it. I have been informed of the risks and benefits involved, and all my questions have been answered to my satisfaction. Furthermore, I have been assured that any future questions that I may have will also be answered by the principal investigator of the research study. I voluntary agree to participate in this study.
By signing this form I have not waived any of my legal rights to which I would otherwise be entitled.
I will be given a copy of this statement."

Printed Name of Subject	Signature of Subject	Date Signed
Printed Name of Person Explaining Consent Form	Signature of Person Explaining Consent Form	Date Signed
Printed Name of Investigator	Signature of Investigator	Date Signed

Appendix B

Scripts

First Step for both groups: -Please read these sentences and rate your familiarity with the underlined words.

SPELLING PRONUNCIATION CONDITION

Step 1:

-Please read these sentences and rate your familiarity with the underlined words.

Step 2:

- I will show you a list of the words. Each word is divided into segments. We will practice pronouncing the separate segments of the words.

- First I will read the whole word. Then I will point to and pronounce the separate segments of each word. You will read them just like I did. Please read each word and the segments right after me without making any pauses.

Routine for each word:

- E reads whole word.

- Then E pronounces separate segments while pointing to the segments.

- Student reads whole word.

- Then student pronounces separate segments while pointing to the segments

- E corrects any incorrect responses. Record what is incorrect on a data sheet.

Step 3:

- “Now let’s review those words again.

- This time you do it by yourself. Read the whole word. Then give the spelling pronunciation by reading the separate segments in the word as you point to the segments, just like we did before. Please read each word and the segments without making any pauses.

Routine for each word:

- Student reads whole word.
- Then student pronounces separate segments while pointing to the segments
- E corrects any incorrect responses. Record what is incorrect on your data sheet.

Step 4:

- "Now let's review those words one more time.
- Read the whole word. Segment the word by drawing lines with this pencil. Then give the pronunciation by reading the separate segments in the word as you point to the segments, just like we did before. Once you have done that move to the next word without making any pauses.

Routine for each word:

- Student reads whole word.
- Then student divides the word into segments by drawing short vertical lines between parts of the word and pronounces separate segments while pointing to the segments
- E corrects any incorrect responses. Record what is incorrect on your data sheet.

-This completes our training. Now let's see if you can remember the spellings of these words. I will read you the words and a sentence that includes each word. Please write the words on the answer sheet next to the numbers.

CONTROL CONDITION

Step 1:

-Please read these sentences and rate your familiarity with the underlined words.

Step 2:

- I will show you a list of the words. We will practice reading the words.

- First I will point to and read each word. Then you will point to and read the word. Then read the word again. Please read each word twice right after me without making any pauses.

Routine for each word:

- E reads whole word.

- E reads word again.

- Student reads whole word.

- Then student reads word again.

- E corrects any incorrect responses. Record what is incorrect on a data sheet.

Step 3:

- "Now let's review those words again.

- This time you read the words by yourself. Pronounce each word twice. Please move to the next word without making any pauses.

Routine for each word:

- Student reads whole word.

- Then student reads word again.

- E corrects any incorrect responses. Record what is incorrect on your data sheet.

Step 4:

- "Now let's review those words again.

- Read the whole word. Then read it again. Please move to the next word without making any pauses.

Routine for each word:

- Student reads whole word.

- Then student reads word again.

- E corrects any incorrect responses. Record what is incorrect on your data sheet.

Step 5: Let's review those words again.

-Read the whole word. Then read it again. Please move to the next words as fast as you can. We are going to use a stopwatch to measure the time that takes for you to read.

Routine for each word:

-Student reads whole word.

-Then student reads word again.

-E using a stopwatch measures and records the time that takes to read all of the words.

Step 6:

Let's review those words again.

-Read the whole word. Then read it again. Please move to the next words as fast as you can. We are going to use a stopwatch to measure the time that takes for you to read.

Routine for each word:

-Student reads whole word.

-Then student reads word again.

-E using a stopwatch measures and records the time that takes to read all of the words.

-This completes our training. Now let's see if you can remember the spellings of these words. I will read you the words and a sentence that includes each word. Please write the words on the answer sheet next to the numbers.

Appendix C

Modified Spelling Component Test

This is a test of your spelling ability. It does not call for you to spell entire words, but only to supply the "letters" which are missing in the following list. Each item consists of a word stem, and one or more blank sections. Each blank section may require from 1 to 5 letters to complete the word. For example, if the word were:

exper____ment

you only need the letter *i* to complete the word "experiment," hence you would write "i" in the blank. If the word were:

obs____ne (offensive, disgusting)

you would need two letters *ce* to spell "obscene", hence you would simply write "ce" in the space provided.

There is only one correct word for each of these roots. Prompts and definitions are given to indicate clearly which word is required. If you cannot figure out what the word or spelling is, skip it, and move on to the next item. You will have 20 minutes for this test, so work steadily and do not stall too long on any one item. If there is time you can always come back to it when you have finished the other items. You will have 20 minutes to complete this test.

Do not begin until the signal to do so is given.

1. permis____ble (allowed by laws or rules)
2. temp____ment (the balance of emotions that affects a person's character)
3. bal____t (you complete it when you vote)
4. s____rg____nt (an officer of lower rank in the army or marines)
5. capt____n (the leader of a team or a company of soldiers, or the commander of a ship or aircraft)

6. disast____ous (unfortunate, a total failure, devastating)
7. veng____nce (the act of doing something to hurt someone because that person did something that hurt you or someone)
8. breth____n(brothers; used chiefly in formal address or in referring to the members of a profession, society, or sect)
9. hind____nce (the act of making it difficult for someone to act or for something to be done)
10. ag____r____vate (to make an injury, problem, etc. more serious or severe)
11. etiq____te (the rules indicating the proper and polite way to behave)
12. pron____ciaton (the act of saying words with proper sound and accent)
13. lon____iness (feelings that come from being apart from other people)
14. capit____l (the most important city or town of a country or region, usually its seat of government and administrative center)
15. auxil____ry (providing supplementary or additional help and support)
16. persever____nce (determination in doing something, not quitting, despite difficulty or delay in achieving success)
17. ind____spens____ble (absolutely necessary, incapable of being disregarded or neglected)
18. in____ent (not guilty)
19. breat____ (to inhale air into the lungs)
20. cemet____ry (a graveyard)
21. twel____h (ordinal number for number 12, like first, second, third,…..)
22. exag____rate (to represent something as being larger, greater, better, or worse than it really is)
23. persist____nt (continuing to exist or endure over a prolonged period)
24. prophe____y (the foretelling or prediction of what is to come)
25. griev____nce (An actual or supposed circumstance regarded as just cause for complaint)
26. conscien____ous (controlled by or done according to one's inner sense of what is right)
27. person____l (the people who work for a particular company or organization)
28. propel____r (a device with two or more blades that turn quickly and cause a ship or aircraft to move)
29. min____ture (a thing that is much smaller than normal)
30. hurr____dly (happening or done very quickly or too quickly)
31. amat____r (a person who engages in a study, sport, or other activity for pleasure rather than for financial benefit or professional reasons)
32. ni____ty (the number that comes after89)
33. forc____bly (use of physical power or status to impose action)
34. maint____n____nce (The work of keeping something in proper condition)
35. exist____nce (The fact or state of continued being)
36. appar____l (Clothing)
37. attend____nce (the action or state of going regularly to or being present at a place or event)
38. compl____ment (a polite expression of praise or admiration)
39. chal____nge (A call to engage in a contest, fight, or competition)
40. incident____ly (an adverb meaning something to happen casually or by chance)
41. rest____rant (a place where people pay to sit and eat meals that are cooked and served on the premises)

42. rec____ve (to get or be given something)
43. superintend____nt (a person who oversees or directs some work, enterprise, establishment, organization, district, etc.; supervisor)
44. embar____s (to cause someone to feel awkward, self-conscious, or ashamed)
45. mi____pelled (to have written a word with incorrect letters or an incorrect arrangement of letters)
46. pa____time (an activity that someone does regularly for enjoyment rather than work; a hobby)
47. simi____r (resembling without being identical)
48. misch____v____us (causing or showing a fondness for causing trouble in a playful way)
49. coun____l (Advice or guidance, especially as solicited from a knowledgeable person)
50. f____ry (consisting of fire or burning strongly and brightly)
51. dis____pline (the practice of training people to obey rules or a code of behavior)
52. interp____t (understand an action, mood, or way of behaving as having a particular meaning or significance)
53. envir____ment (the surroundings or conditions in which a person, animal, or plant lives or operates)
54. prec____ding (existing, coming, or occurring immediately before in time or place)
55. station____ry(not moving or not intended to be moved)
56. n____ce (a daughter of one's brother or sister)
57. opt____mistic (hopeful and confident about the future)
58. arg____ment (an exchange of diverging or opposite views, typically a heated or angry one)
59. depend____nt (decided or controlled by something else)
60. dec____ve (cause someone to believe something that is not true, typically in order to gain some personal advantage)
61. vil____n (in a film, novel, or play a character whose evil actions or motives are important to the plot)
62. cal____nd____r (a chart or series of pages showing the days, weeks, and months of a particular year, or giving particular seasonal information)
63. perm____nent (lasting or intended to last or remain unchanged indefinitely)
64. r____dicul____s (stupid or unreasonable and deserving to be laughed at)
65. consist____nt (continuing to happen or develop in the same way)
66. bar____n (infertile unproductive; unfruitful)
67. ath____te (a person who is proficient in sports and other forms of physical exercise)
68. influent____al (having the power to cause changes)
69. prefer____nce (a greater liking for one alternative over another or others)
70. prom____n____nt (important and well-known)
71. nec____sary (needed, required to be done, achieved, or present; needed; essential)

Appendix D

Questionnaires

Pretest Questionnaire for Both Groups

Date:

Name:

Age:

Major:

- Besides English, do you speak any other languages?____Yes ____No

Please list them,……

- Have you learned any of these languages through courses that you have taken? If so which ones?.....

- Have you learned any of these languages because you have been to different countries? If so which languages?.....

- Do you have parents/relatives that speak those languages? Explain which languages.

……

- Do you have difficulty remembering the spellings of English words? If so please rate this difficulty on a scale from 1 to 10 (1 means you have very little difficulty, 10 means that you have extensive difficulty)

__1 __2 __3 __4 __5 __6 __7 __8 __9 __10

- Please rate your confidence in your spelling skill on a scale of 1 to 10 where 1 means "Not confident at all" and 10 means "Very confident."

__1 __2 __3 __4 __5 __6 __7 __8 __9 __10

In general, on a scale of 1 to 10, how important is it to know the correct spelling of a word from memory? (1 means not important and 10 means very important)

__1 __2 __3 __4 __5 __6 __7 __8 __9 __10

Do you think spelling is important? ____Yes _____No

Explain why you think so……

……

……

- On a scale of -10 to +10 please rate how you evaluate the effect of using spell checks on your spelling skills (-10 means very negative effect; 0 means no effect, and +10 means very positive effect. Circle the number that applies)

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

(very negative) (no effect) (very positive effect)

Posttest Questionnaire for the Experimental Group

Date:

Name:

- You were taught the study words with a spelling pronunciation strategy.

Have you used this strategy before it was instructed in this study? ……..……

If so who taught you this strategy? ……...

How old were you when you learned this strategy first? ……..

Do you use any other strategies in order to remember spellings of words?.....

……

……

……

- On a scale of 0 to 10 how effective do you think this strategy is for learning the spellings of words?

(Not effective) 0__ __1 __2 __3 __4 __5 __6 __7 __8 __9 __10 (Very effective)

- Please add your comments about the strategy……

……

……

Posttest Questionnaire for the Control Group

Date:

Name:

- On a scale of 0 to 10 how effective do you think reading the words is for learning the spellings of words?

(Not effective) 0__ __1 __2 __3 __4 __5 __6 __7 __8 __9 __10 (Very effective)

- What strategies do you use in order to remember the spellings of words?……

……

……

Appendix E Stimuli

Words to be trained with the explanation of the letters that cause difficulty

	Silent Letters	Schwas	Double Letters	Less Common Graphemes
1-Fluorescent	Fluorescent	Fluorescent		-sc-
2-Fahrenheit	Fahrenheit	Fahrenheit		-ei-
3-Millennium		Millennium	Millennium	
4-Occurrence	Occurrence	Occurrence	Occurrence	
5-Rhinoceros	Rhinoceros	Rhinoceros		Rh-
6-Accommodate	Accommodate	Accommodate	Accommodate	
7-Irresistible	Irresistible	Irresistible	Irresistible	
8-Hierarchical		Hierarchical		
9-Privilege	Privilege	Privilege		
10-Questionnaire	Questionnaire	Questionnaire	Questionnaire	
11-Idiosyncrasy		Idiosyncrasy		-y
12-Liaison	Liaison			
13-Maneuver	Maneuver	Maneuver		-eu-
14-Pneumonia	Pneumonia	Pneumonia		
15-Bouquet	Bouquet			-ou-
16-Silhouette	Silhouette	Silhouette	Silhouette	
17- Bureaucracy	Bureaucracy	Bureaucracy		-eau-
18-Chauvinism	Chauvinism	Chauvinism		-ch-
19-Impeccable	Impeccable	Impeccable	Impeccable	
20-Lieutenant	Lieutenant	Lieutenant		

Study Words with Accompanying Sentences

1- Fluorescent. Fluorescent light bulbs save energy.

2- Fahrenheit. During summer, the temperature in New York can go up to 100 degrees Fahrenheit.

3- Millennium. The first day of January 2000, people welcomed a new millennium.

4- Occurrence. We were delayed by several unexpected traffic occurrences.

5- Rhinoceros. The white rhinoceros is the second largest land mammal next to the elephant.

6 -Accommodate. It is hard to accommodate to a big city after living in a small village.

7- Irresistible. The cake was so delicious, it was irresistible.

8- Hierarchical. Hierarchical is an adjective denoting arrangement in order of rank. Kings are above queens in the hierarchical order of royalty.

9- Privilege. The chef considered it a privilege to cook for the queen.

10- Questionnaire. The research instruments include a personal questionnaire.

11- Idiosyncrasy. Idiosyncrasy is a characteristic, habit, or mannerism that is peculiar to an individual.

12- Liaison. She served as a liaison between the school board and the parent association.

13- Maneuver. The ballerina’s maneuver on one foot was impressive.

14- Pneumonia. Pneumonia is a disease characterized by infection of the lungs.

15- Bouquet. The man purchased a bouquet of roses to take to his wife.

16- Silhouette. A silhouette is an outline of an object filled in with a solid black color

17- Bureaucracy. The company's policies were streamlined to eliminate excess bureaucracy.

18- Chauvinism. Chauvinism is boastful patriotism or self-glorification.

19- Impeccable. Impeccable is an adjective that describes something as perfect and free of flaws.

20- Lieutenant. A lieutenant is an army officer.

Training Sheet for the First Step for both of the groups

-Please read each of the sentences below and rate your familiarity with each underlined word.

1) Fluorescent light bulbs save energy.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

2) During summer, the temperature in New York can go up to 100 degrees Fahrenheit.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

3) The first day of January 2000, people welcomed a new millennium.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

4) We were delayed by several unexpected traffic occurrences.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

5) The white rhinoceros is the second largest land mammal next to the elephant.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

6) It is hard to accommodate to a big city after living in a small village.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

7) The cake was so delicious, it was irresistible.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

8) Hierarchical is an adjective denoting arrangement in order of rank. Kings are above queens in the hierarchical order of royalty.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

9) The chef considered it a privilege to cook for the queen.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

10) The research instruments include a personal questionnaire.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

11) Idiosyncrasy is a characteristic, habit, or mannerism that is peculiar to an individual.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

12) She served as a liaison between the school board and the parent association.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

13) The ballerina's maneuver on one foot was impressive.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

14) Pneumonia is a disease characterized by infection of the lungs.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

15) The man purchased a bouquet of roses to take to his wife.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

16) A silhouette is an outline of an object filled in with a solid black color.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

17) The company's policies were streamlined to eliminate excess bureaucracy.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

18) Chauvinism is boastful patriotism or self-glorification.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

19) Impeccable is an adjective that describes something as perfect and free of flaws.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

---

20) A lieutenant is an army officer.

0_Not at all
1_I am not sure but I think I have heard/seen this word before
2_I have seen/heard this word before but I am not very familiar with this word
3_I am familiar with this word
4_I am very familiar with this word

Training Group Study Sheet for Step 2 and Step 3

Fluorescent
Flu-or-e-scent

_____
Fahrenheit
Fah-ren-he-it

_____
Millennium
Mil-len-ni-um

_____
Occurrence
Oc-cur-rence

_____
Rhinoceros
R-hi-no-ce-ros

_____
Accommodate
Ac-com-mo-date

_____
Irresistible
Ir-resist-ible

_____
Hierarchical
Hi-er-arch-ical

_____
Privilege
Priv-il-ege

_____
Questionnaire
question-naire

_____
Idiosyncrasy
Idio-syn-crasy

_____
Liaison
Lia-is-on

_____
Maneuver
Mane-u-ver

_____
Pneumonia
P-neu-mo-nia

_____
Bouquet
bou-quet

_____
Silhouette
Sil-hou-ette

_____
Bureaucracy
Bure-au-cracy

_____
Chauvinism
Chau-vin-ism

_____
Impeccable
im-pec-cable

_____
Lieutenant
Lie-u-ten-ant

_____

Training Group Study Sheet for Step 4
Fluorescent
Fluorescent

_____
Fahrenheit
Fahrenheit

_____
Millennium
Millennium

_____
Occurrence
Occurrence

_____
Rhinoceros
Rhinoceros

_____
Accommodate
Accommodate

_____
Irresistible
Irresistible

_____
Hierarchical
Hierarchical

_____
Privilege
Privilege

_____
Questionnaire
Questionnaire

_____
Idiosyncrasy
Idiosyncrasy

_____
Liaison
Liaison

_____
Maneuver
Maneuver

_____
Pneumonia
Pneumonia

_____
Bouquet
Bouquet

_____
Silhouette
Silhouette

_____
Bureaucracy
Bureaucracy

_____
Chauvinism
Chauvinism

_____
Impeccable
Impeccable

_____
Lieutenant
Lieutenant

Control Group Study Sheet
Fluorescent
Fluorescent

_____
Fahrenheit
Fahrenheit

_____
Millennium
Millennium

_____

Occurrence
Occurrence

_____
Rhinoceros
Rhinoceros

_____
Accommodate
Accommodate

_____
Irresistible
Irresistible

_____
Hierarchical
Hierarchical

_____
Privilege
Privilege

_____
Questionnaire
Questionnaire

_____
Idiosyncrasy
Idiosyncrasy

_____
Liaison
Liaison

_____
Maneuver
Maneuver

_____
Pneumonia
Pneumonia

_____
Bouquet
Bouquet

_____
Silhouette
Silhouette

_____
Bureaucracy
Bureaucracy

_____
Chauvinism
Chauvinism

_____
Impeccable
Impeccable

_____
Lieutenant
Lieutenant

Recording Form for the Training Group

Add a checkmark to indicate participant's correct pronunciation

	Step 1	Step 2		Step 3		Step 4			Training time:____ Notes
	Whole word	Whole word	Segments	Segments	Whole word	Whole word	Divides into segments	Segments	
1-Fluorescent									
2-Fahrenheit									
3-Millennium									
4-Occurrence									
5-Rhinoceros									
6-accommodate									
7-irresistible									
8-Hierarchical									
9-Privilege									
10-questionnaire									
11idiosyncrasy									
12-Liaison									
13-maneuver									
14-pneumonia									
15-bouquet									
16-silhouette									
17-bureaucracy									
18-Chauvinism									
19-impeccable									
20-Lieutenant									

Recording Form for the Control Group

Add a checkmark to indicate participant's correct pronunciation

	Step 1	Step 2		Step 3		Step 4		Training time:___ Notes
	Whole word	Whole word	Whole word	Whole word	Whole word	Whole word	Whole word	
1-Fluorescent								
2-Fahrenheit								
3-Millennium								
4-Occurrence								
5-Rhinoceros								
6-accommodate								
7-irresistible								
8-Hierarchical								
9-Privilege								
10-questionnaire								
11idiosyncrasy								
12-Liaison								
13-maneuver								
14-pneumonia								
15-bouquet								
16-silhouette								
17-bureaucracy								
18-Chauvinism								
19-impeccable								
20-Lieutenant								

Post-test Answer Sheet for Both Groups

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

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