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About the Journal

Founded in 2013, the Journal of Teacher Action Research (ISSN: 2332-2233) is a peer-reviewed online journal indexed with EBSCO that seeks practical research that can be implemented in Pre-Kindergarten through Post-Secondary classrooms. The primary function of this journal is to provide classroom teachers and researchers a means for sharing classroom practices.

The journal accepts articles for peer-review that describe classroom practice which positively impacts student learning. We define teacher action research as teachers (at all levels) studying their practice and/or their students' learning in a methodical way in order to inform classroom practice. Articles submitted to the journal should demonstrate an action research focus with intent to improve the author's practice.

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SPANISH VOCABULARY ACQUISITION BY ENGLISH SPEAKERS USING SPACED-REPETITION ALGORITHMS AND MNEMONICS

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Abstract Two popular techniques for memorizing vocabulary, both in general and in foreign-language learning, are the use of spaced-repetition software and mnemonic phrases. The author gave three classes of first-year Spanish students in high school 20 new high-frequency vocabulary words each Monday, provided 15 minutes of time each day to use spaced-repetition software to memorize them, and quizzed the students on these words at the end of each week. Performance on orthographically similar words was 21% stronger than words that were not orthographically similar prior to the mnemonic intervention described here. The experimental group's performance on words that were not orthographically similar showed statistically significant improvement after the intervention. The control group's performance did not. This suggests two conclusions (1) that the simple addition of mnemonics to words that are not orthographically similar increases vocabulary retention and (2) spaced-repetition algorithms do not adequately account for differences between words of difficulty varying on the basis of orthographic similarity.

Keywords: teacher action research, Spanish, mnemonics, second language acquisition, spaced repetition

Introduction

Two popular strategies for memorizing vocabulary, both in general and in foreign-language learning, are the use of spaced-repetition software (SRS) (Ono, 2017) and mnemonic devices (Paivio & Desrochers, 1981). Appropriate use of SRS should result in learners seeing words that are more difficult for them more often. While the literature suggests that employing a variety of language-learning strategies results in the best outcomes (Gholami, Abdorrahimzadeh, & Behjat, 2014), given a finite amount of time and other practical constraints, finding optimal mixes of language-learning strategies can make optimal use of time and other resources. In this paper, the author finds that SRS usage can be improved on by short interventions with mnemonics on words that are not orthographically similar in L1 and L2.

Literature Review

The second-language acquisition (2LA) literature has individually studied both SRS and mnemonics quite well. Before now, however, there is no known study of the combination of these two strategies in the context of 2LA. Outside of 2LA, one study showed that a combination of both enabled effective memorization of strong passwords (Blocki, Komanduri, Cranor, & Datta, 2014). Seibert Hanson and Brown suggested as a future research direction to analyze the combination of SRS and mnemonics (Seibert Hanson & Brown, 2019). This paper seeks to advance that research.

SRS uses algorithms based on brain research into the mechanics of human memory. Some examples of software that uses SRS algorithms assessed in research include Anki, Memrise, and SuperMemo. Numerous studies have shown SRS to be effective in acquiring L2 vocabulary and to foster a growth mindset in learners and to stimulate learner motivation (Seibert Hanson & Brown, 2019; Ono, 2017). SRS uses flashcards but spaces out reviews based on the learner's subjective estimate of their performance. If the correct answer immediately pops into the student's mind, the word gets marked "easy"; if the correct answer occurs to the student in a second or two, the student marks the word "good"; if the student answers correctly after some time, it gets marked "hard." If the student does not get the answer correct, the student selects "again." The algorithm spaces out reviews of the cards based on these inputs with incorrect answers being shown again in the same session and "easy" words being delayed for review for an increasingly long period of time. SRS research suggests that this creates ideal results for vocabulary retention (Seibert Hanson & Brown, 2019). Despite these results and the algorithmic optimization used by SRS, Ono 2017 still found that word length and prior language experience affected the results. Similarly, this study shows the degree of orthographic similarity creates a disparity of performance when using SRS.

For over a century, language instructors have been using mnemonics to improve retention of L2 vocabulary. Some techniques for creating mnemonics include using acoustic, orthographic, or semantic "links," or, failing that, a picture (Paivio & Desrochers, 1981). For example, for Spanish *perro* (*i.e.*, dog pronounced very roughly like "pear-oh"), we might draw a picture of a pear-shaped dog. The pear-shape is an acoustic link. Research shows that the use of mnemonics, whether created by the learner or the instructor, significantly improve recall (Paivio & Desrochers, 1981).

Vocabulary is perhaps the most important area of language acquisition, and one that is perhaps the most frustrating for learners (Meara, 1980). By emphasizing high-frequency vocabulary, instructors and learners can leverage Zipf's law, which stands for the proposition that most of speech and writing is comprised of a small set of high-frequency lemmata (*i.e.,* groups of word forms that differ only by grammatical prefix or suffix) (Nation & Waring, 1997). The result is that L2 vocabulary acquisition can optimized by learning only the most frequently used lemmata in a language and the memorization of those lemmata can be optimized using SRS.

Educators can present students with numerous language-learning strategies, but thereby risk losing focus, confusing students, and depleting time. By finding a mix of strategies that effectively uses time, educators can make the best use of time. The purpose of this study is to investigate the mix of SRS and mnemonics in 2LA and to make an original contribution to 2LA pedagogy through a rigorous statistical analysis of the results.

Methodology

Participants. The author gave 68 first year high-school Spanish students in the author's three class periods 20 new high-frequency vocabulary words each week, starting with the most frequent at the beginning of the year and progressing towards a goal of completing the top 500 most common Spanish lemmata by the end of the year, which accounts for approximately 50% of the words used in speech and writing. The author quizzed the students on 15 of the 20 new words, 5 words from the prior week, and 5 randomly chosen from weeks prior. Participants were approximately 3% African American, 12% Asian-American, 38% Latino, and 47% Caucasian. Participants were 46% female and 54% male. Ages range from 14 to 17. All participants had completed one semester of high school Spanish I. Each class period, students are given approximately 15 minutes at the beginning of class to study the words with SRS.

Design. The author used an independent but not randomly assigned two group design. The author designated two classes as the experimental group and one as the control. The experimental group was presented with the mnemonic intervention and the control group was not. After reviewing the data, the author finds that there is virtually no difference between the demographics or academic achievement of the two groups. All other instruction, content, lesson plans, and other variables were held constant between the groups.

The Intervention. In preparation for the second quiz, the experimental group was presented with mnemonic sentences (*e.g.,* "*Suceder* / To Happen: He made it *happen* because he was a "succeed-er") for the non-orthographically similar words only. The control group was not. The mnemonics were repeated twice each class period Monday through Friday, taking about 2 minutes per day. Otherwise, the preparation for both groups was identical.
The author created the mnemonics. The author presented the mnemonics to the entire class at the conclusion of the time allocated for spaced repetition software use. The mnemonics were written on the back of flashcards and presented in the following manner: (1) the word was read aloud in Spanish; (2) the word's definition in English was read aloud; (3) followed by a mnemonic story or pun that links the word. For example, "*Fuera*. Outside. She wanted him to go FAR "FUER"-A-way, so he went OUTSIDE." The stories do not need to be sophisticated or clever. Simply linking the two words, even absurdly, is sufficient. After the author read each card twice, 5-10 random students were cold called to check if they remembered the mnemonic.

Quiz Instrument. The quizzes tested 15 new words each week and 5 words chosen from the previous weeks' sets. The further 5 words from past weeks chosen at random are not

analyzed here. Students simply translate the words from English to Spanish and vice-versa. A correct answer may include mild typos if it does not collide with another word. On that basis, the answers are either scored correct or incorrect. There is an equal number of "active" translations from English to Spanish and "passive" translations from Spanish to English. All classes took the same quizzes.

To analyze the quizzes, the author sorted words into two study categories: (1) orthographically similar words (*e.g.,* possibility and *posibilidad*); (2) words that are not orthographically similar (*e.g.,* weight and *el peso*).

Results

Because the data was not clearly normally distributed and the data were paired across the quizzes, the author employs the Wilcoxon Signed Rank Test, as implemented by SPSS software throughout. The small sample size is a result of the smaller student body at the author's school, but it is still sufficient in size to test the hypotheses using the Wilcoxon Signed Rank Test.

As a null hypothesis, we assume that there should be no meaningful change in the control group on non-orthographically similar words between Quiz 1 and Quiz 2.

Table 3: Related-Samples Wilcoxon Signed Rank Test Summary Between Quiz 1 and Quiz 2 For the Control Group (Non-Orthographically Similar Words)

Total N (students)	19
Test Statistic	102.000
Standard Error	21.119
Standardized Test Statistic	1.207
Asymptotic Sig. (2-sided test)	.227

Based on the data in Table 1, we retain the null hypothesis because the asymptotic significance exceeds 0.05. Using the same null hypothesis for the experimental group and an alternative hypothesis that the intervention should result in a difference, we reject the null hypothesis with an asymptotic significance of less than 0.05 in Table 2.

Table 4: Related-Samples Wilcoxon Signed Rank Test Summary Between Quiz 1 and Quiz 2 For the Experimental Group (Non-Orthographically Similar Words)

Total N (students)	49
Test Statistic	685.000
Standard Error	85.653

Standardized Test Statistic	2.218
Asymptotic Sig. (2-sided test)	.027

As a further control, we can see whether there was a meaningful difference between words that were orthographically similar. In both experimental groups (Table 3), control (Table 4), and in the aggregate (Table 5), we retain the null hypothesis of no meaningful differences between the quizzes.

Table 5: Related-Samples Wilcoxon Signed Rank Test Summary Between Quiz 1 and Quiz 2 For the Experimental Group (Orthographically Similar Words)

Total N (students)	49
Test Statistic	259.000
Standard Error	43.859
Standardized Test Statistic	1.277
Asymptotic Sig. (2-sided test)	.202

Table 6: Related-Samples Wilcoxon Signed Rank Test Summary Between Quiz 1 and Quiz 2 For the Control Group (Orthographically Similar Words)

Related-Samples Wilcoxon Signed Rank Test Summary	
Total N (students)	19
Test Statistic	35.000
Standard Error	9.747
Standardized Test Statistic	.769
Asymptotic Sig. (2-sided test)	.442

Table 7: Related-Samples Wilcoxon Signed Rank Test Summary Between Quiz 1 and Quiz 2 For All Students (Orthographically Similar Words)

Related-Samples Wilcoxon Signed Rank Test Summary	
Total N (students)	68
Test Statistic	1094.000
Standard Error	135.444

Standardized Test Statistic	1.322
Asymptotic Sig. (2-sided test)	.186

Discussion

The only statistically significant result is in the performance of the experimental group on words that are not orthographically similar. This is the group that received the simple, 2-minute mnemonic intervention and on the group of words that is the target of the intervention. Because the intervention narrows a previously existing performance gap between orthographically similar words on the one hand, and those that were not orthographically similar on the hand, the data also suggest that SRS alone may not sufficiently practice non-orthographically similar words. It seems possible that the orthographic similarity itself serves as a "built-in" mnemonic. It is unclear why either SRS does not self-adjust for this or why learner input does not reflect this sufficiently for SRS to self-adjust for it.

Implications

This is a small data set from a small group of students too small to be representative of all learners, even of all high-school Spanish-learners. The sample size is sufficient to test the hypotheses using appropriate statistical methods, but not sufficient to cross-tabulate on the basis of demographics, gender, academic achievement, or other factors. The demographic mix in this study is quite different from the country as a whole. It is also quite different from the demographic mix of Spanish learners as a whole and only includes Latino and Caucasian students in significant numbers. Despite these limitations, the result is clear: augmenting SRS with a brief mnemonic intervention of only the non-orthographically similar words improves retention.

Future research should, of course, use larger sample sizes and, if possible, random selectees with a more representative demographic mix. In addition, specifications for what makes mnemonics most optimal in this context and some method of measuring orthographic similarity should be developed. Other questions include whether improving student training with SRS to give more accurate input, if indeed their input is not correct, will result in the algorithm self-adjusting to compensate for the "built-in mnemonic" of similar spelling.

Conclusion

Both SRS and mnemonic devices are popular language-learning strategies. While the use of a variety of language-learning strategies results in the very best outcomes, time and other practical constraints in the classroom call out for time-optimizing approaches to the use of these strategies. This paper has shown that short interventions with mnemonics on words that are not orthographically similar in L1 and L2 can improve outcomes compared with SRS usage alone.

About the Author

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