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Recall Efficacy in EFL Learning*

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This study investigated the efficacy of retrieving EFL vocabulary from memory as a long-term retention strategy. Three learning treatments, rereading, recognizing and recalling target words, were compared with the assistance of 74 university students who underwent the treatments to learn academic American English during a 15-week semester. In addition to investigating the efficacy of the learning treatments, the study explored the effects of recognition and recall testing in relation to the treatments for possible interactions between learning treatment and test format. The study found that while rereading was the preferred student study strategy, recalling words was a more efficacious learning practice. Recognition learning was also less effective than recalling words, which suggests that the use of recall tests will promote long-term retention more than recognition tests such as multiple-choice tests. Learning treatment and test format comparisons suggested that the retrieval of words as a learning strategy was likely to be the most effective study practice regardless of test type despite transfer-appropriate processing inconsistencies.

Key words: rereading, recognition, retrieval, long-term retention, recall and recognition tests

1. INTRODUCTION

Learning a foreign language can be a daunting task. A vast amount of knowledge must be memorized, practiced and automatized before one can use a foreign language well. According to Hamrick, Jarrad, Lum and Ullman (2018), adults learn foreign languages using two memory systems, a declarative system and a procedural system. Vocabulary is learned only in the declarative system while grammar is initially learned in the declarative

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system but makes a transition to the procedural system at higher proficiency levels. With regard to vocabulary learning, which is the focus of this article, the importance of declarative memory highlights the need for learners to not only initially learn vocabulary but also to retain that knowledge in memory so that it can be integrated into the grammatical system when communicating. However, given learners' propensity for forgetting, long-term vocabulary retention presents a challenge for most foreign language learners. To address the challenge of retaining knowledge a common study strategy is to reread information repeatedly until it can be remembered. Some researchers, however, have suggested that it would be more efficacious to adopt a knowledge retrieval strategy, as it has been demonstrated that it leads to superior long-term knowledge retention (Carpenter, Pashler & Cepeda, 2009; Karpicke & Roediger, 2008). Other researchers have challenged this view (Carpenter & DeLosh, 2006), while yet others have questioned the applicability of the retrieval research with regard to classroom pedagogy as much of the research has been conducted in laboratories (McDaniel, Agarwal, Huelser, McDermott & Roediger, 2011).

The present study examines the efficacy of recall practice with regard to long-term vocabulary learning in an English as a foreign language (EFL) classroom environment. The purpose of the study is to test claims for the superiority of recall practice for long-term vocabulary learning as compared to the typically more popular practice of rereading as a study strategy (Karpicke, Butler & Roediger, 2009). In addition, the efficacy of recognition tests versus recall tests with regard to long-term vocabulary learning is investigated, as recognition tests such as multiple-choice tests that rely on recognizing the answer as opposed to recalling it, are commonly used in the classroom context.

2. LITERATURE REVIEW

2.1. The Retention of Learning

Learning requires memory. If what is learned is forgotten, then that knowledge will need to be relearned. With regard to foreign language learning, aptitude for learning languages is a strong predictor of success (Skehan, 1989), and according to Gass and Selinker (2008), one of the four standard elements of language learning aptitude in Carroll's (1962) seminal model is memory, which is especially important for vocabulary learning (Ellis, 1994). However, forgetting is a normal part of the learning process. Ebbinghaus's forgetting curve revealed that substantial memory loss occurs soon after learning takes place and then decreases over time (Anderson & Schooler, 1991). It has been suggested that forgetting is an essential element of good decision-making, and thus is an important survival skill, as

eliminating irrelevant information makes the decision-making process more effective (Richards & Frankland, 2017). Nevertheless, as the retention of learning is necessary for foreign language acquisition, the forgetting effect must be countered.

To minimize forgetting, learners are advised to review the learned material after the initial learning occurs (Schmitt, 2000). As the amount of forgetting decreases over time, it is suggested that an expanding rehearsal pattern is the most effective with more review periods soon after the learning act and fewer as time goes on (Baddeley, 1990). This advice seems contrary to the typical student behavior of studying for exams just prior to the time of testing. When students study a topic at length just before an exam this is called *massed* learning whereas when the studying occurs at different times with spaces between the studying times it is called *spaced* learning (Cepeda, Pashler, Vul, Wixted & Rohrer, 2006). According to the authors, the spacing effect has been demonstrated to result in more effective retention of learning over time. In addition to spacing study periods, it has been suggested that interleaving the topics to be studied also has a beneficial effect on long-term retention as compared to repeatedly studying the same topic even with spaces between the study periods. *Blocked learning*, studying the same topic in sequential study periods (e.g., AAAA BBBB CCCC DDDD), is argued to be less effective than *interleaved learning*, studying different topics sequentially (e.g., ABCD ABCD ABCD ABCD), because the increased difficulty entailed in contrasting and recalling different topical information is believed to enhance long-term retention (Birnbaum, Kornell, Bjork & Bjork, 2013). The researchers suggest that having to discriminate between and recall different topics results in better long-term recall, as more effort is required to access unrelated information as compared to related topics, which are likely to be connected in memory. This contention is supported by the levels of processing framework (Craik & Lockhart, 1972), which suggests that greater processing effort leads to better retention (Battig, 1979; Burton, Niles & Wildman, 1981). With regard to students' perceptions, Birnbaum et al. (2013) state that it has been shown that students often believe blocked learning to be superior to interleaved learning even when the results indicate the opposite. It should be noted that some research has suggested that blocked learning may be superior to interleaved learning when the learning task requires the recall of specific facts, when there is less discriminative contrast, thus, presumably, reducing cognitive demand, and when information is less likely to be retrieved, as in the case of easily forgotten auditory stimuli (Carpenter & Mueller, 2013; Richland, Bjork, Finley & Linn, 2005). In addition, Carpenter and DeLosh (2006) found that restudying learned material, as in blocked learning, was as effective as recalling information with regard to retention. It has been suggested that one explanation for this counterintuitive results was the brief five-minute delay before the final test, which would represent short-term retention more than long-term retention (Kang, McDermott & Roediger, 2007). Finally, Kang et al. (2007) found in their study that without feedback the

restudying of information produced approximately the same results as taking a recognition test, which suggests that rereading material to be learned and taking a recognition test make activate similar memory processes in the brain. Despite this, common sense would suggest that though recognizing an answer on a multiple choice would be less demanding than recalling the answer, it would require more effort than merely rereading information. If this is true, the greater effort should result in better retention.

2.2. The Impact of Word Recall on Memory

Because much of what is learned tends to be quickly forgotten, researchers and educators have focused considerable attention on helping students remember target information. A typical study retention strategy is to cram before exams. This often involves reviewing information thought to be important and this review procedure often entails rereading information in textbooks, notebooks and so on (Karpicke et al., 2009). However, in the interest of improving retention, the efficacy of the practice of rereading has been questioned (Carpenter et al., 2009; Karpicke & Roediger, 2008; Larsen, Butler & Roediger, 2013; McDaniel, Anderson, Derbish & Morrisette, 2007; Nation, 2001; Richland et al., 2005). According to some researchers (Butler, 2010; Karpicke & Roediger, 2008; Thios & D'Agostino, 1976), the strategy of recalling or retrieving information from memory has a more efficacious effect on the retention of learned material than rereading such material. In a study by Thios and D'Agostino (1976), when students studied information a second time by rereading the information, retention was weaker than when the second study session required retrieval of the information from the first study session. Also, a study by Butler (2010) demonstrated that retrieving information from memory resulted in better retention and superior transfer of the information to other educational contexts than rereading the information.

Retrieving a piece of information from memory is believed to strengthen the memory. One explanation for this phenomenon relates to the concept of encoding specificity. The encoding specificity principle holds that retrieval will be more effective when the retrieval cue closely matches the memory trace from the initial learning (Bulter, 2010). The greater the number of the access routes to the memory trace, the more likely it is that a retrieval cue will elicit the memory (McDaniel & Masson, 1985). Every time a memory is successfully retrieved, the access conditions are somewhat different and this is likely to increase brain connectivity (Carrier & Pashler, 1992). One of the explanations for the better long-term retention attributed to interleaved learning as compared to blocked learning is that learners must access memories under different conditions as they change from one topic to another. In support of this view, research has shown that interleaved learning results in greater brain connectivity than blocked learning (Lin et al., 2013). It

may be that electrical stimulation of neurons during retrieval enhances connectivity as synaptic activity has been shown to develop connectivity between neurons (Cho et al., 2015). Another explanation for the retrieval effect is that each successful retrieval of information strengthens an existing retrieval route (Birnbaum et al., 1971; Bjork, 1975).

While the precise neurological explanation for the power of retrieval with regard to the retention of memories remains under development, the efficacy of retrieval in educational settings has been demonstrated by studies that have compared rereading to recalling information. The findings suggest that long-term retention is superior when learners recall information from memory (Carpenter et al., 2009; Carrier & Pashler, 1992; Karpicke & Roediger, 2008; Richland et al., 2005). In addition, many researchers have explored the use of testing as an educational practice rather than just as an assessment tool. Called the testing effect (McDaniel et al., 2011), it has been shown that taking a test on a subject makes it more likely that the material will be remembered in the future. Studies using tests based on educational materials such as text passages, scientific articles, general knowledge questions and foreign language vocabulary learning have demonstrated the power of the testing effect (Carpenter et al., 2009; Larsen, Butler & Roediger, 2009). Gardiner, Craik and Bleasdale (1973) suggested that the reason for the testing effect is the effort that is made by the test taker to retrieve information while undergoing testing. For recall tests in particular, the test taker may make a greater cognitive effort while attempting to answer a question, which has a beneficial effect on retention, as was mentioned above with regard to interleaved learning (Auble & Franks, 1978). Alternatively, or in combination with making a greater effort, it may be that the process of attempting to retrieve information to answer a test question either strengthens a memory trace or creates more access routes to a memory or both (Roediger & Karpicke, 2006). However, not all classroom testing involves recall tests. Multiple-choice tests, for example, are often used in educational settings, and as these tests only require test takers to recognize a correct answer as opposed to retrieving it from memory, less effort is expended. Given this, it would be expected that recognition tests would have a less beneficial effect on long-term retention than recall tests.

2.3. The Testing Format and Retention

There are many ways to test learners. Two commonly used test types are recall tests and recognition tests. Recall tests require the learner to remember information and show evidence of this by producing the information, as on short-answer tests that elicit information with questions or other prompts. These tests are sometimes referred to as productive tests (Nation, 2001) because the test taker is required to generate a response. Recognition tests also include a test-item prompt but differ from recall tests in that they provide the test taker with a set of possible answers, one of which is usually the correct

answer while the others are incorrect distractors. Recognition tests are less difficult than recall tests because the test taker is given information with regard to the correct answer (the provided answer set) that is not available on recall tests (Laufer, Elder, Hill & Congdon, 2004). Thus, as was previously mentioned, recognition tests may be less beneficial with regard to long-term retention than recall tests because less cognitive demand is required when answering recognition questions. Moreover, the superiority of recall testing with regard to retention has been supported by classroom research (McDaniel et al., 2007).

Another issue related to test type is possible differences in learner retention results that are dependent on the similarity between the learning treatment condition and the testing condition. Some research has shown that matching the learning treatment to testing item format will result in a higher success rate than assigning study activities that are not similar to the test format (Griffin & Harley, 1996; Thomas & McDaniel, 2007). One explanation for this effect is based on the concept of transfer-appropriate processing which suggests that better test results, and thus enhanced evidence of retention, will be achieved when the learning activity closely matches the test format (Roediger & Karpicke, 2006). Therefore, it would be expected that learners would achieve higher test scores when a learning activity in which a learner must recall information is followed by a testing format that also requires the recall of information. A study by Duchastel and Nungester (1982) found that when students were given a first recognition test after initial instruction the results were better on a final recognition test than when given a recall test after initial instruction. In this study the first tests acted as activities to consolidate learning. Similarly, when the learners were given an intervening recall test, the results were better on a final recall test than when an intervening recognition test was given. However, according to Roediger and Karpicke, more recent research has not supported this finding. Kang et al. (2007) found that when learners took an intervening recall test after initial instruction the results were better on both the final recall and recognition tests, which suggests that the retention benefit derived from the increased cognitive demand of the recall test was a more important factor than the appropriate-transfer effect. It should be noted that this result was only obtained when feedback in the form of correct answers was given after the intervening tests. Without feedback the intervening recognition test led to better results on both the final recall and recognition tests. The authors suggest that this unexpected result was due to the much higher scores on the initial recognition tests compared to the recall tests, which exposed the learners to more correct answers. When this effect was compensated for with corrective feedback after the initial tests, the intervening recall test produced superior results on both the final recall and recognition tests.

2.4. The Feedback Effect

Feedback on learning is an important part of the learning process (Metcalfe, 2017). As has been mentioned, the learning process involves a great deal of forgetting, which means that knowledge that may be present at one time will not necessarily be available at a later time. Testing and feedback on the results of tests provide learners with an assessment of how much and what kind of knowledge has been forgotten. This is sometimes called formative assessment, and it is intended to guide instruction and help students study more effectively (Black & Wiliam, 1998). According to Metcalfe, there is little benefit to merely telling students they have made a mistake; they must receive the correct answer. Also, feedback must be attended to in order to be effective, and elaborate feedback produces better results than simple feedback. Butler (2010) states that in his study feedback enhanced retention of learning and the transfer of that learning to other contexts. Butler further suggests that feedback is beneficial because it provides error correction, consolidates correct responses, and may even enhance future learning by working in combination with a deep processing of information that can be activated by an unsuccessful answer attempt. Lyster and Ranta (1997) identified six kinds of corrective feedback: repetition of error, clarification requests, elicitation, metalinguistic feedback, explicit correction and recasts, and stated that the first four types created negotiation of form opportunities, which were especially helpful in correcting vocabulary and grammar errors (Lyster, 1998).

Feedback has also been reported to increase retention on recall tests (Kang et al., 2007; Karpicke & Roediger, 2010; McDaniel et al., 2007**;** Pashler, Cepeda, Wixted & Rohrer, 2005). Kang et al. (2007) found that when retention was tested using recall and recognition tests, initial performance on the recall test was much lower than on the easier recognition test. As a result, more error correction occurred in the feedback for the recall test, which it was believed led to superior retention compared to an absence of feedback. It was also hypothesized that the greater retrieval demands of the recall test resulted in a deeper encoding of the feedback, which then led to better future retrieval.

3. RESEARCH QUESTIONS

There is a need for research regarding the retention effects of testing under classroom conditions, as much of the research thus far has been conducted in laboratories, and it is uncertain whether it can be generalized to the classroom environment (Carpenter et al., 2009; McDaniel et al., 2011). For example, the testing effect might be increased in the classroom with the presumably increased motivation to learn of students compared to

laboratory participants. On the other hand, the laboratory offers opportunities such as repeated testing that are often unavailable in classrooms in which teachers are encouraged to introduce large quantities of new material. According to McDaniel et al. (2007), a significant difference between laboratory and classroom studies is that in laboratory studies the time between intervening tests and final tests tends to be quite short, perhaps minutes or a few days, whereas in classroom research the time gaps can be much longer. In particular, the differential effects on retention of rereading versus recalling, given students' penchant for rereading as a study activity, and recall versus recognition tests, because of the common use of multiple-choice testing, need to be researched further.

1. Which learning treatment leads to better long-term EFL vocabulary acquisition, rereading, recognizing or recalling target material?
2. What effect does test type, recognition or recall, have on the long-term acquisition of EFL vocabulary?
3. What are participants' perceptions of the efficacy of recognition and recall tests with regard to EFL vocabulary acquisition?

4. METHOD

The study employed a mixed quantitative and qualitative research design to answer the research questions stated above. The quantitative data were intended to provide objective results regarding learning efficacy, while the qualitative data were expected to supply explanatory information to enhance the interpretation of the quantitative results.

4.1. Participants and Context

The study was conducted at a four-year university in the Republic of Korea. The 74 students who participated in the study were all Korean native speakers studying English as a foreign language. All of the students were English majors taking an English speaking skills development course. The majority of the participants were from 19 to 21 years old with 81% of the students falling into this range, 73% were female and 27% were male, and 80% were sophomores with the remainder being in their third or fourth years of university. The participants had all studied English extensively with the average number of years of language education being 12.1 at the time of the study. The participants were informed of the study goals and procedure by the researcher, who was also their course instructor, and permission was given to use their data for research purposes.

4.2. Procedure

The study tasks were completed during a regular 15-week university course replacing a previously employed vocabulary learning task. A pre-test of target vocabulary was administered in Week 1, a post-test in Week 11 and a delayed post-test in Week 14. In addition, a supplementary test of recognition and recall vocabulary items was administered in Week 12, and two questionnaires were completed as homework assignments in Week 13. The first questionnaire collected the participants' personal information and queried them about vocabulary study techniques. The second questionnaire asked students specifically about the recall and recognition questions used in the study including their past exposure to such questions, the utility of the questions regarding knowledge measurement and their question preference. The study tasks were completed in Weeks 2 through 6 and in Weeks 9 and 10 for a total of seven sessions. In each session, 12 randomly chosen target words were studied. The target vocabulary consisted of 84 words from the second 1,000 words of the Corpus of Contemporary American Academic English (COCA; see Gardner & Davies, 2014). Academic English words were selected as they were likely to be of use to English majors required to read English texts and discuss them in English while the 1,000 to 1,999 word frequency range was chosen as being suitably difficult based on trial tests administered before the study began. With regard to the part of speech of the vocabulary, 30 nouns, 30 verbs, 12 adjectives and 12 adverbs were included in the tests. The target vocabulary was not taught at other times during the classes.

The study procedure began with a PowerPoint introduction of 12 words to be learned showing the Korean word and the English translation. A short description of the meaning of the words, including example sentences, was given by the researcher, and then the participants were given two minutes to study the words on the screen. Next, the words were shown to the students again under three different conditions. Four of the 12 words were randomly selected for the students to reread in Treatment 1. This treatment asked the students to read the Korean translation and English target word repeatedly. The second treatment presented four different target words randomly selected from the 12-word group, but in this instance a Korean word and four English words were displayed. For this multiple-choice test type item, the correct answer was shown along with three distractors from the same word frequency level or a higher level of the COCA. After attempting to recognize the answer, feedback was given highlighting the correct answer. The third treatment type displayed only a Korean translation for each of the final four words of the 12-word group of target vocabulary. The participants were required to recall the correct English word, and once again feedback was given regarding the right answer. During the treatment activities, students were not allowed to record the words to be learned to discourage out-of-class learning, which might have influenced the study results.

The study vocabulary was learned by encountering the Korean translation first and the English target word second as this was judged to be the most useful sequence for students focusing on developing their English speaking ability. When students are preparing to speak English as a foreign language, it is not uncommon for them to compose an utterance in their native language and then translate it into English. Thus, the Korean to English vocabulary learning sequence, productive language learning, would mirror this production pattern and likely enhance language production. In addition, productive language learning is more challenging than receptive language learning and thus requires more practice (Laufer et al., 2004; Makarchuk, 2013).

Finally, approximately one hour after the second study activity was completed the participants were given a quiz (Appendix A) that replicated the conditions of the second study activity. That is, the four words taught under each condition, rereading, recognition and recall, were each tested in the same manner. The four rereading words (Korean translation and target English word) had to be written on the quiz paper by copying the supplied words. For the four recognition words, the correct answer had to be chosen from among four possible answers, three of them incorrect, and for the recall words, the correct English target word had to be recalled and written to match the supplied Korean translation. After the quizzes had been completed, feedback was given in the form of the correct answers to the recognition and recall quiz items. The vocabulary learning intervention took approximately 15 minutes of the 150 minutes students spent in class each week.

Two types of vocabulary tests were administered during the study. The first test type was intended to measure vocabulary learning owing to the study treatments. The pre-test measured initial target vocabulary knowledge, the post-test assessed target vocabulary immediately after the treatment phase had been completed and the delayed post-test checked retention of target vocabulary knowledge three weeks after the post-test was administered. The three tests were identical. Each test contained 84 test items, half of which were recognition items and half of which were recall items. Equal numbers of words were randomly chosen from the words in each learning treatment group for the recognition and recall parts of the tests. Additionally, equal numbers of words for each part of speech were randomly selected from each treatment type for inclusion in the recognition and recall parts of the test. Finally, two forms of the test were created, one beginning with the recall items and the other with the recognition items. Students in adjacent rows were given different versions of the test to discourage cheating. The items measured productive vocabulary knowledge in that the test takers were given the Korean translation of the target word and asked to select the correct English target word from among four possible answers in the case of the recognition items and to recall the correct English word for the recall items. The test items replicated the recognition and recall learning treatment items.

The second test type was developed and administered in response to the unexpected

results of the pre-test. When the pre-test results were analyzed an extremely divergent error rate was found for the recognition and recall items. While it was expected that the recognition items would be somewhat easier than the recall items based on previous research (Laufer et al., 2004), the difference was so extreme that further investigation was warranted to ensure the validity of the test results. A 30-item vocabulary test of words from the same word frequency level of the COCA as the three tests described above with ten nouns and verbs, and five adjectives and adverbs was developed. Next, a counterbalanced test format was adopted. To do this approximately equal numbers of words of each part of speech were randomly selected resulting in two groups of 15 words each. Then two versions of the test were developed such that a word that was tested as a recognition item in one version was tested as a recall item in the other version. The recognition and recall item formats were identical to those used in the pre- and post-tests and the delayed post-test. Finally, the tests were administered to roughly equal numbers of the participants. All of the tests described above were trialed to check for the comprehensibility of the instructions and typographical errors.

5. RESULTS AND DISCUSSION

The first research question is concerned with the efficacy of the three learning treatments, rereading, recognizing and recalling EFL vocabulary, with regard to long-term vocabulary retention. First, to contextualize the results, the total scores of the pre- and post-tests and the delayed post-test for the three learning treatments combined were compared.

TABLE 1

Pre-Test, Post-Test and Delayed Post-Test Total Mean Scores (*N* = 74)

	M		*SD*
	Raw Score	%	
Pre-Test	35.18	41.9	7.21
Post-Test	44.31	52.8	7.07
Delayed Post-Test	44.15	52.6	7.13

A statistically significant difference was found between the pre- and post-tests but not between the post-test and the delayed post-test (Table 1). Parenthetically, with regard to the quantitative data analysis of the study results, when the normality criterion for using parametric tests was not met, non-parametric tests were employed. The mean score for the pre-test was 41.9%, for the post-test 52.8% and for the delayed post-test 52.6%. A Friedman test found a significant difference among the test scores (Friedman $X^2(2) = 45.220$, $p = .000$), and Wilcoxon signed rank tests further identified a significant difference

between the pre- and post-tests (Wilcoxon Z = -5.889, p = .000). These results suggest that the learning treatments on a combined basis increased vocabulary knowledge by 10.9% and that there was no significant loss of learning three weeks after the post-test was administered. The results also support the view that the vocabulary selected for learning during the study represented a challenge for the participants.

Next, when the pre-test and post-test data were analyzed according to particular learning treatment (Table 2), it was found that the rereading treatment resulted in a 9.3% increase in vocabulary knowledge, a significant difference (Wilcoxon Z = -5.691, p = .000). The recognition treatment led to a 10.8% increase in target vocabulary knowledge, again a significant difference (Wilcoxon Z = -6.592, p = .000). Last, the recall treatment produced a 12.8% improvement in vocabulary knowledge, a significant increase (Wilcoxon Z = -7.770, p = .000). These findings suggest that the recall treatment was somewhat more efficacious than the rereading and recognition treatments with regard to vocabulary learning during the time between the pre- and post-tests. In particular, as there was not a statistically significant difference between the rereading treatment and recall treatment scores on the pre-test, but a significant difference was found on the post-test (Wilcoxon Z = -3.683, p = .000), the evidence for the superiority of the recall treatment is compelling. As there was a nine-week period in which the vocabulary was taught, it may be the case that the additional effort required to remember the recalled words aided the long-term retention of the target vocabulary, as has been suggested by previous research (Richland et al., 2005). However, when the delayed post-test scores were compared to the post-test scores for the three treatment types, no statistically significant differences were found. If the additional effort demanded by the recall treatment was efficacious, it might have been expected that the participants would have retained more knowledge of the words learned in that manner. As this was not the case, this interpretation of the results casts some doubt on the efficacy attributed to recalling words to be learned. However, the lack of significant post-test / delayed post-test mean score differences is likely to have been influenced by the nine-week learning period. Typically, delayed post-tests reflect differences resulting from a uniform delay between the end of a treatment and measurement on the delayed post-test. However, in this study delays of various lengths between the time of learning and the time of assessment were necessarily incorporated into the results as words learned early in the study had a larger learning-assessment time gap than words learned later on. Therefore, the delay effect on measurement was distributed over the course of the study and as a result was likely reflected to a large extent in the post-test results, and thus is a likely explanation for the superior learning attributed to the recall treatment. Also, it seems reasonable to describe the results of the post-test as reflecting long-term retention, at least in part, as the target vocabulary was remembered for as long as nine weeks in the case of the words learned in the first session. This view is supported by the attrition rate reported for

TABLE 2

Pre-Test, Post-Test and Delayed Post-Test Mean Scores by Treatment Type and Test Format

(*N* = 74)

	M		*SD*
Treatment &	Raw Score	%	
Pre-Test			
Reread-Recognition Test	10.73	76.6	2.27
Reread-Recall Test	0.54	3.9	.94
Recognize-Recognition Test	11.47	82.0	1.87
Recognize-Recall Test	1.54	11.0	1.32
Recall-Recognition Test	10.38	74.1	2.22
Recall-Recall Test	0.51	3.7	.73
Post-Test			
Reread-Recognition Test	12.39	88.5	1.53
Reread-Recall Test	1.37	9.8	1.83
Recognize-Recognition Test	13.11	93.4	.97
Recognize-Recall Test	2.88	20.6	1.97
Recall-Recognition Test	12.84	91.7	1.06
Recall-Recall Test	1.73	12.4	1.79
Delayed Post-Test			
Reread-Recognition Test	12.38	88.4	1.55
Reread-Recall Test	1.42	10.1	1.38
Recognize-Recognition Test	12.95	92.5	1.26
Recognize-Recall Test	2.89	20.7	1.97
Recall-Recognition Test	12.65	90.4	1.41
Recall-Recall Test	1.87	13.3	1.81

Ebbinghaus's forgetting curve (Anderson & Schooler, 1991), which shows that attrition occurs markedly in the first nine hours after learning but slows sharply thereafter. In addition, as the learning-assessment gap for the three treatments was uniform, the validity of comparisons among the results of the three groups was not impacted. Last, the weakest learning occurred among the words learned under the rereading treatment condition. This learning activity required the least amount of cognitive effort as the participants were not required to remember the target words. This finding further supports the relationship between effort in learning and long-term vocabulary retention. Disconcertingly, when the participants were asked on the questionnaire to describe the most effective way to learn new English words the most common response, which was given by 53.0% of respondents, was to only read, write or say the words, strategies that require little cognitive effort. Only 2.8% of respondents mentioned trying to remember the words to be learned. These results suggest that learners would benefit from training in vocabulary learning strategies.

In support of the argument that the post-test results largely represent long-term retention, when the recognition and recall quiz test items were analyzed together for treatment scores, it was found that 99.1% of the rereading treatment words, 100.0% of the recognition treatment words and 85.1% of the recall treatment words were known by the participants

(Table 3). Table 3's maximum raw quiz score of 14 for each treatment is an average based on the two test questions for each test type, recall and recognition, used to assess each treatment's efficacy for the seven quizzes administered during the study. These scores represent increases in vocabulary knowledge of 58.8% for the rereading treatment words, 53.5% for the recognition treatment items and 46.2% for the recall treatment words compared to the pre-test. The rereading treatment increase is not surprising given the simple quiz item requirement of merely copying a given word pair. However, the 7.2% greater increase for the recognition treatment versus the recall treatment seems counterintuitive if one accepts the position that recalling words results in better vocabulary knowledge retention. Perhaps the cognitively less demanding recognition treatment created a stronger short-term memory trace, in this case one hour, as the quiz was administered one hour after the learning treatments, whereas the more demanding recall treatment resulted in comparatively stronger long-term retention, as has been cited as an explanation for the differential short- and long-term learning effects of blocked versus interleaved learning (Richland et al., 2005). In support of this argument, when the post-test scores and the quiz scores were compared by treatment type it was found that vocabulary knowledge had decreased by 43.0% for the recognition treatment words, 33.0% for the recall treatment words and 49.9% for the rereading treatment words. This represents a 10.0% greater decrease in vocabulary knowledge for words learned under the recognition treatment compared to the recall treatment. It should be noted that it was the rereading treatment words that experienced the largest decline on the post-test. Also, as there were no statistically significant differences between the post-test and delayed post-test results, the better vocabulary retention attributed to the recall treatment continued until three weeks after the learning treatments ceased. These findings support the view that recalling words leads to better long-term vocabulary learning compared to recognizing words and that only rereading words is the least effective learning strategy.

TABLE 3

Vocabulary Quiz Mean Scores by Treatment Type **(*N* = 74)**

	M		*SD*
	Raw Score	%	
Reread	13.89	99.1	.63
Recognize	14.00	100.0	.08
Recall	11.92	85.1	2.43

Research question two examined whether test type had an effect on the participants' vocabulary acquisition results because it may be that a similarity between treatment type and test format influenced the results. First, it was found that test type had a strong effect on reported pre-test vocabulary knowledge with the recognition items resulting in a mean

score of 77.6% and the recall items a score of 6.2% (Table 2). While it was expected that recognition knowledge would be somewhat higher than recall knowledge based on previous research (Laufer et al., 2004), the difference in the two scores was so extreme, given that the test words were drawn from the same word frequency level of the COCA, that a follow-up test was administered to investigate the finding further. A 30-item counterbalanced test of vocabulary from the same frequency level of the COCA found a similar divergence in results with 63.8% of the recognition items being answered correctly while only 1.8% of the recall items resulted in correct responses. When the students were asked about the two types of study test items on a questionnaire, they reported that they had experienced approximately equal exposure on average to both test types in elementary, middle and high school. However, 100% of the participants responded that the recognition items were easier to answer correctly because they could guess the answers. A total of 70.3% of respondents reported using guessing strategies for the recognition items with analyzing words (attending to affix and root word knowledge), eliminating incorrect answers and accessing word networks related to the target word being the most common strategies used. While 86.5% of the participants preferred the recognition items, 93.2% acknowledged that the recall items provided a better assessment of their vocabulary knowledge. The reason given for this response by 64.9% of the respondents was that they could only answer recall items if a word was well known.

Next, the quiz results for only the recognition and recall learning treatments revealed that one hour after the vocabulary was taught, there was no statistically significant difference in vocabulary knowledge as measured by the recognition and recall test items separately with recognition knowledge being 92.4% and recall knowledge 92.7%. Compared with the pre-test results of 78.1% for recognition test knowledge and 7.4% for recall test knowledge, the recognition test scores increased by 14.3% and the recall test scores advanced by 85.3%. These results suggest the learning treatments when analyzed together were effective in overcoming the wide divergence in recognition versus recall vocabulary knowledge, at least in the short term. However, when the recognition and recall treatment results were analyzed in total for the post-test, it was found that recognition knowledge was similar to that at the time of the quiz at 92.6% whereas recall knowledge had fallen to 16.5%. Thus, none of the increased recognition knowledge was lost as of the administration of the post-test, but a decline of 76.2% in recall knowledge occurred. This loss of recall knowledge represents a substantial portion of the knowledge gained through the two learning treatments. This large difference was also found on the delayed post-test with recognition knowledge being 91.5% and recall knowledge 17.0%. Thus, the large gain in recall knowledge reported on the quizzes was not retained by the participants throughout the weeks of the study. This finding suggests that the recognition and recall knowledge learned during the study treatments was sufficient to produce approximately

equal results on the recognition and recall items on the quizzes, and that the knowledge was largely retained at the time of the post-test and delayed post-test for recognition test items. However, much of the knowledge measured by recall items on the quizzes was not available at the time of the follow-up tests. These findings suggest that in the short term (one hour in the study) learning is retained well enough to answer both questions types equally well, but over the long term differences in vocabulary learning retention emerge. There are two factors that are likely to have contributed to the loss of recall knowledge: first, the greater burden required to remember the large amount of recall vocabulary knowledge (85.3%) learned during the treatments as compared to recognition knowledge (14.3%), and second, the less demanding format of recognition test items compared to the recall items, which supports both previous research and the perceptions of the participants.

While the initial recall knowledge gains evidenced by the quiz results decreased over time, it may be that the retention of vocabulary learned during the three treatments was influenced by test-item type as research has suggested that matching learning treatment to assessment format leads to superior results (Griffin & Harley, 1996). When the pre-test to post-test recognition test results (Table 2) were compared, it was found that the recognition learning treatment resulted in an 11.4% vocabulary knowledge gain, a statistically significant difference (Wilcoxon Z = -5.158, p = .000), while the recall treatment led to a 17.6% increase in knowledge as measured on the recognition test, also a statistically significant difference (Wilcoxon Z = -5.975, p = .000). For words studied in the rereading way, it was found that the participants increased their scores statistically significantly by 11.9% (Wilcoxon Z = -4.296, p = .000) on the recognition test. These results suggest that learning in a recall manner produced better knowledge gains when measured by a recognition test. Of particular importance, though a statistically significant difference was not found between the rereading treatment and recall treatment recognition test results on the pre-test, a significant difference was found on the post-test (Wilcoxon Z = -2.787, p = .005). This finding strengthens the support for the superiority of word retrieval as compared to rereading. Perhaps the increased effort required by recall learning led to better knowledge retention as has been suggested (Kang et al., 2007). This finding also casts doubt on the transfer-appropriate processing hypothesis, as the recall learning treatment resulted in better scores than the recognition treatment on the recognition post-test. One explanation for this counterintuitive finding is that the retention benefit of recalling words exceeded the advantage conferred by having similar learning and assessment conditions.

Learning in a recognition manner and being assessed by a recall test resulted in a 9.6% knowledge gain (Wilcoxon Z = -4.173, p = .000) while learning in a recall manner and being measured on a recall test resulted in an 8.7% increase in knowledge (Wilcoxon Z = -4.955, p = .000), both of which were statistically significant differences. These more similar results suggest that it is somewhat more beneficial to learn in a recognition style

when a recall test is to be administered. This finding is somewhat counterintuitive, as thus far the results have suggested that recalling words leads to better long-term vocabulary retention. It may be that the additional exposure to target word form supplied by the recognition test items aided the participants with the correct spelling of the words required by the recall tests. On the questionnaire, a common reason given to explain the difficulty of the recall test items was the challenge of recalling the correct spelling of the answers. That is, even though the students may have been able to retain some word knowledge, that knowledge often did not include the correct orthographical form. Thus, for recall tests the proposed retention benefit of learning vocabulary through recalling words may have been exceeded by the advantage conferred by additional exposure to the target word form experienced during the recognition treatment. Finally, for words studied in the rereading way, it was found that the participants' knowledge increased 5.9% on the recall test, a statistically significant increase (Wilcoxon Z = -3.734, p = .000). According to these results, the least effective way of learning was rereading words when being measured on recall tests. Of especial importance, when the rereading treatment and recall treatment pre-test recall test scores were compared, a statistically significant difference was not found. However, on the post-test a significant difference was found (Wilcoxon Z = -2.416, p = .016). This finding suggests that for recall testing recall learning is more efficacious than rereading the target vocabulary. With regard to a comparison of the post-test and delayed post-test results according to test type, significant differences were not found for the three treatment groups, which suggests that the gains measured by the post-test were retained for at least 3 weeks.

To sum up, the most effectively retained learning as measured by the recognition test occurred during the recall treatment while the recognition and rereading treatments produced similarly weaker results. For the recall test, the least effective treatment was rereading the word pairs while the recognition and recall treatments produced more positive results that were somewhat similar. Therefore, rereading word pairs as a study strategy would seem to be the poorest choice while recalling target words would seem to be the most prudent choice when preparing for indeterminate testing conditions.

6. LIMITATIONS

One limitation of this study is the imprecise definition of long-term retention as the retention of various words was assessed with different periods of time occurring between the learning sessions and the times of the post-test and delayed post-test. For example, words taught in the first learning session were assessed on the post-test after a gap of nine weeks while words learned in the final session were assessed after only one week had

passed. It has been suggested that short intervals between learning and testing, such as one week, are unlikely to be reflective of long-term retention (Mintzes et al., 2011). There is, however, no objective criterion for long-term retention. It includes intervals ranging from minutes to days to months to years, but generally long-term retention refers to something other than short-term memory (working memory), which in turn typically refers to content held in storage for very short periods of time (Carpenter et al., 2009; Kang et al., 2007; Karpicke & Blunt, 2011; Schmitt, 2000). It is reasonable to characterize the post-test results as an assessment of long-term retention because according to the forgetting curve, the most significant loss of knowledge occurs within two days of learning, after which the loss of knowledge happens much more gradually (Anderson & Schooler, 1991). If students can retain their knowledge until after the second day, it is more likely to be remembered over the longer term. As there was a gap of at least seven days between the learning treatments and testing of the study words on the post-test, it seems reasonable to define the results of the final two tests as indicative of long-term retention.

Another limitation of this study was the feedback procedure used to provide information on student errors. Research has suggested that elaborate feedback and especially feedback that encourages the negotiation of meaning is likely to promote learning (Lyster, 1998; Metcalfe, 2017). However, in this study, due to time constraints, the feedback only provided the participants with the correct answers. While this type of feedback is essential, a more elaborate feedback process might have been more efficacious. This is important with regard to the study because the learners experienced more difficulty remembering the recall words during the initial learning treatment than the recognition words. If time had allowed for more elaborate feedback, the participants might have consolidated their recall knowledge better, including their orthographical knowledge, and thus reduced the significant loss of recall knowledge that occurred between the times of the quizzes and the post-test.

7. CONCLUSION AND PEDAGOGICAL IMPLICATIONS

The results of the study support the use of retrieval practices for the long-term retention of EFL vocabulary learning by adults. The study found that recalling words led to a 12.8% increase in vocabulary knowledge while the increases for recognizing and rereading words were 10.8% and 9.3%, respectively. These results lend support to the argument that more demanding learner information processing produces better long-term retention, as recalling information requires more cognitive effort than recognizing and rereading words. Disconcertingly, and similar to previous research, students reported using rereading as a learning strategy much more frequently than recalling information to be learned. With

regard to classroom practice, the study findings suggest that students would benefit from learning strategy instruction that emphasized the benefits of recalling information as a mnemonic strategy. Also significant was the finding that recognition learning was less efficacious than recall learning over the longer term given that 86.5% of the participants preferred recognition test items to recall items. The concern is that the higher success rate on the less demanding recognition questions might give students the mistaken belief that they are learning more by recognizing words than recalling them. The challenge for both students and teachers is twofold: first, to recognize that testing techniques can be used as a learning tool as well as an assessment instrument, and second, to understand that while recognizing answers on tests generally results in higher scores than recalling them, over the longer term retrieving words from memory develops superior retention.

With regard to test type, it was revealed that recalling words as a learning strategy resulted in better long-term retention on a recognition test than rereading and recognizing words, which suggests that educators would be well advised to use recall practice for learning when students will be assessed in a recognition manner as on a multiple-choice test. Again, the explanation for this effect is that the retrieval benefit exceeds any advantage given by having similar learning and assessment conditions. When the participants were assessed in a recall format the least effective learning treatment was rereading the material to be learned, while the recognition and recall learning treatments produced similar results. This outcome was somewhat surprising given that both the more cognitively demanding recall learning activity and transfer-appropriate processing conditions might have been expected to result in superior test results. It was, however, suggested that the learning benefit of being exposed to the correct orthographical form of the target vocabulary during recognition learning might have had a slightly stronger retention effect than the advantages cited for recall learning when tested in a recall format. It was further suggested that more elaborate feedback might have helped to consolidate recall knowledge.

Finally, as the recognition and recall learning treatments produced similar results on the recall test and the recall treatment led to better results on the recognition test, it is suggested that when the assessment instrument is unknown educators ought to use learning activities that require the retrieval of target words. The rereading learning treatment resulted in less effective long-term retention than recall learning on both the recognition and recall tests, which once again highlights the need for both teachers and students to reduce their dependency on rereading as a study strategy and to prioritize recalling information that students wish to remember.

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APPENDIX

Quiz 1

Part 1: Write the word pairs on the line below each pair.

1. 불관용	intolerance
_____	_____
2. 종료	termination
_____	_____
3. 침식하다	erode
_____	_____
4. 풍부한	abundant
_____	_____

Part 2: Choose the English word that is most similar in meaning to the Korean word.

5. 침입 a. descendant b. mediation c. appropriation d. intrusion
6. 수출하다 a. implicate b. impede c. export d. delineate
7. 보상하다 a. counteract b. compensate c. eschew d. elicit
8. 주로 a. logically b. commercially c. internally d. predominantly

Part 3: Write the English word that we learned in class that has the same meaning as the Korean word.

9. 보완물 _____
10. 경향 _____
11. 만들다 _____
12. 원시의 _____

Applicable levels: Elementary, secondary, tertiary

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