



Effects of Equal Spacing, Expanding Spacing, and Massed Condition on EFL Learners' Receptive and Productive Vocabulary Retrieval

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Abstract

This study investigated the effects of expanding and equal spacing on L2 receptive and productive vocabulary retrieval. The participants were 63 pre-intermediate FL learners randomly divided into one control and two experimental groups. Initially, a teacher-made Vocabulary Knowledge Scale (VKS) was used to select 20 unknown word pairs (each word accompanied by its synonym). The 20 target word pairs were later divided into two 10-item A and B sets. During the treatment, the target items were studied under an equally spaced condition (2-2-2), an expanding spaced condition (0-1-5), and the no-spacing or massed condition (0-0-0). At the end of the experiment, the same VKS was used as a posttest to check the effects of the treatments. The results indicated that introducing spacing had enhanced both receptive and productive vocabulary learning with equally spaced schedule being the superior condition.

Keywords: Vocabulary, equal spacing, expanding spacing, massed condition, Vocabulary Knowledge Scale, retrieval

1. Introduction

Vocabulary plays a prominent role in efficacious communication and has long been recognized as a vital component and a good indicator of L2 knowledge. In fact, without a vast body of vocabulary knowledge, even those who show mastery of grammar might experience a failure to communicate [1]. Most learners usually find the task of learning lexical items daunting because of the great number of the words to be learned and the little time at their disposal. They usually consider vocabulary as the major hindrance to reading comprehension, the greatest impediment to listening comprehension, followed by speaking speed and accent, and the greatest obstruction to writing [2].

Successful learners not only use a variety of strategies but also keep records of new words and practice them repeatedly. Interestingly enough, the number of repetitions required to acquire a list of words and the frequency of repetitions are of great importance in this process, and a special relationship between word exposure and vocabulary retention has been found in different studies [3]. Memory research has also revealed that most forgetting occurs immediately after initial exposure to the word. That is, the older the piece of information, the more slowly it will be forgotten. This suggests that repetition and review should take place almost immediately after the initial study of a word, with later encounters spaced further apart [4].

2. Memory and Vocabulary Learning

As a component of the human mind, memory has a key interface with language learning. The bulk of research on L2 lexical processing builds upon Baddeley's model of working memory and its various components including central executive, visuospatial sketchpad, and the phonological loop (phonological memory) [5]. Reportedly, at early stages of language learning, when grammatical knowledge is not deep enough, the learner's main focus is on learning content words [6]. For these learners, grammar acquisition is subordinate to vocabulary acquisition for which phonological memory is of great importance. At this stage, vocabulary learning consumes all or most of the learner's PM capacity. At later stages, when lexical access is easier, PM capacity is redeployed for learning more complicated grammar.

3. Spaced Repetitions

While vocabulary acquisition is certainly contingent upon repeated encounters with target words, exposure frequency alone might not ensure higher acquisition rates of unknown words. Thereupon, researchers argue that the spacing between repetitions is also of great importance in improving

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retention [4]. The lags between intervals can differ according to four schedules: uniform-short spacing, uniform-moderate spacing, expanding spacing, and contracting spacing [7]. In equal spacing conditions, there are two equal intervals between trials for example, a 5-5-5 condition with five lags between trials. The expanding condition involves progressively increased spaces like a 1-4-10 schedules, but the spacing can be inverted in the contracting condition like a 10-4-1 schedule. Thalheimer [8] asserts that spaced repetitions enhance learning compared to repetitions that are not spaced. Spacing repetitions enable the learners to keep information in memory in a way that makes it less vulnerable to forgetting than non-spaced repetitions. He also assumes that longer spacings tend to produce more long-term recallability than shorter spacings.

In another study [9] expanded retrieval spacing and equal-spaced practice produced the same amount of retention after eight weeks. However, average retention was higher during expanded intervals over the whole training period. Expanding spacing is often regarded as the most efficient relative spacing schedule. For example, Nakata's study of vocabulary acquisition under equal and expanding schedules demonstrates a significant advantage for gradually increasing the interval schedules [10]. Nevertheless, Cull [11] argues that, when average spacing is controlled, there may be some restrictions on the advantages of expanding over equal spaced retrieval and, in some cases, there may be no important difference between the two conditions.

4. Method

4.1. Research Question

This study targeted the following question:

Are there any differences between the effects of equal spacing, expanding spacing, and massed condition on EFL learners' receptive and productive vocabulary retrieval?

4.2. Instruments

The following instruments were used to achieve the purposes of this study:

- The Preliminary English Test (PET for schools) from Cambridge ESOL exams
- A teacher-made Vocabulary Knowledge Scale (VKS) pre-test
- A VKS post-test similar to the pretest

4.3. Participants

70 female Iranian pre-intermediate EFL learners between 13 and 17 years of age at a language institute participated in this study. They were in three intact classes randomly assigned to one control and two experimental groups. The same teacher taught the three classes. During the treatment, all the participants studied the book *Solutions* (units 9 and 10) [12] during a 16-session semester. However, the target items were selected from *Oxford Word Skills* (the Intermediate book) [13] to collect 20 words unknown to the students.

5. Procedure

Initially, the PET was used to select 63 participants who were homogeneous regarding English language proficiency. Then a VKS pre-test including 35 vocabulary items was administered to both experimental and control groups to select 20 completely unknown word pairs for the experiment. The VKS involved five levels, from level 1 to level 5 [18]. Based on the scoring scale, a score of 1 or 2 was given to levels 1 and 2, a score of 3 was given when the student provided a satisfactory synonym. A score of 4 was given when the given word was applied in an appropriate context but in a grammatically incorrect way. A score of 5 was given when the student used the target item in an appropriate context and in a grammatically correct way. Finally, the selected 20 target word pairs (those with a score of 1 or 2) were divided into two 10-item A and B sets.

During the 16-session treatment period, the experimental groups encountered both sets of word pairs under different spacing conditions. The first group studied set A under an equally spaced condition based on a 2-2-2 encounter schedule and set B under a 0-1-5 expanding spacing condition. In the equal-interval condition, the items received additional retrieval practice in the 7th, 10th, and 13th sessions, while in the expanding condition, the items received additional retrieval practice in the 5th, 7th, and 13th sessions. The second group also studied both sets A and B; set A under expanding and set B under equal spacing conditions, thus counterbalancing the effects of the order of exposure to the



spacing conditions. Both expanding and equally spaced schedules had the same absolute spacing (the total amount of spacing), which was 6. The control group studied both sets of words under a massed learning condition as a baseline schedule to gauge the effect of mere repetition. Here, all target items were studied four times in a row following a 0-0-0 schedule.

The treatment in all the three groups consisted of 80 trials for the target items (20 items × 4 encounters). The trials for both sets of the target items were mixed together in all the groups. In other words, the second set (set B) was introduced before the first set of target items (set A) was encountered four times. In the first two encounters, the new word and its synonym were presented using flash cards and, in the last two, the students practiced productive retrieval, during which they were shown each word pair again and asked to make sentences orally using each target item. Whenever an error was made, the teacher alerted the students by using a facial expression, making a hand gesture, or saying “Can you say that again?” in order to have them self-correct. Peer- and teacher-feedback were also used when self-correction did not occur. Finally, the same VKS pre-test was administered as a post-test to all the three groups to measure the potential changes in their word knowledge.

6. Results

After scoring the VKS post-test scores of the three groups, three paired samples t-tests were conducted to check the students’ progress at the end of the course. The results indicated that the treatment had helped to improve the word gain of all the three groups. Later, an ANOVA was run to compare the mean scores of the receptive and productive word gains of the three conditions. The results indicated that there was a statistically significant difference among the mean scores of the three groups.

Table 1. ANOVA for VKS Post-test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	933.543	2	466.77	6.158	.003
Within Groups	9323.092	123	75.79		

Post-hoc comparisons indicated that the mean of the equally spaced schedule (M=39.60) differed significantly from that of the massed and expanding schedules. Seemingly, the equal spacing condition was a key element in the superiority of this condition over the other two.

Next, two independent-samples t-tests were run to compare the mean scores of receptive and productive word gains of the equal and expanding spacing groups (Tables 2 and 3).

Table 2. Independent Samples t-test for productive Word Gain of the spacing conditions

	Levene’s test		t-test		
	F	Sig.	t	Df	Sig. (2-tailed)
Equal variances	1.126	0.292	-0.275	78	0.784
Not equal variances			-0.275	77.27	0.784

With $F=1.126$, $p=0.292$ (two-tailed), it was decided that the variances of the two conditions were equal on the post-test. Moreover, with $t(78) = -0.275$, $p=0.784$ (two-tailed), it was concluded there was no significant difference between the means of the participants’ productive word gains under the equal and expanding spacing conditions.

Table 3. Independent Samples t-test for Receptive Word Gains of the spacing conditions

	Levene's test		t-test		
	F	Sig.	t	Df	Sig. (2-tailed)
Equal variances	0.139	0.710	2.147	78	0.035
Not equal variances			2.147	77.274	0.035

With $F(78) = 0.139$, $p = 0.71$ (two-tailed), it was decided that the variances of the two schedules were equal on the post-test receptive word gain scores. With $t(78) = 2.147$, $p = 0.035$ (two-tailed), it was concluded that there was a significant difference between the means of the participants' receptive vocabulary gain under the two experimental conditions. The magnitude of the difference between the means under the two spacing conditions (mean difference = 5.50, 95% CI: 0.4 to 10.60) was moderate ($\eta^2 \approx 0.06$). Therefore, the treatment (equal spacing condition) had helped to improve the L2 learners' receptive vocabulary retrieval.

7. Conclusions and Discussion

The findings of the study demonstrated that the participants of the equally-spaced (2-2-2) schedule had significantly outperformed the expanding and massed schedules regarding receptive vocabulary retention. Although all the three groups had performed significantly better on their post-test, significant changes in receptive vocabulary gain were only observed under the equally spaced condition.

There might be at least two main reasons for this finding. First, unlike most prior studies comparing spacing conditions within a single learning session followed by an immediate post-test soon after the treatment [e.g. 10], here the repetitions and the post-test were given over multiple spaced learning sessions. Spaced repetition and immediate post-test within any single session, however it may be scheduled, is irrelevant to real-world learning scenarios and rarely sufficient for long-term retention [9]. The timing point of testing influences the retention. Moreover, if words are tested minutes after the encounter, the loop is still active, thus it is difficult to say if a record has been created yet [14]. Second, productive retrieval is clearly more demanding than receptive retrieval.

This study demonstrated the advantages of equal spacing over expanding and massed spacing conditions. However, similar studies conducted over a longer period of time and with larger samples at different proficiency levels might yield different results. Moreover, further research should address the optimum spacing condition for vocabulary learning and retention. The use of a delayed post-test to measure long-term vocabulary retrieval in more authentic learning situations could also provide some noteworthy data regarding accessing the learnt material in the long run. Finally, here, the Vocabulary Knowledge Scale was used to measure the participants' receptive and productive word gain. Other measures of vocabulary retention might provide different results.

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