Effects of spacing techniques on EFL learners' recognition and production of lexical collocations

Mohammad Taghi Farvardin

Department of English Language Teaching, Ahvaz Branch, Islamic Azad University, Ahvaz, Iran

ABSTRACT

Spacing technique is a kind of strategy whereby the vocabulary will be revised with breaks between the revision sessions. Using spacing techniques in foreign and second language learning has received a lot of attention recently. However, there are many questions about how EFL learners are able to learn and remember target words. Moreover, few studies have thus far been carried out on the effect of using spacing techniques on EFL learners' lexical collocational knowledge. Thus, this study probed the effects of spacing techniques on EFL learners' recognition and production of lexical collocations. To this end, 62 EFL learners at a junior high school were selected from three intact classes. Each class was assigned to one experimental condition, i.e., uniform spaced retrieval (USR), expanded spaced retrieval (ESR), and massed retrieval (MR). Twelve collocations unknown to the participants were selected as the target collocations. The treatment lasted for one session for the MR group (80 minutes) and four sessions for the USR and ESR groups (each session 20 minutes). After the last treatment session, a multiple-choice test and a translation test were administered to measure the participants' recognition and production of the target collocations, respectively. Two delayed posttests were also administered two weeks and four weeks after the last treatment session. The results revealed that both ESR and USR groups significantly outperformed the MR group on the recognition and production posttests. The results highlight the efficiency of spacing techniques in teaching lexical collocations in a foreign language. The results of this study can lead language teachers to include such techniques as ESR and USR as effective methods to improve language learners' lexical knowledge.

Keywords: EFL learners; expanded spaced retrieval; lexical collocations; massed retrieval; uniform spaced retrieval

INTRODUCTION

Vocabulary is believed to be the building block and basis of communication in a second/foreign language (Nation, 2009). Vocabulary learning is not only a goal, but also it helps learners listen, speak, read, or write better. Learners, for instance, need to know 95-98% of words to understand a text, which implies that second/foreign language learners should learn a large number of word families (Schmitt, 2008). Therefore, learning a language heavily depends on learning its vocabulary.

Word knowledge is complex and multifaceted, as it involves the knowledge of word form, meaning, and usage (Daskalovska, 2015). Moreover, "vocabulary knowledge includes not only acquiring the knowledge of words, but also multi-word phrases that have a clear and formulaic usage" (Mutlu, & Kaşlioğlu, 2016, p. 1232). Formulaic language constitutes a great extent of written and spoken discourse, and collocation as a sub-category of formulaic language deserves special attention (Peters, 2014). Although collocations can be learned incidentally from input, explicit instruction can

Email: farvardin.tefl@gmail.com

help EFL learners more (Gheisari, & Yousofi, 2016; Sonbul, & Schmitt, 2013).

Cameron (2001) proposed that encountering a new word is just the inception of the learning process of a learner. Then, the learner should overcome the challenge of retrieving the meaning of the learned words. Therefore, it has been argued that the learners' level of vocabulary knowledge can be enhanced through efficient memory strategies (Peters, 2014). One such strategy is called spacing technique whereby the vocabulary will be revised with breaks between the revision sessions (Balota, Duchek, & Logan, 2007). The breaks will be increased until the words do not have to be revised any more. Briefly, this technique means that the information will be learned at gradually increasing intervals. In other words, after something is learned, it should be repeated until the item is stored in long-term memory (Sobel, Cepeda, & Kapler, 2011).

Spacing technique is believed to improve long-term retention, and thus it has clear implications for the instructed setting. Spacing techniques are divided into two types. The first technique is expanded spaced retrieval (ESR) in which items are spaced at increasingly distant intervals, and the other is uniform spaced retrieval (USR) in which items are spaced at constant intervals (Bury, 2016). An example of USR spacing is a 2-2-2 schedule in which the numbers indicate an inter-stimulus interval (ISI). In the 2-2-2 schedule, encounters of a given item are always separated by two spacing units (trial or time). On the other hand, an example of ESR is a 1-3-5 schedule in which there is an increasing number of intervening trials as the unit of spacing.

Another technique commonly used by students and teachers in the periods leading up to exams is massed retrieval (MR). In MR, the retrieval process is eliminated, and information is crammed into students' memories through repetition in quick succession with no break in between each repetition. In most studies comparing either an ESR or USR technique to an MR technique, it has been shown that both types of spacing techniques produce better learning than an MR technique (e.g., Bloom & Shuell, 1981; Carpenter & DeLosh, 2005; Çekiç & Bakla, 2019; Delaney, Schuetze, 2015; Verkoeijen, & Spirgel, 2010).

Despite these theoretical supports, there are few empirical studies conducted on the effects of spacing techniques on EFL learners' collocational knowledge. Therefore, to bridge the existing gap between the theoretical and practical aspects of using spacing techniques in teaching collocations, the present study aimed to examine whether spacing techniques can lead to the development of EFL learners' recognition and production of lexical collocations.

In the last three decades, vocabulary has been in the spotlight of second/foreign language learning and teaching (Nation, 2009). Moreover, it has been argued that a majority of words are not acquired incidentally (e.g., Daskalovska, 2015; Sonbul & Schmitt, 2013). Therefore, teachers need to use some explicit instruction

as a supplement to incidental vocabulary learning (Cameron, 2001). It has been also argued that explicit instruction of collocations has a fundamental role in developing learners' collocational knowledge (Sonbul & Schmitt, 2013). For instance, Daskalovska (2015) examined the effect of an explicit method of teaching collocations using corpus-based activities versus traditional activities among 46 EFL learners at the tertiary level. The results revealed that the participants who learned the collocations with the help of explicit instruction using the online concordance outperformed the control group. In another study, Gheisari and Yousofi (2016) investigated the effect of explicit and implicit instruction on Iranian EFL learners' retention of collocations. The results showed that explicit instruction was more effective than the implicit instruction in both immediate and delayed posttests.

Previous studies have shown inconclusive results on comparing the effects of MR, USR, and ESR on L2 learning. Moreover, they have not drawn clear line between short-term gains and long-term retention. Schuetze (2015) addressed this issue in his research by conducting two experiments. To this end, 76 university students at the beginning level of a German language class were selected. They were taught 24 content words and 15 function words with a one plus three and one plus four designs followed by three delayed posttests. Regarding short-term gains, the results showed that the ESR group got higher mean scores than the USR one, while in the delayed posttests, it was the other way around. Furthermore, it was revealed that recalling the function words were particularly difficult for students using the ESR. In the same vein, Kang, Lindsey, Mozer, and Pashler (2014) examined 37 participants who were taught 60 Japanese-English word pairs under USR and ESR conditions. The treatment lasted for four weeks. In the USR condition, the target words were taught on days 1, 10, 19, and 28 (i.e., a 9-9-9 schedule). In the ESR condition, the target words were taught on days 1, 3, 9, and 28 (i.e., a 2-6-19 schedule). Finally, it was found that there was no significant difference between the two conditions on the delayed posttest.

Nakata (2015) later studied the effects of expanded and uniform spaced retrieval on L2 vocabulary learning. To this end, 128 Japanese EFL learners were taught 20 English-Japanese word pairs. The type of spacing (USR and ESR) and the amount of spacing (massed, short, medium, and long) were manipulated. The results showed the superiority of ESR over USR. The results implied that ESR might facilitate vocabulary learning, although introducing spacing could have a larger effect. In another study, Bury (2016) investigated the effect of six different lexical spacing interval schedules on 88 Japanese university students' retention of lexical items on a translation test completed in the first and last lessons of a 15-lecture course. Two schedules used an ESR technique, two of the schedules employed a USR technique, and two were based on MR technique. In this study, all the participants were given a translation test in the first lesson of the course and the items were

reintroduced four times each in the class materials throughout the course. Finally, it was found that the ESR and USR schedules had greater positive effects on students' performance than the MR technique.

Based on the literature, the effect of spacing techniques on EFL learners' recognition and production of lexical collocations has yet to be explored. To fill the existing gap in the literature, this study aimed to shed light on this issue by investigating the extent to which spacing techniques can influence the EFL learners' recognition and production of lexical collocations. To meet the objectives of the study, the following research questions were raised:

1. Are there any significant differences in the effect of massed retrieval, uniform spaced retrieval, and expanded spaced retrieval techniques on EFL learners' recognition of lexical collections?
2. Are there any significant differences in the effect of massed retrieval, uniform spaced retrieval, and expanded spaced retrieval techniques on EFL learners' production of lexical collocations?

METHODS
Participants
This study was conducted at a junior high school in Shiraz, Fars, Iran. Initially, 70 EFL female students from three intact classes in the third grade of junior high school were selected. Their age ranged from 15 to 16. However, after the second delayed posttest, the number of participants reduced to 62. It was found that the participants were at the pre-intermediate level of English proficiency by conducting the Oxford Placement Test (Allan, 2004).

Each class was assigned to one experimental condition (i.e., either MR, USR and or ESR). The MR group ($n = 20$) was taught the target collocations during one session; the USR group ($n = 22$) was taught the target collocations in four sessions in a 2-2-2 interval, and the ESR group ($n = 20$) was taught the target collocations in four sessions in a 1-2-3 interval. They had never been abroad, and their age ranged from 15 to 17. They all had passed general English courses. Their exposure to English outside the classroom was very limited. The participants had 36 hours of instruction per week and English was taught only for two hours. All data collected were non-identifiable, and the participants were assured that the collected data would be confidential. The participants' next of kin provided written consents on behalf of the minors enrolled in this study. The Institutional Review Board (IRB) at the Education Department of Shiraz, Iran, approved this consent procedure.

Instruments and materials
Target collocations
In selecting the target collocations, two criteria were considered. First, all the target collocations should be unknown to the participants. Second, the lexical collocations selected were in different categories according to Durrant's (2008) categorization as well as the distribution of different types of lexical collocations in the participants' textbooks consisting of *noun + noun, verb + adverb, and verb + noun* items.

Initially, 30 lexical collocations with different categories (i.e., 10 *noun + no*un, 10 *verb + adverb*, 10 *verb + noun*) were selected from English Collocations in Use (McCarthy & O'Dell, 2005) and Key Words for Fluency (Woolard, 2008). Then, the selected collocations were administered four weeks prior to the main study to ensure that the participants had no previous knowledge of the collocations. The teacher-researcher asked the participants to translate the collocations into Persian. Moreover, a multiple-choice test was given to the participants to examine their recognition knowledge of the target words. The items which remained unanswered in both tests were selected as the target collocations (see Appendix A). Finally, 12 lexical collocations, including four *noun + noun*, four *verb + adverb*, and four *verb+ noun* items were selected.

Pilot study
First, the recognition and production tests were piloted on 15 junior high school students who were at the same level of proficiency as their peers in the main study. The content validity of the tests was examined by two experienced EFL teachers holding a PhD in Teaching English as a Foreign Language (TEFL). The next step was to establish the desired reliability of the tests. To establish the desired reliability of the recognition test, Kuder-Richardson formula (KR-21) was used. The reliability of the recognition test was estimated at 0.82. Moreover, the scores of the production test were measured by two raters. The inter-rater reliability was 0.96.

Recognition and production tests
After the end of the treatment, three posttests were administered. The immediate recognition and production posttests were administered to all groups one day after the last treatment session. Afterward, two delayed posttests were administered to all groups. The first and second delayed posttests were administered two weeks and four weeks after the last treatment session, respectively. In each posttest, the production test was administered first to avoid the recall of test items.

The production posttests included a translation test containing 20 items (12 items covered the target collocations, and 8 served as distractors) (see Appendix B). The distractors were not scored, and they were included so that the participants could not easily recognize the target words which might have affected the results of the posttests. The Persian equivalents for the target collocations were obtained using a well-established English to Persian Dictionary called Farhang Moaser (Haghshenas, Entekhabi, & Samei, 2007), in which the common colocations used for a word entry are

provided along with their Persian equivalents. Moreover, to increase the quality and accuracy of the equivalents provided in the production test, the translation was validated through the back-translation method in which two experts translated the equivalents from Persian (i.e., the participants' first language) into English. The experts detected no semantic shift in translation.

The recognition posttests included a 20-item multiple-choice test in which 12 items tested the target collocations, and 8 served as distractors (see Appendix C). There were four choices in each item from which the participants were expected to select the best one. All the posttests were scored dichotomously. Each correct answer received one point, and each incorrect answer was scored zero. Therefore, the maximum possible score on each test was 12, and the minimum score was zero. On the production posttests, answers containing minor spelling mistakes were scored as correct.

Procedures
After selecting the target collocations, the treatment began and continued for one week. Three intact classes at a junior high school were selected. The target lexical collocations were taught in four sessions. The treatment was provided by one of the researchers.

For each collocation, one PowerPoint slide was designed with the same font and background color. On each slide, the first language (Persian) equivalent was presented on the left side of the screen. After two seconds, the English equivalent was presented on the right side, sometimes with colorful pictures, while the Persian phrases remained on the screen. The English collocation that appeared was also pronounced. Meanwhile, the participants were required to write down the collocation with its Persian equivalent on a worksheet. Each slide was shown for 10 seconds. Next, the participants were shown a sentence in which the collocation was used, and they were asked to repeat that sentence after the teacher. After being exposed to the collocations, the participants were required to form sentences with the target collocations and share their sentences with class. At the end of each session, all worksheets were collected by the teacher to make sure that the participants would not secretly study the collocations at home. The same activities were included in all groups.

For the MR group, all collocations were taught in one session in 20 minutes. Afterward, the target collocations were reviewed three times for about 60 minutes. The whole procedure lasted for 80 minutes.

For the USR group, the collocations were taught and reviewed in four sessions on a [1, 3, 5, 7] schedule (i.e., the collocations were shown on days 1, 3, 5, and 7). For the ESR group, the collocations were taught and reviewed in four sessions on a [1, 2, 4, 7] schedule (i.e., the slides were shown on days 1, 2, 4, and 7). For the spacing groups, all collocations were taught in the first session. In the following three sessions, the participants reviewed the collocations. In the USR and ESR groups, each treatment session lasted for about 20 minutes.

Three posttests (i.e., immediate, first delayed and second delayed posttest) in two types (recognition and production) were administered to the participants; the immediate posttest was given one day after the last instruction session; the first delayed posttest was administered two weeks after the last treatment session; and the second delayed posttest was held four weeks after the last treatment session. All participants were given 10 minutes to complete the recognition test and another 10 minutes to complete the production test.

The data collected from the recognition and production tests were scored as correct or incorrect by two raters. The inter-rater reliability was measured through Cohen's Kappa as 0.96. On the production posttests, answers containing minor spelling mistakes were scored as correct. Moreover, on both recognition and production posttests, the items left unanswered were regarded as incorrect. The percentage of unanswered items on the immediate, first delayed, and second delayed posttests were 11, 17, and 26, respectively. Then, the participants' scores were collected, calculated, and analyzed.

RESULTS
Table 1 displays the means and standard deviations of the participants' scores on the recognition and production posttests.

Table 1. Descriptive statistics of recognition and production posttests

| Group | Recognition Test | | | Production Test | | |
| | Immediate Posttest | Delayed Posttest 1 | Delayed Posttest 2 | Immediate Posttest | Delayed Posttest 1 | Delayed Posttest 2 |
	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
ESR (*n* = 20)	7.65 (1.872)	6.55 (1.701)	5.90 (1.586)	6.40 (1.569)	5.35 (1.872)	4.40 (1.569)
MR (*n* = 20)	7.50 (1.960)	5.10 (1.252)	4.05 (1.276)	4.25 (2.149)	3.65 (2.498)	2.65 (1.348)
USR (*n* = 22)	8.86 (2.606)	7.05 (1.838)	5.73 (1.882)	7.14 (1.807)	6.14 (2.007)	5.05 (2.011)

Regarding the recognition test, the USR group had the highest mean score on the immediate and first delayed posttests, and the ESR group had the highest mean score on the second delayed posttest. Considering the production test, the USR group had the highest mean score on the immediate, first, and second delayed posttests.
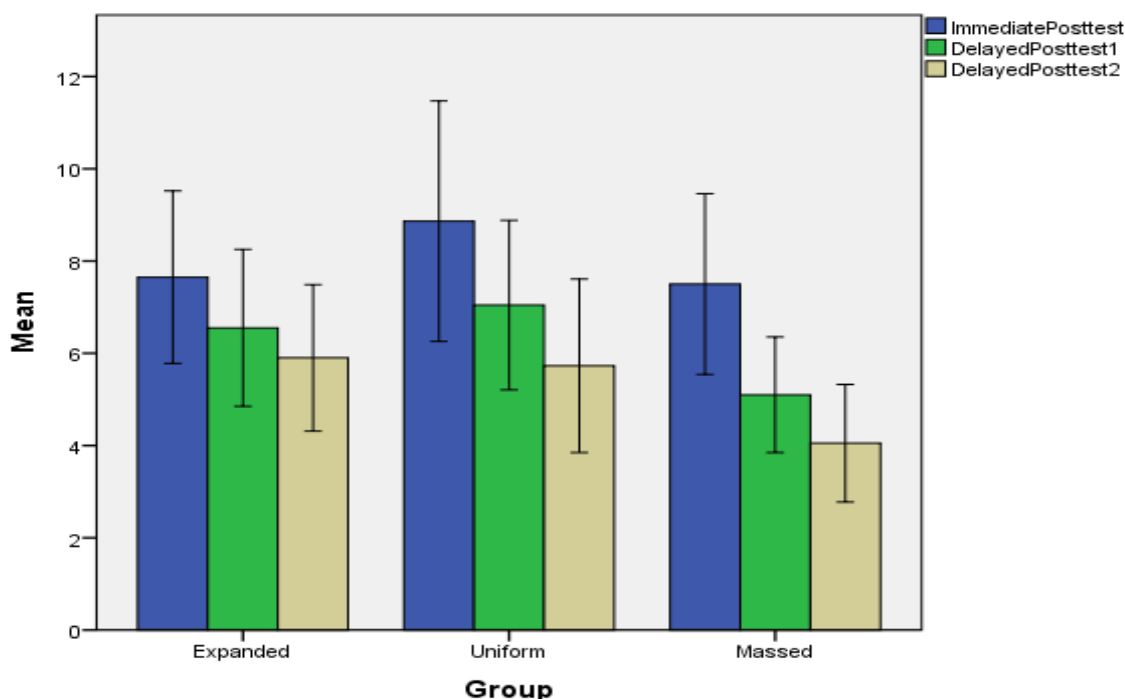
To answer the first research question, a mixed-ANOVA was conducted. One-way ANOVAs were also conducted. The results of mixed 3 x 3 ANOVA showed significant main effects of group ($F_{2, 59} = 5.242$, $p = .008$, partial $\eta^2 = 0.151$). Moreover, there was a main effect for time ($F_{2, 118} = 171.073$, $p = .000$, partial $\eta^2 = 0.744$). However, there was no significant interaction between time and group ($F_{4, 118} = 3.362$, $p = .214$, partial $\eta^2 = 0.057$). Due to the significant main effect of group, a one-way ANOVA was performed for each recognition

(multiple-choice) posttest. No significant main effect of group was found in the immediate posttest ($F_{2, 59} = 2.488$, $p = .092$). Moreover, a significant main effect of group was found in the first delayed posttest ($F_{2, 59} = 7.989$, $p = .001$) and the second delayed posttest ($F_{2, 59} = 8.142$, $p = .001$). As Table 2 depicts, Tukey post hoc analyses show that on the first delayed recognition posttest, the ESR and USR groups scored significantly higher than the MR group ($p < .05$).

Tukey post hoc analyses also revealed that on the second delayed recognition posttest, the ESR and USR groups scored significantly higher than the MR group ($p < .05$). However, on both delayed posttests, there were no significant differences between the ESR and the USR groups. Figure 1 shows the mean changes of recognition posttest scores across all groups over three testing periods.

Table 2. Results of post hoc tests on recognition posttests

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Sig.
First Delayed Posttest	ESR	MR	1.450	.018
	ESR	USR	-.495	.58
	USR	MR	1.945	.001
Second Delayed Posttest	ESR	MR	1.850	.002
	ESR	USR	.173	.93
	USR	MR	1.677	.004

Error Bars: +/- 1 SD

Figure 1. Participants' performance on recognition posttests

As Figure 1 illustrates, the USR group had the highest mean score in Time 1 (immediate posttest) and Time 2 (first delayed posttest). In Time 3 (second delayed posttest), however, the ESR group gained the

highest mean score. To answer the second research question, a mixed-ANOVA with two main factors, Time and Group, was conducted. The results of mixed 3 x 3 ANOVA show significant main effects of group ($F_{2, 59} =$

11.165, $p = .000$, partial $\eta^2 = 0.275$). In addition, there was a main effect for time ($F_{2, 118} = 120.979$, $p = .000$, partial $\eta^2 = 0.672$). However, there was not a significant interaction between time and group ($F_{4, 118} = .990$, $p = .416$, partial $\eta^2 = 0.032$). Due to the significant main effect of group, a one-way ANOVA was also performed for each production posttest. A significant main effect of group was found in the immediate posttest ($F_{2, 59} = 13.476$, $p = .000$). Moreover, a significant main effect of group was found in the first delayed posttest ($F_{2, 59} = 7.318$, $p = .001$) and the second delayed posttest ($F_{2, 59} = 11.253$, $p = .000$). As illustrated in Table 3, Tukey post

hoc analyses show that on all posttests, the ESR and USR groups scored significantly higher than the MR group ($p < .05$).

Tukey post hoc analyses also revealed that on the posttests, there were no significant differences between the ESR and the USR groups. Figure 2 shows the mean changes in production test scores across all groups over three testing periods.

As Figure 2 shows, the USR group had the highest mean score in Time 1 (immediate posttest), Time 2 (first delayed posttest), and Time 3 (second delayed posttest).

Table 3. Results of post hoc tests on production posttests

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Sig.
Immediate Posttest	ESR	MR	2.150	.002
	ESR	USR	-.736	.409
	USR	MR	2.886	.000
First Delayed Posttest	ESR	MR	1.700	.038
	ESR	USR	-.786	.464
	USR	MR	2.486	.001
Second Delayed Posttest	ESR	MR	1.750	.005
	ESR	USR	-.645	.432
	USR	MR	2.395	.000
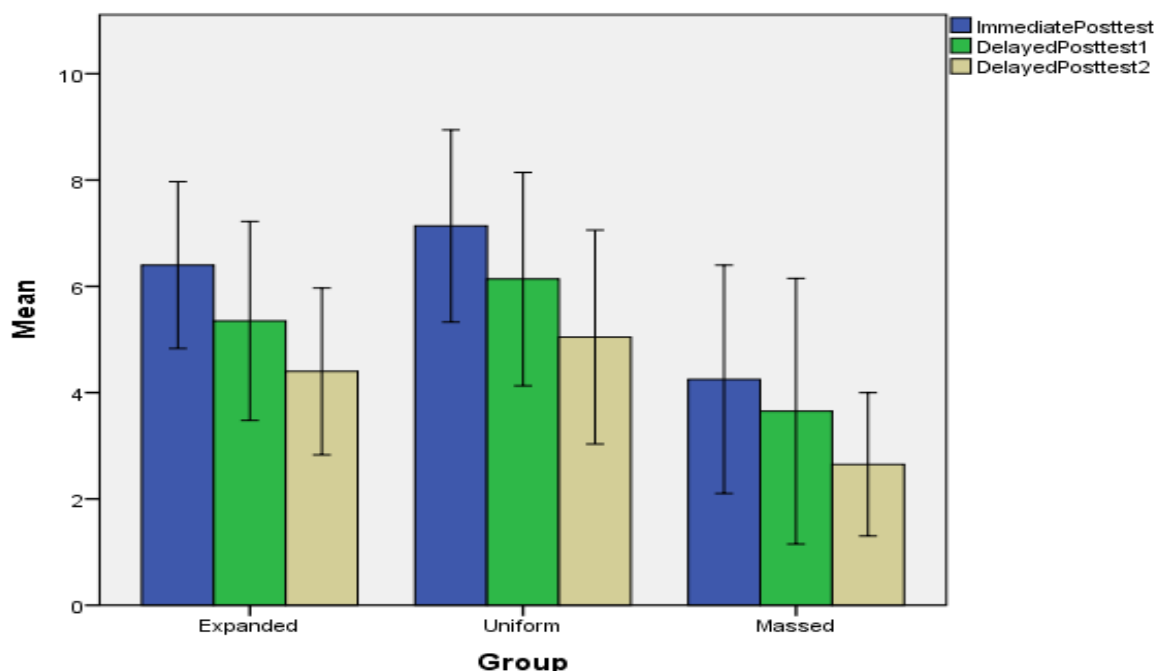
Error Bars: +/- 1 SD

Figure 2. *Participants' Performance on Production Posttests*

DISCUSSION

The results showed that spacing techniques (i.e., ESR and USR) had positive effects on enhancing Iranian EFL learners' recognition of lexical collocations. The findings are in line with Bury (2016) who found that ESR and USR schedules had greater positive impacts on

student' performance than MR. One possibility about why spacing techniques seem to facilitate memory is that the effect may provide an opportunity to practice the recall of material after some periods of time have elapsed. In the present study, when a participant had to be tested and recall the lexical collocations in different

periods of time, she was required to recall the lexical collocations learned on previous days from long-term memory.

There are three explanations of why the USR and ESR techniques led to better results than MT. First, in the ESR and USR schedules where the first retrieval attempt came after just one lesson or activity, the retrieval event was relatively easy, whereas when there was a larger interval, an increased amount of re-sampling could occur (Roediger & Karpicke, 2008). Second, in the ESR and USR groups, early retrieval success in the initial stages of the learning process could encourage successful retrieval in the test stage (Camp, Bird, & Cherry, 2000). Third, the participants in the MR group only had the opportunity to recall information from short-term memory during learning, and they could encode the items in one context. However, the participants could encode the target items in more than one context when they were presented with spaced-repetition (Pashler, Cepeda, Wixted, & Rohrer, 2005).

In the immediate posttest, there were no differences between the groups. As any benefit of massed spacing is relatively short-lived, massed instruction was as effective as the expanded and uniform spacing. The results of the study also confirm Kang et al.'s (2014) findings which failed to detect any benefit of ESR over USR for L2 vocabulary learning, although they used a rather long mean inter-stimulus interval (ISI) of 9 days. In the present study, no significant differences were found between the ESR and USR conditions in learning phase performance. In fact, the ESR group had the IS of 1-2-3 in which the intervals were not long enough to cause a significant difference between the USR and ESR groups.

The results are also in contrast with those of Schuetze (2015) indicating that the ESR group obtained higher mean scores than the USR in the recall (short-term) test, whereas in the long-term test it was the other way around. Besides, the uniform group had the highest mean score in the immediate, first, and second delayed posttests in comparison with the expanded group. The better performance of USR group on the production test can be because of the fact that in an equal-retrieval schedule, the first retrieval attempt occurs only after some delay, and the interval between successive retrieval attempts is uniform. Generally, apart from spacing practice, there are other factors which may produce superior learning such as the difficulty of the to-be-learned material and the type of review (rereading or retrieval practice) (Pashler et al., 2005; Storm, Bjork, & Storm, 2010).

It can also be recommended that beside following the textbook suggestions and the grammatical aspects of collocations, such as parts of speech, EFL teachers should pay more attention to how a collocation is processed. The more difficult collocations could be marked, which can provide students a better opportunity to acquire the collocations in the long-term by repeating them more often using ESR and USR.

The results showed that statistically significant L2 learning of collocations occurred in USR and ESR groups, where the participants were trained through spacing techniques. By looking at the results, it can be proposed that teachers need to consider how the learners' recognition and production of lexical collocations will be affected by adjusting the spacing techniques.

One of the main goals of using spacing techniques is to facilitate L2 learning. Therefore, teachers need to consider using these techniques in order to promote learners' vocabulary learning. The results suggest that learners do benefit from using these techniques and the schedules for ESR and USR can more positively affect the learning of L2 collocations than MT. In this way, the results of this study can lead language teachers to include such techniques as ESR and USR as effective methods to improve language learners' lexical knowledge. The results can also encourage language teachers to take a more systematic approach to teach collocations in their classes.

The present study is not without limitations. First, the sample was limited to 62 high school EFL learners. In addition, as stated earlier, the participants were selected from intact classes and were not randomly assigned. This method of sampling was chosen for the sake of convenience, because it was really difficult, if not impossible, to conduct a true experimental study. The study was limited to pre-intermediate EFL female learners. Investigating the effectiveness of spacing techniques on elementary and upper-intermediate students may be the purpose of future studies. Similar research could be done to investigate the effect of spacing techniques on recognition and production of lexical collocation among male EFL learners at higher or lower levels of language proficiency. Moreover, this study solely focused on lexical collocations, and grammatical collocations were not considered. Similar research could be done investigating grammatical collocations. Finally, in this study, the two delayed posttests were administered with a two-week interval after the last treatment session. Future studies can extend the time interval between the delayed posttests to obtain a richer and clearer picture on the longitudinal effect of spacing technique on learning L2 collocations.

REFERENCES

Allan, D. (2004). *Oxford Placement Test 2: Test Pack*. Oxford: Oxford University Press.

Balota, D. A., Duchek, J. M., & Logan, J. M. (2007). Is expanded retrieval practice a superior form of spaced retrieval? A critical review of the extant literature. In J. S. Nairne (Ed.), *The foundations of remembering: Essays in honor of Henry L. Roediger, III* (pp. 83-105). New York, NY, US: Psychology Press.

Bloom, K. C., & Shuell, T. J. (1981). Effects of massed and distributed practice on the learning and retention of second-language vocabulary. *Journal*

of Educational Research, 74, 245-248. doi: 10.1080/00220671.1981.10885317

Bury, J. (2016). The effects of three spacing methods on students' mid-to long-term retention of lexis. *Journal of the Language Teacher, 40*(3), 3-8.

Cameron, L. (2001). *Teaching languages to young learners*. Cambridge: Cambridge University Press.

Camp, C. J., Bird, M. J., & Cherry, K. E. (2000). Retrieval strategies as a rehabilitation aid for cognitive loss in pathological aging. In Hill, R. D., Backman, L., & Stigsdotter Neely, A. (Eds.), *Cognitive rehabilitation in old age* (pp. 224-248). New York: Oxford University Press.

Carpenter, S. K., & DeLosh, E. L. (2005). Application of the testing and spacing effects to name learning. *Applied Cognitive Psychology, 19*, 619-636. doi: 10.1002/acp.1101

Çekiç, A., & Bakla, A. (2019). The effects of spacing patterns on incidental L2 vocabulary learning through reading with electronic glosses. *Instructional Science*, 1-19. doi: 10.1007/s11251-019-09483-4

Daskalovska, N. (2015). Corpus-based versus traditional learning of collocations. *Computer Assisted Language Learning*, *28*, 130-44. doi: 10.1080/09588221.2013.803982

Delaney, P. F., Verkoeijen, P. P., & Spirgel, A. (2010). Spacing and testing effects: A deeply critical, lengthy, and at times discursive review of the literature. *Psychology of learning and motivation, 53*, 63-147. doi: 10.1016/S0079-7421(10)53003-2

Durrant, P. (2008). *High frequency collocations and second language learning*. Doctoral dissertation, University of Nottingham.

Gheisari, N., & Yousofi, N. (2016). Iranian pre-university student's retention of collocations: Implicit exposure or explicit instruction. *Cogent Education*, *3*, 118-126. doi: 10.1080/2331186X.2016.1184826

Haghshenas, A. M., Entekhabi, N., & Samei, H. (2007). *Farhang Moaser one-volume millennium English-Persian dictionary.* Tehran: Farhang Moaser Publications.

Kang, S. H., Lindsey, R. V., Mozer, M. C., & Pashler, H. (2014). Retrieval practice over the long term: Should spacing be expanding or equal-interval? *Psychonomic Bulletin & Review*, *21*, 1544-1550. doi: 10.3758/s13423-014-0636-z

McCarthy, M. J., & O'Dell, F. (2005). *English collocations in use*. Cambridge: Cambridge University Press.

Mutlu, G., & Kaşlioğlu, Ö. (2016). Vocabulary size and collocational knowledge of Turkish EFL learners. *Journal of Theory and Practice in Education*, *12*(6), 1231-1252.

Nakata, T. (2015). Effects of expanding and equal spacing on second language vocabulary learning. *Studies in Second Language Acquisition*, *37*, 677-711. doi: 10.1017/s0272263114000825

Nation, P. (2009). *Teaching vocabulary: Strategies and techniques*. Boston, MA: Heinle.

Pashler, H., Cepeda, N. J., Wixted, J. T., & Rohrer, D. (2005). When does feedback facilitate learning of words and faces? *Journal of Experimental Psychology: Learning, and Cognition, 31*, 3-8. doi: 10.1037/0278-7393.31.1.3

Peters, E. (2014). The effects of repetition and time of post-test administration on EFL learners' form recall of single words and collocations. *Language Teaching Research, 18*, 75-94. doi: 10.1177/1362168813505384

Roediger, H. L., & Karpicke, J. D. (2008). Test-enhanced learning: Taking memory tests improves long-term memory. *Psychological Science, 17*, 249-255. doi: 10.1111/j.1467-9280.2006.01693.x

Schmitt, N. (2008). Review article: Instructed second language vocabulary learning. *Language Teaching Research*, *12*, 329-363. doi:10.1177/1362168808089921

Schuetze, U. (2015). Spacing techniques in second language vocabulary acquisition: Short-term gains vs. long-term memory. *Language Teaching Research, 19*, 28-42. doi: 10.1177/1362168814541726

Sobel, H. S., Cepeda, N. J., & Kapler, I. V. (2011). Spacing effects in real-world classroom vocabulary learning. *Applied Cognitive Psychology, 25*, 763-767. doi: 10.1002/acp.1747

Sonbul, S., & Schmitt, N. (2013). Explicit and implicit lexical knowledge: Acquisition of collocations under different input conditions. *Language Learning*, *63*, 121-59. doi: 10.1111/j.1467-9922.2012.00730.x

Storm, B. C., Bjork R. A., & Storm J. C. (2010). Optimizing retrieval as a learning event: When and why expanding retrieval practice enhances long-term retention. *Memory & Cognition, 38*, 244-53. doi: 10.3758/MC.38.2.244

Woolard, G. C. (2008). *Key words for fluency: Intermediate collocation practice.* Hove, England Language Teaching Publications.

APPENDIX A
Target Collocations

go smoothly	piece of advice	make a choice
pick up gently	stream of visitors	take a trip
rain solidly	star twinkle	have sympathy
wonder aimlessly	roar of traffic	make friends

APPENDIX B
Production Posttest
Write the English collocations for the given Persian phrases.

به شدت باران باریدن	دلسوزی کردن	به آرامی پیش رفتن
سیل بازدیدکنندگان	محکم نگه داشتن	مشکل داشتن
انتخاب کردن	یک نصیحت	وقت کشی کردن
دوست پیدا کردن	به سفر رفتن	بی هدف پرسه زدن
چشمک ستاره	خاموش کردن کامپیوتر	به آرامی برداشتن
سر وصدای ترافیک	به طور تصادفی قرار دادن	سپری شدن (زمان)
	توجه کردن	جرائم خیابانی

APPENDIX C
Recognition Posttest
Complete the sentences below by selecting the best choice.

1- It had rained _____ for four days. Most of the people got in trouble.
a) lightly   b) solidly c) seriously   d) a little

2- Betty had to _____ a choice between her job and her family.
a) have   b) do   c) make   d) get

3- All the students must _____ attention to the teachers.
a) pay   b) attract c) have   d) take

4- Helen gave me a very useful _____ of advice.
a) part   b) set   c) piece   d) sense

5- The days seemed to go _____ very slowly.
a) for   b) by   c) after   d) down

6- Mina _____ picked up a plate and examined it.
a) strongly   b) gently c) softly   d) deeply

7- The books were placed _____ on the shelf. I couldn't find an English book easily.
a) randomly   b) gently c) centrally   d) steadily

8- Make sure you _____ down your computer before you leave the office.
a) turn   b) perform   c) shut   d) store

9- Jack is very good at _____ friends. He never plays alone.
a) becoming   b) talking   c) getting   d) making

10- I could see the star _____ in the sky last midnight.
a) shades   b) tears   c) twinkles   d) flashes

11- I _____ no sympathy for airlines that lose customers.
a) do   b) have   c) make   d) take

12- We got to the airport very early, so we had a meal in the restaurant to _____ time.
a) kill   b) save   c) break   d) pass

13- I didn't know what to do, so I just wondered _____ around all morning.
a) deeply   b) suddenly   c) carefully   d) aimlessly

14- Everything went very _____. I didn't have any problems.
a) sharply   b) smoothly   c) softly   d) slowly

15- My little sister held her doll _____ in her arms.
a) badly   b) rapidly c) firmly   d) deeply

16- Ask the teacher if you _____ problems with the exercises.
a) have   b) take   c) make   d) get

17- There was a _____ of visitors behind the door of museum.
a) rain   b) flow   c) stream   d) center

18- Today, street _____ are a big problem for the police.
a) cleaners   b) parties c) corners   d) crimes

19- I couldn't sleep with the constant _____ of the traffic outside my window.
a) voice   b) roar   c) load   d) volume

20- Yesterday, we _____ a trip to the mountains.
a) came   b) went   c) took   d) got