The impacts of spaced and massed distribution instruction on EFL learners’ vocabulary learning

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Abstract: This study intended to investigate the effect of spaced and massed distribution instruction on vocabulary learning. To fulfil this objective, 68 Iranian pre-intermediate EFL learners (14–16 years) participated in 16 sessions. The participants were randomly divided in to two experimental groups; spaced distribution group (n = 34) and massed distribution group (n = 34). The massed distribution group had one intensive session on learning the target vocabulary; the spaced distribution group had three sessions at irregular time intervals. Using a before and after design, students were retested after 8 weeks. To collect data, a vocabulary test was performed as the pretest and posttest. The results of the paired samples t test and One-way ANCOVA indicated that the spaced distribution group significantly outperformed the massed distribution group on the posttest (effect size .75). The results propose that EFL practitioners can synthesize spacing as a beneficial teaching technique into the curricula and educational materials to promote vocabulary learning.

Keywords: pre-intermediate EFL learners; spaced distribution instruction; massed distribution instruction; vocabulary learning

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PUBLIC INTEREST STATEMENT

Massed Practice refers to conditions in which individuals practice a task continuously without rest. Spaced Practice refers to conditions in which individuals are given rest intervals within the practice sessions. While information repeated in a distributed fashion or spaced over time learned more slowly, it is retained for much longer. Following the significant importance of Massed and in Spaced instruction in language learning, this study compared these two types instruction to check their effects on EFL Learners’ Vocabulary Learning. After implementing the treatment sessions which were teaching vocabulary through Spaced and Masses instruction, it was revealed that Spaced instruction improved the Iranian EFL learners’ Vocabulary Learning. Thus, it can be concluded that spacing instruction can be successfully employed in EFL classes.
1. Introduction
According to Carpenter, Cepeda, Rohrer, Kang, and Pashler (2012), most of foreign language teachers have become discouraged regarding their role in enhancing education consequences due to forgetting much of the prior learned materials by the learner. Thus, it is obscure for many EFL teachers and learners, whether presenting and studying material across two or more sessions that are separated in time (i.e. spaced distribution instruction) can result in better learning than spending the same amount of time in a single session with no interruption in between, that is, massed distribution instruction (Miles, 2014; Namaziandost & Nasri, 2019).

In turn, it is fundamental to second/foreign language learning and teaching, particularly for the automatization of language skills to be exposed to repetitious and frequent linguistic items or structures (Azadi, Biria, & Nasri, 2018; DeKeyser, 2007; Mashhadi, Forvardin, & Mozaffari, 2017; Segalowitz, 2010). However, what is not completely obvious is whether this input repetition should preferably be spaced or massed (Hosseini, Nasri, & Afghari, 2017; Segalowitz, 2010). In cognitive psychology, learning has been revealed to develop when the repetitions of the items to be learned happen in spaced sequences, as opposed to massed or concentrated presentations (Segalowitz, 2010). Yet, despite the copiousness of researches on spacing effect in cognitive psychology, few experimental researches have investigated the impact of spaced distribution instruction on second/foreign language learning and teaching (Namaziandost, Nasri, & Rahimi Esfahani, 2019a; Serrano, 2012). This deficiency of research is specifically astonishing given the calls for further researches in this field (Ellis, 2006).

In the meantime, one of the polemical and challenging issues in teaching vocabulary to second/foreign language learners is that some researchers have interrogated the concept of spaced distribution instruction supremacy over massed distribution instruction (Nasri & Biria, 2017; Serrano & Munoz, 2007; Stoltzfus & Sukseemuang, 2018). Furthermore, although the spacing impact has been well investigated and checked for second/foreign grammar learning and language skills (Mashhadi et al., 2017; Namaziandost, Hashemifardnia, & Rahimi Esfahani, 2018), few studies have been carried out to check its feasible allotment to vocabulary learning, particularly in EFL contexts. Accordingly, Ellis (2006) suggested that, at least with respects to vocabulary instruction, the issue of massed vs. spaced distribution instruction has remained unresolved and therefore further researches should investigate this issue.

2. Literature review
Encoding variability and defective processing are two fundamental hypothetical accounts of spaced distribution practice (Greene, 1989). Encoding variability hypothesis underscored on the fact that spaced materials are preferred to be remembered over the massed ones, since every presentation in the spaced dispensation is encoded in an unexpected way, therefore giving more reclamation clues. Indeed, this hypothesis focuses on the role of the specific circumstance and asserts that the context where an item is given is encoded together with its meaning (Anderson & Bower, 1972; Namaziandost, Rahimi Esfahani, Nasri, & Mirshekaran, 2018). On the other hand, defective processing theory (Challis, 1993) propounds that the massed presentation does not get adequate processing, as the prior presentation is nevertheless too up-to-date. On the contrary, when a topic is displayed after some periods of time has elapsed and after some intervening items have been demonstrated, the complete processing will be essential, because the prior presentation will not be as effortlessly existent as in the case of massed instruction (Mashhadi et al., 2017; Nasri, Biria, & Karimi, 2018).

In the meantime, the superior learning effect of spaced instruction over massed instruction have been divulged in most of prior researches in learning of grammar (Mashhadi et al., 2017; Miles, 2014), and reading comprehension (Namaziandost, Sabzevari & Hashemifardnia, 2018). There is, however, strikingly little studies on the impacts of spaced distribution instruction in foreign language learning, particularly vocabulary learning (Miles, 2014). In fact, experimental researches which have definitely checked the impact of spaced and massed distribution instruction on foreign language vocabulary learning are few in number, but they are promising.
Year (2009) investigated the potential role of the spacing effect in foreign language grammar learning. To fulfill, three groups of middle school students learning English in Korea were exposed to ditransitive verb structures based on massed or spaced distribution instruction, with the massed group receiving the input over a 4-day period and two spaced groups keeping a 4-week or 8-week schedule. The findings indicated that the spaced distribution learners significantly outperformed the massed distribution learners on the elicited production and acceptability judgment tests.

Moreover, Miles (2014) also carried out a study on the impact of spaced distribution instruction versus massed distribution instruction on learning a few grammar items chosen to be taught throughout the course period for 45 South Korean university students as the participants. The outcomes demonstrated that the spaced distribution group significantly outperformed the massed distribution group on the error analysis and correction test. However, neither groups outperformed the other on the delayed translation posttest.

Similarly, the findings of former researches reconnoitering input spacing indicated an uncertain picture as to whether exposure to a second language, whether in instructed or naturalistic contexts, should be massed or spaced. Some researchers have shown that, when measured only on immediate posttests, massed (i.e. intensive) distribution instruction seemed better than spaced distribution instruction (Namaziandost, Nasri, & Rahimi Esfahani, 2019b; Serrano, 2011; Serrano & Munoz, 2007; Stoltzfus & Sukseemuang, 2018). In contrast, there is, in turn, there are new proofs that in the preservation of target language structures spaced distribution instruction is premiere than massed one, that is, when learning is measured subsequent a delayed posttest (Hashemifardinia, Namaziandost, & Sepehri, 2018; Miles, 2014; Schuetze, 2015). Thus, this project aimed to complete (at least slightly) the existing gap by examining the impact of spaced and massed distribution instruction on EFL learners’ vocabulary learning. Therefore, to this end, the following research questions were formulated:

RQ 1: Does spacing instruction have any significant effect on Iranian EFL learners’ vocabulary learning?

RQ 2: Does massed instruction have any significant effect on Iranian EFL learners’ vocabulary learning?

RQ 3: Is there any significant difference between Iranian EFL learners’ vocabulary learning through spacing instruction and massed instruction?

3. Methodology

3.1. Participants

The sixty-eight participants took part in this research were selected among 98 Iranian students between the ages of 14 and 16 years old. They were chosen based on the results of an Oxford Quick Placement Test (OQPT). The English proficiency level of the participants was intermediate. The participants were male and they were native speakers of Persian. To conduct the study, the participants were randomly assigned to two experimental groups; spaced distribution group (n = 34) and massed distribution group (n = 34).

3.2. Instruments

The first instrument which was utilized in the present study was the OQPT. This test was used to homogenize the participants. It helped the researcher to have a greater comprehension of what level (i.e. elementary, pre-intermediate, intermediate) her participants are at. This test has 60 multiple-choice items and based on it the learners whose scores are 40 to 47 are intermediate. Based on the results of this test, 68 intermediate learners were considered as the target participants of the present study.
The second instrument for collecting the sufficient data to answer the research question of the study was a researcher-made vocabulary pre-test which was designed based on the students’ text book. This test consisted of 50 multiple choice items. Internal validity of the items in the test was checked by five English experts. It was piloted on a similar group from another institute. It should be mentioned that the reliability of the pre-test was calculated through KR-21 formula as it was $r = .956$.

The third instrument which was used in this study to determine the impacts of the treatment on the participants’ vocabulary was a researcher-made vocabulary post-test. The post-test was the modified version of the pre-test; the pre-test was used both as the pre-test and post-test of the study. There was a slight difference between pre and post-tests, that is, the order of options and questions was changed to avoid the students’ recalling of pre-test answers. The validity of the posttest was confirmed by those who validated the pretest; and the reliability was computed through KR-21 formula as it was $r = .899$.

3.3. Data collection procedure

After making the participants homogenous, their proficiency level of English vocabulary knowledge was measured by a vocabulary pre-test. Afterwards, the students in the experimental groups received the same treatment but in different way. The new words were taught to the experimental groups through spacing instruction and massed instruction. In massed class, the words were taught during 90 minutes to the students. In fact, 90 minutes was allocated to each session. In spacing class, 90 minutes were divided into three 30 minutes and each session lasted 30 minutes. The spacing class was held three times a week but the massed class was held once a week.

In the treatment phase of the study, the massed distribution group was taught the target words in an intensive 90-minute session, while the spaced distribution group was taught in three short sessions (about 90 minutes. total). The first session lasts for 30 minutes; while the second occurred two days after the initial session (lasts 30 minutes); and the third session took 30 minutes and was held two days after the second session.

The instruction lasted 16 sessions. At the end of the instruction, the post-test was given to the participants of both experimental groups to measure the effects of the treatment on the students’ vocabulary learning.

3.4. Data analysis

After collecting the sufficient data, the researcher used the mean and standard deviation to point out the differences between the performances of the two groups during the pretest. In order to analyze the data quantitatively, after the post test, the Paired samples t-test and One-way ANCOVA were run to determine the differences between the two groups. Finally, SPSS (Statistical Package for Social Sciences), version 25, which was a computer software, was used to analyze the data in the present and post-test of the study.

4. Results

Before conducting any analyses on the pretest and posttest, it was necessary to check the normality of the distributions. Thus, Kolmogorov-Smirnov test of normality was run on the data obtained from the above-mentioned tests. The results are shown in Table 1:

The $p$ values under the Sig. column in Table 1 determine whether the distributions were normal or not. A $p$ value greater than .05 shows a normal distribution, while a $p$ value lower than .05 indicates that the distribution has not been normal. Since all the $p$ values in Table 1 were larger than .05, it could be concluded that the distributions of scores for the pretest and posttest obtained from both groups had been normal. It is thus safe to proceed with parametric test (i.e. Paired samples t test and One-way ANCOVA in this case) and make further comparisons between the participating groups.
As the main aim of the study was to find out whether spaced and massed distribution instruction could help learners improve their vocabulary learning or not, the pretest and posttest scores of the learners in both experimental groups were compared using a paired-samples t-test:

As Table 2 shows, the Spaced Distribution group learners obtained the mean scores of 12.8529 on the vocabulary pretest and 15.7206 on the vocabulary posttest. Moreover, the descriptive statistics in Table 2 show that the Massed Distribution learners did not improve from the mean score of 12.7206 on the vocabulary pretest to the mean score of 12.8676 on the vocabulary posttest. In order to determine whether the difference between these two mean scores in each group was statistically significant or not, the researcher needed to consult the paired-samples t test table (Table 3):

In Table 3, the single most important piece of information is the p value under the Sig. (2-tailed) column. This p value should be compared with the pre-specified significance level (i.e. .05) to see if the difference between the pretest and posttest scores had been statistically significant or not. A p value less than .05 would indicate a significant difference between the two sets of scores, while a p value larger than .05 would imply a difference which did not reach statistical significance. As the p value under the Sig. (2-tailed) column was smaller than the significance level (.000 < .05), it could be
construed that the difference between the vocabulary pretest (M = 12.8529) and posttest (M = 15.7206) of the Spaced distribution group learners was of statistical significance. In order to find out whether massed instruction also led to the improvement of the vocabulary knowledge of the learners, the pretest and posttest scores of the learners in the Massed Distribution Group were also compared via a paired-samples t test (Pair 2). As can be seen in Table 3, the p value under the Sig. (2-tailed) column was higher than the significance level (.063 > .05), it could be understood that the difference between the vocabulary pretest (M = 12.7206) and vocabulary posttest (M = 12.8676) of the Massed Distribution Group learners was not statistically significant.

As it was stated above, the aim of comparing SDG and MDG was to see if there was a difference between extent to which they benefited from their particular instructions or not. In other words, it was aimed to see if spaced distribution instruction was more effective than massed distribution instruction as far as the vocabulary learning of the students was concerned or not. To fulfil this objective, the researcher had to compare the vocabulary post-test scores of the SDG and MDG learners, for which an independent-samples t test could be conducted. Nonetheless, to control for any possible pre-existing differences between these two groups, and compare their post-test scores accordingly, one-way ANCOVA was conducted:

In Table 4, it could be found that the post-test mean score of the SDG learners (M = 15.7206) was larger than the post-test mean score of the MDG learners (M = 12.8676). To find out whether this difference was a statistically significant one or not, the researcher had to look down the Sig. column and in front of the Groups row in Table 5:

In Table 5, if you find the row labeled Groups in the leftmost column, and read across this row, under the Sig. column, you can find the p value, which should be compared with the alpha level of significance (i.e. .05). The p value here was smaller than the alpha level of significance (.00 < .05), indicating that the difference between the two groups of SDG (M = 15.7206) and MDG (M = 12.8676) on the vocabulary post-test was statistically significant. This means that spaced distribution instruction was significantly more effective than using massed distribution instruction for the purpose of improving the vocabulary learning of the EFL learners. Another noteworthy piece of information in Table 5 is the effect size value, shown under the Partial Eta Squared column in front of Groups. This value equaled .75, which means that the treatment (i.e. spaced and massed instruction) accounted for 75% of the difference between the SDG and MDG learners. The existence of a significant difference between the vocabulary post-test scores of the SDG and MDG learners is graphically represented in Figure 1 below:

Figure 1 shows that the SDG learners considerably outperformed the MDG learners on the vocabulary posttest, indicating that the spaced instruction had significant effects on Iranian EFL learners’ vocabulary learning.

5. Discussion and conclusion
This study investigated whether spaced and massed distribution instruction could enhance EFL learners’ vocabulary. After collecting the needed data and analyzing them, the results indicated that the spaced group improved on their post-test compared to their pre-test. Their scores on

| Groups               | Mean  | Std. Deviation | N   |
|----------------------|-------|----------------|-----|
| Spaced Distribution Group | 15.7206 | .71976         | 34  |
| Massed Distribution Group  | 12.8676 | 1.28103       | 34  |
| Total                | 14.2941 | 1.76879       | 68  |
the post-test were very better than their scores on the pre-test. This improvement may be due to spaced distribution instruction. Moreover, after analyzing the data, the outcomes demonstrated that the massed group did not progress on their post-test compared to their pre-test. Their scores on the pre-test and post-test were almost the same.

The finding is in line with prior studies in cognitive psychology (Pavlik & Anderson, 2005; Seabrook, Brown, & Solity, 2005) which confirmed the impact of spaced distribution instruction in various realms of learning. Furthermore, the outcome is additionally confirming some former studies (e.g. Miles, 2014; Namaziandost et al., 2018; Year, 2009) indicating that the spaced distribution instruction enhanced foreign language learning.

Spacing instruction helped Iranian EFL students to improve their vocabulary knowledge. In spacing instruction students had more time to rest, had more time to think, and had more time to study; this may lead to the students’ vocabulary development.
These results are in line with researches from cognitive psychology (e.g. Carpenter et al., 2012) and foreign language learning (Miles, 2014), which have corroborated the supremacy of spaced instruction conditions in promoting learning. Accordingly, Miles (2014) study showed that spaced distribution group outperformed the control and massed distribution groups on both immediate and delayed posttests. Furthermore, Pavlik and Anderson (2005) and also Rohrer and Pashler (2007) believed that spacing training sessions is effective for long-term retention, though immediate recall tends to be commensurate for spaced and massed items.

Based on the encoding variability theory, the more spaced two items are, the more likely it is that they will be encoded differently in the participant’s mind (Anderson & Bower, 1972; Mirshekaran, Namaziandost, & Nazari, 2018). This variability in memory representation, which is facilitated by the various contexts in which spaced items emerge, provides more retrieval clues (Mashhadi et al., 2017). As a result, remembering is favored in spaced distribution instruction. Moreover, based on deficient processing theory, in spaced sequences, the first presentation is not easily accessible at the time of the second presentation, and full processing of the second presentation is thus essential (Jacoby, 1978; Namaziandost, Abedi, & Nasri, 2019). Consequently, this processing, in turn, simplifies learning and retention. To put it in a nutshell, it is assumed that when participants are presented to two items concomitantly or within a short period of time, they do not dedicate as much consideration to these items as when they are exposed with adequate spacing.

The consequences of this study showed the impacts of spaced distribution instruction on improving EFL long-term vocabulary learning. Some implications have been suggested for EFL practitioners. First of all, homework assignments might be utilized to re-expose learners to the materials that they have learned before. It may be especially appropriate when class time is confined and a review is hard. Second, teachers could give exams and quizzes that are cumulative. Cumulative exams and quizzes provide learners with a good reason to review information on their own. Third, teachers should enable learners to have conscious control over the metacognitive strategies they choose. This can be done by utilizing explicit self-regulatory strategies such as setting up a spaced practice schedule. Fourth, learners can space their self-study sessions out in time to enhance the amount of their learning. It could be a good idea for teachers to schedule classroom learning activities according to a spaced schedule to increase learners’ performance at the tests. Fifth, it will help syllabus designers and curriculum developers through which they will be able to plan the course books to facilitate foreign vocabulary learning. That is, because spacing has an increasing impact on learners’ long-term memory syllabus designers and curriculum developers will have the chance to decide when in a course and where in a book a word requires to be repeated. Finally, curriculum designers and materials developers can incorporate spacing as an instructional strategy into learning curricula and educational materials.

In spite of making efforts to achieve as comprehensive research as it was possible, the study, however, has some limitations. The sampling method utilized in this study was based on the availability of the participants. Similar studies with a more representative sample can provide more generalizable results. Another limitation is that this study was done on intermediate learners only; the upcoming studies should work on high school students, pre-intermediate and also elementary learners in order to get richer findings. Besides, the current study was done with a small population of Iranian EFL learners. The future studies can include more respondents from across the country. Furthermore, the treatment for both groups was chiefly restricted to explicit instruction and testing. Thus, applying communicative approaches to vocabulary instruction (i.e. focus on form) or implicit learning can be beneficial. The present research covered only vocabulary learning, so the forthcoming studies can investigate other skills and sub skills. Moreover, Thus, the current study only looked at the retention of the words over 16 sessions. Future studies should replicate the study employing longer time intervals and several delayed posttests. Such data may provide more profound insights into young learners’
word learning processes and spacing effects Finally, the participants of this study were male EFL learners. Future studies can investigate the effect of spacing and massed distribution instruction across different genders.

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