

Effects of Spaced and Massed Distribution Instruction on EFL Learners' Recall and Retention of Grammatical Structures

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Abstract

The efficacy of massed and spaced distribution instruction in second/foreign language learning is still an issue of debate. Moreover, few studies have probed the possible effect of spaced distribution practice on English as a foreign language (EFL) learners' recall and retention of grammatical structures. This study, therefore, aimed to examine this issue by recruiting 72 Iranian EFL junior high school students in a public school. The participants were randomly assigned to spaced distribution ($n = 24$), massed distribution ($n = 23$), and control ($n = 25$) groups. The massed distribution group had one intensive session on learning the target grammatical structures (i.e., the simple present affirmative, negative, and interrogative forms); the spaced distribution group had three sessions at irregular time intervals; while the control group received no instruction. To collect data on the recall and retention of the target structures, an error correction test was administered to the participants three times as the pretest, immediate posttest and delayed posttest. The results of the repeated measures mixed ANOVAs, one-way ANOVAs, and post hoc Tukey tests revealed that the spaced distribution group significantly outperformed the other two groups on the delayed posttest. However, there was no significant difference between the spaced and massed distribution groups on the immediate posttest. The findings suggest that EFL practitioners can incorporate spacing as an instructional strategy into the curricula and educational materials to foster the recall and retention of English grammatical structures.

Keywords: EFL learners, Grammar learning, Recall; Retention, Spaced Distribution Instruction, Massed Distribution Instruction

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1. Introduction

In the field of foreign language learning and teaching, it is held that many teachers have become discouraged concerning their role in improving education outcomes due to forgetting much of the previously learned materials by the students (Carpenter, Cepeda, Rohrer, Kang, & Pashler, 2012). Therefore, for many English as a foreign language (EFL) teachers and learners, it is unclear whether presenting and studying material across two or more sessions that are separated in time (i.e., spaced distribution instruction) can lead to 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).

In turn, repetitions and frequent exposure to linguistic items or structures are believed to be crucial to second/foreign language learning and teaching, especially for the automatization of language skills (DeKeyser, 2007; Ellis, 2002; Segalowitz, 2003, 2010). However, what is not quite clear is whether this input repetition should ideally be spaced or massed (Segalowitz, 2010). In cognitive psychology, learning has been shown to progress when the repetitions of the items to be learned occur in spaced sequences, as opposed to massed or concentrated presentations (Segalowitz, 2010). Yet, despite the abundance of studies on spacing effect in cognitive psychology, few empirical studies have examined the effect of spaced distribution instruction on second/foreign language learning and teaching (Serrano, 2012). This lack of research is particularly surprising given the calls for more studies in this area (Ellis, 2006).

Meanwhile, one of the controversial issues in teaching grammar to second/foreign language learners is that some scholars have questioned the notion of spaced distribution instruction superiority over massed distribution instruction (Collins, Halter, Lightbown, & Spada, 1999; Collins & White,

2011; Serrano & Munoz, 2007). Moreover, although the spacing effect has been well tested for second/foreign vocabulary learning, little research has been conducted to investigate its possible contribution to grammar learning, especially in EFL contexts. In the same vein, Ellis (2006) proposed that, at least with respects to grammar instruction, the issue of massed vs. spaced distribution instruction has remained unresolved and hence more studies should examine this issue.

2. Literature Review

Two main theoretical accounts of spaced distribution practice are known as *encoding variability* and *deficient processing* (Greene, 1989). Encoding variability theory lays emphasis on the fact that spaced materials are better remembered than massed, because each presentation in the spaced distribution is encoded differently, thus providing more retrieval cues. In fact, this theory emphasizes the role of the context and claims that the context in which an item is presented is encoded together with its meaning (Anderson & Bower, 1972). On the other hand, deficient processing theory (Challis, 1993; Greeno, 1970) proposes that the second presentation of massed materials does not receive enough processing, as the previous presentation is still too recent. In contrast, when a subject is presented after some time has passed and after some intervening items have been shown, full processing will be necessary, since the previous presentation will not be as easily available as in the case of massed sequences.

Meanwhile, the majority of previous studies have revealed the greater learning potential of spaced instruction over massed instruction in learning of grammar (Miles, 2014), vocabulary (Miles & Kwon, 2008; Nakata, 2015; Pavlik & Anderson, 2005; Rohrer & Pashler, 2007; Schuetze, 2015), and reading (Seabrook, Brown, & Solity, 2005). There is, however, strikingly little research on the effects of spaced distribution instruction in

foreign language learning, especially grammar learning (Miles, 2014). In fact, empirical studies which have specifically delved into the effect of spaced and massed distribution instruction on foreign language grammar learning are few in number, but they are promising.

Year (2009) examined the potential role of the spacing effect in foreign language grammar learning. To that end, 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 results revealed that the spaced distribution learners significantly outperformed the massed distribution learners on the elicited production and acceptability judgment tests. In a more recent study, Miles (2014) also conducted a study on the effect of spaced distribution instruction versus massed distribution instruction on learning a few grammar items selected to be taught throughout the course period for 45 South Korean university students as the participants. The results revealed 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 results of previous studies exploring input spacing show an unclear picture as to whether exposure to a second language, whether in instructed or naturalistic settings, should be massed or spaced. Some studies have revealed that, when measured merely on immediate posttests, massed (i.e., intensive) distribution instruction appeared superior to spaced distribution instruction (Collins & White, 2011; Serrano, 2011; Serrano & Munoz, 2007). Conversely, there is, in turn, recent evidence that spaced distribution instruction is superior to massed distribution instruction in the

retention of target language structures, that is, when learning is measured following a delayed posttest (Miles, 2014; Schuetze, 2015). Therefore, this study intended to fill in (at least partially) the existing gap by investigating the effect of spaced and massed distribution instruction on EFL learners' recall and retention of some selected grammatical structures (i.e., present simple affirmative, negative, and interrogative forms). Thus, to fulfill the objectives set for the study, we put forward the following research questions:

1. To what extent does spaced distribution instruction significantly enhance EFL learners' recall and retention of grammatical structures (i.e., present simple affirmative, negative, and interrogative forms)?
2. To what extent does massed distribution instruction significantly enhance EFL learners' recall and retention of grammatical structures (i.e., present simple affirmative, negative, and interrogative forms)?
3. If both spaced and massed distribution instruction significantly enhance EFL learners' recall and retention of grammatical structures (i.e., present simple affirmative, negative, and interrogative forms), which instruction will be more effective?

3. Methods

3.1 Participants

Seventy-two Iranian EFL male students from three classes of a junior public high school in Behbahan were taken as the participants of the study in the school year of 2015-2016. The age range of the participants was between 13 to 14 years old and at the time of the study they had been studying English for two years. To conduct the study, the participants were, then, randomly assigned to two experimental groups, including massed distribution group ($n = 23$) and spaced distribution group ($n = 24$), and one control group ($n = 25$). The participants were taught by one of the researchers.

In order not to interrupt the school schedules, the data collection was conducted as an extracurricular activity, namely outside the normal class time. Moreover, to ensure the homogeneity of the participants in terms of their prior knowledge of the target structures (i.e., the simple present affirmative, negative, and interrogative forms), a pretest including 20 items was administered to the participants in all groups. No statistically significant differences between the groups were found ($p > .05$) in terms of their familiarity with the target structures (i.e., the simple present affirmative, negative, and interrogative forms).

3.2 Instruments and Materials

3.2.1 Pretest and Posttests

The grammar test was an error identification/correction test (i.e., editing test) consisting of 20 items devised by the researchers, each having one or two grammatical errors (see Appendix A). In effect, there were 20 errors in the test measuring the participants' knowledge of the target structures (i.e., the simple present affirmative, negative, and interrogative forms) intended to be taught throughout the course period requiring the participants to identify and correct the erroneous items, as instructed in a 15-min time limit. In addition, some grammatical errors were included in the test items to serve as distractors. The participants were instructed to identify and correct the errors.

The reliability and validity of the test was also investigated in a piloting session before embarking on the study with a group of 15 junior high school students other than the major participants using Kuder-Richardson formula (KR-21) and it was found to be 0.84. Furthermore, assessment and measurement experts in this field were asked to confirm the appropriateness of the test content and it was found to be satisfactory.

Once the final question items were generated, the grammar test (i.e., pretest) was first administered to the participants before the treatment. The

same test was also administered in the immediate and delayed posttests with some minor vocabulary modifications and some change in the order of the test items. It should be noted that the time interval between the pretest and the delayed posttest was about three months; thus, it was less likely that the participants could recall the content of the pretest. As far as the scoring mechanism was concerned, the maximum possible score on the test was 20 as each correct answer received 1 point while no score was considered for the incorrect ones. To increase the inter-rater reliability of the tests' scores, the scoring was done by two raters and the inter-rater reliability coefficients for the pretest, immediate, and delayed posttests were found to be 0.95, 0.91, and 0.93, respectively.

3.2.2 Target Structures

In this study, the target structures were affirmative, negative, and interrogative forms of simple present tense. The rationale for selecting the simple present tense was some basic problems among Iranian EFL students in learning English verb tenses, especially simple present tense due to the fact that there is no exact equivalent in Persian for the emphatic *do, does* in English simple present tense (Manuchehri, 1974).

3.3 Procedure

Seventy-two Iranian EFL male students from three classes of a junior public high school in Behbahan were selected. To measure the participants' knowledge of the target structures, the pretest was administered to each group one week before the commencement of the treatment. Then, the participants were randomly assigned to two different experimental groups to learn the intended materials containing the same target structures through each respective scenario, namely massed distribution or spaced distribution, and one control group receiving no instruction. The history effect, meanwhile, was controlled by including the control group. In other words, the researchers

aimed to control the extent of the participants' gains coming from issues other than this study interventions, such as participants simply improving their general English skills over the semester, or the participants making gains because of test familiarity.

In the treatment phase of the study, the massed distribution group was taught the target structures in an intensive 65-minute session, while the spaced distribution group was taught in three short sessions (about 65 min. total). The first session lasted for 30 minutes; while the second occurring one week after the initial session, lasted for 15 minutes; and the third and final session took 20 minutes and was held approximately 35 days after the first session. Each session introduced new exercises in order to maintain the participants' interest and provided a wider range of rehearsal with sample sentences. The total time of instruction for both experimental groups was 65 minutes as there were three main parts for the treatment, including explanation stage and grammar exercises, along with quizzes accompanied by communicative activities.

The explanation stage began with an inductive grammar exercise, followed by the teacher-researcher's presentation and explanation of the grammar points. The quizzes were then of error identification and correction forms; presenting the participants with sentences containing one or more errors on each target grammatical structure, and requiring them to identify and correct the errors. The quizzes were also used as a way for the participants to check their grammatical knowledge, and provide more opportunities for them to review the target structures (see Appendix B). A mix of pair work and individual activities was also used to provide variety to the activity types. In the pair work, students were able to get support from their peers and check their answers. However, in the individual activities, students were required to test their knowledge of the concepts without any help from others.

Subsequently, the first posttest was conducted immediately after the intensive training session for the massed group and following the third

training session for the spaced group on week 7. This enabled the researchers to measure the recall of the participants' grammatical knowledge. The delayed posttest was, in turn, administered after a 5-week delay (i.e., on week 12). This allowed the researchers to assess the retention of the participants' grammatical knowledge. The procedure of this study is depicted in Table 1.

Table 1

Procedure of the Study

Time	Spaced Distribution Group	Massed Distribution Group	Control Group
Week 1	Pretest	Pretest	Pretest
Week 2	Session 1 (30 min.)	-	-
Week 3	Session 2 (20 min.)	-	-
Week 7	Session 3 (15 min.)	Session 1 (65min.)	-
Week 7	Immediate posttest	Immediate posttest	Immediate posttest
Week 12	Delayed posttest	Delayed posttest	Delayed posttest

3.4 Data Analysis

In order to answer the research questions, repeated-measures mixed ANOVAs were run. Moreover, one-way ANOVAs and post hoc Tukey tests were run to identify the differences between groups at each posttest.

4. Results

Before embarking on choosing appropriate statistical tests, the normality of the data was tested through Shapiro-Wilk test of normality and it was found that the data were normally distributed. Table 2 shows the descriptive statistics of the grammar scores on the pretest, immediate posttest, and delayed posttest.

Table 2
Descriptive Statistics of the Grammar Tests

	Group	<i>M</i>	<i>SD</i>	<i>N</i>
Pretest	Control	6.20	1.633	25
	Massed Distribution	5.74	1.356	23
	Spaced Distribution	6.00	1.719	24
	Total	5.99	1.570	72
Immediate Posttest	Control	6.44	2.002	25
	Massed Distribution	15.87	2.302	23
	Spaced Distribution	16.54	2.000	24
	Total	12.82	5.130	72
Delayed Posttest	Control	6.28	1.370	25
	Massed Distribution	12.26	1.839	23
	Spaced Distribution	15.58	1.860	24
	Total	11.29	4.261	72

Table 2 illustrates the mean scores and standard deviations of the participants on the pretest in the control group ($M = 6.20$, $SD = 1.633$), massed distribution group ($M = 5.74$, $SD = 1.356$), and spaced distribution group ($M = 6.00$, $SD = 1.719$). Moreover, Table 4.2 shows the mean scores and standard deviations of the participants on the immediate posttest in the control group ($M = 6.44$, $SD = 2.002$), massed distribution group ($M = 15.87$, $SD = 2.302$), and spaced distribution group ($M = 16.54$, $SD = 2.000$). The mean scores and standard deviations of the participants on the delayed posttest are also displayed: control group ($M = 6.28$, $SD = 1.370$), massed distribution group ($M = 12.26$, $SD = 1.839$), and spaced distribution group ($M = 15.58$, $SD = 1.860$). The spaced distribution group had the highest mean score on the immediate and delayed posttests. To answer the research questions, a mixed 3 x 3 ANOVA with two main factors, Time (i.e., pretest, immediate posttest, and delayed posttest) and Group (i.e., control, massed distribution, and spaced distribution) was conducted. Moreover, one-way ANOVAs were conducted for the overall comparison of the three groups in terms of their scores on the pretest and the posttests. Table 3 shows the results of mixed ANOVA on the grammar tests.

Table 3
Results of Mixed ANOVA on grammar Pre- and Posttests

Source		Type III SS	MS	df	F	Sig.	Partial η^2
Between Subject	Group	1665.749	832.874	2	111.873	.000	.764
	Error	513.691	7.445	59			
Within Subject	Time	1922.084	961042	2	824.884	.000	.923
	Time x Group	992.295	248.074	4	212.927	.000	.861
	Error (Time)	160.779	1.165	138			

Note. SS = sum of squares; MS = mean square

The results of mixed 3 x 3 ANOVA show the significant main effects of group ($F_{2, 59} = 111.873$, $p < .001$, partial $\eta^2 = 0.764$). Moreover, there was a main effect for time ($F_{2, 138} = 1922.084$, $p < .001$, partial $\eta^2 = 0.923$). There was also a significant interaction between time and group ($F_{4, 138} = 212.927$, $p < .001$, partial $\eta^2 = 0.861$). Due to the significant main effect of group, a one-way ANOVA was performed for each grammar test. Table 4 displays the results of one-way ANOVAs on the grammar pre- and posttests.

Table 4
Results of One-Way ANOVAs on Grammar Pre- and Posttests

		SS	df	MS	F	Sig.
Pretest	Between Groups	2.551	2	1.276	0.51	.602
	Within Groups	174.435	69	2.499		
	Total	174.986	71			
Immediate Posttest	Between Groups	1563.926	2	781.963	177.06	.000
	Within Groups	304.727	69	4.416		
	Total	1868.653	71			
Delayed Posttest	Between Groups	1091.567	2	545.783	190.86	.000
	Within Groups	197.308	69	2.860		
	Total	1288.875	71			

Note. SS = sum of squares; MS = mean square

Effects of Spaced ...

No significant main effect of group was found in the pretest ($F_{2, 69} = 0.510, p > .05$). Moreover, a significant main effect of group was found in the immediate posttest ($F_{2, 69} = 177.062, p < .001$) and the delayed posttest ($F_{2, 69} = 190.864, p < .001$). As illustrated in Table 5, Tukey post hoc analyses showed that on the immediate posttest, both massed and spaced distribution groups scored significantly higher than the control group ($p < .001$). However, there was no significant difference between the spaced and massed distribution groups on the immediate posttest.

Table 5

Results of Post Hoc Tests on the Grammar Posttests

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Immediate Posttest	Massed	Control	9.430	0.607	.000
	Spaced	Control	10.102	0.601	.000
	Spaced	Massed	0.672	0.613	.520
Delayed Posttest	Massed	Control	5.981	0.489	.000
	Spaced	Control	9.303	0.483	.000
	Spaced	Massed	3.322	0.493	.000

Tukey post hoc analyses also revealed that on the delayed posttest, the massed distribution and spaced distribution groups scored significantly higher than the control group ($p < .001$). Furthermore, on the delayed posttest, the spaced distribution group scored significantly higher than the massed distribution group ($p < .001$). Figure 1 shows the mean changes of grammar scores across all groups over three testing periods.

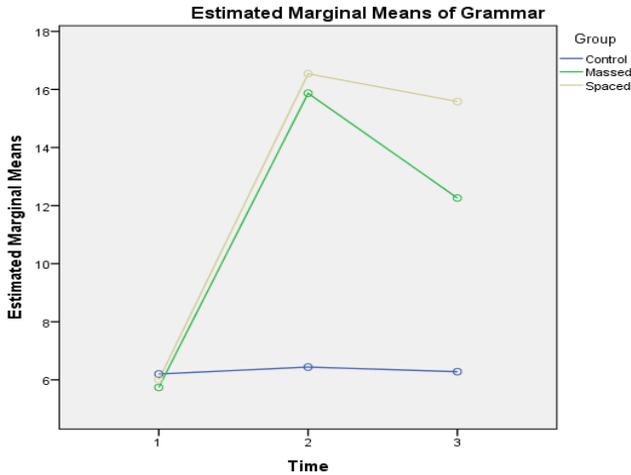


Figure 1. Participants' performance on grammar tests across all groups

As shown in Figure 1, the spaced distribution group had the highest mean score in the immediate posttest (Time 2) and delayed posttest (Time 3). In the pretest (Time 1), however, the mean scores were very close to each other.

4. Discussion

This study investigated whether spaced and massed distribution instruction could enhance EFL learners' recall and retention of grammatical structures. Furthermore, it aimed to examine which instruction could have a better effect on recall and retention of EFL grammar.

The results revealed no significant difference between the massed and spaced distribution groups on the participants' recall of the target structures. In other words, both groups made roughly equal progress on the immediate posttest. These results are in line with previous studies (Collins & White, 2011; Miles, 2014), which found no clear advantage of spaced conditions over massed conditions on immediate posttests. However, when measured on the 5-week delayed posttest (i.e., retention test), the group

which received spaced exposure significantly outperformed the massed group.

The results also revealed that the spaced distribution group outperformed the massed distribution and the control group on the delayed posttest. The findings imply that spaced distribution instruction may enhance EFL learners' long-term grammar learning. The finding is in tandem with previous studies in cognitive psychology (Pavlik & Anderson, 2005; Seabrook et al., 2005) which confirmed the effect of spaced distribution instruction in different domains of learning. Moreover, the result is also corroborating some previous studies (e.g., Miles, 2014; Miles & Kwon, 2008; Pavlik & Anderson, 2005; Rohrer & Pashler, 2007; Year, 2009) showing that the spaced distribution instruction improved foreign language learning.

Although both groups experienced a drop on the delayed posttest, the massed group showed a far steeper decline (See Figure 1). These results are also in conformity with studies from cognitive psychology (e.g., Carpenter et al., 2012) and foreign language learning (Miles, 2014), which have confirmed the superiority of spaced training conditions in promoting learning which is durable against the effects of time. In a similar vein, Miles (2014) reported that spaced distribution group outperformed the control and massed distribution groups on both immediate and delayed posttests. Moreover, Pavlik and Anderson (2005) and also Rohrer and Pashler (2007) contend that spacing training sessions is beneficial for long-term retention, though immediate recall tends to be comparable for spaced and massed items. As Miles (2014) put it,

One of the benefits of learning grammar through spaced distribution instruction is giving the learners a better opportunity to retain a sufficient amount of knowledge gained from instruction until the next

opportunity for review arises, either accidentally through input, explicitly through additional instruction, or through the need to use the specific item in speaking or writing. (p. 421)

According to 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). This variability in memory representation, which is facilitated by the different contexts in which spaced items appear, provides more retrieval cues. Consequently, remembering is favored in spaced distribution instruction. Besides, according to 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 necessary (Greeno, 1970; Jacoby, 1978). As a result, this processing, in turn, facilitates learning and retention. In effect, it is deemed that when participants are exposed to two items simultaneously or within a short period of time, they do not devote as much attention to these items as when they are presented with sufficient spacing.

5. Conclusions

The results of this study revealed the effects of spaced distribution instruction on enhancing EFL long-term grammar learning (i.e., retention of grammatical structures). The results have some implications for EFL practitioners. First of all, homework assignments might be used to reexpose learners to the materials that they have learned before. It may be particularly suitable when class time is limited and a review is difficult. 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 using explicit self-regulatory strategies such as setting up a spaced practice schedule. Finally,

curriculum designers and materials developers can incorporate spacing as an instructional strategy into learning curricula and educational materials.

The findings of this study are subject to a number of limitations. The sampling method used 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 the scope of grammar covered in this study which was limited to the simple present tense structure. Therefore, other forms of grammar should be studied to realize if spaced distribution instruction can be consistently effective. Moreover, the treatment for both groups was mainly limited to explicit instruction and testing. Thus, applying communicative approaches to grammar teaching (i.e., focus on form) or implicit learning can be insightful. The test used in this study was error identification/correction test which is mostly a measure of declarative knowledge, and is not necessarily representative of how the study participants would use the grammar in spontaneous speech or writing. Finally, the participants of this study were elementary level EFL learners. Future studies can investigate the effect of spacing and massed distribution instruction across different levels of proficiency.

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Appendix A

Error Identification/Correction Test

Each of the following sentences has 1 or 2 grammatical errors.

1. Do he live in New York?
2. She watch TV at night.
3. What does Sam eats for dinner?
4. I usually plays in the park.
5. David don't clean her room.
6. Where does they live?
7. Dennis and I doesn't drink coffee.
8. Does she makes lunch?
9. Andy study her lessons after school.
10. It don't rain a lot.
11. Does they buy two sandwich?
12. My father buy a books every week.
13. What does she bakes every morning?
14. Sally doesn't rides his bicycle.
15. Bill put on a blue jackets every day.
16. Does Eva reads an newspaper?
17. My mother make two cake on Friday.
18. They doesn't help their mother.
19. When do Ms White clean the house?
20. Do your sister wash his hands after lunch?

Appendix B
A Sample of Grammar Quizzes

Review Quiz 1

Directions: Find the errors in each sentence and correct them.

Example: I are very happy.

I am very happy.

1. Robert and Kim works in a hotel.
2. Sam does not goes to the library on Tuesdays.
- 3 Where does you play in the park every day?
4. The girls helps their mother.
5. He don't like vegetables.

Review Quiz 2

Directions: Find the errors in each sentence and correct them.

Example: Sam are a neat boy.

Sam is a neat boy.

1. Does Sara plays the piano every afternoon?
2. My father usually read a newspaper at night.
3. When does they go to school?
4. Do Mr. Black wear his red shirt?
5. I does not have time.