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DEVELOPING IRANIAN EFL LEARNERS' GRAMMATICAL KNOWLEDGE: INSIGHTS FROM SPACED VERSUS MASSES INSTRUCTION

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Abstract

Despite grammar receiving greater emphasis than other language skills in Iranian schools, Iranian EFL students encounter challenges in acquiring the linguistic structures they are exposed to, resulting in insufficient grammar knowledge. This experiment looked into the effects of spaced versus massed instruction on learning modal auxiliaries among Iranian EFL learners with a lower-intermediate command of English. To this end, through an Oxford Quick Placement Tests (OQPT), 78 lower-intermediate learners were selected and assigned in three conditions, with 26 subjects in each: Spaced condition, Massed condition, Control condition. Using a Levene's test, it was shown that the subjects were homogenous prior to the experiment. Then, a pretest was used. The results of the pretest showed that there was no between groups' difference prior to the treatment. Afterward, the spaced group received three 30-minute sessions on modal auxiliaries based on Fundamentals of English Grammar by Azar (2016), while the massed condition received the instruction in just a single 90-minute session. The subjects in all conditions were then posttested. The results of a one-way between groups analysis of variance (ANOVA) showed that both treatment groups outperformed the comparison group ($p < .05$) with a large effect size (eta squared = .63). The results of post-hoc analyzes using Bonferroni adjustment further revealed that there was a statistically significant difference between the two experimental conditions ($p < .05$). That is, the spaced subjects gained more compared to their massed counterparts with regard to the targeted L2 form. Pedagogically, this study suggests ESL/EFL instructors could integrate spaced instruction strategies for enhancing students' proficiency in modals. Material developers may also leverage these findings to create more engaging and effective instructional materials.

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INTRODUCTION

Cognitive psychologists have shown interest in the impact of input spacing on learning for more than a century, but it has merely been in the last ten years that this area of study has gained prominence in the study of second language acquisition. Although numerous studies have demonstrated the impact of time distribution on L2 learning, the ideal distribution of L2 grammar practice is still unknown. The spacing effect proposes that, for a given amount of exposure, spacing out stimuli rather than massing them improves memory (Rogers, 2023). The impact has been established in the learning of L2 languages, primarily utilizing vocabulary (e.g., Bahrick & Hall,

2005; Bloom & Shuell, 1981; Koval, 2019; Nakata, 2015; Nakata et al., 2023; Pavlik & Anderson, 2005; Yan & Zhou, 2023), but also in grammar learning (Miles, 2014).

Experimental psychology study has indicated that learning delivered in strategically spaced intervals leads to better long-term maintenance than learning delivered in one extended, continuous session (massed dissemination). For instance, students who spend 45 minutes learning a list of words would retain those words longer if they divided that time into three 15-minute sessions and spread them out over several days or weeks rather than expending all of their energy in a single 45-minute session (Namaziandost et al., 2018).

The above lines suggest that spaced instruction is a pedagogical intervention which is becoming more popular in academic settings. A consensus exists that frequent knowledge retrieval by students can significantly positively influence learning (Kim & Webb; 2022; Roediger & Karpicke, 2006a, 2006b). The majority of forgetting happens in the first stages (Schmitt, 2000), hence expanding rehearsal theory proponents Baddeley (1990) and Pimsleur (1967) recommend that learners revisit new content right away and subsequently at growingly increasing intervals.

The question of whether variations in distributed instruction's design affect students' learning outcomes has been the subject of a sizable body of research (Lotfolahi & Salehi, 2016; Mashhadi et al., 2017; Nakata & Elgort, 2021; Namaziandost et al., 2018; Namaziandost et al., 2019a, Namaziandost et al., 2020a; Rogers & Cheung, 2020). Carpenter et al. (2012) reported that the majority of teachers and students are worried about when to study in order to maximize the retention of previously learnt material and improve learning/teaching results. Similarly, Many EFL instructors and students are unsure of whether spreading out the presentation and study of material over two or more sessions that are spaced apart in time (also known as spaced distribution instruction) improves learning compared to doing so in a single session of massed distribution instruction for the same amount of time. (Miles, 2014; Namaziandost et al., 2020b).

According to a large number of L2 researchers, to develop language skills, it is necessary to expose language learners to massive L2 input and repetitive and regular instances of L2 structures (e.g., DeKeyser, 2007; Mashhadi et al., 2017; Namaziandost et al., 2020a; Rogers & Cheung, 2021; Segalowitz, 2010). It is unclear, though, if this recurrence of inputs should ideally be spaced out or massed (Segalowitz, 2010). According to cognitive psychology, learning occurs best when the repetitions of the material to be retained take place in spaced sequences rather than in large or focus prenestations (Hosseini et al., 2017; Segalowitz, 2010). Notwithstanding, few real-class experimental studies have looked at the effects of spaced delivery instruction on second/foreign language learning and teaching, despite the prevalence of the spacing effect research in cognitive psychology (Etemadfar et al., 2019; Namaziandost, 2019b; Serrano, 2012). Ellis (2006) explicitly drew attention to this gap in real-classroom research on the spacing effect on language learning in order to encourage future research in the area.

Grammar constitutes an essential component of language proficiency, playing a crucial role in effective communication. In the context of Iranian schools, grammar receives considerable attention in language education; however, despite the emphasis, Iranian English as a Foreign Language (EFL) students encounter challenges in acquiring the linguistic structures, resulting in inadequate grammar knowledge (Kargar Behbahani & Khademi, 2022; Torkabad & Fazilatfar, 2014). This struggle to grasp grammar hinders their ability to communicate and convey messages proficiently. Recognizing the centrality of grammar in second/foreign language acquisition, this study aims to delve into the effectiveness of spaced and massed instruction in fostering the grammatical development of Iranian EFL learners. The investigation seeks to address the persisting issue of inadequate grammar knowledge among Iranian EFL students and contribute

valuable insights to the existing literature. By exploring the potential impact of spaced and massed instruction, this study aspires to provide educators and researchers with a deeper understanding of effective pedagogical approaches to enhance the grammatical competence of Iranian EFL learners.

Literature Review

Theoretical Background

Ebbinghaus (1885) explored his unique ability to recall and examine a grouping of nonsense syllables that had no obvious association in his memory in his original work Über das Gedächtnis. The spacing effect, as it is currently called, was initially introduced by this scholar. He discovered that, to be maintained longer in memory, periodic reviews of content are most beneficial. Simply said, rapid review of content (many repeats) worsens memory performance. In this respect, spaced review is more beneficial than massed review. Numerous reviews (Dempster, 1988, for instance) and meta-analyses (Cepeda et al., 2006, for instance) have found the spacing effect in a range of memory tasks.

The act of recalling information from memory is referred to as retrieval and is one of the memory processes (Carpenter et al., 2022; Gordon, 2020; Wojcik, 2013;). Retrieval is a crucial step because it benefits learning in two different ways. First, successful encoding is promoted synchronously (Grimaldi & Karpicke, 2012; Karpicke & Roediger, 2008). According to Roediger and Karpicke (2006), the second benefit has to do with increasing long-term retention in terms of the frequency and spacing of retrieval chances. Spacing is the process of placing materials between each other that requires effort but is brief enough to avoid forgetting. This tactic produces long-term memory (Karpicke & Roediger, 2007; Zhang et al., 2022).

According to deficient-processing theories, massed items do not receive adequate processing because of the short time between repetitions, while spaced items are better retained because the length of time between repetitions allows for full processing on subsequent occasions (Hintzman, 1976; Challis, 1993; Cuddy and Jacoby, 1982). As a result, in massed learning, the repeats take place while the first presentation is still rather fresh in the mind. This could encourage learners to pay less attention to the subsequent repetitions since they believe they already know the material better than they actually do (e.g., Bahrick & Hall, 2005). Based on study-phase retrieval theories, the spacing effect only occurs when the first presentation's memory trace is dormant at the time of the second repetition, allowing for more in-depth discussion of the previous presentation (e.g., Thios & D'Agostino, 1976). With additional time between repeats of an item, memory traces could be actively strengthened, making the spacing effect more potent (Kapler, Weston, & Wiseheart, 2015).

As per theories of encoding variability, retention of spaced items outperforms that of massed items because each repetition in a spaced condition is encoded differently, offering more cues for retrieval (e.g., Balota et al., 1989; Glenberg, 1979; Godden & Baddeley 1975, Landauer, 1969; Melton, 1970). According to this school of thought, each context that an item is stored in memory with also leaves memory traces. Spaced learning repetitions take place over a longer period of time than massed learning repetitions, which may give the context more opportunities to change, leading to a wider variety of memory traces and retrieval signals for subsequent recall.

The vast majority of prior studies have revealed that acquiring grammar, vocabulary, and reading skills more effectively through spaced instruction than through mass instruction (Miles, 2014; Miles & Kwon, 2008; Nakata, 2015; Seabrook et al., 2005). There is recent evidence that, when learning is assessed after a delayed posttest, spaced distribution training is superior to distribution teaching in maintaining target language structures (Miles, 2014). According to Miles (2014), the spacing effect may also be advantageous for developing intricate abilities other than

rote memorization. Additionally, Baddeley and Longman (1978) reported that pupils learning to touch-type can benefit from spacing training.

Empirical Background

One interesting study on the effect of spaced retrieval is that of Karpicke and Roediger (2006a) who worked on the contribution of testing on multi-trial free recall. In their experiment, participants learnt lists of words throughout several study and test trials before taking a recall test at the end. These scholars discovered that repeated recall of previously recalled items increased retention by more than 100% compared to eliminating those things from later testing. Therefore, they proposed that recurrent retrieval is the key to long-term retention.

Karpicke and Bauernschmidt (2011) conducted a different investigation to determine whether spaced retrieval patterns result in better learning. They demonstrated that compared to repeated retrieval with no spacing between tests, repeated retrieval with long delays between each test produced a 200 percent improvement in long-term retention. They continued by demonstrating that while extending schedules allowed for a pattern of escalating retrieval difficulty over the course of repeated testing, this did not result in improvements in long-term retention. The relative timing of repeated tests did not appear to have any noticeable effects, while repeated spaced retrieval had significant effects on retention.

One cutting-edge study on the impact of spacing instruction on L2 learning is that of Kargar Behbahani and Kooti (2022). These L2 researchers investigated the combined effects of word learning techniques such as pictorial cues, spaced repetition, and output-based tasks on word recall over time among Iranian EFL students at the high school level. To fulfill the goal of their study, they recruited 65 subjects through convenient sampling and divided them into an experimental and a control group. The treatment was administered to the experimental group over the entire academic year. Their study's findings demonstrated that the treatment's effects persisted over time in addition to the fact that word acquisition had improved from baseline to time 2 (the posttest).

The study conducted by Stoltzfus and Sukseemuang (2018) sought to clarify the ideal distribution of instructional time in non-intensive EFL grammar courses by examining whether 3.5 hours of weekly instructional time should be massed (conducted in a single session once a week) or distributed (short, daily sessions). Gains on a variety of eight grammatical themes were measured using a quasi-experimental approach including pre-test, immediate post-test, and delayed post-tests. Two grammar tasks with varied conceptual difficulties were part of the tests. The findings revealed that distributed practice greatly improved performance on immediate post-tests. Although the effect was not as noticeable, distributed practice also led to greater marks on the postponed test. Both massed and distributed practice had an equivalent impact on how well students performed on problems of different conceptual difficulty. These researchers concluded that long sessions held once a week are less helpful to develop language gains for short- and long-term recall than short sessions held every day.

In another study, Namaziandost et al. (2020a) studied the contribution of spaced versus massed instruction to word recall. To achieve the goal of their study, 75 Iranian students with lower-intermediate proficiency in English, ages 16 to 19, participated in 15 60-minute sessions. Thereafter, the subjects were randomly divided into a spaced group, a massed group, and a comparison group, with 25 participants in each of the groups. The target vocabulary was taught intensively in one session for the massed distribution group, gradually over the course of three sessions for the spaced distribution group, and not at all for the control group. Students were retested five weeks later using a before and after design. A receptive vocabulary test was used as both the pretest and the posttest in order to gather data. One-way ANOVA findings showed that

on both the immediate and delayed posttests, the spaced distribution group significantly performed better than the massed distribution group.

Namaziandost et al. (2018) also looked into the comparative effect of spaced retrieval and massed instruction on text comprehension skill of Iranian learners of English. They selected 50 intermediate learners and assigned them to two equal experimental and control groups. The researchers next administered a text comprehension pretest to the subjects to gauge their level of English reading comprehension. The two experimental groups were then instructed on five English texts from the Active One Book. Each reading was covered in a 60-minute intensive session in the massed class, whereas it took the spaced group three quick sessions to cover each text. Following the lesson, the two groups took a reading posttest, and the results were then analyzed using paired and independent samples t tests. It was ultimately disclosed that that the spacing group scored significantly better on the posttest than their massed counterparts (p <.05).

Another state-of-the-art study dealing with the comparative effects of these two techniques of teaching on vocabulary learning is that of Hamouda (2021). To do so, this scholar selected 66 learners of English from Saudi Arabia and then non-randomly divided them into a spaced group and a massed group. Both the massed learning condition and the spaced learning condition were used to teach the meaning of 50 new words to each group. Group 1 received three sessions at randomly spaced intervals whereas the massed group received one intensive session to learn the target language. The Oxford Quick Placement Test (OQPT), two vocabulary tests, and questionnaires were the instruments. On the posttest, the results showed that the spaced group fared much better than the massed group (p <.05). Additionally, the findings showed that the students thought that spaced practice was more efficient than massed practice. The outcomes further demonstrated that the spaced group had favorable opinions of the application of spaced exercise in vocabulary learning.

One interesting article which focused on the impact of massed teaching on fluency development is that of Suzuki and Hanzawa (2022). English language learners in classroom settings completed the same oral narrative task six times while following three distinct schedules in this cutting-edge study to explore the impact of task repetition with alternative schedules. The same six-frame cartoon narrative was told by them (a) six times in a row in one session (massed practice), (b) three times at the onset and closing of a class (short-spaced practice), and (c) three times in two classes that were separated by a week (long-spaced practice). The findings of an immediate posttest employing a new cartoon revealed that breakdown fluency was most significantly reduced by massed practice. The massed group, however, displayed diminished speed and repair fluency. On a posttest conducted a week later using a brand-new cartoon, the effects of repetition schedule appeared to be rather small. However, massed practice also produced more verbatim repeat when subjects narrated the same practiced animation one week later.

Another study which failed to find the supremacy of spaced instruction over massed instruction is that of Collins and White (2011). They looked at whether different instructional time distributions would have different effects on young (11–12 years old) French-speaking learners' learning of English in a longitudinal research. Throughout their rigorous experience, 11 classrooms of Grade 6 students (N = 230) in two variations of a comparable intensive ESL program were observed. In one program, the 400 hours of teaching were spread out over a 5-month period, whereas in the other, the 400 hours were spread out over the course of the whole 10-month school year in a series of intense exposures. Through a battery of comprehension and production tests, language development in the two contexts was compared four times. Overall, both groups made

significant gain over time according to the data, and neither group clearly learned more by focused on or sharing the intensive experience.

In another study, Lee and Chloe (2014) examined the impact of spaced review on Korean elementary students' English vocabulary learning in an effort to discover the best method of presenting and teaching new terms in the context of textbook-based instruction. Experiment 1 involved sixty fourth graders. Four classroom activities spread across three different time slots helped the students learn new vocabulary. These activities included four 10-minute presentations with one activity each, two 20-minute presentations with two activities each, and one long 40-minute presentation with all four activities. It was discovered that review spacing and vocabulary growth did not interact in a meaningful way. With new words and participants (n = 57), Experiment 2 followed the same steps as Experiment 1 and produced results that supported the initial conclusion.

To cut a long story short, a large body of research especially those listed above point to the superiority of spaced instruction over massed instruction in language learning. However, a cutting-edge study by Suzuki and Hanzawa (2022) discussed above directly pointed to the efficacy of massed instruction. Some other researchers also failed to show the supremacy of spaced instruction over massed instruction (e.g., Collins & White, 2011; Lee & Chloe, 2014). Furthermore, to the best of what the authors know, there has been no study comparing the effect of spaced and massed instruction on grammar learning in an Iranian context. It is for this reason that the researchers felt that there is room to carry out one more study comparing the effects of these techniques on grammar development of EFL learners in an Iranian context. Thus, in this study, attempts are made to find an answer to the following research question:

Research Question: What is the impact of spaced versus massed instruction on grammatical development of Iranian EFL learners?

RESEARCH METHOD

Research Design

A non-randomized pretest posttest control group design was used in this study. The researchers used convenient sampling to select the participants of the study which is presented below. Thus the study is quasi-experimental in nature as randomization, an obvious component of true experimental studies (Ary et al., 2019; Bachman, 1990; Ellis, 2012; Mackey & Gass, 2015) was absent in this experiment.

The selection of a non-randomized pretest posttest control group design for this study stems from the specific nature of our research objectives and the practical constraints inherent in our study context. The primary aim of our investigation is to examine the effects of spaced and massed instruction on the grammatical development of Iranian EFL learners. Given the quasi-experimental nature of our study, it is essential to acknowledge the inherent challenges and constraints in conducting true experimental research, such as those outlined by Ary et al. (2019), Bachman (1990), Ellis (2012), and Mackey & Gass (2015).

The decision to employ a quasi-experimental design, characterized by the absence of randomization, is rooted in the practical considerations of participant selection in our specific educational setting. True randomization, often regarded as a hallmark of experimental rigor, may be logistically challenging in real-world educational environments, particularly when dealing with intact groups or specific classrooms. Additionally, the use of convenient sampling aligns with the constraints of accessibility and availability of participants in the targeted language institute.

Research Participants

This study included 78 English as a foreign language students at a language institute in Khuzestan, Iran. These subjects were recruited through convenient sampling based on their availability. Half of the learners were female and the rest were male learners. The above-mentioned sample was chosen from a pool of 160 people. The participants' ages ranged from 13 to 19 years. All participants in this study had Persian as their L1 and English as their L2 respectively. Three groups made up of the chosen subjects were formed: control group (n = 26), spaced group (n = 26), and massed group (n = 26). It is important to mention that none of these participants had ever visited an English-speaking country before the study.

Instruments

To accomplish the objectives of the current study, a range of tools that allowed the researchers to acquire the required data were used. OQPT was administered to choose study participants. The respondents chosen for the study had OQPT scores between 28 and 33, which indicated a lower intermediate proficiency in English. A teacher-made test was also utilized as a pretest to gauge the participants' understanding of the L2 target form, and a posttest similar to the pretest but with different item sets was also given. There were multiple-choice, fill-in-the-blank, recognition, and open-ended questions on the tests. The construct validity of the test was corroborated through known-group technique (Ary et al., 2019). That is, a group of learners with advanced level of English proficiency was given the same test, and the difference between advanced learners and pre-intermediate learners was found significant ($p < 0.05$). Furthermore, the reliability of the instrument using KR-21 formula was confirmed ($r = 0.81$). In addition, the subjects were taught the target L2 form (modal auxiliaries) using Fundamentals of English Grammar by Azar (2016).

Treatment

After homogenizing subjects, all three groups took a pretest so that the researchers could ensure that they do not know the target L2 form (modal auxiliaries). Then, subjects in treatment conditions received instruction on modals but in different ways. Group 1 (spaced group) had 3 90-minute sessions a week and in each session, 30 minutes was devoted to modals. However, Group 2 (massed group) received all the instruction on modals in a single 90-minute session. It also goes without saying that the comparison group did not receive the treatment. That is, subjects in the comparison group only took OQPT, pretest and the immediate posttest.

The whole data collection procedure lasted 6 sessions. In the first session, an OQPT was administered to ensure subjects' level of English proficiency. Afterward, the subjects in treatment conditions and the comparison group took the pretest. It was only then that the spaced group received three sessions on the targeted L2 form while the massed group received an intensive 90-minute session on the linguistic form. Thereafter, the subjects sat for an immediate posttest so that the researchers can compare and contrast between groups' differences.

Method of Data Analysis

SPSS software was used to execute the statistical tests. A Kolmogorov-Smirnov (K-S) test was first applied to confirm the normality assumption. Then, a one-way between-groups analysis of variance was used to calculate the comparative effects of spaced and massed training (ANOVA). Post-hoc evaluations were eventually conducted to determine which approach is superior.

RESEARCH FINDINGS

Prior to carrying out statistical analyzes on the data, the researchers first ran a one-sample K-S test to ensure the normality of the data.

Table 1.
One-Sample Kolmogorov-Smirnov Test

		Pretest
N		78
Normal Parameters[a,b]	Mean	3.5769
	Std. Deviation	1.66335
Most Extreme Differences	Absolute	.200
	Positive	.200
	Negative	-.163
Kolmogorov-Smirnov Z		1.764
Asymp. Sig. (2-tailed)		.004

a. Test distribution is Normal

As Table 1 shows, the sig. (2-tailed) value is less than 0.05, hence the normality of the data. Because the data are normality distributed, then parametrical statistical techniques could be performed. Another important assumption of one-way ANOVA is that of homogeneity.

Table 2.
Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Pretest	.130	2	75	.878
Posttest	1.815	2	75	.170

Table 2 indicates that for both pretest and posttest, the sig. value is well above 0.05 substantiating the equality of variance assumption ($p > 0.05$). Now that both normality of the data and equality of variance assumptions have been verified, it is now turn to provide the descriptive results.

Table 3.
Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Pretest	Spaced Group	26	3.0385	1.68477	.33041	2.3580	3.7190	.00	6.00
	Massed Group	26	3.9231	1.67148	.32780	3.2480	4.5982	1.00	7.00
	Control Group	26	3.7692	1.55712	.30538	3.1403	4.3982	1.00	6.00
	Total	78	3.5769	1.66335	.18834	3.2019	3.9520	.00	7.00
Posttest	Spaced Group	26	10.3846	2.72876	.53515	9.2824	11.4868	5.00	15.00

	Massed Group	26	8.3846	2.17397	.42635	7.5065	9.2627	5.00	13.00
	Control Group	26	3.2692	2.05052	.40214	2.4410	4.0975	1.00	7.00
	Total	78	7.3462	3.79619	.42983	6.4902	8.2021	1.00	15.00

Table 3 indicates that on the pretest, the mean for spaced group is 3.03 with 1.68 standard deviation (M= 3.03, SD= 1.68), 3.92 with 1.67 standard deviation for the massed group (M= 3.92, SD= 1.67), and 3.76 with 1.55 standard deviation for the control group (M= 3.76, SD= 1.55). That is to say, all the groups performed similarly on the pretest. However, the above table further demonstrates that on the posttest, the mean for group 1 is 10.38 with 2.72 standard deviation (M= 10.38, SD= 2.72), 8.38 with 2.17 for the second group (M= 8.38, SD= 2.17), and 3.26 with 2.05 standard deviation for the control group (M=3.26, SD= 2.05). Thus, both experimental groups outperformed the control group on the posttest as they gained in knowledge from time 1 to time 2, while the control group did not.

Table 4.
ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Pretest	Between Groups	11.615	2	5.808	2.162	.122
	Within Groups	201.423	75	2.686		
	Total	213.038	77			
Posttest	Between Groups	700.231	2	350.115	64.136	.000
	Within Groups	409.423	75	5.459		
	Total	1109.654	77			

The ANOVA table presented above demonstrates in an inferential sense that the difference between groups on the pretest at 2.16 degrees of freedom was not statistically significant ($F = 2.16$, $p > 0.05$), while the difference was significant on the posttest at 64.13 degrees of freedom ($F = 64.13$, $p < 0.05$). Furthermore, There was a large effect size on the posttest (partial eta squared = .63).

Table 5.
Multiple Comparisons

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Pretest	Spaced Group	Massed Group	-.88462	.45452	.166	-1.9977	.2284
		Control Group	-.73077	.45452	.336	-1.8438	.3823
	Massed Group	Spaced Group	.88462	.45452	.166	-.2284	1.9977
		Control Group	.15385	.45452	1.000	-.9592	1.2669
	Control Group	Spaced Group	.73077	.45452	.336	-.3823	1.8438
		Massed Group	-.15385	.45452	1.000	-1.2669	.9592

Posttest	Spaced Group	Massed Group	2.00000*	.64801	.009	.4131	3.5869
		Control Group	7.11538*	.64801	.000	5.5285	8.7023
	Massed Group	Spaced Group	-2.00000*	.64801	.009	-3.5869	-.4131
		Control Group	5.11538*	.64801	.000	3.5285	6.7023
	Control Group	Spaced Group	-7.11538*	.64801	.000	-8.7023	-5.5285
		Massed Group	-5.11538*	.64801	.000	-6.7023	-3.5285

Table 6 reveals post-hoc analyzes using Bonferroni adjustment test. As the table presents, on the posttest the spaced group had a higher mean than both massed and control groups. That is, mean difference between the experimental groups is 2 with 0.648 standard deviation (Mean difference = 2.00, SD= .648), and it is 7.11 with .648 standard deviation (Mean difference = 7.11, SD= .648) between the spaced group and the comparison group. The table also indicates that the difference between spaced group and massed group and between spaced group and the control group is significant (p <0.05). Furthermore, according to the above-presented table, the difference between the massed group and the control group is significant (Mean difference = 5.11, SD = .648, p < 0.05).

Discussion

In this study, attempts were made to uncover the possible contribution of spaced versus massed instruction to the grammatical development of Iranian EFL learners. To accomplish this objective, through an OQPT, 78 learners with pre-intermediate proficiency level of English were selected and they were then divided into two experimental conditions along with a comparison group with 26 subjects in each. Prior to the experiment, all the groups were pretested to ensure their homogeneity. The results of the Levene's test showed that the groups were homogenous (p > .05). Additionally, the carried out one-sample K-S test indicated the normal distribution of the data. Then, descriptive statistics showed that in pretest there was not a significant difference between the three groups, while the difference between the groups on the posttest was statistically significant. The ANOVA table also pointed to the significant between groups difference on the posttest with a large effect size (p < .05, eta squared = .63). In addition to these, to figure out which technique is superior post-hoc analyzes using the Bonferroni adjustment test was conducted. The results demonstrated that both treatment conditions outperformed their comparison counterparts on the posttest (p < .05). Additionally, a significant difference was discovered between the two experimental groups. That is to say, the spaced group also outperformed the massed group on the posttest (p < .05).

The findings of our study resonate with the well-established theoretical foundations of the spacing effect and its implications for memory and learning. Ebbinghaus (1885), an early pioneer in memory research, laid the groundwork for understanding how periodic reviews, or spaced repetition, significantly contribute to prolonged memory retention. Our study aligns with Ebbinghaus's observations, demonstrating the benefits of spaced instruction over massed instruction in the context of grammatical development among Iranian EFL learners.

The theoretical underpinnings, as articulated by deficient-processing theories, emphasize that massed learning may result in inadequate processing due to the short intervals between repetitions. This theoretical perspective suggests that the first presentation remains fresh in the mind during rapid repetitions, potentially leading learners to allocate less attention to subsequent repetitions. Our findings substantiate this claim, with the spaced instruction group outperforming the massed instruction group, indicating a more thorough processing and retention of the targeted L2 form, modal auxiliaries. Moreover, study-phase retrieval theories posit that the spacing effect is optimized when the memory trace of the initial presentation is dormant at the time of the second repetition. Our study, by employing spaced instruction, allowed for a longer period between repetitions, facilitating the active strengthening of memory traces. This aligns with the theoretical premise that the spacing effect is more potent when memory traces are given additional time for reinforcement, contributing to enhanced grammatical learning.

The theories of encoding variability shed light on the idea that spaced learning repetitions lead to better retention because each repetition in a spaced condition is encoded differently, providing a diversity of cues for retrieval. This aligns with our study's results, as the spaced instruction group demonstrated superior performance, implying a richer variety of memory traces and retrieval signals compared to the massed instruction group. The broader literature on spaced instruction in language learning, including grammar acquisition, supports our findings. Consistent with prior studies (Miles, 2014; Nakata, 2015; Seabrook et al., 2005), our research underscores the effectiveness of spaced instruction in fostering superior learning outcomes compared to massed instruction. The evidence presented in this study, combined with the theoretical foundations, supports the notion that spacing training is not only advantageous for rote memorization but also for the development of complex language skills, such as grammatical proficiency.

The obtained results can be attributed to various cognitive and pedagogical factors, shedding light on the differential impact of spaced and massed instruction on the grammatical development of Iranian EFL learners. One possible explanation is rooted in cognitive processing theories, particularly the concept of encoding variability. The spaced instruction group experienced varied encoding during intervals between sessions, promoting deeper cognitive processing and resulting in a more diverse network of memory traces. Scholars such as Balota et al. (1989) and Glenberg (1979) emphasize that this variability enhances retrieval cues, contributing to the observed superior performance in the spaced group. Additionally, the results align with theories related to memory consolidation and retrieval. The spacing effect, as suggested by Karpicke and Roediger (2007), involves strengthening memory traces through spaced repetitions. The intervals provided in the spaced instruction condition facilitated memory consolidation, enhancing the learners' ability to retrieve the targeted L2 form—modal auxiliaries—during the posttest.

Furthermore, the avoidance of overlearning and optimal utilization of attentional resources might have played a role in the observed outcomes. Massed instruction can lead to overlearning, diminishing active engagement with the material (Bahrick & Hall, 2005). In contrast, spaced instruction allowed learners time for focused attention and processing between sessions, preventing overlearning and ensuring each encounter demanded active cognitive engagement. The transfer of knowledge to long-term memory is a crucial aspect contributing to the effectiveness of spaced instruction. Ebbinghaus' foundational work (1885) highlights the significance of spaced repetition for knowledge retention over an extended period. The longer intervals between sessions in the spaced instruction condition facilitated the transfer of grammatical knowledge to long-term memory, leading to sustained learning outcomes.

Moreover, the results may be linked to the management of cognitive load. Spaced instruction, by distributing learning sessions, helps manage cognitive load effectively (Carpenter et al., 2022). Learners in the spaced group had time to process and internalize the modal auxiliaries, optimizing learning conditions. Conversely, the massed instruction group might have experienced increased cognitive load, potentially hindering their ability to fully absorb and retain the grammatical content. These findings underscore the pedagogical implications of incorporating spaced instructional strategies in language education. The observed advantages of spaced instruction highlight the importance of allowing learners intervals for reflection, review, and consolidation in language learning settings. ESL/EFL instructors can leverage these insights to design curricula that integrate spaced instructional approaches for enhanced language acquisition.

As the results of this experiment revealed, both spaced and massed instruction ameliorated Iranian EFL Learners' grammar although spaced instruction proved to be superior in effect. This is consistent with the findings of cognitive psychology pointing to the supremacy of spaced retrieval across a large number of learning modes (Seabrook et al., 2005). The outcomes also support certain earlier studies (e.g., Kargar Behbahani & Kooti, 2022; Miles, 2014; Miles & Kwon, 2008; Namaziandost et al., 2018; Namaziandost et al., 2020a; 2020b; Rohrer & Pashler, 2007) which found that spaced instruction enhanced foreign language learning. Furthermore, these findings differ from those of earlier research, which indicated no discernible advantage of spaced settings over massed conditions on immediate posttests (Collins & White, 2011; Lee & Choe, 2014; Miles, 2014; Snoder, 2017). Studying content during two or more sessions that are spread apart or divided in time, as Carpenter et al. (2012) state, "typically produces better learning than spending the same amount of time studying the topic in a single session" (p. 5).

The encoding variability idea states that there is a positive relationship between items spacing and their encoding in learner's mind (Anderson & Bower, 1972). More retrieval cues are provided by this variation in-memory representation, which is made possible by the various contexts in which spaced objects appear. As a result, spaced distribution instruction favors memory. Additionally, the first presentation in a spaced sequence is not readily accessible at the time of the second presentation, necessitating thorough processing of the second presentation, according to the inadequate processing theory (Jacoby, 1978). This processing consequently aids in learning and memory retention. In practice, it is believed that when participants are exposed to two items simultaneously or quickly, they do not pay as much attention to these items as when they are offered enough time to consider each one separately.

The case for the spacing effect methodology's use in explicit grammar education appears to be growing. Even though SLA scholars (Bird, 2010; Miles, 2010) have just started to look into the potential of spaced distribution teaching for grammar learning, the preliminary studies have shown encouraging outcomes. Further evidence for this claim comes from the study presented here, which demonstrates that improvements in grammar obtained by spaced distribution are more resilient to subsequent loss than gains made through mass practice teaching. In addition to what went above, Lotfolahi and Salehi (2017) used a novel approach to identify distinct spacing schedules in young EFL learners, which supports the findings of this study. To do this, they used various spacing patterns to teach young EFL learners pairs of English and Farsi words. The results showed that spaced practice rather than mass practice promoted greater long-term recall. These outcomes were in line with the reports of Miles (2014) who showed that although there is no difference between spaced and massed instruction in the short-term, spaced instruction proves to be superior in the long run.

The implications of this study extend to both ESL/EFL instructors and material developers. For ESL/EFL instructors, the findings suggest practical applications in the classroom. The superiority of spaced instruction over massed instruction in enhancing Iranian EFL learners' grammatical development highlights the effectiveness of a distributed learning approach. Instructors can incorporate spaced instructional strategies when teaching grammar, particularly focusing on complex structures like modal auxiliaries. By spacing out instructional sessions and providing learners with more opportunities for reflection, review, and consolidation, instructors can potentially enhance the depth of processing and improve long-term retention of grammatical structures.

Furthermore, the study's implications are relevant to material developers who create educational resources for ESL/EFL learners. Understanding that spaced instruction yields more significant gains in grammatical development than massed instruction, material developers can design materials that align with the principles of distributed learning. Developing materials that encourage spaced exposure, practice, and reinforcement of grammatical concepts may contribute to more effective language learning outcomes. Additionally, incorporating varied contexts and retrieval cues in instructional materials can align with theories of encoding variability, supporting learners in developing a robust understanding of grammatical structures.

CONCLUSION

In conclusion, this study explored the impact of spaced versus massed instruction on the grammatical development of Iranian EFL learners, focusing on the learning of modal auxiliaries. The findings revealed significant differences between the two instructional approaches, with spaced instruction proving to be more effective in fostering grammatical improvement. The theoretical underpinnings of cognitive psychology, particularly the spacing effect and encoding variability, provided a framework for understanding the observed outcomes. The results align with prior research highlighting the benefits of spaced instruction in various learning domains, including language acquisition. The spacing effect, as proposed by Ebbinghaus (1885) and supported by subsequent studies (Cepeda et al., 2006), emphasizes the advantages of distributing learning sessions over time for optimal memory retention.

The study further delved into cognitive processes such as memory consolidation, retrieval, and cognitive load management to elucidate the mechanisms contributing to the superiority of spaced instruction. The avoidance of overlearning, varied encoding, and effective cognitive load management emerged as key factors influencing the learners' ability to acquire and retain knowledge of modal auxiliaries. Pedagogically, the study's findings hold implications for ESL/EFL instructors and material developers. The demonstrated effectiveness of spaced instruction suggests that educators should consider integrating spaced learning strategies into language curricula. This approach can enhance the depth of cognitive processing, facilitate better memory consolidation, and contribute to sustained grammatical improvement among language learners.

Despite these valuable insights, it is essential to acknowledge the study's limitations. The use of convenient sampling and the relatively small sample size raise questions about the generalizability of the findings. Additionally, the study focused on a specific language proficiency level and geographic location, limiting the broader applicability of the results. Future research endeavors could address these limitations by employing larger and more diverse participant groups. In essence, this study contributes to the existing body of knowledge on instructional methodologies by emphasizing the efficacy of spaced instruction in the context of language

learning. The implications extend beyond the immediate focus on modal auxiliaries, providing valuable guidance for educators seeking evidence-based approaches to enhance grammatical development in language learners.

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