

The Effects of Three Spacing Methods on Students' Mid- to Long-term Retention of Lexis

James Bury

Shumei University, Japan

This article investigates the effect that six different lexical spacing interval schedules had on Japanese university students' retention of lexis on a translation test completed in the first and last lessons of a 15-lecture course. Two schedules used an expanded spaced retrieval (ESR) technique, two employed a uniform spaced retrieval (USR) technique, and two were based on massed retrieval (MR) methods. It was found that the ESR and USR schedules had greater positive effects on student performance than MR. It is also posited that the challenging learning conditions created by expanding the intervals between the initial encoding of a lexical item and subsequent retrieval attempts can positively affect students' retention rates and overall learning experiences. Consequently, it is suggested that teachers and curriculum developers implement ESR and USR techniques more when planning and adapting materials.

本論は、日本の大学生が全15回の講義の初回と最終回に行う訳の試験での語彙定着力に、6つの異なる語彙分散間隔スケジュールがどのような効果を与えるかを調査したものである。2つで間隔伸張検索 (ESR: expanded spaced retrieval) 法を使用し、別の2つで均一間隔検索 (USR: uniform spaced retrieval) 法、残りの2つは集中検索 (MR: massed retrieval) 法を用いた。結果としてESRとUSRは、MRよりも学生の成績により良い影響を与えた。また、語彙の最初の発信と次の検索の間隔を延ばすという厳しい学習条件が、学生の語彙の定着率と総体的な学習経験に良い影響を与えると仮定される。そのため、教師やカリキュラム作成者は、教材の教授予定を作成する際、より多くのESRやUSR法を取り入れるよう推奨したい。

When teaching reading courses, or reading segments of more integrated courses, instructors regularly use materials that include complex grammatical structures and exigent lexical items (Bury, 2014). Exposing students to vocabulary that is too challenging can be overwhelming and demotivating (Huang & Liou, 2007), negatively affecting retention of vocabulary and the overall learning process (Fulcher, 1997). Therefore, finding a way to introduce new, more advanced vocabulary in a way that engages students and improves their mid- to long-term retention of lexical items is imperative for teachers.

This article examines the effects of three spacing methods on students studying in an English for Tourism course at a Japanese university. The methods investigated were expanded spaced retrieval (ESR), uniform spaced retrieval (USR), and massed retrieval (MR). A recent study by Bury (2014) found that Japanese university students reported increased levels of confidence and perceptions of ability following a course incorporating USR, but that study did not investigate the comparative effect of ESR or MR. As ESR and USR methods have predominantly been tested on college-age adults (Balota, Duchek, & Logan, 2007) and Alzheimer's patients (Camp, Bird, & Cherry, 2000), this paper adds to the current literature, expands the contexts in which the methods have been investigated, and identifies a practical way to improve students' mid- to long-term retention of lexis.

Literature Review

Texts used in traditional English courses are often grammatically complex and introduce academic lexical items that have not been previously encountered by the students. Consequently, students are exposed to more advanced vocabulary and this can aid language acquisition, as in Krashen's (1981) theory of comprehensible input. However, if learners are presented with too many new items, or with items of a level that is perceived as unattainable, they can quickly become demotivated, raising their affective filters (Krashen, 1981). Research has shown that students often become overwhelmed with the complexity of the texts they encounter in class (Murphy, 2007), and this can negatively affect their learning experiences (Fulcher, 1997).

Spaced retrieval is a method of memory improvement in which items are spaced over a lesson, or set of lessons, and not massed together in quick succession, as in MR. Spaced retrieval can be divided into two types: expanded spaced retrieval (ESR) and uniform spaced retrieval (USR). When implementing ESR, items are spaced at increasingly

distant intervals, instead of being standardized, as in USR (Logan & Balota, 2008). In terms of lesson and syllabus planning, the retrieval plan for an item in an ESR schedule could be [1-3-6-10], where the numbers represent the lessons in a course, or possibly activities, if used in a shorter course, in which the item would be reintroduced after the initial presentation. The retrieval schedule used in a USR method could be based around a schedule similar to [1-3-5-7]. MR, which is a technique commonly employed in the periods leading up to exams by students and teachers, attempts to cram information into students' memories through repetition in quick succession.

Camp, Bird, and Cherry (2000) claimed that ESR is particularly beneficial for long-term retention of information, and Landauer and Bjork (1978) demonstrated an average increase in final recall tests in an ESR experiment. Cull, Shaughnessy, and Zechmeister (1996) also found a significant advantage for ESR schedules over USR in final recall tests.

Three explanations of why the ESR method produces generally better results than USR and MR can be identified. Firstly, the increased intervals between items being reintroduced makes it necessary for the information to be retained for longer periods before it is retrieved than in USR and MR methods. This makes it more difficult to access an item, leading to increased retrieval effort (Carpenter & DeLosh, 2005), and thus, a strengthening of retrieval routes (Baddeley, 1997). Therefore, in a retrieval schedule where the first retrieval attempt comes after just one lesson or activity, the retrieval event is relatively easy, whereas when there is a larger interval, an increased amount of re-sampling occurs (Karpicke, 2004, cited in Logan & Balota, 2008).

Secondly, Landauer and Bjork (1978) found an increase in performance during the learning phase of their ESR experiment, and early retrieval success in the initial stages of the learning process encouraged successful retrieval later in the test stage (Camp, Bird, & Cherry, 2000). However, although retrieval success is important during learning for maintaining student motivation, retrieval schedules that have consistently high rates of retrieval success, such as MR, are less effective in developing long-term retention, indicating that mid- to long-term retention benefits from a certain level of difficulty and imperfect performance during the learning process (Bjork, 1999).

Thirdly, spaced retrieval techniques present learners with opportunities to encode items in more than one context (Pashler, Cepeda, Wixted, & Rohrer, 2005), increasing the likelihood that the word will be successfully retrieved later (Cobb, 1999;

Schmitt, 2000). Schedules that incorporate multiple retrieval attempts allow students to reprocess items, and increased exposure can help students consolidate meaning (Schmitt & Carter, 2000; Folse, 2004). However, recalling items that are already highly accessible does not require much additional contextual sampling, and therefore does little to consolidate mid- to long-term lexical retention.

Therefore, the most effective retrieval schedules are likely to be those that balance retrieval effort with retrieval success multiple times throughout a course. Consequently, mid- to long-term retention of an item will optimally occur when it requires maximum effort to retrieve in a number of contexts, without being totally inaccessible (Bjork, 1999).

Method

Eighty-eight students in the Tourism and Business Management Department and the English and I.T. Department at a university in the Kanto region of Japan enrolled in three different classes that covered the same materials based around English for Tourism. The classes were made up of 46, 26, and 16 first- to fourth-year mixed-ability students. Students that did not have 100% attendance were not included in the final analysis as their absence may have negatively impacted the effect the different retrieval schedules had. Consequently, this article reports on the test results collected from 71 students ($M = 19.6$ years old, $SD = 1.3$).

All participants were given a translation test (Appendix A) in the first lesson of the course. The items were then reintroduced four times each in the class materials throughout the course using six different retrieval schedules: two for ESR, [5-7-10-14] (S1) and [2-5-9-14] (S2); two for USR, [8-10-12-14] (S3) and [5-8-11-14] (S4); and two for MR, [13-13-14-14] (S5) and [14-14-14-14] (S6). All six retrieval methods were used in all of the classes. The test consisted of 36 items, six from each schedule. A second test, using the same items ordered differently, was then administered in the last lesson of the course of 15 lectures. Results for both tests were returned to the students.

The schedules used in this investigation were chosen because they best fitted the Japanese university semester length of 15 lectures. As performance in memory retention and retrieval tests is affected by the intervals between the last engagement with an item and the final recall test (Crowder, 1976), all of the schedules finished in Lesson 14, one week before the last test in Lesson 15.

According to Huang and Liou (2007), in order to improve students' retention of lexical items, it is essential for vocabulary instruction to be targeted

to their needs and goals. Ensuring that the target language in a course is relevant to students' contexts is of particular importance, as relating new vocabulary to their own experiences strengthens their associations and can improve language retention (McAdams, 1993; Sökmen, 1997). In view of this, the items used in this study were selected according to relevance to the course content, as well as level according to the JACET 8000 Level Marker (<http://www.tcp-ip.or.jp/~skim/J8LevelMarker/j8lm.cgi>) (Appendix B). Each subset (1-6) consists of six items within the same JACET 8000 level, and is made up of only nouns, verbs, or adjectives. The items within the six subsets were assigned to each of the six schedules randomly.

When teaching English for Tourism, the focus on communicative competence and intercultural communication is especially pertinent (Alred, Byram, & Fleming, 2003). Consequently, unlike traditional English courses, which have been regarded as noncommunicative (Zhang, 2009; Rustipa, 2010), this course was developed and taught in a way that encouraged the students to engage with the lexical items communicatively in extension activities. Low-frequency lexical items were avoided where possible, and the complexity of the texts increased throughout the course. Furthermore, by providing the participating students with positive and encouraging feedback, the teacher aimed to improve students' self-belief, perceptions of ability, and confidence, which would in turn help to improve communicative competence (Bury, 2014).

Results and Discussion

From Table 1, it can be seen that all of the items on the test showed improved recognition rates across all six schedules. The smallest positive effect was 5.4% on Item 4 of Schedule 5, and the greatest was 33.7% on Item 6 in Schedule 4.

Table 1. Test Results and Differences in Percentage by Item

S1 [5-7-10-14]							
	1	2	3	4	5	6	Total
Test 1	75.7	67.6	58.1	54.1	43.2	63.5	60.4
Test 2	94.6	89.2	73.6	82.5	68.9	91.9	83.5
Diff.	18.9	21.6	15.5	28.4	25.7	28.4	23.1
S2 [2-5-9-14]							
	1	2	3	4	5	6	Total
Test 1	77.8	63.5	56.8	64.9	70.3	56.8	65.0
Test 2	90.2	84.5	75.0	81.1	83.8	86.5	83.5
Diff.	12.4	21.0	18.2	16.2	13.5	29.7	18.5

S3 [8-10-12-14]							
	1	2	3	4	5	6	Total
Test 1	87.8	78.4	86.5	71.6	56.8	62.2	73.9
Test 2	97.3	94.6	98.6	90.5	75.7	86.5	90.5
Diff.	9.5	16.2	12.1	18.9	18.9	24.3	16.7
S4 [5-8-11-14]							
	1	2	3	4	5	6	Total
Test 1	84.5	79.7	54.1	80.5	52.7	59.5	68.5
Test 2	93.6	87.8	79.7	89.3	83.8	93.2	87.9
Diff.	9.1	8.1	25.6	8.8	31.1	33.7	19.4
S5 [13-13-14-14]							
	1	2	3	4	5	6	Total
Test 1	83.8	70.3	90.5	58.1	60.8	54.1	69.6
Test 2	97.3	81.1	98.6	63.5	68.9	67.6	79.5
Diff.	13.5	10.8	8.1	5.4	8.1	13.5	9.9
S6 [14-14-14-14]							
	1	2	3	4	5	6	Total
Test 1	87.8	78.4	74.3	59.5	79.7	56.8	72.8
Test 2	95.9	87.8	89.2	73.0	90.5	71.6	84.7
Diff.	8.1	9.4	14.9	13.5	10.8	14.8	11.9

As Table 1 shows, the schedule that had the greatest positive effect on test results was S1 (23.1%), followed by S4 (19.4%), S2 (18.5%), S3 (16.7%), S6 (11.9%), and S5 (9.9%). These data, when looked at in conjunction with that shown in Table 2, indicate that ESR has the greatest positive effect on students' retention of lexical items, with a combined average of 20.8%, followed by USR (18.1%), then MR (10.9%). Thus, it can be stated that the students showed substantial benefits of both ESR and USR when compared to MR. This is consistent with findings from Balota, Duchek, Sergeant-Marshall, and Roediger (2006), and Logan and Balota (2008).

Table 2. Test Results and Differences in Percentage by Schedule

	Test 1	Test 2	Difference	Average diff.
S1	60.4	83.5	23.1	20.8
S2	65.0	83.5	18.5	
S3	73.9	90.5	16.7	18.1
S4	68.5	87.9	19.4	
S5	69.6	79.5	9.9	10.9
S6	72.8	84.7	11.9	
Average	68.4	84.9	16.6	

While there was variation in the levels of positive effects between the different schedules, the two schedules that showed the highest average differ-

ence were S1 and S4. Both of these schedules had an average interval of three lessons (S1 [2-5-9-14] and S4 [5-8-11-14]). This suggests that in the EFL and ESP contexts, retrieval schedules with intervals averaging three lessons have the greatest positive effect on students' retention of lexis over a 15-lecture course. S2 had the third greatest effect, with an average interval of four lessons ([2-5-9-14]), followed by S3 with intervals of two lessons ([8-10-12-14]).

A number of limitations in this study can be identified. The course was conducted over 15 lectures, so it was not possible to examine the effects that larger periods of expansion may have had on retention levels. Furthermore, each lesson was at least a week apart, so the students would have come into contact with multiple external inputs outside of this study. The course was not studied in isolation, and other external factors that the students were exposed to, including both formal and informal learning, may have affected the findings outlined above (Erstad, Gilje, Sefton-Green, & Vasbo, 2009; Furlong & Davies, 2012). Additionally, the data do not control for words the students may already have known before the course. Finally, there were non-native Japanese students among the participants in this study, and, although all students at the university must have achieved a standardised level of Japanese proficiency before enrolment, it is possible that a translation test could have negatively affected their test scores.

Conclusion

Although one technique did not produce consistent advantages in the final recall test, it is important to note that all of the schedules for ESR and USR showed a greater positive effect than MR. This is consistent with previous studies that found spaced retrieval in any form is a beneficial memory improvement technique in terms of the learning stage, final recall tests, and students' confidence and perceptions of ability (Camp, Bird, & Cherry, 2000; Balota, Duchek, & Logan, 2006; Bury, 2014). Therefore, it is suggested that more teachers and curriculum developers implement both ESR and USR techniques when planning and adapting their course materials.

It is also posited that the challenging learning conditions created by expanding the intervals between the initial encoding of a lexical item and subsequent retrieval attempts can positively affect students' retention rates and overall learning experiences. In certain circumstances, higher degrees of success during learning could improve motivation and students' confidence, especially for students who are often frustrated by difficulties with their memory. However, finding a schedule that successfully balanc-

es the maximum effort required to retrieve items and multiple opportunities for processing those items in different contexts is of paramount importance. If a teacher can teach the same students over a longer period of time, it may be possible to determine the best retrieval schedules according to their specific abilities, goals, and preferences (Pavlik & Anderson, 2004), and this should be one of the main aims of teachers when attempting to develop their students' retention of lexical items.

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James Bury is a lecturer at Shumei University, Japan. He has taught in a range of universities, colleges, and schools in England, Thailand, Vietnam, and Japan. He has an MA in English Linguistics and a Masters degree in Education. His research interests include classroom language, developing students' communicative confidence, and teaching English for Specific Purposes. James can be reached at <james_bury_1@yahoo.co.uk>.



Appendix A. Lesson 1: Test with Answers

Vocabulary Test

Section A

- | | | |
|-----------------------|-------|--------|
| 1. economy (n.) | _____ | a. 経済 |
| 2. distant (adj.) | _____ | b. 遠く |
| 3. society (n.) | _____ | c. 社会 |
| 4. independent (adj.) | _____ | d. 独立 |
| 5. tradition (n.) | _____ | e. 伝統 |
| 6. ancient (adj.) | _____ | f. 古代 |
| 7. local (adj.) | _____ | g. 現地 |
| 8. development (n.) | _____ | h. 開発 |
| 9. cultural (adj.) | _____ | i. 文化的 |
| 10. growth (n.) | _____ | j. 成長 |
| 11. specific (adj.) | _____ | k. 特定 |
| 12. nation (n.) | _____ | l. 国家 |

Section B

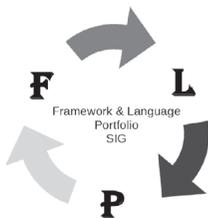
- | | | |
|----------------------|-------|---------|
| 1. negative (adj.) | _____ | a. 陰性 |
| 2. border (v.) | _____ | b. 境界 |
| 3. founding (adj.) | _____ | c. 創立 |
| 4. surround (v.) | _____ | d. 囲む |
| 5. expensive (adj.) | _____ | e. 高価な |
| 6. promote (v.) | _____ | f. 推進する |
| 7. claim (v.) | _____ | g. 主張する |
| 8. developing (adj.) | _____ | h. 発展途上 |
| 9. prevent (v.) | _____ | i. 防ぐ |
| 10. global (adj.) | _____ | j. 世界的 |
| 11. maintain (v.) | _____ | k. 維持する |
| 12. positive (adj.) | _____ | l. 積極 |

Section C

- | | | | | | |
|------------------------|-------|---------|-----------------------|-------|---------|
| 1. contemporary (adj.) | _____ | a. 現代の | 7. destination (n.) | _____ | g. 生き場 |
| 2. wildlife (n) | _____ | b. 野生生物 | 8. significant (adj.) | _____ | h. 重要 |
| 3. severe (adj.) | _____ | c. 厳しい | 9. selection (n.) | _____ | i. 選択 |
| 4. territory (n.) | _____ | d. 領土 | 10. ethnic (adj.) | _____ | j. 民族的な |
| 5. sacred (adj.) | _____ | e. 神聖な | 11. peak (n.) | _____ | k. 頂点 |
| 6. stability (n.) | _____ | f. 安定性 | 12. urban (adj.) | _____ | l. 都市 |

Appendix B. Test Items and JACET 8000 Levels

	1. noun		2. adj.		3. adj.		4. verb		5. adj.		6. noun	
S1	economy	1	local	2	negative	2	claim	2	contemporary	3	destination	3
S2	development	1	distant	2	developing	2	border	2	significant	3	wildlife	3
S3	society	1	cultural	2	founding	2	prevent	2	severe	3	selection	3
S4	growth	1	independent	2	global	2	surround	2	ethnic	3	territory	3
S5	tradition	1	specific	2	expensive	2	maintain	2	sacred	3	peak	3
S6	nation	1	ancient	2	positive	2	promote	2	urban	3	stability	3



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