Forgetting Curve: Experiments on Intervals and Total Time in Recall

Ping Zhan*, Jeffrey Hanks**

Abstract

This manuscript is a continuation of our previous work ([1], [2]). In [1], we mainly tested the spacing effect and whether intervals affect the recall ratio in recalling English words. From the forgetting curve, learning data like English words and their definitions, it has been assumed that initial intervals should be shorter than later ones. But our experiments showed that the ratio of remembered words is not related to the patterns of intervals, (1) initial intervals shorter than later ones, and (2) uniform one-week interval. The main result of this manuscript also shows that intervals are irrelevant to the total time for recall. Finally, we shall point out that our experiments are dealing with a limited data set.

Keywords：forgetting curve, the hop-step-and jump interval, one-week interval

1. Introduction

With current globalization, learning English in effective and efficient ways is always a challenge in English education for nonnative speakers.

This manuscript is a continuation of our previous works ([1], [2]). In [1], as a pretest, we mainly tested the spacing effect and patterns of intervals that affect the recall ratio in recalling English words. As expected, the spacing effect is confirmed by testing. The well-known forgetting curve ([3] [4] [5]) hypothesizes the decline of memory retention in time. Therefore, for remembering something like English words, it has been naturally assumed that the initial intervals should be shorter than later ones, or the hop, step, and jump style, as it is called. But our experiments showed that the ratio of remembered words showed no difference in patterns of short, followed by longer intervals, and a one-week fixed interval.

As a next step to the former experiments, our manuscript here is a subtler test to see whether there is a difference between these two interval types on the total time in recalling words, if ratios of remembered words do not differ significantly. Our experiments this time are also tests on the meaning of words. We also add another type, phrases, which require more precise remembering.

As a continuation of the pretest, we close this section by showing the summarization of [1] here.

1. The number of repetitions of around 6-7 is appropriate for maintaining motivation.
2. The maximum spacing between reinforcement is near to one week, especially in early stages.
3. Up till now, no obvious difference exists between the hop, step, and jump pattern and a uniform one-week interval pattern.
4. The interval of one-week reinforcement is also an effective in leaning words. This type is relatively easy to maintain, not only the schedule in education of schools and universities, but also in various other fields. So it is very encouraging.
5. To get a meaningful result, not only the interval, but also the total review time should be recorded.

2. Preparation for tests

Some of the contents here have been described in [1], we repeat part of it here for the sake of completement.

In the case of English words, we only test whether the Japanese meaning can be remembered. We think this is the more practical in recalling English because remembering the English spelling has become less relevant in the age of online translators and spell-check. Because of this, lengths of the words become irrelevant in our experiments.

2.1 Words and phrases used for tests

There are three groups of words used for our tests. First, the "Academic Word List" (AWL) developed by Averil Coxhead at Victoria University in Wellington. It was developed as a companion to the "General Service List" (GSL), but focuses on words occurring frequently in academic texts. Second, words are chosen from the contents of lectures. Students are tested on these two groups of words. We control the level of difficulty from level 6 to 12 on a scaled used by a popular Internet English-Japanese dictionary, Weblio. This is because a word that is too easy may be already known by our subjects, and words that are too difficult might not be useful knowledge for the student participants. The third group, tested by one of the authors, consists of unknown words encountered in reading. Their level is above 8-10 on the Weblio scale.

Phrases were not included in our pre-test. In tests of phrases, we perform the test in reverse; writing the English phrase from the Japanese meaning. Here, the individual words themselves are usually simple, so spelling is not important. The word combinations are emphasized. So, as mentioned in the introduction, it is more memory intensive than the testing on words alone. We introduced the phrases experiment to increase variety in the testing. The phrases are only tested by one of authors, not the student subjects.

The source of phrases is mainly from an NHK radio program, "Practical Business English". Phrases chosen for the test include phrases containing words that are used differently from their original or familiar meanings, also some novel combinations for non-native speakers. Some examples are "going places", meaning success, and "out of the blue" meaning suddenly, "go out of one's way" meaning making extra effort, "see something in the crystal ball" meaning to predict. By their nature, these phrases are easily misunderstood in reading or listening, and also can be used in writing to make descriptions appear more natural and intelligent.

2.2 The patterns of tests

The tests by students are done in classes, so we have only a one-week interval pattern. The number of words is ten or fifteen for each set.

There are two interval types for the tests done by the author, a one-week interval and the graduated [hop, step, and jump] type shown in Table 2.1.

Table 2.1 Graduated [hop, step, and jump] intervals for testing

start	1 hour	1 day	2 days	1 week	1 week	2 weeks

The number for both words and phrases of one set test is twenty-five. For each test, we add a posttest one month later to see the ratio of remembered words.

2.3 Testing processes

We use Excel spreadsheets to record our tests. After one test, or one check, we use the random function "RAND" to shuffle the order of words.

For each round of tests, the first time we begin with pairs of English words and their Japanese meanings. We spend some time trying to memorize all of the words in one set. From the second time and on, we begin with a test of recall, and then testers are allowed to review the Japanese meaning. As a result, the test is not simply a forgetting test, but also a reinforcement process. We adopted this procedure because it is more in line with English education. To make more data available, we also allow skipping the recall check from the second time, because a long interval after absence from class makes it difficult to remember a significant ratio. This removes one obstacle for students to participate in the experiments. Also we emphasize more the total time spent in remembering, above the methods.

Since students did the test voluntarily and are lacking motivation. We found that it was hard to ask them to record the words remembered and calculation of the time elapsed in a spreadsheet, while simultaneously paying attention to the contents of their lecture. Therefore we abandoned recording the variable of time. Instead we controlled the total time by allowing five minutes per test.

Each pattern of tests repeats from 5 to 7 times. By the author's experience, seven is a "magic number" for repetitions.

3. Results of tests

Tables 3.1 Graduated "hop, step, and jump" interval pattern

words remembered/ 25	17	21	18	21	23	21	22	20	sum
time for recall (min.)	8	3	9	4	3	6	7	0	40
time for reviewing (min.)	16	6	7	8	6	6	6	8	63
sum of above two (min.)	24	9	16	12	9	12	13	8	103

words remembered/ 25	22	25	22	21	21	22	20	19	sum
time for recall (min.)	4	0	2	4	4	3	5	0	22
time for reviewing (min.)	16	2	4	4	5	4	5	5	45
sum of above two (min.)	20	2	6	8	9	7	10	5	67

words remembered/ 25	25	22	22	24	19	16	21	23	sum
time for recall (min.)	4	4	4	3	8	6	5	0	45
time for reviewing (min.)	15	5	5	6	6	5	3	5	48
sum of above two (min.)	19	9	9	9	14	11	8	7	93

phrases remembered/25	22	24	24	25	18	16	19	21	sum
time for recall (min.)	5	6	9	7	9	7	5	7	55
time for reviewing (min.)	20	6	8	7	10	11	8	0	70
sum of above two (min.)	25	12	17	14	19	18	13	7	125

In the case of phrases, [phrases remembered] also includes those that have less than one mistake if the phrase is otherwise comprehensible.

The total time of first table is longer than the others. The simple reason here is we were not used to recording time. Unlike pre-testing, we did not count the time of recording the results of tests. Time elapsed while considering and hesitating about how much information was needed to record the process of testing for checking later.

Tables3.2 One-week interval pattern

words remembered/ 25	25	14	18	21	22	23	25	21	sum
time for recall (min.)	18	8	5	5	4	5	0	3	48
time for reviewing (min.)	6	12	6	4	3	5	4	8	48
sum of above two (min.)	24	20	11	9	7	10	4	11	96

words remembered/ 25	25	4	13	21	23	25	25	20	sum
time for recall (min.)	5	3	3	2	2	2	2	8	27
time for reviewing (min.)	17	12	7	7	4	0	0	0	47
sum of above two (min.)	22	15	10	9	6	2	2	8	74

words remembered/ 25	24	6	13	15	19	22	21	22	sum
time for recall (min.)	2	4	5	6	4	5	4	7	37
time for reviewing (min.)	16	9	5	5	6	4	4	0	49
sum of above two (min.)	18	13	10	11	10	9	8	7	86

phrases remembered/25	24	4	18	18	19	19	23	17	sum
time for recall (min.)	6	9	6	8	8	7	6	10	60
time for reviewing (min.)	22	10	8	8	4	5	5	0	22
sum of above two (min.)	28	19	14	16	12	12	11	0	122

Compared to the pre-test in [1], there is a sharp drop of remembered words in earlier intervals. This is because the emphasis was on total time in the recall process in this test. In later trials, we stopped spending so much time trying to remember words that were not recalled in a short time.

The following are test results of the students' number of remembered words out of a total of 15 words. The students did not record the time carefully. But on the first test, 5-10 minutes are spent; from the second time it was about 1-3 minutes.

Table 3.3 Remembered words out of 15

8	11	12	15	14	15	15
5	8	8	10	10		
9	10	11	14	11		
5	5	8	5	7		
8	8	12	11			
5	5	6				
4	5					
10						
5						

The second group, remembered number of words out of 10, the variation is too large.

Table 3.4 Remembered words out of 10

10	10
3	1

As pointed out above, since our tests are lacking large samples, and the students are lacking in motivation to participate in the research, these factors left our data limited and incomplete. Therefore, we omit data mining, calculations, and statistical methods of data analysis on our test data to generate more meaningful results. Rather, we only present our raw test data here for reference.

4. Conclusion

This series is the first time for us to do experiments dealing with human behavior. We were concerned in the pretest about whether we could get meaningful results. Because not only there are many uncertainties as in lots of cases, but also the unpredictability of human behavior. To our surprise, we noted some interesting trends, and also found an unexpected result: that a one-week interval appears to be adequate for recalling newly learned data like English vocabulary.

It seems that common sense also applies to the results here. No so called secret and special technique exists for learning English vocabulary: only an unavoidable trade-off. One must sacrifice their time and be patient!

Finally, we must again point out that our results are derived from a limited amount of data.

References
[1] Ping Zhan, Jeffrey Hanks, Forgetting curves and spacing effect: Pre-experiments on Remembering Intervals, 江戸川大学紀要, No.24, p337-344, 2014.
[2] Jeff Hanks, Ping Zhan, The Forgetting Curve and Learning Algorithms, 江戸川大学紀要 No. 23, p53-60, 2013.
[3] John Henderson, Memory and Forgetting, Routledge, 1999.
[4] Michael Jacob Kahana, Foundations of Human Memory, Oxford University, 2012.
[5] Sergio Della Sala, Forgetting, Psychology Press, 2010.