

INFLUENCES OF ACHIEVEMENT TESTS ON VOCABULARY RETENTION

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ABSTRACT

The study discussed in this paper investigates which type of achievement test helps EFL (English as a foreign language) students retain and recall newly-learned words. Three groups of Japanese college students learned 60 English words from a word list. These students took three types of achievement tests (a translation test, a monolingual test, and a bilingual test) 1, 2, 4, and 5 weeks after they first received the word list. A posttest was administered 4 weeks after the last achievement test. Students scored highest on the bilingual test. The monolingual test produced the second-highest results, and students scored lowest on the translation test. The effectiveness of using a first language (L1) translation strategy for learning second language (L2) words is also discussed.

INTRODUCTION

Introduction

Many students, researchers, and teachers think vocabulary learning plays an integral role in learning a second/foreign language (SL/FL). In fact, many studies show that the learner's proficiency in reading, listening, writing, and speaking in a second language (L2) is connected to his/her knowledge of L2 vocabulary. In the EFL (English as a foreign language) context, it is very important for students to find an effective and

efficient way of learning a foreign language vocabulary. Although EFL students study many foreign words in a short period of time, they are rarely able to practice this vocabulary outside the classroom. Is there an effective way for EFL students to learn a foreign vocabulary? How can a teacher help students learn a foreign vocabulary effectively and efficiently? The study discussed in this paper was designed to, at least partially, answer these questions.

This study examined the results of vocabulary achievement tests. An achievement test is “designed to assess how well the learners have mastered a vocabulary skill” (Read, 2000, p. 250). An achievement test has two aims: (1) “to check if learning has taken place, and (2) to help this learning take place...by providing motivation to study and by giving another meaningful repetition of the words” (Nation, 1990, p. 116). A vocabulary achievement test provides students with the opportunity to recognize, recall, and retrieve the form and meaning of target words.

There are three major processes that may lead to a word being remembered: (1) noticing, (2) retrieval, and (3) creative or generative use (Nation, 2001). Retention is indispensable to the acquisition of vocabulary. This study investigated the (1) condition that helps learners retain L2 vocabulary and (2) the most effective achievement test format.

Rationale

Nation (2001) claims that bilingual tests are more effective than monolingual test for foreign language students. Read (2000) also mentions that “the first language (L1) provides a better means for test-takers to express their understanding of the target vocabulary” (p. 170). In fact, in Japanese educational settings, Japanese teachers of English often use bilingual tests to check their students’ level of vocabulary comprehension and encourage their acquisition of a foreign language vocabulary. Is Nation’s hypothesis applicable to Japanese EFL college students? Do vocabulary tests promote the retention of L2 vocabulary?

This study was designed to find out what type of vocabulary test is most effective for the learning and retention of a foreign language vocabulary. This study examined three types of test formats: (1) a translation test, (2) a monolingual vocabulary test with multiple choices, and (3) a bilingual vocabulary test with multiple choices. In the achievement tests, the context of the sentence was designed to help students recognize, recall, and retrieve target words.

REVIEW OF LITERATURE

The Word Pair Approach

There are two ways to learn foreign words: (1) incidental (indirect or implicit) learning and (2) intentional (direct or explicit) learning. In addition, there are two types of intentional learning: (1) contextual learning and (2) decontextual learning. The word pair approach (also called “paired associate learning” [Higa, 1965], “learning word pairs” [Nation, 1982], and “list learning” [Griffin & Harley, 1996]) is a decontextual vocabulary learning style. “Learning from word cards” (Nation, 2001) also is a form of the word pair approach. In the word pair approach, students learn L2 words using a word list that contains target words and their meanings, “often in the form of a first language translation” (Nation, 2001, p. 296). This approach is a typical way to learn L2 vocabulary and is used by many language students.

Although Nation (2001) and Sökmen (1997) show that the word pair approach is an effective learning style, some researchers (e.g., Judd, 1978; Oxford and Crookall, 1990; Laufer and Shmueli, 1997) have criticized the word pair approach and think a context approach is more effective for learning a foreign language. In spite of this criticism, most researchers admit that the word pair approach has several advantages over other learning styles:

1. Students can learn a large foreign vocabulary in a short period of time. Nation (2001) points out that this approach “is efficient in terms of return for time and effort” (p. 302). For foreign language students, learning a large vocabulary in a

set time efficiently is a high cost/high benefit exercise. Using L1 in L2 vocabulary learning is “quick, simple, and easily understood” (Nation, 2001, p. 86). Word lists can be used for the initial exposure to a word and for review and retention. Word lists can be “taken almost anywhere and studied when one has a free moment” (Schmitt, 1997, p. 215). Crothers and Suppes (1967), Lado, Baldwin, and Lobo (1967), and Thorndike (1908) found that students could learn a large number of foreign language words in a short period of time using word pairs and retain most of the target words for up to 7 weeks.

2. Pairing foreign words with a translation of the word in the student’s first language provides a useful foundation for vocabulary development (Nation, 1990; Read, 2000). Researchers such as Nation and Read think connecting a foreign language word to the L1 creates a firm foundation for the future learning. Critics of this approach claim that the use of L1 reduces a student’s opportunities to practice the second language; however, supporters point out that learning a word and its meaning from a word list are “prerequisites for using a word” (Nation, 2001, p. 301). Learning high-frequency words from a word list helps build a large sight vocabulary, which enables L2 students to notice and retain foreign words they read and hear (Nation, 2001; Sökmen, 1997).
3. L2 students can retain large numbers of words learned from a word list, even without a context, for a very long time. Beaton, Gruneberg, and Ellis (1995) conducted a longitudinal study on retention of foreign vocabulary learned using the keyword method. In this case study, an English-speaking student of Italian retained about 80 percent of the target words learned from a word list for 10 years. Word list learning is especially suited to explicit, conscious learning (Ellis, 1995). This approach allows learners to control the amount of repetition, which leads to deliberate word processing. The approach also enables them to establish lexical associations between L2 words and their L1

equivalents, which leads to better retention. The L1 equivalents are stored in the learner's memory more easily, which helps him/her build L2 vocabulary. When the learner tries to remember an L2 word, the L1 equivalent functions as a recall cue or "conceptual mediation" (Griffin & Harley, 1996, p. 455). Also, word list learning "allows learners to consciously focus on an aspect of word knowledge that is not easily gained from context [and provides them with] an opportunity to focus on the underlying concept of a word that runs through its various related uses" (Nation, 2001, p. 302).

4. There are many widely used word lists, such as the General Service List of English Words (West, 1953), the Cambridge English Lexicon (Hindmarsh, 1980), and the Longman Lexicon of Contemporary English (McArthur, 1981). These word lists contain about 2,000 frequently-used words. The University Word List (Xue & Nation, 1984) and the Academic Word List (Coxhead, 1998) are used to teach academic English. Although these word lists do not contain L1 equivalents, the fact that they are popular with L2 students suggests they are effective for learning foreign language words.

Repetitive Vocabulary Learning

The repetition of words plays a crucial role in vocabulary learning because, in most cases, words are gradually learned over a period of time from many encounters. Vocabulary learning has an incremental nature (Schmitt, 2000), and repetition "adds to the quality of knowledge and also to the quantity of strength" (Nation, 2001, p. 79). The results of studies by Crothers and Suppes (1967), Kachroo (1962), and Tinkham (1993) show that most students learn a new foreign word after encountering it seven times.

According to Craik and Lockhart (1972) and Craik and Tulving (1975), repetition alone does not lead to successful vocabulary retention. Nation (1990) states that vocabulary retention becomes more effective when the student has to make an effort to

recall the word and its meaning. Baddeley (1990) suggests that the repeated opportunity to retrieve target words is more important than simple repetition, and he argues that the retrieval of a word strengthens the path linking the form of the word to the meaning and makes subsequent retrieval easier.

Although repetition that gives a student more opportunities to recall a word is important, the interval between each opportunity to recall a word is also important. The memory of a newly-learned foreign word often fades if the student does not have frequent opportunities to repeat and recall the word. The results of research investigating long-term vocabulary retention support Pimsleur's (1967) memory schedule, which proposes that most people forget something immediately after learning it and that the rate of forgetting becomes slower as time passes. Furthermore, Baddeley (1990) concludes that spaced repetition, which involves spreading the repetitions over a long period of time, results in secure retention. Russell (1979) proposes a learning schedule that will minimize the loss of newly-learned material. With this schedule, the new material is reviewed 5 to 10 minutes after first learning it, then it is reviewed at 24 hours, 1 week, 1 month, and finally 6 months after the material is first learned.

The Monolingual Test Versus the Bilingual Test

In most of the studies that have investigated the effectiveness of learning a foreign vocabulary from a word list, bilingual testing was used as a pretest and a posttest. Nation (2001) considers the bilingual test a reliable and efficient way to assess vocabulary. The teacher who knows the students' L1 can check their vocabulary knowledge quickly by using bilingual tests. The use of L1 in vocabulary testing limits the number of second language words students must remember. Read (2000) agrees that the use L1 in vocabulary testing provides test takers, especially low-proficiency students, a good opportunity to express their understanding of the target vocabulary. On the other hand, Read claims that bilingual testing may mislead students into thinking there is an exact equivalence between the L1 and the target language.

According to Nation (2001), there has been no research demonstrating the validity and effectiveness of bilingual testing. He implies that supplying L1 definitions makes a multiple-choice or matching test more valid and much easier for students. In order to test Nation's view of bilingual tests, Mochizuki (1998) and Aizawa (1998) analyzed Nation's Vocabulary Levels Test (VLT) (1990) and found that this test did not accurately measure the vocabulary knowledge of Japanese EFL students. They point out that Japanese students had difficulty understanding the English definitions of the target words. They found that replacing Nation's English definitions with Japanese translations produced a more reliable test of Japanese students' knowledge of the target words.

Multiple-choice Tests (M-C Tests)

The multiple-choice test format is widely used to assess vocabulary knowledge in both L1 and L2. Nist and Olejnik (1995) used four types of tests to measure students' knowledge of infrequently-used L1 words and found that students scored highest on multiple-choice tests. Even if multiple-choice tests are valid, it is possible to make these types of tests more difficult by using distractors (see Nagy, Herman, & Anderson, 1985). Hancock, Thiede, Sax, and Michael (1993) argue that the M-C test format provides a significantly more reliable measure than the true-false format. Mason (1984) concludes that M-C tests of grammar, vocabulary, and reading comprehension are an effective way to assess student achievement in large English-language programs.

Nation (2001) points out that multiple-choice tests have two advantages:

- 1) Students can draw on partial knowledge. M-C tests can focus on a particular meaning for words that have more than one meaning; and
- 2) M-C tests are easier for students to pass than tests such as translation, asking students to use the word in a sentence, filling in the blanks, and so forth.

On the other hand, Wesche and Paribakht (1996) suggest that multiple-choice tests

have several problems:

- 1) Multiple-choice tests are difficult to construct and require laborious field testing, analysis, and refinement;
- 2) students may know another meaning for the word but not the meaning sought by the test;
- 3) students may choose the right word by a process of elimination, and they have a 25 percent chance of guessing the correct answer if four options are provided;
- 4) students' knowledge of distractors rather than their ability to identify an exact meaning of the target word may be tested;
- 5) it is difficult to tell if students' miss items because they do not know the target word or because they do not understand the syntax of the distractors;
and
- 6) this format permits only a very limited sampling of students' total vocabulary.

M-C items have a significant effect on the number of correct answers on the test. Perkins and Linnville (1987) administered a vocabulary test with M-C items to ESL students and native-speaking undergraduates and found that the use of multisyllable words and abstract words were the best distractors. Nation (2001) claims that "it is important to be consistent about the closeness of the relationship between the distractors and the correct answers in form and meaning" (p. 350). Referring to Champion and Elley (1971), Nation (1990) maintains that test makers should be careful when they choose items for M-C tests and suggests creating criteria for items used on M-C tests.

RESEARCH QUESTIONS

Research Questions

The following questions guided the study discussed in this paper:

- 1) Does L1 help Japanese college students learn and retain English words in an EFL situation that gives them limited exposure to English outside the classroom?
- 2) Can repeated achievement tests of foreign words learned from a word list help students recall and retain vocabulary? If so, what type of test format is most effective?

Hypothesis

In the context of Japanese educational settings, the following hypothesis is proposed based on previous studies of bilingual vocabulary tests and Nation's (2001) theory that bilingual tests are more effective than monolingual tests for assessing students' knowledge of foreign language words:

Students who take bilingual vocabulary tests retain more target words than students who take monolingual or translation tests.

METHOD

Subjects

The participants in this study were coeducational, sophomore university students. Most of the students had the same level of English comprehension (intermediate level), and their educational backgrounds were similar:

- group A: 40 students majoring in economics; ,
- group B: 42 students majoring in economics; and
- group C: 38 students majoring in economics.

The students took tests that measured their reading skills and their vocabulary size in the beginning of the academic year. The reading skills test was a TOEFL reading comprehension test, and the vocabulary test was based on Mochizuki's (1998) vocabulary levels test. The test scores showed that there was no significant difference across the groups.

Selection of Target Vocabulary

Sixty low-frequency English words were chosen for the foreign language word list. It may seem that this study dealt with too many target words, but previous studies have found that reliable data can be obtained when around 30 target words are tested in an experiment (Ikeda, 1992; Nation, 2001). In addition, 30 words of the target words were used as distractors in the posttest.

The sixty words, which were extracted from two TOEFL vocabulary workbooks, were related to the natural sciences such as astronomy, meteorology, geology, environmental studies, physiology, chemistry, and physics. The words were expected to be unfamiliar to the participants, who were all majoring in economics and unlikely to have prior knowledge of the target words.

PROCEDURE

The study discussed in this paper used the following procedure to test the effectiveness of various achievement tests:

- 1) Vocabulary pretest sheets were used to check students' prior knowledge of the target words. The students were asked to choose the scale that indicated their knowledge of each target word and then to write a Japanese translation if they knew the word. In the vocabulary pretest, most of the students answered two or three words correctly. Mean scores of the pretest were 3.2 for group A, 3.1 for group B, and 2.9 for group C. There was no significant differences across the groups.
- 2) After the pretest, a word list containing the 60 target words and their Japanese translations (see appendix 1) was distributed to the students. They were asked to memorize the words to prepare for achievement tests and given a schedule of the achievement tests. The purpose of this study was explained to them, and they were asked to take part in it. The students were told what kind of achievement test they would take, but they were not told

how to learn the target words or how to use the target words in sentences. They only were told that they did not have to memorize the exact spelling.

- 3) At 1, 2, 4, and 5 weeks after the students' received the word list, achievement tests were administered. One test covered the half of the target words: That is, the test administered 1 and 4 weeks covered the first 30 words on the word list, and the test administered at 2 and 5 weeks covered the last 30 words on the word list. Therefore, students in each group were tested on the whole word list twice. Three types of achievement tests were used in this study:

Translation test (see appendix 2-1) : A translation test with 30 English sentences containing 30 target words and 30 sentences in Japanese containing 30 blanks was administered to group A. The students were required to translate the target words into Japanese and fill in the blanks.

Monolingual test (see appendix 2-2) : A monolingual test with 30 English sentences containing 30 blanks with four multiple-choice items in each blank was administered to group B. The students were required to choose the appropriate item.

Bilingual test (see appendix 2-3) : A bilingual test with 30 English sentences containing 30 blanks with four multiple-choice items in each blank and 30 sentences in Japanese was administered to group C. The students could choose appropriate items using the Japanese translations as a guide.

- 4) Four weeks after the last achievement test, a vocabulary posttest was administered to all the students. The posttest had not been announced in advance. The posttest was based on vocabulary tests designed by Aizawa (1998) and Mochizuki (1998) (see appendix 3). The students were required to match each English word to its Japanese definition without the help of sentences. As stated above, in the posttest, 30 words from the word list were

used as correct answers, and the rest of the target words were used as distractors. The achievement tests and the posttest were in a different order from the word list, which made both kinds of the tests less list-dependent.

- 5) After the posttest, students were asked to fill out a questionnaire that asked them how many hours they spent memorizing the target words, what type of learning strategy they used, which test format was most effective for helping them learn the target words, which test format they preferred, and what type of word was difficult to learn. In total, 120 students participated in this study: 40 in group A, 42 in group B, and 38 in group C. However, fewer students took all the achievement tests and the posttest: 25 in group A, 26 in group B, and 25 in group C. This study was conducted over 9 weeks in order to examine students' long-term retention of new vocabulary. It was not possible to ensure that every student would be able to participate in every test.

All the test forms were collected and scored by the researcher, but they were not returned to the students. A correct response received a full point. A semantically appropriate response in the translation test received half a point.

RESULTS

Results of the Achievement Tests

The scores for students who participated in all four achievement tests are shown in Table 1. The first and third achievement tests covered the first 30 on the word list, and the second and fourth tests covered the last 30 words on the word list. K-R 21 was calculated in order to estimate reliability of the achievement tests. As each number was bigger than 0.6, each achievement test was considered reliable.

Students were given advance notice about all four achievement tests, and most of them were able to prepare for the tests. As a result, the majority of participants were able to recall most of the target words on all four tests. Therefore, Pimsleur's memory schedule does not apply in this case.

INFLUENCES OF ACHIEVEMENT TESTS ON VOCABULARY RETENTION

On the whole, the scores show that the translation and bilingual testing formats were easiest for the students. As Read (2000) and Nation (1990, 2001) point out, an L1 word or sentence can be a recall cue. However, group C students, who had to choose the correct word from multiple choices, scored higher than group A students, who had to write the translation out in a sentence. In contrast, students in group B had difficulty achieving high scores on the monolingual tests, and these tests took longer to complete than translation or bilingual tests. In the monolingual tests, students were given only English sentences as recall cues.

Table 1
Results of Four Achievement Tests

Group	N	Achievement Test	1	2	3	4
A translation test	25	Mean	27	25.4	26.4	26.7
		SD	2.52	5.8	4.66	6.07
		K-R 21	0.6	0.91	0.85	0.93
B monolingual test	26	Mean	25.7	24.5	26	24.4
		SD	4.97	5.3	5.41	5.06
		K-R 21	0.88	0.79	0.91	0.83
C bilingual test	25	Mean	27	27.1	26.9	27.8
		SD	5.76	5.65	4.58	3.68
		K-R 21	0.98	0.95	0.9	0.88

Results of the Posttest

Retention scores of the 76 students who had been present at both all the achievement tests and the post test are displayed in Table 2. The results of one-way layout ANOVA showed significant difference across the groups ($F = 3.122$, $F \text{ Prob.} = 4.828$, $p = .05$). Group C, who took the bilingual achievement tests, achieved the highest scores on the posttest, followed by group B, who took the monolingual achievement tests. Group A, who took the translation tests, achieved the lowest scores. The results of this study support the hypothesis that bilingual achievement tests are the most effective tests for helping student retain L2 vocabulary.

Table 2

Results of the Posttest*

Group	N		Posttest
A translation	25	Mean	23
		SD	5.03
B monolingual	26	Mean	24.11
		SD	4.62
C bilingual	25	Mean	26.64
		SD	2.69

*K-R 21 of the posttest was 0.8, which proves the test's reliability.

Results of the Questionnaire

Question 1 asked students to indicate how many hours they spent preparing for each achievement test. The results show that 59 percent of the students spent from 30 to 60 minutes preparing for each achievement test.

Table 3
Time Spent Preparing for Each Achievement Test

	Group A	Group B	Group C	Total
0-30 min.	4	6	3	13
30-60 min.	18	17	10	45
60-90 min.	2	3	10	15
90-more	1	0	2	3
Total	25	26	25	76

Question 2 asked students to indicate how they learned the target words. Many students folded the word list in half when they studied the target words. They tried to recall the L1 equivalents when looking at the target words. One student used a computer to study the target words, and another student employed a keyword technique.

Table 4**Vocabulary strategies Used to Study Target Words**

	Group A	Group B	Group C	Total
Look at the English words, try to translate them into Japanese	12	13	15	40
Try to recall target words by looking at the Japanese translation	9	7	8	24
Written repetition	3	5	9	17
Verbal repetition	7	8	5	20
Making word cards	0	0	2	2
Studying with classmates	6	8	2	16
Other strategies	1	0	1	2

Question 3 asked students which type of test format was the most effective for retaining newly-learned vocabulary? Fifty-two percent of the students considered monolingual vocabulary tests the most effective way to learn L2 vocabulary.

Table 5

Most Helpful Vocabulary Test Format

	Group A	Group B	Group C	Total
Translation test	5	7	9	21
Monolingual test	14	14	12	40
Bilingual test	5	6	4	15

Question 4 asked students to indicate which type of test format they preferred. 72 percent of the students felt comfortable taking bilingual vocabulary tests.

Table 6

Most Preferred Vocabulary Test Format

	Group A	Group B	Group C	Total
Translation test	2	2	3	7
Monolingual test	7	3	4	14
Bilingual test	16	19	20	55

Question 5 asked students to indicate which L2 words were difficult to learn. Forty-five percent of the students thought the words below were difficult to learn because they were similar in form or meaning:

- latitude, longitude, and altitude,
- metamorphosis and mutation,
- hibernation and fertilization, and
- antibody and immunity.

Thirty-two percent of the students thought the words below were difficult to learn because the students did not know much about subjects such as geology, physics, and biology:

- ore,
- drone,
- cerebrum,
- resonance,
- inertia, and
- velocity.

DISCUSSION

The results of this study show that the method of recalling newly-learned words is important for vocabulary retention. The bilingual achievement test format was effective for helping students retain target words. Nation (1995) maintains that vocabulary teaching should be considered in the light of costs/benefits. In an EFL context such as Japan, in which students have limited exposure to the target language, bilingual word lists and achievement tests help students learn and retain target words quickly. In this sense, L1 functions as “mediation” between a target word and its meaning and as a recall cue. Target words became strongly linked to their L1 equivalents, and a network of links between the English words and their Japanese equivalents is established. Although the bilingual format has been criticized and

contextual vocabulary learning has been encouraged, the results of this study show that bilingual formats help students learn and retain foreign vocabularies effectively and efficiently.

In addition, 72 percent of the students preferred the bilingual test format, though 53 percent thought the monolingual test format helped them retain target words more effectively. In fact, when preparing for achievement tests, more students tried to recall the meanings in Japanese by looking at the target words in the word list rather than to recall the target words looking at the Japanese translation. This suggests that L1 translation is significant to the students. Schmitt's (1997) survey of vocabulary learning strategies used by EFL students in Japan supports this finding. According to his study, 85 percent of students use a "bilingual dictionary" to learn the meaning of new L2 words, and 54 percent use "word lists" to retain the meaning. The students in this present study who had studied English for at least 6 years seemed to think that learning L2 words using a Japanese translation of their meaning helped them retain the words and their meanings more effectively.

Lawson and Hogben (1996) found that advanced EFL students use many strategies to learn new words. Kroll and Curley (1988) suggest that beginner students tend to rely on L1 translations when learning new words and then change strategies after about 30 months of study. Cohen and Apeh (1980) argue that context provides useful cues in vocabulary learning once students have reached a level where they are not overwhelmed by the context of the target language.

Most of the students in the present study were intermediate learners. They were accustomed to and preferred learning new L2 words with the help of Japanese translation. On the other hand, some of the students could transfer their knowledge to new contexts without Japanese translations. In fact, some students in group B (5 out of 26) achieved good scores in monolingual achievement tests even though they learned the target words from the bilingual word list. They could choose the correct word with only contextual cues in English. They also achieved a good score on the posttest. This

finding agrees with the involvement load hypothesis (Hulstijn & Laufer, 2001), which claims that the “retention of unfamiliar words is, generally, conditional upon the degree of involvement in processing these words” (p. 545): In other words, the more involved the task, the better the retention. This hypothesis held true for some of the students in group B. This may be the result of their higher level of proficiency in English. If levels of English proficiency had been used as another variable in this study, different results may have been obtained.

In this study, it was found that the computer might help students learn L2 words more effectively and efficiently. In fact, one student changed the order of the target words in the list using a computer in order to prepare for achievement tests. There is a famous study conducted by Coady et al. (1993) in which EFL students learn frequently-used words through computer-assisted program that employs the students’ L1 and a keyword technique. These researchers conclude that using computers to learn a word list was an efficient use of time. As computer technology advances, more students may be able to benefit from computer-assisted vocabulary learning.

The results of the present study show that using L1 in L2 vocabulary learning is not always an advantage. The students who took the translation tests (group A) retained the fewest words in the posttest, even though they had the second-highest scores all the achievement tests. This indicates that translation tests were not a very effective way to retain and recall L2 words. There could be a reason for the ineffectiveness of translation tests. As the results of the questionnaire show, many students translated the target words into Japanese when studying for the achievement tests. Therefore, it was easy for group A to answer the questions on the translation tests. However, it appears that this lack of difficulty achieving high scores on achievement tests does not guarantee that a student will retain more L2 words. Griffin and Harley (1996) examined the presentation of L2 vocabulary items and compared a group presented items in a L1–L2 order with a group presented items in a L2–L1 order. They found that the L1–L2 group retained more words than the L2–L1 group, and they conclude

that “difficult learning can lead to better retention over time” (p. 447). Their conclusion agrees with Hulstijn and Laufer’s (2001) involvement load hypothesis. It appears that learning L2 words easily does not result in better retention, and it might be necessary to provide students with difficult tasks or achievement tests in order to promote better retention.

The results of the study discussed in this paper show that bilingual achievement tests help Japanese college students retain L2 technical words related to natural science; however, two problems must be solved in any future research investigating the retention of L2 vocabulary. First, it is necessary to find a way to measure retention. It is difficult to determine when target words are retained. The posttest in this study measured only one aspect of the students’ retention. Prince (1996) examined beginner and advanced French university students learning new English words using a L1 translation and a L2 context. The results show that both beginner and advanced students who used the L1 translation strategy retained more words. However, advanced students had higher posttest scores with L2 contextual cues. According to Prince, learning and recalling L2 words using the L1 translation strategy is superior “in terms of quantity” (p. 478) and may be more superior to other learning strategies in terms of quality.

Second, it is necessary to carefully choose the appropriate type of L2 word list. In this study, the word list consisted of technical words related to the natural sciences. This word list was chosen because there was little possibility that the students had prior knowledge of these words or would encounter these words while the study was being conducted. The results show that students had difficulty learning words from unfamiliar subjects. For instance, according to the survey, words such as “metamorphosis,” “mutation,” “antibody,” “immunity,” “resonance,” “inertia,” and “ore” were difficult to learn because the students had little knowledge of biology, physiology, physics, and geology. In this case, bilingual dictionaries as well as the word list could not compensate for this lack of knowledge. According to Nation (1990,

2001), when teaching technical words in ordinary language classes, teachers need to use teaching aids. Therefore, the use of technical words without the use of teaching aids might have affected the test scores in the present study. Furthermore, the word list used in this study contained 55 nouns, 4 verbs, and only 1 adjective. The use of so many nouns might have affected test scores because, in general, nouns are easier to learn from a word list and with the help of L1 equivalents. Future research should consider using word lists that contain a variety of parts of speech. In this way, future research could compare two dimensions of vocabulary retention: (1) the quality of L2 word retention and recall using the L1 translation strategy and (2) the effect of using different types of word lists.

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Appendix 1: Word List

In the original word list, the Japanese translations in roman letters were not added.

	English words	Japanese translations	in roman letters
1	observatory	観測所、天文台、气象台	kansokujo
2	constellation	星座	seiza
3	eclipse	< 太陽・月の > 食	syoku
4	meteorite	隕石	inseki
5	revolve	公転する、回転する、自転する	kouten-suru
6	meteorology	気象学	kisyougaku
7	greenhouse effect	温室効果	onshitsu-kouka
8	precipitation	降水(量)	kousui
9	drought	干ばつ	kanbatsu
10	geology	地質学	chishitsugaku
11	altitude	海拔、標高、水位	kaibatsu
12	latitude	緯度	ido
13	longitude	経度、経線	keido
14	equator	赤道	sekidou
15	erosion	侵食	sinsyoku
16	epicenter	震央(震源の真上の地表上の地点)	sin'ou
17	radioactive	放射性(能)のある	housyasei-no-aruru
18	ore	鉱石(金属・非金属)	kouseki
19	conservation	保護、管理、保全、保護地区	hogo
20	petroleum	石油	sekiyu
21	refinery	精製所、製油所	seiyujo
22	pollutants	汚染物、汚染物質	osen-bussitsu
23	habitat	環境、生息地	seisokuchi
24	photosynthesis	光合成	kougousei
25	botany	植物学	syokubutsugaku

26	reptile	爬虫類の動物	hacyuurui
27	amphibian	両生類の、両生類の生物	ryouseirui
28	metamorphosis	変態(動物が卵からかえって成体になるまでにいろいろな形態をとること)	hentai
29	larva 複数 larvae	幼虫	youcyuu
30	fertilization	受精、肥沃化	jusei
31	drone	雄(おす)バチ	osu-bachi
32	incubate	卵を抱く・かえず、卵がかえる	tamago-o-daku
33	hibernation	冬眠	toumin
34	primates	霊長類	reicyourui
35	fetus	胎児	taiji
36	hybrid	雑種(の)	zassyu
37	mutation	突然変異	totsuzenhen'i
38	trait	特性、特色、特徴	tokusei
39	antibody	抗体	koutai
40	immunity	免疫(性)	men'eki
41	digestion	消化	syouka
42	intestine	腸	cyou
43	cerebrum	大脳	dainou
44	ulcer	潰瘍	kaiyou
45	diabetes	糖尿病	tounyoubyou
46	diarrhea	下痢	geri
47	enzyme	酵素	kouso
48	protein	タンパク質	tanpakushitsu
49	sulfur	硫黄	iou
50	narcotic	麻醉薬、麻薬、睡眠薬、鎮痛剤	masui
51	molecule	分子	bunshi

INFLUENCES OF ACHIEVEMENT TESTS ON VOCABULARY RETENTION

52	nuclear reactor	原子炉	genshiro
53	velocity	速度	sokudo
54	friction	摩擦	masatsu
55	gravitation	重力、引力	juuryoku
56	generate	生ずる、発生させる (produce)	syouzuru
57	resonance	共鳴、共振	kyoumei
58	inertia	慣性	kansei
59	circulate	循環する	junkan-suru
60	Coriolis force	コリオリの力 回転座標系の中で運動している物 体に、遠心力とは別に物体の進行 方向に対して横向きに働くみかけ の力。転向力。	koriori-no-chikara

Appendix 2 : Achievement test format

Appendix 2 - 1 : The test format used as the second and fourth achievement tests for Group A

(Excerpt)

* In the original format, Japanese sentences in roman letters were not added.

Fill in each blank in Japanese translations of English sentences.

1. Pregnant women who are heavy drinkers risk damaging the unborn fetus.

かなりお酒を飲む妊婦は、()にダメージを与える危険性がある。 [Kanari osake wo nomu ninpu wa, () ni damage wo ataeru.]

2. A drone is a male bee. 「ドローン」とは、()のことである。

[“ Drone ” towa () nokoto dearu.]

3. Some mutations make organisms better adapted to their environment.

()により、生物は環境によりよく適応するようになる。

[() ni yori, seibutsu wa kankyō ni yoriyoku tekiou suruyouninaru.]

4. When the incubation period is over, baby birds crack open the shells of their eggs and hatch. ()時期が過ぎると、雛は卵の殻を破って孵化する。

[() jiki ga sugiruto hina wa tamago no kara wo yabutte fuka suru.]

5. Traits are characteristics, such as leaf shape, eye color, and stripes, that are passed from parent to offspring. ()とは、葉の形、目の色、縞など親から子へと受け継がれるものである。

[() towa, ha no katachi, me no iro, shima nado, oya kara ko eto uketsugareru mono dearu.]

6. Of all the many orders of mammals, the primates are the most highly developed.

哺乳類の中で、()は最も高度に発達している。

[Honyuurui no naka de, () wa mottomo koudoni hattatsu shiteiru.]

7. Mendel crossed thousands of pure and hybrid plants and kept careful records of his findings. メンデルは純粋種と()を何千回となく交配し、丹念にその結果を記録した。

[Mendel wa junsuisyū to () wo nanzenkai tonaku kouhaishi, tannenni sono kekka wo kiroku shita.]

8. Frogs go through the process called hibernation during cold weather.

カエルは寒い季節、()と呼ばれる時期を過ごす。

[Kaeru wa samui kisetsu, () to yobareru jiki wo sugosu.]

Appendix 2 -2 : The test format used as the second and fourth achievement tests for Group B

(Excerpt)

Circle the appropriate word to complete each sentence.

INFLUENCES OF ACHIEVEMENT TESTS ON VOCABULARY RETENTION

1. By the end of its third month, an embryo looks human and is called a (fetus drones primates). It is 9 cm long and weighs about 15 g (the weight of a post card).
2. A (larva reptile drone) is a male bee.
3. (Fetus Mutations Antibodies) are sudden, random changes in genes that are passed from one generation to the next.
4. When the (fertilization incubation hibernation) period is over, baby birds crack open the shells of their eggs and hatch.
5. (Traits Traps Trades) are characteristics, such as leaf shape, eye color, and stripes, that are passed from parent to offspring.
6. Monkeys, apes, and humans are (reptiles primates mutations). All have brains, fingers capable of grasping, and eyes that can focus on one spot.
7. Mendel crossed thousands of pure and (trait enzyme hybrid) plants and kept careful records of his findings.
8. Animals that (hibernate incubate fertilize) spend the winter in a state like a deep sleep.

Appendix 2 - 3 : The test format used as the second and fourth achievement tests for Group C (Excerpt)

* In the original format, Japanese sentences in roman letters were not added.

Circle the appropriate word(s) to complete each sentence.

1. By the end of its third month, an embryo looks human and is called a(fetus drone primate). 3 カ月後には胎芽は人間らしく見え、この時期から胎児という。

[3 kagetsu no owari niwa, taiga wa ningen rashiku mie, kono jiki kara taiji to iu.]

2. A (larva drone primate) is a male bee. * とは、雄バチのことである。

[* towa osu-bachi no koto dearu.]

3. (Mutations Incubations Hibernations) are sudden, random changes in genes that are passed from one generation to the next. 突然変異は世代間で受け継がれる遺伝子に、たまたま突発的な変化が起こることである。[Totsuzen-hen i wa, sedai kan de uketsugareru idenshi ni, tamatama toppatsuteki na henka ga okoru koto dearu.]

4. When birds (incubate hibernate mutate) their eggs, they keep the eggs warm until the baby birds hatch. 鳥が卵を抱く時は、雛がかえるまで卵をあたためる。

[Tori ga tamago wo daku toki wa, hina ga kaeru made tamago wo atatameru.]

5. (Primates Traits Enzymes) are characteristics passed from parent to offspring. 特性とは親から子へと受け継がれる特徴である。

[Tokusei towa oya kara ko eto uketsugareru tokucyou dearu.]

6. Monkeys, apes, and humans are (fetus primates hybrids). All have large brains, fingers capable of grasping, and eyes that can focus on one spot. サルや人間は霊長類である。どれも大きな脳、物をつかむことのできる指、一点に焦点の合う目を備えている。

[Saru ya ningen wa reicyourui dearu. Doremo ookina nou, mono wo tsukamu koto no dekiru yubi, itten ni au me wo sonaete iru.]

7. A/An (hybrid trait enzyme) is an animal or plant that has been bred from two different species of animal and plant.

雑種とは、二つの動物あるいは植物の種からつくられた動物あるいは植物である。

[Zassyu towa, futatsu no doubutsu arui wa syokubutsu no syu kara tsukurareta

doubutsu aruiwa syokubutsu dearu.]

8. Animals that (incubate hibernate mutate) spend the winter in a state like a deep sleep. 冬眠する動物は深い眠りのような状態で冬を過ごす。

[Toumin suru doubutsu wa, fukai nemuri no youna joutai de fuyu wo sugosu.]

Appendix 3 : Posttest

日本語の意味または定義に最も近い語を(1)から(6)の中から選び、番号で答えなさい。

(Choose the right word to go with each Japanese meaning or definition. Write the number of that word next to its meaning.)

* In the original format, roman letters were not added.

1. 共鳴(共振)[Kyoumei] [] 2. 慣性[Kansei] []

(1)Coriolis force (2)friction (3)gravitation (4)inertia (5)resonance (6)velocity

3. 地質学[Chishitsugaku] [] 4. 気象学[Kisyougaku] []

(1)archaeology (2)botany (3)geology (4)meteorite (5)meteorology (6)climate

5. 経度・経線[Keido] [] 6. 海拔・標高[Kaibatsu] []

(1)altitude (2)equator (3)high (4)altitude (5)longitude (6)precipitation

7. 突然変異[Totsuzen-hen i] [] 8. 冬眠[Toumin] []

(1)fetus (2)hibernation (3)hybrid (4)photosynthesis (5)mutation

(6)metamorphosis

9. 爬虫類の動物[Hacyuurui] [] 10. 霊長類[Reicyourui] []

(1)amphibian (2)drone (3)habitat (4)lizard (5)primates (6)reptile

11. 星座[Seiza] [] 12. <太陽・月の>食[Shoku] []
(1)constellation (2)eclipse (3)epicenter (4)galaxy (5)greenhouse
(6)observatory

13. 干ばつ[Kanbatsu] [] 14. 侵食[Shinsyoku] []
(1)drought (2)erosion (3)metamorphosis (4)precipitation (5)pollutant
(6)refinery

15. 潰瘍[Kaiyou] [] 16. 免疫[Men eki] []
(1)antibody (2)diabetes (3)fetus (4)immunity (5)ulcer (6)virus

17. 大脳[Dainou] [] 18. 腸[Chou] []
(1)cerebrum (2)diarrhea (3)digestion (4)intestine (5)larva (6)sulfur

19. 生ずる、発生させる[Syouzuru] [] 20. 卵を抱く[Tamago-wo-daku] []
(1)circulate (2)conserve (3)generate (4)incubate (5)radioactive (6)reactor

21. 睡眠薬・鎮痛剤[Suimin-yaku] [] 22. 酵素[Kouso] []
(1)enzyme (2)petroleum (3)narcotic (4)nuclear (5)pollutant (6)protein

23. 公転する、回転する[Kouten-suru] [] 24. 循環する[Junkan-suru] []
(1)circulate (2)generate (3)digest (4)incubate (5)radioactive (6)revolve

25. 受精[Jusei] [] 26. 消化[Syouka] []
(1)diarrhea (2)digestion (3)fertilization (4)intestine (5)larva (6)sulfur

27. 震央[Shin ou] [] 28. 鉱石[Kouseki] []
(1)earthquake (2)epicenter (3)equator (4)magnitude (5)meteorite (6)ore

29. 保護・管理・保全[Hogo] [] 30. 特性・特色[Tokusei] []
(1)conservation (2)conversation (3)effect (4)greenhouse (5)molecule (6)trait