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Effects of Glosses on Incidental Vocabulary Learning : Which Gloss-type Works Better,L1,L2,Single Choice, or Multiple Choices for Japanese University Students?

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Effects of Glosses[1] on Incidental Vocabulary Learning:

Which Gloss-type Works Better, L1, L2, Single Choice, or Multiple Choices for Japanese University Students?

Osato Shiki

Abstract

This study explores the effects of using glosses on incidental vocabulary learning which takes place during L2 reading. In order for students to reach the 3,000 word level, which has been suggested as the minimum size of vocabulary for successful L2 reading comprehension, teachers need to assist them to increase their vocabulary in incidental vocabulary learning conditions. Since a number of L2 vocabulary studies have shown that use of glosses can play a significant role in this type of vocabulary learning, this study compared four types of glosses to find the most effective gloss-type for the retention of L2 word meanings. The gloss-types used in the study include L1 single glosses (L1 equivalent), L2 single glosses (L2 synonym), L1 multiple-choice glosses, and L2 multiple-choice glosses. From the cognitive perspective of L2 reading process which stresses that the process of reading is constrained by cognitive resources limitations, it is hypothesized that beginning or intermediate Japanese EFL learners profit more from L1 multiple-choice glosses to retain words they encounter while reading L2 texts. The hypothesis was tested three times in total, and the results of one-way ANOVA comparing the retention scores among the four gloss-type groups showed a similar tendency over the three studies, suggesting that L1 multiple-choice glosses enhance the retention of the target words better than the other three types of glosses during L2 reading.

Keywords: Multiple-choice glosses, Single glosses, Incidental learning, L2 vocabulary learning, Cognitive loads

1. Introduction

Acquisition of vocabulary is of prime importance for L2 reading (Laufer & Sim, 1985; Haynes & Baker, 1993). Studies have shown that the estimated number of words to be learned

for successful L2 reading has ranged somewhere between 3,000 and 5,000 word families, which accounts for 95 or 98 percent coverage of words per a given text (Laufer, 1989; Hu & Nation, 2000) and vocabulary size of around 3,000 word families has been identified as a turning point between proficient and less proficient L2 readers (Laufer, 1992; Shimamoto, 1998). Although these empirical data indicated that there seems to be a threshold level of vocabulary suggesting that L2 reading performance can be impeded for learners whose vocabulary knowledge falls short of the specified level, the number of English words learned by Japanese learners before entering universities has been reported to be far behind such an optimum level. Sugiura (2002) pointed out that the number of English words introduced to students in public schools through junior and senior high school years was reduced to about "2,300 lemmas" (p. 129). It is less than 1,500 word families. This suggests that EFL instruction in Japanese universities is largely responsible for providing appropriate assistance for students to increase their vocabulary size.

Vocabulary, both in L1 and L2, can be learned from two distinctive conditions: intentional learning and incidental learning. Intentional vocabulary learning refers to the learning of vocabulary driven by intentions of learners to memorize or study words in vocabulary-related activities entailing their attention primarily centered on vocabulary (e.g., being taught or learning about a meaning and grammatical function of a target word, memorizing new words with a word list, and memorizing words for the test), while "incidental vocabulary learning refers to the learning of vocabulary as the by-product of any activity not explicitly geared to vocabulary learning" (Hulstijn, 2001, p. 271) (e.g., some words happened to be memorized as a result of reading a passage to finish writing its summary). Studies have showed that for L2 vocabulary learning intentional learning plays a significant role in increasing L2 vocabulary knowledge of students (e.g., Zimmerman, 1994; Paribakht & Wesche, 1997). In reality, however, during regular class hours of university reading instruction, teachers can not spend much time on assisting students to memorize new words; only relying on intentional learning of vocabulary is, therefore, not promising for increasing students' vocabulary. This pedagogical reality on vocabulary learning makes it reasonable to suggest that incidental vocabulary learning through reading may play a large role to compensate for the loss since reading instruction, by itself, can regularly provide students with many opportunities to encounter and process new English words. It is obviously profitable if such incidental learning is made more available and effective to Japanese university students who often encounter new words while reading a text in English.

Studies of L2 incidental vocabulary learning have shown that providing glosses during L2 reading can assist learners to memorize new words incidentally compared to when glosses are

not provided for reading (e.g., Hulstijn, 1992; Hulstijn, Hollander, & Greidanus, 1996; Jacobs et al., 1994; Ko, 1995; Watanabe, 1997a). This study, thus, emphasizes using glosses as one approach to make incidental vocabulary learning effective and applicable to Japanese university students. The most important question here is, however, what type of glosses can facilitate L2 incidental vocabulary learning of students most effectively. This study will explore this issue and discuss the effects of glosses on incidental vocabulary learning in L2.

2. Review of Literature

2.1. Findings of past studies

Most studies on glosses have commonly put emphasis on discussions over effects of two contrasting formats of glosses on retention of L2 word meanings; i.e., L1 glosses (L1 equivalents of target words) vs. L2 glosses (synonyms of target words) or single glosses (one choice given in either L1 or L2) vs. multiple-choice (hereafter MC) glosses (more than two choices given including more than one distracter either in L1 or L2), and the glosses are sometimes presented in different ways (e.g., either with paper-based or computer-based texts) (Yoshii, 2002). To compare the effects of glosses in a mixture of the aforementioned traits, the past studies have also developed the following four distinctive types of glosses: L1 single glosses, L2 single glosses, L1 MC glosses, and L2 MC glosses. Studies of L2 incidental vocabulary learning for glosses mostly follow the same research procedure in which participants are given a reading material equipped with marginal glosses and told to read it without being notified that a vocabulary test will be conducted after the reading task. The vocabulary tests (mostly producing definitions for target words) are usually given immediately after the treatment so as to examine if the target words are retained incidentally by reading a given L2 text. After that, a delayed test is often conducted (e.g., two or four weeks from when the first test is administered) so as to clarify if a specific type of glosses has strengthened the memory trace of the previously learned target words more than the other types.

With this research design, Hulstijn (1992) first developed MC glosses aiming to reduce the percentage of wrong inferences L2 learners often make during free reading and compared the effects of L2 MC glosses with L2 single glosses among non-native speakers learning Dutch as a second language. The scores of the immediate tests showed that the MC gloss had a higher retention effect than the single gloss, citing "mental efforts hypothesis" as a reason for the effect. The hypothesis explains that inferred word meanings involve high mental effort (i.e., deep-

er processing), which leads to successful retrieval of the meanings for the previously learned words. Studies on glosses, since then, have tested effects of MC glosses to explore the validity of the hypothesis; however, there has been no strong empirical evidence to clarify their effects so far; and the studies have also failed to confirm which gloss types are the most effective for incidental vocabulary learning.

In the study conducted on Japanese university students learning English as a foreign language (EFL), Watanabe (1997a) reported that although the gloss use conditions facilitated vocabulary learning of the participants than no gloss use conditions and L2 single group did slightly better than L2 MC group on their retention scores of the target English words both on the immediate and delayed vocabulary tests, no significant difference was detected between them. The result may imply that L2 MC glosses may not facilitate incidental vocabulary learning when the study is administered in an EFL setting, and possibly it may be too demanding for EFL students to use L2 MC glosses to construct meanings of new words. To identify any reason for this result, the study, however, needs further clarification by comparing L2 MC glosses not only with L2 single but also with any types of L1 glosses among EFL students.

In another study of Watanabe's (1997b), L1 glosses were included to examine the effects of three types of glosses: L1 single, L2 MC, and No gloss conditions among non-native speakers of English studying in the United States (ESL students from different nationalities in the United States). The result, in this case, showed that in the immediate vocabulary test, L1 single group did better than L2 MC group while for the higher proficiency learners the result was reversed. The study concluded that L1 single glosses, though it involves less cognitive effort than L2 MC glosses, can work better in the decoding process of lower proficiency students; however, the result can not clarify what specific feature of the glosses (e.g., either L1, or single) contributes to the advantage of L1 glosses for the lower L2 proficiency since it did not investigate any comparisons between L1 single and L2 single, and L1 single and L1 MC.

In the same vein, Nagata (1999) developed the Watanabe's study, comparing the effects of L1 single glosses with L1 MC glosses among American students studying Japanese as a foreign language by using the reading materials presented on computers and found that the group with L1 MC glosses outperformed the group using L1 single glosses on the vocabulary posttest given immediately after the treatment. In this study the computer-assisted reading was designed to provide immediate feedback to the word meanings students inferred from the MC glosses; accordingly, the study concluded that participants using L1 MC glosses also benefited from the immediate feedback given for the inferences they made during reading. Although this study in-

dicated that for a foreign language-learning setting, even within L1 glosses, MC gloss conditions can facilitate the incidental vocabulary learning, the result, again, needs another clarification to suggest the advantage of L1 MC gloss for incidental vocabulary learning. It needs to prove that L1 MC glosses even work better than L2 single or L2 MC glosses in the specific learning condition.

Since these experiments were carried out in different learning settings (i.e., whether students learn a language as a foreign language or second language) and participants have different linguistic backgrounds in each study, these results are inconclusive, and much difficulty remains to suggest which gloss type works better for university EFL students in Japan. Obviously more empirical studies need to be done in the way that the effects of the four types of glosses (L1 single, L2 single, L1 MC, and L2 MC glosses) are compared altogether for the participants with the same levels of English proficiency in a specific learning condition. For high school students in Japan, Miyasako (2002) has compared the four types of glosses and found that L2 gloss conditions (L2 MC or L2 single) had positive effects on vocabulary learning and MC gloss conditions (L1 MC or L2 MC) did not have much positive effects. He suggested that using L2 glosses tended to be more effective for advanced learners and L1 for lower proficiency learner. The interpretation from this study can not be applied to college-level students since the proficiency of the high school participants was measured based on a non-standardized measurement (called "Jitsuryoku Test" made by the high school where the participants attended); thus, further studies comparing those four types of glosses need to be conducted for university EFL students so as to clarify the interpretation and obtain clear-cut answers to which gloss type can enhance incidental vocabulary learning of the particular age group.

2.2. Theoretical background of which gloss types are effective for Japanese EFL learners

This study aims to explore which gloss types out of the four gloss conditions can facilitate incidental vocabulary learning of college-level EFL students whose English proficiency is at the beginning to intermediate level. Assuming that many students at this level still have difficulty reading fluently in English, this study hypothesizes that it is more effective for them to utilize L1 glosses (L1 single or L1 MC) than L2 glosses (L2 single or L2 MC) and of the two types of L1 glosses (L1 MC or L1 single), L1 MC would be a better one to be used when less proficient readers retain meanings of newly encountered L2 words incidentally during reading. This hypothesis can be made logical from conceptualizing how meanings of L2 words are processed at the decoding level. The following four assumptions regarding decoding of L2 words are intertwined

to rationalize why L1 glosses are better than L2 glosses and L1 MC gloss conditions can be effective for low proficient L2 readers.

The first assumption explains the reason why less proficient L2 readers benefit more from L1 glosses than L2 glosses. That is, compared with proficient L2 readers, less proficient readers have a limited vocabulary in L2; thus, they have difficulty constructing meanings of the given text in L2 during reading without L1 translation equivalents. L1 glosses can provide them with a strong confirmation of the meanings of newly encountered L2 words and that meaning confirmation via L1 also strengthens the link between the forms of the given L2 words and concept previously built in their long-term memory to facilitate retention of vocabulary.

The second assumption explains why L1 MC glosses are more effective than L1 single glosses. Compared with single glosses, MC glosses encourage learners to invest their mental efforts to retrieve meanings of words. As the mental effort hypothesis reveals, the more the input information can be elaborated at the decoding, the better and longer it is retained. This hypothesis shares the same perspective as discussed in "Levels of Processing Theory" by Craik and Lockharts (1975); that is, high cognitive load involved with the input elaborations at the stage of information intake increases chances to strengthen its memory trace. This makes it possible to assume that compared with L1 MC glosses, cognitive loading involved with use of L1 single glosses may not be enough to facilitate incidental learning of new words.

The third assumption reveals that the positive effects of MC glosses explained in the second assumption are not always expected; especially when less proficient readers are decoding words during reading in L2. Just and Carpenter (1992) pointed out that processing with the limited working memory capacity requires "trade-off" of the cognitive resources between memorizing tasks and other cognitive tasks. This theory implies that reading comprehension involves the dynamic interplay of multiple cognitive processes under which one aspect of processing performance is often constrained by the trade-off of available cognitive resources at a time. Accordingly, for decoding unfamiliar information contextualized in a L2 text, the positive effects of elaborations using high cognitive load (explained in the second assumption above) can diminish and turn to be negatively correlated with the information processing performance. That is, poor L2 readers whose decoding skills have not been automatized cannot handle the task requiring the greater cognitive loading for the decoding of new words under the working memory capacity limited during reading; thus, in such a contexualized vocabulary learning, the reversed effect appears in the way that for them the full activation of cognitive resources expected to increase memory effects of input can become an obstacle in retaining the new infor-

mation. Thus, for less proficient L2 readers, when the information processing using MC glosses involves too much mental work, it can not be expected to increase memory effects; rather, it hinders them from retaining words.

The final assumption specifies the point made by the third assumption to suggest why L2 MC or L2 single may not be effective for the vocabulary retention for less proficient L2 readers. This is drawn from the studies of dual-language lexicon. Koda (2005) explains that those studies suggest that "L2 lexical processing is mediated by L1 until sufficient proficiency is attained. ...L1 words afford easier access to meanings, they are likely to mediate semantic processing of L2 word, but the reverse is not likely during L1 lexical processing" (p.65). This implies that processing L2 words via L1 translations involves lower cognitive load than processing them via L2 synonyms and that inferring meanings of unfamiliar L2 words from unknown L2 words or multiple choices written in L2 is too demanding for less proficient L2 readers. With this assumption, it can be said that L1 MC is more likely to allow low proficient L2 readers to retain words during reading than L2 single or L2 MC since mental efforts required to process decoding of words through L1 MC during reading are not overloaded and not too few to strengthen memory trace of the word meanings.

These assumptions make it logical to say that L1 glosses work better when learners' L2 cognitive processes are underdeveloped and moreover in a comparison between L1 MC and one of the other types (L1 single, L2 single, or L2 MC), it can be hypothesized that L1 MC can provide an optimum level of cognitive load required to facilitate incidental vocabulary learning among less proficient L2 readers. Based on these assumptions, the following research questions can be explored: 1) Can L1 glosses heighten retention of new words better than L2 glosses? 2) Is L1 MC the most facilitative gloss-type to heighten retention of new words among the four gloss types?

3. Method

3.1. Participants

Three separate studies were carried out in the same procedure with the same materials in 2005. Participants were Japanese students from EFL classes enrolled in Japanese universities. The first and second studies were conducted in the first semester separately in two different universities, and the other study was conducted in the second semester in one university. Their TOEFL scores were reported by participants, and they ranged somewhere between 420 and

450. After removing those who reported that their TOEFL scores were over 450 and failed to fulfill some parts of tasks required for this study, the number of participants became as follows: Study 1 included 40 male students majoring in non-English subjects; Study 2 included 67 female students majoring in English; and Study 3 had 39 female students majoring in English.

3.2. Materials

Independent variables of this study are the four gloss types: 1) single Japanese glosses – SJ (providing a Japanese translation to a target word), 2) multiple-choice Japanese glosses – MCJ (providing one correct choice and one distracter of Japanese translation), 3) single English glosses – SE (providing an English synonym to a target word), 4) multiple-choice English glosses – MCE (providing one correct choice and one distracter of English synonym to a target word).

For the dependent variables, two simple vocabulary tests were developed. The first one was Word Recognition Test which showed a list of words including 16 correct target words and 20 distracters and simply asked participants to identify which words appeared in the passage they just read. The second one was Meaning Recall Test which simply asked participants to recall and write down meanings of the 16 target words either in Japanese translations or English synonyms. Word Recognition Test was expected to measure each participant's memorization of orthographic information (visual memory) of the target words while Meaning Recall Test was expected to measure their memorization of semantic information of the words. For both types of tests, 1 point was given to each correct answer, and the maximum score of each test was 16 points. Answers were assessed by the author himself with the following exceptional criterion: as long as the answers made by participants carried core meanings of the words, they were considered being correct even when they were given in a different part of speech or in somewhat different translations or synonyms from those given in the glosses. The reason is because of the belief that retention of a word is stabilized incrementally as the link between the word form and prior concept gets strengthened through repeatedly encountering the word; thus, any output that implies the linkage of the word with the core concept should be assessed as an important part of the vocabulary learning continuum that assists the further retention of the word.

For the reading material, a 400-word passage was prepared including 10 comprehension questions for the passage. Readability[2)] for the text was 63.7 (Flesch Reading Ease) and 7.2 (Flesch – Kincaid Grade Level), which indicate that the material is relatively easy for the intermediate EFL learners. The material also consists of frequently used words (the average fre-

quency level of the content words is 1.63 based on the JACET 8000[3] word list). 16 words which include 7 verbs, 2 adjectives, 6 nouns, and 1 adverb were chosen and transformed into non-words with the help of a native-speaker of English to determine whether they phonetically and morphologically sounded English. This method was chosen to completely eliminate the chance that participants knew or had encountered the target words previously. Four types of glosses were made for 16 non-words, and for MCE and SE glosses, original English words were used to form their synonyms. Those 16 words were also underlined in the passage.

3.3. Procedure

The study was conducted during the regular class periods (about 50 minutes including the treatment, administering the vocabulary test, instruction on teaching words they just read, and explaining the results of the study). In each study, participants were randomly assigned to one of four gloss-type groups (SJ, MCJ, SE, and MCE). In advance of the treatment (a week before the treatment was done), they all took the reading comprehension tests consisting of 20 questions adapted from the reading section of TOEFL for 25 minutes). The average scores of four groups were compared to confirm that they were all equivalent in terms of reading proficiency in English. The result of one-way ANOVA showed no significant differences among the four groups divided based on the gloss type in all three studies (Study1: $F = .64$, $p = .591$; Study 2: $F = .46$, $p = .705$; Study 3: $F = .25$, $p = .85$). Thus, the four groups in each study were equal in their reading proficiency level.

As a treatment, participants in each group were told to read the English passage equipped with one of the four types of marginal glosses. They were also told to memorize its contents to prepare for the 10 comprehension questions (multiple-choice formats) they were later told to answer without looking at the passage, and the length of reading time was 20 minutes which was chosen to provide them enough time to read the passage carefully. They were neither told to memorize vocabulary nor informed of vocabulary tests administered afterward. With these conditions, much of their attention was expected to be directed on understanding the contents rather than memorizing the words, which has been a commonly used approach for the study of incidental vocabulary learning. Participants of MCJ and MCE were told to circle correct definitions or synonyms on each MC gloss for each target word while memorizing the contents of passage. Immediately after they read the passage, Word Recognition Test and Meaning Recall Test were unexpectedly administered to see if they incidentally memorized both forms and meanings of words through the 20 minutes reading. Word Recognition Test was first ad-

ministered and collected, and then, Meaning Recall Test was administered. Eventually, the results of those immediate vocabulary tests and the comprehension scores of the passage were statistically analyzed by SPSS with a one-way ANOVA of four-between-subject factors. Any significant differences detected by ANOVA among the four factors were further examined by post hoc analyses. For the scores of correct inferences of two MC groups, two-tailed t-tests were performed to assess significant between-group differences.

In this study, delayed tests were not administered since many of the past studies failed to detect significant differences at the delayed tests and it is also unrealistic to assume that students can retain new words only through the incidental learning for more than a week. Vocabulary learning, in general, requires some forms of intentional learning to take place so as to reinforce words students encountered. This study can become significant when we discuss how effectively words should be encountered and retained through specific types of glosses to make follow-up vocabulary reinforcement tasks more meaningful. In this sense, administering immediate tests is enough to give an implication to discuss effective incidental vocabulary learning through glosses.

4. Results

4.1. Study 1

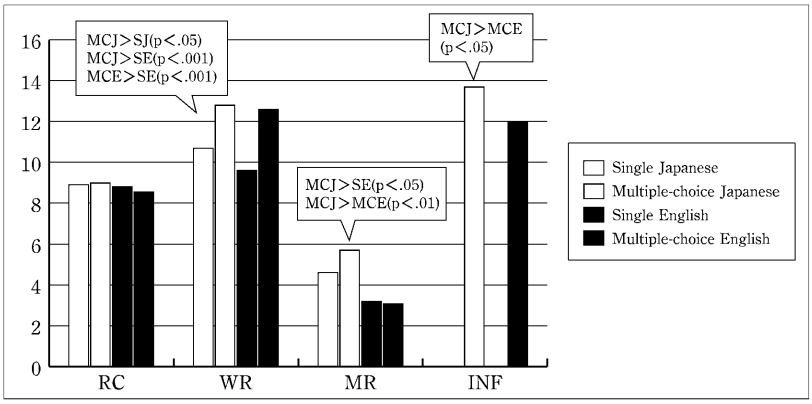
As shown in the table 1 below, the one-way ANOVA detected there was a significant difference among the four groups on Word Recognition Test, and it is also obvious on Meaning Recall Test. The results of t-test also showed that the number of correct inferences made through MC gloss conditions was significantly higher for the group using MCJ than those with MCE. No significant differences were detected on comprehension scores among the four groups.

Table 1: Results of Study 1

Test Type	Group(N)	M	SD	p
Reading Comprehension Max. 10	SJ (10) MCJ (9) SE (10) MCE (11)	8.9 9 8.8 8.55	1.2 0.87 1.14 1.13	F(3, 36)=.32, p=.806
Word Recognition Test Max. 16	SJ (10) MCJ (9) SE (10) MCE (11)	10.7 12.8 9.6 12.6	2.45 1.39 1.84 1.12	F(3, 36)=7.58, p<.001 MCJ>SJ(p<.05) MCJ>SE(p<.001) MCE>SE(p<.001)
Meaning Recall Test Max. 16	SJ (10) MCJ (9) SE (10) MCE (11)	4.6 5.78 3.2 3.09	2.84 2.54 1.75 1.22	F(3, 36)=3.39, p<.005 MCJ>SE, p<.05 MCJ>MCE, p<.01
Inferences Max.16	MCJ (9) MCE (11)	13.7 12	0.87 1.73	t=2.62, p<.05

post hoc test (LSD)

SJ=Single Japanese Glosses, MCJ=Multiple-choice Japanese Glosses,
SE=Single English Glosses, MCE=Multiple-choice English Glosses



RC=Reading Comprehension, WR=Word Recognition Test, MR=Meaning Recall Test,
INF=Inferences (the number of correct inferences through multiple-choice glosses)

Figure 1: Comparisons of SJ, MCJ, SE, and MCE on Reading Comprehension, Word Recognition Test, Meaning Recall Test, and Correct Inferences (Study 1)

A multiple comparison by LSD showed that on the word recognition test, MCJ did better than SJ and SE while MCE did better than SE. Overall, MC glosses did better than any single gloss types on the WR test. For the meaning recall test, MCJ did better than SE and MCE, though MCJ did not outperform SJ.

4.2. Study 2

For the second study, the one-way ANOVA indicated a significant difference on WR and MR among the four gloss types. Again, there was no significant difference among the four

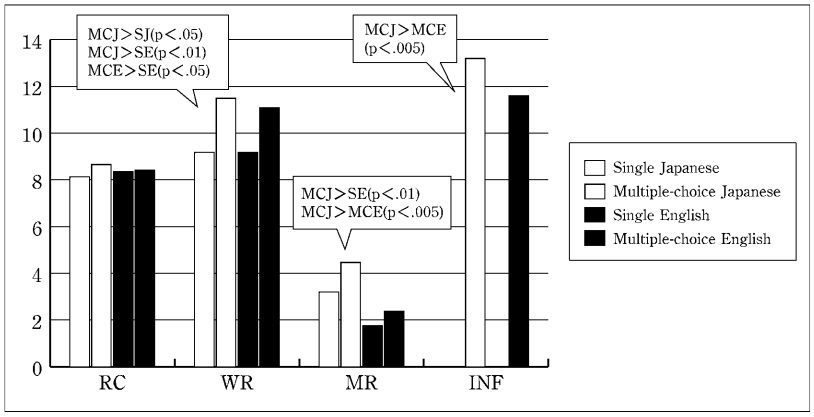
groups on the comprehension measure. T-test also showed that the success rate of drawing inferences with MC glosses was higher for the group using MCJ than those with MCE. A multiple comparison again revealed that the multiple-choice gloss conditions did better than single glosses conditions on the word recognition test, and on the meaning recall test MCJ outperformed SE and MCE, but again there was no significant difference detected between MCJ and SJ.

Table 2: Results of Study 2

Test Type	Group(N)	M	SD	p
Reading Comprehension Max. 10	SJ (16) MCJ (15) SE (17) MCE (19)	8.13 8.67 8.35 8.42	1.2 1.45 1.37 1.12	F(3, 63)=.46, p=.705
Word Recognition Test Max. 16	SJ (16) MCJ (15) SE (17) MCE (19)	9.19 11.5 9.18 11.1	3.27 1.55 2.46 2.04	F(3, 63)=4.13, p<.001 MCJ>SJ(p<.05) MCJ>SE(p<.01) MCE>SE(p<.05)
Meaning Recall Test Max. 16	SJ (16) MCJ (15) SE (17) MCE (19)	3.19 4.47 1.76 2.37	2.23 2.17 2.33 1.61	F(3, 63)=5.01,p<.005 MCJ>SE(p<.01) MCJ>MCE(p<.005)
Inferences Max.16	MCJ (15) MCE (19)	13.2 11.6	0.94 1.64	t=3.29, p<.005

post hoc test (LSD)

SJ=Single Japanese Glosses, MCJ=Multiple-choice Japanese Glosses,
SE=Single English Glosses, MCE=Multiple-choice English Glosses



RC=Reading Comprehension, WR=Word Recognition Test, MR=Meaning Recall Test,
INF=Inferences (the number of correct inferences through multiple-choice glosses)

Figure 2: Comparisons of SJ, MCJ, SE, and MCE on Reading Comprehension, Word Recognition Test, Meaning Recall Test, and Correct Inferences (Study 2)

4.3. Study 3

Again, significant differences were detected on Word Recognition Test and Meaning Recall Tests and no significant difference was obtained for the comprehension scores. However, this time, t-test showed no significant difference between MCJ and MCE on the scores of correct inferences.

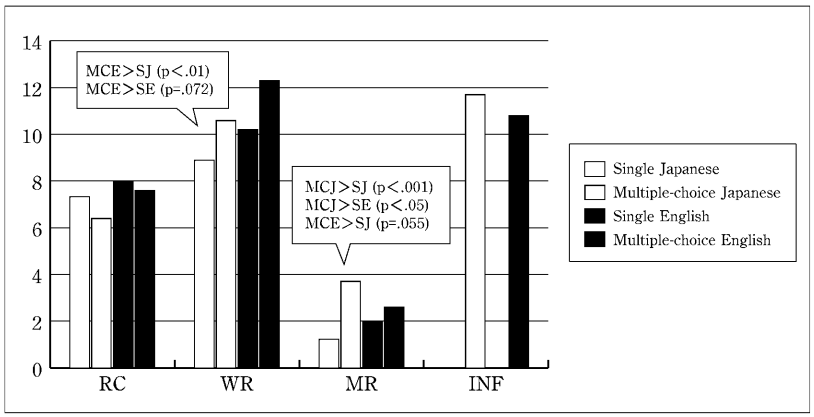
Table 3: Results of Study 3

Test Type	Group(N)	M	SD	p
Reading Comprehension Max. 10	SJ (9) MCJ (10) SE (10) MCE (10)	7.33 6.4 8 7.6	1.22 1.51 1.94 1.17	F(3, 35)=2.05, p=.12
Word Recognition Test Max. 16	SJ (9) MCJ (10) SE (10) MCE (10)	8.89 10.6 10.2 12.3	2.37 2.55 3.33 1.57	F(3, 35)=2.94, p<.05 MCE>SJ (p<.01) MCE>SE (p=.072)
Meaning Recall Test Max. 16	SJ (9) MCJ (10) SE (10) MCE (10)	1.22 3.7 2 2.6	0.97 1.64 1.49 1.78	F(3, 35)=4.57, p<.001 MCJ>SJ (p<.001) MCJ>SE (p<.05) MCE>SJ (p=.055)
Inferences Max.16	MCJ (10) MCE (10)	11.7 10.8	0.94 1.47	t=1.62, p=.12

post hoc test (LSD)

SJ=Single Japanese Glosses, MCJ=Multiple-choice Japanese Glosses,
SE=Single English Glosses, MCE=Multiple-choice English Glosses

The successful rate of inferences was similar this time among MCJ and MCE. In contrast to the previous two studies, a multiple comparison showed that effect of MCJ was diminished on the word recognition test. On the meaning recall test, overall, multiple choice glosses did better than single gloss types, but the results differed from the previous two studies in that a significant difference was not detected between MCJ and MCE, and MCJ did better than SJ while MCE also did better than SJ though the *p*-value is close to a significance level (.055). Study 3 brought some mixed results to this whole experiment.



RC = Reading Comprehension, WR = Word Recognition Test, MR = Meaning Recall Test, INF = Inferences (the number of correct inferences through multiple-choice glosses)

Figure 3: Comparisons of SJ, MCJ, SE, and MCE on Reading Comprehension, Word Recognition Test, Meaning Recall Test, and Correct Inferences (Study 3)

5. Discussion

Over the three studies there was no significant difference detected among the four groups on the comprehension scores. This means that while reading the given passage, participants could focus on understanding the contents of the passage successfully and none of the gloss types either facilitated or interfered with the reading comprehension more than the others. This helps us to confirm that all the participants, regardless of the glosses they used, could devote their attention equally on the 20-minute reading.

Study 1 and 2 revealed the same tendency on all the three dependent variables (Scores of Word Recognition Test, Meaning Recall Test, and Correct inferences), but Study 3 indicated a little different picture on the comparisons on the three dependent variables. This makes it difficult to draw an appropriate interpretation over three studies. The cause of this variance is not known from this study; but it could be a variance of student motivation levels or failure of the test design itself. The results of these three studies, however, have provided the following significant findings.

On Meaning Recall Tests, the same tendency was observed from the separate studies, Study 1 and Study 2. That is, MCJ was better than both MCE and SE. Although there was no significant difference between SJ and SE on the tests, overall, the prominence of L1 MC over three studies reveals that L1 glosses appeared more effective for the participants in this study than L2 glosses in order to retain words incidentally during reading. This answers the research question 1 and contradicts Miyasako's study showing that L2 glosses appeared effective for

high school students. Assuming that the participants are not more than being intermediate L2 readers, reading assisted with L1 glosses can facilitate incidental vocabulary learning better. In all three studies, MCJ showed the highest retention scores, and this tendency implies that MCJ is the most effective for the participants of this study. However, this study cannot strongly suggest the advantage of the L1 plus MC gloss condition since MCJ did not outperform SJ on both Study 1 and 2. As suggested in Watanabe (1997a), in this study L2 MC glosses did not show any strong effects over L2 single.

The study 3, however, gives a little different story. MCJ appeared superior to both SJ and SE while MCE did slightly better than SJ on the meaning recall test. The result still implies that MCJ is the best facilitator for retention of the word meanings, but MCJ did not outperform MCE. Though the result can be interpreted as the advantage of using L1 MC over L1 single glosses as suggested in Nagata (1999), the effect of MCJ was not completely clear. One notable finding from study 3 is that when there was no significant difference between the number of correct inferences from MCJ and those from MCE, there was also no significant difference detected between MCE and MCJ on Meaning Recall Test. This may lead to another interpretation of the results. That is, "trade-off" of cognitive resources is not only a factor to differentiate the effects of one gloss from another, but confirmation of meanings retrieved may also play a significant role for incidental vocabulary learning through glosses.

The most interesting finding of the study can be observed on the comparison between the tendency observed on Word Recognition Tests and that of Meaning Recall Tests in all three studies. On Word Recognition Tests, both MCE and MCJ (only MCE in Study 3) outperformed SE and SJ. Since this test asked participants to identify the words that appeared in the passage, their visual memory of words (how well orthographic information of words was stored) was tested. Those who used the multiple-choice glosses did better on the test, which means that inferring meanings of words facilitated their memorization of orthographic information of words. It is probably the amount of time spent on inferring the target words with MC glosses that facilitated the learning. On the meaning recall tests, however, the result was reversed in the way that the effect of MCJ was increased while that of MCE diminished. It is obviously not the amount of time spent on inferring word meanings that brought this reversal. This implies that for the participants of this study, semantic retrieval with L2 MC let them use many of their cognitive resources during reading, minimizing their chances to store semantic information of the target words.

One principle could be drawn as follows: storing orthographic information itself required

less cognitive load (shallow processing or "maintenance rehearsal") and, thus, are not constrained by the trade-off of cognitive resources; on the other hand, retaining semantic information is heavily constrained by the trade-off during reading since it requires more cognitive load to be processed (deep processing or "elaborative rehearsal") (Craik and Lockhart, 1972). This implies that the trade-off of working memory capacity becomes influential to any cognitive tasks during reading; thus, the optimum level of cognitive load involved in vocabulary learning must be considered to make incidental learning applicable to less proficient L2 readers. The reversal of the effects observed between MCJ and MCE on the meaning recall tests indicates that for the incidental vocabulary learning in this study, a gloss type of L1 MC worked well as an optimum task for beginning or intermediate EFL readers. Thus, this finding partly supports the hypothesis of this study.

6. Conclusion

This study showed that a particular type of gloss can be effective for retention of L2 word meanings and suggested that reading assisted with use of L1 MC glosses can facilitate incidental learning of new words since the gloss type entails an optimum cognitive load suitable to incidental vocabulary learning during L2 reading. However, the study left several issues to be addressed in the future. In this study, Meaning Recall Test simply asked participants to produce meanings either in Japanese or English; but most participants, even those who used L2 glosses, gave the answers in Japanese. The results showing preference over L1 glosses may be attributed to the one assumption that the participants who used L1 glosses may perform better because the test itself asked them to produce answers in Japanese. For the next study, this problem should be addressed (e.g., using cues to retrieve acquired meanings or fill-in-the-blank tests to avoid asking participants to use a particular language to answer). This study did not administer any delayed tests. It would be interesting to see how long the strength of memory trace for retained words will last to better imply the effects of specific types of glosses. However, the author strongly believes that adding any intentional vocabulary learning activities can reinforce the word knowledge gained through the reading assisted with L1 MC glosses for the further retention of the acquired knowledge. The results of this study encourage use of L1 glosses, but this does not deny any activities to build up L2 vocabulary knowledge in English-only learning conditions since the purpose of such an approach is to increase students' sensitivity to pragmatic dimensions of vocabulary, which is not the objective this study deals with. Finally, for the

further studies, effects of glosses should be studied involving different proficiency levels in terms of their vocabulary size. For exploring cognitive aspects of vocabulary learning, studies should be precisely designed to pinpoint the cause of the variances observed among different gloss uses. In that case, the total amount of time each participant spent on reading a text and fixing eyes on a target word should be controlled for more precise analysis of the effects of glosses.

Notes:

1) The term "gloss" refers to an annotation to look up meanings of vocabulary items. In most studies on glosses, the term indicates marginal glosses, which means that annotations are put in a margin of the bottom of the page. In this study, glosses also refer to marginal glosses.
2) Readability is a commonly used index that predicts how difficult reading passages are to read. The formulas are based on the number and length of words and syllables on a given text. For example, in Flesch Reading Ease Scale, "30" indicates the passages are suitable for college students, and those with "70" are for ninth grade students. The scores of Flesch-Kincaid Grade Level predict for which grade level of students from the first grade to the university level a given text should be read for.
3) JACET8000 (JACET List of 8000 Basic Words) is a word list for Japanese university students. Words were selected out of British National Corpus (BNC) and the sub-corpus (e.g., entrance examinations, STEP, TOEFL) including frequently used words by Japanese students. JACET 8000 consists of 8 different frequency levels (8 indicates the least frequently used words).

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