Context-Based Activation of Deliberately Learned New Words:  
A Pilot Study  

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Abstract  
Recently, researchers have become aware that deliberate learning of new words in a foreign language may facilitate implicit as well as explicit lexical knowledge. Previous research has found the existence of mental connections between newly learned words and their meanings through priming studies. In the present study, a small-scale experiment using priming methodology was conducted to explore the possibility that learners construct a mental association between new words and other words they encounter in the same context. Graduate and undergraduate students (n = 10) memorized a word list consisting of 10 English rare words paired with their Japanese translations and example sentences. After that, the participants performed a lexical decision task that required prompt recognition of new-word targets presented on a PC screen; the targets were primed by words that had appeared in the example sentences (i.e., context primes) or by unrelated words (i.e., control primes). The response time of all participants was shortened for context primes, suggesting an implicit connection between new words and contexts in the learner’s mind. Pedagogical implications and suggestions for future research are discussed.  

1. Introduction  

1.1 Current Issues on Deliberate Learning of New Words  
Researchers have pointed out that there are two typical modes of learning vocabulary in a second or foreign language (L2): intentional and incidental learning. Intentional vocabulary learning includes deliberate learning of new word forms and their translations in the learner’s first language (L1) and such other activities as making efforts to guess word meanings in context (see Nation, 2013). Although the currently favored language teaching paradigm promotes communicative, meaning-oriented learning, the deliberate learning of a word list has many advantages compared to guessing or the incidental learning that occurs during extensive reading and listening. In fact, guessing from context is often unreliable, especially if the learner knows less than 98% of the words in the discourse or if the learner understands the overall message without paying attention to the new words (Nation, 2006; see also Schmitt, 2008). Therefore, recent studies on second language acquisition suggest that the most economical way to learn L2
vocabulary is to first memorize the form and meaning of new words deliberately and then learn contextualized aspects, such as collocation knowledge, through extensive exposure in context (Ellis & Shintani, 2014; Schmitt, 2008).

The most appealing feature of the deliberate learning of new words is its efficacy; when the students make an effort to learn vocabulary with an explicit focus, it almost always leads to greater and faster gains regardless of the students’ proficiency levels, as long as the vocabulary knowledge is measured by paper-based recall or recognition tests (i.e., tests of explicit knowledge; Hulstijn, 2005). On the other hand, critics have argued that deliberate learning is not really helpful because it does not affect the acquisition of linguistic knowledge. This view is related to Krashen’s (1989) theory that linguistic knowledge is acquired only when the learner’s attention is focused on the message and that only acquired knowledge is involved in authentic language use. Acquired knowledge is almost synonymous with implicit knowledge, in that both terms refer to lexical knowledge that is (a) subconscious, (b) fluently available when understanding or producing language, and (c) well-integrated with other items in the language system (Nation & Webb, 2011). However, it has long been unclear whether implicit lexical knowledge can be gained through deliberate learning of new words.

1.2 Previous Studies on Implicit Lexical Knowledge

To test whether deliberate learning leads to implicit knowledge of lexical items, Elgort (2011) conducted three experiments using a priming methodology. Detailed discussion of specific methods of priming experiments is given below in Section 1.3. In her study, advanced learners of English (aged 18–52) deliberately learned 48 pseudowords (i.e., disguised word forms paired with meanings) over the period of one week. The learning materials included a definition of each pseudoword with an example of use in a sentence, such as “This set of exercises focuses on the proster [pseudoword] area.” To confirm their explicit knowledge of the learned words, the participants were tested at the end of the week. After the learning phase, the participants took part in a priming experiment where a word appeared very briefly on a PC screen (the prime) followed by another word that stayed on the screen for a longer time (the target). The participants were asked to indicate whether the target word was a real word (the lexical decision task). The speed of correct responses was compared between an experimental condition where the prime–target pairs had a semantic or orthographic relation and a control condition with unrelated prime–target pairs. The results showed a shorter response time under the experimental condition, suggesting that the learned words had entered into lexical relationships with other related words in the learners’ minds.

On the other hand, Sonbul and Schmitt (2013, Experiment 2) reported that postgraduates studying at a British university (aged 21–41) did not indicate implicit knowledge of new lexical items learned intentionally (deliberately) or incidentally. In their experiment, five medical collocations, such as decaying lung and frosted heart, were learned under one of the following

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Note

1. Deliberate learning causes memory traces of collocations. Further investigation is necessary to clarify if the “decontextualized” condition in Sonbul and Schmitt’s study because the other two conditions (i.e., enriched and enhanced) had a semantic or orthographic relation and a control condition with unrelated prime–target pairs.
three conditions: enriched, enhanced, and decontextualized. First, in the enriched condition five collocations were embedded in a reading passage. The passage included three occurrences of each collocation. Second, in the enhanced condition, five collocations were included three times in the same passage, but the collocations were made salient with red, bold font. In contrast, in the decontextualized condition five collocations were taught in isolation. Thus, the first (enriched) condition resembled a pure “incidental” learning situation; the third (decontextualized) was a pure “intentional” learning situation with the learner’s explicit focus. The second (enhanced) condition can be viewed as incidental learning, but the learners may have paid attention to the target items more carefully than under the first (enriched) reading condition. The participants’ implicit knowledge was measured in terms of whether the first word of a two-word collocation had priming effects on the lexical decision for the second word of the same collocation. However, the results from mixed-effects modeling showed that no condition facilitated implicit collocational priming effects.1

Although both studies relied on priming, there were many differences in the deliberate learning methods of Elgort’s (2011) and Sonbul and Schmitt’s (2013, the decontextualized condition) experiments. Some major differences are summarized in Table 1. In contrast to Elgort’s study, participants in Sonbul and Schmitt’s experiment did not develop any durable implicit memory traces of collocations. It is still unclear whether this is due to the quite short time allowed for deliberate learning or a lack of important information, such as definitions of the collocations and example sentences. Otherwise, one might argue that the collocational relationship, the focus of Sonbul and Schmitt, is not as durable as the semantic relationship because collocation is simply a co-occurrence of two words in the same context. Further investigation is necessary to clarify if deliberate learning causes memory traces of collocations.

Table 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of time</td>
<td>For a week</td>
<td>For 10 minutes</td>
</tr>
<tr>
<td>Definition of the learned items</td>
<td>Available</td>
<td>N.A.</td>
</tr>
<tr>
<td>Example sentence</td>
<td>Available</td>
<td>N.A.</td>
</tr>
<tr>
<td>Test of explicit knowledge</td>
<td>Before the LDT</td>
<td>After the LDT</td>
</tr>
</tbody>
</table>

Note. LDT = the lexical decision task. Elgort’s (2011) procedures were compared only to the “decontextualized” condition in Sonbul and Schmitt’s study because the other two conditions (i.e., “enriched” and “enhanced”) were incidental learning conditions rather than deliberate learning.

The present study is the first attempt to examine whether deliberate learning of unfamiliar words for a short time affects the memory traces of co-occurring words in the example sentences. In the priming experiment, this study used newly learned words as targets and other words that
appeared in the same example sentences as primes. For example, the rare word esplanade was learned with its translation and the following example sentence: “All the children played in the narrow esplanade last Sunday.” In this item, Sunday was the prime for the target esplanade. In contrast to Sonbul and Schmitt (2013), this pair of words does not make an idiomatic sequence but is simply a co-occurrence of two words without a direct semantic relationship. The Sunday–esplanade pair (hereafter, the context prime condition) was compared to the Thursday–esplanade pair (hereafter, the control prime condition). If the lexical decision time is shortened for the context prime, this would suggest that the learners had constructed a mental association between new words and other words they encounter in the same context. Although such mental associations may not seem very helpful in daily language use, language teachers should not underestimate the effect of word–context associations, as the memory trace of contextual information is a useful cue to recall the meanings of newly learned words in the primary stage of lexical development (Hasegawa, 2016).

1.3 The Priming Paradigm

The design of this study was based on the priming paradigm. However, this technical term does not refer to any specific task but to a technique for constructing and presenting experimental materials often used in combination with many reaction-time measurements (Jiang, 2012). Among a variety of tasks that deal with reaction time, the lexical decision task was selected as the method to assess implicit knowledge by both Elgort (2011) and Sonbul and Schmitt (2013) because it is one of the best-established paradigms for studying processes involved in word recognition and the structure of the mental lexicon (Elgort, 2011, p. 375). The use of the lexical decision task is based on the premise that a learner’s response latency in judging whether a given item is a real word indicates the recognition time of that word. In a semantic priming study such as Elgort’s Experiment 3, there is a semantic relation between the prime (e.g., veranda) and the target (e.g., balcony). In a collocational priming study such as Sonbul and Schmitt’s experiment, an idiomatic two-word phrase (e.g., vanishing lung) is divided into the prime part (e.g., vanishing) and the target part (e.g., lung). In both types of priming, the recognition of the target is facilitated by prior presentation of the prime. If such a positive priming effect is observed for newly learned words or phrases, this shows that the prime and target are linked in the learner’s mind.

When the priming paradigm is applied to vocabulary acquisition research on deliberate learning of new lexical items, there are four possible patterns for constructing materials, as displayed in Table 2. In Pattern A, a newly learned word is used as the prime and examined for a positive priming effect on the recognition of a related known word. The reaction times of the new-word prime condition and the control prime condition(s) are compared, as in Elgort’s (2011) study. On the other hand, in Pattern B, a new word is presented as the target and the reaction times for the related known-word prime condition and the unrelated known-word prime condition are compared. Furthermore, when the newly learned items are two-word collocations, as in Sonbul
and Schmitt’s (2013) study, Pattern C is applied if the collocations consist of two familiar words; otherwise, the research design follows Pattern D.

Table 2
Four Possible Patterns of Prime–Target Combination

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Prime</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>New word</td>
<td>Known word</td>
</tr>
<tr>
<td>B</td>
<td>Known word</td>
<td>New word</td>
</tr>
<tr>
<td>C</td>
<td>Known word</td>
<td>Known word</td>
</tr>
<tr>
<td>D</td>
<td>New word</td>
<td>New word</td>
</tr>
</tbody>
</table>

Among these four patterns, Elgort (2011) adopted Pattern A because the tested hypotheses included the matter of whether deliberately learned words activate semantic representations. However, Pattern A is only suitable for advanced L2 learners; if the learner’s word recognition process is not automatized (i.e., so fluent that the learner is almost unconscious of the process), the new word primes will not activate semantic representations in such a short time. On the other hand, Pattern B is useful if the researchers aim to investigate the word recognition process of less proficient learners. Because the primes are familiar to the participants, semantic or collocational associations may be activated more easily than in Pattern A. In a cross-language primed lexical decision task (see de Groot, 2011, pp. 166–167), researchers use prime words in the participants’ L1 to test if there is interlanguage association between L1 primes and L2 targets; the paradigm of this task is closest to Pattern B in Table 2. In the present study, new words that had been learned deliberately were presented to the learners as targets (Pattern B). Pattern A was avoided because the participants included low-intermediate learners whose word recognition process was not fully automatized and because the new words were learned within only a short time.

1.4 The Present Study

This study focuses on learners’ recognition of new words learned deliberately. Despite the finding that the deliberate learning of a word list, including unfamiliar word forms, meanings, and example sentences, facilitates implicit knowledge of the learned words in the long run (Elgort, 2011), previous research could not find evidence of gain of implicit knowledge after 10 minutes of learning (Sonbul & Schmitt, 2013). Empirical study is necessary to study what happens in the learner’s mind on the first day of learning. There has been no study examining the possibility that learners construct a mental association between new words and other words they encounter in the same context. To address this issue, the present study raises the following hypothesis (H):
H: Recognition of L2 words learned deliberately within a short time becomes faster when the words are presented immediately after other words that have been used in the same context (i.e., priming effect).

If this hypothesis is supported, it would suggest the memory trace of a mental association between new words and other words they encounter in the same context. Researchers believe that learners’ knowledge of newly learned vocabulary is episodic memory (also called context-dependent memory) at first, which gradually changes to procedural memory (also called context-independent memory; Godden & Baddeley, 1975; see also Kadota, Noro, Shiki, & Hase, 2014, pp. 45–53). During intentional learning of a word list consisting of target words, translations, and example sentences, a learner first encodes words in the context of all surrounding information (such as the example sentence, the classroom environment, and even the language instructor). However, learners’ memory of word meanings gradually becomes context-independent as the same words are encountered repeatedly in various situations and contexts. In this manner, when words are finally mastered, learners are able to comprehend and use them without remembering any situational information. The present study’s hypothesis assumes that the context-dependent memory of new words is acquired through deliberate learning within a short time, which facilitates recognition of the new words.

2. Method

2.1 Participants

Participants were 12 graduate and undergraduate students majoring in education at a Japanese university. However, the data for two participants were excluded from analysis because the participants did not follow the instructions for the lexical decision task; the number of participants was thus reduced to 10 (five females and five males, aged 18–38). They had studied English as a foreign language for more than six years. Written informed consent was obtained and the rights of the participants were protected. Their English proficiency varied from low-intermediate to advanced levels (around Grade Pre-2 to Grade 1 of the STEP Eiken test). None had ever participated in the author’s previous research.

2.2 Materials

This study used a list of 10 low-frequency words in the participants’ L2 (English) with translations in their L1 (Japanese) and example sentences. The learned words were as follows: don, esplanade, gloaming, indite, mosey, reminisce, repast, sanatorium, tram, and visage. These words were used in the same sense as Webb’s (2008) 10 pseudowords (i.e., disguised word forms paired with meanings); however, the use of pseudowords was avoided in this study for pedagogical reasons. None of the target words was listed in the standard EFL vocabulary list JACET 8000.
2.2 Materials
None had ever participated in the author’s previous research. The rights of the participants were protected. Their English proficiency varied from low-intermediate to advanced levels (around Grade Pre-2 to Grade 1 of the STEP Eiken test). Written informed consent was obtained and the participants did not follow the instructions for the lexical decision task; the number of facilitates recognition of the new words.

Facilitating memory of new words is acquired through deliberate learning within a short time, which learners’ memory of word meanings gradually becomes context-independent as the same words are presented immediately after other words that have been used in the same context. Researchers believe that learners’ knowledge of newly learned vocabulary is episodic memory (also called context-dependent memory) at first, which gradually changes to procedural memory (also called context-independent memory) of these example sentences was high (M = 5.07, SD = 0.62), based on 28 undergraduates’ ratings using a 7-point Likert scale (7 = easy to imagine the situation described; 1 = difficult to imagine anything about the context).

In the priming experiment, the 10 low-frequency words described earlier in this section were used as the targets of the lexical decision task and primed by other words that were familiar to the participants, as displayed in Table 3. High-frequency prime words were selected from the words used in the example sentences. For example, in the context prime condition, the prime word for esplanade was Sunday, from the following example sentence: “All the children played in the narrow esplanade last Sunday.” These two words do not form an idiomatic sequence. For the control primes, another set of 10 high-frequency words that were comparable with the context primes was selected (see Appendix). For example, the control prime for esplanade was Thursday, whose lexical properties (e.g., frequency and semantic category) are quite similar to Sunday. All the prime words were either common words that belong to the 1,000 most frequently used words listed in the new version of JACET 8000 (Basic Word List Revision Special Committee, 2016) or proper nouns that appear in English textbooks used in Japanese junior high schools; all the control words were either synonyms or antonyms of the prime words or proper nouns that were as popular as the prime words.

Both the context and control prime conditions required a “Yes” response in the lexical decision task because the targets were real words. To create a situation where the participants gave “No” responses, 10 pseudowords were made by changing some letters of the targets (see Appendix). To reduce the word length effect on recognition time, the number of letters of each pseudoword was the same as the original target; also, the first letter was not changed from the original (e.g., esplanade vs. eldrewice). The pseudowords had almost the same syllable structure
as the original words. Although the pseudowords were primed by the same words as the targets, the participants’ responses for the pseudowords were not analyzed.

Table 3

<table>
<thead>
<tr>
<th>Trial type</th>
<th>Prime</th>
<th>Target</th>
<th>Correct response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Context prime–target</td>
<td>Sunday</td>
<td>explanade</td>
<td>“Yes”</td>
</tr>
<tr>
<td>2. Control prime–target</td>
<td>Thursday</td>
<td>explanade</td>
<td>“Yes”</td>
</tr>
<tr>
<td>3. Context prime–pseudoword</td>
<td>Sunday</td>
<td>elderwice</td>
<td>“No”</td>
</tr>
<tr>
<td>4. Control prime–pseudoword</td>
<td>Thursday</td>
<td>elderwice</td>
<td>“No”</td>
</tr>
<tr>
<td>5. Filler–Filler</td>
<td>along</td>
<td>narrow</td>
<td>“Yes”</td>
</tr>
</tbody>
</table>

*Note. This study focuses on the difference between the context prime condition (1) and the control prime condition (2). The two pseudoword conditions (3 and 4) were not analyzed because the correct response was different from the other conditions.*

In addition, using high-frequency words, another 10 prime–target pairs were prepared as fillers (e.g., *along–narrow*). Without the filler trials, the participants would press the “Yes” button only when the learned words were presented; this was not a lexical decision. Therefore, it was necessary to include other real words in the trials. All filler items were high frequency and used at least once in an example sentence; thus the filler condition induced the fastest response among the participants. In total, 50 trials were created as follows: 10 context-prime–target, 10 control-prime–target, 10 context-prime–target, 10 control–pseudoword, and 10 filler–filler trials (see Table 3)

2.3 Procedure

As shown in Table 4, this study consisted of deliberate vocabulary learning, written tests of the learned words, and the lexical decision task.

Table 4

<table>
<thead>
<tr>
<th>Phase (required time)</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning (5–10 mins.)</td>
<td>Deliberate learning of the word list</td>
</tr>
<tr>
<td>Testing (5–10 mins.)</td>
<td>(a) Recall test of the word list</td>
</tr>
<tr>
<td></td>
<td>(b) L2–L1 translation test</td>
</tr>
<tr>
<td></td>
<td>(c) Gap-filling test</td>
</tr>
<tr>
<td></td>
<td>(d) Checking the answers</td>
</tr>
<tr>
<td>Lexical decision (15–20 mins.)</td>
<td>Lexical decision task consisting of 50 trials</td>
</tr>
</tbody>
</table>
In the learning phase, the participants were asked to learn a list consisting of the 10 target words and their translations along with example sentences. A preannouncement about the post-learning task was given to draw learners’ attention to the presented materials. To urge the participants to read the example sentences carefully, another instruction was given that asked the participants to rate how easily each sentence evoked a mental image (i.e., imageability) on a 7-point Likert scale. There was no time limit; all participants finished the deliberate learning of the new words in 5 to 10 minutes.

To confirm that the participants’ knowledge was gained through deliberate, explicit learning, three different tests were given immediately after the learning phase. The first test was a recall test of the word forms (10 items): The participants were presented with phonetic symbols of the learned words and asked to write the corresponding spellings. The second was a meaning recall test in the L2–L1 translation format (10 items): The participants were presented with the word forms of the learned words and asked to write the corresponding translations. The third was a gap-filling test that required a combination of the learned words and context (10 items): The participants were presented with the example sentences that they had read in the learning phase with blanks in place of the target words and asked to fill the blanks with the best-fitting target words. The mean scores of the first ($M = 9.70, SD = 0.48$), second ($M = 8.90, SD = 0.99$), and third tests ($M = 8.90, SD = 1.85$) were high; however, total scores of the three tests varied across participants, ranging from 22 to 30 ($M = 27.50, SD = 2.59$). To consolidate the participants’ explicit knowledge, the word list used in the learning phase was presented again and the participants checked the answers of the three tests by themselves.

The testing phase was followed by the speeded lexical decision task, which requires the participants to make a word/pseudoword decision as quickly and as accurately as possible. The experiment was conducted using SuperLab 5 software on an Intel Core i7 computer with an NEC 27-inch LCD monitor (screen area: $1,920 \times 1,080$ pixels). Experimental stimuli were presented in the middle of the screen using black 36-point MS P-Gothic font against a white background. The participants were instructed to indicate their decision using the response box connected to the computer. They had to press the “Yes” button if the string of letters on the computer screen was an English word and the “No” button if it was not a real word. At the beginning of each experiment, the participants were given a set of practice trials to familiarize themselves with the task and allowed to ask questions about the experiment if necessary.

In each trial, a string of six hash marks (######) was presented for 1,000 milliseconds (ms), then the prime was shown for 1,000 ms, followed by the target (see Section 2.2 for the content of 50 trials). The stimuli of the next trial appeared automatically after a 400 ms interval, during which a blank screen was displayed. These display times were almost twice those in Elgort’s (2011) experiment, considering the proficiency level of the current participants. The order of trials
was randomized across the participants. The whole session, including some general instructions and the three phases displayed in Table 4, was completed within 30–50 minutes.

2.4 Analysis

The results were analyzed by participant ($F_1$) and by item ($F_2$) at a 5% alpha level. This study regards the $F_1$ analysis as the main analysis. In the $F_1$ analysis, a one-way Analysis of Variance (ANOVA) was run on the correct answer rates and the response time data to compare the context and control prime conditions and the filler condition. In the $F_2$ analysis, a $t$ test was used to compare the context and control prime conditions; endnotes to this article provide the results of Wilcoxon signed-rank tests. Incorrect responses (i.e., the “No” responses) were excluded from the response time analyses. To avoid the influence of outliers, response time data that were more than two $SD$s above or below the average for a given participant were excluded from the analyses.

In addition to the statistical hypothesis testing, effect size was calculated using Cohen’s $d$, which shows the number of $SD$s by which one group’s mean is greater than another’s. With reference to Mizumoto and Takeuchi (2008), criteria for small ($d > .20$), medium ($d > .50$), and large effect sizes ($d > .80$) were determined.

3. Results

3.1 Analyses by Participant ($F_1$)

The correct response rates and response time by participants are summarized in Table 5. First, the correct rates were quite high under all conditions; a one-way ANOVA confirmed that there was no significant difference among the three conditions, $F(2, 18) = 0.00, p = 1.00$. The participants’ responses were quite accurate in general.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Correct rate</th>
<th>Response time (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Context prime</td>
<td>.98</td>
<td>.04</td>
</tr>
<tr>
<td>Control prime</td>
<td>.98</td>
<td>.04</td>
</tr>
<tr>
<td>Filler</td>
<td>.98</td>
<td>.04</td>
</tr>
</tbody>
</table>

Second, the result of another one-way ANOVA indicated a significant difference among the three conditions, $F(2, 18) = 25.09, p < .001$. Therefore, paired comparisons were performed using Bonferroni’s adjustment. Most importantly, the difference between the context and control prime conditions was significant ($p = .037; d = 0.38$ [small effect size]). Additionally, there were
significant differences between the context prime and filler conditions ($p = .001; d = 0.49$ [small effect size]) and between the control prime and filler conditions ($p = .001; d = 0.86$ [large effect size]).

The difference between the context and control conditions (63.89 ms) seems very small.

However, priming effects in lexical decision experiments are often around 50–70 ms (e.g., Elgort, 2011). Furthermore, in this study all the participants responded faster under the context prime condition than under the control prime condition. This suggests that the context primes facilitated the participants’ recognition of the deliberately learned new words.

### 3.2 Analyses by Item ($F_2$)

The correct response rates and response time by item are summarized in Table 6; there was no filler condition in the $F_2$ analyses because targets used in the filler condition were different from those used in the context and control prime conditions. First, the correct rates were quite high under both context and control prime conditions; a paired-sample $t$ test confirmed that there was no significant difference between the two conditions, $t(9) = 0.00, p = 1.00$. In general, the responses on the 10 target items were quite accurate.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Correct rate</th>
<th>Response time (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Context prime</td>
<td>.98</td>
<td>.06</td>
</tr>
<tr>
<td>Control prime</td>
<td>.98</td>
<td>.04</td>
</tr>
</tbody>
</table>

Second, the result of another paired-sample $t$ test was not significant but the $p$ value was close to the alpha level, $t(9) = 2.23, p = .053$. The effect size in the $F_2$ analysis ($d = 0.55$ [medium effect size]) was larger than in the $F_1$ analysis. The response time for eight items was shorter under the context prime condition (i.e., *don*, *esplanade*, *gloaming*, *indite*, *mosey*, *sanatorium*, *tram*, and *visage*), whereas the response time for the other two items was shorter under the control prime condition (i.e., *reminisce* and *repast*).

### 4. Discussion

The results of the $F_1$ analysis supported the hypothesis that recognition of L2 words learned deliberately within a short time becomes faster when the words are primed by other words that have been used in the same context. This suggests that L2 learners can construct a mental association between new words and other words they encounter in the context. In the $F_2$ analysis,
however, the results were not as clear as the $F_1$ analysis; the reason for this is discussed later in this section. Nevertheless, the data obtained in this study were supportive of the hypothesis.

Past studies have found that presenting a context during the deliberate learning of new words and their translations is not as effective as teachers might expect (Prince, 1996; Webb, 2007); the role of reading example sentences has yet to be closely examined. This study is the first attempt to examine whether deliberate learning of new words affects the memory traces of co-occurring words in the example sentences. Despite the fact that the memory trace makes learners recognize the learned words only 64 ms faster and that the learners themselves were not aware of that effect (i.e., implicit knowledge), the memory of contextual information may be a useful cue to recall the meanings of words (Hasegawa, 2016). Applying the present study’s finding to the classroom context, one may draw the analogy that if a student reads glossed sentences including an unfamiliar word carefully and encounters the same word again in a similar context, the lexical information of that word will be activated by contextual information. Research findings have shown that vocabulary acquisition is incremental in nature and learners develop their lexical knowledge through extensive exposure to contextual input (Schmitt, 2008). This study’s results suggest that reading an example sentence during learning vocabulary plays an important role in the incremental cycle of the contextualized learning of L2 vocabulary.

Although this research was a pilot study with only 10 participants and 10 items, the priming effect was observed to some extent across all the participants. Given that the participants included both low-intermediate and advanced learners, the context-based activation of newly learned words seems ubiquitous. On the other hand, the priming effect was rather erratic in the analysis by item. Response time and priming effect may be affected by word-related factors, such as the number of letters, regularity of spellings, and frequency of stimulus words, as well as context-related factors like the position of the prime word in an example sentence and the relationship between a prime word and target word in context.

In this study, the author admits the following problems concerning the two items that did not show a positive priming effect (i.e., reminisce and repast). First, the spelling of reminisce seems less familiar to the students compared to the other target words. Although the letter string “sc” can be seen at the beginnings of some frequent words, such as science and school, the word form reminisce is very unusual. Orthographic regularity affects the speed of word recognition; in fact, the mean response time for reminisce was the longest of the 10 items. Eye-tracking studies have revealed that fixation times on targets are affected by their morphological properties; a compound word with a rare beginning or ending requires a longer fixation time than do other words (see Rayner, 2009). As for repast, a thematic relationship between the target and the primes (i.e., restaurant and kitchen) may have caused another priming effect, resulting in contamination of response time data. In addition, the participants’ prior knowledge of English vocabulary should have been assessed in this study. Researchers investigating context effects on word recognition should be careful of the characteristics of the items used. It is advisable for researchers to conduct
Finally, based on this pilot study, future research should examine context-based priming effects on the recognition of newly learned words with a much larger sample size. Power analysis using G*Power 3 software (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that if the priming effect obtained in this study is an accurate estimate of the true effect size, 57 or more participants would be needed for the test to have power equal to about .80; otherwise, 29 or more items would be necessary for power equal to about .80. Therefore, a desirable replication for this study may be a priming experiment with 30 items and 60 participants. If participants were to learn 30 new words deliberately, it would take at least 90 minutes to complete the experimental session.

Acknowledgements

This research was supported by JSPS Grant-in-Aid for Research Activity Start-up (15H06231). I would like to thank the three anonymous reviewers for their helpful comments.

Notes

1. The mean reaction times were rather difficult to interpret. Whereas the enhanced condition shortened the mean reaction time on the target collocations, the other two conditions showed the opposite tendency. The mixed-effect modeling suggested these tendencies could be caused by other factors, such as the length and frequency of the collocates.
2. When Webb (2007) compared translation-based learning with and without a context, learners’ test scores showed no overall difference between these two conditions, suggesting that the major sources of vocabulary knowledge were word forms and translations.
3. In Hasegawa (2016), the one-week retention of deliberately learned word meanings was affected by memory of example sentences, suggesting the effectiveness of giving more easily remembered example sentences.
4. According to Hulstijn (2005), the most typical situation of intentional learning can be created when the learner’s attention is placed on the memorization of a list of words and when the learner is aware that there will be a test on the material learned.
5. The average rate of correct answers by Elgort’s (2011) participants was 94%.
6. The standardized mean difference has been called Cohen’s $d$ by some researchers or Hedge’s $g$ by others, and there are several distinct specific calculation methods. This study adopted the calculation introduced by Norris and Ortega (2000, p. 443).
7. A Wilcoxon signed-rank test showed no significant difference in the correct rates between the two conditions ($p = 1.000$).
8. However, a Wilcoxon signed-rank test showed a significant difference in the response times between the two conditions \((p = .047)\).

**References**

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Committee of Revising the JACET List of Basic Words (Ed.). (2003). *JACET list of 8000 basic words*. Tokyo, Japan: Japan Association of College English Teachers.


**Appendix: Stimuli Used in the Lexical Decision Task**

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<td>reminisce</td>
<td>repast</td>
<td>sanatorium</td>
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<td>graipset</td>
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<td>rosidecky</td>
<td>rogimp</td>
<td>siletedius</td>
<td>twex</td>
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<td>paper</td>
<td>Paris</td>
<td>Christmas</td>
<td>restaurant</td>
<td>London</td>
<td>dark</td>
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<td>Canada</td>
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<td>Tokyo</td>
<td>Halloween</td>
<td>kitchen</td>
<td>Washington</td>
<td>bright</td>
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</tbody>
</table>

Note. (a): the real word targets, which were used in the learning phase and the lexical decision task; (b): the pseudowords, which were presented only in the lexical decision task; (c): the context primes, which were the words used in the example sentences; (d): the control primes, which were selected to assess the priming effect of the context primes.
The Effects of Syllable Sequence Frequency on EFL Learners' Speech Recognition

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Abstract
Previous studies of visual and spoken word recognition that focused specifically on the recognition of individual content words have reported the word frequency effect. A problem arises, however, when considering the fact that most high frequency words are monosyllabic content words and function words that are difficult to recognize in continuous L2 speech. No study has yet to clarify a word frequency effect in L2 speech recognition. However, instead of a word frequency effect, the present study aimed to examine whether the frequency effect is found in syllable sequences, as the unit of processing spoken words is considered to be a phonological unit of combined syllables rather than an individual word. In the study, 63 university students in Japan participated in a sentence dictation task where each sentence contained tri-syllabic sequences with high and low frequencies of occurrence based on the database of 18 authorized English textbooks used in Japanese junior high schools. The results of ANOVA and correlation analyses revealed that the frequency of individual syllables or words does not relate to the recognition of speech, whereas the frequency is significant for syllable sequences larger than a word. The findings clarified the importance of the intentional rather than incidental learning of phonological words for better speech processing in EFL settings.

1. Introduction
1.1 Word frequency effects on L2 spoken word recognition

Word frequency effects have been widely acknowledged in the study of word recognition. Most studies have focused on visual word recognition by using a lexical decision task or measuring eye movements, showing that high frequency words are recognized faster than low frequency words, both in L1 and L2 (Dufau, Lete, Touzet, Glotin, Ziegler, & Grainger, 2010; Duyck, Vanderelst, Desmet, & Hartsuiker, 2008; Takashima, 2009; Whitford & Titone, 2012). This tendency has also been observed in studies on L1 spoken word recognition (Connine, 2000; Hartsuiker, Duyck, & Desmet, 2004; Duyck, Vanderelst, Desmet, & Hartsuiker, 2008; Takashima, 2009; Whitford & Titone, 2012).