How EFL Learners Process Unknown Words While Reading: Effects of Contextual Constraints and Recall Instructions

Akira HAMADA
Graduate School, University of Tsukuba

Abstract

This study examined how Japanese EFL learners process unknown words in a text while reading, with a focus on two factors: (a) contextual constraints, and (b) recall instructions of a contextual sentence. Thirty-eight undergraduates read 16 contextual sentences with target words in four conditions: strongly contextual constraints with or without a free-written recall task, and weakly contextual constraints with or without the same task. They then performed a plausible judgment task and a priming task to assess how they processed the words and whether the word information extracted from contexts were retained or not. The results showed that the strongly contextual constraints enabled the learners to predict the meanings of unknown words without any instructions of lexical inferencing; additionally, the recall task facilitated the identification of the meanings of unknown words even if they were weakly constrained. Interestingly, it is implied that the even weakly contextual constraints might contribute to the immediate retention of identified meanings. These suggest that teachers should consider the interaction between contextual constraints and comprehension of given contexts, when requiring students of various proficiencies to learn vocabulary through reading.

1. Introduction

Many studies revealed that L2 learners could incidentally acquire the aspects of vocabulary breadth (Horst, Cobb, & Meara, 1998; Hulstijn, 1992; Knight, 1994; Pulido, 2007; Swanborn & de Glopper, 2002) and depth (Hamada, 2011; Paribakht & Wesche, 1997; Wesche & Paribakht, 2009) when they were explicitly asked to infer the meanings of unknown words they encountered while reading (i.e., lexical inferencing). Some research, however, indicated that the effects of extensive reading that applied the theory of incidental learning to vocabulary acquisition were statistically significant but relatively small (Day, Omura, & Hiramatsu, 1991; Waring & Takaki, 2003). Fraser’s (1999) introspective study explained that L2 learners tended to pay attention to particular unknown words only when they were required for comprehending a text. Paribakht and Wesche (1999) also argued that L2 learners might ignore the unknown words without guessing
the intended meanings when they were not necessary to complete a given task. Thus, L2 learners cannot gain greater lexical knowledge when teachers simply instruct them to read texts.

Empirical accounts of incidental vocabulary learning suggest that lexical inferencing is required for the acquisition of word knowledge (e.g., Daneman & Green, 1986; de Bot, Paribakht, & Wesche, 1997; Fraser, 1999; Hamada, 2011; Hulstijn, 1992; Nation, 2001; Paribakht & Wesche, 1997, 1999; Wesche & Paribakht, 2009). Given the clear importance of incidental learning through contexts, it is necessary to understand the conditions that support such learning by focusing on lexical processing of unknown words.

1.1 Lexical Inferencing and Incidental Vocabulary Learning

The reading of texts starts with the identification of individual words. As a word is identified, the reader has to connect it to a continuously updated representation of the text to achieve a text-based comprehension (Just & Carpenter, 1992). In this way, word-by-word processing leads to word-to-text integration; however, unknown words can interfere with this process of text comprehension (Nation, 2001). Various L1 and L2 studies, therefore, have argued that a reader has to infer the meanings of unknown words for text comprehension (e.g., Bolger, Balass, Landen, & Perfetti, 2008; Pulido, 2007), which is considered to contribute to the development of lexical knowledge by retaining word information identified through lexical inferencing (de Bot et al., 1997). In fact, previous research has empirically demonstrated the acquisition of vocabulary knowledge through reading when L2 learners were explicitly instructed to derive the meanings of unknown words they encountered (Hamada, 2011; Hulstijn, 1992; Paribakht & Wesche, 1997; Swanborn & de Glopper, 2002; Wesche & Paribakht, 2009).

However, several researchers distinguish between deriving word meaning and incidental learning from contexts (Bolger et al., 2008; Swanborn & de Glopper, 2002). According to Bolger et al., lexical inferencing involves some degrees of the goal of attempting to learn the meaning of unfamiliar words, whereas incidental learning assumes the absence of any explicit learning goal. This suggests that some tasks force L2 learners to derive word meanings from the context; for example, the think-aloud method used in Wesche and Paribakht (2009) could yield overestimated gains in word knowledge in terms of incidental learning. Actually, some studies that have examined the effects of reading only on incidental word learning showed that L2 learners could gain little knowledge of words (Day et al., 1991), even if they encountered the target words many times throughout an extensive reading (Waring & Takaki, 2003). On the other hand, reading with a lexical inferencing task in mind led to greater gains in word knowledge (Horst et al., 1998; Knight, 1994).

In particular, Knight (1994) indicated that high proficiency L2 learners could acquire more lexical knowledge through reading. Because lexical inferencing requires the reader’s cognitive resource to identify the intended meaning from contexts (Daneman & Green, 1986), it can be argued that high proficiency L2 learners possessing a larger amount of cognitive resources can afford to extract and retain the information of unknown words from a text. Nevertheless,
considering that most L1 readers acquire a large amount of vocabulary knowledge through reading (Bolger et al., 2008; Borovsky, Kutas, & Elman, 2010; Daneman & Green, 1986; Nation, 2001), another factor should affect incidental learning of vocabulary.

1.2 Contextual Constraints

Although the success of lexical inferencing depends on L2 proficiency or cognitive resources, Otten and van Berkum (2008, 2009) indicated that L1 readers can predict the meaning of upcoming words that were strongly contextually constrained. For example, let us consider the following contextual sentence from Borovsky et al. (2010, p. 289):

*He tried to put the pieces of the broken plate back together with...*

When readers are asked to complete a succeeding word, most of them will answer *glue* before adding anything else. If a large number of respondents in such a cloze test converge in believing that *glue* is the most appropriate word to continue this incomplete sentence, this means that the contextual constraint for the upcoming word is very strong. Otten and van Berkum (2008) investigated the effects of the contextual constraints on word meaning prediction among L1 readers and showed that such readers predicted the specific meaning of upcoming words based on the discourse as the text unfolded.

Various studies demonstrated that in addition to the effects on the lexical processing, L1 readers acquired the word knowledge extracted from strongly constraining sentences (Bolger et al., 2008; Borovsky et al., 2010). Borovsky et al. tested whether strongly contextual sentences could provide more specific information about the meaning and proper usage of target words. After presenting strongly or weakly constraining sentences (e.g., *He tried to put the pieces of the broken plate back together with marf* or *She walked across the room to Mike’s messy desk to return his marf*), they asked their participants to rate the plausibility of the target word’s (i.e., *marf*) usage in two types of successive test sentences: (a) *They used the marf* (plausible); and (b) *She drove the marf* (implausible). They found that L1 readers could extract semantic and grammatical word information only when the new word had been presented in a strongly constraining sentence, and that the conceptual representations of the words constructed through the contexts were then rapidly integrated into the mental lexicon. In other words, as contextual constraints increase, the specificity of the inference about the upcoming concepts also increases; accordingly, the inferred conceptual representations can be strongly encoded (O’Brien & Lassonde, 2009).

However, there is little research in L2 that examines the effects of the contextual constraints on lexical processing of unknown words and the succeeding encoding, although the importance of the quality of contexts is widely recognized in learning vocabulary through reading (e.g., Nation, 2001; Webb, 2008; Wesche & Paribakht, 2009). Webb (2008) demonstrated that Japanese EFL learners could incidentally gain the knowledge of word meaning only through strongly
constraining sentences; however, the conditions under which EFL learners process the meanings of unknown words remain unascertained. Although L2 reading proficiency (e.g., Knight, 1994) and text comprehension (e.g., Pulido, 2007) are regarded as the critical factors that affect the lexical processing of unknown words and encoding, Webb did not consider these variables. For example, low proficiency EFL learners may have still ignore the target words that are not highly required for text comprehension, even if they were strongly constrained. Therefore, it is necessary to inspect how EFL learners process unknown words while reading and encode the conceptual representations constructed from various contexts. The main goal of the present study is to examine whether contextual constraints affect the lexical processing of L2 unknown words and the succeeding encoding process. A second goal is to test how contextual constraints interact with recall instructions that direct L2 learners’ attention to target words. On the basis of the previous literature, one hypothesis (H) and two research questions (RQs) are addressed in this study:

H: EFL learners can accurately infer the meanings of unknown words that the contextual sentences strongly constrain without any instruction in lexical inferencing.

RQ1: Can EFL learners accurately infer the meanings of unknown words if such words are essential for comprehending the contextual sentences?

RQ2: How do contextual constraints interact with recall instructions which require L2 learners to fully comprehend sentences in terms of the retention of the inferred meanings?

2. Method

2.1 Participants

The participants in this study were 38 Japanese EFL learners majoring in the humanities, education, or the social sciences. They had studied English for more than six years. Half of them possessed higher L2 proficiency based on a median split for performance on the reading section of the pre-first (6 items) and second grade (20 items) in the Society for Testing English Proficiency (STEP) test conducted in 2007 (26 items, Cronbach’s α = .84). These 19 participants, categorized as upper, showed substantially better performance in the test than the other 19 participants categorized as lower, t (36) = -8.17, p < .001, r = .81, 95% CI [-10.51, -6.33] (see Table 1).

<table>
<thead>
<tr>
<th>Proficiency</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>19</td>
<td>18.68</td>
<td>3.11</td>
<td>15</td>
<td>25</td>
<td>[17.19, 20.18]</td>
</tr>
<tr>
<td>Lower</td>
<td>19</td>
<td>10.26</td>
<td>3.25</td>
<td>3</td>
<td>14</td>
<td>[8.70, 11.83]</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>14.47</td>
<td>5.30</td>
<td>3</td>
<td>25</td>
<td>[12.73, 16.21]</td>
</tr>
</tbody>
</table>

Note. CI = confidence interval.
2.2 Materials

2.2.1 L2 Reading Proficiency Test

The test used to measure the participants’ L2 reading proficiency consisted of six reading texts, with 26 comprehension questions from the reading section of the pre-first (6 items) and second grade (20 items) of the STEP test conducted in 2007 (Obunsha, 2010a, 2010b).

2.2.2 Stimuli

a. Contextual sentences: The reading materials used in this study were based on 32 contextual sentences used in the previous study (Griffin & Bock, 1998). There were 16 strongly and weakly constraining sentences and 16 filler sets of materials. In addition, each target word presented in the sentence pairs was completed using one of 16 pseudowords used by the past studies (Waring & Takaki, 2003; Webb, 2008; see Appendix). Griffin and Bock subsequently validated each contextual constraint by a cloze completion task. This showed that the strongly constraining sentences (e.g., George taught his son to drive an ancon) were completed by the highest cloze probability words (e.g., the pseudoword ancon could refer to car): $M = .93, SD = .08, Min = .73, Max = 1.00$, and the same words were low cloze probabilities (e.g., The commercial was for a new ancon) for the weakly constraining sentences (e.g., the pseudoword ancon could refer to furniture, household appliances, or car): $M = .32, SD = .16, Min = .05, Max = .58$. On the basis of JACET 8000, excessively difficult words in the contextual sentences were replaced with easier synonyms.

b. Test sentences: Two types of test sentences were created for each contextual sentence pair as a plausible judgment task on the basis of Borovsky et al. (2010). The test sentences were composed of the following word sequence: a Pronoun + Transitive Verb + Article/Pronoun + Target Word. One test sentence involved plausible usage of the target word (e.g., He crashed his ancon), and the other involved implausible usage (e.g., He read his ancon). The plausibility of the test sentences was independently verified by five raters using a yes/no judgment task; all the raters agreed on the acceptability of the target words’ usage.

c. Probe words: To investigate whether the conceptual representations constructed from the contextual sentences were encoded, each set of pseudowords had a probe word corresponding to the original synonym of the pseudoword (e.g., a probe word car corresponding with the meaning of the pseudoword ancon was prepared for a priming task). The probe words were high frequency nouns selected from JACET 8000, levels 1 to 3 (see Appendix). The probe words were not used in any other part of the experiment in order to ensure that priming of those words could not occur elsewhere. Each set of filler contextual sentences also had probe words that satisfied these criteria but the prime-probe pairs of filler were unrelated to each other in order to counterbalance the number of “related” and “unrelated” responses.
2.3 Procedure

The participants individually took part in a 60-minute single experimental session. Before the experiment started, the participants were given an alphabetical word list with all the words presented in the experiment, and were asked to verify whether these words were known or unknown. Next, they were given 30 minutes to take the L2 reading proficiency test.

Figure 1 shows the sequence of the trials. In the reading section, each contextual sentence was presented on the computer screen and the participants were instructed to read at their own pace by pressing a button on a response pad (RB 730). After reading the contextual sentence, they then read and rated the corresponding test sentence, which could be either plausible or implausible in meaning. Each test sentence began with a row of central fixation crosses (*** ) for 500 ms. The participants were asked to accurately and quickly respond whether the test sentence was plausible (Yes) or implausible (No) by pressing the appropriate keys. Following the plausible judgment task, the participants were shown only a target word (i.e., a prime word) for 500 ms followed by a probe word that was either related or unrelated in meaning. They were similarly told to answer whether the two words were semantically related by pressing the correct keys.

![Diagram of the experimental procedure](image)

Figure 1. An example of the sequence of each trial in the experiment.

To examine the effects of necessity for full sentence comprehension on lexical processing, four strongly and four weakly constraining sentences were first randomly displayed without a free-written recall task (-Recall). The other contextual sentences were then presented with the same task (+Recall). A set of 16 fillers was also given; all the trials were counterbalanced with each other. During the experiment, the participants were presented with five practice sets to familiarize them with the procedure. SuperLab 4.5 for Windows was used to record the response latencies of the plausible judgment and priming task. Table 2 shows the overall sequence of the experimental tasks.
Table 2
The Overall Sequence of the Tasks

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Example of material</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>Strong: George taught his son to drive an ancon.</td>
<td>-Recall (8 trials)</td>
</tr>
<tr>
<td></td>
<td>Weak: The commercial was for a new ancon.</td>
<td>+Recall (8 trials)</td>
</tr>
<tr>
<td>Plausible judgment</td>
<td>Plausible: He crashed his ancon.</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td>Implausible: He read his ancon.</td>
<td></td>
</tr>
<tr>
<td>Priming</td>
<td>ancon (prime word) → car (probe word)</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

2.4 Data Analysis
In the analyses of the response latencies of the plausible judgment and priming task, errors and response latencies that did not fall within the range of ± 3.0 standard deviations for each participant were excluded. Each trial that included some unknown words reported by each participant was also eliminated. The within-participant independent variables were the contextual constraints (Strong, Weak) and the recall instructions (+Recall, -Recall). The between-participant variable was the L2 reading proficiency (Upper, Lower). An alpha level of .05 was used and the effects of marginal significance were regarded as insignificant.

3. Results

3.1 Plausible Judgment Task
The results of the plausible judgment task are reported in Table 3. Two three-factor mixed analyses of variance (ANOVAs) for the mean success rate and response latencies were conducted.

Table 3
Mean Success Rate and Response Latencies of the Plausible Judgment Task

<table>
<thead>
<tr>
<th>Proficiency</th>
<th>Strong constraints</th>
<th>Weak constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+Recall</td>
<td>-Recall</td>
</tr>
<tr>
<td></td>
<td>Success rate (%)</td>
<td></td>
</tr>
<tr>
<td>Upper (n = 19)</td>
<td>75.00 (16.67)</td>
<td>64.47 (20.94)</td>
</tr>
<tr>
<td>Lower (n = 19)</td>
<td>67.11 (22.13)</td>
<td>72.37 (23.42)</td>
</tr>
<tr>
<td>Total (N = 38)</td>
<td>71.05 (19.73)</td>
<td>68.42 (22.27)</td>
</tr>
<tr>
<td>Response latencies (ms)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper (n = 19)</td>
<td>3196.95 (1388.77)</td>
<td>3198.86 (988.85)</td>
</tr>
<tr>
<td>Lower (n = 19)</td>
<td>4153.77 (3110.68)</td>
<td>4045.49 (1478.53)</td>
</tr>
<tr>
<td>Total (N = 38)</td>
<td>3675.36 (2425.02)</td>
<td>3622.17 (1312.71)</td>
</tr>
</tbody>
</table>

Note: Standard deviations are in parentheses.
a. Accuracy: Figure 2 graphically displays the results of the success rate in the plausible judgment task. There were significant main effects of the contextual constraints, $F(1, 36) = 28.43, p < .001, \eta^2 = .16$, and the recall instructions, $F(1, 36) = 24.14, p < .001, \eta^2 = .12$; while a main effect of the L2 reading proficiency was not significant, $F(1, 36) = 0.06, p = .801, \eta^2 < .01$. Moreover, the outcomes also showed a significant interaction of the contextual constraints $\times$ recall instructions, $F(1, 36) = 10.83, p = .002, \eta^2 = .07$. A subsequent analysis revealed there was greater accuracy deriving the word meanings from the strongly constraining sentences in the -Recall condition, $F(1, 37) = 35.15, p < .001, \eta^2 = .49$ (68.42\% vs. 43.42\%) regardless of L2 proficiency. In the weakly constraining sentences, the +Recall condition led to more accurate performance, $F(1, 37) = 41.47, p < .001, \eta^2 = .53$ (66.45\% vs. 43.42\%).

b. Response latencies: Figure 3 presents the results of the response latencies in the plausible judgment task. The results showed a significant main effect of the contextual constraints, $F(1, 36) = 6.12, p = .018, \eta^2 = .04$, and the L2 reading proficiency, $F(1, 36) = 5.93, p = .020, \eta^2 = .02$. However, the main effect of the recall instructions, $F(1, 36) = 3.28, p = .079, \eta^2 = .03$, and interactions among these factors, were not found. These findings were almost consistent with those of accuracy; namely, the strongly contextual constraints enabled the participants to activate the prediction about the meanings of the target words. As Otten and van Berkum (2009) indicated, the response latencies of the high proficiency participants were shorter than those of the low proficiency ones in every condition.
3.2 Priming Task

The means and standard deviations of the priming task are presented in Table 4. In the analysis of the response latencies, a total of eight participants (Upper = 4, Lower = 4) were eliminated due to lack of data; in other words, their accuracy in the priming task was 0.00% in every condition. Two three-factor mixed ANOVAs on the mean success rate and the response latencies were conducted.

Table 4

<table>
<thead>
<tr>
<th>Proficiency</th>
<th>Strong constraint</th>
<th>Weak constraint</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+Recall</td>
<td>-Recall</td>
</tr>
<tr>
<td>Upper (n = 19)</td>
<td>69.74 (29.57)</td>
<td>42.11 (26.42)</td>
</tr>
<tr>
<td>Lower (n = 19)</td>
<td>65.79 (23.88)</td>
<td>50.00 (25.00)</td>
</tr>
<tr>
<td>Total (N = 38)</td>
<td>67.76 (26.58)</td>
<td>46.05 (25.68)</td>
</tr>
</tbody>
</table>

Note. Standard deviations are in parentheses.

a. Accuracy: Figure 4 shows the accuracy of the performance in the priming task. Significant main effects of contextual constraints, $F(1, 36) = 12.51, p = .001, \eta^2 = .10$, and recall conditions, $F(1, 36) = 18.94, p < .001, \eta^2 = .12$, were found. However, there was no significant main effect of the L2 reading proficiency, $F(1, 36) = 0.09, p = .765, \eta^2 < .01$, and there were no significant interactions among these factors. These results suggest that in terms of immediate retention, all the participants were able to encode some conceptual representations extracted from the strongly constraining sentences. However, a lack of the recall instructions did not promote encoding of conceptual representations.

b. Response latencies: Figure 5 displays the response latencies of each proficiency group in the priming task. There was a significant main effect of the recall instructions, $F(1, 28) = 6.77, p$
which indicated that the +Recall condition could contribute to stronger encoding of the inferred word information. In addition, the interaction of the contextual constraints × L2 reading proficiency was significant, $F(1, 28) = 5.05, p = .033, \eta^2 = .04$; contrary to expectations, a subsequent analysis indicated that there was no significant main effect of the contextual constraints on the strength of encoding in the upper group, $F(1, 28) = 2.74, p = .109, \eta^2 = .08$, and in the lower group, $F(1, 28) = 2.32, p = .139, \eta^2 = .07$. On the other hand, the results showed a significant main effect of the L2 reading proficiency in the weakly constraining sentences, $F(1, 28) = 6.64, p = .016, \eta^2 = .19$. This indicates that the high proficiency L2 learners were able to more strongly encode the conceptual representations constructed from the weakly constraining sentences than the low proficiency L2 learners.

![Response latencies of each proficiency group for the priming task in each condition.](figure5.png)

**Figure 5.** Response latencies of each proficiency group for the priming task in each condition.

## 4. Discussion

The present study hypothesized that strongly contextual constraints could trigger spontaneous lexical inferences. It also examined how contextual constraints interacted with the necessity for full sentence comprehension, leading to the succeeding encoding of conceptual representations between the high and low levels of L2 reading proficiency during reading.

The experiment produced results consistent with this hypothesis. Considering the effects of the contextual constraints on processing of unknown words, the findings clearly indicate that in a strongly constraining sentence, the Japanese EFL learners as well as L1 readers could spontaneously infer the meanings of unknown words. Furthermore, this lexical processing did not seem to be limited only to readers with high L2 proficiency. Previous studies explained that L2 learners tended to skip over unfamiliar words that were not essential for text comprehension (Fraser, 1999; Paribakht & Wesche, 1999); however, the results of the present study showed that Japanese EFL learners attempted to identify the meanings of such words if they were strongly constrained by the contextual sentences. In the weakly constraining sentences, the learners failed
only to identify the meaning of the target words, although they tried guessing. However, in the +Recall condition, their performance with regard to target words in the plausible judgment task was more accurate, even for those words that were weakly constrained. As proposed by previous studies (Hulstijn & Laufer, 2001; Paribakht & Wesche, 1997), when the sufficient comprehension of a context sentence was not essential, the learners might have only shallowly processed the unknown words. In other words, they did not extract enough word information to judge the plausibility of the usage of the target words in the task.

The response latencies in the plausible judgment task also supported the hypothesis. If the learners derive the meanings of the target words from the contexts, they can quickly judge the plausibility of the test sentences. The results showed that strongly contextual constraints promoted quick responses for each test sentence, whereas the learners responded more slowly to the items in the weakly constraining sentences. This suggests that weakly contextual constraints produced some ambiguous representations for the meanings, and that they were activated in the learners’ working memory; accordingly, the response latencies for the plausible judgment increased. Moreover, L2 reading proficiency affected the activation of the lexical inferencing. Otten and van Berkum (2009) revealed that among L1 readers, the latencies of the activation of lexical inferences depended on their working memory capacity. This is because inferential processes require the integration of successively encountered contextual cues, and the processes are less easily accomplished if the earlier relevant cues are no longer accessible to the working memory (Daneman & Green, 1986). Although differences in the latencies of activation of lexical inferences are found between L2 reading proficiency, these outcomes suggest that Japanese EFL learners, as well as L1 readers (Otten & van Berkum, 2008, 2009), can spontaneously process the meanings of unknown words while reading if the words are strongly constrained.

With regard to RQ1, the experiment showed that the recall instructions could play an important role in the lexical processing of unknown words. When the EFL learners were asked to try to fully understand a sentence, the results indicated that they succeeded in inferring the meanings of the target words that were even weakly constrained by the contextual sentences. Because the meanings were not too difficult to identify in these contexts (i.e., the cloze probability was .32 on average), the recall task could require EFL learners to make more sophisticated lexical inferences of the semantic information from the contexts. As previous studies have mentioned, vocabulary enhancement activities including text comprehension enrich the effects of incidental word learning through reading (Horst et al., 1998; Knight, 1994; Paribakht & Wesche, 1997). These findings suggest that EFL learners may skip rather difficult, unfamiliar words and derive their meanings from the contexts alone; however, they try to identify the word meanings when sufficiently comprehending the text (see also Pulido, 2007).

In this study, the recall instructions also helped to strengthen the encoding of the identified conceptual representations in terms of immediate retention (RQ2). Task-induced involvement can lead to better retention of word knowledge because the learner fully uses enough cognitive
resources to process the unknown words more deeply (Hulstijn & Laufer, 2001). Therefore, even if the learners were not explicitly asked to infer the meanings of unknown words while reading, the recall task that required the sufficient comprehension of sentences could direct their attention to the target words, leading to a deeper processing of the words in order to encode the conceptual representations constructed from the contexts.

However, this study did not identify the effects of contextual constraints on the strength of encoding of the conceptual representations. Accuracy in the priming task was lower in the case of weakly constrained target words (e.g., *The commercial was for a new*...), and it is assumed that EFL learners could not narrow down the various meanings inferred from the context (e.g., *furniture, household appliances, or vehicles*) to the most appropriate one corresponding to the probe words (i.e., *car*). EFL learners, as well as L1 readers (O’Brien & Lassonde, 2009; Otten & van Berkum, 2008, 2009), face difficulties in making specific inferences when the contexts are unhelpful, as Figure 6 shows; however, note that some conceptual representations might be activated.

![Figure 6. The difference in conceptual representations encoded from strongly or weakly constraining sentences.](image-url)

Because previous studies have demonstrated that L2 learners can acquire word knowledge through reading, it is supposed that the encoding of the conceptual representations occurred incidentally in this study. That is, once EFL learners can construct some conceptual representations from contexts, they will be encoded without regard to the contextual constraints for the target meanings. The task-induced involvement (Hulstijn & Laufer, 2001) implies that more challenging contexts may lead to greater vocabulary gains, while helpful contexts can facilitate word identification (Landi et al., 2006), which will cause learners to pay little attention to the target words. In particular, the results of the present study showed that compared to the lower group, the upper group could better encode word information from weakly constraining sentences. Hulstijn (1992) suggested high proficiency L2 learners have enough cognitive resources to make a “mental effort” to process the meanings of unknown words that are weakly constrained. Although the present study cannot clearly discuss the strength of the encoding, even challenging contexts may trigger the encoding of the conceptual representations constructed through reading.
5. Future Research and Pedagogical Implications

In incidental vocabulary learning, lexical inferencing is essential for acquiring word knowledge from contexts, and the findings of the present study suggest that EFL learners can predict and encode the meanings of unknown words not strategically but spontaneously regardless of their L2 reading proficiency. Also this lexical processing can be reinforced by necessity for sufficient comprehension of contextual sentences. However, some aspects require future research. This experiment showed the encoding of the conceptual representations extracted from contexts, but it is necessary to perform a delayed test to examine the effects on long-term storage. The acquisition of word knowledge through reading is an incremental process that moves from form to meaning (e.g., Nation, 2001; Paribakht & Wesche, 1997; Wesche & Paribakht, 2009); therefore, these limitations require long-term research to reveal incremental lexical development, focusing on form-meaning mapping (Pulido, 2007).

The present study has educational as well as theoretical implications. As past studies have mentioned, providing a comprehension task while reading contributes to incidental learning of vocabulary (Horst et al., 1998; Knight, 1994; Paribakht & Wesche, 1997). However, such tasks are not necessarily regarded as favorable in incidental learning through reading activities (e.g., extensive reading); therefore, teachers should consider the effects of contextual constraints on lexical processing of unknown words. Although any class will contain students with various L2 proficiencies, teachers can develop their ability in unknown word processing if the words are strongly constrained in a text. For example, teachers could replace a highly guessable word with a synonym that is unfamiliar to their students in an original context as shown:

Original context: George taught his son to drive a car.
Revised context: George taught his son to drive a motor vehicle.

According to the results of this study, the students can spontaneously infer the meaning of the target word from the helpful context. If they encounter the same target words in the strongly constraining sentences many times, their incremental vocabulary development will be quite advanced (e.g., Bolger et al., 2008; Webb, 2008). In addition, their ability in lexical inferencing can be expected to improve simultaneously. Thus, it may be more efficient to rewrite parts of the text, replacing some of the least useful words in terms of vocabulary learning with more useful words (Nation, 2001). Revising the texts will be a time-consuming process but if the texts are used with many different classes and contribute to vocabulary acquisition; then, it will be a sensible option.
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References


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Appendix

Contextual Sentences, Target Words, and Probe Words Used in the Experiment

S: George taught his son to drive an ancon (car).
W: The commercial was for a new ancon (car).
S: The astronauts landed on the cader (moon).
W: The satellite went around the cader (moon).
S: Bob was tired so he went to dangy (bed).
W: He lay down on the dangy (bed).
S: The plane exploded because of a hidden windle (bomb).
W: The mailman delivered a mysterious package which contained a windle (bomb).
S: Always knock before you open my denent (door).
W: The girl moved slowly toward the denent (door).
S: To fill in the mark sheet the student needed a sharp parrow (pencil).
W: The student needed a parrow (pencil).
S: He couldn’t unlock the door without the right masco (key).
W: In the mysterious box, they found a masco (key).
S: The pitcher threw the prink (ball).
W: The dog was taught to catch a thrown prink (ball).
S: He bought his girlfriend an engagement sagod (ring).
W: The jeweler put a diamond on the sagod (ring).
S: The bank robber aimed at the security officer and shot the greal (gun).
W: The robber had a greal (gun).
S: He lighted the candle with one tasper (match).
W: The big fire was started by just one tasper (match).
S: On top of his head, the king wore an extremely expensive blund (crown).
W: They stole the queen’s blund (crown).
S: The little puppy grew up to be a big tance (dog).
W: At the park she saw a man with a tance (dog).
S: The farmer milked the rimple (cow).
W: The farmer had an old rimple (cow).
S: The Valentine’s Day card was shaped like a faddam (heart).
W: The best students received a sticker shaped like a faddam (heart).
S: He tried to put the pieces of the broken plate back together with bettle (bond).
W: She walked across the large room to Mike’s dirty desk and returned his bettle (bond).

Note. A total of 16 target words are each paired with a strongly (S) and a weakly (W) constraining sentence context. The target words and their meanings (probe words) are presented in italics.