Introduction

Research suggests that L1 learners acquire much of their vocabulary incidentally when they attempt to understand new words they read in the context. However, the role of reading in L2 vocabulary acquisition remains uncertain. Although it is generally agreed that L2 vocabulary learning also occurs when reading for comprehension, researchers hold different views as to the degree; some studies show large amounts of learning (Haynes & Baker, 1993), but others show small amounts (Pitts, White, & Krashen, 1989). Only recently did researchers begin to focus on L2 incidental vocabulary acquisition, and its mechanism still is not well understood. This study attempts to discover the lexical processing strategies (LPSs) L2 learners use to deal with unknown words they encounter when reading an English text. It also examines the relationship between LPS use, the success in determining word meaning, and the retention of the meaning.
Lexical Processing Strategies in Reading

Readers use a variety of LPSs to deal with unknown words when reading, including ignoring and continuing to read, consulting a dictionary or another individual, and inferring their meaning from linguistic and contextual cues (Fraser, 1999). If these strategies are used successfully, they can help the comprehension of words and, under optimal conditions, contribute to their retention. However, L2 readers do not use them as effectively as L1 readers (Wesche & Paribakht, 2010). Moreover, their success in using such strategies depends on their L2 proficiency, especially their L2 lexical knowledge (Béjoint, 1994; Haynes, 1993; Nassaji, 2003; Wesche & Paribakht, 2010). Only a few studies have investigated how L2 learners combine these LPS options to cope with unknown words when reading.

Paribakht and Wesche (1999) examined the use of LPSs by ESL students when reading. The participants ignored a large portion of the words (56% for the summary task, 53% for the question task). When they attempted to understand unknown words, they used inferencing almost 80% of the time. Fraser (1999) found that the students inferred 55% of the time. In contrast, they consulted 39% of the time and ignored 35% of the time. In general, they determined word meaning successfully when consulting or inferring; 78% of consults and 52% of inferences led to full success and another 29% of inferences were partially successful. These studies show that L2 students tend to ignore a large proportion of unknown words they encounter when reading, and that for the words they attend to, inferencing is the major strategy used.

Lexical Inferencing

Lexical inferencing is a process that “involves making informed guesses as to the meaning of a word in the light of all available linguistic cues in combination with the learner’s general knowledge of the world, her awareness of the co-text and her relevant linguistic knowledge” (Haastrup, 1991, p. 13). Depending on the conditions, a wide variability has been found in the rate of success in L2 inferencing, such as 56.8% (Huckin & Bloch, 1993), 33% (Parry, 1993), 28% (Frantzen, 2003), and 25.6% (Nassaji, 2003).

Parry (1993) reports on a longitudinal case study of a Japanese university student’s acquisition of English vocabulary. The results showed that she was remarkably successful in her guesses; 33% of them were successful and 36% were partially successful. Parry attributed the student’s success to her experience and knowledge as an adult and to the breadth of the context in which the vocabulary was encountered academically over a full semester. Although this study indicates that L2 learners are capable of inferring word meaning effectively, other studies show they are not good guessers. For example, Nassaji (2003) investigated the think-aloud protocols of 21 intermediate ESL students and found that the rate of success for each word was low, ranging from 9.5% to 38.1%, with the mean being 25.6%.
Research has identified factors that influence learners’ inferential behavior and success in guessing an appropriate meaning: they include text (difficulty, genre); word (part of speech, frequency); learner (L2 proficiency, learning experience, L1, familiarity with the text topic); and task (summary task, question task). Of these factors, learners’ L2 proficiency appears to make a major contribution to inferential behavior and success.

Nassaji (2004) found that the mean rate of success for the lexically skilled (LS) group was significantly higher than for the lexically less skilled (LLS) group. The LS students made more frequent and effective use of evaluative and context-based strategies, whereas the LLS students used word-based strategies more frequently. Wesche and Paribakht (2010) compared the L1 and L2 lexical inferencing by speakers of two languages (Persian and French). In both groups, learners with higher L2 lexical proficiency were more successful in inferring word meanings and retained more words. Although both groups were far less successful in inferencing and retention of new word meanings in L2 than in L1, the differences between L1 and L2 success were particularly large for the Persian group. This appeared to be related to the relative typological distance of Persian to English. These two studies highlight the centrality of vocabulary knowledge in determining inferential success. Wesche and Paribakht’s (2010) study also delineates the effects of learners’ L1 on L2 inferencing.

Research has demonstrated readers’ use of various linguistic and nonlinguistic knowledge sources (KSSs) and strategies (Chern, 1993; Fraser, 1999; Haynes, 1993; Nassaji, 2003; Nassaji, 2004; Paribakht, 2005; Paribakht & Wesche, 1999; Wesche & Paribakht, 2010). Haynes (1993) found that ESL readers were good guessers when cues were available in the immediate sentence context. Although the students frequently used word-level graphemic cues, word-form identification was not always easy for them. Insufficient context, global cues, or a student’s lack of vocabulary knowledge presented difficulties.

Chern (1993) found that Chinese ESL students were able to use contextual cues, graphic cues, and sounds, as well as background knowledge in reading. Sentence-bound local cues were often used by both high- and low-proficiency students. Morphemic, graphemic, and phonetic cues were also frequently used by both groups. The use of global cues correlated highly with the students’ proficiency levels.

These studies indicate that L2 learners are able to guess word meaning from both context-based and word-based cues. They are better at the use of sentence-bound local cues than that of global cues that requires the integration of information throughout the passage. The use of context-based cues, especially global contextual ones, distinguishes high- and low-proficiency students.

Vocabulary Development through Reading

A wide variability also has been found in the rate of word retention through reading, such as 6% and 8% (Pitts, White, & Krashen, 1989), 7% (Hulstijn, 1992), 19% and 38% (Haynes & Baker, 1993). Except for a few exceptions, however, L2 students learn a
relatively small number of words from context. With access to a dictionary, a higher retention rate has been found, such as 28% (Fraser, 1999), 29% (Knight, 1994), 33% and 62% (Laufer & Hill, 2000).

Fraser (1999) compared the retention rates associated with each of the three LPS options (consult, infer, ignore). About 30% of the time, ESL students recalled the determined word meaning when they consulted or inferred alone. Inferring followed by consulting yielded a higher retention rate (50%). This study suggests that consulting and inferring both result in the retention of some words, although their combined use is more effective.

The studies discussed above looked into students’ LPS use mainly in ESL contexts. We still know little about their LPS use in the EFL context like in Japan. In particular, we know little about how they combine the three LPS options to deal with unknown words when reading. Given that LPS use is influenced by students’ L1 (Wesche & Paribakht, 2010), it is important to discern the patterns of LPS use specific to Japanese students. Therefore, this study examined the LPSs used by Japanese university students to cope with unknown words when reading. It also explored how LSP use relates to success in determining word meaning and its retention. Furthermore, it investigated how vocabulary knowledge affects LPS use and word retention. Specific research questions were as follows:

1. What LPSs do Japanese learners of English use to deal with unknown words?
2. How successful are they in determining word meaning?
3. What proportion of words do they retain?
4. What is the relationship between vocabulary knowledge, LPS use, and word retention?

Method

Participants

The participants in this study consisted of 22 Japanese students of English from two universities in western Japan. They participated in the study on a voluntary basis. They were all freshmen, including 17 females and 5 males. They studied a variety of disciplines. All of the students had studied English for six years prior to entering university, but their levels of proficiency varied. Their mean score on the Reading Comprehension section of the Test of English as a Foreign Language (TOEFL) was 21.32 out of 50 (SD = 11.78). Their mean score on the Vocabulary Levels Test (Schmitt, Schmitt, & Clapham, 2001) was 88.14 out of 150 (SD = 25.20). The students were classified into high- and low-proficiency groups, according to their scores on the Vocabulary Levels Test, using the median split. The high-proficiency group had a mean score of 106.83 (SD = 7.79), and that of the low-proficiency group was 65.70 (SD = 19.55).
Instruments

**Vocabulary Levels Test.** A longer version of the Vocabulary Levels Test (Schmitt, Schmitt, & Clapham, 2001) was used to measure the participants' vocabulary size. Schmitt revised the original version designed by Nation (1990) and created the longer version. The test contains words from five frequency levels: 2000, 3000, 5000, 10,000, and academic. Each frequency level includes 10 sections, each of which requires a test taker to match six words to three definitions. It consists of 150 items in total with 30 items in each level.

**Reading text.** A text taken from the *Shukan ST* was used (Hards, 2004; Appendix A). It discusses the impact on society of such new diseases as avian flu, BSE, and SARS. Its length is 517 words and has a readability of 10.4, as measured by the Flesch-Kincaid index.

**Retrospective think-aloud protocols.** The students participated in an oral interview following the reading period, in which retrospective think-aloud protocols of their LSP use were elicited. Roughly the same set of questions was asked in Japanese of all the students (Appendix B). The students were asked to report on the LPS(s) they used to deal with each unknown word, the reason they used the LPS(s), and the meaning they determined when either inferring or consulting.

**Vocabulary posttest.** In order to assess word retention, an open-ended vocabulary posttest was administered. It required a test taker to supply Japanese equivalents for all the words that each student had indicated to be unknown in the reading period. Therefore, the test was tailored to individual students, each being asked about different sets of words.

Procedures

A week before the data-collection session, the participants were asked to complete the Vocabulary Levels Test. On the day of the experiment, the researcher met with the students on a one-by-one basis. In the data-collection session, all instructions and prompts were given in Japanese. First, the students received 10-15 minutes of training, so that they could get used to the retrospective think-aloud procedure. After the training period, the students were asked to read the passage within 40 minutes, using a bilingual dictionary. Next, they answered comprehension questions orally. Then, they were asked to circle unknown words that they had encountered in the text. After that, they engaged in an interview where they reported on their use of LPSs. The interviews were audio-taped. The entire session lasted 50-70 minutes. A week later, they were given the open-ended vocabulary posttest.

Analysis

The retrospective think-aloud protocol data were transcribed by the researcher. The researcher and a former ESL instructor coded the protocols in order to identify the LPS(s) used to deal with each unknown word. Each response was coded as the use of one
of the three options (ignoring, consulting, inferring) or the combined LPS use (consulting after inferring). The inter-coder reliability was 94.9%. In the cases of inferring, the instance was further classified according to the KS(s) used, as discussed in the Results section.

Then the researcher and the second rater evaluated a determined meaning for which the students had either consulted or inferred. Each response was evaluated using a three-point scale (successful, partially successful, unsuccessful), adapted from the one developed by Fraser (1999). A successful response was defined as a case where the determined meaning was appropriate for the text context with little or no meaning distortion, a partially successful response as a case where the determined meaning worked generally for the text context despite some distortion or loss of the text representation, and an unsuccessful response as a case where no or an inappropriate meaning was determined. The inter-rater reliability was 87.9%.

Following the coding of the responses, the researcher calculated the rates of use of the three LPS options based on the total number of unknown words. She also calculated the success rates of determining word meaning associated with the use of the two LPS options (consulting, inferring).

The researcher and the second rater scored the vocabulary posttest using the same three-point scale mentioned above. The inter-rater reliability was 91.3%. Then the rates of retention based on the total number of test items were calculated.

For the above analyses, when any disagreement occurred, the researcher and the second rater resolved it through discussion with each other and a third rater to achieve 100% agreement. The obtained rates of LPS use, success rates, and the vocabulary test scores were analyzed using descriptive statistics such as means, standard deviations, ranges, and percentages. In addition, Pearson correlations were calculated to determine the relationship between the students’ vocabulary knowledge, LPS use, and word retention.\(^5\)

**Results**

**LPS Use**

On average, the students identified 26 unknown words, which accounted for 5% of the total. The number of unknown words ranged from 11 to 52 words, which was 2 to 10% of the total. Nation (2001) asserts that a reader needs to know 95% of the words to gain reasonable comprehension. This indicates that the difficulty level of the text may have been appropriate for some students but a little high for others.

Table 1 presents the rates of use of the three LPS options. On average, the students looked up in a dictionary 69% of unknown words, inferred 49%, looked up after inferring 28%, and ignored 10%, although great individual differences were found, as indicated by the high standard deviations and the wide ranges.
Success in LPS Use

Table 2 presents the rates of success in determining appropriate word meaning, associated with the LPS options, consulting and inferring. The students successfully consulted 80% of the time, successfully inferred 45% of the time, and successfully consulted after inferring 83% of the time. The success rates become even higher when partial success is included in the calculation (85%, 83%, and 88%, respectively). This indicates that the students were generally successful in determining word meaning when consulting or inferring, although there was a wide variability.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Max</th>
<th>Min</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consult</td>
<td>22</td>
<td>.689</td>
<td>.247</td>
<td>1.00</td>
<td>.07</td>
<td>.93</td>
</tr>
<tr>
<td>Infer</td>
<td>22</td>
<td>.487</td>
<td>.181</td>
<td>.79</td>
<td>.16</td>
<td>.63</td>
</tr>
<tr>
<td>Consult/Infer</td>
<td>22</td>
<td>.277</td>
<td>.181</td>
<td>.64</td>
<td>.00</td>
<td>.64</td>
</tr>
<tr>
<td>Ignore</td>
<td>22</td>
<td>.103</td>
<td>.125</td>
<td>.53</td>
<td>.00</td>
<td>.53</td>
</tr>
</tbody>
</table>

Knowledge Sources for Inferencing

When the students inferred word meaning, the researcher and the second coder examined each instance to identify the KS(s) used to determine it. A taxonomy was developed drawing on earlier research (Paribakht, 2005; Wesche & Paribakht, 2010) (see Appendix C), and the KSs were classified according to it. Inter-coder reliability was 90.2%. The researcher and the second rater resolved disagreements through discussion to achieve 100% agreement. The taxonomy consists of two main categories, linguistic and nonlinguistic. Linguistic sources include those based on L2 and those based on L1. L2-based sources are further divided into sources related to the target word itself, sentence-level sources, and discourse-level sources. Nonlinguistic sources include the learner’s world knowledge (knowledge of the topic of the text and other related background knowledge) and previous experiences (knowledge based on their previous encounters with the word).

In total, 256 cases of inferencing were indentified. Among them, 227 cases (88.7%) were single-KS use and 29 cases (11.3%) were multiple-KS use. Table 3 presents the overall use of KSs for inferring word meaning, along with the rates of inferential success.
associated with each KS. Most frequently used KSs were sentence-level sources (34%). These KSs were also associated with high rates of success; 88% of cases were either successful or partially successful. Other frequently used KSs included word-level sources (30%) and previous experiences (28%), although relatively large percentages of their use resulted in complete failure (21%, 27%, respectively).

Table 3: Frequency of Knowledge Sources and Inferential Success

<table>
<thead>
<tr>
<th>KS</th>
<th>N</th>
<th>%</th>
<th>Success</th>
<th>Partial success</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>88</td>
<td>30%</td>
<td>33(38%)</td>
<td>36(41%)</td>
<td>19(21%)</td>
</tr>
<tr>
<td>Sentence</td>
<td>100</td>
<td>34%</td>
<td>46(46%)</td>
<td>42(42%)</td>
<td>12(12%)</td>
</tr>
<tr>
<td>Discourse</td>
<td>6</td>
<td>2%</td>
<td>6(100%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>L1-based</td>
<td>6</td>
<td>2%</td>
<td>4(67%)</td>
<td>0(0%)</td>
<td>2(33%)</td>
</tr>
<tr>
<td>World</td>
<td>2</td>
<td>1%</td>
<td>2(100%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Previous</td>
<td>81</td>
<td>28%</td>
<td>49(61%)</td>
<td>10(12%)</td>
<td>22(27%)</td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
<td>3%</td>
<td>2(20%)</td>
<td>6(60%)</td>
<td>2(20%)</td>
</tr>
<tr>
<td>Total</td>
<td>293</td>
<td>100%</td>
<td>142(49%)</td>
<td>94(32%)</td>
<td>57(19%)</td>
</tr>
</tbody>
</table>

Word Retention

Table 4 demonstrates the rates of word retention. On average, the students successfully recalled word meaning for 55% of unknown words they had encountered when reading. The rate increased to 64% when partial success was included in the calculation. The results suggest that the students learned many words from reading the text, although, again, there were substantial individual differences.

Table 4: Mean Rates of Word Retention

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Max</th>
<th>Min</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>22</td>
<td>.547</td>
<td>.206</td>
<td>.88</td>
<td>.17</td>
<td>.71</td>
</tr>
<tr>
<td>Success/Partial success</td>
<td>22</td>
<td>.644</td>
<td>.195</td>
<td>.88</td>
<td>.25</td>
<td>.62</td>
</tr>
</tbody>
</table>

Vocabulary Knowledge, LPS Use, and Word Retention

Table 5 presents the correlations between the rates of LPS use and vocabulary size. A significant positive correlation was found between vocabulary knowledge and rates of inferring ($r = .54, p < .01$). This shows that students with higher lexical proficiency inferred word meaning more frequently than those with lower lexical proficiency.

Table 5: Correlations Between LPS Use and Vocabulary Size

<table>
<thead>
<tr>
<th>Vocabulary</th>
<th>Consulting</th>
<th>Inferring</th>
<th>Inferring/Consulting</th>
<th>Ignoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-.367</td>
<td>.540*</td>
<td>-.157</td>
<td>.153</td>
</tr>
</tbody>
</table>

*p < .01.
Table 6 presents the correlations between success rates of LPS use and vocabulary knowledge. A positive correlation was found between vocabulary knowledge and successful/partially successful inferring ($r = .57$, $p < .01$). This shows that students with higher lexical proficiency inferred word meaning more successfully than those with lower lexical proficiency.

### Table 6: Correlations Between Success Rates of LPS Use and Vocabulary Size

<table>
<thead>
<tr>
<th></th>
<th>CSR</th>
<th>CSPR</th>
<th>GSR</th>
<th>GSPR</th>
<th>COSR</th>
<th>COSPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>$-.046$</td>
<td>$.053$</td>
<td>$.170$</td>
<td>$1.569^*$</td>
<td>$.296$</td>
<td>$.361$</td>
</tr>
</tbody>
</table>

*Note. $^*p < .01$. CSR = rate of successful consulting; CSPR = rate of successful/partially successful consulting; GSR = rate of successful guessing; GSPR = rate of successful/partially successful guessing; COSR = rate of successful combined LPS use; COSPR = rate of successful/partially successful combined LPS use.*

The relationships between vocabulary size and LPS use were further investigated by comparing the high- and low-proficiency groups in the KSs used to infer word meaning (see Appendixes D and E). Both groups frequently used such KSs as sentence-level sources, word-level sources, and previous experiences. However, the high-proficiency group used sentence-level sources more frequently (38% vs. 29%), whereas the low-proficiency group used word-level sources and previous experiences more (33% vs. 27%; 30% vs. 26%, respectively).

The success rates of the high-proficiency group were greater for most types of KSs than those of the low-proficiency group. In particular, the rates of success associated with word-level sources were much better in the high-proficiency group (54% vs. 22%). An exception was the use of previous experiences; the success rate associated with this KS was higher in the low-proficiency group (66% vs. 55%), although the success rates were about the same when partial success was included in the calculation.

The correlations between word retention and vocabulary knowledge were also calculated. A significant positive relationship was found between vocabulary knowledge and the rate of successful recall ($r = .44$, $p < .05$), as well as between vocabulary knowledge and the rate of successful/partially successful recall ($r = .63$, $p < .01$). This indicates that the students with high lexical proficiency retained more words than the low-proficiency students.

### Discussion

#### Patterns of Japanese Students’ LPS Use

The Japanese students were heavy users of dictionaries. On average, they looked up 69% of unknown words, inferred 49%, consulted after inferring 28%, and ignored 10%. This shows that they consulted more words and ignored fewer words than those in previous studies. For example, Fraser (1999) found that the ESL students in her study consulted a dictionary 39% of the time, half of which followed an inference, inferred 55%
of the time, and ignored 35% of the time. One of the possible reasons for the different patterns in LPS use is that the students of the previous studies were ESL students, while the subjects of the present study were EFL students. EFL students are usually required to read a limited amount of material with maximum comprehension, whereas ESL students are required to read a large amount of material with general comprehension. Post-study interviews revealed that the students had been taught reading skills primarily in the grammar-translation method. This could explain their intensive style of reading.

Success in Determining Word Meaning

Both consulting and inferring were associated with high success rates, although consulting resulted more often in full success. The success rate for consulting was 80%, the success rate for inferring was 45%, and success rate for consulting after inferring was 83%. The success rates increased to 85%, 83%, and 88%, respectively, when partial success was included in the calculation. The students were as successful in determining word meaning as those in previous studies involving access to a dictionary. For example, Fraser (1999) found that 78% of consults and 52% of inferences were fully successful and another 29% of inferences were partially successful.

Moreover, the students were more successful in determining word meaning than the participants in many of the previous studies that focused solely on inferencing. For example, Frantzen (2003) reported a success rate of 28%, and Nassaji (2003) reported a success rate of 25.6%. Taken together, these studies show that students determine word meaning more successfully when using a dictionary. Even when inferring alone is considered, the success rate of the present study is much higher. It seems that students infer word meaning more successfully with access to a dictionary. Perhaps dictionary consultation decreases the proportion of unknown words in the surrounding text, making context-based cues more salient.

The students used a variety of KSs to infer word meaning. Sentence-level sources were used most often (34%). This type of KS was also associated with a high rate of success. Other frequently used KSs were word-level sources (30%) and previous experiences (28%), although their use was associated with high rates of failure. The results corroborate other studies which have found that L2 learners frequently use sentence-level KSs such as sentence meaning and sentence grammar to infer word meaning, and their use largely results in inferential success (Chern, 1993; Haynes, 1993; Huckin & Bloch, 1993, Paribakht, 2005; Wesche & Paribakht, 2010). Previous studies have shown that L2 learners also use word-level KSs such as graphemic cues frequently, but their use often results in failure (Frantzen, 2003; Haynes, 1993; Huckin & Bloch, 1993; Nassaji, 2003). This is because L2 learners tend to mistake new words for other words that resemble them and fail to examine the context carefully (Frantzen, 2003; Haynes, 1993; Huckin & Bloch, 1993). All these studies indicate that L2 students depend heavily on local cues found in the word itself or in the immediate sentence context, and have
difficulty integrating a wider variety of KSs, including discourse-level ones.

This study found that the students often drew on previous encounters with the word to infer meaning. The retrospective think-aloud protocols collected following the reading period showed that in many cases the students were often familiar with word forms but were not sure about their meanings. They tried to figure out the meanings by refreshing their memories. As the relatively high rate of inferential failure indicates, however, this strategy was not very successful. This suggests that vocabulary learning is an incremental process in which various aspects of word knowledge are gradually learned (Schmitt, 2000), and a learner's knowledge is only partial at some point; he or she may recognize word forms, but may not be able to associate them with their meanings.

Word Retention

The students retained a large proportion of words they had encountered when reading the text. The word retention rate was 55% and increased to 64% when partial success was included in the calculation. The students learned as many as or more words than those in previous studies providing access to a dictionary (Chun & Plass, 1996; Fraser, 1999; Knight, 1994; Laufer & Hill, 2000). For example, Fraser (1999) found a retention rate of 28% on the vocabulary test administered a week after the reading session. Knight (1994) reported a retention rate of 29% on the immediate supply-definition test, 61% on the immediate select-definition test, 14% on the delayed supply-definition test, and 51% on the delayed select-definition test. Laufer and Hill (2000) found that the Israeli students recalled the meanings of 33% of the target words, and the Hong Kong students recalled 62% of them.

Compared with these studies, much lower retention rates were found in the studies in which students were not provided with access to a dictionary (Hulstijn, 1992; Krashen, 1989; Pitts, White, & Krashen, 1989). For example, Hulstijn (1992) reported a retention rate of 7%. Pitts, White, and Krashen (1989) found a retention rate of 6% in their first experiment and a retention rate of 8% in their second experiment. This suggests that students retain more words by actively dealing with unknown words through dictionary consultation. This might be particularly true when students are as successful in retrieving an appropriate word meaning as those in this study.

One of the reasons for the high retention rate found in the present study is research design. The students themselves indentified unknown words. Therefore, the unknown words were those that students had noticed. Moreover, the students were asked to report the LPS they used to deal with each unknown word as well as the determined meaning during the reading period. This may have provided additional learning opportunities.

Although the results suggest that the students learned many words from reading the text, again, there were substantial individual differences. Individual differences were also found in LPS use and the success rates of LPS use. This shows that LPS use is a process that is idiosyncratic and subject to learner-related variables.
Vocabulary Size, LPS Use, and Word Retention

The students with high lexical proficiency inferred word meaning more frequently than those with low lexical proficiency. Moreover, when inferring, they were more successful. The results support the finding of other studies that success in inferencing depends largely on L2 lexical knowledge (Haynes, 1993; Nassaji, 2003; Wesche & Paribakht, 2010).

Students with high and low lexical proficiency differed in the frequency of KS use as well as success rates of KS use. Both groups often used such KSs as word-level sources, sentence-level sources, and previous experiences. However, the high-proficiency group made more frequent use of sentence-level sources (38% vs. 29%), whereas the low-proficiency group made slightly more use of word-level sources and previous experiences (33% vs. 27%; 30% vs. 26%, respectively). For most types of KSs, success rates were higher in the high-proficiency group than in the low-proficiency group. In particular, the rates of success associated with word-level sources were much higher in the high-proficiency group (54% vs. 22%). These findings indicate that the low-proficiency group depended heavily on word-level cues, which they were unable to use effectively. The retrospective think-aloud protocols showed that L2 learners at times mistakenly identified new words as familiar words or erroneously associated them with similar-looking words. Moreover, they often inferred word meaning based on poor morphological knowledge. To make matters worse, they did not check their initial guesses carefully against the context. As discussed above, other studies (Frantzen, 2003; Haynes, 1993; Huckin & Bloch, 1993) also found that L2 learners’ use of word-level KSs often results in failure. These studies and the present study indicate that low-proficiency students are unable to use word-level cues effectively, despite their heavy dependence on them, because of a lack of word recognition skill or knowledge of word morphology, or the inability to integrate word-level information with context-based information.

The students with higher lexical proficiency retained more words than those with lower lexical proficiency. This may be related to their more frequent and more successful inferencing; since the high proficiency students laboriously inferred word meaning using various cues, and many of their inferences were successful, they may have learned many words from reading the text.

Conclusion

The Japanese students dealt with unknown words actively, consulting a dictionary, and they were generally capable of using one effectively. Their frequent and effective use of dictionaries may have contributed to the learning of a larger proportion of words through reading. This suggests that dictionaries play a significant role in word learning for EFL students like the subjects of the present study, despite the current pedagogical trend that discourages their use.

In general, the students also made frequent and effective use of inferencing, employing a variety of KSs. However, the low-proficiency students made less frequent use of
inferencing. Moreover, they were not very successful at it. They depended heavily on word-based cues and failed to use context-based ones. They should be trained to use various cues effectively. Since students’ patterns of LPS use may be partially related to their limited English proficiency, there is some controversy as to whether students can be trained to use certain strategies. However, some studies (Fraser, 1999; Huckin & Jin, 1987) have reported positive effects as a result of training in LPS use. Given the important role played by reading in L2 vocabulary acquisition, it would seem that such training is called for.

There were several limitations to the present study. First, it only looked into vocabulary size (how many words are known), and did not examine how the depth of vocabulary knowledge (how well each word is known) is related to LPS use and its success. Since some studies show that not only vocabulary size but also depth of vocabulary knowledge affects lexical inferencing (Nassaji, 2004), future research should be designed to take into account the depth of vocabulary knowledge. Second, this study mainly used quantitative analyses of data. Although they revealed the overall patterns of Japanese students’ LPS use when reading, they did not provide a detailed and concrete picture of their LPS use. Future research could include qualitative analyses to enhance our understanding of the mechanism of vocabulary learning through reading. Last but not least, many factors, such as texts, words, learners, and tasks, influence LPS use and its success. More studies need to be conducted under various conditions before drawing any conclusions about L2 learners’ LPS use.

(1) The students’ majors included agriculture (7), cross-cultural studies (5), and English (10).
(2) The score of 21.32 corresponds to 44-46 in the Reading Comprehension section (Educational Testing Service, 2003). If a student scores the same in all three section of the TOEFL, the total score will be 440-460.
(3) Since this study was conducted as part of a larger study that compares pocket electronic dictionaries (EDs) and printed dictionaries (PDs) in their efficiency, half of the students used an ED and the other half used a PD.
(4) These questions were asked to ensure that the students read the text for comprehension.
(5) Prior to carrying out these correlations, assumptions such as normal distribution and linear relationship were carefully checked.

References


The other day over dinner, a TV news story reported that eggs and meat from chickens with avian flu had been resold to restaurants and other businesses. The announcers read the story in a grave tone, suggesting a crisis had struck Japan’s food supply. The story’s impact on my mother-in-law was quick: “That’s scary,” she mumbled between bites of food. The fearmongers had done their work.

For the past several months, we’ve been bombarded with scary news stories about new ways to get sick and die. There’s SARS and mad cow disease (or BSE) and now avian flu. Our entire food supply is in jeopardy, they tell us. The media reports their spread and the subsequent scramble by authorities to try to contain the crisis. But among all this, what frequently doesn’t get reported, or not enough anyway, is a level-headed analysis of the actual risk.

After my mother-in-law’s comment, I quickly reassured her: “The avian flu virus is easily killed if you cook the meat or eggs. In fact, there hasn’t been a single case of avian flu spread to humans through eating infected chickens.” But for some reason, these facts were missing from the TV report.

Likewise, Japan was quick to ban all imports of beef from the United States when a single cow was found to have BSE there - to squeals of delight from domestic cattle
producers - but reports about BSE almost never point out that you cannot get sick by eating regular meat portions of sick cows. It’s parts of their nervous systems that present a problem.

And reports from Taiwan about a sole researcher there getting a new case of SARS topped the news that day, but also failed to mention that there’s never been a single case in Japan, let alone the fact that more people die from “regular” pneumonia and influenza every day than have died from the entire SARS outbreak globally.

Don’t get me wrong: These new diseases do, of course, present a risk (especially to animal handlers and health professionals), but that risk is insignificant when compared to all the old, traditional risks we face daily.

Unfortunately, “news,” as the roots of the word imply, needs to be something “new.” Old-type stories, like “routine” deaths from car accidents, cancer, strokes and heart disease don’t get much air time, even though the vast majority of all deaths are from one of these causes.

So the next time you find yourself getting disturbed or uptight over news reports about the latest rare disease, terrorism, or some horrible unsolved murder somewhere, just turn off the TV, put down your newspaper, or close that Web browser.

Try a self-imposed “news blackout” for a day or so and give yourself a break from the fearmongers. You may find it does wonders for your state of mind.

And while you’re relaxing, keep the following in mind: If you live in Japan, watch your weight and blood pressure, and drive safely with your seat belt on, congratulations! You’re living one of the lowest-risk lifestyles on the entire planet.

Now pass the chicken, please.

Appendix B. Prompts for the Retrospective Think-Aloud Interview

1. その単語を最初に見たときどんなことを考えましたか。どんなことをしましたか。辞書を引きましたか。文脈から推測しましたか。飛ばし読みをしましたか。
2. 何故、辞書を引いたのですか。文脈から推測したのですか。飛ばし読みしたのですか。

(辞書を引いた時)
3. 見つけた意味は何ですか。（何がわかりましたか。）
4. 意味はすぐ見つかりましたか。（辞書のどこを見ましたか。）
5. 辞書で見つけた意味には自信がありますか。
6. その単語について他に分かったことはありますか。

(文脈から推測した時)
7. 推測した意味は何ですか。
8. どういう方法で推測しましたか（語の構造に注目した、文の構造に注目した、文の意味を考えたなど）。
9. 推測した意味には自信がありますか。
Appendix C. Taxonomy of Knowledge Sources Used in Lexical Inferencing

<table>
<thead>
<tr>
<th>Knowledge source</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linguistic</strong></td>
<td></td>
</tr>
<tr>
<td>L2-based Word level</td>
<td>Information available within the word (e.g., word morphology, homonymy)</td>
</tr>
<tr>
<td>L2-based Sentence level</td>
<td>Information available within the sentence containing the word (e.g., sentence grammar, sentence meaning)</td>
</tr>
<tr>
<td>L2-based Discourse level</td>
<td>Information available beyond the sentence containing the word (e.g., discourse meaning, formal schemata)</td>
</tr>
<tr>
<td>L1-based</td>
<td>Knowledge based on the learner’s native language (e.g., loan words)</td>
</tr>
<tr>
<td><strong>Nonlinguistic</strong></td>
<td></td>
</tr>
<tr>
<td>World knowledge</td>
<td>Knowledge of the topic of the text and other related background knowledge</td>
</tr>
<tr>
<td>Previous experiences</td>
<td>Knowledge based on previous encounters with the word</td>
</tr>
</tbody>
</table>

Appendix D. Frequency of Knowledge Sources and Inferential Success for High-Proficiency Group

<table>
<thead>
<tr>
<th>KS</th>
<th>N</th>
<th>%</th>
<th>Success</th>
<th>Partial success</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>43</td>
<td>27%</td>
<td>23(54%)</td>
<td>16(37%)</td>
<td>4(9%)</td>
</tr>
<tr>
<td>Sentence</td>
<td>60</td>
<td>38%</td>
<td>32(53%)</td>
<td>25(42%)</td>
<td>3(5%)</td>
</tr>
<tr>
<td>Discourse</td>
<td>4</td>
<td>3%</td>
<td>4(100%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>L1-based</td>
<td>2</td>
<td>1%</td>
<td>2(100%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>World</td>
<td>1</td>
<td>1%</td>
<td>1(100%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Previous</td>
<td>40</td>
<td>26%</td>
<td>22(55%)</td>
<td>7(17%)</td>
<td>11(28%)</td>
</tr>
<tr>
<td>Others</td>
<td>7</td>
<td>4%</td>
<td>1(14%)</td>
<td>5(72%)</td>
<td>1(14%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>157</td>
<td>100%</td>
<td>85(54%)</td>
<td>53(34%)</td>
<td>19(12%)</td>
</tr>
</tbody>
</table>

Appendix E. Frequency of Knowledge Sources and Inferential Success for Low-Proficiency Group

<table>
<thead>
<tr>
<th>KS</th>
<th>N</th>
<th>%</th>
<th>Success</th>
<th>Partial success</th>
<th>Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>45</td>
<td>33%</td>
<td>10(22%)</td>
<td>20(45%)</td>
<td>15(33%)</td>
</tr>
<tr>
<td>Sentence</td>
<td>40</td>
<td>29%</td>
<td>14(35%)</td>
<td>17(43%)</td>
<td>9(22%)</td>
</tr>
<tr>
<td>Discourse</td>
<td>2</td>
<td>2%</td>
<td>2(100%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>L1-based</td>
<td>4</td>
<td>3%</td>
<td>2(50%)</td>
<td>0(0%)</td>
<td>2(50%)</td>
</tr>
<tr>
<td>World</td>
<td>1</td>
<td>1%</td>
<td>1(100%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Previous</td>
<td>41</td>
<td>30%</td>
<td>27(66%)</td>
<td>3(7%)</td>
<td>11(27%)</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>2%</td>
<td>1(33%)</td>
<td>1(33%)</td>
<td>1(34%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>136</td>
<td>100%</td>
<td>57(42%)</td>
<td>41(30%)</td>
<td>38(28%)</td>
</tr>
</tbody>
</table>