Does Look-up Frequency Help Reading Comprehension of EFL Learners? Two Empirical Studies of Electronic Dictionaries

TOSHIKO KOYAMA
Osaka Ohtani College

OSAMU TAKEUCHI
Kansai University

ABSTRACT
Two empirical studies were conducted in which the differences in Japanese EFL learners’ look-up behavior between hand-held electronic dictionaries (EDs) and printed dictionaries (PDs) were investigated. We focus here on the relation between learners’ look-up frequency and degree of reading comprehension of the text. In the first study, a total of 34 college students were divided into two groups. Each group was assigned a reading task with a quiz under two conditions: ED and PD. The frequency of looked-ups, the time the students needed for the task, and the quiz scores in each condition were statistically examined. The results showed: (a) the subjects in the ED condition looked up more words to comprehend the texts in a shorter period of time than those in the PD group and (b) no significant difference in the quiz scores between the groups. To further investigate these results under different conditions, a second study was performed with 31 university students whose English proficiency levels were higher than those in the first study. Despite the fact that the subjects and the text used in the second study were different, the results of the second study corresponded to the first. These findings indicate that, although EDs might enhance EFL learners’ look-up behaviors, the increased look-up frequency does not necessarily ensure improvement in learners’ reading comprehension. Some pedagogical implications are suggested based on the findings.

KEYWORDS
Hand-held Electronic Dictionaries, Printed Dictionaries, Look-up Frequency, Reading Comprehension, EFL Learning

INTRODUCTION
Advances in technology provide a wide variety of learner dictionaries. Digitized dictionaries such as those on CD-ROM and on the web have become widespread during the last two decades, and quite a number of detailed studies have appeared on these electronic-based dictionaries (e.g., Aust, Kelley, & Roby, 1993; Hulstijn, 1993; Knight, 1994; Koga, 1995; Laufer & Levitzky-Aviad, 2003; among others).

Recently, with the advent of hand-held electronic dictionaries (EDs), the number of English as a foreign language (EFL) learners using EDs has been rapidly expanding in Japan. Market research indicates a considerable demand for EDs in universities, colleges, and even in high schools (Nakamura, 2003). The ED market, in fact, has grown approximately fourfold in the last 5 years (Yagi, 2004). According to Ichikawa, Shimizu, Takahashi, Kanazashi, and
Ishii (2005), a survey conducted in a university revealed that 81 out of 113 students used an ED for their daily English study. Although the best way for Japanese learners to use EDs is a popular discussion topic, only a handful of studies have been done to investigate the effects of EDs on EFL learning (e.g., Koyama & Takeuchi, 2003, 2004; Osaki & Nakayama, 2004; Shizuka, 2003).

Koyama and Takeuchi (2003) is one of the first attempts to clarify the differences between the two types of dictionaries through both quantitative and qualitative techniques. In their study, they found some relationships between the dictionary’s interface design and the learners’ impression of the dictionary. They also reported that the number of look-ups in using EDs was not necessarily proportional to the retention of looked-up words and claimed that, contrary to expectation, the rudimentary interface design of printed dictionaries (PDs) might lead to higher word retention. A subsequent study conducted by the same authors (Koyama & Takeuchi, 2004) confirmed this prediction and revealed that the words looked up in the PD tended to be better retained than those in the ED. They maintained that the difference in word retention between the two types of dictionaries might be attributed to the longer search process involved in using the PD, which is inherent to its interface design. Theoretical support for this interpretation can be found in the depth of processing hypothesis (Craik & Lockhart, 1972; Craik & Tulving, 1975), which was later modified into the mental effort hypothesis by Hulstijn (1992).

Osaki and Nakayama (2004) performed two experiments with 167 and 152 Japanese EFL students, respectively, at the same university and compared the differences in comprehension of unknown words, reading comprehension of the texts, and retention of the looked-up words between ED and PD. The subjects in each experiment were divided into two proficiency groups on the basis of the results of the placement tests: upper and lower proficiency levels. The subjects in each group were instructed to read a text under three conditions (ED, PD, and no dictionary) and asked to complete comprehension and vocabulary tests after reading within the allotted time. Based on the combined data of the two experiments, their findings were: (a) the ED was not superior in word retention to the PD, (b) the ED helped the learners find the suitable meanings for the texts better than the PD did, and (c) the ED promoted better reading comprehension than the PD. To summarize these findings, they concluded that the use of an ED might help learners find appropriate meanings—and thus temporarily facilitate better text comprehension—when reading texts containing numerous unfamiliar words within a specified time limit. They also indicated that the use of an ED might not necessarily guarantee better retention of looked-up words than that of a PD.

On the other hand, Shizuka (2003) claimed the superiority of the ED over PD, based on the results of a speed test which was performed with 77 university EFL students. In this study, he maintained that the ED was superior to the PD in accessing words and identifying their meanings more quickly. Shizuka also insisted that the ED could lower the “consultation trigger point” (Aust et al., 1993, p. 70), thereby offering the learners more frequent and efficient access. Although he emphasized the importance of a higher look-up frequency with an ED, he did not make any attempts to confirm whether it really led to better EFL learning.

As described above, there was little agreement concerning the relative advantages of the ED over PD in EFL learning. Does the ED actually increase learners’ look-ups more than a PD does? Does higher look-up frequency induced by using an ED actually help EFL learning? These are still unresolved questions, despite the fact that dictionary use plays a key role in EFL learning (e.g., Nation, 2001; Knight, 1994; etc.). Hence, we attempted to clarify the possible relations between look-up frequency and EFL learning.
RESEARCH QUESTIONS

In this article, we investigate how the difference between ED and PD usage affects EFL learning. We focus on the relationship between look-up frequency and reading comprehension. For this purpose, the following two research questions were proposed:

1. How does look-up frequency of Japanese EFL learners differ between ED and PD conditions with reading materials written in English?
2. Does higher look-up frequency affect the comprehension of the reading materials?

STUDY 1

Subjects

The subjects in Study 1 were 34 Japanese female college students who participated in the experiment on a voluntary basis. According to an evaluation of their English proficiency by the authors and the result of a 45-item cloze test given to them in advance, they were considered to be false beginners (\(M = 13.5\), \(SD = 3.719\)). Approximately half of them reported using an ED in their daily EFL study.

Dictionaries

Two types of learners’ dictionaries were used in this study. One was *Taishukan’s Genius English-Japanese Dictionary* (third edition), which is one of the most popular conventional paper dictionaries in Japan. The other was the *CASIO EX-word XD-R9000* (See Figure 1), a hand-held electronic dictionary, including an electronic version of the same *Taishukan’s Genius English-Japanese Dictionary* (see Figure 1). The same number of headwords, definitions, examples, and usages were contained in the PD and the ED.

Figure 1

*CASIO EX-word XD-R9000 Used in the Study*
Materials

Two sets of reading materials (Texts A and B) were selected from an English reading textbook \(^2\) (see Appendix A). As seen in Table 1, their calculated readability levels differed only slightly, and the authors considered, based on their teaching experiences, that both materials were appropriate in terms of text difficulty and topic selection.

Table 1
Readabilities of Texts A and B

<table>
<thead>
<tr>
<th></th>
<th>Flesch reading ease</th>
<th>Flesch-Kincaid grade level</th>
<th>Number of words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text A</td>
<td>74.5</td>
<td>7.3</td>
<td>144</td>
</tr>
<tr>
<td>Text B</td>
<td>80.4</td>
<td>6.1</td>
<td>149</td>
</tr>
</tbody>
</table>

Procedure

Since the number of the subjects was small and they had varying levels of English proficiency, a nonparametric Mann-Whitney \(U\) test was conducted on the 45-item cloze test (Siegel & Castellan, Jr., 1988). Based on the results of the cloze test, the subjects were divided into two groups with comparable proficiency (Mann-Whitney \(U = 141.500, ns\)). Each group was assigned a reading task under two conditions: ED and PD. All the subjects repeated this process twice with a different text and a different type of dictionary to ensure a counterbalanced design (see Figure 2). The subjects were allowed to make free use of the designated dictionaries to help them understand the texts. They were asked to circle the looked-up words in each text while reading.

The experiment was conducted one student at a time with an appointment system. Before reading the text, the subjects were first given sufficient time to get used to the ED. Then, to investigate the words the subjects already knew in advance, they were given a vocabulary list consisting of all the words minus function words in texts A and B and were instructed to check the words they thought they knew without any advanced notice.

To measure their comprehension of the texts, the subjects took a quiz immediately after reading each text (see questions in Appendix A). Each quiz consisted of two questions, which the subjects could not answer correctly unless they fully comprehended the texts. Five points were allotted to each question so that partial credit could be given to incomplete or not entirely accurate answers; therefore a full mark was ten. Since the experiment was conducted individually, the first author took advantage of the opportunity to interview some of the subjects after the completion of the experiment.

Results

Table 2 shows the comparisons of look-up behaviors and reading comprehension between ED and PD conditions. The combined data of tasks 1 and 2 appear in the table.
Figure 2
Procedure of Study 1

Group 1 ($n = 17$)
- Vocabulary checklist
- **Task 1**
  - Reading Text A + PD
  - Quiz
- **Task 2**
  - Reading Text B + ED
  - Quiz

Group 2 ($n = 17$)
- Vocabulary checklist
- **Task 1**
  - Reading Text B + PD
  - Quiz
- **Task 2**
  - Reading Text A + ED
  - Quiz

Table 2
Comparisons of Look-up Behaviors and Reading Comprehension ($N = 34$)

<table>
<thead>
<tr>
<th></th>
<th>ED condition</th>
<th>PD condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Lapsed time</td>
<td>11'54&quot;</td>
<td>5'11&quot;</td>
</tr>
<tr>
<td>Looked-up words</td>
<td>11.12</td>
<td>4.916</td>
</tr>
<tr>
<td>Reported words</td>
<td>3.03</td>
<td>2.736</td>
</tr>
<tr>
<td>Quiz score</td>
<td>8.50</td>
<td>2.453</td>
</tr>
</tbody>
</table>

“Lapsed time” in the table is the time the participants needed to read a text (A or B) and to answer the quiz questions while consulting a dictionary in each condition (ED or PD), which was measured with a stopwatch by the authors. “Looked-up words” indicates the total number of words the subjects looked up while reading the texts in each condition. “Reported words” refers to the number of the looked-up words which the subjects reported they knew in the vocabulary check beforehand but actually consulted during the task. “Quiz score” is the score marked on the subject’s quizzes by the first author. Additionally, to confirm the reliability coefficient, it was re-checked by an EFL instructor. The Pearson correlation coefficient between the two markers was .920 (ED condition) and .892 (PD condition) respectively ($p < .001$).
Table 3 contains the results of the t tests applied to the data reported in Table 2.

Table 3
Results of t-test Analysis

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lapsed time</td>
<td>33</td>
<td>2.120*</td>
</tr>
<tr>
<td>Looked-up words</td>
<td>33</td>
<td>-3.984**</td>
</tr>
<tr>
<td>Reported words</td>
<td>33</td>
<td>-4.408**</td>
</tr>
<tr>
<td>Quiz score</td>
<td>33</td>
<td>0.515</td>
</tr>
</tbody>
</table>

*p < .05

**p < .001

The t-test analysis revealed that significant differences existed in “Lapsed time,” “Looked-up words,” and “Reported words” between the ED and PD conditions but not for “Quiz score.” These findings indicate that the subjects in the ED condition needed less time to accomplish the task, looked up more words, and more frequently rechecked the words they had reported they knew beforehand. This last finding was corroborated by the following comments from some of the subjects who used PDs in their daily study.

The search-function of the ED was very convenient for me. So even if I knew the meanings of those words in advance, I was willing to confirm them once more with the ED, but not with the PD.

This ED is very useful! So I checked the meanings of the words I knew again and again.

I use the same PD in my daily study. But the ED I used in the experiment was easy to consult. So I looked up more words with the ED than I thought.

However, the t-test analysis indicates the quiz score of the ED condition was not significantly better than that of the PD condition. This result means that our subjects obtained almost the same score in the reading comprehension quizzes under either condition, even though they looked up more words in the ED condition.

**Discussion**

The analysis above indicates that students can reduce the time they spend reading a text for comprehension by using an ED. In addition, the subjects in this project looked up more words using EDs, regardless of their prior knowledge of those words. These findings suggest that the ED could indeed lower the “consultation trigger point” (Aust et al., 1993), thereby inducing higher look-up frequency by students.

Note that, in this experiment, no time constraint or limit on the number of target words to be looked up were set. The subjects spontaneously consulted dictionaries in order to understand the texts and answer the quiz questions. We, therefore, can claim that EFL learners’ look-up frequency increases through using an ED when they try to comprehend reading materials written in English in real learning situations.

Another important point is that no significant difference was found in the quiz scores
between the ED and PD conditions. This finding indicates that EFL learners might obtain the same degree of reading comprehension under either condition, even though they look up more words in the ED condition. Hence, EFL learners’ reading comprehension appears to be unaffected by the increased look-up frequency induced by the use of an ED.

Since Study 1 was the first attempt to investigate possible relationships between learners’ look-up frequency and reading comprehension, a second study was conducted with new subjects who had a different English proficiency level from those in the first study.

**STUDY 2**

**Subjects**

The subjects in the second study were 31 undergraduate EFL students at a large university. A 45-item cloze test used in Study 1 was also given to these subjects ($M = 23.7$, $SD = 3.6$). The results of a $t$ test indicated that the English proficiency level of our subjects in Study 2 was significantly higher than that of Study 1 ($t = -11.162$, $df = 63$, $p < .0001$). The subjects in the second study were also asked about their daily dictionary use beforehand via a questionnaire.

On the basis of the scores of the cloze test, they were divided into two groups (ED and PD Groups) with approximately the same proficiency ($U = 84.000$, ns). Daily dictionary use was also balanced between both groups as well (see Table 4).

---

**Table 4**

<table>
<thead>
<tr>
<th>Group</th>
<th>Cloze test</th>
<th>Daily dictionary use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>ED ($n = 15$)</td>
<td>24.47</td>
<td>3.461</td>
</tr>
<tr>
<td>PD ($n = 16$)</td>
<td>22.94</td>
<td>3.714</td>
</tr>
</tbody>
</table>

---

**Dictionaries**

The ED and the PD containing the same version of *Taishukan’s Genius English-Japanese Dictionary* (third edition) were used again in this study.

---

**Material**

Taking account of the subjects’ English proficiency, the reading material used in the second study (Text C), which was considerably difficult for Japanese EFL learners, was selected from the Pre-1st grade test of The Society for Testing English Proficiency (STEP), a common proficiency test in Japan (see text and questions in Appendix B). The readability of the text is shown in Table 5.

---

**Table 5**

<table>
<thead>
<tr>
<th>Readability of Text C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flesch reading ease</td>
</tr>
<tr>
<td>Text C</td>
</tr>
</tbody>
</table>
Procedure

The subjects in the ED Group were given an abridged version of the users’ manual of the ED and were provided enough time to get used to the ED before the experiment. The data collection procedure is summarized in Figure 3.

Figure 3
Procedure of Study 2

To investigate the words the subjects already knew, a vocabulary list was distributed to the subjects composed of all the words in text C, excluding the words they should have already learned in junior high school.4 The words on the list were arranged in alphabetical order, and no prior information about the purpose of the list was given to the subjects. They were asked to circle the words they thought they knew.

As seen in Figure 3, each group was assigned a reading comprehension task using the designated dictionary. The subjects in the second study could make free use of the designated dictionary while performing the task. They were asked to circle the looked-up words while reading in the text. To measure their comprehension, they took a comprehension quiz which consisted of six questions with four multiple-choice options. One point was given to each correct answer, so that a perfect score was six.

To confirm the reliability of each quiz, the scores of the cloze test and those of the quiz scores were correlated. The correlation coefficient shows that these two sets of scores were significantly related (r = .498, p < .005). Additionally, the Spearman-Brown prophecy formula showed a coefficient of .665 for the reliability of the quiz. We could, thus, maintain that the relatively reliable data were obtained, irrespective of the small number of quiz items. In the experiment, the subjects were given sufficient time to read the text that allowed them to work at their own pace.

Results

The descriptive statistics are provided in Table 6. “Lapsed time” in the table indicates the time the subjects needed to read the texts and to answer the quiz while consulting a dictionary in
each condition (ED or PD), which was self-measured and reported by the subjects. "Looked-up words" indicates the total number of words the subjects looked up while reading the texts. "Reported words" means the number of the words which the subjects said they knew in the vocabulary list prior to the reading but looked up anyway during the task.

Table 6
Means of Look-up Behaviors and Reading Comprehension in ED and PD Conditions (N = 31)

<table>
<thead>
<tr>
<th>Group</th>
<th>Lapsed time</th>
<th>Looked-up words</th>
<th>Reported words</th>
<th>Quiz score</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED</td>
<td>25'08&quot;</td>
<td>25.00</td>
<td>6.07</td>
<td>3.40</td>
</tr>
<tr>
<td>PD</td>
<td>32'41&quot;</td>
<td>12.25</td>
<td>1.00</td>
<td>3.38</td>
</tr>
</tbody>
</table>

Table 7 shows the results of a Mann-Whitney U test applied to the data reported in Table 6.

Table 7
Results of Mann-Whitney U Test

<table>
<thead>
<tr>
<th></th>
<th>Lapsed time</th>
<th>Looked-up words</th>
<th>Reported words</th>
<th>Quiz score</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>42.500**</td>
<td>49.000*</td>
<td>38.000**</td>
<td>111.500</td>
</tr>
</tbody>
</table>

As can be seen in Table 7, there were significant differences in "Lapsed time," "Looked-up words," and "Reported words" between the ED and the PD groups, which means that the ED group looked up more words to comprehend the text than the PD group did in a shorter period of time. These differences were considerably larger than those in the first study. Additionally, the results also demonstrate that the ED group more often rechecked words which they thought they knew than the PD group did.

Nevertheless, the computed U values indicate no significant difference in the "Quiz score." Despite the fact of the substantial difference in the subjects’ English proficiency level between Study 1 and Study 2, these findings precisely corresponded to those in Study 1, and thus we can conclude that increased look-up frequency was not of much benefit to our subjects’ reading comprehension.

Discussion

We see from Table 6 that the number of the looked-up words in the ED group was more than twice that of the PD group. Furthermore, in the case of the rechecked words, the difference between the two groups was considerably wider. These differences were substantial considering the larger number of words in the reading material used in Study 2.

In contrast to the number of the looked-up words, the time needed to perform the task of the subjects in the ED group was much shorter than that in the PD group. These findings clearly indicate that the subjects who used the ED could consult a much greater number of words in a shorter time owing to the superior search function of the ED, including confirming the word meanings they thought they knew. Put another way, the ED seems to encourage learners’ look-up behavior more than the PD.

A further important finding in the second study is that no significant difference in the
quiz scores was found. This finding indicates that although the ED group looked up more words than the PD group, reading comprehension of the text did not differ. In other words, increased look-up frequency by using ED does not necessarily guarantee an increase in learners’ reading comprehension.

The crucial point to note here is that the second study was conducted with the subjects who had a higher English proficiency level than those in the first study. The texts used and the manner of the two studies were also different. Despite these differences, the results derived from both studies were virtually identical. Consequently, we can claim that higher look-up frequency does not necessarily lead to better EFL reading comprehension.

LIMITATIONS, SUMMARY, AND IMPLICATIONS

The two studies described here have two limitations. First, the number of the subjects in each study was relatively small. The research therefore needs to be replicated on a larger scale. Second, the reliabilities of the comparison tests were not very high, although they reached the critical values and could be regarded as appropriate considering that the number of the subjects was small.

With these limitations in mind, we can summarize the results of the studies as follows:

1. learners’ look-up frequency increases when they use an ED;
2. the use of an ED reduces the time required for foreign language reading; and
3. higher look-up frequency induced by using an ED does not necessarily produce a corresponding beneficial effect on learners’ reading comprehension.

As was mentioned above, the results of Shizuka’s study (2003), who insisted that the use of EDs could lower the “consultation trigger point” (Aust et al., 1993), was supported by the findings in the two studies. Shizuka also emphasized that the advantage of a much larger number of look-ups outweighed the drawbacks of fewer retained words in using ED, making reference to the findings in Koyama and Takeuchi (2004). However, our study shows that higher look-up frequency induced by using an ED does not automatically lead to better reading comprehension and better retention of looked-up words.

Therefore, we maintain that EFL learners and teachers should be aware of the characteristics of EDs reported in this article and apply their advantages appropriately to learning and teaching. Since the dictionary use in learning EFL is indispensable (e.g., Carduner, 2003; Wingate, 2004), further research should aim at finding an effective strategy for ED use.
NOTES

1 Aust, Kelley, and Roby (1993) made a comparison between hyperreferences and conventional paper dictionaries in foreign language learning. They reported that readers consulted hyperreferences much more frequently than comparable paper references because hyperreferences appear to lower the “consultation trigger point,” meaning the point at which foreign language learners are willing to consult a dictionary to confirm the meaning of unknown words and phrases.

2 This book (Hill, 1977) contains 30 stories, and each story consists of approximately 150 words at the 1,500-headword level.

3 The analyses of all the items also yielded statistically significant values even when we applied a rigorous alpha level based on the Bonferroni’s adjustment, the procedure often used in comparing several items from the same data set (Pallant, 2001).

4 This vocabulary list was based on the wordlist composed of all the vocabulary which is adopted in the authorized text books of Japanese junior high schools (middle schools). These words were supposed to be learned by the subjects by the time of the experiments, and we, thus, excluded them from the vocabulary list.

REFERENCES


APPENDIX A
次の英文を読み、以下の問1と問2に日本語で答えなさい。わからない単語や熟語は、渡された辞書を自由に使ってよいが、辞書を引いた単語や熟語は必ず○で囲むこと。

Text A
Joe was going into this usual bar before lunch when he saw a poorly dressed man fishing in a small pool of rain-water about five centimeters deep outside it.

Joe stopped and watched the man for a few minutes. He saw that most of the people who passed by him believed he must be rather mad.

Joe pitied the man, so after a few minutes he went up to him and said kindly, ‘Hullo, would you like to come into the bar and have a drink with me?’

The fisherman was delighted to accept his offer, and the two men went into the bar together. Joe bought the fisherman a few drinks, and finally said to him, ‘You’ve been fishing outside here, haven’t you?’ How many did you manage to catch this morning, if I may ask?’

‘You’re the eighth,’ the fisherman answered merrily.

問1 Joeは、どうしてその釣り人を飲み屋に誘ったのか？
‘Question 1. Why did Joe invite the man into the bar for a drink?’

問2 その釣り人は、ほんとうは何を釣ろうとしていたのか？
‘Question 2. What was the fisherman actually going to catch?’

Text B
A clerk who worked very hard and was usually very punctual arrived at his office very late one morning. He had bruises on his face, a scratch on one of his lips, sticking-plaster on his left wrist and thumb, and a bandage on his right shoulder. He had also hurt his knees, ankles and some of his toes.

The manager of the office was not a patient man, and he had been waiting for the clerk, because he had some work to give him. When he saw him come in at last, he said angrily, ‘You’re an hour late, Tomkins!’

‘I know, sir,’ answered the clerk politely. ‘I’m very sorry. My flat is on the eighth floor, and just before I left home this morning, while I was closing one of the windows, I slipped and fell out.’

‘Well,’ the manager answered coldly, ‘did that take you an hour?’


問1 事務員はある朝、どんな状態（様子）で事務所に現れたか？
‘Question 1. How was the clerk in the morning when he appeared in his office?’

問2 その事務員はどうしてそのような状態になったか？
‘Question 2. Why did the clerk become such a serious condition?’

APPENDIX B

Text C
次の英文を読んで、問（1）～問（6）のそれぞれ4つの選択肢の中から最も適切なものを選び、その番号を○で囲みなさい。解答する際、指定された辞書を自由に使ってよいが、辞書で確認した単語は必ず○で囲むこと。
‘Read the text below. Choose the best answer among the four multiple-choice options and circle it. You can use the designated dictionary while reading the text or answering the questions. Do not fail to circle the words you actually look up in the dictionary.’

The average American a hundred years ago was able to sleep 20 percent longer than the average American today. Experts at universities and hospitals say that as a nation Americans are laboring under a large and increasingly burdensome “sleep deficit,” defined as the difference between how much sleep they need and how much they get.
Why, by degrees, are they omitting sleep? Many commentators would blame it on what we might call the AWOL factor—that is, the American Way of Life. Americans are by nature a busy and ambitious people whom social forces—declining average wages, higher rates of divorce, instant telecommunications, jet travel across time zones—have made busier and busier to no clear end.

It is hard not to credit the importance of the AWOL factor, but the driving force behind the sleep deficit is global in nature: the triumph of light. The widespread, seemingly harmless use of electricity in powering the common light bulb has reduced the amount of sleep people get. Electricity has made it possible for the first time in history for large numbers of human beings to conquer darkness.

In the United States at midnight, more than five million people are at work at full-time jobs. Supermarkets, gas stations, copy shops—many of them never close. The supply-side theory may not have worked in economics, but it has certainly worked with regard to light: the more we get, the more we find ways to put it to use. The result of all this is that we have distanced ourselves from the basic rhythms of night and day in which we evolved as human beings.

Having said this, what exactly can we do about the situation? The only suggestion for improvement that I have to offer comes from reflecting on life in Ireland in the 1960s. One of the elements that made Irish life so amicable was that the Electric Supply Board somehow or other managed to produce frequent but unpredictable blackouts. The progress of time would suddenly be frozen for an uncertain duration. Lights would go off. Clocks would stop. Television screens would go black. The entire community would take a brief timeout. Perhaps what Americans need is some sort of periodic timeout, a mandatory rest from their busy routine.

Question 1. According to the article, the “sleep deficit”

1. actually started over a hundred years ago.
2. affects few Americans very severely.
3. is a term used for a chronic lack of sleep.
4. refers to the difference between two types of sleep.

Question 2. The writer believes that the AWOL factor is

1. the prime reason for the “sleep deficit.”
2. of secondary importance for the “sleep deficit.”
3. of no importance in considering the “sleep deficit.”
4. really global in nature.

Question 3. In general, the reason why many shops never close at midnight is

1. they obey the government policy.
2. they contribute to reduction of crimes.
3. they notice the relationship between supply and demand.
4. they work according to the AWOL factor.
Question 4. The writer believes that the supply-side theory has worked with light because

1. the demand decreases when supply is increased.
2. the demand increases when more light is provided.
3. the supply always remains greater than the demand.
4. the supply and demand work independently of each other.

Question 5. The writer states that the main result of light on human life is that

1. it has created social forces such as higher rates of divorce.
2. it has enabled us to organize our life better.
3. it has separated us from natural cycles and rhythms.
4. it has helped us evolve as human beings.

Question 6. The main argument of the writer is that

1. a short period without electricity would be beneficial to our modern pace of life.
2. the Electric Supply Board in Ireland had a plan to reduce the tension caused by light in daily life.
3. frequent and unpredictable blackouts can make life less amicable.
4. going to bed earlier will help Americans deal with their busy routine.

(A revised version from the written examination of the pre-1st grade test of STEP, 1996)

ACKNOWLEDGMENTS
This research was supported by the Grant-in-Aid for Scientific Research (C) (2), No. 16520364, awarded to the authors of this article in the fiscal year of 2004-2005. The authors would like to express their gratitude to Professor Thomas Robb of Kyoto Sangyo University for his valuable comments on the earlier version of this article. The authors also thank CASIO Computer Co., Ltd. for its support of the experiments.

AUTHORS’ BIODATA
Toshiko Koyama (Ph.D. in Foreign Language Education) is currently Assistant Professor at Osaka Ohtani College, Osaka, Japan. She teaches classes in elementary computer skills, English, and English teaching methods. Her research focuses on the application of new technologies to foreign language education.

Osamu Takeuchi (Ph.D. in Education) is Professor at the Graduate School/Institute of Foreign Language Education and Research, Kansai University, Osaka, Japan. His research interests include language-learning strategies, testing, and educational technology.
AUTHORS’ ADDRESSES
Toshiko Koyama
Department of Life and Creative Science
Osaka Ohtani College
3-11-1, Nishikiori-kita, Tondabayashi-shi, Osaka,
584-8522 Japan
Phone: +81-721-24-0381
Email: mtkoyama@osaka-ohtani.ac.jp

Osamu Takeuchi, Ph.D.
Graduate School/Institute of Foreign Language Education and Research
Kansai University
3-3-35, Yamate-cho, Suita-shi, Osaka, 564-8680
Japan
Phone: +81-6-6368-1121
Email: takeuchi@ipcku.kansai-u.ac.jp