Pocket Electronic versus Printed Dictionaries: The Effects of Their Use on Lexical Processing Strategies

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This article reports on a study that investigated the use of pocket electronic dictionaries (EDs) compared with printed dictionaries (PDs) by Japanese learners of English, and the impact of EDs on their use of lexical processing strategies (LPSs) (e.g., consulting, inferring, and ignoring). Data were obtained from 279 university students through a questionnaire. The results show that EDs already played an important part in their learning of English. The majority of students owned an ED, and those who own an ED appeared to depend heavily on it. EDs had a rather positive impact on student LPS use. EDs increased the frequency of dictionary consultation of students, especially of those of low vocabulary proficiency. Furthermore, EDs did not have a negative influence on the student LPS use. Successful students frequently used a variety of LPSs, regardless of whether they were using an ED, or a PD.

本稿は、日本人英語学習者による、印刷辞書と比較した場合の電子辞書の使用と電子辞書のレキシカルプロセシングストラテジー（辞書を使用する、人に尋ねる、推測する、無視する）の行使への影響についての研究をまとめている。データは２７９人の大学生からアンケートによって集められた。電子辞書は既に、学生の英語学習に重要な役割を果たしてしていることがわかった。学生の大半が、電子辞書を所有しており、所有者は電子辞書を多用していた。電子辞書は学生のレキシカルプロセシングストラテジーの行使にむしろ効果的であることがわかった。電子辞書は、学生の、得に語彙力の低い学生の辞書使用回数増加につながっていた。また、電子辞書はレキシカルプロセシングストラテジーの行使に悪い影響は及ぼしていなかった。電子辞書を使っている、印刷辞書を使っているにかかわらず、上位レベルの学生は多用なレキシカルプロセシングストラテジーを頻繁に使用していた。

Dictionaries are one of the most important tools for second language (L2) learners. They contribute to learner autonomy by developing learner capabilities as independent analysts and allow them to continue to learn L2 outside the classroom (Odlin, 2001). In addition to traditional printed dictionaries (PDs), recently various types of electronic reference materials are increasingly available to L2 learners. In particular, pocket electronic dictionaries (EDs) are rapidly becoming popular. While learners appear to be excited about their convenience, many educators are concerned about the pedagogical value of EDs (Tang, 1997). The lack of empirical evidence highlights the need to investigate these concerns. In order to fill this gap, this study investigated the use by Japanese learners of English of EDs compared with PDs, and the effects of EDs on their lexical processing strategy (LPS) use.

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Literature Review

Under the influence of top-down communicative approaches, current dominant perspectives emphasize implicit learning of vocabulary (Sökmen, 1997). Many educators and researchers emphasize global understanding of discourse and encourage students to infer word meaning using contextual cues (Cho & Krashen, 1994; Krashen, 1989). These researchers and educators claim that L2 learners should use dictionaries sparsely, and only as a last resort (Fraser, 1999b). Moreover, they are concerned that the frequent consultation of dictionaries hinders comprehension processes (Knight, 1994).

Dictionary use has drawn increasing attention in the field of L2 acquisition (Fraser, 1999b). Results from recent studies suggest that the role of dictionary use for L2 learning needs to be reconsidered. These studies show that dictionaries or marginal glosses facilitate not only vocabulary acquisition (Hulstijn, Hollander, & Greidanus, 1996; Knight, 1994; Luppescu & Day, 1993; Watanabe, 1997), but also comprehension of texts (Knight, 1994; Watanabe, 1997). However, the studies also show that dictionary use slows reading, and some learners who can cope with contextual guessing may use a dictionary when they don't need to (Knight, 1994; Luppescu and Day, 1993).

There is less research on how dictionary consultation interacts with other LPSs. LPSs refer to the strategies that L2 readers use when confronting unknown words (Fraser, 1999a, 1999b; Paribakht & Weshe, 1999). They include consulting a dictionary, consulting others, inferring word meaning using contextual cues, and ignoring. A reader combines multiple LPSs to deal with unknown words in natural contexts. Learners are generally strategic about the words they look up, paying more attention to the words that are important for reading comprehension (Fraser, 1999b; Hulstijn, 1993). However, less successful readers engage in word-by-word decoding, looking up almost all words at the expense of overall comprehension (Adamson, 1990; Hosenfeld, 1977). The strategic choice between dictionary use and other LPS options seems to be an important skill for L2 readers.

Using a retrospective think-aloud technique, Fraser (1999a) investigated how English as a second language (ESL) students use a dictionary in combination with other LSPs (inferring and ignoring) to deal with unknown words while reading, and the impact of student LPS use on vocabulary learning. Fraser found that students inferred more frequently (55% of total encounter with unfamiliar words) than consulted (39%) or ignored (35%). When students consulted or inferred alone, they recalled word meaning about 30% of the time. However, when they inferred and then consulted, they had a higher retention rate (50%). This suggests that consulting a dictionary in combination with inferring maximizes vocabulary learning. Gu and Johnson (1996) examined the impact of vocabulary learning strategies of Chinese learners of English on their vocabulary size and general English proficiency. One finding was that skillful use of dictionaries and contextual guessing were both positively correlated with general proficiency and vocabulary size. This suggests that dictionary use and contextual guessing are complementary; successful learners rely on both dictionaries and contextual guessing.

Although L2 learners increasingly take advantage of EDs, few studies have examined the impact of EDs on L2

learning. Koga (1995) compared the effectiveness of an online ED and a PD for L2 reading. He concluded that the ED had less interference in the reading process due to the reduced time for dictionary consultation, and it facilitated student comprehension. Similarly, Inami, Nishikata, Nakayama, and Shimizu (1997) found that a CD-ROM dictionary was more efficient for learning a set of English words than a PD. These studies concluded that EDs were superior to PDs, mainly due to reduced search time.

Through a questionnaire and interviews, Taylor and Chan (1994) investigated the use of handheld EDs by 424 students in a tertiary education institution in Hong Kong. Student perceived advantages of EDs included portability and the ease and speed of use, whereas perceived disadvantages included inaccuracy of information and the lack of detailed usage and grammatical information. Using Hartmann's (1992) criteria of a good learner dictionary, the researchers evaluated student EDs, and confirmed student perceptions of problems in quality of EDs. In a study with ESL students in Canada, Tang (1997) found that students valued their EDs highly for portability and speed.

Koyama and Takeuchi (2003) examined the effects of a handheld ED over a PD on Japanese English as a foreign language (EFL) learners' dictionary use while reading a text. Koyama and Takeuchi found no significant differences in respect to either the number of words searched or search time. Also, there were no significant differences in the rate of recall and the rate of recognition on the vocabulary tests given a week after the reading task. Although the ED and the PD contained the same amount of information, students felt that the ED did not provide sufficient information due to interface design, allowing students to access only fragmentary information at one time. In a similar study where easier texts were used, Koyama and Takeuchi (2004) found that the rate of recognition was significantly higher in the PD condition, although no significant differences were found in the rate of recall. Koyama and Takeuchi concluded that the elaborative work in the process of searching in the PD condition led to higher retention. With a limited number of studies and mixed results, it is impossible to claim EDs' superiority to PDs in their effectiveness for L2 learning. Clearly, more research should be conducted on the relative advantages of EDs and PDs.

In an attempt to bridge the gaps identified above, this study investigated the use of handheld EDs compared with PDs by Japanese learners at the college level and the impact of EDs on their LPS use. This study also examined how vocabulary learning and reading were related to LPS use. Specifically, this study addressed the following questions:

1. How often and for what purposes do Japanese learners of English use EDs compared with PDs?

2. Are there any differences between ED and PD users in terms of use of dictionaries and other LPSs (i.e., guessing, ignoring, and asking others)?

3. Are there any differences between large- and small-vocabulary students in terms of dictionary use and other LPSs?

4. Are there any differences between high- and low-reading ability students in terms of their dictionary use and other LPSs?

Method

Participants

Participants were 279 students from seven intact classes at three universities in the western part of Japan. The sample consisted of 169 freshmen, 81 sophomores, 21 juniors, and 8 seniors. The students majored in a variety of disciplines including agriculture, education, English, and international understanding. All students, except for a few Chinese speakers, were native speakers of Japanese. Prior to the study, students had studied English for six or seven years and were considered to be at the intermediate level of English proficiency.

Instruments

A written questionnaire, adapted from Gu and Johnson (1996), was used to elicit students' use of EDs, PDs, and other LPSs. The questionnaire, written in Japanese, included 85 closed-ended items, 3 open-ended items, and items on background information. Section 1 asked about the frequency and purposes of using an ED and a PD. It also asked about the features of EDs. Section 2 required students to indicate their use of LPSs - those that were grouped into 13 categories, and those that were treated individually (i.e. three types of dictionaries: English-Japanese, Japanese-English, and monolingual). They were asked to rate each statement on a five-point scale ranging from "never or almost never true of me" to "almost always true of me." Section 3 elicited student demographic information. Table 1 lists the 13 categories, the number of items under each category, and the internal consistency reliability of each category.

Among the 13 categories, *basic dictionary use* includes dictionary use for definitions, pronunciation, and parts of speech. *Extended dictionary use for meaning, usage,* and *grammatical information* involve dictionary use beyond basic information regarding meaning (e.g., looking for synonyms), usage (e.g., looking for collocations), and grammar (e.g., looking for the sentence patterns in which the word can be used), respectively. *Dictionary use for vocabulary learning* includes dictionary use for enhancing vocabulary knowledge, rather than for comprehension (e.g., scanning nearby entries of the unknown word out of curiosity). *Lookup strategies (skills)* involve strategies or skills needed for successful consultation (e.g., removing the inflections to recover the base form to look up). *Self-initiation* includes LPS use in an independent activity (e.g., looking up an unknown word when reading for pleasure). *Note-taking strategies* involves writing a note about information discovered about a word. Two types of guessing strategies were distinguished: *guessing strategies using immediate context* (within the same sentence) and *guessing strategies using wider context* (across the sentence). *Combined use of LPSs* involves the use of multiple LPSs on one word (e.g., consulting a dictionary to confirm guessed meaning). *Selective use of LPSs* includes a decision to use a certain LPS over others according to the word's nature (e.g., looking up a word necessary for comprehension). *Social strategies* include the strategies of consulting others.

Table 1. 13 LPS Categories

LPS Categories	No. of Items	Reliability
Basic Dictionary Use	4	.663
Extended Dictionary Use for Meaning	3	.663
Extended Dictionary Use for Usage	6	.734
Extended Dictionary Use for Grammatical Information	3	.751
Dictionary Use for Vocabulary Learning	4	.618
Lookup Strategies (Skills)	5	.782
Self-Initiation	2	.536
Note-Taking Strategies	5	.708
Guessing Strategies Using Wider Context	9	.901
Guessing Strategies Using Immediate Context	5	.840
Combined Use of LPSs	2	.512
Selective Use of LPSs	9	.748
Social Strategies	2	.601

A longer version of the *Vocabulary Levels Test* (Schmitt, 2000; Schmitt, Schmitt, & Clapham, 2001), Version 2, was used to determine participant vocabulary size. The *Vocabulary Levels Test* contains words at five frequency levels: 2,000, 3,000, 5,000, 10,000 and academic level. Each item of the test requires a test taker to match six words to three definitions. The test contains 60 words and 30 definitions at each level. The reliability of Version 2 for each level ranges between .922 and .960 (Schmitt, Schmitt, & Clapham, 2001).

A subsection of the Test of English as a Foreign Language (*TOEFL*), Section 3, Vocabulary and Reading Comprehension, was administered to assess student reading ability. It requires students to read five short passages and answer comprehension questions in the multiple-choice format within 55 minutes.

Procedures

Prior to the administration of the questionnaire, all participants had completed the *TOEFL* and the *Vocabulary Levels Test.* The researcher distributed the questionnaire to students during a regular class period. She was present in the classroom and responded to student questions concerning the questionnaire. It took between 20 and 30 minutes for students to complete the questionnaire.

Data Analyses

Descriptive statistics were used to analyze student responses on Section 1 of the questionnaire. These analyses included all 279 students. In addition to descriptive statistics, two sets

of two-way ANOVAs were used to analyze student responses on Section 2. These analyses included only 226 students who completed all three instruments: the questionnaire, the vocabulary test, and the reading test. First, separate two-way ANOVAs were carried out with dictionary types (ED or PD) and vocabulary size (large or small) as independent variables, and the mean score for each of the 13 LPS categories and three types of dictionaries (English-Japanese, Japanese-English, or monolingual) as a dependent variable. Then, separate two-way ANOVAs were performed with dictionary types (ED or PD) and reading ability (high or low) as independent variables, and the mean score for each of the 13 LPS categories and three types of dictionaries as a dependent variable. For these analyses, ∂ level was set at .05.

For ANOVAs, students were classified into ED and PD users according to the frequency of use of each type of dictionaries. Operationally, those who used an ED more often than a PD were considered ED users, whereas those who used a PD more often than or as often as an ED were considered PD users. This resulted in 149 ED users and 77 PD users. Users of each type were subdivided into large- and small-vocabulary groups according to their scores on the vocabulary test. The median split was used to classify students into the two vocabulary groups[1]. Likewise, users of each type of dictionary were subdivided into high- and low-reading-ability groups using the median split of their scores on the reading test. [2]

Results and Discussions

Student Use of EDs

Seventy-two percent of all students owned an ED, whereas a slightly higher percentage of English and English-related majors (78%) owned an ED. Many of those who did not own an ED reported that they did not own it because they could not afford it. Those who owned an ED appeared to depend heavily on it. Seventy-five percent of ED owners primarily used an ED, although they also owned a PD. Only 31% of ED owners used a PD and an ED for different purposes. These findings suggest that students tended not to use a PD once they had an ED. Those who used these two types of dictionaries for different purposes used an ED to find out a word's meaning quickly and used a PD to look at examples or detailed usage information (65%) and detailed grammatical information (54%).

The EDs owned by most students were quite expensive and cost between ¥10,000 and ¥40,000. Upon examination by the researcher against Hartmann's (1992) criteria, their EDs did not have the deficiencies in quality identified in previous studies (Taylor & Chan, 1994; Tang, 1997). Due to recent improvements, student EDs provided detailed grammatical and usage information; many of them were equipped with the full contents of PDs. Students' high level of satisfaction with their EDs may be the result of the improved quality of EDs; the majority of ED users were either satisfied (41%) or somewhat satisfied (50%) with their EDs.

The perceived strengths of EDs included portability (91% of ED owners), the speed of looking up a word (90%), the ease in changing from one dictionary to another (71%), and

the capability of looking up a word that students were not sure how to spell (36%). As write-in answers, a few students also pointed out the capability of recording the words looked up, the availability of an idiom search function, the capability of adding dictionaries by inserting cards, and the availability of multiple dictionaries and practice exercises. These findings confirm the previous studies (Taylor & Chan, 1994; Tang, 1997) that found the major advantages of EDs to be their portability and quickness of search.

On the other hand, the perceived disadvantages of EDs included the unavailability of diverse examples (39% of ED owners), the lack of detailed grammatical information (32%), the lack of usage information (27%), and the limited number of headwords (16%). These perceived problems with EDs' quality, contradictory to the researcher's observation, may be explained by ED interface design (Koyama & Takeuchi, 2003; 2004). Since EDs did not allow the entire entry to be viewed at once due to their small screens, students had to scroll or tap to different screens for detailed information. Therefore, EDs might have given students the impression that such information was unavailable. In fact, 19% of ED owners identify the small screen as one of the disadvantages of EDs. A few students noted additional perceived disadvantages, such as difficulty of use, unavailability of a sound function, unavailability of illustrations, the inability of creating a notation, and ineffectiveness for word retention. The percentage of students who marked each perceived disadvantage was very low compared with the percentage of those who marked each perceived advantage; some students even left this section completely blank. Again, this suggests that students were highly satisfied with their EDs.

EDs enabled students to use different types of dictionaries. EDs contained multiple dictionaries including an English-Japanese dictionary (100%), a Japanese-English dictionary (98%), and a monolingual English dictionary (43%). Students reported taking advantage of these dictionaries, including the monolingual English dictionary. Furthermore, EDs allowed students to use a dictionary in different locations, including home, school, and the library.

EDs have become important tools for Japanese university students to learn English. The majority of students in this study owned an ED, and those who owned an ED appeared to depend heavily on it. Although some of them recognized several limitations, most ED owners were satisfied with their EDs.

Impact of Dictionary Types and Language Abilities on LPS Use

Two-way ANOVAs were carried out with dictionary types (ED or PD) and vocabulary size (large or small) as independent variables, and mean scores for three types of dictionaries (English-Japanese, Japanese-English, or monolingual) as dependent variables. There were significant main effects for dictionary types (ED or PD) for all three types of dictionaries (p=.024, p=.000, and p=.006, respectively), significant main effects for vocabulary size for an English-Japanese dictionary (p=.000) and a monolingual dictionary (p=.004), and a significant interaction between dictionary types and vocabulary size for an English-Japanese dictionary (p=.019) (see Table 2). ED users consulted a Japanese-English dictionary and

Table 2. Results of Two-Way ANOVAs with Dictionary Types (DT; ED or PD) and Vocabulary size (VS; Large or Small) as Independent Variables for Three Types of Dictionaries

E-J	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	3.791	3.791	5.159	.024	Large	4.65	4.66	4.65
VS	1	13.322	13.322	18.129	.000	Small	4.42	3.86	4.24
DT*VS	1	4.069	4.069	5.538	.019	Total	4.53	4.29	4.45
Within	221	162.403	.735						
Total	225	4633.000							
J-E	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	39.451	39.451	30.793	.000	Large	3.97	3.17	3.69
VS	1	1.524	1.524	1.190	.277	Small	3.88	2.92	3.57
DT*VS	1	.328	.328	.256	.613	Total	3.93	3.05	3.63
Within	222	284.421	1.281						
Total	226	3300.000							
E-E	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	6.276	6.276	7.597	.006	Large	1.86	1.56	1.76
VS	1	6.981	6.981	8.450	.004	Small	1.54	1.14	1.41
DT*VS	1	.123	.123	.149	.700	Total	1.71	1.36	1.59
Within	219	180.927	.826						
Total	223	756.000							

E-J (English-Japanese), J-E (Japanese-English), E-E (English-English)

a monolingual dictionary more often than PD users (3.93 and 3.05; 1.71 and 1.36, respectively); however, only in the small-vocabulary group did ED users consult an English-Japanese dictionary more often than PD users (4.42 and 3.86). The large-vocabulary group used an English-Japanese dictionary and a monolingual dictionary more often than the small-vocabulary group (4.65 and 4.24; 1.76 and 1.41, respectively).

Similarly, two-way ANOVAs were performed with dictionary types (ED or PD) and reading ability (high or low) as independent variables, and mean scores for three types of dictionaries (English-Japanese, Japanese-English, or monolingual) as dependent variables. The ANOVA yielded significant main effects for dictionary types (ED or PD) for a Japanese-English dictionary (p=.000) and a monolingual dictionary (p=.014), significant main effects for reading ability for an English-Japanese dictionary (p=.002) and a monolingual dictionary (p=.006) (see Appendix 1). ED users consulted a Japanese-English dictionary and a monolingual dictionary more often than PD users (3.93 and 3.05; 1.71 and 1.36, respectively). The high-reading-ability group used an English-Japanese dictionary and a monolingual dictionary more often than the low-reading-ability group (4.65 and 4.25; 1.75 and 1.41, respectively).

The results of two-way ANOVAs using vocabulary size and dictionary types (ED or PD) as independent variables and mean scores for the 13 LPS categories as dependent variables indicated no significant main effects for dictionary types (ED or PD) for all 13 categories, although the mean difference almost reached the significant level for *social strategies* (p = .053). On the other hand, significant main effects were found for vocabulary size for all 13 categories except for *dictionary use for vocabulary learning* and *self-initiation* (see Appendix 2). ED users used *social strategies* less often than PD users, although the difference did not reach the significant level. Among the 11 categories on which vocabulary size had significant effects, the small-vocabulary group used *social strategies* more often than the large-vocabulary group. On the contrary, the large-vocabulary group used the remaining 10 categories more often than the small-vocabulary group. [3]

Likewise, two-way ANOVAs using reading ability and dictionary types (ED or PD) as independent variables and mean scores for the 13 LPS categories as dependent variables yielded no significant main effects for dictionary types (ED or PD) for all 13 categories. On the other hand, significant main effects were found for reading ability for all 13 categories except for *dictionary use for vocabulary learning* and *combined use of LPSs* (see Appendix 3). Among the 11 categories on which reading ability had significant effects, the low-reading-ability group used *social strategies* more often than the high-reading-ability group. In contrast, the high-reading-ability group used the remaining 10 categories more often than the low-reading ability group. [4]

Although both ED users and PD users depended on dictionaries, ED users consulted dictionaries more often than PD users. The significant interaction between dictionary types and vocabulary size for an English-Japanese dictionary, (the type of dictionary most frequently used by students; mean = 4.45), indicates that EDs increased the frequency of dictionary use, especially of small-vocabulary students. Given the finding that ED users tended to use it

rather exclusively, this seems to suggest not so much that ED users had more options to look up a word (i.e., EDs and PDs) as that EDs did facilitate dictionary consultation due to their ease of search. ED users also consulted a wider range of dictionaries, including Japanese-English and monolingual dictionaries. EDs seem to make different types of dictionaries accessible to users because they contain multiple dictionaries in one device and allow users to jump from one dictionary to another.

However, ED users and PD users did not differ significantly in terms of their LPS use except for the sheer frequency of dictionary consultation. In contrast, large- and small- vocabulary students differed in the use of the 11 LPS categories, and large-vocabulary students used 10 of the 11 categories more often than small-vocabulary students. Furthermore, high-reading-ability students used the similar 10 categories more frequently than low-reading-ability students. This suggests that language proficiency rather than dictionary types mattered for LPS use. Regardless of whether they were using an ED or a PD, successful students used a variety of LPSs frequently.

However, one concern remains about the impact of EDs. Although the mean differences between ED and PD did not reach statistical significance for any of the 13 LPS categories, for many of the dictionary strategies, ED users had higher means than PD users. In contrast, for guessing strategies, PD users had higher means than ED users (see Appendix 4). This may show a possibility that some ED users consulted a dictionary at the expense of contextual guessing.

Many of the 13 LPS categories were used more often by high-proficiency groups in both vocabulary and reading than low-proficiency groups. However, the category of *social strategies* was an exception. These strategies were used more often by low-proficiency groups in both vocabulary and reading than high-proficiency groups, suggesting that they may not be helpful for both vocabulary learning and reading. The finding that ED users tended to use these strategies less often than PD users may point to the positive effects of EDs.

The strategy of *self-initiation* was more important for distinguishing high- and low-proficiency groups in reading than in vocabulary. In contrast, the strategy of *combined use of LPSs* was more important for distinguishing high- and low-proficiency groups in vocabulary. This may indicate that reading a good deal is more important for improving reading ability, rather than spending time looking up the word that has already been dealt with by other LPSs such as contextual guessing.

Conclusion and Implications

EDs already play an important part in the learning of English by Japanese university students. Despite educator concerns, this study shows that EDs enhance L2 learning rather than hinder it. EDs increased the frequency of dictionary consultation by students, especially, those of low vocabulary proficiency. Furthermore, EDs did not have a negative influence on students' LPS use; language ability rather than dictionary types explained active LPS use. This suggests that the use of EDs should not be discouraged.

This study also found that successful learners used both dictionaries and contextual guessing more often than less successful learners did. Dictionary use should not be frowned on for the reason that it impedes contextual guessing.

This study found rather positive effects of EDs for users at the college level who also owned a PD, and had extensive experience with it. However, different populations, such as younger ED users without a PD, or much experience with it, might exhibit a different picture. Since this study was one of the first to investigate the impact of EDs on students' dictionary use, more studies should be conducted using different populations, types of texts, and research methods. With this limitation, this study offers the following pedagogical implications for ESL/EFL teachers.

1. Rather than discourage the use of EDs, teachers should advise students to use an ED and a PD for different purposes, considering its pros and cons (Ronald, 2004).

2. Teachers should provide students with instructions in how to take full advantage of an ED by demonstrating available functions on a common model.

3. Many LPSs involving dictionary use and guessing that are related to high vocabulary and reading proficiency should be taught to students.

4. Teachers should instruct students in the skill of using a dictionary selectively, recognizing when to use a dictionary and when to turn to other LPSs.

5. Strategies that are more related to either high vocabulary proficiency or high reading proficiency should be taught, taking into account the desired outcome.

Notes

[1] The large-vocabulary group had an average of 93.7 (max. = 150) (SD = 16.3). The small-vocabulary group had an average of 42.6 (SD = 15.4). The results of ANOVA using the two vocabulary groups as independent variables and vocabulary test scores as dependent variables confirmed significant differences among the two groups, $F(1, 224) = 583.311$, $p < .000$.

[2] The high-reading-ability group had an average of 26.1 (max. = 50) (SD = 8.5). The low-reading-ability group had an average of 10.7 (SD = 3.3). The results of ANOVA using the two reading-ability groups as independent variables and reading test scores as dependent variables confirmed significant differences among the two groups, $F(1, 224) = 325.850$, $p < .000$.

[3] Specifically, the 10 categories the large-vocabulary group used more often than the small-vocabulary group were *basic dictionary use, extended dictionary use for meaning, extended dictionary use for usage, extended dictionary use for grammatical information, lookup strategies, note-taking strategies, guessing strategies using immediate context, guessing strategies using wider context, combined use of LPSs,* and *selective use of LPSs.*

[4] Specifically, the 10 categories the high-reading-ability group used more often than the low-reading ability group were *basic dictionary use, extended dictionary use for meaning, extended dictionary use for usage, extended dictionary use for grammatical information, lookup strategies, self-initiation, note-taking strategies, guessing strategies using immediate context, guessing strategies using wider context,* and *selective use of LPSs.*

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Appendix 1

Results of Two-Way ANOVAs with Dictionary Types (DT; ED or PD) and Reading Ability (RA; High or Low) as Independent Variables for Three Types of Dictionaries

E-J	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	2.636	2.636	3.464	.064	High	4.73	4.47	4.65
RA	1	7.167	7.167	9.418	.002	Low	4.32	4.12	4.25
DT*RA	1	.036	.036	.047	.829	Total	4.53	4.29	4.45
Within	221	168.184	.761						
Total	225	4633.000							
J-E	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	37.915	37.915	30.141	.000	High	4.13	3.03	3.78
RA	1	1.813	1.813	1.441	.231	Low	3.70	3.07	3.47
DT*RA	1	2.786	2.786	2.215	.138	Total	3.93	3.05	3.63
Within	222	279.259	1.258						
Total	226	3300.000							
E-E	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	5.085	5.085	6.126	.014	High	1.82	1.61	1.75
RA	1	6.357	6.357	7.658	.006	Low	1.57	1.15	1.41
DT*RA	1	.595	.595	.717	.398	Total	1.71	1.36	1.59
Within	219	181.797	.830						
Total	223	756.000							

E-J (English-Japanese), J-E (Japanese-English), E-E (English-English)

Appendix 2

Results of Two-Way ANOVAs with Dictionary Types (DT; ED or PD) and Vocabulary Size (VS; Large or Small) as Independent Variables for 13 LPS Categories

BDU	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	.714	.714	1.215	.272	Large	3.76	3.68	3.73
VS	1	7.078	7.078	12.042	.001	Small	3.43	3.27	3.38
DT*VS	1	.074	.074	.126	.723	Total	3.59	3.49	3.56
Within	222	130.485	.588						
Total	226	3001.111							
EDUM	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.058	.058	.076	.783	Large	3.29	3.32	3.30
VS	1	16.125	16.125	20.922	.000	Small	2.79	2.69	2.76
DT*VS	1	.172	.172	.223	.637	Total	3.04	3.03	3.03
Within	222	171.093	.771						
Total	226	2268.333							
EDUU	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.308	.308	.657	.418	Large	3.00	2.92	2.97
VS	1	10.604	10.604	22.609	.000	Small	2.54	2.46	2.52
DT*VS	1	.000	.000	.001	.975	Total	2.77	2.71	2.75
Within	222	104.124	.469						
Total	226	1822.643							
EDUGI	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.072	.072	.081	.776	Large	3.12	3.18	3.14
VS	1	17.624	17.624	19.875	.000	Small	2.55	2.56	2.56
DT*VS	1	0.29	0.29	.033	.856	Total	2.83	2.89	2.85
Within	222	196.854	.887						
Total	226	2055.111							
DUVL	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.001	.001	.001	.975	Large	2.76	2.76	2.76
VS	1	.973	.973	1.500	.222	Small	2.62	2.63	2.62
DT*VS	1	.000	.000	.000	.990	Total	2.69	2.70	2.69
Within	222	144.031	.649						
Total	226	1783.500							

LS	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	.012	.012	.019	.891	Large	4.04	4.02	4.04
VS	1	23.470	23.470	38.266	.000	Small	3.36	3.35	3.35
DT*VS	1	.000	.000	.000	.983	Total	3.70	3.71	3.70
Within	222	136.159	.613						
Total	226	3258.168							
SI	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.048	.048	.039	.844	Large	2.89	3.06	2.95
VS	1	3.883	3.883	3.147	.077	Small	2.75	2.64	2.72
DT*VS	1	1.066	1.066	.864	.355	Total	2.82	2.86	2.83
Within	222	273.863	1.234						
Total	226	2093.250							
NTS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.459	.459	.866	.353	Large	2.85	2.82	2.84
VS	1	4.648	4.648	8.775	003	Small	2.61	2.45	2.56
DT*VS	1	.240	.240	.454	.501	Total	2.73	2.65	2.70
Within	221	117.066	.530						
Total	225	1762.880							
GSUI	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.039	.039	.061	.805	Large	3.37	3.60	3.45
VS	1	17.249	17.249	27.321	.000	Small	2.98	2.81	2.93
DT*VS	1	1.946	1.946	3.082	.081	Total	3.17	3.23	3.19
Within	221	139.529	.631						
Total	225	2452.967							
GSUW	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.146	.146	.256	.614	Large	3.40	3.51	3.44
VS	1	19.063	19.063	33.430	.000	Small	2.84	2.84	2.84
DT*VS	1	.181	.181	.317	.574	Total	3.12	3.20	3.15
Within	221	126.022	.570						
Total	225	2377.105							
CULPS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.000	.000	.000	.993	Large	3.61	3.76	3.67
VS	1	4.561	4.561	5.794	.017	Small	3.45	3.31	3.41

DT*VS	1	.984	.984	1.250	.265	Total	3.53	3.55	3.54
Within	221	173.964	.787						
Total	225	2998.250							
SULPS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.568	.568	1.561	.213	Large	3.31	3.28	3.30
VS	1	3.493	3.493	9.601	.002	Small	3.12	2.94	3.06
DT*VS	1	.273	.273	.751	.387	Total	3.22	3.12	3.18
Within	221	80.412	.364						
Total	225	2366.492							
SS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	3.401	3.401	3.799	.053	Large	2.10	2.38	2.20
VS	1	13.399	13.399	14.967	.000	Small	2.63	2.88	2.71
DT*VS	1	.016	.016	.017	.895	Total	2.37	2.61	2.45
Within	222	198.734	.895						
Total	226	1575.000							

BDU (Basic Dictionary Use), EDUM (Extended Dictionary Use for Meaning), EDUU (Extended Dictionary Use for Usage), EDUGI (Extended Dictionary Use for Grammatical Information), DUVL (Dictionary Use for Vocabulary Learning (EDUV), LS (Lookup Strategies), Self-Initiation (SI), NTS (Note-Taking Strategies), GSUI (Guessing Strategies Using Immediate Context), GSUW (Guessing Strategies Using Wider Context), Combined Use of LPSs (CULPS), Selective Use of LPSs (SULPS), Social Strategies (SS)

Appendix 3

Results of Two-Way ANOVAs with Dictionary Types (DT; ED or PD) and Reading Ability (RA; High or Low) as Independent Variables for 13 LPS Categories

BDU	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	.421	.421	.715	.399	High	3.80	3.53	3.72
RA	1	3.474	3.474	5.906	.016	Low	3.36	3.45	3.40
DT*RA	1	1.613	1.613	2.742	.099	Total	3.59	3.49	3.56
Within	222	130.589	.588						
Total	226	3001.111							
EDUM	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.010	.010	.012	.913	High	3.26	3.27	3.26
RA	1	10.769	10.769	13.585	.000	Low	2.79	2.81	2.80
DT*RA	1	.002	.002	.002	.963	Total	3.04	3.03	3.03
Within	222	175.974	.793						
Total	226	2268.333							
EDUU	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.085	.085	.177	.674	High	2.99	2.87	2.95
RA	1	7.391	7.391	15.467	.000	Low	2.52	2.57	2.54
DT*RA	1	.364	.364	.761	.384	Total	2.77	2.71	2.75
Within	222	106.089	.478						
Total	226	1822.643							
EDUGI	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.377	.377	.434	.510	High	3.20	3.04	3.15
RA	1	13.612	13.612	15.669	.000	Low	2.43	2.76	2.55
DT*RA	1	3.059	3.059	3.522	.062	Total	2.83	2.89	2.85
Within	222	192.856	.869						
Total	226	2055.111							
DUVL	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.061	.061	.025	.875	High	2.80	2.76	2.79
RA	1	1.561	1.561	2.425	.121	Low	2.57	2.64	2.60
DT*RA	1	.137	.137	.213	.645	Total	2.69	2.70	2.69
Within	222	142.904	.644						
Total	226	1783.500							

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LS	Df	SS	MS	F	P	Mean	ED	PD	Total
DT	1	.056	.056	.084	.772	High	3.98	3.87	3.95
RA	1	10.383	10.383	15.636	.000	Low	3.39	3.56	3.45
DT*RA	1	.997	.997	1.502	.222	Total	3.70	3.70	3.70
Within	222	147.410	.664						
Total	226	3258.168							
SI	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.202	.202	.166	.684	High	3.01	3.01	3.01
RA	1	5.778	5.778	4.739	.031	Low	2.61	2.73	2.66
DT*RA	1	.157	.157	.129	.720	Total	2.82	2.86	2.83
Within	222	270.637	1.219						
Total	226	2093.250							
NTS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.239	.239	.450	.503	High	2.89	2.71	2.83
RA	1	2.674	2.674	5.042	.026	Low	2.55	2.59	2.56
DT*RA	1	.604	.604	1.139	.287	Total	2.73	2.65	2.70
Within	221	117.181	.530						
Total	225	1762.880							
GSUI	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.339	.339	.514	.474	High	3.39	3.47	3.41
RA	1	9.882	9.882	14.989	.000	Low	2.94	3.03	2.97
DT*RA	1	.000	.000	.000	.986	Total	3.17	3.23	3.19
Within	221	145.700	.659						
Total	225	2452.967							
GSUW	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.559	.559	.927	.337	High	3.36	3.43	3.38
RA	1	10.834	10.834	17.962	.000	Low	2.86	3.00	2.91
DT*RA	1	.086	.086	.143	.706	Total	3.12	3.20	
Within	251	133.303	.603						
Total	225	2377.105							
CULPS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.037	.037	.046	.830	High	3.60	3.65	3.61
RA	1	1.298	1.298	1.618	.205	Low	3.46	3.46	3.46

DT*RA	1	.044	.044	.054	.816	Total	3.53	3.55	3.54
Within	221	177.294	.802						
Total	225	2998.250							
SULPS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	.335	.335	.910	.341	High	3.32	3.24	3.29
RA	1	2.357	2.357	6.405	.012	Low	3.11	3.02	3.07
DT*RA	1	.002	.002	.005	.944	Total	3.22	3.12	3.18
Within	221	81.325	.368						
Total	225	2366.492							
SS	**Df**	**SS**	**MS**	**F**	**P**	**Mean**	**ED**	**PD**	**Total**
DT	1	2.538	2.538	2.687	.103	High	2.28	2.40	2.32
RA	1	4.344	4.344	4.600	.033	Low	2.47	2.79	2.59
DT*RA	1	.475	.475	.502	.479	Total	2.37	2.61	2.45
Within	222	209.665	.944						
Total	226	1575.000							

BD (BLANK) Dictionary Use for Grammatical Information), DUVL (Dictionary Use for Vocabulary Learning (EDUV), LS (Lookup Strategies), Self-Initiation (SI), NTS (Note-Taking Strategies), GSUI (Guessing Strategies Using Immediate Context), GSUW (Guessing Strategies Using Wider Context), Combined Use of LPSs (CULPS), Selective Use of LPSs (SULPS), Social Strategies (SS)" -- " BDU (Basic Dictionary Use), EDUM (Extended Dictionary Use for Meaning), EDUU (Extended Dictionary Use for Usage), EDUGI (Extended Dictionary Use for Grammatical Information), DUVL (Dictionary Use for Vocabulary Learning (EDUV), LS (Lookup Strategies), Self-Initiation (SI), NTS (Note-Taking Strategies), GSUI (Guessing Strategies Using Immediate Context), GSUW (Guessing Strategies Using Wider Context), Combined Use of LPSs (CULPS), Selective Use of LPSs (SULPS), Social Strategies (SS)

Appendix 4

Mean Scores of Two Dictionary Groups (ED or PD) for 13 LPS Categories

LPS Categories	ED (n=149)		PD (n=77)		
	Mean	SD	Mean	SD	Mean Def.
BDU	3.59	0.76	3.49	0.83	0.10
EDUM	3.04	0.88	3.03	0.98	0.01
EDUU	2.77	0.69	2.71	0.77	0.06
EDUGI	2.83	0.95	2.89	1.04	-0.06
DUVL	2.69	0.78	2.70	0.85	-0.01
LS	3.70	0.82	3.71	0.91	-0.01
SI	2.82	1.09	2.86	1.17	-0.04
NTS	2.73	0.73	2.65	0.76	0.08
GSUI	3.17	0.78	3.23	0.94	-0.06
GSUW	3.12	0.78	3.20	0.86	-0.08
CULPS	3.53	0.84	3.55	1.00	-0.02
SULPS	3.22	0.57	3.12	0.69	0.10
SS	2.37	0.95	2.61	1.03	-0.24

BDU (Basic Dictionary Use), EDUM (Extended Dictionary Use for Meaning), EDUU (Extended Dictionary Use for Usage), EDUGI (Extended Dictionary Use for Grammatical Information), DUVL (Dictionary Use for Vocabulary Learning (EDUV), LS (Lookup Strategies), Self-Initiation (SI), NTS (Note-Taking Strategies), GSUI (Guessing Strategies Using Immediate Context), GSUW (Guessing Strategies Using Wider Context), Combined Use of LPSs (CULPS), Selective Use of LPSs (SULPS), Social Strategies (SS)