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A similarity in word-recognition procedures among second language readers with different first language backgrounds

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ABSTRACT
This study investigated word recognition among fluent readers of English as a second language (ESL). Specifically, the study examined whether ESL readers' first language (L1) affects the procedures underlying second language word recognition, with respect to the effects of word frequency and regularity on word recognition. The results revealed a similarity in word-recognition procedures between fluent ESL readers with various L1 backgrounds (i.e., Chinese, Japanese, and Persian). In processing high-frequency words, all the ESL groups recognized exception words as quickly as regular words; low-frequency exception words, on the contrary, took longer to recognize than low-frequency regular words.

Transfer has been an important concept in research on second language (L2) learning; differences between a first language (L1) and L2 were addressed. For example, L2 reading research considered aspects of learners' L1 that appear to influence their L2 reading. Studies investigating L1 effects on L2 word recognition suggest that the fundamental processing procedures underlying L2 word recognition may be shaped by critical L1 orthographic properties, such as representational units and orthographic depth (Koda, 1996). There is, however, some contradicting evidence in L1 reading research. Studies demonstrating commonalities in word recognition between different languages (e.g., Baluch & Besner, 1991; Seidenberg, 1985) suggest that words are recognized fundamentally in the same manner, regardless of differences in such orthographic properties as representational units or orthographic depth. The present study uses the framework of these studies supporting similarities in word recognition between different orthographies and investigates word recognition among L2 readers with different L1 orthographic backgrounds.

One of the L1 orthographic properties that are considered to affect L2 word recognition is a representational unit in a word. A representational unit refers to

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the linguistic unit that is represented by a grapheme (i.e., a minimal functional unit); according to the nature of the representational unit, orthographic systems are categorized into three types: logography, syllabary, and alphabet. A major difference between logography and the other two types of orthographies (syllabary and alphabet) is that the representational unit in logography is normally a word or morpheme, whereas that in a nonlogographic system is a component of a word, a syllable in syllabary, or a phoneme in alphabet (Muljani, Koda, & Moates, 1998). This difference is considered to affect the efficiency of L2 word recognition (e.g., Akamatsu, 1999; Brown & Haynes, 1985; Muljani et al., 1998). Specifically, readers of English as a second language (ESL) with a nonalphabetic L1 background (e.g., Japanese, Chinese) are less efficient in processing the constituent letters of an English word than those with an alphabetic L1 background (e.g., Arabic, Indonesian, Persian, Spanish).

Even readers with the same L1 background (logography) differ in word-recognition skills due to the difference in exposure to alphabetic symbols in learning to read in a L1 (e.g., Holm & Dodd, 1996; Huang & Hanley, 1994; Read, Zhang, Nie, & Ding, 1986). Holm and Dodd (1996), for example, investigated Chinese readers' ability to manipulate speech sounds in an English word. They found that ESL learners from the People's Republic of China, who had used pinyin (an alphabetic-based written form of Chinese) in learning to read Chinese, were better in segmenting phonemes in an English word and in processing nonwords than the ESL learners from Hong Kong, who had not learned an alphabetic system before they were exposed to English. Holm and Dodd suggested that the use of alphabetic symbols (pinyin) in the initial phase of L1 reading acquisition provided the Chinese group with better ability to isolate and manipulate intraword components than the Hong Kong group.

Orthographic depth, another critical orthographic property seemingly affecting L2 word recognition, refers to the degree of regularity in sound–symbol correspondence. An orthography that represents its phonology following regular grapheme–phoneme correspondences is called a shallow orthography (e.g., Spanish, Serbo-Croatian). Because of the transparent relationships between spelling and pronunciation, the phonological information of a word in a shallow orthography can be easily recovered from its spelling, resulting in the extensive use of phonological recoding, even at a prelexical level (e.g., Carello, Turvey, & Lukatela, 1992). On the contrary, in a deep orthography, which has a more complex or opaque relation of spelling to phonology (e.g., English, Hebrew), readers are more dependent on orthographic information than phonological information when processing printed words. This is because the accurate phonological representation of a word cannot be easily generated from its spelling (Frost & Bentin, 1992). In L1 reading research, this notion of orthographic depth has been used to support the proposal that word-recognition procedures may vary according to differences in writing systems (Frost, 1994).

In L2 reading research, several studies applied the basic concepts of the orthographic depth hypothesis (ODH) and argued for the transfer of specific L1 word-recognition procedures to L2 reading. Chitiri (1991), for example, examined bilingual word-recognition processes in two alphabetic languages differing in orthographic depth: Greek (a shallow orthography) and English (a deep orthog-

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raphy). She found that bilinguals (Greek-L1 advanced learners of English) attended to phonological information (i.e., syllable and stress) in the processing of English words more than English monolinguals. Because such bilingual performance was identical to that of Greek monolinguals in the processing of Greek words, she suggests that differences in orthographic depth between the L1 and L2 may affect word-recognition processes in the L2 (Chitiri, 1991; Chitiri, Sun, Willows, & Taylor, 1992).

The basic concepts of the ODH are also used in cross-linguistic studies on L2 word recognition among different orthographies, although the ODH was originally proposed to explain cross-linguistic differences among alphabetic writing systems only (Katz & Frost, 1992). As mentioned earlier, the basic proposal of the ODH is that differences in orthographic depth lead to word-processing differences; in a shallow orthography, phonological information is dominantly used in word recognition whereas a deep orthography encourages the reader to process words via orthographic information. In other words, the crucial proposal of the ODH is that the variation in the relationships between phonology and morphology determines the type of information dominantly used in word recognition. It is this concept that underlies the theoretical framework of studies on bilingual word recognition with different orthographies (e.g., Chinese-L1 and English-L2).

Koda (1988) focused on the degree of availability of phonological information in spelling (phonological recoverability) by investigating the effects of L1 orthographic features on L2 word recognition. She found that ESL readers whose L1 is phonologically least recoverable (e.g., Japanese[1]) were more dependent on orthographic information in recognizing English words than those whose L1 is relatively high in phonological recoverability (e.g., Arabic, Spanish). Similar results were also observed among adult learners of a nonalphabetic L2; Chinese-L1 learners of Japanese (L2 learners whose L1 is a phonological least recoverable orthography) relied more on orthographic information in processing Japanese *kana* words (syllabic words) than did English-L1 learners of Japanese, whose L1 is relatively higher in phonological recoverability (Chikamatsu, 1996; Mori, 1998).

These cross-linguistic studies, which argue for L1 effects on L2 word recognition, use various measures and focus on different aspects of L2 word recognition; the rationale of the studies, however, is rooted in the same assumption of the ODH. That is, the orthographic properties (i.e., orthographic depth) of the writing systems determine word-recognition procedures. There is, however, another view that emphasizes similarities, rather than differences, in word-recognition processing among difference orthographies.

Seidenberg (1992) stated that, regardless of differences in orthographic depth, all writing systems involve heavy reliance on phonology in processing printed words. His claim is supported by some empirical evidence that, even in a deep orthography such as English or Hebrew, phonological mediation is employed for lexical access (e.g., Van Ordern, Johnston, & Hale, 1988). This contradicts the orthographic depth hypothesis in which word recognition in deep orthography is thought to be orthographically mediated because of the opaque relations between spelling and pronunciation.

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Similarly, the universal direct access hypothesis highlights similarities in word recognition among different types of orthographies (e.g., Baluch & Besner, 1991; Seidenberg, 1985). This hypothesis holds that what determines word-recognition procedures is neither orthographic depth nor the nature of the representational units, but whole-word knowledge of spelling. Skilled readers in all writing systems are seen to recognize printed words via both visual and phonological mediation; "which route dominates for a given word depends on factors such as [word] frequency and reading skill" (Seidenberg, 1992, p. 99). Specifically, the major assumption of the universal direct access hypothesis is that, in any writing system, high-frequency words (i.e., common words) are recognized via visual mediation, whereas low-frequency words are processed on a phonological basis (McCusker, Hillinger, & Bias, 1981; Seidenberg, 1985; Seidenberg, Waters, Barnes, & Tanenhaus, 1984).

In Seidenberg's (1985) study, for example, the availability of reliable phonological information within a word did not affect Chinese readers' processing speed for high-frequency Chinese words. High-frequency phonograms (i.e., words containing phonetic components that provide reliable phonological information) were processed as quickly as high-frequency nonphonograms. On the contrary, in processing low-frequency Chinese words, the phonological information within words facilitated the Chinese readers' word recognition; low-frequency phonograms were processed more quickly than low-frequency nonphonograms. The identical results were obtained from L1 adult readers of English; the facilitating effects of regularity between spelling and pronunciation were observed only in processing low-frequency English words. This similarity in word-recognition procedures between Chinese and English seems to reflect remarkable similarities in word recognition, despite apparent differences among orthographies (Seidenberg, 1992).

The view supporting similar word-recognition procedures among different orthographic systems provides an opportunity to address one hypothesis concerning L1 effects on L2 word recognition. This hypothesis states that L2 readers with different L1 orthographic backgrounds may have the same or similar procedures underlying L2 word recognition, which is inconsistent with the results of several studies on L1 orthographic effects on L2 word recognition (e.g., Akamatsu, 1999; Chikamatsu, 1996; Koda, 1988, 1990; Mori, 1998).

The present study examined the word-recognition procedures of ESL readers with different L1 orthographic backgrounds: Chinese (logography), Japanese (logography and syllabary), and Persian (alphabet). Comparisons of Chinese, Japanese, and Persian speakers on word-recognition tasks permit one to test the hypothesis concerning the relationships between L1 orthographic features and L2 word recognition because these languages include all three types of orthographies.

The study excluded ESL readers with a Roman orthography to focus only on the possible effects of L1 orthographic features on L2 word recognition. In other words, there was a concern that interlexical resemblance, which itself may affect L2 word-recognition procedures to a large extent, provides additional complications with the issue of cross-linguistic influence on word recognition, because cognates are considered to affect the development of L2 word recognition in a

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particular manner (e.g., Tréville, 1996). The major purpose of this study, therefore, was to investigate whether the nature of L1 orthography affects the manner in which one recognizes L2 words. The study replicated Seidenberg's (1985) experiment: L2 word-recognition procedures were examined on a naming task in which L2 readers were given monosyllabic English words of varying frequency and regularity.

There are three hypotheses in this study. First, the differences in L1 orthographic systems do not determine word-recognition procedures. Therefore, ESL readers with different L1 orthographic backgrounds should recognize English words in the same or a similar manner. More specifically, regardless of the differences in the nature of L1 orthography, L2 word-recognition processing should be facilitated by the availability of phonological information only within low-frequency words. In processing high-frequency words, all L2 readers should read irregular words as quickly as regular words.

An alternative hypothesis is suggested by the results of most studies on L1 orthographic effects on L2 word recognition. There is some empirical evidence that L2 word recognition may be influenced by the nature of the L1 orthography in terms of word-recognition procedures. L2 readers with a deep L1 orthographic background were shown to be less dependent on phonological information in word-recognition processing than those with a shallow L1 orthographic background. Thus, if L1 orthographic features affect L2 word recognition, then Chinese and Japanese participants should show less facilitating effects of the availability of phonological information within a word than Iranian participants (Persian-L1). Moreover, if readers of a deep orthography exclusively use visual mediation for lexical access, and if such word-recognition procedures are transferred to L2 reading, then Chinese and Japanese participants should show no regularity effects in processing either high-frequency or low-frequency words.

Finally, it is possible that the nature of representational units in the L1 contributes to the efficiency of L2 word recognition. It has been pointed out that ESL readers with an alphabetic L1 background are more efficient in processing the constituent letters in an English word than those with a nonalphabetic L1 background (e.g., Akamatsu, 1999; Brown & Haynes, 1985; Muljani et al., 1998). Thus, Iranian participants may demonstrate better performance on the naming task than Chinese or Japanese participants. In other words, if Iranian participants benefit from their L1 orthography in processing alphabetic words, they should recognize English words more quickly and/or more accurately than Chinese or Japanese participants.

METHOD

Participants

A total of 48 fluent ESL readers (17 Chinese,[2] 16 Japanese, and 15 Iranians) participated in this study. The participants were skilled readers in their L1, and they had obtained their bachelor degrees in their home countries. The participants were also skilled readers of English who scored higher than 57 (an accuracy rate of 85%) in the vocabulary and reading-comprehension sections of the

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TOEFL (see Appendix A). The scores ranged from 57 to 68 (i.e., 80–100% in accuracy). There was no significant difference in the TOEFL scores between the groups, $F(2, 45) = 2.68$, $p > .05$. A majority of the participants were pursuing their graduate studies at the University of Toronto, Canada.

Materials

A naming task was used in the study. The stimuli consisted of 40 high-frequency and 40 low-frequency monosyllabic English words. For each frequency type, there were 20 regular and 20 exception words. The stimuli were selected in such a way that there was no difference between the sets in the proportion of stimuli of varying word length, frequency, and regularity (see Appendix B). High- and low-frequency words were chosen with reference to the *American Heritage Word Frequency Book* (Carroll, Davies, & Richman, 1971), *Computational Analysis of Present-Day American English* (Kucera & Francis, 1967), and *Cambridge English Lexicon* (Hindmarsh, 1980). In choosing regular and exception words, Berndt et al.'s article, "Empirically derived probabilities for grapheme-to-phoneme correspondences in English," was used as a reference (Berndt, Reggia, & Mitchum, 1987).

Procedure

The experimental session consisted of two blocks of trials. Each block provided written instructions, 8 practice trials, and 40 test trials. The 40 trials in each block consisted of 10 stimulus items randomly chosen from each of the four categories (i.e., high-frequency regular and exception and low-frequency regular and exception). The practice trials and test trials were randomized in the computer and presented to the participant. The procedure of the test trials was identical in all other respects to the set of practice trials, and the order of presentation of stimulus frequency type and regularity type was counterbalanced across participants.

At the beginning of each test trial, an asterisk appeared on the screen to mark the fixation point and was displayed for 500 ms. A blank screen followed the fixation mark for another 500 ms. Then the stimulus item was presented and displayed until the onset of a subject's vocal response. A masking stimulus, consisting of ###### on the computer screen, was introduced after the offset of the stimulus item. The duration of the mask was 50 ms. A blank screen followed the offset of the mask for 1 s (i.e., a 1-s interval between trials).

Each stimulus word was presented singly in the center of the screen of a computer that was connected to a real-time clock. The participant was asked to name each stimulus word as quickly and accurately as possible. The participant read the word aloud into a microphone connected to the voice key of the computer. Latency was timed from the onset of the stimulus to the onset of the participant's response. Inappropriate responses (e.g., mispronunciation errors, noise, and low voice) were recorded in observational notes by the experimenter and then eliminated from the data.

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Table 1. *ANOVA Analyses of reaction time of word naming for the first language (L1) groups by participants*

Source	*df*	*F*
Between subjects		
L1	2	10.24**
Error	45	24,821.43
Within subjects		
Word frequency (*F*)	1	221.74†
F × L1	2	7.37*
Error	45	1,707.06
Word regularity (*R*)	1	119.01†
R × L1	2	0.04
Error	45	562.13
F × *R*	1	12.29**
F × *R* × L1	2	2.8
Error	45	557.36

Note: The errors represent mean square errors.
*$p < 0.05$; **$p < .001$; †$p < .0001$.

Experimental design and data analysis

The analysis used a 3 × 2 × 2 factorial design with the first language of participants (Chinese, Japanese, and Persian), stimulus frequency type (high and low), and stimulus regularity type (regular and exception) as factors. The data were analyzed on the basis of both participants and items. For the participant analysis, the first language of participants (L1) was used as a between-subjects factor; for the item analysis, the stimulus frequency type (frequency) and the stimulus regularity type (regularity) were used as between-subjects factors. Data were analyzed using analyses of variance (ANOVAs) and the reaction time (RT) constituted the dependent measures.

RESULTS

RT analyses

After the item analyses based on response errors, four stimulus words (*grind, pear, pint,* and *tomb*) were omitted; their response accuracy was lower than 40%. Furthermore, RTs greater or less than 2 *SD* from the mean for each participant, across all conditions, were replaced with a value of 2 *SD* from the mean. Table 1 lists the ANOVA statistics based on the participant analysis.

The analysis of the RT was based on correct responses only. The main effect of L1 was significant both by participants, $F(2, 45) = 10.24$, $p < .001$, and by

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items, $F(2, 144) = 300.05$, $p < .0001$. According to a post hoc analysis (i.e., the Scheffé Test), the Japanese ($M = 673.3$, $SD = 81.2$) named words significantly more quickly than the Chinese ($M = 794.71$, $SD = 101.1$, $p < .001$) and the Iranians ($M = 759.0$, $SD = 104.4$, $p < .05$).

There were also significant main effects of: frequency by participants, $F(1, 45) = 221.74$ and by items, $F(1, 72) = 68.89$, $p < .0001$ for both; and regularity by participants, $F(1, 45) = 119.01$, $p < .0001$ and by items $F(1, 72) = 13.66$, $p < .001$. These significant effects indicated that high-frequency words ($M = 698.3$, $SD = 86.4$) were named significantly more quickly than low-frequency words ($M = 787.8$, $SD = 113.3$) and that regular words ($M = 763.2$, $SD = 109.0$) were named significantly more quickly than exception words ($M = 812.5$, $SD = 113.3$).

There was a significant interaction between L1 and frequency by participants, $F(2, 45) = 7.37$, $p < .05$ and by items, $F(2, 144) = 16.66$, $p < .0001$. This significant interaction appears to reflect the fact that the impact of word frequency produced a significant difference in the word-recognition time for low-frequency words between the Chinese and the Iranians ($p < .01$). Furthermore, the interaction between frequency and regularity was significant only by participants, $F(1, 45) = 12.29$, $p < .01$, suggesting that regularity effects for low-frequency words were larger than those for high-frequency words. The interaction between L1 and regularity and the three-way interaction between L1, frequency, and regularity were not significant.

Although the three-way interaction was not statistically significant, a post hoc analysis was carried out to examine whether regularity effects were observed in high-frequency words according to L1. This is because the significant Frequency × Regularity interaction indicated that regularity effects were statistically significant both for high- and low-frequency words. According to the Scheffé test, each group did not show a statistically significant difference in naming between high-frequency regular and exception words. On the contrary, all the groups showed regularity effects in naming low-frequency words, reflecting the fact that, regardless of L1 differences, low-frequency regular words were recognized significantly more quickly than were low-frequency exception words ($p < .05$ for the Chinese and the Iranian groups; $p < .0001$ for the Japanese group). Table 2 lists the means and standard deviations of word-recognition time under all the conditions.

DISCUSSION

The present study addresses two related issues. The first involves the effects of L1 orthographic depth on L2 word recognition: the degree to which phonological information is used for L2 lexical access and its relationship with L1 orthographic depth. The second is the contribution of the nature of representational units in a L1 to L2 word-recognition performance.

The results showed that L1 orthographic features did not change the procedures underlying L2 word recognition. Fluent ESL readers recognized English words in the same manner, regardless of their different L1 orthographic backgrounds. In naming high-frequency English words, the Chinese, Japanese, and

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Table 2. *Mean reaction times* (*ms*) *for each first language* (*L1*) *group under all conditions*

	L1		
Word type	Chinese (n = 17)	Japanese (n = 16)	Persian (n = 15)
High frequency			
Regular	720.7 (65.2)	635.8 (56.9)	699.9 (79.2)
Exception	752.2 (75.4)	649.5 (63.8)	730.1 (86.3)
Low frequency			
Regular	832.3 (88.6)	673.8 (70.9)	780.3 (101.5)
Exception	873.7 (91.1)	734.0 (96.8)	826.7 (108.6)

Note: The values enclosed in parentheses represent standard deviations.

Iranian participants all recognized exception words as quickly as regular words. In naming low-frequency English words, on the other hand, all the ESL groups named regular words more quickly than exception words. This lack of L1 effects on L2 word-recognition procedures supports the initial hypothesis derived from the universal direct access hypothesis, whose central assumption is that in any writing system, familiar words are recognized on a visual basis whereas phonological mediation is used for processing unfamiliar words (Seidenberg, 1992). According to this hypothesis, therefore, the effects of phonological coding should be observed only in recognizing unfamiliar or low-frequency words. This is exactly the pattern that all the ESL groups showed in the study. It should also be noted that these results were almost identical with those of Seidenberg's (1985) study, thereby suggesting that the procedures underlying L2 word recognition may be fundamentally the same as those underlying L1 word recognition.

With respect to the second issue addressed in the study, the results appear to provide no evidence that the nature of representational units in an L1 contributes to L2 word-recognition performance. The Iranian participants, whose L1 is the same orthographic type as English, did not outperform in the word-recognition task. In other words, the Iranian group did not show that their experiences of processing alphabetic words in their L1 promoted better word-recognition ability in ESL than the Chinese and the Japanese, whose L1 is not an alphabetic orthography. This result did not support one of the initial hypotheses: that ESL readers with an alphabetic L1 background would demonstrate better word-recognition performance than those with a nonalphabetic L1 background. Furthermore, this result contradicts the findings of previous studies examining L1 orthographic effects on L2 word recognition. Previous studies showed that the similarities in the nature of representational units between the L1 and L2 would facilitate the L2 reader's skills in word-recognition processing. It has been pointed out, for example, that processing alphabetic words in the L1 helps ESL learners acquire subskills associated with word-recognition ability in English,

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such as sensitivity to intraword structures (e.g., Muljani et al., 1998) and phonological awareness skills (e.g., Holm & Dodd, 1996).

The two major findings of this study (i.e., no L1 orthographic effects on L2 word-recognition procedures and no contributions of the nature of L1 representational units to L2 word-recognition performance) did not support L1 transfer to L2 word recognition and are inconsistent with those of previous studies arguing for L1 effects on L2 word recognition. It is beyond this study's scope to clarify the reason for discrepancy between these results and those of previous studies, but it could be speculated that the discrepancy might reflect differences in (a) stimulus words for the measures, (b) L2 reading proficiency of the participants, and/or the (c) theoretical framework.

This study used real words in the word-recognition task; the majority of studies investigating L1 effects on L2 word recognition or reading, on the other hand, used nonreal words in their measures, such as pseudowords or nonwords (e.g., Koda, 1988, 1990; Holm & Dodd, 1996; Mori, 1998). This may be because the theoretical frameworks of the studies did not prefer real words as stimuli or because simply using real words was considered inappropriate for making L1 transfer observable. It has been pointed out, however, that the usage of pseudowords or nonwords as stimuli has some limitations. That is, the processing of pseudowords or nonwords may relate to orthographic and phonological processing to a certain degree, but because there are no unitary mental representations of pseudowords or nonwords, the measures on processing pseudowords or nonwords may not evaluate word-recognition ability, but rather reflect a skill developed through experience in reading (Vellutino, Scanlon, & Tanzman, 1994). In other words, the measures on word recognition with pseudowords or nonwords may not examine the same cognitive activity as those with real words. Thus, previous studies on L2 word recognition using pseudowords or nonwords may provide some evidence of L1 influence on L2 word-recognition *skills* or *strategies,* but one should be cautious of seeing their findings as evidence of L1 effects on L2 word-recognition *processing ability*.

Differences in L2 reading proficiency may also have resulted in the discrepant findings between this and previous studies. Cross-linguistic studies on bilingual word recognition vary in their participants' level of reading proficiency in the target language. Some studies recruit ESL learners from an intensive English program (e.g., Brown & Haynes, 1985; Koda, 1999) whereas others ask international college students to participate in the experiments (e.g., Holm & Dodd, 1995; Koda, 1990). Although different measures on L2 reading proficiency and limited information on participants prevent precise comparisons across the studies, it seems that the participants in this study are relatively more proficient in L2 reading than those in the majority of previous studies.

Most participants in this study scored higher than 60 (an accuracy rate of 90%) in the vocabulary and reading-comprehension sections of the TOEFL (see Appendix A). Four participants even scored 100%. Furthermore, they were pursuing their graduate studies in Canada at the time of the study and were regularly and fairly intensively involved in English literacy practice. This environment, along with the high level of L2 reading proficiency, may have reduced distinctions among the ESL groups, resulting in no observable affects of L1

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orthographic features on L2 word recognition. This is because increased L2 processing experience helps readers acquire faster and more accurate word recognition in the L2 (e.g., Favreau & Segalowitz, 1982; Segalowitz & Segalowitz, 1993; Segalowitz, Segalowitz, & Wood, 1998) and because performance patterns of more proficient L2 readers tend to be more like those of native speakers than of less proficient L2 readers (Bernhardt, 1996; Haynes & Carr, 1990). Simply put, a high level of reading proficiency in the L2 could conceal transfer effects that are specific to L1 processing. Therefore, less proficient ESL learners with the same L1 backgrounds as those in this study might show particular word-recognition procedures reflecting their L1 orthographic features.

The controversial findings of this study could also be explained by the universal direct access hypothesis. The major proposal of the hypothesis is that the basic mechanism of word-recognition processing is the same for all languages and that, in any language, multiple sources of information contribute to word recognition, such as orthographic structure, spelling–speech correspondences, and lexical identity (Seidenberg, 1992). This does not correspondingly imply, however, that word recognition in all languages is the same in every aspect; rather, languages are seen to be processed similarly, with "the differences between languages being one of degree rather than kind. . . . [The] differences found between languages are due to differences in information and not to differences in information processing" (Massaro & Cohen, 1994, pp. 1124–1125). Furthermore, it is proposed that the extent to which a source of information contributes to word-recognition performance depends on its information value, and the least ambiguous source is thought to have the largest influence on word-recognition performance. Therefore, according to the universal direct access hypothesis, what seems to differentiate between word recognition across languages is the extent to which a source of information is used, not the nature of word-recognition processing (or procedures).

Following this framework of the universal direct access hypothesis, or taking into consideration the distinction in word recognition between information processed, and information processing, one could speculate that the present study's results reflect mainly information processing in L2 word recognition, whereas those of previous studies reflect mainly L1 effects on information processed in L2 word recognition. Most cross-linguistic studies on transfer in word recognition focus on a specific difference or differences between an L1 and an L2 and examine whether any features derived from the differences affect L2 word recognition. For example, some studies, which focused on L1–L2 difference in the linguistic unit represented by a grapheme (i.e., representational unit), reported that the L1 affects the L2 reader's ability to use phonological information at a phoneme level (e.g., Holm & Dodd, 1996; Huang & Hanley, 1994; Wade-Woolley, 1996). Others focused on a difference in orthographic depth (or phonological recoverability) between the L1 and L2 and showed that L2 readers with an orthographically deep L1 tend to be more dependent on orthographic information in recognizing L2 words than those whose L1 is shallow in orthographic depth (e.g., Chikamatsu, 1996; Koda, 1988, 1990; Mori, 1998).

Although these studies used various measures, the experiments were designed on the same basis: to force L2 readers to use a specific source of information

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in the processing of L2 words. This design was widely used because it allows one to examine whether the L1 affects the manner in which L2 readers use the specific information in word recognition. The results of these studies, therefore, were seen as evidence of L1 effects on L2 word recognition. It should be noted, however, that one needs to be cautious of using these results as evidence of L1 effects on L2 word-recognition *processing*.

As mentioned earlier, previous studies on L1–L2 transfer in word recognition tend to investigate L1 effects on the information processed in L2 word recognition. However, there have been few, if any, studies that directly examine L1 effects on L2 word-recognition processing. Thus, even if the L1 affects the manner in which L2 readers use information in the processing of L2 words, one may not be able to specify whether, or to what extent, their way of using information may influence the procedures underlying word recognition. In other words, from findings of the studies examining the information processed in L2 word recognition, one can only speculate that L1 effects on information *use* in L2 word recognition might be transferable to L2 word-recognition *procedures*.

What seems to be needed now is a careful distinction between information that has been processed and information processing in L2 word recognition. In L1 reading research this distinction has produced numerous studies, resulting in a number of important findings regarding differences and similarities in word recognition across languages. Consequently, although there are still controversies, L1 reading researchers "are converging on the reasonable idea that all languages are processed similarly" (Massaro & Cohen, 1994, p. 1124). This might suggest that L2 researchers also should take into consideration the distinction between information that has been processed and information processing in carrying out research on L1–L2 transfer in L2 word recognition. More studies examining how L2 readers with different L1 backgrounds process L2 words, along with others that focus on various aspects of L1–L2 transfer in reading, would ultimately tell us more about what factors in a L1 are transferable in L2 word recognition and to what extent the L1 affects L2 word recognition.

In summary, the results of this study showed that the nature of L1 orthography did not affect L2 word-recognition processing. In processing English words, the ESL readers of an alphabetic L1 background (i.e., the Iranians) demonstrated no observable advantages from the experience of reading their alphabetic L1 orthography. Furthermore, the fluent ESL readers with different L1 backgrounds recognized English words fundamentally in the same manner. The ESL participants whose L1 was Chinese, Japanese, or Persian recognized high-frequency exception words as quickly as high-frequency regular words. Low-frequency exception words, however, took longer to recognize than low-frequency regular words. Similar results were reported in the studies investigating L1 readers' word-recognition procedures (e.g., Seidenberg, 1985), thereby suggesting that fluent ESL readers' procedures that underlie word recognition in English may be fundamentally the same as, or similar to, those of L1 readers.

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APPENDIX A

Screening test (TOEFL) results of the ESL participants

		TOEFL			
L1	Sex	Voc.	RC	Sum	Score
Chinese	M	28	25	53	59–61
Chinese	M	29	30	59	65–67
Chinese	M	29	28	57	65–67
Chinese	F	25	24	49	56–58
Chinese	F	26	27	53	59–61
Chinese	F	29	23	52	59–61
Chinese	F	25	27	52	59–61
Chinese	M	30	29	59	65–67
Chinese	M	30	29	59	65–67
Chinese	F	29	28	57	65–67
Chinese	F	29	30	59	65–67
Chinese	M	30	29	59	65–67
Chinese	F	29	27	56	62–64
Chinese	F	29	29	58	65–67
Chinese	F	30	29	59	65–67
Chinese	M	30	29	59	65–67
Chinese	M	28	30	58	65–67
Japanese	M	28	30	58	65–67
Japanese	M	26	25	51	59–61
Japanese	M	29	27	56	62–64
Japanese	F	29	27	56	62–64
Japanese	F	27	29	56	62–64
Japanese	F	28	26	54	62–64
Japanese	M	25	28	53	59–61
Japanese	F	27	29	56	62–64
Japanese	F	27	29	56	62–64
Japanese	M	27	29	56	62–64
Japanese	F	30	30	60	68
Japanese	F	30	30	60	68
Japanese	F	30	30	60	68
Japanese	M	27	27	54	62–64
Japanese	M	27	28	55	62–64
Japanese	F	30	25	55	62–64
Persian	M	26	28	55	62–64
Persian	M	26	28	54	62–64
Persian	M	24	29	53	59–61
Persian	M	30	30	60	68
Persian	M	21	29	50	56–58
Persian	M	22	27	49	56–58
Persian	M	23	28	51	59–61
Persian	M	25	29	54	62–64
Persian	M	27	28	55	62–64
Persian	M	27	24	51	59–61

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APPENDIX A (*cont.*)

		TOEFL			
L1	Sex	Voc.	RC	Sum	Score
Persian	F	26	24	54	62–64
Persian	M	24	26	50	59–61
Persian	F	29	29	58	65–67
Persian	M	28	26	54	62–64
Persian	M	24	27	51	59–61

Note: M, Male; F, female; Voc., vocabulary section; RC, reading comprehension section.

APPENDIX B

STIMULUS WORDS

High-frequency regular words

Back	From	Most	Very
Both	Get	Much	What
Down	Just	Not	Where
Each	Long	Place	Which
First	Make	Time	While

High-frequency exception words

Are	Great	Some	Were
Could	Have	Their	Who
Does	High	Them	With
Find	Know	There	Would
Good	Said	They	Your

Low-frequency regular words

Bean	Fate	Mess	Stain
Bless	Gasp	Mist	Tray
But	Grape	Pinch	Weep
Crush	Grip	Rob	Wipe
Fade	Heel	Sore	Yawn

Low-frequency exception words

Couch	Gear	Pear	Sweat
Deaf	Glue	Pearl	Sword
Debt	Grind	Pint	Tomb
Dumb	Knit	Sew	Worm
Fare	Lamb	Sigh	Wrist

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NOTES

1. Japanese is considered a phonologically least recoverable language, or an orthographically deep language, seemingly because of the important role that Japanese *kanji* plays in text. There are two types of orthographies in normal Japanese text: logography (Kanji) and syllabary (Kana). Kanji are the Chinese characters that were borrowed from China and adopted in the Japanese writing system. Hiragana (cursive kana) and Katakana (square kana) are the syllabaries that were originally simplified forms of Chinese characters. Each Kana character represents a speech unit that is either a vowel, a combination of a consonant and a vowel, or a nasal sound (Morton & Sasanuma, 1984). In normal Japanese text, a majority of words written in Kanji are content words, that is, semantically important words; they are roots of nouns, adjectives, verbs, and names. Words written in *Katakana* are loan words from foreign languages and onomatopoeic words (Taylor & Taylor, 1983). The rest of the text is written in *Hiragana*, which is used for grammatical morphemes, such as particles and verb inflections. Sakamoto (1976) investigated each type of script in texts and estimated their frequency of occurrence as approximately 30% in Kanji, 4% in Katakana, and 65% in Hiragana.
2. All the Chinese participants were from the People's Republic of China. They did not use pinyin when they began learning to read in Chinese.

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