SECOND LANGUAGE PRINTED WORD RECOGNITION: A REVIEW OF THE CURRENT LITERATURE[1]

Lauren Lukkarila
Georgia State University

ABSTRACT

The purpose of this paper is to explore and explain the state of current research on second language (L2) printed word recognition and, in so doing, to distinguish those aspects of the process that seem to be universally accepted from those that merit further study. The paper first provides a brief overview of the theories, processes, and models associated with first language (L1) printed word recognition and describes how these relate to investigations in L2 printed word recognition. This brief introduction is followed by detailed analyses of the role of phonology and the role of orthography, respectively, in L2 printed word recognition. Among the questions considered in the analyses are the transferability of L1 strategies to L2, types of strategies utilized, interactions between L1 strategies and L2 orthography, the effectiveness of non-native strategies, the effect of L2 print experience on L2 strategies, and the possibility of alteration to the L1 cognitive mechanism that controls word recognition strategies. The final section of the paper lists and describes future directions for research in the area of L2 printed word recognition that emerge from the synthesis and analysis of the information presented.

INTRODUCTION

The importance of literacy in a foreign language has long been recognized as a critical factor in the second language (L2) mastery process. While a plethora of skills and methods may be used in the specific act of L2 reading, the process of *printed word recognition* is perhaps the most basic and, as such, cannot be over emphasized. It is somewhat surprising, then, that the research available to this point on printed word recognition in L2 is not more thorough. Indeed, while certain research of particular methods has contributed to our knowledge of printed word recognition processes, lacunae—and literally so—remain that beg to be filled. Accordingly, this paper will first address the state of current research on printed word recognition with a dual focus on phonology and orthography, followed by suggestions for future research in order to more fully understand the significance and processes of printed word recognition.

Among the multiple processes involved in reading comprehension, printed word recognition has emerged as one that is inextricably linked to reading ability (Perfetti, 1985; Rayner & Pollastek, 1989; Stanovich, 1982, 1991; Wagner & Stanovich, 1996). This concept of word recognition specifically refers to the process or processes by which an individual printed word is linked to its entry in the mental lexicon. The probable processes utilized during word recognition include a phonological recoding strategy (accessing a lexical entry via a reconstruction of the phonological code of the printed word), a visual-orthographic strategy (accessing a lexical entry via familiarity with orthographic patterns), or a combination of phonological recoding and visual-orthographic strategies. Thus, the ability to recognize a word requires that a reader have mastery of both the phonological system and the writing system of a given language as well as how these two systems interact (Gholamain & Geva, 1999). However, prior to

[1]I would like to acknowledge and express my appreciation for the contributions made to this paper by Dr. Nan Jiang of Georgia State University. His comments and questions were instrumental in determining not only the topic for this paper but also the depth of inquiry achieved. He also provided invaluable assistance in finding sources for this paper.

beginning to acquire mastery in the phonological and written systems of a given language, the reader must possess the knowledge that concepts can be represented by printed words. As such, word recognition also requires the pre-existence of an oral vocabulary, particularly in L1 (Koda, 1994).

Word recognition processes in L2 do not differ from those in L1; the three probable processes are still a phonological recoding strategy, a visual-orthographic strategy, or a combination of those strategies. However, to say that the processes do not differ is not to imply that word recognition in L1 is exactly the same as word recognition in L2. Printed word recognition in L2 is, in fact, significantly affected by factors that distinguish it from printed word recognition in L1. Koda (1996, 1994) lists several factors that distinguish L2 word recognition from L1. Among these factors are: a) L2 adult readers have prior reading experience in L1; b) L2 readers learn the L2 in a variety of settings by means of different instructional methods; c) L2 readers, in most cases, have limited linguistic knowledge of the L2; d) L2 readers already know one language and are learning another so there are cross-linguistic interactions between the two languages; e) the L1 and the L2 of L2 readers may be orthographically very different; and f) L2 adult readers typically learn vocabulary and reading skills simultaneously which means that they do not have a highly developed pre-existing oral vocabulary in the L2. In addition to the previously mentioned factors, the reader obviously has to identify the language of individual words found in the L2. This may be self-apparent when reading in context as the reader quite likely is aware that the text is written in the target L2, but when identifying individual, decontextualized words, language identification is an additional step in the word recognition process. Clearly, printed word recognition in L2 is a complex process and research done in this area must attempt to account for the effects of a variety of both linguistic and non-linguistic variables.

While L2 word recognition has generally subscribed to the models postulated for L1 word recognition, L2 models have necessarily involved a modification to account for the fact that two languages are represented in the mental lexicon. Issues such as the role of phonology and the role of orthography are explored in both L1 and L2. Both L1 and L2 word recognition research subscribes to the following ideas and theories: a) there is some phonological mediation involved in lexical access; b) automatized word recognition develops with print experience; c) higher frequency words are recognized more quickly and are accessed via a visual-orthographic strategy rather than a phonological strategy, and d) the phonological recoding strategy and the visual-orthographic strategy are simultaneously operational. In addition, both L1 and L2 word recognition research considers the possibility of combining competing positions like those that champion central processing—approaches which propose that there are universal processes at work in the development of word recognition skills in all languages, such as, verbal ability and verbal working memory (Bowers, 1995; Doctor & Klein, 1992; Gholamain & Geva, 1999)—and those that favor script dependent processing—approaches which propose that word recognition strategies vary in relation to the regularity of the orthographic script (Frost, 1994; Katz & Frost, 1992). Since word recognition research in L1 is relatively plentiful, especially for languages like English and Japanese, L2 word recognition research has been able to draw from the findings of L1 research in order to predict how L2 readers with specific L1 backgrounds may respond to L2 stimuli. As the following sections on the role of phonology and the role of orthography in L2 printed word recognition indicate, all L2 printed word recognition research has its foundation and bases much of its hypotheses on what is known about the target language as an L1 and native readers of that target language.

THE ROLE OF PHONOLOGY

Recognition of the printed word in any language always involves, to varying degrees, some type of phonological recoding (Perfetti & Zhang, 1991, 1995; Perfetti, Zhang, Berent, 1992; Seidenberg, 1985; Wagner & Torgesen, 1987; Katz & Frost, 1992; Lam, Perfetti, & Bell; 1991*)*. As this phonological recoding varies among languages with different orthographic systems, the two primary purposes of the recoding will vary in use and importance as well. The first purpose, strongly associated with alphabetic and syllabic languages, is to provide one route of lexical access. For instance, upon seeing the word the reader reconstructs a phonological code as part of an attempt to link the printed word with its lexical

entry. While such a phonological route of lexical access is also associated to some extent with morphographic languages, phonological recoding has been shown in the latter cases to play a lesser role than the visual route of access (Feldman & Turvey, 1980; Kimura, 1984; Sinamura, 1987; Perfetti & Zhang, 1991; Perfetti, Zhang, & Berent, 1992). A second purpose of phonological recoding, which is strongly associated with all orthographic systems, is to store words in short-term memory for reading comprehension (Mori, 1998; McCutchen & Perfetti, 1982; Zhang & Simon, 1985; Yu, et al., 1985). With this use, the reader reconstructs a phonological code that allows the word to be stored in short term memory while contextual information about the word continues to be absorbed. Regardless of whether phonological recoding is used primarily for lexical access or for short-term memory storage, the relationship of phonological recoding to printed word recognition is an essential part of the recognition and comprehension process.

It is the orthographic script of a language that, in large part, determines the amount of phonological recoding which occurs during the process of word recognition. Ostensibly, some orthographic scripts convey more phonological information than others, thereby making the use of phonological recoding a more viable means of lexical access. If the printed word readily lends itself to phonological recoding, for example, then readers will more likely use phonological recoding as a strategy for word recognition. On the other hand, if the printed word does not easily lend itself to phonological recoding, the recoding will still occur but to a lesser extent. To illustrate, Chinese, as a logographic script, does include in its characters pronunciation cues; however, these cues are generally not considered sufficient enough to activate word recognition processes and, thus, are not as emphasized in the recognition process (Everson, 1998; Koda, 1989; Wang, Koda, & Perfetti, 2003). In comparison, Korean, which is a non-linear alphabetic script, exhibits a higher grapheme to phoneme correspondence and, as a result, Korean readers utilize phonological recoding more immediately and extensively (Kim, 1999; Yoon, Bolger, & Perfetti, 1999; as cited in Wang, Koda, & Perfetti, 2003). A final example of note here is the Japanese language that uses two writing scripts: Kana, a syllabary, and Kanji, a logography. Accordingly, studies have revealed that Japanese readers process Kana and Kanji words differently (Sinamura, 1987; Yamada, Mitarai, & Yoshida, 1991). Regardless of the language, therefore, the amount of phonological information conveyed by the orthographic script determines how much phonological recoding will occur during printed word recognition.

It is worth mentioning here that the question of *when* phonological recoding occurs during printed word recognition is a topic of much debate. This debate centers on whether phonological activation is automatic and occurs at the pre-lexical level, or if the activation depends upon word frequency or orthography and occurs at the lexical level. While this concern of when phonological recoding occurs has important implications for establishing a model of L1 recognition processing, the current status of the debate has not proceeded far enough yet to greatly impact L2 word recognition.

L2 printed word recognition research, however, has been much more interested in establishing the effect of L1 phonological recoding on L2 printed word recognition. Consequently, the research questions regarding the role of phonology and L2 printed word recognition have focused on the following issues: (1) the question of the transferability of L1 phonological coding strategies to L2 word recognition; (2) the types of L1 phonological coding strategies used in L2 word recognition and their effectiveness; (3) the contributions of phonemic awareness to L2 word recognition; and (4) the interactions of L1 phonological coding strategies and L2 orthography. Before addressing these issues, it is necessary to point out that, somewhat surprisingly, the underlying question of whether phonological recoding occurs in L2 printed word recognition has not been directly addressed by research. Rather, the rationale for investigations dealing with phonological recoding and L2 printed word recognition stems from the established and accepted evidence provided by research in L1 printed word recognition. Most studies, therefore, simply begin with the assumption that, since recoding occurs to a greater or lesser extent in L1, then recoding must take place in L2. As additional justification, researchers generally offer a description of how phonological recoding functions relative to word recognition for native speakers of the target language that will be used in their tests. The implied assumption, then, is that L2 readers will necessarily need to interact with the target language in a manner similar to that of L1 readers in order to recognize words.

Significantly, while the assumption that phonological recoding does occur in L2 printed word recognition is validated by the research (Koda, 1989, 1998; Mori, 1998; Wang, Koda, & Perfetti, 2003; Everson, 1998; Abu-Rabia, 2001; Holm & Dodd, 1996), the corresponding assumption that L2 readers will necessarily need to use the same strategies as L1 readers is not validated (Wade-Woolley, 1999; Koda, 1998; Holm & Dodd, 1996).

Transferability of L1 phonological coding strategies to L2 word recognition

As mentioned above, the first, and perhaps most predominant, question in L2 printed word recognition research is the question of whether L1 phonological recoding strategies can be transferred to L2. The answer is a resounding yes. L1 phonological recoding strategies can be and are transferred to L2 printed word recognition processes (Koda, 1989, 1998; Mori, 1998; Wang, Koda, & Perfetti, 2003; Everson, 1998; Abu-Rabia, 2001; Holm & Dodd, 1996). The four primary means to identify phonological activation in L2 word recognition have been: ordered recall tasks, phonemic awareness tasks, an oral pseudoword task, and a pronunciation-meaning recall task. Each of these four means will be explained with examples below.

First, ordered recall tasks like those used in Koda (1989) and Mori (1998), while not specifically testing for word recognition, still arrive at the underlying processes of what occurs when an L2 reader confronts an unknown printed word in L2. Ordered recall tasks require participants to attempt to remember the position of visually presented words when a series of words is given. For instance, the participant may be shown a series of five words, which is followed by a probe word that is one of those five previously presented words. The participant then chooses from a stimulus card—a card that has visual representations of all the stimuli—which word followed the probe word. By manipulating the visual stimuli for language, graphic similarity, and phonological similarity, researchers are able to determine which factors are most detrimental to the performance of L2 learners. As examples, Koda (1989) in some trials manipulated English words and non-words to create stimuli that were either (a) phonologically similar (they all sounded the same using English pronunciation rules), (b) phonologically dissimilar but graphically similar (they all looked similar with only a one letter difference in spelling that was a non-initial letter), or (c) an unpronounceable set (the letter combinations violated the orthographic constraints of English and could not be pronounced). She found that her participants (L1 Arabic, L1 Spanish, and L1 Japanese speakers) all performed better when English non-words were not phonologically similar. This result indicates that phonological interference was affecting all groups. The L1 Japanese speakers, however, were able to recall unpronounceable English non-words better than phonologically similar non-words while the reverse was true for Arabic and Spanish speakers. Because these same Japanese participants were also tested in trials that used Japanese stimuli manipulated to form the same three conditions as the English stimuli, Koda was able to compare their strategies in L1 to L2. She discovered that in L1, Japanese speakers' performance was the most negatively affected in the phonologically similar set and, as with the English stimuli, they did better with unpronounceable stimuli than phonologically similar stimuli. From these results, Koda concluded that her Japanese participants were engaging in phonological recoding in L1 and L2 and, in addition, that they, via their experience in L1 with an arbitrary sound to grapheme correspondence in Kanji, had developed an invention strategy for words that do not contain phonological clues. This ability to presumably invent a code for unpronounceable words, then, enabled the Japanese speakers to store these words effectively in short-term memory despite the absence of a true phonological code. The similar performances of the Japanese on both L1 and L2 tests reflect consistency in both languages with regard to the use of phonological recoding. Because of this consistency, Koda inferred that the Japanese participants had successfully transferred their L1 ability to invent phonological codes for unknown words to L2.

In a replication study, Mori (1998) obtained similar results in an ordered recall task where the target language was Japanese and the participants were native speakers of English, Chinese, and Korean. Mori's stimuli were Japanese Kanji pseudocharacters, which were manipulated for phonological accessibility. The procedure for her experiment was identical to that of Koda (1989). Mori found that

English speakers performed worse when the Japanese pseudocharacters were phonologically inaccessible, while Chinese and Korean speakers performed similarly regardless of phonological accessibility. She attributes English speakers' difficulties with phonologically inaccessible characters to their attempts to transfer their native language phonological recoding strategy. However, Mori, unlike other researchers in this area, categorizes Korean readers as examples of morphographic rather than phonographic readers. Her results do support the idea that English speakers rely on phonological accessibility in L2, but they do not explain why Korean speakers, who by most accounts are considered to be experienced with an alphabetic system, would not show the same pattern.

Second, phonemic awareness tasks, like ordered recall tasks, do not always specifically test for real word recognition. They do, however, allow researchers to assess the phonological skills of L2 readers with regard to the printed word and, thereby, to draw some conclusions for how these skills might affect word recognition. Phonemic awareness tasks generally call for the participant to manipulate the phonemes within the target word in some way that often results in the production of a new word. For example, Wang, Koda, and Perfetti (2003) asked their ESL participants to complete a phoneme deletion task as one part of their test. The L1 Chinese and L1 Korean participants were instructed to read aloud a target word, remove a designated phoneme (which resulted in the formation of a new word), read the new word aloud, and then write the new word. The L1 Korean participants produced more phonologically and orthographically acceptable responses than the L1 Chinese participants. However, the L1 Chinese participants produced more phonologically incorrect but orthographically correct responses than the L1 Korean participants. Wang, Koda, and Perfetti (2003) interpret these results as evidence of L1 transfer of strategies; namely, that the L1 Korean group is predisposed through L1 experience to attend to phonemes within words while the L1 Chinese group is not. The L1 Chinese speakers, rather, rely on a whole-word-based strategy and are, thus, not as effective at manipulating sounds within English words. .

It is interesting to note that Koda (1998) did not find a difference in phonemic awareness between Chinese and Korean ESL readers; though she did find that phonemic awareness was more highly correlated to word decoding and reading comprehension for Koreans than for Chinese. Among the tasks that Koda's participants completed were four phonemic awareness tasks. The first task dealt with auditory discrimination and required the participant to decide if the two words heard were the same or different. The second task was a phonemic substitution task. This task was completed according to the following procedure: the participants heard a pseudoword that was different from a high frequency English word by only one phoneme, they were then asked to identify the substituted phoneme and, finally, to identify the position of the substituted phoneme in a written version of the original real English word. The third task required of participants was phoneme deletion. For this task, participants first heard an English word, then they were asked to repeat the word, this was followed by the instruction to delete a specified phoneme and, finally, to say the word without that phoneme. The fourth task was a phoneme insertion task. The stimuli were pseudowords in English created from high frequency English words. The pseudowords had been created by adding two to four phonemes to the original words. The participants heard the pseudowords and were asked to insert the added phonemes in a written version of the original English real word. Koda had predicted that the L1 Korean group would out perform the L1 Chinese group in this task as their L1 requires more attention to phonemic information via the process of alphabetic phonological recoding. Curiously, she did not find a quantitative difference between the groups. A qualitative difference, however, was reported in debriefing interviews that immediately followed the phoneme deletion task. In these interviews, thirty percent of Chinese participants self-reported using only a visual strategy for this task while only one Korean participant reported using only a visual strategy. In fact, the majority of Koreans reported using only a phonological strategy. The similarities in quantitative results and the differences in qualitative results led Koda to conclude that it is possible that L2 groups of dissimilar L1 orthographic backgrounds can achieve similar accuracy and awareness through different processes.

Similarly, Holm and Dodd (1996) found that Chinese speakers with pinyin background and Vietnamese speakers (alphabetic script) were better able to use phonological skills in the target language of English than Chinese speakers without pinyin background. Holm and Dodd used three phonemic

awareness tasks as part of their test. The first task was phoneme segmentation. The participants heard a word and were asked to identify the number of sounds that made up the word. The second task was spoonerisms. Spoonerisms required participants to transpose specified phonemes in a pair of words to create a different sounding pair of words or non-words. The third task was rhyme judgment. For this task, participants decided if written and oral word pairs rhymed. The L1 Chinese group that did not have a pinyin background performed worse than the other two groups in phoneme segmentation, spoonerisms, and verbal rhyme judgment. In the visual rhyme judgment portion of the task, the groups were significantly different and the L1 Chinese group without a pinyin background had the lowest scores. Holm and Dodd concluded from these results that the two groups with alphabetic experience—L1 Chinese with pinyin background and L1 Vietnamese—were able to transfer their phonological awareness skills developed in L1 to L2. Notably though, in other tasks completed by participants as part of this experiment, all ESL groups performed with similar accuracy on real word reading and spelling. Thus, while the transfer of L1 phonological awareness to an L2 that also utilizes phonological awareness may be useful for the learner, it is not an absolute requirement for developing accuracy in real word reading and spelling.

An example of the third means for identifying phonological activation is found in Abu-Rabia's (2001) use of an oral pseudoword task to test the phonological coding skills of his L1 Russian EFL learners. One of the tasks in Abu-Rabia's battery of tests required participants to decide which of a pair of orally presented English pseudowords sounded like an English word. The participants were tested in both L1 and L2 for the purposes of comparison. Through a multiple regression analysis Abu-Rabia was able to conclude that his findings suggest that Russian phonological skills are a strong predictor of English (L2) word recognition. In other words, L1 phonological skills can positively transfer to L2 when the two orthographies are typologically similar.

Finally, an instance of the fourth and final means for identifying phonological activation can be found in Everson's (1998) use of a pronunciation-meaning based task to test his Chinese students as Foreign Language learners. In separate tests, participants' ability to pronounce characters and their ability to provide an English meaning for the characters were assessed. He found a strong correlation between the ability to pronounce a character and the ability to recall its meaning among English speakers learning Chinese. This, then, indicates the possibility of some connection between phonological recoding and lexical access. Presumably, English speakers employ this strategy since phonological recoding is an integral part of word recognition in English.

Types of L1 Phonological Coding Strategies Used in L2 Word Recognition

Now that it has been established that L1 phonological recoding strategies can and do transfer to L2 word recognition processes, the question of which strategies are transferred and their relative effectiveness can be addressed. Koda (1989) cites the following three strategies for L1 phonographic readers: lexical analogy (Glushko, 1979; Henderson, 1985), grapheme-phoneme translation (Coltheart, 1978; Patterson & Morton, 1985), and a combination of both (Rosson, 1985). For morphographic readers, she lists both memory search—a search that identifies phonological coding based on a visual processing and scanning of lexical entries—and invention, a strategy that allows morphographic L1 readers to invent a phonological code for unknown words because they are less accustomed to strict grapheme to phoneme correspondence. Additionally, Mori (1998), Wade-Woolley (1999), and Fender (2003) contribute the notion that morphographic readers possess more flexible strategies that may allow them to choose the strategy best suited to the task. As would be expected, much of the research suggests that readers from an L1 alphabetic background of any type tend to rely on phonological recoding as their dominant strategy in L2 word recognition (Everson, 1998; Wang, Koda, & Perfetti, 2003; Mori, 1998; Holm & Dodd, 1996; Wade-Woolley, 1999).

In contrast, readers with an L1 morphographic background seem to perform best on L2 reading skills tasks that require less involvement of phonological skills, and where they can exercise their L1 acquired strength in visual processing (Holm & Dodd, 1996; Wang, Koda, Perfetti, 2003; Fender, 2003).

The general conclusion, therefore, with regard to the use of L1 phonological recoding strategies, is that they are particularly effective when L1 and L2 are both alphabetic and, even more so, when the grapheme to phoneme correspondence of L1 to L2 is comparable. In cases, however, where the grapheme to phoneme correspondence between the two languages is not comparable, L2 readers with an alphabetic background may experience more difficulty than L2 readers with a morphographic background as with the case in Fender (2003). Here, his Arabic participants responded slower to a lexical decision task in English than did his Japanese participants. Since Arabic is more phonologically transparent than English, Fender speculates that the difference can be attributed to the over-reliance of his Arabic participants on phonological recoding.

Other research suggests that L2 readers with a morphographic background such as Chinese can use phonological recoding strategies when L2 is alphabetic, but they may choose more specifically when to apply these strategies (Koda, 1998). While Koda finds that phonemic awareness highly correlates with word decoding for a task that requires participants to read a pseudoword aloud, she does not find the same correlation between homophone detection and word decoding. She theorizes that the demands of the task played a part in the selection of strategies for her Chinese participants. Little research, however, has been done on the strategies employed by L2 readers of a morphographic script who have an L1 alphabetic background. What little has been done, does indeed suggest that these L2 readers continue to rely on phonological recoding and are not as sensitive to the orthographic information contained in the script (Everson 1998; Mori, 1998). Mori (1998), too, attempts to look at the strategies employed by L1 morphographic readers when L2 is also morphographic and finds that they perform equally well regardless of whether the L2 Japanese pseudocharacter is phonologically accessible or inaccessible. In sum, the research has not been able to specify what strategies L2 readers are using besides the designations phonological, visual, or a combination. This is perhaps due in part to the difficulty of creating tasks that can definitively measure the specific strategy employed.

As to the question of how effective L1 strategies are, the findings generally seem to indicate that they are useful unless overused (Fender, 2003). Phonological recoding strategies from L1 are not the absolute determiner of word recognition ability, nor do they have to be native-like in order for L2 readers to attain high accuracy ratings. Koda (1998) found that the use of different strategies in phonemic decoding for Korean and Chinese speakers learning English did not necessarily produce quantitative differences in accuracy. Likewise, Wade-Woolley (1999) concluded that both Russian and Japanese speakers used phonological and orthographic knowledge in the recognition process, yet each group used these to a different degree of accuracy. Notably, the groups' differences in accuracy with regard to measures that tested phonological and orthographic knowledge did not result in overall differences in accuracy in real word or pseudoword reading. Correspondingly, Holm and Dodd found that Chinese speakers with pinyin background, Chinese speakers without pinyin background, and Vietnamese speakers (an alphabetic language) performed similarly in real word reading tasks despite differences in phonological awareness. Clearly, L2 printed word recognition can occur even when non-native strategies are utilized.

Contributions of Phonemic Awareness to L2 Word Recognition

The next topic of research in the area of phonological recoding and printed word recognition in L2 is the role of phonemic awareness. Phonemic awareness in L2 word recognition research generally refers to the ability to recognize and manipulate phonemes, an ability that has been deemed essential in alphabetic languages for L1 readers. Several studies of bilingual children learning two alphabetic languages have found a positive relationship between phonemic awareness and word recognition (Chiappe & Siegel, 1999; Comeau, et al., 1999; Cormier & Kelson, 2000; Durgunoglu, Nagy, & Hancin-Ghatt, 1993). However, LeFrancois and Armand (2003) in an experiment that attempted to assess the relationship of word recognition and phonemic awareness for their bilingual child participants did not find a positive correlation between the two. They suggest, rather, that other experiments do not distinguish between word decoding, which they define as the ability to read a pseudoword by means of grapheme to

phoneme correspondence, and word recognition, which they define as the ability to associate a printed word with its lexical representation. Holm and Dodd (1996) found that adult L2 alphabetic readers with a morphographic background did indeed exhibit a lack of phonemic awareness in L2 as compared with other L2 readers. In other words, they were not as strong at those particular skills, yet they still managed to read and spell real words accurately. Likewise, Koda (1998) found that adult Korean ESL learners, who presumably should possess greater phonemic awareness than Chinese ESL learners based on L1 experience, in fact did not perform differently on phonemic awareness tasks. They all did self-report the use of different strategies, but the use of different strategies did not affect the quantitative outcomes of the tasks. Thus, it would seem that phonemic awareness is possibly more important for child learners of an alphabetic L2 than for adult learners of an alphabetic L2, since adults appear to be able to compensate more quickly for any phonemic awareness weakness through the use of other strategies.

Interactions of L1 Phonological Coding Strategies and L2 Orthography

The final issue with regard to phonological recoding and L2 printed word recognition is the interaction of L1 phonological recoding strategies and L2 orthography. Indeed, as many of the studies have suggested, experience with the L2 orthography interacts with L1 phonological recoding strategies. Otherwise, how can selective use of these strategies as is implicated by Koda (1998) be employed by L2 readers? The suggestion that experience with an orthography plays a role in phonological recoding strategies comes directly from L1 research on alphabetic languages (Bowey & Francis, 1991; Perfetti, Beck, Bell, & Hughes, 1987; Vellutino & Scanlon, 1987). As phonological awareness is believed to be enhanced and reinforced in a reciprocal fashion by print exposure in L1, so the assumption follows for L2 as well—even when L1 and L2 are typologically different. The interaction in the latter case is assumed to be even more complex with cross-linguistic interactions. This interaction is the reason that has often been stated for finding a difference in strategies, but without a corresponding difference in overall accuracy (Wade-Woolley, 1999; Koda, 1998; Holm & Dodd, 1996). The issue itself of exactly how and to what extent L1 phonological recoding strategies and experience with L2 orthography interact has not been directly addressed. Two primary problems inherent in addressing this question seem to be obvious: a) what task or tasks would be used and b) the study would quite likely need to be longitudinal in order to investigate the effect of experience.

THE ROLE OF ORTHOGRAPHY

While the initial point of departure for printed word recognition obviously occurs when the reader sees the word, the pressing question is 'What happens after the word is seen?' Do readers assemble the phonological code as their mode of access to its lexical entry? or do they attempt to match the whole word to its lexical entry via a visual mode of access? As discussed in the previous section on the role of phonology, phonological recoding has been implicated in printed word recognition for languages of all types as well as in L2 word recognition for different languages (Perfetti & Zhang, 1991, 1995; Perfetti, Zhang, Berent, 1992; Seidenberg, 1985; Wagner & Torgesen, 1987; Katz & Frost, 1992; Lam, Perfetti, & Bell; 1991; Koda, 1989, 1998; Mori, 1998; Wang, Koda, & Perfetti, 2003; Everson, 1998; Abu-Rabia, 2001; Holm & Dodd, 1996). However, phonological recoding is not the only process at work. Research on languages with different orthographic scripts has demonstrated that the visual mode of access is also used by all languages (Katz & Frost, 1992; Frost, 1994; Seidenberg, 1985; Besner & Hildebrandt, 1987; Jared & Seidenberg; 1991; Besner & Smith, 1992; Hirose, 1992; Yamada, Imai, & Ikebe, 1990). In fact, for some languages, such as Chinese or unpointed (without vowels) Hebrew, the visual mode of access is the dominant strategy (Blederman & Tsao, 1979; Turnage & McGinnies, 1973; Perfetti & Zhang, 1991; Frost, 1994). The choice of which strategy—phonological or visual—achieves dominance has been attributed to what is termed the orthographic depth of the script (Katz & Frost, 1992; Turvey, Feldman, & Lukatela, 1984; Navon & Shimron, 1984; Tzeng & Wang, 1983; Sasanuma, 1984; Besner & Hildenbrandt, 1987).

Orthographic depth refers to the relationship between the script of a language and its phonology. The Orthographic Depth Hypothesis theory has been proposed to explain this relationship (Katz & Frost, 1992; Frost, Katz, & Bentin, 1987; Turvey, Feldman, & Lukatela, 1984). The Orthographic Depth Hypothesis maintains that orthographic scripts exist on a continuum, which has at its two extremes the labels 'shallow' and 'deep'. A shallow orthography is one that allows readers to reassemble the phonological code of a word easily through transparent grapheme to phoneme correspondence rules. Serbo-Croatian and Spanish are often cited as languages that demonstrate shallow orthographies. Serbo-Croatian, for example, is so transparent that even dialectal differences in pronunciation are accompanied by changes in the spelling of words (Katz & Frost, 1992). On the other hand, a deep orthography is one in which the grapheme to phoneme correspondence is opaque. Readers are not able to reassemble the phonological code simply by applying grapheme to phoneme correspondence rules; they may require additional information provided by the context in order to approximate the phonological code of the word. Unpointed Hebrew is an example of a deep orthography. Readers are only given the consonants and must reassemble the phonological code based on context (Katz & Frost, 1992). This inability to easily construct a phonological code causes readers of deep orthographies to rely less on phonological recoding and more on visual processing. In visual processing, the reader attempts to match the visual information to a lexical entry or a subset of lexical entries and then use clues such as context to assist in making the final selection. While phonology may play a role in the final selection, there is a decided reliance and preference for utilizing the visual mode of access initially. Thus, the type of orthographic script—shallow or deep—employed by a given language is seen as the primary determinate of whether the phonological recoding strategy or the visual strategy will be predominant for L1 readers of a given language.

In addition to the depth of the orthographic script, another variable that appears to influence the predominance of a visual strategy over a phonological strategy is word frequency. Words that are high frequency in any language appear to be accessed directly through a visual strategy (Seidenberg, 1985; Besner & Hildebrandt, 1987; Besner & Smith, 1992; Hirose, 1992; Muljani, Koda, Moates, 1998; Perfetti & Zhang, 1991). The strength of the connections between the orthographic representations of high frequency words and their lexical entries allows direct visual access to meaning without phonological recoding. In contrast, low frequency words in all languages appear to undergo phonological recoding to some degree (Seidenberg, 1985; Besner & Hildebrandt, 1987; Besner & Smith, 1992; Hirose, 1992; Muljani, Koda, Moates, 1998; Perfetti & Zhang, 1991). This frequency effect, which allows direct visual access even in shallow orthographies, is the product of L1 print experience. Logically, the more times that a reader has been called upon to make the connection between a printed word and its meaning, the more automatized this process has become and the stronger the direct link between the orthographic representation of the word and its meaning has become.

Printed word recognition in L2 is somewhat different than word recognition in L1 simply because the reader comes to the task with a predetermined strategic preference based on L1 orthographic experience. Consequently, much of the research in L2 printed word recognition has involved comparing L2 learners of similar proficiency, but with typologically different L1 orthographic backgrounds. The research questions have concerned themselves with four issues, which will be addressed in more detail below. The four issues of concern are: the transferability of L1 orthographic strategy to L2 printed word recognition, the effectiveness of a non-native L1 orthographic strategy in L2 printed word recognition, the effect of L2 print experience on L2 orthographic strategies, and the possibility of altering the L1 cognitive mechanism that controls orthographic strategies for L2 purposes.

Transferability of L1 Orthographic Strategy to L2 Printed Word Recognition

The first research question concerning the transfer of L1 orthographic strategy to L2 has received the most attention. The answer to this question, albeit with some exceptions, has been that readers whose L1 script predisposes them to use a visual strategy will transfer this same strategy to L2. Researchers who have tested for the use of L1 visual-orthographic strategy in L2 word recognition were essentially trying to determine if L1 readers of deep orthographies transfer their whole word search strategy to more

shallow orthographies, or if they alter their strategy to take advantage of the more consistent grapheme to phoneme correspondence rules that govern those more shallow orthographies. To this end, the researchers employed tasks that were designed to measure the participants' relative reliance on a visual strategy versus a phonological recoding strategy. In order to test for reliance on a visual strategy, researchers used tasks like lexical decision, naming, and semantic categorization. They manipulated the variables in these tasks to test for things such as intraword sensitivity, grapheme to phoneme regularity, and disruption in recognition due to visual interference (examples to follow). Each type of variable manipulation has yielded similar results in demonstrating that readers were transferring their dominant L1 visual-orthographic strategy regardless of its relative effectiveness.

The first type of variable manipulation involved testing for intraword sensitivity. Intraword sensitivity refers to the L2 reader's sensitivity to the frequency of letter positions or letter combinations in the L2 (Koda, 1999). Presumably, L2 readers who are accustomed to analyzing a string of graphemes in order to arrive at a phonological code will be more sensitive to intraword orthographic constraints, while those who are accustomed to a whole word visual lexical search strategy would not be as sensitive to intraword orthographic constraints. For instance, Koda (1999) compared two groups of ESL readers in an orthographic acceptability judgment task in which positional frequency and letter sequence legality were two of the variables. The orthographic acceptability judgment task is similar to a lexical decision task except for the fact that the participant is not required to decide if the target is a word in the L2. Rather, the participant is asked to determine if the target could possibly be a word in the L2. The stimuli were divided into four conditions according to English orthographic constraints and letter positional frequencies as follows: legal high (the letter positional frequency was high and the letter combinations were legal), illegal high (the letter positional frequency was high but the letter combinations were illegal), legal low (the letter positional frequency was low but the letter combinations were legal), and illegal low (the letter positional frequency was low and the letter combinations were illegal). The two groups under comparison were a Chinese as L1 group—a group assumed to utilize a dominant visual strategy—and a Korean as L1 group—a group assumed to utilize a dominant phonological recoding strategy. Koda predicted that the L1 Korean group would be more sensitive to letter cluster distribution. The groups performed similarly when the positional frequency of letters was high, irrespective of the legality of the letter combinations. In the low frequency condition, the L1 Chinese group's scores decreased more in the illegal condition than those of the L1 Korean group. Koda interprets this decrease as evidence that Korean L1 ESL readers were transferring their L1 intraword analysis awareness to L2 while L1 Chinese ESL readers who did not engage in this process in L1, likewise did not engage in this process in L2.

Muljani, Koda, and Moates (1998) also found intraword analysis transfer effects for ESL learners with L1 Indonesian as compared with ESL learners with L1 Chinese. For example, Muljani, Koda, and Moates (1998) manipulated word frequency in English and letter combination congruency between English and Indonesian to create four sets of stimuli. The stimuli were high-frequency congruent, high-frequency incongruent, low-frequency congruent, and low-frequency incongruent. The participants were asked to perform a lexical decision task. The effect of congruency was significant for the L1 Indonesian group. (The findings for frequency will be presented in the section addressing L2 print experience below.) The significant effect of congruency for the L1 Indonesian group was attributed to the transfer of L1 intraword structural knowledge to L2. The conclusion follows that this intraword structural knowledge was not available to the L1 Chinese group, as it is not a process required by their L1 orthography.

In a comparison of two languages of the same orthographic typology, Beauvillain (1992) also found intraword analysis to be important. Beauvillain (1992) reported on his investigations that tested for intraword sensitivity in a lexical decision task completed by French-English bilinguals. Beauvillain manipulated the frequency of bigram and trigram frequencies in French and English to create stimuli that were language specific, that is, orthographically constrained to only one of the two languages, or language non-specific, able to occur in either language. He found that French-English bilinguals responded more quickly to language specific words than to non-specific words. In order to minimize the role of phonological recoding for non-specific words in the non-target language, Beauvillain devised specific and non-specific stimuli that shared the same number of lexical subset candidates (words sharing all the letters

at the same positions except for one with the stimulus word). For example, a French specific word would have only five lexical subset candidates in French while a French non-specific word might have two lexical subset candidates in English and three in French. When the number of lexical subset candidates was controlled, reaction times for specific and non-specific words did not differ. Beauvillain interpreted these results as indicating that it is the orthographic representation of a word that determines its lexical subset, and the number of candidates in the lexical subset is responsible for the amount of time required to recognize a word. Thus, if two languages are orthographically similar and share some letter combinations, the intraword analysis processes used in one language that would generate a subset of lexical candidates for that language cannot be inhibited and the entire lexical subset of candidates will include words from both languages. In other words, transfer of orthographically similar information is inevitable when two languages possess similarities with respect to letter combinations.

In a similar experiment, Vaid and Frenck-Mestre (2002) found that orthographic markedness speeded word recognition for French-English bilinguals for whom English was their second language. Vaid and Frenck-Mestre (2002) used stimuli that contained digram frequencies unique only to French, unique only to English, and those that were shared between languages. The participants were asked to decide if the letter string was a word in French or in English. Only the identification of the marked or language specific digrams in English, the L2, were accelerated. Thus, the participants were relying on a perceptual strategy of intraword analysis acquired in L1 to facilitate word recognition in L2.

Wade-Woolley (1999) also finds in favor of L1 transfer of strategies in an orthographic knowledge task despite the fact that her results are contrary to those previously mentioned. Wade-Woolley (1999) conducted an experiment that involved a number of tasks, one of which was an orthographic acceptability judgment task for pseudowords in English. Her participants were an L1 Russian group and an L1 Japanese group. In this experiment, Japanese participants were found to be faster and more accurate in making orthographic acceptability judgments than Russian participants. While Russian is an alphabetic script similar in orthographic depth to English (Wade-Woolley, 1999), Japanese, on the other hand, uses two scripts, a syllabary and a logography. It would seem that given its L1 background, the Russian group should be more sensitive to intraword analysis and thus have faster response times, but this was not the case. Wade-Woolley (1999), however, still found evidence for L1 transfer by asserting that the Japanese L1 group's experience with Kanji might have fostered "an awareness of holistic orthographic patterns that is transferred to English-language processing" (464). Essentially, she claims that learning Kanji requires greater attention to visual detail and this attention to detail was transferred to L2 (Wade-Woolley, 1999).

In contrast, Abu-Rabia (2001) did not find in favor of L1 transfer of intraword sensitivity to specific letter combinations. In one task, his L1 Russian EFL readers were asked to decide which of a pair of pronounceable English pseudowords could be a legal word in English. They were also asked to do this task in Russian. In this case, the orthographic skill of sensitivity to legal letter combinations in L1 was not found to transfer to L2. Abu-Rabia found that letter combination sensitivity was language specific and, therefore, suggests that it can only be developed in L2 through increased print exposure in L2.

The second type of variable manipulation involves manipulation of the regularity of the grapheme to phoneme relationship. A regular grapheme to phoneme relationship is one in which the phonological code can be assembled easily through the application of grapheme to phoneme correspondence rules. Alternatively, an irregular grapheme to phoneme relationship is one in which the application of grapheme to phoneme correspondence rules does not result in the appropriate phonological code for the word. As a consequence, L2 readers who are accustomed to applying consistent grapheme to phoneme correspondence rules in L1 will attempt to transfer this strategy to L2. To exemplify, Koda (1988) tested ESL readers with L1 Japanese, L1 Spanish, and L1 Arabic. Spanish and Arabic are both languages that are considered orthographically shallow as compared to English while Japanese is considered orthographically deep. In a lexical decision task, Koda asked participants to decide which word of a pair was a real word when one word was real and the other was a pseudohomophone. Additionally, in an orthographic acceptability judgment task, she asked participants to decide which word of a pair could be a word in English when one word was a pseudohomophone and the other was a nonsense word. While all

groups spent more time on the orthographic acceptability judgment task, which required applying grapheme to phoneme correspondence rules, the Japanese group showed the greatest increase in time between the two tasks. Koda (1988) concluded that this was due to the fact that they were unable to utilize their well-developed visual processing strategy from L1 to assist in this task since neither letter string was a real word and the task depended solely on the ability to apply grapheme to phoneme correspondence rules.

In opposition to Koda's (1988) findings, however, Akamatsu (2002) was not able to find an L1 transfer effect that either facilitated or hindered the use of grapheme to phoneme correspondence rules in L2. Akamatsu used a naming task in which his L1 Chinese, L1 Japanese, and L1 Persian participants were asked to name one of four types of English words—high frequency regular, high frequency irregular, low frequency regular, and low frequency irregular. Persian participants who are accustomed to an alphabetic script with a shallow orthography could presumably be expected to name regular words faster than other groups if they were transferring their L1 strategy; while Chinese participants and Japanese participants might be expected to name irregular words, particularly of high frequency, faster if they would be utilizing their L1 visual whole word strategy. The results indicated that the groups all performed similarly and that word frequency was the most important variable in determining naming speed. Akamatsu (2002) attributed his inability to find L1 orthographic transfer effects to three possible sources: his use of real words instead of pseudowords (many other researchers use pseudowords in this type of experiment), the relatively high L2 reading proficiency of his participants, and the universal direct access hypothesis which claims that the basic mechanism for word recognition is the same in all languages.

Wang, Koda, and Perfetti (2003) also investigated the application of grapheme to phoneme correspondence rules by ESL learners. Their participants were L1 Chinese and L1 Korean. One of two tasks used was a semantic category judgment task. The participants saw a category name and were then shown a target word and asked to decide if the target word was a member of the designated category or not. The target words were manipulated in the following four ways to test the strategies used by the L2 readers: a similarly spelled homophone to the category exemplar (i.e., 'beech' when the exemplar is 'beach'), a similarly spelled control to the category exemplar (i.e., 'bench' when the exemplar is 'beach'), a less similarly spelled homophone to the category exemplar (i.e., 'bare' when the exemplar is 'bear'), and a less similarly spelled control to the category exemplar (for example, 'beat' when the exemplar is 'bear'). Wang, Koda, and Perfetti hypothesized that if participants responded 'yes' more often to homophone trials, then it would provide evidence of the activation of a grapheme to phoneme correspondence strategy. Correspondingly, if there were more false positives to spelling controls, the words were being processed via a whole-word strategy. Koreans were found to make more errors in judging homophone foils than spelling controls, which suggests that they were utilizing the L1 developed strategy of applying grapheme to phoneme correspondence rules. Chinese were more affected by spelling similarities than the Koreans, which in turn suggests their reliance on a visual-whole-word strategy that may make them less attentive to minor visual differences.

The third type of variable manipulation, disruption in recognition due to visual interference, has been tested in two ways. One way is through case alternation. If L2 readers are accustomed to computing letter sequences in an alphabetic L1, then their computation in an alphabetic L2 should not be disrupted by the alternation of cases (Akamatsu, 1999). If, on the other hand, their L1 doesn't require the computation of letter sequences, then their L2 computational process should be negatively affected by the alternation of cases (Akamatsu, 1999). The task for this disruption manipulation was a naming task in English and the participants were of L1 Chinese, L1 Japanese, L1 Persian, and L1 English backgrounds. There were four types of stimuli—high frequency regular, high frequency irregular, low frequency regular, low frequency irregular—each presented once in lower case and once in alternated case. Participants took the test in two sessions so that the same word only appeared once in each session. Native speakers of English were not affected by case alternation. All non-native groups were affected by case alternation with regard to reaction time and accuracy. The Chinese and Japanese groups' reaction times were more affected by case alternation than the Persian group and the accuracy of the Chinese and Japanese groups was also more affected by case alternation in the naming of low frequency irregular

words. These results led Akamatsu (1999) to conclude that the L1 Persian group was transferring its more efficient alphabetic processing strategy from L1 which allowed it to be less detrimentally affected by case alternation in L2. The Chinese and Japanese, however, were not able to transfer such a strategy and this was shown by the decrease in their performance when the visual stimuli were altered.

Jackson, et al. (1999) also utilized mixed case stimuli in a timed reading task performed by EFL readers with L1 Mandarin who learned L1 using Zhuyin Fuhao (a quasi-alphabetic approach), L1 Cantonese who in learning L1 began directly with characters, and L1 Korean, a non-linear shallow orthographic orthography. They found that the L1 Cantonese group was less affected by case alternation than the other groups though they were more affected than adult or adolescent native English speakers. Jackson, et al. (1999) attributed the difficulty of L1 Mandarin and L1 Korean groups to a lack of efficiency in processing the Roman alphabet and specific letter patterns of English. The L1 Cantonese group did not experience as much difficulty because they had more exposure to printed L2. Because neither of the groups that had experience with an alphabetic system in the learning of L1 were facilitated in the recognition of L2 mixed case text, Jackson, et al. (1999) theorized that the transfer of L1 orthographic strategy is not as important as exposure to L2 print.

At least two experiments have investigated the effect of visual interference on L2 printed word recognition in languages other than English (Sun, 1991 in Chitiri, Sun, and Willows, 1992; Chikamatsu, 1996). Chitiri, Sun, and Willows (1992) reported on an investigation conducted by Sun (1991) in which Chinese was the target language. The participants were asked to decide in a serial presentation if the second character (test item) was the same as the first (target item). Half of the test items were real words that resembled the target item graphically, phonologically, or semantically. The participants also performed a task that required them to read sentences and decide if they were valid or not. In half of the sentences, one character had been replaced by another character that graphically, phonologically, or semantically resembled the target, but made the sentence invalid. The participants were an L1 Chinese group, a non-native high proficiency group, and a non-native low proficiency group. In the same/different task, the main differences between groups occurred in the graphically similar condition. The L1 Chinese group performed best, followed by the high proficiency group, and finally, the low proficiency group. The reverse was true in the second task requiring a decision regarding the validity of a sentence; the L1 Chinese group and the high proficiency group were more affected by graphic foils that the low proficiency group. Chitiri, Sun, and Willows (1992) interpreted the results of task 1 as evidence that automatization of the processing of visual information increases with experience. As for the results of task 2, they concluded that higher proficiency groups were more focused on higher level meaning based processes and are as a consequence, less attentive to word level information. The automatization of the processing of lower level visual information had, in essence, freed up the higher proficiency readers to utilize higher level processes. In addition to experience, another possible interpretation of the findings of task 1 could be that the L2 low proficiency group was transferring an inefficient L1 phonological processing strategy. Since the L1 of the non-native groups was not specified, this interpretation is purely speculative.

Chikamatsu (1996) also employed visual interference in a language other than English, namely, Japanese. Chikamatsu (1996) used a lexical decision task to compare reaction times of American and Chinese JFL learners. Because Japanese has three scripts, Chikamatsu (1996) was able to visually distort words by writing a pronounceable version of a word normally written in Hiragana in Katakana, or, conversely, by writing a pronounceable version of a word normally written in Katakana in Hiragana. (He did not use Kanji in this experiment.) His prediction, based on the respective L1 dominant strategies of the two groups, was that the Chinese who rely on a predominantly visual strategy would have slower reaction times than the Americans when a word appeared in an unfamiliar script. He also predicted that Americans would slow down more in the non-word condition due to their L1 dominant phonological recoding strategy. Chinese participants did, in fact, demonstrate a more marked effect in the unfamiliar condition, but both groups performed similarly in the non-word condition. Chikamatsu (1996) concluded that the significant increase in reaction times for Chinese participants in the unfamiliar condition was evidence of their dependence on an L1 visual strategy. When their whole word search strategy failed, then

they would use phonological recoding, but this resulted in longer reaction times. The fact that groups were similar in the non-word condition was attributed to the nature of the task, which would have required both groups to rely on phonological recoding. Clearly, the majority of research involving the manipulation of orthographic variables indicates that L2 readers do attempt to transfer their dominant L1 strategy.

The Effectiveness of a Non-Native Orthographic Strategy in L2

The second major research question regarding the effectiveness of the transfer of an L1 orthographic strategy has been investigated indirectly through the results of experiments that have attempted to establish whether the transfer of strategies exists. There is evidence to support the position that the transfer of L1 strategies is useful and effective. For example, Koda (1999) compared the results of her ESL readers with those of native speakers and found that sensitivity to letter sequences was a distinguishing factor between native and non-native readers. Non-native readers who are able to transfer some intraword analysis and letter combination sensitivity should have and do have an advantage when learning English, a fact that is also supported by the research of Muljani, Koda, Moates (1998). Part of the effectiveness of an L2 reader may lie in an ability to limit the lexical subset of candidates in the process of word recognition by a sensitivity to language specific letter combinations when both languages are alphabetic. A reader who immediately knows that a word is specific to one and only one language will recognize words faster in L2 as the research of Beauvillain (1992) and Vaid, et al. (2002) has shown. This thereby demonstrates that the transfer of L1 intraword sensitivity has enhanced L2 printed word recognition. Visual attention to detail may also be a product of positive L1 transfer as Wade-Woolley (1999) suggests in her assertion that Japanese learners are more sensitive to L2 letter combinations because of the transfer of their visual processing strategy from L1.

Of course, there is also evidence to support the position that the transfer of L1 strategies is detrimental and inhibits effective L2 word recognition. Koda (1988) found that Japanese ESL learners were more impaired when judging the orthographic acceptability of pseudohomophones than Arabic and Spanish ESL learners. Their dominant L1 strategy of visual processing did not positively transfer to the demands of the task. Likewise, inexperience with the type of computational analysis of graphemes that occurs in alphabetic languages inhibits ESL readers with non-alphabetic backgrounds from utilizing a more effective processing mechanism in L2 (Akamatsu, 1999). Even when it would seem that the transfer of an alphabetic strategy is possible as with L1 Mandarin and L1 Korean ESL learners, lack of experience with processing a linear Roman alphabet may prohibit any positive transfer (Jackson, et al., 1999). When the L2 is not English and is not alphabetic, L1 orthographic strategy transfer can still prove detrimental as was the case for Chinese JFL learners in Chikamatsu (1996).

The Effect of L2 Print Experience on L2 Orthographic Strategies

The third research question pertaining to orthography and printed word recognition in L2 addresses the role of L2 print experience. Some of the previously discussed experiments have included word frequency in L2 as a variable and have found that it is a major factor in L2 word recognition (Akamatsu, 2002, 1999; Muljani, Koda, & Moates, 1998). As in L1, the connection between an L2 printed word and its lexical entry grows stronger through repetition. This is true even when L1 and L2 are orthographically different. The aforementioned experiments included ESL readers with L1 Chinese, L1 Japanese, L1 Persian, and L1 Indonesian backgrounds, and the effect for word frequency in L2 was pronounced for all groups (Akamatsu, 2002, 1999; Muljani, Koda, & Moates, 1998). ESL learners have also demonstrated sensitivity to letter position frequency, which is attributed to L2 print experience (Koda, 1999). L1 Chinese and L1 Korean ESL readers were more affected by positional frequency than letter sequence legality (Koda, 1999). Koda's ESL learners were more likely to judge a word possible when the letters were in high frequency positions, but the letter combinations were illegal. Thus, they were less attentive to letter combination legality and more affected by positional frequency, which is a perceptual base acquired in L2 via L2 print processing experience (Koda, 1999). Jackson, et al. (1999), in

a finding that did not support the transfer of L1 orthographic strategy, hypothesized that the superior performance of their L1 Cantonese EFL readers relative to L1 Mandarin and L1 Korean EFL readers was due to more prolonged L2 exposure and greater L2 print experience. The L1 Cantonese group had begun formal English studies earlier in their educational system and had more exposure to English in their society. Though the transfer of L1 strategies is clearly important in printed L2 word recognition processes, the findings of Akamatsu (2002, 1999), Muljani, Koda, & Moates (1998), Koda (1999), and Jackson, et al. (1999) make a strong case for the importance of L2 print experience as well.

Alteration of the L1 Cognitive Mechanism that Controls Word Recognition Strategies

The fourth and final research question in the area of orthography and L2 printed word recognition deals with the possibility or impossibility of modifying the L1 cognitive mechanism that has been developed through exposure, use, and practice for processing the orthography of L1. Some studies like the one by Sun (1991) reported in Chitiri, et al. (1992) suggest that, over time, L2 processing strategies may become more native-like. (Sun's high proficiency L2 group behaved more like the native speaker group than the low proficiency group did.) Doctor and Klein (1992) also found in a longitudinal study of a bilingual English-Afrikaans child, who initially relied on a poorly established visual word recognition system in both languages, some evidence of the adoption of a more native-like process for Afrikaans word recognition after two years. The child's reading of Afrikaans words and non-words improved, which suggested that she was applying the more consistent grapheme to phoneme correspondence rules that govern Afrikaans. However, it is not clear if these changes are due to greater L2 print experience or an actual change in strategy. Akamatsu (1998, 1999) believes that once an L1 cognitive mechanism for word recognition is established, it cannot be modified to accommodate more efficient strategies in L2. The conclusions of Wade-Woolley (1999) and Koda (1999), namely, that accuracy is not compromised due to the use of non-native strategies, would seem to support Akamatsu's position. Thus, strategy modification is in large part an area that remains unexplored and unexplained.

DIRECTIONS AND CONSIDERATIONS FOR FUTURE RESEARCH

Although certain questions such as whether L1 processing strategies transfer to L2 have received considerable attention, there is still much in the field of L2 word recognition that remains unexplained. As the previous sections on the roles of phonology and orthography indicate, L1 does play an important role in determining how L2 readers approach the task of word recognition; but much of the research continues to suggest that L1 alone is not solely responsible. As example, L2 readers whose L1 did not predispose them to phonemic awareness were nonetheless able to achieve accuracy levels similar to those of L2 readers whose L1 did predispose them to phonemic awareness (Koda, 1998; Holm & Dodd, 1996). This finding of comparable accuracy in tests where L1 experience would predict an obvious advantage for one group over another clearly indicates the need for continued research in the field of printed word recognition, as well as the need for continued effort in the development of tasks that are able to effectively measure procedural differences among readers. As a result, based on (a) the findings of the literature reviewed, (b) suggestions offered by the researchers of this literature, and (c) analysis of the total picture that emerges when all of these factors are synthesized, the following seven areas appear to merit further research and consideration: longitudinal analysis, linguistic knowledge, qualitative data collection and analysis, task development, the role of instruction, increased variation in the L1s and L2s compared, and the role of sociolinguistic factors. Each of these areas will be discussed in turn in the following sections.

Longitudinal Analysis

As L2 readers acquire more print experience with L2 and more automatized connections between high frequency words and their lexical connections, one possible result is that L2 readers will alter their use of L1-based processing strategies to accommodate more effectively the demands of L2 orthography.

Koda (1996) points out that systematic longitudinal analysis is one way to ascertain if initial differences in efficiency with regard to L2 word recognition skills found in learners with typologically different L1 backgrounds can be altered. As Koda indicates, the results of such studies have three possible results: a) L2 learners with an L1 background that is not orthographically similar to the target L2 will, over time, acquire the processes used by efficient readers and will, accordingly, achieve proficiency similar to that of L2 learners whose L1 experience initially gave them an advantage in the target L2; b) L2 learners whose L1 is more similar to the target L2 will always enjoy a processing advantage; or c) L2 readers with a typologically different L1 will achieve proficiency similar to that of efficient readers using processes different than those utilized by L1 readers of the target language.

By means of longitudinal testing and analysis, researchers could gain insight into the exact nature of the cognitive processing mechanism associated with word recognition. Namely, they could come closer to answering the question of whether this mechanism is, in fact, alterable once it has been set in L1. Certain researchers have suggested that the cognitive processing mechanism established in L1 cannot be altered (e.g., Akamatsu, 1999), while other researchers have simply left this question open (Wade-Woolley, 1999). Research studies that followed the same L2 readers over time and tested them at regular intervals would provide data that could indicate what, if any, changes occurred in processing strategies. At present, the available data are only able to suggest strategic preferences for a given set of L2 learners at a specific point in their L2 acquisition process. While the groups within each individual experiment are carefully tested and screened to ensure comparable proficiency levels in L2, it is virtually impossible to compare groups between experiments. Consequently, the findings of a preference for a visual strategy for group X when learning language Y in one experiment may or may not correlate with the findings for group X and language Y in another experiment. One way that researchers have attempted to conduct what can be called quasi-longitudinal research is by testing groups of differing proficiency levels with the same tasks, as was the case with Sun (1991). One of the inherent problems with this sort of testing is that there may be differences or similarities between the groups that are not accounted for by the research design, such as instructional methods. As a result, groups may appear different or similar with regard to how they approach specific tasks, but the conclusions drawn from these similarities or differences may be questioned on the grounds that the groups represented more than just simply two different proficiency levels. In addition, adopting the quasi-longitudinal approach of testing different proficiency levels within one study does not allow for researchers to record subtle changes in strategy over time and, as a consequence, researchers are unable to propose a model of the development of processing strategies over time. Since proficiency in the acquisition of L2 skills has traditionally been seen as closely related to time—when time equals experience and exposure to the L2—research designs, therefore, that incorporate time as one of the variables would not only be acknowledging the contribution of time to changes in skill levels, and perhaps choice of strategies, they would also be able to contribute significantly to our knowledge of how, when, and why any observed changes do occur.

Linguistic Knowledge

Just as L1 transfer alone does not account for word recognition skill in L2, neither does linguistic knowledge. Koda (1996) calls for research that establishes the following: a) which specific aspects of linguistic knowledge are the ones needed for efficient processing; b) what distinguishes the acquisition of these aspects of linguistic knowledge from the acquisition of other aspects of linguistic knowledge; and, c) which variables contribute to the effective use of specific linguistic knowledge during word recognition. The issue of identifying which specific aspects of linguistic knowledge are the ones needed for efficient processing has received some attention in studies that look at phonemic awareness, intraword analysis, and differences in grapheme to phoneme correspondence between L1 and L2. However, the issue of what distinguishes the acquisition of these aspects from others has not been addressed, and the issue of which variables contribute to the use of specific linguistic knowledge has only been hinted at by studies such as Mori (1998) and Koda (1998) who both observed procedural differences, but were unable to explain them. Indeed, more studies like Koda (1999), who was able to determine that the ability to

reject illegal letter sequences was a critical factor distinguishing native readers from non-native readers, are needed. Also for future research, studies like Koda (1999) that look at which types of linguistic knowledge differentiate between native readers of the target L2 and non-native readers of the L2 could provide insight into the specifics of what linguistic knowledge is used by native readers of the target L2 and how much the lack of this knowledge affects L2 readers. Additionally, these studies could provide some directions for pedagogy in terms of which types of linguistic knowledge should be stressed.

Qualitative Data Collection and Analysis

As is the case with most psycholinguistic research, quantitative procedures have been the ones predominantly utilized for exploring printed word recognition in L2. Only two of the studies reviewed gave evidence of having used any qualitative procedures in their testing, Koda (1998) and Mori (1998). In both of these studies, the addition of data collected via qualitative techniques was able to confirm that L2 readers were aware of either employing a specific strategy (Koda, 1998) or noticing specific information (Mori, 1998). Koda (1996) herself acknowledged the need for the use of procedures that can measure both quantitative and qualitative variations in conjunction. Because several quantitative experiments have observed that participants of different L1 backgrounds can achieve similar accuracy despite differences in processing strategies, it would seem that the obvious next step would be to employ qualitative techniques to explore which steps or strategies L2 readers are aware of utilizing. Data collected via qualitative techniques, when combined with quantitative results, could provide a more complete picture of the processes at work during L2 word recognition and the development of these processes. Quite possibly, the qualitative data might reveal that processing differences are more individual than language specific, or that the processes vary due to instructional methods, or that the processes are influenced by factors that have yet to be considered. In any case, the inclusion of qualitative information that results from sustained researcher interaction with, and observation of, participants could add insights to the field of L2 word recognition, which could not be gained through quantitative techniques.

Task Development

The tasks used by the studies reviewed represent, for the most part, uniformity and adherence to techniques that have become universally established and accepted in the field of psycholinguistics. Yet, this fact that the tasks utilized are considered established and accepted in no way indicates that they are above scrutiny. In fact, there are several issues that are debated and should be considered in the course of task development. One of these issues is the testing of word recognition through the use of decontextualized, isolated words. For instance, Chikamatsu (1996) maintains that testing words in isolation has shown a strong correlation with reading skill, while Jackson, et al. (1999), proposes that testing word identification in context is important because it allows hypotheses about L2 word recognition to be tested under conditions that approximate normal reading. Another task related issue in the testing of L2 word recognition is the use of pseudowords versus real words. Many of the studies reviewed used pseudowords in their tasks as a way to see how L2 readers dealt with unfamiliar words; however, Akamatsu (2002) used real words and his results did not support the transfer of L1 strategies to L2. Akamatsu conjectured that one possible reason was his use of real words as opposed to pseudowords. As he argued, perhaps pseudowords do not really reflect word recognition processes since they are not connected to any real lexical entries. To sum up, the choice of task and the construction of the task can have a major impact on the results obtained and the generalizability of those results. If tasks elicit findings that are more the result of the demands of the task than the underlying cognitive processes, then the results of the tasks do not contribute to our overall understanding of L2 word recognition. For this reason, future research should consider carefully both the issues and means, such as the use of words in isolation and pseudowords, when constructing tasks.

Other methodological issues related to task development have also been raised by researchers. For instance, the problem of task equality when an L2 reader's performance in both L1 and L2 are being tested is one discussed by Gholmain and Geva (1999) and Geva and Siegel (2000). As they pointed out, it

is very difficult to create tasks in both languages that are equal in every aspect. A word that has two syllables in one language and a high grapheme to phoneme correspondence may have three syllables in the other language and a low grapheme to phoneme correspondence. Obviously, researchers cannot take into account all these differences in their choice of stimuli; although, in the event that there are extreme differences in the respective complexity of words, it would seem prudent to consider this difference as a factor that might affect any results acquired in testing procedures.

The Role of Instruction

There are essentially two topics within the area of the role of instruction that merit further consideration. The first of these is the role of instruction prior to the testing and the second is the use of instructional methods as a part of the experimental procedure. Though many of the studies reviewed did not mention the role of instruction, there were a few studies that discovered possible roles that instructional methods may have played in the results (Jackson, et al., 1999; Akamatsu, 1998). Akamatsu, for example (1998), provides a thorough description of the history of the teaching of both Japanese and English in Japan. From his description, it becomes clear that the choice of a visual strategy for the processing of Kanji is not only a matter of orthographic determination, but is also an instructional method. As evidence of this, repetition drills that involve the repeated writing of Kanji characters are favored in the teaching of Kanji. Instructional methods for L1 have influenced the teaching methods for English as a Foreign Language and, consequently, the learning styles of Japanese students. Clearly, the types of tasks used thus far to test for word recognition in L2 would not have been able to distinguish how much of the choice of processing strategy was due to the orthography of L1 and how much was due to instructional methods in L1 or L2. Future research, then, should describe and consider the roles that instructional methods may have played in the choice of processing strategies utilized by L2 readers. The most practiced strategy—due to L1 orthographic experience or L2 instructional methods—will be the one that L2 learners are most likely to use.

Despite the fact that research in an area such as L2 printed word recognition, which falls under the umbrella of second language acquisition (SLA), is (or should be) used to inform pedagogical practices, it seems at times that the two fields do not see themselves as connected in any way. Very few of the studies reviewed even mentioned the pedagogical implications of the results of their research, and not one of the studies attempted to see how instruction in strategies or skills that were used by native readers of the target L2 affected the development of non-native readers of the L2. This question of the relation of pedagogical practices to strategy and skill development is not a new one. Segalowitz (1986) pointed out the need to determine how training in word recognition instead of reading strategies might improve the reading speed of L2 learners. While the consensus of researchers is that word recognition is a crucial component of the reading comprehension process, very little (or perhaps nothing) has been done to determine how or even if word recognition can be enhanced by overt instructional methods. Future longitudinal experiments should consider including specific instructional methods as a treatment variable. Results that included both time and instruction as variables could provide valuable information to both the fields of SLA and foreign/second language pedagogy.

Increased Variation in the L1s and L2s Compared

The majority of research conducted in L2 printed word recognition tests learners of ESL or EFL. Very few of the experiments look at L2 learners of any other languages. There are a few notable exceptions to this rule in Mori (1998), Everson (1998), and Chikamatsu (1996). One of the problems with using only one L2 as the basis for all hypotheses concerning L2 printed word recognition is the orthographic nature of the L2 itself. As mentioned in prior sections of this review, the L2 interacts with L1 processing strategies and influences the choices L2 readers make with regard to strategies. For example, English is not considered a shallow language. There are many words that cannot be pronounced simply by applying grapheme to phoneme correspondence rules, which has led some researchers like Koda (1999) to speculate that L2 readers of an L1 morphographic background are still able to use their

dominant visual processing strategy quite effectively in L2 English. None of the studies reviewed tested L2 readers of an L1 morphographic background in a language that is considered orthographically shallow. Likewise, none of the studies that looked at L2 readers of a morphographic target language tested participants whose L1 background was orthographically shallow. Thus, the nature of English orthography itself may be a confounding factor in many of the experiments reviewed. Future research should seek to test a wide variety of learners with different L1 backgrounds as well as a variety of target L2s, so that conclusions drawn from studies can be compared and assessed for generalizability.

Role of Sociolinguistic Factors

Notwithstanding the fact that L2 printed word recognition research is primarily a psycholinguistic endeavor, some attention should be given to the role that sociolinguistic factors may play in influencing psycholinguistic processes. In sociolinguistics it is commonly acknowledged that factors such as language prestige, gender, etc., play an important role in shaping the L2 acquisition processes. It would be interesting to consider how a factor like language prestige or perceived language prestige might influence the choice of cognitive processing strategies. If L2 learners perceive the L2 as more prestigious than their L1, might they abandon the dominant L1 cognitive processing strategies more easily in favor of those processing strategies used by native speakers of the more prestigious language? Or, would they hold on to processing strategies even when they appear to be ineffective simply out of a desire to identify with the L1 language and culture? The interaction of psycholinguistic processes and sociolinguistic factors would not be an easy one to tease out via traditional research approaches. Research in this area would require creativity and flexibility. Researchers would most assuredly need to combine quantitative and qualitative techniques in a longitudinal study in order to attempt to address the interactions of psycholinguistic processes and sociolinguistic factors. Despite the difficulty, analysis in this area could help determine just how much one's cognitive processes are amenable to alteration and choice.

In conclusion, the purpose of this review has been to synthesize the knowledge that has been acquired in the area of L2 printed word recognition and to provide ideas for directions for future research in this area. Ostensibly, our knowledge of L2 word recognition processes at present is incomplete. A great deal of research supports the transfer of L1 processing strategy preferences, yet, there are many questions that remain unanswered regarding discoveries of similar accuracy despite procedural differences. In addition, many of the studies can be critiqued on the grounds that they are not generalizable to all languages since the majority of studies have used English as the L2. The studies that have been completed thus far do provide the beginnings of a knowledge base from which future studies can position themselves and refer to for comparative purposes. While the two aspects of L2 printed word recognition that have received the most attention are the role of phonology and the role of orthography, neither of these areas has been exhausted in terms of research potential. In fact, combinations of studies that address the role of orthography or phonology along with one of the future directions for research ideas mentioned above, such as longitudinal analysis, could yield significant results and critical contributions to what is already known about each area. In sum, L2 printed word recognition is an area about which relatively little is known despite the fact that word recognition is seen as a crucial step in L2 reading comprehension. Further research in this area would not only contribute to the development of psycholinguistic L2 processing models, but would also contribute to other fields including, but not limited to, the pedagogy of foreign and second languages.

REFERENCES

Abu-Rabia, S. (2001). Testing the interdependence hypothesis among native adult bilingual Russian-English students. *Journal of Psycholinguistic Research, 30*(4), 437-455.

Akamatsu, N. (1998). L1 and L2 reading: The orthographic effects of Japanese on reading English. *Language, Culture and Curriculum, 11*(1), 9-27.

Akamatsu, N. (1999). The effects of first language orthographic features on word recognition processing in English as a second language. *Reading and Writing, 11*(4), 381-403.

Akamatsu, N. (2002). A similarity in word-recognition procedures among second language readers with different first language backgrounds. *Applied Psycholinguistics, 23*(1), 117-133.

Beauvillain, C. (1992). Orthographic and lexical constraints in bilingual word recognition. In R. J. Harris (Ed.), *Cognitive Processing in Bilinguals* (pp. 221-235). North-Holland: Elsevier Science Publishers.

Besner, D., & Hildebrandt, N. (1987). Orthographic and phonological codes in the oral reading of Japanese Kana. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13*, 335-343.

Besner, D., & Smith, M. C. (1992). Basic processes in reading: Is the orthographic depth hypothesis sinking? In R. Frost, & Katz, L. (Ed.), *Orthography, phonology, morphology, and meaning* (Vol. 45-66). Amsterdam: Elsevier.

Blederman, I. T., I.C. (1979). On processing Chinese ideographs and English words: Some implications from Stroop-test results. *Cognitive Psychology, 2*, 125-132.

Bowers, P. G. (1995). Tracing symbol naming speed's unique contributions to reading disabilities over time. *Reading and Writing: An Interdisciplinary Journal, 7*, 189-216.

Bowey, J. A., & Francis, J. (1991). Phonological analysis as a function of age and exposure to reading instruction. *Applied Psycholinguistics, 12*, 91-121.

Chiappe, P., & Siegel, L. S. (1999). Phonological awareness and reading acquisition in English- and Punjabi-speaking Canadian children. *Journal of Educational Psychology, 91*(1), 20-28.

Chikamatsu, N. (1996). The effects of L1 orthography on L2 word recognition: A study of American and Chinese learners of Japanese. *Studies in Second Language Acquisition, 18*(4), 403-432.

Chitiri, H., Sun, Y., Willows, D. M., & Taylor, I. (1992). Word recognition in second-language reading. In R. J. Harris (Ed.), *Cognitive Processing in Bilinguals* (pp. 283-297).

Coltheart, M. (1978). Lexical access in simple reading task. In G. Underwood (Ed.), *Strategies of information processing*. London: Academic Press.

Comeau, L., Cormier, P., Grandmaison, E., & Lacroix, D. (1999). A longitudinal study of phonological processing skills in children learning to read in a second language. *Journal of Educational Psychology, 91*, 29-43.

Cormier, P., & Kelson, S. (2000). The roles of phonological and syntactic awareness in the use of plural morphemes among children in French immersion. *Scientific Studies of Reading, 4*, 267-293.

Doctor, E. A., & Klein, D. (1992). Phonological processing in bilingual word recognition. In R. J. Harris (Ed.), *Cognitive Processing in Bilinguals* (pp. 237-252).

Durgunoglu, A. Y., Nagy, W.E., & Hancin-Bhatt, B. J. (1993). Cross-language transfer of phonological awareness. *Journal of Educational Psychology, 85*, 453-465.

Everson, M. E. (1998). Word recognition among learners of Chinese as a foreign language: Investigating the relationship between naming and knowing. *Modern Language Journal, 82*(2), 194-204

Feldman, L. B., & Turvey, M. (1980). Words written in Kana are named than the same words written in Kanji. *Language and Speech, 23*, 141-147.

Fender, M. (2003). English word recognition and word integration skills of native Arabic- and Japanese-speaking learners of English as a second language. *Applied Psycholinguistics, 24*(2), 289-315.

Frost, R. (1994). Prelexical and postlexical strategies in reading: Evidence from a deep and a shallow orthography. *Journal of Experimental Psychology: Learning, Memory and Cognition, 20*, 116-129.

Frost, R., Katz, L., & Bentin, S. (1987). Strategies for visual word recognition and orthographic depth: A multilingual comparison. *Journal of Experimental Psychology: Human Perception and Performance, 13*, 104-115.

Geva, E., & Siegel, L. S. (2000). Orthographic and cognitive factors in the concurrent development of basic reading skills in two languages. *Reading and Writing, 12*(1-2), 1-30.

Gholamain, M., & Geva, E. (1999). Orthographic and cognitive factors in the concurrent development of basic reading skills in English and Persian. *Language Learning, 49*(2), 183-217.

Glushko, R. J. (1979). The organization and activation of orthographic knowledge in reading aloud. *Journal of Experimental Psychology: Human Perception and Performance, 5*, 674-691.

Henderson, L. (1985). Issues in the modeling of pronunciation assembly in normal reading. In K. E. Patterson, Marshall, J. C., & Coltheart, M. (Ed.), *Surface dyslexia*. Hillsdale, NJ: Erlbaum.

Hirose, T. (1992). Recognition of Japanese Kana words in printing tasks. *Perceptual and Motor Skills, 75*, 907-913.

Holm, A. D., B. (1996). The effect of first written language on the acquisition of English literacy. *Cognition, 59*, 119-147.

Jackson, N. E., Chen, H., Goldsberry, L., Kim, A., & Vanderwerff, C. (1999). Effects of variations in orthographic information on Asian and American readers' English text reading. *Reading and Writing, 11*(4), 345-379.

Jared, D., & Seidenberg, M. S. (1991). Does word identification proceed from spelling to sound to meaning? *Journal of Experimental Psychology: General, 120*, 358-394.

Katz, L., & Frost, R. (1992). Reading in different orthographies: The orthographic depth hypothesis. In R. Frost & L. Katz (Eds.), *Orthography, phonology, morphology and meaning* (pp. 67-84). Amsterdam: Elsevier.

Kimura, Y. (1984). Concurrent vocal interference: Its effects on Kana and Kanji. *Quarterly Journal of Experimental Psychology, 36*, 117-131.

Koda, K. (1988). Cognitive process in second language reading: Transfer of L1 reading skills and strategies. *Second Language Research, 4*, 133-156.

Koda, K. (1989). Effects of L1 orthographic representation on L2 phonological coding strategies. *Journal of Psycholinguistic Research, 18*, 201-222.

Koda, K. (1994). Second language reading research: Problems and possibilities. *Applied Psycholinguistics, 15*, 1-28.

Koda, K. (1996). L2 word recognition research: A critical review. *Modern Language Journal, 80*(4), 450-460.

Koda, K. (1998). The role of phonemic awareness in second language reading. *Second Language Research, 14*(2), 194-215.

Koda, K. (1999). Development of L2 intraword orthographic sensitivity and decoding skills. *The Modern Language Journal, 83*(1), 51-64.

Koda, K. (2000). Cross-linguistic variations in L2 morphological awareness. *Applied Psycholinguistics, 21*, 297-320.

Lam, A., Perfetti, C. A., & Bell, L. (1991). Automatic phonetic transfer in bidialectal reading. *Applied Psycholinguistics, 12*, 299-312.

Lefrancois, P., & Armand, F. (2003). The role of phonological and syntactic awareness in second-language reading: The case of Spanish-speaking learners of French. *Reading and Writing, 16*, 219-246.

McCutchen, D., & Perfetti, C. A. (1982). The visual tongue-twister effect: Phonological activation in silent reading. *Journal of Verbal Learning and Verbal Behavior, 21*, 672-687.

Mori, Y. (1998). Effects of first language and phonological accessibility on Kanji recognition. *Modern Language Journal, 82*, 69-82.

Muljani, D., Koda, K., & Moates, D. R. (1998). The development of word recognition in a second language. *Applied Psycholinguistics, 19*(1), 99-113.

Nas, G. (1983). Visual word recognition in bilinguals: Evidence for cooperation between visual and sound based codes during access to a common lexical store. *Journal of Learning and Verbal Behavior*(22), 525-534.

Navron, D., & Shimron, J. (1984). Reading Hebrew: How necessary is the graphemic representation of vowels? In L. Henderson (Ed.), *Orthographies and reading: Perspectives from cognitive psychology, neuropsychology, and linguistics* (Vol. 91-102). Hillsdale, NJ: Erlbaum.

Patterson, K. E., & Morton, J. (1985). From orthography to phonology: An attempt at an old interpretation. In K. E. Patterson, Marshall, J. C., & Coltheart, M. (Ed.), *Surface dyslexia*. Hillsdale, NJ: Erlbaum.

Perfetti, C. A., & Zhang, S. (1991). Phonological processes in reading Chinese characters. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 17*, 633-643.

Perfetti, C. A., & Zhang, S. (1995). Very early phonological activation in Chinese reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 24-33.

Perfetti, C. A., Beck, I., Bell, L.C., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: a longitudinal study of first grade children. *Merrill-Palmer Quarterly, 33*, 283-319.

Perfetti, C. A., Zhang, S., & Berent, I. (1992). Reading in English and Chinese: Evidence for a "universal" phonological principal. In R. a. K. Frost, L. (Ed.), *Orthography, phonology, morphology, and meaning*. Amsterdam: Elsevier.

Rayner, K. P., A. (1989). *The psychology of reading*. Englewood Cliffs, NJ: Prentice-Hall.

Rosson, M. B. (1985). The interaction of pronunciation rules and lexical representation in reading aloud. *Memory and Cognition, 13*, 90-99.

Sasanuma, S. (1984). Can surface dyslexia occur in Japanese? In L. Henderson (Ed.), *Orthographies and reading: Perspectives from cognitive psychology, neuropsychology and linguistics* (pp. 43-56). Hillsdale, NJ: Erlbaum.

Segalowitz, N. S. (1986). Skilled reading in the second language. In J. Vaid (Ed.), *Language processing in bilinguals: Psycholinguistic and neurological perspectives* (pp. 3-19). Hillsdale, NJ: Erlbaum.

Seidenberg, M. S. (1985). The time course of phonological code activation in two writing systems. *Cognition, 19*, 1-30.

Sinamura, A. P. (1987). Word comprehension and naming: An analysis of English and Japanese orthographies. *American Journal of Psychology, 100*, 15-40

Stanovich, K. E. (1982). Word recognition skill and reading ability. In M. H. Singer (Ed.), *Competent reader, disabled reader: Research and application* (pp. 81-102). Hillsdale, NJ: Erlbaum.

Stanovich, K. E. (1991). Word recognition: Changing perspectives. In R. Barr, M. Kamil, P. Mosenthal & P. D. Pearson (Eds.), *Handbook of reading research, Vol. II* (pp. 418-452). New York: Longman.

Sun, Y. L. (1991). *Word recognition processes of second language readers of Chinese.* Paper presented at the International Conference on Second Language Acquisition in the Chinese Context, Hong Kong.

Turnage, T. W., & McGinnies, E. (1973). A cross-cultural comparison of the effects of presentation mode and meaningfulness on short-term memory. *American Journal of Psychology, 86*, 369-381.

Turvey, M. T., Feldman, L.B., & Lukatela, G. (1984). The Serbo-Coratian orthography constrains the reader to a phonologically analytic strategy. In L. Henderson (Ed.), *Orthographies and reading: Perspectives from cognitive psychology, neuropsychology and linguistics* (pp. 81-89). Hillsdale, NJ: Erlbaum.

Tzeng, O. J. L., & Wang, W.S.-Y. (1983). The first two R's: The way different languages reduce speech to script affects how visual information is processed in the brain. *American Scientist, 71*, 238-243.

Vaid, J., & Frenck-Mestre, C. (2002). Do orthographic cues aid language recognition? A laterality study with French-English bilinguals. *Brain and Language, 82*(1), 47-53.

Vellutino, F. R., & Scanlon, D.M. (1987). Phonological coding, phonological awareness, and reading ability: evidence from a longitudinal and experimental study. *Merrill-Palmer Quarterly, 33*, 321-363.

Wade-Woolley, L. (1999). First language influences on second language word reading: All roads lead to Rome. *Language Learning, 49*(3), 447-471.

Wagner, D. A., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 2*, 192-212.

Wagner, R. K., & Stanovich, K. (1996). Expertise in reading. In K. A. Ericsson (Ed.), *The road to excellence* (pp. 189-225). Hillsdale, NJ: Erlbaum.

Wang, M., Koda, K., & Perfetti, C. A. (2003). Alphabetic and nonalphabetic L1 effects in English word identification: A comparison of Korean and Chinese L2 learners. *Cognition, 87*(2), 129-149.

Yamada, J., Imai, H., & Ikebe, Y. (1990). The use of the orthographic lexicon in reading Kana words. *The Journal of General Psychology, 117*, 311-323.

Yamada, J., Mitarai, Y., & Yoshida, T. (1991). Kanji words are easier to identify than Katakana words. *Psycholgical Research, 53*, 136-141.

Yu, B., Zhang, W., Jing, Q., Peng, R., Zhang, G., & Simon, H. A. (1985). STM capacity for Chinese and English language materials. *Memory and Cognition, 13*, 202-207.

Zhang, S., & Perfetti, C. A. (1993). The tongueative adult bilingual Russian-English students. *Jo* -twister effect in reading Chinese. *Journal of Experimental Psychology: Learning, Memory and Cognition, 19*, 1082-1093.