

ENGLISH WORD SEGMENTATION IN KOREAN-ENGLISH BILITERATES:  
A HANGUL ORTHOGRAPHIC STRUCTURE EFFECT

A Dissertation

by

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## ABSTRACT

It has been claimed that skilled readers of English syllabify written words using morphological and orthographic knowledge (e.g., the Basic Orthographic Syllable Structure, or BOSS) rather than phonological considerations (e.g., the Maximal Onset Principle, or MOP). However, biliterate English readers whose first language is phonologically transparent have been found to rely on a MOP-based segmentation preference. Little is known about the specific contribution of first language orthographic knowledge on second language word parsing, particularly when the two languages differ in orthographies.

The present research investigated how first learned orthographic knowledge in Korean Hangul may affect word segmentation of a later learned script (English). A split-view lexical decision task was administered in which visually presented stimuli included gaps at junctures corresponding to three different segmentation strategies: a MOP-based strategy, a BOSS-based strategy, and a strategy based on Hangul orthographic structure (HOS). It was hypothesized that lexical decision would be faster and more accurate for stimuli segmented based on a MOP or a HOS analysis than on a BOSS analysis. Of additional interest was whether reliance on a HOS strategy would be greater for readers with greater proficiency in Hangul and for English words that have been borrowed into Korean as loanwords (with a Hangul written counterpart) than for non-borrowed words.

Participants in Experiment 1 were native readers of Korean ( $n = 48$ ) with low English proficiency; Experiment 2 compared Korean-dominant ( $n = 48$ ) with English-

dominant biliterate readers ( $n = 49$ ). Stimuli in both experiments included 60 borrowed words and 60 non-borrowed words. Results from Experiment 1 found evidence for a Hangul orthography-based segmentation strategy, particularly for loanwords. Experiment 2 found a HOS effect among Korean-dominant readers for loanwords and a weaker HOS effect for non-borrowed words. By contrast, English-dominant readers did not show a differential HOS preference as a function of loanword status. Furthermore, across experiments, all groups demonstrated a MOP effect in response time and accuracy. Taken together, the findings are discussed in terms of transfer effects of L1 alphasyllabic Hangul writing system characteristics to the reading of words in an L2 alphabetic writing system.

## DEDICATION

In most loving memory of my late mother, my one and only, Myung Soon Woo.

As you see, I kept my promise, albeit ten years later. *Igun, nae sunmuleya, umma.*

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## NOMENCLATURE

BOSS	Basic Orthographic Syllable Structure
ED	English Dominant
HB	Higher Bilingual proficiency
HOS	Hangul Orthographic Structure
KD	Korean Dominant
L1	First-learned Language
L2	Second-learned Language
LB	Lower Bilingual proficiency
MOP	Maximal Onset Principle
PS	Phonological Syllable
TL	Transposed Letter

## TABLE OF CONTENTS

	Page
ABSTRACT .....	ii
DEDICATION .....	iv
ACKNOWLEDGEMENTS .....	v
NOMENCLATURE .....	vii
TABLE OF CONTENTS .....	viii
LIST OF FIGURES .....	x
LIST OF TABLES .....	xi
CHAPTER I INTRODUCTION.....	1
Studies of Visual Word Recognition Across Different Languages.....	3
Polysyllabic Word Recognition .....	9
CHAPTER II KOREAN-ENGLISH BILITERACY .....	23
Orthographic Properties of Hangul .....	24
Hangul-Specific Characteristics in Word Recognition .....	26
English Reading Success in Korean-English Biliterates.....	29
How Might Hangul Orthographic Knowledge Affect Polysyllabic English Word Recognition? .....	33
The Present Research .....	36
CHAPTER III EXPERIMENT I: INVESTIGATION OF THE HANGUL ORTHOGRAPHIC STRUCTURE EFFECT IN KOREAN NATIVE READERS..	40
Introduction .....	40
Method .....	41
Results .....	47
Discussion .....	53

	Page
CHAPTER IV EXPERIMENT II: THE ROLE OF LANGUAGE DOMINANCE AND THE HANGUL ORTHOGRAPHIC STRUCTURE EFFECT .....	56
Method .....	58
Results .....	59
Discussion .....	70
CHAPTER V GENERAL DISCUSSION AND CONCLUSION .....	76
Limitations and Future Directions.....	82
Conclusion .....	85
REFERENCES.....	87

## LIST OF FIGURES

FIGURE		Page
1	Mean Percent Accuracy of Korean-Native Biliterate Readers' Lexical Decision Performance by Stimulus Type and Segmentation Type.....	52
2	Mean Reaction Time of Korean-Native Biliterate Readers' Lexical Decision Performance by Segmentation Condition and Stimulus Type ....	53
3	Mean Percent Accuracy of Readers' Lexical Decision Performance by Stimulus Type and Segmentation Type per Language Dominance Group.....	64
4	Mean Reaction Time of Biliterate Readers' Lexical Decision Performance by Stimulus Type and Segmentation Type, Separately Grouped by Language Dominance.....	66
5	Mean Percent Accuracy of Biliterate Readers' Lexical Decision Performance by Stimulus Type and Segmentation Type, Separately Grouped by Bilingual Proficiency.....	68
6	Mean Reaction Time of Biliterate Readers' Lexical Decision Performance by Stimulus Type and Segmentation Type, Separately Grouped by Bilingual Proficiency.....	70

## LIST OF TABLES

TABLE		Page
1	Mean Reaction Time (in ms) and Percent Accuracy by Stimulus Type and Segmentation Condition .....	50
2	Mean Reaction Time (in ms) and Percent Accuracy of Korean-Dominant and English-Dominant Biliterate Readers' Lexical Decision Performance by Condition .....	63
3	Summary of the Predictions and Outcomes from Experiments 1 and 2 ....	77

# CHAPTER I

## INTRODUCTION

Consider the visually presented word “doctor.” How might it be perceived by readers of different language backgrounds? To a monolingual speaker of American English, this word would be pronounced as /daktər/; a native speaker of Spanish would probably pronounce it as /dokˈtor/. In other words, the same visual configuration - “doctor” - may elicit very different readings among users of different languages. Then, consider a second language reader of English whose first language script uses a different direction in writing, namely, right to left. How would such a user approach the word “doctor” - would they read it in the sequence of d-o-c-t-o-r, that is, in the order in which it is read and written in English, or would they be inclined to read it in the sequence of r-o-t-c-o-d, reflecting the reading and writing order of their first language? What about a reader of English whose first language is written in a non-alphabetic script? Would they bring to bear orthographic properties of that script when reading words in English, or does English word reading activate only orthographic knowledge associated with alphabetic scripts? In other words, to what extent does bilingual users’ orthographic knowledge of their first learned script affect their reading of words in a second learned script?

This dissertation examines the role of first language (L1) orthographic knowledge in the reading of words in a second language (L2). For the purpose of this dissertation, I define orthographic knowledge as knowledge of the basic symbols

characterizing a particular written language and orthotactic rules governing their sequencing and visuospatial arrangement. I will use the terms “orthography” and “script” somewhat interchangeably. When the emphasis is on how written symbols map onto spoken units, I will refer to “writing systems”.

The dissertation is organized as follows. Chapter I presents a cross-language review of studies of word recognition in adult readers focusing on studies that suggest that characteristics of the first learned orthography may influence word recognition of a second learned orthography. A detailed review is presented of studies examining whether word recognition of polysyllabic words is primarily affected by phonological or orthographic/morphological considerations. Chapter II summarizes structural properties of written Hangul and reviews relevant studies of word recognition in Hangul-English readers. A Hangul orthographic structure based segmentation strategy is identified, and a rationale is presented for two experiments with Hangul-English readers’ segmentation of English words. Chapter III describes the design and results of Experiment 1, a study of the relative contribution of three potential influences on English word segmentation in Korean-English biliterates. Chapter IV describes the design and results of Experiment 2, which extends the scope of Experiment 1 to consider potential effects of language dominance. Chapter V discusses the overall findings from the two experiments in the context of the broader issue of cross-language differences in word recognition in relation to orthographic knowledge, identifies potential limitations of the present studies, and outlines directions for further research.

## **Studies of Visual Word Recognition Across Different Languages**

There is a vast experimental literature on factors influencing written word recognition in adult skilled readers. The present review will not attempt to be comprehensive but will focus on factors related to word recognition in different writing systems (e.g. Perfetti, Zhang, & Berent, 1992). Based on how spoken sounds map onto written units, how they are represented in a writing system and how written symbols are combined, writing systems can be categorized in three ways: 1) alphabetic writing systems, such as English, which map sounds at the level of phonemes, 2) syllabic writing systems, such as Japanese kana, which map sounds at the level of syllables, and 3) morpho-syllabic (also sometimes termed logographic) writing systems, such as Chinese, in which written symbols map onto morphemes.

In alphabetic writing systems readers a key predictor of successful word recognition is phonological awareness. This is defined as tacit knowledge of the phonological structure of spoken words (Gillón, 2004), demonstrated by readers' ability to identify and manipulate speech sounds at the level of syllables, onsets and rimes, and phonemes (Rvachew & Grawburg, 2006). Phonological awareness ability in young children, independent of other cognitive abilities, has been shown to one of the best predictors of reading and writing success later in life (Richgels, 2001; Bryant, 2002; Hogan, Catts, & Little, 2005).

However, most studies on phonological awareness have been conducted on languages written in alphabetic, and specifically, Roman scripts, such as English, French and German (Reilly & Radach, 2012). Yet a growing number of studies on word

recognition show that properties of a script can affect word recognition processes. It thus becomes important to investigate word recognition in each writing system.

Wang, Perfetti and Liu (2003) reported that Chinese readers demonstrate enhanced attention to graphic properties of the word during the early stages of reading development, a process which is not observed for emergent readers of English. This was further demonstrated by Liu, Perfetti and Hart (2003), who reported that differences in orthography lead to a different pattern of phonological effect in ERP studies with homophone pairs. Whereas in English the activation of speech sound processing (phonological effect) is observed much earlier (200 ms), in Chinese the effect was found much later (400 ms). Liu et al. (2003) reasoned that the “coupling of graphic with phonological form” (p. 203) in Chinese logographs may have provided such latencies in phonological activation in word reading. As such, Perfetti and Liu (2005) claimed that the comprehension of orthographic structures of a given script is critical in acquiring literacy in both alphabetic and non-alphabetic writing systems alike, as the skills needed for word identification will be heavily dependent on the combination of the reader’s phonological skills and the level of expertise in orthographic structures specific to that language.

Underscoring this issue, Reilly and Radach (2012) demonstrated that Japanese and Chinese readers, compared to users of the alphabetic scripts, are more sensitive to spacing alterations. The authors argue that this difference in spatial sensitivity results from the differential functions of space according to orthographic structure: whereas in alphabetic scripts a word consists of a string of letters combined together, separated by a

space, in Chinese a word includes a combination of units, each of which contains combined semantic strokes, and in Japanese one word is a representation of each syllabic unit.

Winskyel and Perea (2014) as well as Kohsom and Gobet (1997) provide evidence that for native readers of Thai, which does not have interword spaces in writing, the position of the letters within a word is not as important as long as all the letters of a word are present. In particular, the results indicated that Thai readers did not show any difference between words and transposed letter non-words (created by changing the consonants within a word, such as *napkin-nakpin* in English). Even when the letters from the first word and second word were transposed (for example, *napkinholder-napkihholder* in English), as long as all the letters of the words were present, the reading speed was uninfluenced by the presence of letter transposition. Thus, native readers of Thai did not pay much attention to gaps in English word reading. Thus, it can be argued that based on how a writing system maps sound to print, spaces between written units are given different importance in literacy acquisition.

A review by Nag, Caravolas and Snowling (2011) further illustrates the importance of properties of the script in word recognition. The authors argued that for learners of Indic scripts, which are categorized as alphasyllabic writing systems in that they simultaneously represent sound at the level of the syllable as well as the phoneme, word recognition greatly benefits from instruction that enhances learners' syllable awareness. The importance of syllable awareness had not been addressed in previous studies involving literacy acquisition in alphabetic scripts, understandably due to the

relatively low (to non-existent) emphasis on syllables in written representations in alphabetic scripts such as that of English. Therefore, Nag et al. (2011) argued that literacy development is an orthography-specific process.

A study by Wang, Koda, and Perfetti (2003) also illustrates the importance of first learned orthography in word recognition. The authors compared Chinese-native readers to Korean-native readers in English word identification performance. The authors stated that word recognition in Chinese would necessitate skills that are greatly different from English due to the graphic complexity of the script, whereas word recognition in Korean Hangul would provide relatively common skills that would be similar to English word recognition. Based on these observations, Wang et al. (2003) hypothesized that whereas Chinese-native ESL students would produce more “phonologically and orthographically incorrect responses, and more phonology based errors” (*p.* 132) than Korean students, Korean-native ESL students will produce more error in processing of homophones, given the high grapheme-phoneme correspondence in Hangul. Consistent with their hypothesis, participants’ performance on two tasks (semantic category judgment and phoneme deletion task) revealed a differing strategy between the two ESL groups. Whereas Korean-native EFL students were significantly better on the phonologically-based task (phoneme deletion), Chinese-native ESL students were better at distinguishing homophone foils. Moreover, Chinese-native ESL students were shown to rely significantly less on the phonological information during word identification, compared to the Korean-native students.

However, Yamada (2004) argued that Wang et al. (2003) did not explicitly demonstrate how using Hangul is “directly associated with the development of phoneme awareness” (p. 129) but nevertheless claimed that using Hangul would improve the users’ phonemic awareness. In particular, Yamada (2004) argued that how the visuospatial nature of Hangul either assists or interferes with phonemic awareness is undetermined in Wang et al. (2003) and instead was explained as not affecting phonological awareness in either Korean or English. Thus, Wang and Koda (2007) tested a new group of Chinese-native and Korean-native ESL students for an experiment similar to Wang et al. (2003), but with stimuli differing in frequency and regularity (in spelling) of the words. Wang and Koda (2007) reported that while both groups demonstrated poorer performance in low-frequency words, Korean-native ESL students again outperformed their Chinese-native counterparts on the spoken-word recognition tasks, consistent with Wang et al. (2003). Therefore, the authors concluded that “the power of word properties in the L1 writing systems is evident among L2 learners with different L1 background” (p. 217).

The literature on the Transposed Letter (TL) effect further illustrates the relevance of taking readers’ orthographic knowledge into account. The TL effect refers to the phenomenon whereby non-words created by transposing letters of real words are erroneously perceived as real words more so than non-words that do not involve letter transpositions of real words (Lee & Taft, 2009). For example, a TL non-word of the word *napkin* would be created by exchanging the coda of the first syllable with the onset of the second syllable, *nakpin*; or, a non-TL word could be created by exchanging onsets

between syllables, *kapnin*; or codas between syllables, *nankip*. In studies of this effect, English native speakers have been shown to incorrectly categorize TL non-words (e.g., *nakpin*) as being real words, whereas non-TL non-words (e.g., *kapnin*) did not show such errors; further, correct judgments of TL non-words as non-words took a considerably long response time.

According to Taft (2003), the TL effect provides support for sublexical processing of polysyllabic English words. Specifically, the effect is argued to show that 1) onset and coda assignment occurs concurrently and automatically, for native readers, and 2) the TL effect may arise from the linear aspect of alphabetic writing, since in such scripts it is difficult to visually identify the coda of the first syllable and the onset of the following syllable. With respect to the second point in particular, Taft (2003) reasoned that in orthographies where syllables are demarcated more clearly the TL effect might not be as strong as it is in English. Indeed, when Perea and Perez (2009) transposed morae in polysyllabic words presented in the syllabic Katakana script (e.g., presenting *a.me.ri.ka* as *a.ri.me.ka*), a TL effect was found, but a transposition of letters within morae (such as *a.re.mi.ka*) did not lead to any demonstration of the TL effect.

Based on such findings, Lee and Taft (2009) aimed to apply the TL effect in Hangul, which is analogous to English in that it is partly alphabetic, but also similar to Japanese Katakana in that it is partly syllabic in nature. Lee and Taft (2009) further argued that the first letter of the word would become highly salient as well as the syllable boundaries, as Hangul readers use letter position as well as the demarcated codas of each syllable in their reading process. These Hangul-specific properties led Lee

and Taft to hypothesize that Korean literate speakers should demonstrate little or no difficulty in classifying a TL non-word in Korean which was created based on the same principle as a TL non-word created in English. A TL non-word for 한글 would be 학늘, in which case the consonants corresponding to the coda of the first syllable and the onset of the second syllable become swapped in their position.

As expected, no TL effects were observed in Korean word reading, further suggesting strong Hangul-specific orthographic properties at play during lexical processing. This finding was further replicated in a later study (Lee & Taft, 2011) in which a TL effect was again not observed, leading the authors to conclude that “Hangul is probably the only orthographic system whereby the onset, vowel, and coda positions can be unambiguously determined from the orthographic input” (*p.* 133). These findings provide experimental evidence that word recognition is influenced by orthographic properties that are language-specific.

### **Polysyllabic Word Recognition**

Whereas the majority of studies of visual word recognition to date have been conducted on word stimuli that are monosyllabic, a growing number of studies, such as those on the transposed letter effect, have begun to examine the processing of polysyllabic words. How language users assign boundaries to polysyllabic words is a question that has generated much debate among linguists and psychologists alike. Of particular relevance for the present research is the notion of the Maximal Onset Principle (MOP), first discussed by Kahn (1976). Based on this notion, Taft (1979) proposed an

alternative principle, termed the Basic Orthographic Syllabic Structure (BOSS) to account for how written word syllabification may proceed somewhat differently, reflecting orthographic and morphological properties. Since these two notions are central to the present inquiry they are discussed in more detail below.

### **Native readers of English**

Previous research on word reading in English has investigated the role of phonological structure such as phonemes and spoken syllables, as well as orthographic structures such as morpheme and orthographic syllables. In an attempt to better comprehend the lexical processing of English words, two main principles arose; of those, the Maximal Onset Principle first reported by Kahn (1976) and Phonological Syllable (Taft & Forster, 1976) are reviewed first, followed by the Basic Orthographic Syllable Structure as introduced by Taft (1979).

Based on the claims by Savin and Bever (1970) that the syllable is perceived to be the basic unit in English speech processing for native speakers of English, Kahn (1976) argued that English words are syllabified based on the Maximal Onset Principle. This principle holds that syllables in word onsets are to “include as many consonants as are allowed in the syllable structure of the language and as can occur at the beginning of a word in the language, as long as it abides by English syntactic, morphological and phonotactic constraints” (p. 55, Kahn, 1976). Thus, the MOP analysis leads to production of the maximum possible number of onsets within a word. For example, consider the syllabification of the word *athlete*. According to MOP, the syllabification

occurs between the boundary of *th* and *l*, given that in English words may begin with /l/ but not with /θl/. Thus, the “correct” syllabification of *athlete* would be *ath.lete*.

In many ways, MOP coincides with the Phonological Syllable, or PS, which defines syllables in terms of phonological considerations (Taft & Forster, 1976; Taft, 2001). Research on the phonological cues that speakers attend to in their perception of the end of the first and the beginning of the second syllable has identified that stress patterns within each word play the most important role (Mattys, Jusczyk, Luce, & Morgan, 1999). In particular, Cutler and Carter (1987) argued that listeners attend to the placement of the stronger syllable within a word; for example, the words *panic* and *athlete* both contain the stronger phonological first syllable, and this stress pattern (strong-weak) is the dominant pattern for two syllable nouns in English. Cutler and Norris (1988) further argued that whereas for words with the dominant stress pattern statistical segmentation occurs in perceptually segmenting the syllable boundaries within a word, for words with a less dominant stress pattern (weak-strong), such as that of *belong* and *prefer*, listeners attend to the permissible restrictions of the order of phones within a word according to English phonotactic constraints.

In the case of the word *panic*, it was argued that the boundaries between the first and the second spoken syllable could be decided in multiple ways; the boundaries could be identified as being *pa.nic*, according to both MOP and PS considerations, but there is a presence of ambiguity, which leads to the main difference between the MOP and the PS analysis of syllabification. Specifically, the boundaries could also be identified as being *pan.nic* as /n/ is maintained as an onset in the second syllable, while avoiding

having the first syllable end in a short vowel, /æ/ (Taft, 2001), therefore differing from the PS analysis. It was argued that the latter segmentation would better represent the account given by Kahn (1976), as it would produce a maximal number of onsets within a given word while attending to phonological constraints of spoken English.

There have been a great number of debates in the last forty years about the central unit in processing written words. Spoehr and Smith (1973) hold that visual word processing occurs on a syllabic unit, with the syllable defined as the phonological syllable in accordance with the spoken syllable boundaries. Mehler and Hayes (1981) argue that word-initial phonemes play the most important role in word processing, *not* the onset of the second syllable, and suggest that MOP may not be the most trustworthy account. Fallows (1981) similarly argues that since MOP seems to characterize the segmentation strategy of unstressed vowels, the method of syllabification is dependent upon the stress placement in the word, thus MOP and PS are both utilized in English lexical processing.

Other findings also show the importance of syllables, be they based on a MOP or a PS. For example, in a study by Smith and Pitt (1999) participants demonstrated a strong syllable-based word reading strategy for English (see also Croot & Rastle, 2004). While numerous findings have reported a syllable-based segmentation of polysyllabic words in other alphabetic languages as well, such as French (Conrad, Grainger, & Jacobs, 2007), Dutch (Cholin, Schiller, & Levelt, 2004) and German (Stenneken, Conrad, & Jacobs, 2007), it should be noted that the definition of syllable boundaries in English and reliance on syllables in English lexical processing is still under heated

debate among linguists and psychologists (Perry, Ziegler, & Zorzi, 2010; Devonshire, Morris, & Fluck, 2013; Montani, Facoetti, & Zorzi, 2014), particularly with regards to the inclusion of orthographic boundaries in the definition of syllables.

In the debate on ways of perceptually segmenting spoken speech sounds into manageable units, a claim by Taft (1979) has received considerable attention and has since been widely investigated. Calling it the Basic Orthographic Syllable Structure, or BOSS, Taft (1979) argued that the lexical representation of a spoken word should be based on a combination of orthographic and morphological considerations, instead of on phonological grounds (spoken boundaries) alone, as argued by Kahn (1976), Spoehr and Smith (1973) as well as others.

The basis of this claim comes from Taft's argument (1979) that the pronunciation of a polysyllabic word does not correctly and consistently determine the boundaries between the coda of the first syllable and the onset of the second syllable. He argued that there is a mismatch between the first spoken syllable and the first lexical syllable; for example, the word *actor* would be broken into *ac.tor* in the spoken syllable, whereas the word comes from the base word of *act* and thus the correct lexical syllabification would be in the form of *act.or*.

Taft claimed that syllable boundaries used by readers are more likely based on the following strategy: "include in the first syllable as many consonants following the first vowel of the word as orthotactic factors will allow without disrupting the morphological structure of the word" (Taft, 1979, p. 24). For example, the word *spider* would be segmented as *spid.er*, as /d/ would be the consonant following the first vowel

/i/, and it does not disrupt the morphological structure of the word. As such, the orthographic syllable boundary occurs in a different location compared to that of MOP/PS, which would segment the same word as *spi.der*.

To test this idea, Taft (1979) devised a split-view lexical decision task, in which spaces were inserted between the first and the second syllable of visually presented words in a lexical decision task, according to the phonological/articulated syllable, e.g., LAN TERN, or according to the BOSS principle, e.g., LANT ERN. Taft argued that if the boundary marked by the space coincides with the way participants are likely to segment the word it would be “less disruptive to recognition” (*p.* 25) compared to when the space does not coincide with the participant’s perceived segmentation of the word. Participants were instructed to make a lexical decision (i.e., decide whether the string of letters presented forms a word or not) ignoring the inserted space, and to respond in the most accurate and prompt manner.

Across a set of experiments, Taft (1979) reported that reaction times were consistently faster (and accuracy higher) to items in which the space occurred at the juncture that would be predicted by the BOSS analysis, as compared to that of the MOP. Taft interpreted this finding as support for his claim that words are “stored on an orthographic basis and *not* on a pronunciational basis,” and that phonological syllable boundaries, without consideration of orthographic syllables, can only be “disruptive” in the lexical processing of English words (*p.* 28). He subsequently extended this argument to claim that processes in visual word recognition involve translation of spoken speech

units into orthographic units, and that such translation activates lexical access according to the BOSS principle (Taft, 1986).

Taft further proposed that in a polysyllabic English word, the body (vowel + coda) of the BOSS (what he termed, BOB) serves a critical role in determining the boundaries between the first and the second syllable (Taft, 1992). Consider the word *meadow*: according to a BOSS analysis, the parsing occurs in the manner of *mead.ow*, with *mead-* belonging to the first and *-ow* to the second syllable. In this case, the BOB would be *-ead-*; it was found that the pronunciation of the word was primed when congruent with the BOB of the non-word in pair presentation. Based on such findings, Taft (1992) claimed that it is the body of BOSS, not the spoken syllable, which constitutes a “functional subword unit in reading” (p. 1010). Given that the subsyllabic structure of the word that most influenced participants’ judgments was the body of BOSS, Taft argued that the orthographic syllable is essential in English lexical processing.

In a later study, Taft (2001) argued that the so-called BOSS advantage - namely, recognizing a word more rapidly during split-view lexical decision task when items are segmented according to the orthographic syllables as dictated by the BOSS principle than by the MOP principle - is stronger in readers with high than low reading comprehension ability. This claim was based on the finding of a significant correlation between the size of the BOSS advantage and scores on a reading comprehension test (Taft, 2001, Exp. 1). When he factored reading ability into the design by selecting participants from a pool of poor vs. good readers, Taft (2001) found that while a BOSS

analysis did not positively influence the recognition speed for poor readers, good readers seemed to benefit from the BOSS advantage more.

Importantly, Taft (2001) noted that the BOSS advantage was larger for items in which there were shared morphemic cues in the base word (such as ANG from ANGLE, which then can be attached to form words such as ANGULAR). The BOSS advantage was less marked in words without such morphemic cues (such as ANK from ANKLE, and CRIS from CRISIS). From these results, Taft (2001) concluded that whereas poorer adult readers make less use of orthographic information in their reading process and instead depend more on the phonological properties of a word, better readers are able to utilize orthographic information as a resource with which to parse not only words but also non-words.

Attempts to replicate a BOSS advantage in English readers have shown mixed success. Chen and Vaid (2007) noted that the stimuli used by Taft (2001) were not controlled for frequency. They systematically examined this variable while also manipulating the presence/absence of morphemic cues, in a split-view lexical decision task, following the experimental paradigm devised by Taft (2001). The results from this study revealed no effect of the presence/absence of morphemic cues, whereas there was a significant effect of word frequency, with the BOSS advantage emerging only for low frequency words. Thus, in testing the BOSS principle, word frequency should be factored into the experimental design. In addition, Chen and Vaid (2007) found a weak relationship between reading ability and the BOSS advantage. Chen and Vaid (2007) reported that whereas there is a good possibility that the 'poor' readers as indicated by

the subjects' self-reported SAT verbal scores still have relatively high reading comprehension ability given their status as undergraduate students in a respected 4-year university, it is also equally likely that reading ability is not a decisive factor in testing of the BOSS advantage, after controlling for the frequency of the words.

In accordance with this view, Perry (2013) extended the discussion on the relationship between reading ability and the BOSS advantage. By using the same split-view lexical decision paradigm, Perry (2013) developed a new set of stimuli that was well controlled in terms of word frequency, length, as well as neighborhood size. He argued that stimuli should also control for the existence of consonant clusters after the vowel, namely, -VCC (i.e., *leprosy*) and -VCV (i.e., *cavalry*), since the effect of orthographic boundaries as determined by the BOSS principle is more ambiguous in the former than the latter. Indeed, whereas a BOSS advantage was demonstrated in -VCV words, this was not the case for -VCC words; this led Perry (2013) to argue that “there is no clear-cut evidence for the BOSS at all” (p. 363). However, participants' performance in the reading proficiency test showed a significant correlation to the BOSS advantage, leading Perry to concede that more proficient readers may be able to benefit more from the BOSS analysis, most likely due to their more extensive lexical and orthographic knowledge.

### **Biliterate users of English**

Given what has been argued in terms of phonological processing and visual representation of spoken speech sounds in English for native speakers, the question then arises whether biliterate users of English may show a different parsing strategy,

influenced by properties of their first learned script (L1), in cases where the L1 has different writing system characteristics than English. On the one hand, it is possible to argue that the phonological processing theories such as that of PS/MOP and BOSS would only be demonstrated in literate users of alphabetic languages such as English, and that for users of non-alphabetic languages, it may not be appropriate to readily apply the findings based on the data from native English speakers. On the other hand, it is equally possible to argue that the lexical processing principles of English are based on English-specific characteristics, and therefore, L2 users of English would demonstrate a behavioral trait that resembles that of native English users, either emergent or fully literate, irrespective of their L1 script. Therefore, in order to better our understanding of processes involved in visual representation of phonological processing of English, one must consider lexical processing of English in users of non-alphabetic scripts.

The main question here is whether there is an effect of L1 on L2 (in this case, English) processing. A study by Jackson, Chen, Goldsberry, Kim and Vanderwerff (1999) approached this question by investigating text level reading of English. They reasoned that word recognition for non-native readers should be highly sensitive to context, and thus it would be inappropriate to test it using isolated words. Jackson et al. (1999) were interested in comparing different groups of English as a Foreign Language (EFL) learners, categorized by the type of their L1 orthography. The groups they tested were 1) Korean EFL students, 2) Chinese and Taiwanese EFL students whose L1 is morphological in nature but have acquired their L1 by using alphabetic representations

initially, and 3) EFL students from Hong Kong who have more exposure to English but acquired their logographic L1 in a purely morphological manner.

Somewhat different from their expectations, Jackson et al. (1999) reported that L1 orthography did not differentially affect the EFL learners' English reading proficiency. The main difference that could be observed from these groups was only on the oral quality - namely, their pronunciation of the words - which led the authors to conclude that L1 orthography does not play a critical role in L2 literacy.

One aspect of the study by Jackson et al. (1999) presents a potential concern. The authors reported that the reading performance of Taiwanese and Korean EFL students was indistinguishable from one another, and thus the two groups were aggregated and treated as one group in the analysis. Jackson et al. (1999) reasoned that the similarities in phonological processing between the two groups lend further support that Korean Hangul is similar to Chinese characters due to the spatial arrangement. However, this statement overlooks the fact that whereas in Hangul the spaces are functionally determined so that the position of the vowels and the consonants is strictly identified, in Chinese logographs this is not so; instead, in Chinese, each stroke represents a different part of the meaning that in combination constitutes the full meaning of the character (Taft, 2002). Therefore, it can be argued that simply combining the two EFL groups and treating them as a homogeneous set would not allow for an accurate investigation of the role of L1 script type on L2 reading performance, and that Jackson et al.'s claims about L1 orthographic influence on L2 reading remain uncertain.

An investigation was carried out by Taft (2002) to examine this issue further. Taft (2002) argued that the preference between the Maximal Onset Principle (that corresponds to the spoken syllable) and Maximal Coda Principle (that corresponds to the morpho-orthographic characteristics of syllables, or the BOSS) may be differentially shown in non-native English readers, particularly those who use a non-alphabetic L1 script. For this purpose, he compared Japanese-native and Chinese-native speakers tested in English on a split-view lexical decision task.

Given that written Japanese is considered a syllabary whereas written Chinese is considered a morpho-syllabic script, Taft (2002) reasoned that a preference for a MOP segmentation strategy should characterize Japanese more than Chinese L1 readers. He hypothesized that Chinese readers would not demonstrate a clear preference in English word segmentation as their literacy skills acquired from L1 logographs, such as those of visuospatial processing, would not be transferrable to alphabetic English words, as graphic complexity is not a relevant dimension in English writing. Finally, he argued that both the Japanese and the Chinese group would demonstrate a different trend compared to English native speakers in their segmentation strategy preference, as the non-native speakers' L1 orthographic knowledge would not lead to "optimal" English processing (*p.* 533). The results supported his prediction: whereas native English speakers (particularly high proficient readers) preferred the BOSS analysis, this preference was not observed in non-native users of English. Japanese readers demonstrated a strong preference for the Max Onset analysis across all word types whereas the Chinese L1 readers did not illustrate a preference in any of the word types

examined. Based on these findings, Taft (2002) argued that “the non-native English readers may adopt an orthographic analysis that is not ideal for effective English reading,” and further claimed that “the adoption of such a strategy by Japanese readers makes them different not only from better native English readers, but also from poorer native English readers” (p. 540).

Further cross-linguistic investigations have been conducted using the split-view paradigm. Vaid, Chen, Martinez and Rao (2004) demonstrated that native readers of Spanish prefer a MOP strategy in Spanish, and further hypothesized that this MOP preference in word recognition would cross over to English word segmentation as well. Indeed, their results demonstrated that in English word recognition as well, Spanish-English biliterate readers demonstrated a strong MOP preference, particularly for words with morphemic cues (Vaid et al., 2004).

Taft’s split view lexical decision paradigm was further applied to Hindi-English biliterate readers. Vaid, Rao, and Chen (2006) hypothesized that, as a phonologically transparent script, Hindi, would show a strong MOP preference. The authors also hypothesized that this MOP preference would cross over to affect native Hindi readers’ lexical decision performance in English. The findings confirmed both hypotheses, as Hindi-native biliterate readers demonstrated a strong preference for a MOP analysis in Hindi and English alike. Similar findings were noted for native readers of Hangul, another alphasyllabary, namely, a strong MOP preference for both Hangul and English word recognition (Chen, Vaid, & Choi, 2004). Taken together, the few existing studies with biliterate readers that have examined the role of the first learned orthography on how

words in a subsequently learned orthography are segmented suggest that a BOSS advantage is not the norm. Instead, a MOP advantage tends to be found. What remains to be explored is whether there may be yet other segmentation strategies besides either the BOSS or the MOP, depending on particular orthotactic properties of a first learned orthography that differ from those of English. To identify what these might be in the case of Hangul was the central aim of the present research. In the next chapter I review features of Hangul and discuss relevant studies.

## CHAPTER II

### KOREAN-ENGLISH BILITERACY

As investigations in literacy acquisition and development began to expand their languages of interest, a body of research turned to non-Roman scripts, as previously discussed in Chapter I. Readers of non-Roman scripts demonstrated a unique difference regarding “gaze” – be it gaze direction, fixation probability or number of re-fixation on a word. Such findings seem to imply that the sets of skills necessary to become literate and develop further literacy skills in non-Roman scripts necessitate orthography-specific encoding abilities (Just & Carpenter, 1987; Yang & McConkie, 1999; Yan, Tian, Bai, & Rayner, 2006).

Only in very recent years has research begun to emerge that focuses on orthographic structures in non-Roman scripts. Hangul is an example of such a script. As alphasyllabary scripts commonly require visuospatial complexity of the symbol system due to their simultaneous representation of phoneme and syllable in the language (Nag, Caravolas, & Snowling, 2011), it may be argued that literacy in Hangul invites developmental and cognitive differences for emergent readers. Indeed, research by Kim, Radach and Vorstius (2012) demonstrated that skilled Hangul readers showed similarities with Chinese readers in terms of processing the complexity of the strokes; however, due to its alphasyllabic nature, Hangul readers showed similarities with the readers of both syllabic (Japanese) and alphabetic (English) readers in terms of their phonological processing of the words, particularly with their heightened sensitivity to

syllable structures. In a way, skilled Hangul readers demonstrated a hybrid nature, combining across the skills used for literacy in alphabetic and syllabic scripts, by paying attention to both phonemes and syllables.

In what follows, I first summarize orthographic properties of Hangul and refer to research on the sets of skills necessary for successful word recognition in Hangul. I then provide a rationale for the studies I undertake in this dissertation.

### **Orthographic Properties of Hangul**

Hangul orthography has been categorized in different ways: some have argued that it is simply an alphabetic script (i.e., Kim-Renaud, 1997; Taft, 2002), others have claimed it is a hybrid of alphabetic script containing properties of logographic script due to its complex configuration of symbols (i.e., Wang, Koda, & Perfetti, 2003; Wang & Koda, 2007), while others have argued that it is an alphasyllabary which contains properties of both alphabetic and syllabic scripts (Taylor & Taylor, 1995; Kim & Davis, 2004; Nag, Caravolas, & Snowling, 2011). Why are researchers so divided on the categorization of Hangul? In an attempt to answer this question, the unique properties of Hangul are explained in further detail in this chapter.

As noted by Sohn (1994) and Kim-Renaud (1997), Hangul has interesting aspects starting from the history of its development. It was commissioned by King Sejong in the mid 15<sup>th</sup> century, with the specific aim of creating an orthographic system that would best represent the spoken Korean language and replace the Chinese script that

was only understood by very few people, largely with higher societal status (Taylor & Taylor, 1995).

One of the reasons why Hangul is viewed as an easy script to master comes from the fact that it is categorized as a shallow orthography with highly transparent grapheme-phoneme correspondences (Kim, 2007; 2008). By using 10 vowels and 14 base consonants, the letters in Hangul create a rich combination of a minimum of 2000 syllables (compared to Japanese with 112 syllables, and Chinese around 400; Yamada, 2004), which would be more than sufficient to account for any spoken speech sounds in Korean (Sohn, 1994). From the perspective of researchers, this flexibility in the representation of speech sounds is of particular interest.

Hangul also has interesting properties when it comes to the specific details of how it is written. In Hangul, each syllable is physically represented in writing by a square-shaped syllabic block, with each syllable boundary demarcated with a small gap in between. As outlined by Simpson and Kang (2004), the precise configuration of the syllable is determined by the phonemes within the block. In particular, each block consists of three positions - initial, medial, and final. The initial position must be occupied with a consonant, and the medial position with the vowel. The final position is not mandatory, making CV the most basic unit of Korean syllable (Sohn, 1994). For words with CVC syllable structure, the coda of the syllable is written in the final position. The specific details of how consonants and vowels are written also provide a visual cue; whereas vowels are built from a single vertical or horizontal line, consonants are more angular in nature (Simpson & Kang, 2004) thus making consonants and vowels

visually distinctive within a syllable and further making both onsets and codas visually highly salient (Cho & McBride-Chang, 2005a). Due to this configuration, Hangul is written from left to right, and top to bottom, making it a non-linear arrangement (Taylor & Taylor, 1995). For syllables that contain vowels written with a vertical line, the vowel is written to the immediate right side of the consonant (the onset), whereas for syllables with vowels written with a horizontal line, the vowel is placed beneath the initial consonant, and above the final consonant if there is one (Simpson & Kang, 2004).

Therefore, given its hybrid orthographic nature of having properties of both alphabetic and syllabic scripts, it could be argued that both syllables and phonemes may receive a considerable amount of attention from the perspective of Hangul users. Furthermore, given the system's non-linear visuospatial arrangement, Hangul users may rely on spatial cues more than users of linearly arrayed scripts might.

### **Hangul-specific Characteristics in Word Recognition**

Although the focus of the present study is on adult, skilled readers of Hangul with some knowledge of English, studies from emergent Hangul readers may be of some relevance as arguably some of the factors that influence literacy achievement in Hangul would be present in fully literate Hangul readers as well. Each identified factor in literacy acquisition on Hangul, based on findings from those who are beginning to acquire literacy in Hangul is noted below.

### **Phonological processing**

Kim and Davis (2004) presented their participants with a Same-Different tone-matching task, in which participants were asked to judge if two tones presented were of the same or different pitch, or to match the sounds of the same/different tone. While spoken Korean is not a tonal language and thus it was thought to be of less importance to distinguish between the tones, Kim and Davis (2004) found that a general auditory processing ability highly correlated with children's reading ability. Similarly, particularly given the high grapheme-phoneme correspondence in Hangul, several other studies indicate that phonological processing ability correlates with successful reading comprehension in emergent Hangul readers, particularly in word recognition (Yi, 1996), spelling accuracy (Simpson & Kang, 1994; Kang & Simpson, 2001), and reading comprehension (Park, 2000; Cho & Ji, 2011).

### **Syllable processing**

One of the most unique characteristics of Hangul comes from its usage of syllabic blocks in writing. As discussed in an earlier section of this chapter, the syllabic blocks demarcated by the construction of Hangul provide a clear visuospatial cue for syllable boundaries. Nam, Seo, Choi, Lee, Kim and Lee (1997) reported that emergent readers' performance on word reading was significantly influenced by their skills of syllable detection. Simpson and Kang (2004) reported that learners with higher skills in syllable processing had better literacy skills in reading and also spelling, and that this ability seemed to be "independent of the lexical or sub-syllabic properties of the stimuli"

(p.149), further suggesting that the syllable serves a unique role in Hangul literacy acquisition and development.

Similarly, Cho and McBride-Chang (2005a) found that syllable awareness was one of the strongest predictors of reading performance in Hangul and that attention to syllabic information was independent of phoneme awareness and phonological processing ability. As Kim (2011) has argued, many researchers seem to converge on the idea that syllable awareness plays a more important role than phoneme awareness in literacy acquisition and development in Hangul.

### **Visual processing**

The non-linear visuospatial packaging of Hangul has been examined in some studies in relation to Hangul literacy acquisition. For example, Kim and Davis (2004) examined visual perception of rapidly changing stimuli and found that Hangul learners' ability to detect the visual change was not significantly linked to their literacy performance in Hangul. However, Cho and Ji (2011) examined Hangul learners on a Test of Visual-Perceptual Skills (Non-Motor, revised from Gardner, 1996) and found a significant relationship with successful literacy development in Hangul. Specifically, the task from Cho and Ji (2011) was devised to probe the ability to use spatial information. One subtest - Visual Form Constancy Task - involved finding stimuli that matched in shape with the target, regardless of alterations in size, direction, and color. Given that visuo-perceptual skills are "particularly salient" (p. 322) in the recognition of Korean words, the authors argued that learners with better visuospatial processing skills would

have much better resources to use in their attempt to achieve mastery in Hangul literacy (Cho & Ji, 2011).

### **Morphological awareness**

Numerous studies have also reported that even though not as highly significant as the other factors described above, learners' morphological awareness could influence the level of success in reading and writing in Hangul. In particular, studies by McBride-Chang, Cho, Liu, Wagner, Shu, Zhou, Cheuk and Muse (2005) and Cho, McBride-Chang and Park (2008) have reported that the learners' morphological awareness could significantly assist their performance on irregular word recognition. However, as noted by Kim (2011), the influence of morphological awareness on Hangul literacy development is relatively small, as the grapheme-phoneme correspondence in Hangul is quite high. In particular, Park and Uno (2012) note that only the receptive, but not productive, vocabulary skills have been found to be related to literacy success in Hangul, particularly limited to the domain of spelling development.

### **English Reading Success in Korean-English Biliterates**

Korean-English bilingual learners' phoneme-level awareness was one of the very first factors that researchers investigated to determine whether cross-linguistic transfer occurs from Hangul to the learning of English script. Cho and McBride-Chang (2005b) reasoned that in order to fully take into account the alphasyllabic nature of Hangul, the role of cross-linguistic phonological awareness in Korean-English bilingual learners should be separately investigated for phonemes and syllables. Their findings indicated

that in fact, there was a difference between phoneme-level and syllable-level awareness in predicting success in L2 reading. The syllable-level awareness measured in 2<sup>nd</sup> grade uniquely predicted 3<sup>rd</sup> grade word recognition in Korean but not in English; phoneme-level awareness in 2<sup>nd</sup> grade did not predict 3<sup>rd</sup> grade word recognition in Korean, but it significantly did in English. The authors concluded that for emergent ESL learners, it is not syllable-level but phoneme-level awareness that assists their literacy development in English, which could benefit from the phonemic properties of Hangul.

In accordance with such findings, Wang, Park, and Lee (2006) reported that phoneme-level awareness in Korean uniquely explained the amount of variance in English pseudoword reading performance, providing further evidence for the interplay between orthographic properties of Hangul and English in emergent ESL readers. Kim (2009b) reiterated this finding by suggesting that Korean-English bilingual children's phonemic awareness in L1 highly correlated with their literacy skills in English, particularly in pseudoword decoding skills, even after controlling for sight word reading skills in English. Cho, Chiu and McBride-Chang (2011) provided further evidence that this L1 phonemic awareness transfer to English reading was particularly evident for older compared to younger learners, even though phonemic awareness in Korean, particularly compared to syllabic awareness, is not a strong predictor of literacy success in Hangul.

This led researchers to investigate the bidirectional influence between the two languages; if phonemic awareness in Korean assisted English literacy development, even if it did not directly benefit them in literacy development in Hangul, would this mean

that literacy skills in L1 and L2 influence one another in a bidirectional fashion? Indeed, Kang (2012a, b) reported a language transfer in processing both L1 and L2. In comparing phonological awareness of Korean-English bilingual learners to their Korean monolingual counterparts, the author reported that bilingual learners outperformed monolingual students in both measures of phonemic and syllabic awareness. In particular, the author noted that after controlling for L2 phonological awareness and emergent skills, phonological awareness in Korean was a strong predictor of decoding abilities in English words and pseudowords. Based on such findings, Kang (2012a, b) argued that bilingual learners, due to the cross-linguistic transfer effects between the two languages, seem to have a stronger metalinguistic awareness compared to monolingual speakers, as the process of biliteracy development involves a combination of different foci necessary for literacy achievement in each language.

Researchers have also investigated the role of orthographic and morphological awareness in biliteracy development in Korean and English. Wang, Park and Lee (2006) did not find a strong link between the learners' performance in an L1 orthographic choice task in which the learners were instructed to choose the form that looks like a real, 'legal' word and English word reading performance. The authors argued that their finding did not illustrate any cross-linguistic transfer of morphological awareness due to the differences in linearity and spatial configuration between the two orthographies. Wang, Ko, and Choi (2009) reported that when the task was modified to incorporate morphological awareness specifically -- so that children would be reading single-morpheme and two-morpheme words -- children's morphological awareness in Hangul

words uniquely predicted the learners' reading performance in English, suggesting that morphological awareness in Hangul can assist English literacy development. Lee (2012) supported this claim by demonstrating that for Korean-English bilingual readers, morphological knowledge in Hangul is applied to their reading of English words, and while this may not always be advantageous due to different orthographic structures of Korean and English, bilingual speakers nevertheless benefit from this cross-linguistic transfer.

In summary, for Korean-English bilingual readers, Hangul-specific skills that assist their literacy development in Korean are transferred in their attempt to achieve literacy success in English. Moreover, it seems that the English-specific skills that were developed as a result of their literacy development in English are also transferred and demonstrated even when the learners are attempting to master their literacy in Hangul. Furthermore, the findings suggest that in the case of Korean-English bilinguals, the differing orthographic structures between the two scripts do not necessarily lead to an interference in biliteracy development, but instead serve to enhance their metalinguistic awareness by developing different subsets of skills that are language-specific and combining them together. Differently stated, the skills that Korean-English bilinguals possess are not only Hangul- or English-specific, but a unique combination of skills as a result of interaction between the two languages.

## **How Might Hangul Orthographic Knowledge Affect Polysyllabic English Word Recognition?**

The aim of the present research is to extend our understanding of how words in a second learned orthography may be processed depending on characteristics of the first learned orthography, with particular reference to Hangul as the first language and English as the second. The specific question to be examined is whether Hangul-based processing strategies may be enlisted by Hangul-English adult readers in their parsing of English words. To examine this question I will use the split lexical decision task devised by Taft (2001). The research seeks to improve on prior research using this task in several ways.

First, previous studies by Taft did not fully control for word frequency of the English stimuli; other findings have suggested that word frequency may in fact affect whether a BOSS or a MOP advantage is detectable; a BOSS advantage was found only for low frequency words, even in English monolinguals (Chen & Vaid, 2007; Perry, 2013). It could be argued that for non-native readers, who presumably do not have as much experience with and exposure to the English language as native readers, even their “familiar” words in English would actually have less exposure than native speakers’ “less familiar” words. In other words, from the non-native speakers’ perspective, they only mostly participated in the “less frequent” condition whereas the native speakers had familiar versus less frequent words. Therefore, it may well be the case that non-native speakers are not in any way crucially lacking in English reading ability *because* they did not show a BOSS advantage; rather, it may simply have been that non-native speakers

did not use the BOSS advantage as much because the English stimuli words were “less familiar” words to them. Unless the stimuli used for presentation are controlled for frequency, the interpretation of non-native biliterate readers’ performance on high- versus low-frequency words, in particular, remains unexplained. The present research carefully controlled for English word frequency.

Second, very few cross-language comparisons have thus far been undertaken with the split lexical decision task and existing studies have not directly probed the specific contribution of L1 orthographic properties in L2 word recognition. For example, although Taft (2002) noted that Chinese speakers remain “unaffected” by the structure of the English polysyllabic words, it may just be that the factors that Chinese-native speakers utilize in lexical processing (which might also provide a useful heuristic for their understanding of English words) were not included in the study design. The point is that the study design needs to factor in the non-native speakers’ L1 orthography-specific characteristics in order to more directly investigate how L1 orthographic knowledge affects the processing of L2 English words.

Thus, although there has been one previous study with Hangul-English biliterates on the split lexical decision task (Chen, Vaid, & Choi, 2004), demonstrating that Hangul-native readers show a MOP preference over a BOSS one, the study does not in itself provide a basis to link how knowledge of word segmentation in Hangul may differentially affect English word recognition. Inclusion of another segmentation analysis (besides a MOP or BOSS) that reflects the orthographic properties of Hangul,

would enable a more direct investigation. This was incorporated into the design of the present research.

Third, another variable previously mentioned in Taft (2002) was examined in the present research. Taft had stated that his original design included a comparison of English words that were borrowed into the readers' L1 (Japanese) with those that were non-borrowed, as a way of addressing word familiarity. However, as borrowed words in Japanese are written in *katagana*, a different type of orthography, this manipulation had to be dropped. In the case of Korean-English biliterate readers, as both the borrowed and the non-borrowed words are written in the same script, Hangul, it would be beneficial to include both word types in the lexical decision stimuli. In particular, borrowed words would have a written form in L1 (Korean), which could allow for a stronger demonstration of L1-based orthographic influence, even when the words are presented in English. Such an effect could be significantly diminished, or even disappear, in non-borrowed words as there would not be a written rendition in readers' L1 (Korean).

Finally, in the present research the role of language dominance was also investigated. It could be argued that even within biliterate readers, some may be more fluent in English than others, not just in English reading proficiency but also in terms of language dominance. For example, Korean-English biliterates could be categorized into Korean-dominant biliterate readers whose exposure to and experience with English would be more limited compared to Korean, and English-dominant biliterate counterparts whose orthographic knowledge of English may be greater than that of Korean. Given that potentially different extents of orthographic knowledge between the

language dominance group may determine the level of reliance on L1 orthographic knowledge, inclusion of the language dominance factor into the design would allow for an exploration of the relationship between language dominance and L1 orthographic knowledge in L2 word recognition.

### **The Present Research**

As noted earlier, word recognition is influenced by the orthographic structure of the script (Wang et al., 2003; Liu et al., 2003; Nag et al., 2011; Reilly et al., 2012). Moreover, L1 orthographic knowledge seems to influence L2 word recognition (Wang et al., 2003; Wang et al., 2007; Brennan, Cao, Pedroarena-Leal, McNorgan, & Booth, 2013). However, research has yet to explore the impact of specific orthographic knowledge associated with a particular language on the processing of words in another language.

As previously discussed, some research has argued that word recognition in English is influenced by phonological criteria, such as the MOP principle (Kahn, 1976), whereas other research has argued that orthographic criteria are equally if not more important in reading polysyllabic English words (e.g., the BOSS principle, advocated by Taft, 1976). While Taft (2002) argued that cross-linguistic interference from L1 may prevent second language readers of English from using effective reading strategies corresponding to BOSS, the particular interaction between the users' L1 and L2 (English) has not been examined directly. Korean-English biliterates provide an interesting group to examine transfer effects from L1 to L2 in English lexical processing,

given that Korean Hangul is distinctive due to the way in which the writing represents speech sounds both at the level of phonemes and syllables.

There are three possibilities with regards to the syllabification strategy that Hangul-English biliterate readers may adopt in reading English words. First, if word reading in English is solely dependent on properties of written English, then one would expect Korean-English users to demonstrate a syllabification strategy similar to that of native English readers, namely, a BOSS analysis. However, if word recognition in English is influenced in part by a strategy arising from characteristics of the first learned script, then one may expect Korean users of English to show a MOP effect, to the extent that Korean is phonologically more transparent than English.

A third possibility is that Korean readers may segment English words the way they might segment them if the words were actually written in Hangul. Use of such a strategy would lead to a preference for what I am calling a Hangul Orthographic Structure (HOS) effect. I define a Hangul-based Orthographic Structure (HOS) segmentation as one in which syllable boundaries reflect the way the word would have to be written under the orthographic conventions of Hangul, namely, in terms of three subdivisions rather than two for bisyllabic words with the syllable structure CCVCVC and CVCCVC.

For example, for the word *spirit*, the first consonant would comprise the first written syllable, and it would be followed by the CV as the second syllable, and the remaining CVC as the third syllable. This is because Hangul orthographic conventions require that each syllabic block must begin with a consonant; in the case of consonant

clusters in English (*sp* of the word *spirit*), as the sound */sp/* does not exist as a diagraph in Korean, the clusters would be separated so that each consonant of the cluster represents a independent consonantal sound. Thus, whereas a MOP analysis would place the syllable boundaries for the word *spirit* as *spi.rit*, and a BOSS analysis as *spir.it*, we are hypothesizing that a Hangul-based segmentation of the same word would place syllable boundaries as *s.pi.rit*. The same logic is applied to words with a CVCCVC structure – for the word *signal*, as the vowel is inserted after the postvocalic word-final stop of */g/* and each syllabic block starts with a consonantal sound, the HOS analysis would place the syllable boundaries as *si.g.nal*, compared to a MOP analysis as *sig.nal*, and a BOSS analysis as *sign.al*. If Hangul readers of English show a HOS preference in reading English words it would be evidence for a carryover effect of Hangul-specific orthographic knowledge of syllable structure.

The primary aim of the present experiments, then, is to determine whether biliterate Hangul-English readers will be more likely to use a MOP, a BOSS, or a Hangul-based segmentation strategy in reading of English words. Based on whether the biliterate readers prefer a MOP, a BOSS, or a HOS analysis of English word reading, the specific nature of the influence of L1 orthographic knowledge in L2 word reading can be discerned.

A second aim of the research is to determine whether a Hangul-based segmentation preference would be restricted to English words that have been borrowed into Korean. Whereas on both the spoken and the written level, borrowed and non-borrowed English words are likely to be pronounced in a similar manner reflecting a

common sound substitution process, borrowed and non-borrowed words present a difference with regards to the salience of Hangul-based orthographic representation in the biliterate readers' minds. Simply put, whereas borrowed words have a written Hangul rendition, the non-borrowed words do not. Thus, if L2 reading is influenced by L1 orthographic knowledge, reading of borrowed English words would benefit even more from a Hangul-based segmentation analysis, compared to non-borrowed English words. However, if L2 reading is relatively independent of L1 orthographic influence, there would not be a marked difference between borrowed and non-borrowed English words in readers' selection of parsing strategy.

Finally, the research will examine the influence of relative degree of knowledge of Hangul relative to English as an additional influence on how English words are parsed by biliterates.

## CHAPTER III

### EXPERIMENT I: INVESTIGATION OF THE HANGUL ORTHOGRAPHIC STRUCTURE EFFECT IN KOREAN NATIVE READERS

#### **Introduction**

The few studies that have been conducted with non-native readers of English have found that there is no uniform evidence for a BOSS advantage. This in turn has led to speculations that English L2 word reading may be influenced by properties of readers' L1 script (Taft, 2002; Wang et al., 2003; Wang et al., 2007). Specifically, readers whose first script is syllabic (e.g., Japanese kana) or alphasyllabic (e.g., Hindi) appear to show a MOP rather than a BOSS analysis in segmenting English words (Taft, 2002; Vaid et al., 2004), lending support to the notion that phonological transparency of a first learned script may be associated with greater use of a MOP analysis in the L2.

The current study was designed to test this notion with L1 readers of a highly transparent script, Hangul. A previous study with Hangul-English biliterates demonstrated that native Hangul readers strongly preferred a MOP analysis in English word recognition compared to a BOSS analysis (Chen, Vaid, & Choi, 2004). However, this study did not directly examine whether specific properties of Hangul orthography may also affect readers' segmentation preference. This was addressed in the present study, conducted with readers of Hangul with very little proficiency in English. The study examined whether – in addition to an expected MOP-analysis strategy – Hangul

readers would show a HOS-based segmentation strategy when making lexical decision judgments in English.

It was hypothesized that stimuli segmented according to a HOS-analysis (e.g., *s.pi.rit*) would demonstrate faster reaction time and higher accuracy than the same stimuli presented with a BOSS segmentation (e.g., *spir.it*). It was further hypothesized that a HOS effect would be greater for English stimuli that exist in Korean as borrowed words than for those that do not. Additionally, reflecting on the findings of a previous study with native Hangul readers that indicated a MOP preference (Chen, Vaid, & Choi, 2004), it was hypothesized that a MOP preference should be found in our study as well.

## **Method**

### **Participants**

Forty-eight Korean-native readers (13 male), ranging in age from 22 to 48 years ( $M = 34.84$ ,  $SD = 9.62$ ), with little to no experience in English were recruited from and tested in Seoul, South Korea. Data from 3 participants were excluded as their responses exceeded 2 standard deviations from the mean, leaving 45 participants in the sample. The inclusion criteria for selection in the study were twofold: 1) participants must not have lived in an English-speaking country for more than three months, and 2) if they had lived abroad for less than three months, the experience should have occurred more than three years prior to testing. These selection criteria enabled control of recency and length of exposure to English, further ensuring that the participants were likely to be largely Korean-dominant in their language use. Nevertheless, all participants had studied

English in school and were assessed on their proficiency in it using self-reports and a standardized test (Woodcock-Johnson test, Woodcock, McGrew, & Mather, 2001).

Participants' self-rated reports of Korean proficiency on a 7-point scale (where 7 was excellent) were 6.21 for speaking ( $SD = 1.1$ ), 6.3 for listening ( $SD = 1.07$ ), 6.21 for reading ( $SD = 1.16$ ), and 6.07 for writing ( $SD = 1.21$ ). Their English reading proficiency was measured by using Subtest 2 of the Woodcock-Johnson test (Woodcock, McGrew, & Mather, 2001). Out of 98 questions, the average number of questions completed by participants was 26 ( $SD = 11$ ) during the 3-minute test time (with a range of 3 to 48 questions). Given that none of the participants completed all 98 questions and that the maximum number of questions completed was less than half of the test set indicates that participants' English reading comprehension was very limited.

### **Materials and procedure**

The design was a 2 (Stimulus Type: Borrowed vs. Non-borrowed words) x 3 (Segmentation Type: HOS vs. MOP vs. BOSS) repeated measures factorial. The task was lexical decision, and stimuli consisted of 120 English words and 120 non-words. Following Taft (2001, Experiment 3), stimuli were presented with a single gap inserted at different positions corresponding to either a BOSS or a MOP analysis, and with two gaps inserted corresponding to a HOS analysis or to a control condition. Further, half of the word stimuli were comprised of English words that have a borrowed form in written Korean (henceforth, "borrowed words"), and the other half consisted of non-borrowed words. The list of borrowed words was taken from a list available from the National Institute of Korean Language (1991, 2002). The borrowed words and non-borrowed

words were matched in terms of their frequency as noted in the MRC Psycholinguistic Database (Wilson, 1988), and included an equal number of items ( $n = 20$  words per type) with low frequency (1000 – 4000), mid frequency (4000 – 7000), and high frequency (7000 – 10000)<sup>1</sup>.

Stimuli were presented individually centered on a computer screen. As noted above, the stimuli contained spaces at different junctures corresponding to each of the three parsing analyses under investigation: MOP, BOSS, or HOS, the Hangul Orthographic Structure condition. The size of each space corresponded to two letters, as was the case in Taft's original design of the split-view lexical decision task (1979; 1986; 2001; 2002). This was done to make clear to the participants that the spaces were intentionally inserted.

The HOS condition was created based on how English words are adapted into Korean lexicon as loanwords (Oh, 2012), by matching the initial consonant of each syllabic block in Korean with the consonant in English. For example, the word “spirit” is written as 스피릿 in Hangul, and by matching the initial consonants in Korean with the consonants in English, the HOS condition of the word would become *s.pi.rit*. Following this rule, half of the stimuli included the onset-based words in which the Hangul adaptation leads to a segmentation in the onset (i.e., *flower*, in Hangul, is written as *f.lo.wer*, 플라워, with the segmentation occurring between *f* and *lo* of the original word); and the remaining half comprised of body-based words in which the Hangul adaptation

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<sup>1</sup> The frequency number stands for the rounded frequency per million word tokens.

leads to a segmentation in the body of the original word (i.e., the word “signal,” in Hangul, is written as *si.g.nal*, 시그널, with the segmentation occurring between *g* of the first syllable and *n* of the second syllable). Regardless of where the segmentation occurs, onset or body, all items were written as three-syllables in length.

For example, in the onset-based loanword *flower*, the HOS condition included two gaps as follows: F.LO.WER, corresponding to the Hangul-specific orthographic boundaries (*flower* would be presented as “FLO.WER” in the MOP condition, and as FLOW.ER in the BOSS condition; the dot here is intended to refer to the gap.) Similarly, in the body-based loanword, *signal*, the HOS condition would be presented as “SI.G.NAL”, whereas it would be “SIG.NAL” for MOP and “SIGN.AL” for BOSS condition. In accordance with Taft’s design (1979), all stimuli were presented in upper case letters using a black Arial font size 36.

The HOS condition was also applied to non-borrowed English words, using the same logic of matching the initial consonants of each syllable in Hangul as the basis for segmentation in English. Even though the non-borrowed English word would not have a written counterpart in Hangul, it was still possible to arrive at their segmentation based on how they would be transcribed if they were to be written in Hangul. For example, the word *prefer* is a non-borrowed English word, which is transcribed in Korean as the onset-based segmented word, *p/re/fer* (프리퍼 in Hangul). This word was presented in one of the three conditions: “P.RE.FER” in HOS, “PRE.FER” in MOP, and “PREF.ER” in BOSS; the same goes for the body-based non-borrowed English word, such as *kidnap*

(which will be transcribed in Hangul as *ki.d.nap*, or 키드냅) presented as “KI.D.NAP” in HOS, “KID.NAP” in MOP, and “KIDN.AP” in BOSS.

The three segmentation conditions were grouped in blocks as follows: in Set 1, both items 1-10 of words and non-words were presented with syllable boundaries corresponding to HOS, items 11-20 were presented in a MOP-segmentation, and items 21-30 were presented in a BOSS segmentation. For Set 2, items 11-20 were presented in boundaries corresponding to HOS, items 21-30 in MOP, and items 1-10 in BOSS; and finally, in Set 3, items 21-30 were presented in boundaries corresponding to HOS, items 1-10 in MOP, and items 11-20 in BOSS. Each participant was administered only one of the sets; thus, no participant saw a given item in more than one segmentation version, but each item was presented in each of the three versions across participants.

Dependent variables were accuracy rate and reaction time (in milliseconds), initiated at stimulus onset until participants made their response. Reaction time was measured using the Paradigm Experiments software installed on the computer (Perception Research System, 2007).

In addition, to control for the difference in the number of gaps within the stimuli in the HOS condition compared to those in the MOP and BOSS conditions, a 2-gap control condition was added to test whether differences between the conditions reflect number of gaps per se or something unique to the HOS condition. A total of 120 words in the 2-gap condition were used for this purpose. For the control condition, the gaps were placed immediately before and after the vowel. For example, in onset-based word *spirit*, the 2-gap control condition had the gaps as *sp.i.rit*, compared to *spir.it* (BOSS),

*s.pi.rit* (MOP), or *s.pi.rit* (HOS). Comparatively, in body-based word *signal*, the 2-gap control condition had the gaps as *si.gn.al* compared to *sign.al* (BOSS), *sig.nal* (MOP), or *si.g.nal* (HOS). Furthermore, a total of 120 non-words were constructed by either changing the onset of the first syllable (*printer-trinter, standard-blandard*), the coda of the first syllable (*poster-pogter, technique-teshniqie*), the onset of the second syllable (*witness-witmess, magnet-magpet*), or the coda of the second syllable (*picnic-picnid, publish-publith*). In all cases the non-words were pronounceable.

Participants were first asked to complete a language background questionnaire. Upon completion of the questionnaire, the lexical decision task was initiated. Participants were tested individually. They were seated in front of a computer screen and were instructed that they would be shown a string of letters and their task was to decide if the letters formed a word in English or not. They were instructed to answer as accurately and as fast as possible. In accordance with the instructions used in Taft (2001), participants were instructed to “simply ignore the gap between the items on the screen and determine if the item without the gap would make a word or not.” If the presented word is a real word, they were to press the “J” key on the computer keyboard, and the “F” key if the item was not a word. Each trial in the lexical decision task started with a focal point in the center, marked by “+”, which was replaced by a letter string after 400 ms. Participants advanced to the next trial at their own pace, as the new trial started on participants’ response (either “J” or the “F” key) of the previous trial. For the analysis of response latencies only correct responses were considered.

After completion of the lexical decision task, the reading proficiency test was administered, and participants were instructed to simply mark “Y” or “N” after reading a short sentence, as per the instructions of the Subtest 2 of the Woodcock-Johnson test. Some of the sample items were, “A cow is an animal” (in which case the correct answer would be Y), and “A fish lives on land” (in which case the correct answer would be N). Participants were told that they would be given a total of 3 minutes to respond to the set of items (98 questions in total), and that the timer would sound at the end of the 3 minutes, at which point they should stop answering the questions.

## **Results**

Before turning to the main findings I report the results of two preliminary analyses.

The first preliminary analysis was conducted to determine whether participants responded differently to words than to non-words in the study, that is, whether lexical status made a difference in reaction time. A repeated measures analysis of variance was conducted on mean response times as a function of 2 (lexical status: words vs. non-words) x 2 (stimulus type: borrowed vs. non-borrowed words) x 4 (segmentation type: HOS vs. MOP vs. BOSS vs. Control 2-gap). The results revealed significant main effects of lexical status,  $F(1, 44) = 30.73, p < .001$  and stimulus type,  $F(1, 44) = 11.09, p < .05$ , and a significant two-way interaction between lexical status and stimulus type,  $F(1, 44) = 4.63, p < .05$ . The three-way interaction was also significant,  $F(3, 42) = 5.05, p < .05$ .

The main effect of lexical status indicated that reaction time for non-words (2291.15 ms) was significantly longer than for words (1846.14 ms). Breakdown of the interaction of lexical status and stimulus type showed that in borrowed words, reaction time for non-words (1918.85 ms) was significantly longer than for words (1773.43 ms). Similarly in non-borrowed words, reaction time for non-words (2302.14 ms) was significantly longer than for words (2280.16 ms). Moreover, further analysis of the stimulus type by segmentation type interaction showed that reaction times were slower for non-words than words in each condition; HOS, borrowed:  $t(44) = -5.07, p < .001$ , non-borrowed:  $t(44) = -4.27, p < .001$ ; MOP, borrowed:  $t(44) = -4.68, p < .001$ , non-borrowed:  $t(44) = -2.59, p < .05$ ; BOSS, borrowed:  $t(44) = -2.62, p < .05$ , non-borrowed:  $t(44) = -4.01, p < .001$ ; and 2-gap, borrowed:  $t(44) = -5.9, p < .001$ , non-borrowed:  $t(44) = -3.04, p < .05$ .

Given that reaction time in non-words was consistently slower than that in words across all stimulus and segmentation types, this pattern of results indicates that the lexical status of the word significantly influences participants' word recognition performance. In accordance with previous studies on word recognition in which the discussion had been centered on word recognition of actual words (Taft, 1979; Chen & Vaid, 2007; Perry, 2013; among others), the trials in the non-words condition were subsequently dropped from further analysis.

After removing the non-word trials, a second preliminary analysis of variance was conducted (on the word stimuli only) to determine whether having two gaps vs. a single gap in the stimuli made a difference in response time. The analysis was a 2

(stimulus type: borrowed vs. non-borrowed words) x 4 (segmentation type: HOS vs. MOP vs. BOSS vs. Control 2-gap) repeated-measures analysis of variance. The results revealed significant main effects of stimulus type,  $F(1, 44) = 16.91, p < .001$  and segmentation type,  $F(3, 42) = 11.01, p < .001$ ; and a significant two-way interaction,  $F(3, 42) = 5.35, p < .001$ . Post-hoc comparisons of the interaction indicated that for borrowed words, reaction time in the 2-gap control condition ( $M = 2190.2$  ms) was significantly slower than that in the HOS condition (1739.15 ms),  $t(44) = -5.90, p < .001$ , the MOP condition (1783.43 ms),  $t(44) = -6.36, p < .001$ , and the BOSS condition (1928.33 ms),  $t(44) = -3.63, p < .001$ . Similarly, for non-borrowed words, response times were slower in the 2-gap condition ( $M = 2261.74$  ms) than in the HOS condition (1932.09 ms),  $t(44) = -3.84, p < .001$ , the MOP condition (1980.78 ms),  $t(44) = -3.6, p < .001$ , or the BOSS condition (1914.33 ms),  $t(44) = -4.5, p < .001$ .

If having two gaps inserted within an item would slow down lexical decision judgments compared to having a single gap, one would expect that items segmented according to HOS and the 2-gap control conditions would be significantly slower than those segmented according to the one gap MOP and BOSS conditions. Moreover, one would not expect a difference in response latency between the HOS and the 2-gap condition. However, the results from this analysis indicate that 1) both words and non-borrowed words in the (two-gap) HOS condition were nevertheless read significantly faster than those in the 2-gap condition, and 2) the mean reaction time to words presented in the HOS condition was faster than that to words presented in either of the 1-gap conditions. For example, within borrowed words, the mean average reaction time for

HOS was 1739.15 ms, as compared to the mean response latency for MOP (1783.43 ms) or BOSS (1928.33 ms). Therefore, one may conclude that number of gaps within a word does not account for the pattern of findings obtained, and that there is something specific to HOS that is relevant to explain this difference.

Having established that the pattern of response cannot be attributed merely to the presence of one gap vs. two gaps in the stimuli, the data from the two-gap control condition were removed and the remaining response time data for correct responses were entered into a 2 (borrowed vs. non-borrowed) x 3 (HOS vs. MOP vs. BOSS) repeated measures analysis of variance. A separate analysis was done on the mean accuracy scores. The mean scores on accuracy and reaction time are summarized in Table 1.

*Table 1.*  
Mean reaction time (in ms) and percent accuracy by stimulus type and segmentation condition

		Reaction Time	Percent Accuracy
Borrowed Words	HOS	1739.15 (661.72)	72.22 (23.78)
	MOP	1783.43 (667.7)	76.22 (18.59)
	BOSS	1928.33 (799.89)	75.78 (21.48)
Non-borrowed Words	HOS	1932.09 (756.02)	62.00 (24.18)
	MOP	1980.78 (697.37)	69.78 (20.37)
	BOSS	1914.44 (671.46)	67.33 (20.02)

*Note.* Standard deviations are indicated in parentheses.

### **Accuracy**

Mean percentage of correct responses (that is, correctly identifying that a string of letters was a word when it was in fact a word) was calculated for each stimulus type (borrowed vs. non-borrowed words) and segmentation type (HOS vs. MOP vs. BOSS) and entered into a 2 x 3 repeated measures analysis of variance. Significant main effects were found for stimulus type,  $F(1, 44) = 39.05, p < .001$ , indicating that the percent accuracy was higher for borrowed compared to non-borrowed words regardless of segmentation type. A main effect was also found for segmentation type,  $F(2, 44) = 3.16, p < .05$ . This revealed that mean accuracy was higher for MOP (73%) and BOSS (71.56%) than for HOS (67.1%). The two-way interaction was not significant. Figure 1 illustrates the accuracy results per segmentation type subdivided by stimulus type.

### **Reaction time**

Mean reaction time was calculated for each participant in each of the six conditions of stimulus type and segmentation type, as already presented in Table 1. As noted earlier, reaction time data from incorrect responses were eliminated from the analysis. The results of the 2 x 3 analysis of variance indicated a significant main effect of stimulus type,  $F(1, 44) = 13.2, p < .001$ , showing that responses were faster to borrowed than to non-borrowed words (1816.94 vs. 1992.44 ms, respectively). The main effect of segmentation type was not significant, indicating that responses were equally fast to words segmented according to MOP, BOSS and HOS.

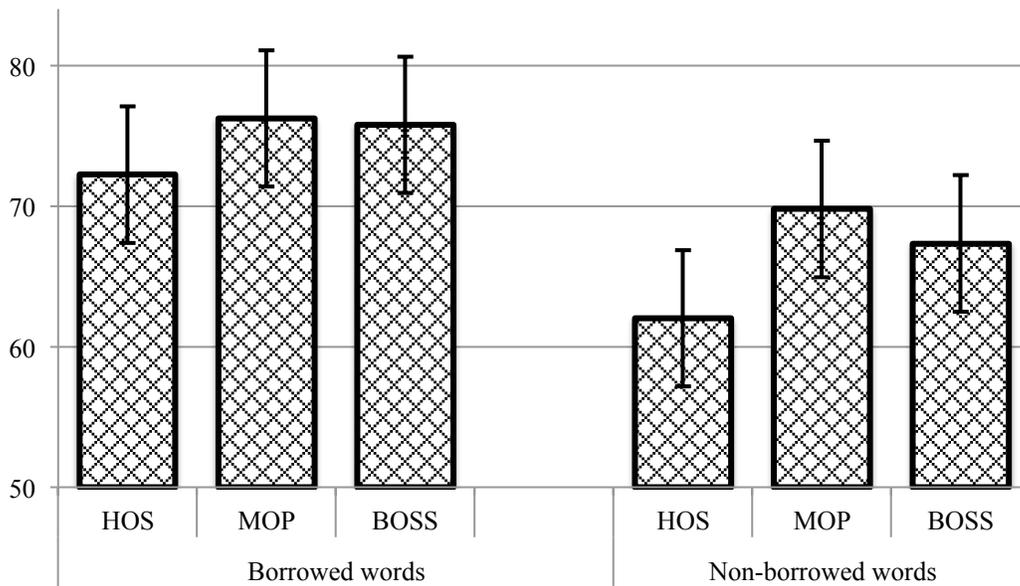


Figure 1. Mean percent accuracy of Korean-native biliterate readers' lexical decision performance by stimulus type and segmentation type.

However, the two-way interaction between stimulus type and segmentation type was significant,  $F(2, 43) = 3.57, p < .05$ . Further post-hoc analyses were conducted to pinpoint the source of the interaction effect. Comparing across borrowed vs. non-borrowed English words per condition, the analyses revealed that items with HOS analysis were read significantly faster in borrowed words compared to non-borrowed words,  $t(44) = -2.46, p < .05$  (see Figure 2). Moreover, items with a MOP analysis were read significantly faster in borrowed words compared to non-borrowed words,  $t(44) = -4.19, p < .001$ . However, no significant difference was found between borrowed and non-borrowed words for items segmented according to a BOSS analysis.

Additionally, post-hoc analyses revealed that within borrowed words, items with HOS analysis were read significantly faster compared to items with a BOSS analysis,

$t(44) = -2.06, p < .05$ , but there was no difference in response latencies to HOS vs. MOP analysis items. Furthermore, items with a MOP analysis showed a tendency to be faster than those with a BOSS analysis,  $t(44) = -1.95 p = .06$ . Notably, within non-borrowed words, none of the comparisons indicated a significant difference among any of the segmentation type (HOS, MOP, and BOSS).

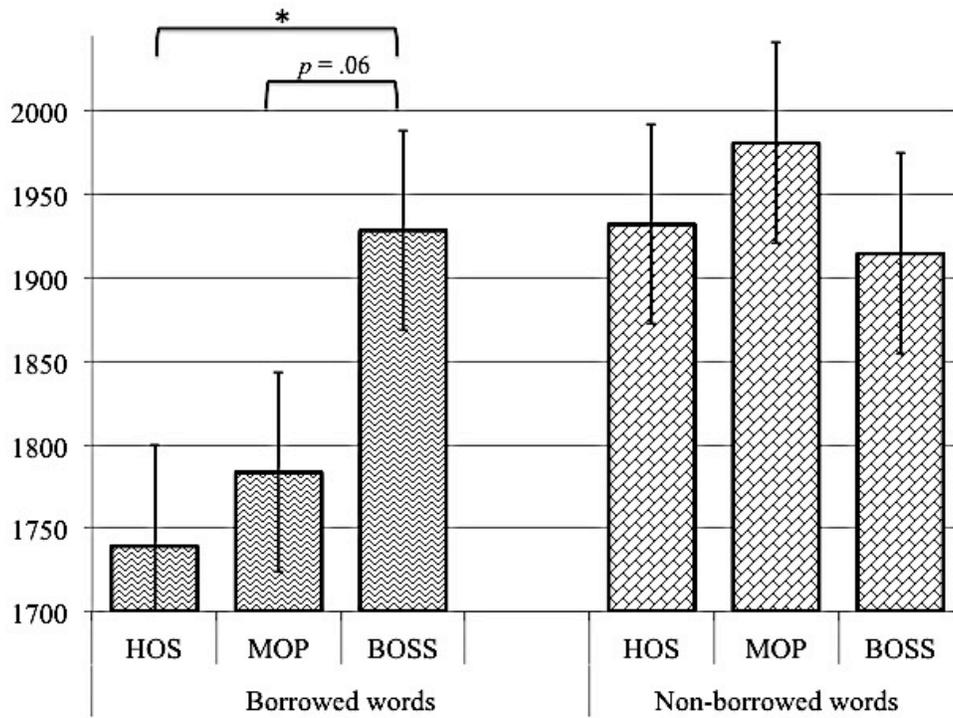


Figure 2. Mean reaction time of Korean-native biliterate readers' lexical decision performance by segmentation condition and stimulus type.

## Discussion

The main prediction of the study was that skilled Hangeul readers should show faster lexical decision responses to stimuli segmented based on a Hangeul orthographic

structure analysis than to stimuli segmented according to a BOSS analysis, particularly when the words had Hangul counterparts (were borrowed words). The results support this prediction: for borrowed words performance was significantly faster for items segmented according to a HOS analysis than according to a BOSS analysis. No significant HOS effect was found in the reading of non-borrowed words. Thus, the results provide clear support for the notion that properties of the L1 script affect L2 word reading (Vaid et al., 2004; Wang et al., 2003). Simply put, for words with a Korean equivalent written form, readers were influenced by their orthographic knowledge of Hangul, even when the word was presented in English. For non-borrowed words that do not have a Korean written form, HOS analysis did not provide any benefit, which further suggests that L1 orthographic knowledge strongly influences L2 word reading.

The lack of a BOSS advantage as illustrated in our sample could be interpreted as being consistent with the claim by Taft (2002) and others (Wang et al., 2003, 2007) that a BOSS advantage requires some degree of proficiency in English. Non-proficient L2 users of English (such as those tested in the present study) would thus not be expected to demonstrate a BOSS advantage in English word reading.

A second prediction made at the outset was that participants would show a preference for a MOP analysis over a BOSS analysis, given similar findings in prior work with Hangul readers (Chen, Vaid, & Choi, 2004) and with other readers of transparent L1 scripts. There was some support for this notion although the difference in response time to MOP vs. BOSS items was significant only at  $p = .06$ .

Taken together, the findings lead to the conclusion that cross-linguistic transfer of L1-specific orthographic knowledge occurs in L2 words with L1 nativized forms, and more generally that orthographic properties of L1 influence word reading in L2. In reading of English words, Korean readers seem to utilize a word parsing strategy that mirrors the Hangul-based structure, especially when the word has a Korean written equivalent. Thus, it can be concluded that a “HOS effect” is present in Korean-native biliterate readers’ word reading in English. This is the first demonstration of such an effect.

## CHAPTER IV

### EXPERIMENT II: THE ROLE OF LANGUAGE DOMINANCE AND THE HANGUL ORTHOGRAPHIC STRUCTURE EFFECT

The results from Experiment 1 indicated that for heavily Korean-dominant biliterate readers of English, the orthographic knowledge of Hangul was influential in how the readers approached word reading in English. While the presence of the HOS advantage in Korean-native biliterate readers demonstrated the important role of L1 orthographic knowledge in L2 word recognition, the question still remains with regards to the relationship between bilinguals' language dominance, their relative orthographic knowledge of both languages, and the amount of reliance of L1 orthographic knowledge as a result of such dominance. Therefore, reflecting on previous findings that suggested that the greater an individual's degree of literacy in Hangul the reliance on L1 orthographic knowledge becomes greater (Kim & Vaid, 2014), the degree to which cross-linguistic transfer occurs in L2 reading was examined in this second experiment.

The main research question here was whether biliterate readers with differing degrees of L2 language dominance would differ in their degree of reliance on an L1 parsing strategy. It was hypothesized that both Korean-dominant and English-dominant biliterate readers would demonstrate a HOS advantage in word recognition speed and accuracy, as participants in both groups are expected to rely on Hangul-specific orthographic knowledge, regardless of language dominance. However, as their orthographic knowledge of Hangul would presumably affect the level of biliterate

readers' L1 reliance on L2 reading, Korean-dominant readers were expected to show a stronger HOS advantage in reading of borrowed words compared to non-borrowed words (as found in the previous experiment) and English-dominant readers were not expected to show a difference between stimulus types.

Second, given previous findings that suggested that non-native speakers with non-alphabetic native script do not demonstrate a BOSS advantage in English word recognition speed (Taft, 2002), it was hypothesized that neither group would demonstrate a BOSS advantage in reaction time. However, reflecting on the evidence that suggests that readers with higher proficiency do benefit from the BOSS analysis (Taft, 2001; Perry, 2013), it was hypothesized that whereas Korean-dominant readers would demonstrate a stronger HOS advantage in accuracy compared to BOSS conditions across both stimulus types, this difference would not be found in English-dominant readers. Instead, it was hypothesized that English-dominant readers would demonstrate both the HOS and the BOSS effect of accuracy across both stimulus types.

Third, reflecting on previous findings with Hangul native readers that demonstrated a MOP advantage compared to BOSS (Chen et al., 2004), as well as based on the trend of MOP advantage from Experiment 1, it was hypothesized that Korean-dominant readers would demonstrate a MOP advantage relative to BOSS, particularly for borrowed words. Based on previous studies suggesting that L1 users of syllabic scripts (Taft, 2002) as well as alphasyllabic scripts (Vaid et al., 2004) benefit from a MOP analysis, it was hypothesized that English-dominant readers would demonstrate a

similar pattern of a MOP advantage, and that this would be found in both borrowed and non-borrowed words.

Finally, given that both the participants from Experiment 1 and the Korean-dominant participants would be equivalent in terms of their dominant language (Korean), it was hypothesized that any differences found in parsing strategy between the two groups could be attributed to English proficiency. In particular, it was hypothesized that while both groups would demonstrate a HOS advantage in word recognition speed, the readers with higher bilingual proficiency would demonstrate a statistical difference between the MOP and the BOSS conditions, based on their comparatively higher level of bilingual proficiency in English. For bilingual readers of lower proficiency, it was hypothesized that neither the MOP nor the BOSS analysis would significantly benefit their word reading in English, due to their very limited English orthographic knowledge, and instead would only demonstrate the HOS advantage.

## **Method**

### **Participants**

Data were collected at a large university in the southwestern United States. After removing 3 participants whose response exceeded 2 standard deviations from the mean, participants included 97 Korean-English bilingual biliterates (49 male), ranging in age from 18 to 49 years ( $M = 30.85$ ,  $SD = 10.21$ ).

Of those, 48 participants considered themselves to be Korean-dominant bilingual (KD). The KD participants' self-rated reports of proficiency on a 7-point scale for

Korean was 6.79 for speaking ( $SD = .53$ ), 6.81 for listening ( $SD = .45$ ), 6.83 for reading ( $SD = .43$ ), and 6.75 for writing ( $SD = .56$ ), and for English it was 4.46 for speaking ( $SD = .97$ ), 4.67 for listening ( $SD = .95$ ), 4.77 for reading ( $SD = 1.02$ ), and 4.38 for writing ( $SD = 1.08$ ). The KD participants reported to use a daily average of 69.69% for Korean ( $SD = 14.08\%$ ) and 28.22% for English ( $SD = 14.58\%$ ).

The other 49 participants rated themselves as English-dominant bilingual (ED). The ED participants' self-rated reports of proficiency on a 7-point scale for Korean was 5.06 for speaking ( $SD = 1.3$ ), 5.27 for listening ( $SD = 1.15$ ), 4.73 for reading ( $SD = 1.38$ ), and 4.57 for writing ( $SD = 1.47$ ), and for English it was 6.94 for speaking ( $SD = .24$ ), 6.94 for listening ( $SD = .24$ ), 6.94 for reading ( $SD = .24$ ), and 6.94 for writing ( $SD = .24$ ). The KD participants reported to use a daily average of 28.22% for Korean ( $SD = 14.58\%$ ) and 70.82% for English ( $SD = 15.46\%$ ).

### **Materials and procedure**

For the lexical decision task, a 2 (Stimulus type: Borrowed vs. Non-borrowed words) x 3 (Segmentation Type: HOS vs. MOP vs. BOSS) mixed factorial design was used, with language dominance group (Korean-dominant vs. English-dominant) as a between-subjects factor. The stimuli used and the experimental procedure were the same as Experiment 1. The reading proficiency test was not administered in Experiment 2.

### **Results**

As in Experiment 1, a preliminary analysis of variance was conducted to determine whether lexical status made a difference in reaction time. The analysis was a 2

(lexical status: words vs. non-words) x 2 (stimulus type: borrowed vs. non-borrowed words) x 4 (segmentation type: HOS vs. MOP vs. BOSS vs. Control 2-gap) repeated-measures analysis of variance. The results revealed a significant main effect of lexical status,  $F(1, 96) = 38.34, p < .001$ , and a significant two-way interaction of lexical status and stimulus type,  $F(1, 96) = 14.59, p < .001$ , as well as an interaction of stimulus type and segmentation type,  $F(3, 96) = 3.37, p < .05$ . The three-way interaction was not significant.

The main effect of lexical status indicated that reaction time for non-words (891.16 ms) was significantly longer than for words (832.93 ms). Breakdown of the interaction of lexical status and stimulus type showed that whereas for both borrowed and non-borrowed stimuli responses were faster to words than to non-words, the word superiority effect was much larger for borrowed items: borrowed items: non-words - 896.52 ms, words - 823.69 ms; non-borrowed items: non-words - 885.81 ms, words - 842.17 ms. Moreover, further analysis of the stimulus type by segmentation type interaction showed that reaction times were slower for non-words than words in each condition; HOS, borrowed:  $t(96) = -6.18, p < .001$ , non-borrowed:  $t(96) = -3.20, p < .01$ ; MOP, borrowed:  $t(96) = -5.09, p < .001$ , non-borrowed:  $t(96) = -2.89, p < .01$ ; BOSS: borrowed:  $t(96) = -5.23, p < .001$ , non-borrowed:  $t(96) = -3.71, p < .001$ ; and 2-gap, borrowed:  $t(96) = -4.55, p < .001$ , non-borrowed:  $t(96) = -3.28, p < .001$ .

As discussed in Experiment 1, given that reaction time in non-words was consistently lower than that in words across all stimulus and segmentation types, it seems logical to argue, based on the pattern of results, that the lexical status of the word

significantly influences participants' word recognition performance. Therefore, in accordance with previous studies on word recognition in which the discussion had been centered on word recognition of actual words (for example, Taft, 1979; Chen & Vaid, 2007; Perry, 2013; among others), the non-word data from the current experiment were dropped from further analysis.

After removing the non-word trials, another analysis of variance on the word stimuli only was conducted to determine whether having two gaps vs. a single gap in the stimuli made a difference in response time. The analysis was a 2 (stimulus type: borrowed vs. non-borrowed words) x 4 (segmentation type: HOS vs. MOP vs. BOSS vs. Control 2-gap) repeated-measures analysis of variance.

The results revealed significant main effects of stimulus type,  $F(1, 96) = 4.59, p < .05$  and segmentation type,  $F(3, 94) = 6.31, p < .001$ , and a significant two-way interaction between stimulus type and segmentation type,  $F(3, 94) = 3.09, p < .05$ . Post-hoc comparisons indicated that for borrowed words, reaction time in the 2-gap control condition ( $M = 902.72$  ms) was significantly slower than that in the HOS condition (827.32 ms),  $t(96) = -6.44, p < .001$ , the MOP condition (825.81 ms),  $t(96) = -6.19, p < .001$ , and the BOSS condition (876.06 ms),  $t(96) = -2.71, p < .05$ . Similarly, for non-borrowed words, response time to stimuli in the 2-gap condition ( $M = 904.96$  ms) was slower than that to the HOS condition (837.25 ms),  $t(96) = -5.43, p < .001$ , to the MOP condition (831.45 ms),  $t(96) = -6.48, p < .001$ , as well as to the BOSS condition (882.93 ms),  $t(96) = -2.27, p < .05$ .

As discussed in Experiment 1, the pattern of results can be taken to argue that performance on the HOS task cannot be attributable merely to the fact that it had two gaps whereas the other conditions had one gap, given that the two-gap control condition was significantly slower than the (two-gap) HOS condition. Since the pattern of response cannot be attributed merely to the presence of one gap vs. two gaps in the stimuli, the data from the 2-gap control condition were removed and the remaining data were entered into a 2 (Stimulus type: borrowed vs. non-borrowed) x 3 (Segmentation type: HOS vs. MOP vs. BOSS) x 2 (Group: Korean-dominant vs. English-dominant) analysis of variance. The mean accuracy and reaction time results are summarized in Table 2.

### **Accuracy**

Percentage of correct responses was calculated for each stimulus type (borrowed vs. non-borrowed words) and segmentation type (HOS vs. MOP vs. BOSS), per language dominance group (Korean-dominant vs. English-dominant). The design was a mixed factorial with stimulus type and segmentation type as the within-subjects variables and language dominance group as the between-subjects manipulation.

A significant main effect was found for language dominance group,  $F(1, 95) = 49.75, p < .001$ , and segmentation type,  $F(2, 94) = 29.96, p < .001$ . All of the two-way interactions were significant: stimulus type and language dominance,  $F(1, 95) = 6.33, p < .001$ ; segmentation type and language dominance,  $F(1, 95) = 2.56, p < .05$ ; and stimulus type and segmentation type,  $F(2, 94) = 4.47, p < .05$ . In addition, the three-way interaction was significant,  $F(2, 94) = 7.12, p < .001$ .

Table 2.

Mean reaction time (in ms) and percent accuracy of Korean-dominant and English-dominant biliterate readers' lexical decision performance by condition

		Korean Dominant Biliterate Readers ( <i>n</i> = 48)		English Dominant Biliterate Readers ( <i>n</i> = 49)	
		RT	Accuracy	RT	Accuracy
Borrowed Words	HOS	979.11 (202.93)	91.98 (8.98)	678.63 (99.22)	97.76 (3.96)
	MOP	969.85 (207.79)	84.06 (11.61)	684.71 (86.85)	93.88 (5.13)
	BOSS	1055.90 (258.20)	85.68 (10.73)	720.30 (112.37)	96.38 (4.02)
Non- borrowed Words	HOS	995.44 (214.18)	91.72 (8.99)	682.29 (96.71)	97.45 (4.91)
	MOP	981.03 (226.68)	83.91 (12.78)	684.92 (83.04)	93.57 (6.50)
	BOSS	1050.80 (882.93)	87.42 (9.97)	718.49 (110.14)	95.84 (4.74)

Note. Standard deviations are noted in the parentheses.

Following the significant main effects of language dominance group as well as significant interaction effects, separate post-hoc analyses were conducted for language dominance group. Figure 3 depicts the mean accuracy rate results. For borrowed words, Korean Dominant participants showed higher accuracy for HOS compared to the MOP condition,  $t(47) = 6.46, p < .001$ , and HOS compared to the BOSS condition,  $t(47) =$

3.92,  $p < .001$ . The HOS accuracy advantage was also found for non-borrowed words: HOS compared to MOP,  $t(47) = 4.98, p < .001$ ; HOS compared to BOSS,  $t(47) = 2.8, p < .05$ .

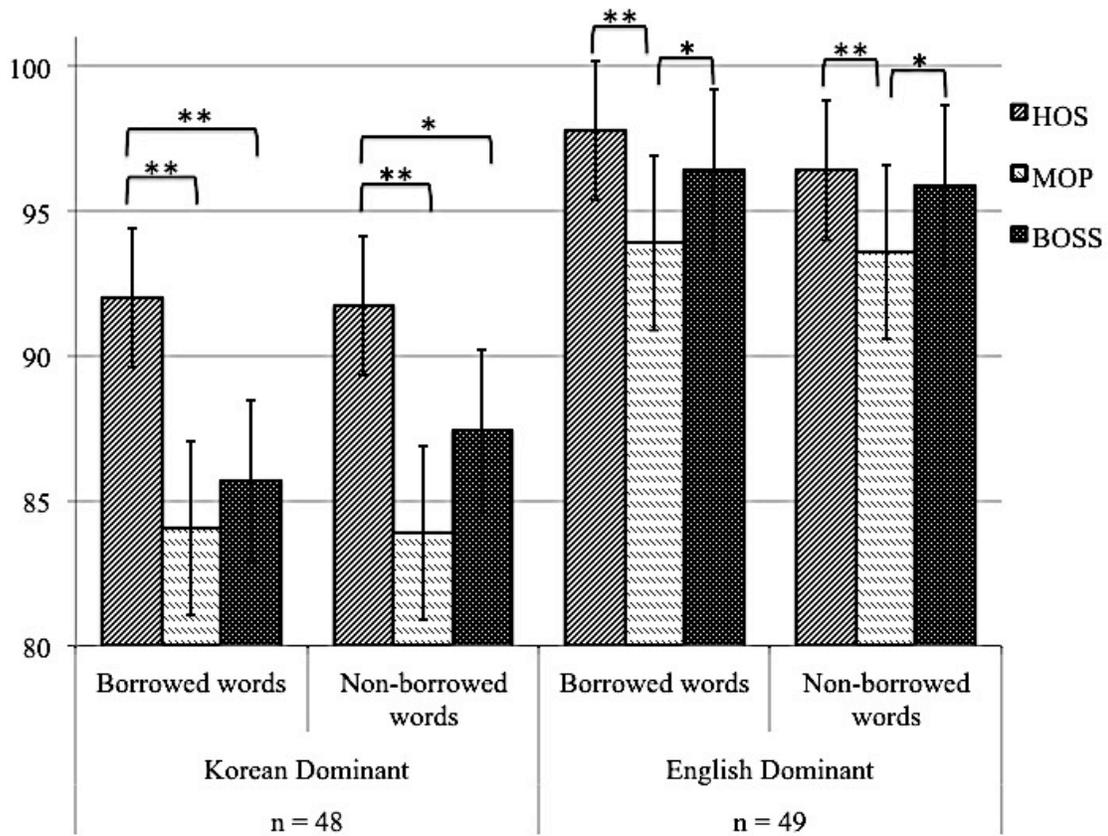


Figure 3. Mean percent accuracy of readers' lexical decision performance by stimulus type and segmentation type per language dominance group.

For English Dominant participants, the accuracy rate for borrowed words was significantly higher in the HOS than in the MOP condition,  $t(48) = 4.24, p < .001$ , and in the BOSS compared to the MOP condition,  $t(48) = 2.61, p < .05$ . The English Dominant

participants also showed higher accuracy for HOS than MOP for non-borrowed words,  $t(48) = 3.37, p < .001$ , and for BOSS compared to MOP,  $t(48) = 2.04, p < .05$ . No significant difference was found between the accuracy rate in HOS compared to BOSS condition for either stimulus type.

### **Reaction time**

Mean reaction time was calculated for each participant in each of the six conditions of stimulus type and segmentation type, for both KD and ED participants. Reaction time data from incorrect responses were eliminated from the calculation. The results indicated significant main effects of language dominance group,  $F(1, 95) = 93.52, p < .001$ , stimulus type,  $F(1, 95) = 4.36, p < .05$ , as well as for segmentation type,  $F(2, 94) = 8.03, p < .001$ . The two-way interaction between stimulus type and segmentation type was significant,  $F(2, 94) = 4.9, p < .05$ . A three-way interaction was not found.

The stimulus type and segmentation type interaction was examined at each level of group, given a priori predictions involving group (see Figure 4). For Korean Dominant participants, responses were faster in the HOS condition than in the BOSS for borrowed words,  $t(47) = 2.87, p < .05$ ; but not for non-borrowed words. The differing amount of HOS effect per stimulus type was significant,  $t(47) = 2.39, p < .05$ . For KD participants a MOP advantage relative to BOSS was observed in both borrowed words,  $t(47) = 3.28, p < .05$ ; as well as in non-borrowed words,  $t(47) = 2.37, p < .05$ . No significant differences were found between the HOS and the MOP conditions, across both stimulus types.

For English Dominant participants, the HOS advantage to BOSS was observed in both borrowed words,  $t(48) = 4.37, p < .001$ , and in non-borrowed words alike,  $t(48) = 3.99, p < .001$ . No statistical difference was found between the amounts of HOS effect per stimulus type. The MOP advantage to BOSS was observed in both borrowed words,  $t(48) = 3.69, p < .001$ ; as well as in non-borrowed words,  $t(48) = 3.23, p < .05$ . No significant differences were found between the HOS and the MOP conditions, across all stimulus types.

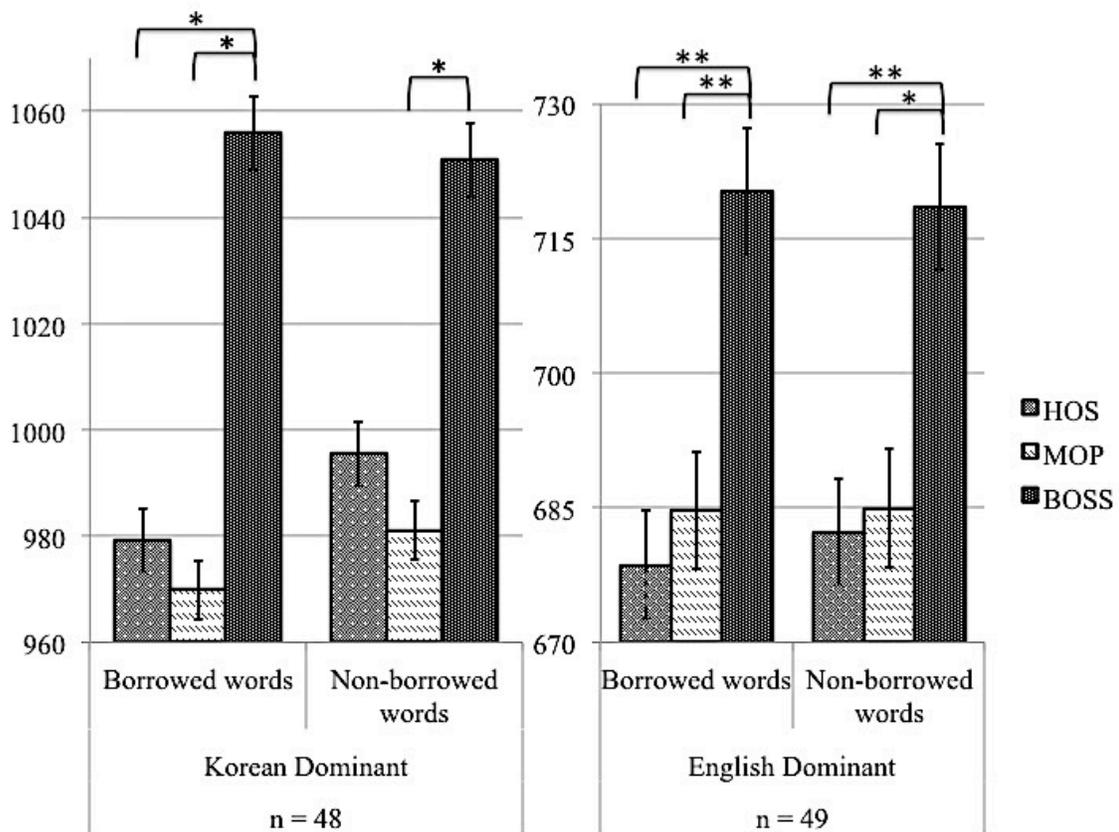


Figure 4. Mean reaction time of biliterate readers' lexical decision performance by stimulus type and segmentation type, separately grouped by language dominance.

### **Comparison between two groups of Korean-dominant readers**

Additional analyses were conducted to compare the performance among the Korean-dominant readers, which included the heavily Korean-dependent readers from Experiment 1 (Lower Bilingual proficiency, LB,  $n = 45$ ) and the Korean Dominant participants from Experiment 2 (Higher Bilingual proficiency, HB,  $n = 48$ ). The data included in the analyses were percentage of correct responses and the mean reaction time calculated for each stimulus type (borrowed vs. non-borrowed words) and segmentation type (HOS vs. MOP vs. BOSS) per bilingual proficiency group (LB vs. HB). A 2x2x2 mixed factorial analysis of variance was conducted for reaction time and accuracy with repeated measures on stimulus type and segmentation type, and with bilingual proficiency group as the between-subjects manipulation.

*Accuracy.* For accuracy, the results indicated a significant main effect of stimulus type,  $F(1, 91) = 35.74, p < .001$ , and a main effect of proficiency group,  $F(1, 91) = 35.39, p < .001$ . The two-way interaction between segmentation type and group was also significant,  $F(2, 90) = 9.41, p < .001$ , as was the interaction of stimulus type and group,  $F(1, 91) = 44.16, p < .001$ . The higher order interaction was not significant. The mean accuracy rate for both bilingual proficiency groups is depicted in Figure 5.

As evident from Figure 5, whereas Low Bilingual proficiency readers show a difference between borrowed and non-borrowed words, this was not the case in High Bilingual proficiency readers. In LB readers, the difference between stimulus type was statistically significant for all segmentation types, with significantly higher accuracy rate for borrowed words compared to non-borrowed words; HOS:  $t(44) = 4.96, p < .001$ ;

MOP:  $t(44) = 3.23, p < .001$ ; BOSS:  $t(44) = 3.75, p < .001$ . In contrast, in HB readers, significant differences between stimulus type were only found in the BOSS condition,  $t(47) = 5.7, p < .001$ , and the accuracy rate was higher in non-borrowed words compared to borrowed words. Thus, it seems logical to state that for LB readers there exists a difference between words that have a Korean written rendition vs. those do not. For HB readers with higher English orthographic knowledge, both the borrowed and the non-borrowed words show an equivalent accuracy rate.

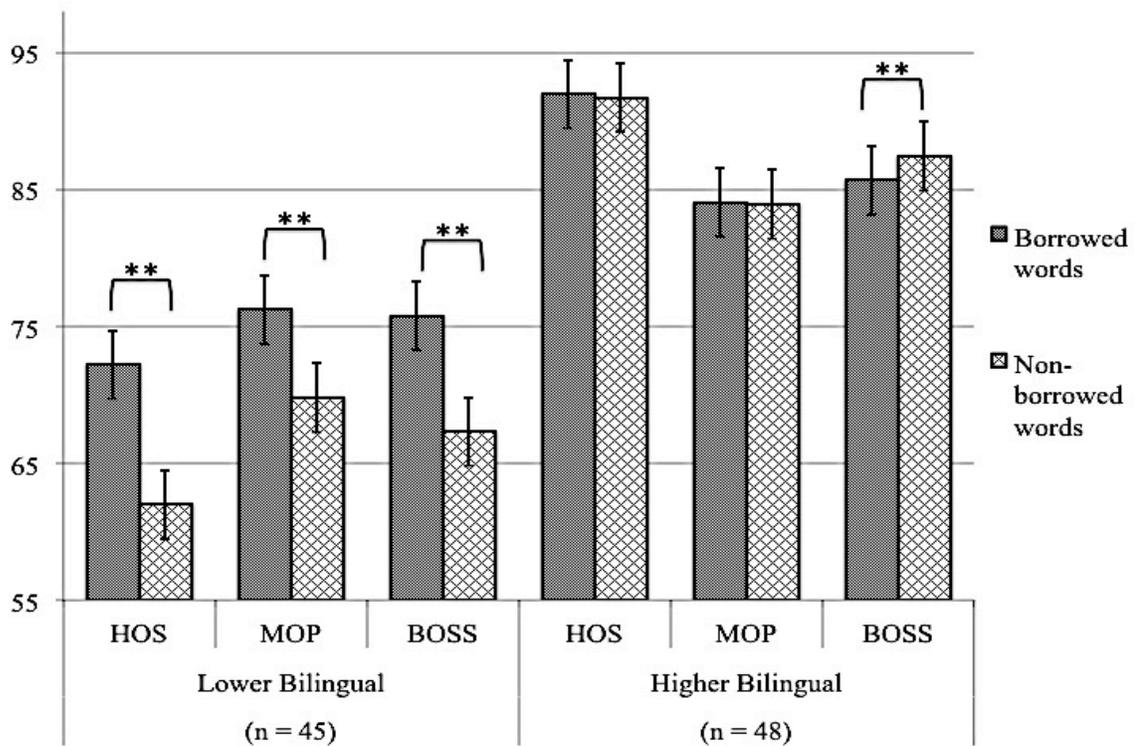


Figure 5. Mean percent accuracy of biliterate readers' lexical decision performance by stimulus type and segmentation type, separately grouped by bilingual proficiency.

*Reaction time.* For reaction time, the results indicated significant main effects of group,  $F(1, 91) = 78.81, p < .001$ , stimulus type,  $F(1, 91) = 15.63, p < .001$ , and segmentation type,  $F(2, 90) = 4.19, p < .05$ . The two-way interaction between stimulus type and segmentation type was significant,  $F(2, 90) = 4.44, p < .05$ , as was the interaction of stimulus type and group,  $F(1, 91) = 12.32, p < .001$ . The three-way interaction between stimulus type, segmentation type, and bilingual proficiency group was also significant,  $F(2, 90) = 3.23, p < .05$ .

Figure 6 provides the mean reaction time for both bilingual groups. Inspection of Figure 6 indicates that LB readers demonstrate a difference between stimulus types (borrowed vs. non-borrowed words) for both the HOS and the MOP condition, as confirmed by previous simple effects analyses (HOS:  $t(44) = 2.46, p < .05$ ; MOP:  $t(44) = 4.19, p < .001$ ). With regards to the HOS condition, HB readers demonstrate this difference as well but only for HOS,  $t(47) = 2.39, p < .05$ ; the difference by stimulus type in the MOP condition was not significant for HB readers. While both groups demonstrate a similar HOS advantage across both stimulus types, it is noteworthy that for HB readers the MOP effect is not observed. Thus, it would appear that for LB readers with comparatively lower English orthographic knowledge reliance on a more phonology-based segmentation strategy is beneficial in word recognition.

Moreover, it can also be stated that along with the increase in English orthographic knowledge, this phonological reliance in word reading is diminished, as evidenced by the absence of a borrowed/non-borrowed difference in the MOP effect in HB readers. Furthermore, it can be stated that regardless of the level of English

orthographic knowledge, the biliterate readers demonstrate a reliance on Hangul-specific orthographic knowledge, thereby demonstrating a cross-linguistic transfer of word parsing strategies between the readers' L1 and L2.

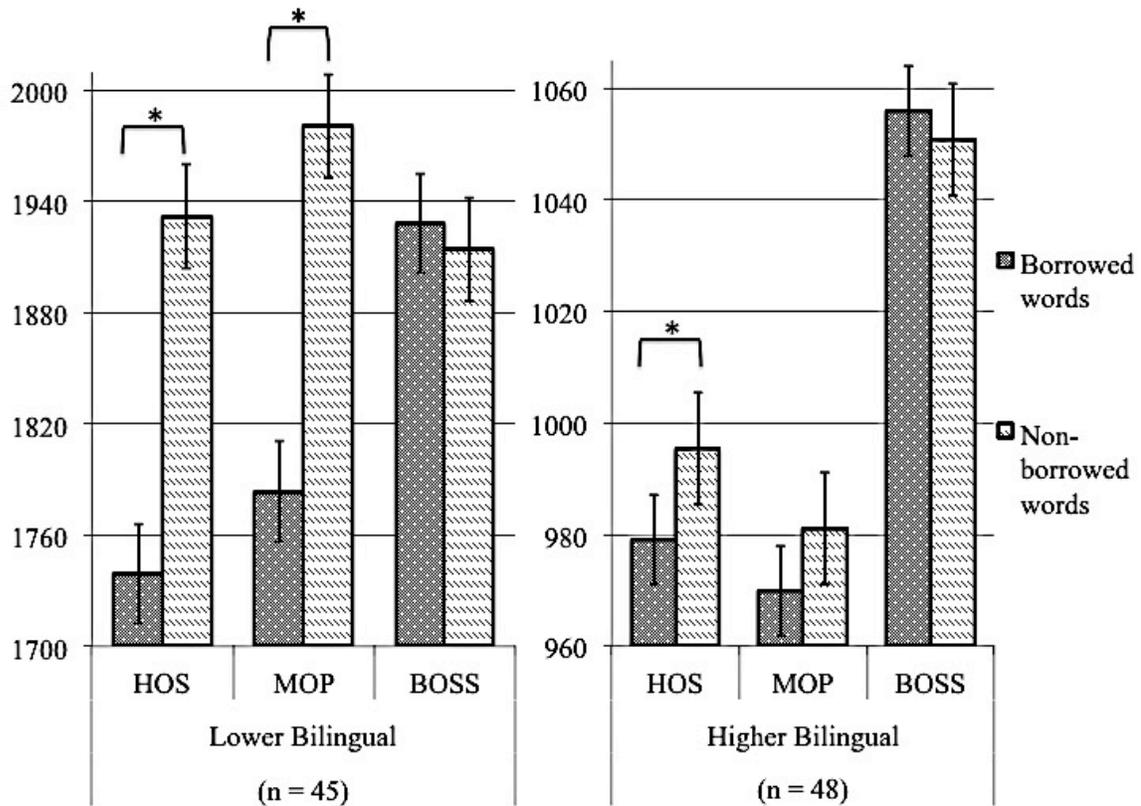


Figure 6. Mean reaction time of biliterate readers' lexical decision performance by stimulus type and segmentation type, separately grouped by bilingual proficiency.

## Discussion

The main prediction of the study was that greater orthographic proficiency in Hangul would result in a HOS effect emerging for borrowed words only, whereas less

proficiency in written Hangul would result in an overall HOS effect regardless of stimulus type. This prediction was supported: whereas Korean-dominant biliterate readers demonstrate a stronger HOS advantage in the recognition of borrowed words compared to non-borrowed words, similar to the participants from Experiment 1, the English-dominant readers did not show this difference between stimulus types. Thus, the results provide clear evidence that language dominance does influence the amount of reliance on L1 orthographic knowledge in L2 word reading. Simply put, for Korean-dominant readers, borrowed words were not treated as the same as non-borrowed words, due to their orthographic knowledge of Hangul in which borrowed words are represented with a Korean rendition. For English-dominant readers, while their oral proficiency in Korean was of similar level to Korean-dominant counterparts, their comparatively lower orthographic skills in Hangul led them to treat borrowed and non-borrowed words equally. Regardless, the fact that the HOS effect was observed across different groups indicate that word parsing in English is strongly influenced by the orthographic properties of Hangul.

A second prediction made at the outset was that a BOSS advantage would not be observed, except perhaps in the English-dominant group. The findings partially supported this prediction in that no BOSS advantage was observed in reaction time, but in accuracy English-dominant readers showed a BOSS effect (together with a HOS effect). This particular result corroborates claims by Taft (2001; 2002), Wang et al. (2003), Wang et al. (2007), and Perry (2013) that more proficient English readers benefit from a BOSS analysis. In the case of our participants, it could be understood that

English-dominant readers would possess a richer orthographic knowledge of English compared to Korean-dominant readers, which led them to recognize words segmented according to the BOSS analysis with higher accuracy than the MOP analysis.

It is noteworthy that for English-dominant readers, while the BOSS analysis assists with correctly identifying a given word, it does not lead to a fast recognition speed. As noted earlier, the English-dominant participants self-reported to be native readers of English. The fact that English-dominant participants did not show a similar BOSS advantage in reaction time suggests three things: 1) the BOSS advantage from Taft's experiments (1979; 2001) should be interpreted to mean that native *monolingual* readers of English may benefit from a BOSS analysis, 2) even among native readers of English, the presence of an added orthography may lead biliterate readers to not show a BOSS advantage, and 3) for biliterate readers, the nature of both orthographic system interacts with one another, as argued by Wang et al. (2003) and Vaid et al. (2004), thereby demonstrating a unique set of word parsing strategies in L2 reading, as shown in the English-dominant Korean-English biliterate participants. From the English-dominant readers in Experiment 2, it seems evident that the HOS effect is a much stronger influence than the BOSS effect in their reading of English words.

A third prediction was that participants would show a preference of a MOP analysis over a BOSS analysis, in accordance with similar findings from previous studies with Hangul readers (Chen et al., 2004), but that a MOP preference would be shown only in borrowed words for Korean-dominant readers, and in both borrowed and non-borrowed words for English-dominant readers. The findings supported this hypothesis as

illustrated by a preference of a MOP analysis over a BOSS analysis in both groups, but an unexpected MOP preference was also found in Korean-dominant readers' reading of non-borrowed words. This particular finding of a MOP advantage extends the findings of Taft (2002) and Vaid et al. (2004), as well as the findings from Experiment 1, in which non-native readers of non-alphabetic systems were shown to recognize the words with higher speed when segmented according to the MOP analysis. Not only do our participants demonstrate a MOP advantage, but also considering the strong HOS advantage found in our sample, it can be argued that the combination of both the MOP and the HOS advantage may be attributed to the alphasyllabic nature of Hangul orthography. While syllabic boundaries are not demarcated in writing of English words, it seems that Hangul-biliterate English readers nevertheless benefit from the alphasyllabic syllabification, much like the way Hangul is written. Therefore, it seems logical to argue that biliterate reading of English words is not independent of the orthographic knowledge of Hangul.

The final prediction was that whereas readers with low bilingual proficiency would demonstrate a HOS effect only in borrowed words, readers with high bilingual proficiency would demonstrate a preference for both a HOS and a MOP analysis. The results supported this prediction: whereas a HOS effect was present in both groups of Korean dominant readers, the readers with higher bilingual proficiency also demonstrated a preference for a MOP analysis over a BOSS analysis. This finding seems to indicate that with an increase in bilingual proficiency, readers become more apt to

employ a phonology-based parsing strategy, which may in turn lead to their developing a preference for MOP segmentation.

Finally, given that all three groups (Korean-native readers from Experiment 1, Korean-dominant and English-dominant bilingual readers from Experiment 2) demonstrate a preference for a MOP analysis regardless of bilingual proficiency or language dominance, it can be argued that the preference for the MOP strategy does not entirely stem from an employment of phonological strategies due to lack of orthographic knowledge. Rather, it would appear that a MOP analysis was used favorably because of the common element in all three groups, namely, the nature of the biliterate readers' L1. While bilingual proficiency and language dominance may determine the extent to which a MOP preference is shown, it seems that all three groups demonstrate a preference of both the HOS and the MOP analysis, both reflecting the orthographic properties of Hangul, particularly in its transparency of grapheme-phoneme correspondence and an increased syllable awareness in word reading (Cho & McBride-Chang, 2005b; Kim & Cho, 2001).

Taken together, the results from Experiment 2 provide evidence that for Korean-English biliterate readers, word reading in English is not independent of the orthographic knowledge of Hangul; rather, biliterate reading strongly reflects the nature of the L1 orthography. While language dominance does play a role in determining the extent of orthographic reliance on Hangul, it seems that for readers with more than one orthographic system, the nature of the L1 script seems to be a much stronger element in determining the reading behavior. In particular, it seems that for biliterate readers, their

native orthography provides a template upon which word reading in L2 occurs; thus, it can be argued that while orthographic properties of both systems interact with one another, the selection of word parsing strategies in L2 reflects properties of L1 orthography.

## CHAPTER V

### GENERAL DISCUSSION AND CONCLUSION

The aim of the present study was to explore further the relationship between biliterate readers' orthographic knowledge of L1 and L2, as reflected in L2 word recognition strategy. In particular, biliterate readers' word parsing strategy selection in English was investigated in detail, specifically by observing how orthographic properties of Hangul would be reflected in biliterate participants' parsing of English words. Table 3 provides a summary of the predictions and results from the two experiments.

Experiment 1 was motivated by the lack of specific attention in previous studies of L2 word recognition to L1 orthography-specific parsing strategies. In particular, whereas a previous study conducted with Hangul-native readers' English word parsing strategy demonstrated a strong preference for a MOP analysis compared to a BOSS analysis (Chen, Vaid, & Choi, 2004), the study design did not provide a test of whether an alternative parsing strategy, one based on a Hangul-appropriate analysis, might show an even stronger effect. Therefore, to examine the role of L1 orthographic knowledge in L2 word recognition, an additional segmentation condition was introduced to reflect orthographic properties of Hangul in reading of English words. Moreover, to examine the level of cross-linguistic transfer of L1 orthographic knowledge, the stimuli were comprised of English words that are borrowed into Korean as well as non-borrowed words. For participation in the adapted version of the split-view lexical decision task

devised by Taft (1979; 1981), heavily Korean-dependent Korean-native speakers were recruited.

*Table 3.*  
Summary of the predictions and outcomes from Experiments 1 and 2.

		Predictions	Outcomes
Korean- Heavy (Exp. 1)	Speed	HOS < BOSS, Borrowed only	(O)
		MOP < BOSS, Borrowed only	<i>Trend</i>
	HOS Effect	Borrowed > Non-borrowed	(O)
		HOS Effect: Yes	(O)
	Accuracy	BOSS Effect: No	(O)
Korean- Dominant Bilinguals (Exp. 2)	Speed	HOS < BOSS, All words	(O)
		MOP < BOSS, Borrowed only	(O; <i>All words</i> )
	HOS Effect	Borrowed > Non-borrowed	(O)
		HOS Effect: Yes	(O)
	Accuracy	BOSS Effect: No	(O)
English- Dominant Bilinguals (Exp. 2)	Speed	HOS < BOSS, All words	(O)
		MOP < BOSS, All words	(O)
	HOS Effect	Borrowed = Non-borrowed	(O)
		HOS Effect: Yes	(O)
	Accuracy	BOSS Effect: Yes	(O)

The reaction time results from Experiment 1 revealed a strong HOS advantage in English word reading in borrowed words, but not in non-borrowed words. Even though all participants had very limited proficiency in English, participants nevertheless demonstrated a higher success rate in recognition of words that have a L1 nativized form. In accordance with findings such as those of Wang et al. (2003), Wang et al. (2007), and Vaid et al. (2004), this result also indicated that the orthographic properties of L1 are evident in L2 word reading; while the HOS analysis significantly assisted in English words that have a Korean rendition (borrowed words), this was not the case for words that do not have a Korean written equivalent (non-borrowed words). From these results, it can be stated that the results demonstrate how L2 word recognition is not independent of L1 orthographic knowledge of biliterate readers.

The stimulus type manipulation (borrowed vs. non-borrowed words) introduced in Experiment 1 also provided implications for further investigation on L1 orthographic influence in L2 word recognition. To date, whereas homophones have been used in investigations on phonological processing of bilinguals (for example, Ben-Dror, Frost, & Bentin, 1995; Vaid & Chen, 2010; among others), previous lexical decision studies on biliterates' word recognition (Taft, 2002; Chen et al., 2004; Vaid et al., 2004; Vaid, Rao, & Chen, 2006) did not specifically look at how words that have a L1-nativized form would be processed differently from words that do not. While it may be inadequate to incorporate the borrowed vs. non-borrowed variable in some scripts, such as Japanese (as noted by Taft, 2002, as borrowed words are written in different orthography than non-borrowed words), for other scripts in which both the borrowed and non-borrowed

words are represented in the same orthography, inclusion of this variable would enable the demonstration of readers' reliance on L1 orthographic knowledge in L2 lexical processing.

Based on the findings from Experiment 1 that demonstrated the presence of a HOS effect in Korean-English biliterates, investigation on the role of bilingual proficiency in HOS effect was conducted. Experiment 2 included Korean-English bilingual speakers that differ in language dominance. The results indicated that the different levels of L1 orthographic knowledge between the groups was reflected in the discrimination between borrowed and non-borrowed words as shown by Korean-dominant readers, but not by English-dominant counterparts. Nevertheless, the HOS effect was observed in both groups, further suggesting that even for biliterate readers who self-report to be a native reader of English with lower reading/writing proficiency in Hangul, the orthographic properties of Hangul were reflected in their English word recognition.

This pattern of results could be explained, as in Yamada (2004), due to the visuospatial nature of Hangul that provides visual salience to phonemes. Thus, the phonemic awareness in Hangul serves to assist phonological awareness in English and lead participants to prefer a HOS strategy, not because of the Hangul-specific orthographic knowledge. However, according to Pae, Sevcik and Morris (2010), emergent biliterate readers demonstrate increased attention to phonemes in Korean word recognition, but to phonological segments (onsets and rimes) in English word recognition, due to difference in the level of grapheme-phoneme correspondence of

Korean and English. In this case then, the HOS strategy could interfere with English word recognition, as the HOS segmentation does not correctly reflect onsets and rimes in English. Moreover, if phonemic awareness in Hangul was the decisive factor in participants' choice of word parsing strategy, the HOS segmentation would not be beneficial, as illustrated by Yoon, Bolger, Kwon and Perfetti (2002) that emphasized the sensitivity to phoneme codas in bilinguals' English word reading. The segmentation that most closely emphasizes the phoneme codas would correspond to the BOSS analysis, the preference of which was not observed in our sample.

More notably, if word reading is language-specific and the HOS effect stems from the readers' phonemic awareness in Hangul that assisted in English word recognition, it should still not demonstrate any differences between participants' reading of borrowed and non-borrowed words. However, given that a HOS strategy was preferred only in borrowed words, in Korean-heavy readers and the Korean-dominant bilingual readers alike, it seems logical to argue that the readers' preference of a HOS strategy stems not from the phonological transparency of Hangul and its consequent influence on phonological decoding of English words, but from the readers' reliance on L1-specific orthographic properties in English word recognition. In this case, the English-dominant readers' HOS preference in both borrowed and non-borrowed words could be explained thus: it seems to be the presence, rather than the amount, of orthographic knowledge of Hangul that leads readers to demonstrate a cross-linguistic transfer in word reading in L2. Furthermore, in accordance with claims by Wang, Park, and Lee (2006) and Kim (2009a, b) that stated that orthographic skills in Hangul

significantly influences English word reading success - even in the reading of English pseudowords. Our finding suggests that a cross-linguistic transfer of L1-specific word parsing strategies occurred for biliterate readers in our studies. Our finding also corroborates that of Cho, Chiu, and McBride-Chang (2011) in which the authors argued that emergent ESL readers' transfer of L1 skills in L2 reading increases with improved literacy skills in English.

Our findings also demonstrated an increase in the amount of a MOP preference along with the increase in the level of English dominance and proficiency. Contrary to Taft's claim (2002) that the preference of a MOP over a BOSS strategy occurs due to lack of English orthographic knowledge, our findings corroborate that of Chen and Vaid (2007) in claiming that proficiency and the BOSS effect do not seem to correlate. As illustrated by Cho and McBride-Chang (2005b), Kim and Cho (2001), Kang (2009) and Kim (2009a, b), for Korean-English biliterate readers syllabic awareness developed because the orthographic transparency of Hangul assists word recognition in English, which could further explain the presence of a MOP effect in our sample. Given that no significant differences were observed between the HOS and the MOP effect in any of the groups, regardless of language dominance or level of bilingual proficiency, it can be stated that for Korean-English biliterate readers, both strategies are used in combination, further reflecting the orthographic properties of their first learned script.

Finally, our findings suggest that the BOSS advantage (as argued by Taft, 1979; 2001; 2002) may be limited to monolingual readers, or, at the very least, is not applicable to bilingual readers of English. Even though the English-dominant readers

self-reported to be native readers of English, the readers' demonstrated a much stronger preference of a HOS and a MOP analysis over a BOSS analysis. In accordance with claims by Wang, Ko, and Choi (2009) and Lee (2012) that for Korean-English biliterates morphological knowledge in Hangul is applied to word reading in English, our findings suggest that the unique interaction between the readers' orthographic knowledge of the two scripts seemed to have diminished the BOSS effect. Therefore, it seems logical to conclude that in the case of biliterate readers, the properties of first learned orthography holds more significance in selection of word parsing strategies than the morphological segmentation of English words as observed in English-native monolingual readers.

### **Limitations and Future Directions**

Whereas findings from this investigation provide multiple insights into biliterate readers' sublexical processing of English, the current studies contain a few caveats. First, particularly in Experiment 1, response times were fairly long (ranging from the 1300 to 10,000 milliseconds), even when specifically instructed multiple times to try to answer as fast and as accurately as possible. Therefore, even after excluding trials that took a significant amount of time to respond (i.e., over 5000 milliseconds), the mean average reaction time of the participants is considerably long across all conditions in the experiment. Given that the reaction time data on lexical decision experiments are measured by millisecond differences, the significantly longer average reaction time of our Korean-heavy participants may not potentially demonstrate all the subtle differences that are found in lexical decision tasks.

Moreover, the setup of the current studies did not include investigation of emergent biliterate readers of English. Whereas Experiments 1 and 2 differed significantly with regards to their relative reading proficiency in English, the population that is actively increasing their orthographic knowledge of English was not included. For example, the EFL (English as Foreign Language) or ESL (English as Second Language) learners might initially demonstrate a stronger reliance on L1 orthographic knowledge in borrowed words, much like the participants from Experiment 1, and along with the increase in English proficiency, assimilate the word parsing strategy of Korean-dominant biliterate participants from Experiment 2; or it could be that emergent biliterate readers themselves demonstrate a unique set of interactions between the two languages, similar to those of the English-dominant biliterate participants from Experiment 2. At present, it remains unclear how gaining orthographic knowledge in L2 could influence word parsing strategy selection in L2 reading. Future inclusion of this population, particularly in a longitudinal setting, would enable in-depth investigation on the relationship between the increase in L2 proficiency and its effect on the selection of word parsing strategies in English.

Furthermore, all of the participants in Experiment 2 were sequential bilinguals, in which learning of L2 occurred after L1; none of the participants could be categorized as simultaneous bilinguals. Given that the interplay between the two orthographic systems was observed in our participants whose first learned orthography influences word reading in the second learned script, the question of how simultaneous literacy acquisition/development across differing orthographic systems remains unanswered.

Based on our findings from English-dominant biliterate readers that demonstrated it is the presence, rather than the amount, of literacy knowledge in L1 that influences word reading in L2, it is highly probable that simultaneous bilinguals demonstrate a similar pattern in their reliance on orthographic properties of Hangul in word reading in English. However, reflecting on our findings that indicate that English-dominant biliterate readers show a similar, yet distinctive, word parsing strategy compared to Korean-dominant biliterate readers, it is equally probable that simultaneous learning across orthography types may lead to a development of a mixed orthographic learning, encompassing the properties of both Hangul and English. Therefore, further research is needed to investigate how the manner of bilingualism, as well as language dominance, would influence word reading in L2.

Finally, while different levels of word frequency was taken into consideration and matched by frequency during the design stage to control for any possible confounds, it should be noted that the basis of the word frequency came from the rating normed for English native readers. While it can be argued that English-proficient biliterate readers in Experiment 2 can be expected to similarly perceive the native-rated frequency of the words, it is highly likely that for heavily Korean-dependent readers in Experiment 1, the subjective bilingual-rated frequency may not necessarily match the native-rated frequency. Simply put, a word with high frequency for English native readers may not be recognized as high frequency word for biliterate readers. Moreover, particularly in the case of words that are borrowed into Korean, word frequency in Korean written form may not always be congruent with the frequency in the original English word. As some

loanwords may be more frequent than others in the Korean language, the bilingual frequency should be examined separately from the English-native frequency of the words.

## **Conclusion**

Our findings provide support for an effect of orthographic structure that carries over to a very different orthography. This in turn suggests that knowledge of orthographic structure must be represented at a very abstract and deep level in the mental lexicon, as it is relied on even when there are vast differences in the surface representation of words, as is the case for words written in Hangul vs. English. Our results strongly indicate that reading in a second language is not something that occurs independently of a reader's orthographic knowledge of their first language. Rather, orthographic properties of readers' first learned script affect biliterate reading across different orthographic types. The robust and consistent demonstration across two studies for the presence of a Hangul-specific segmentation preference in the processing of English words is the first empirical demonstration of how properties of a first learned orthography are relied on by readers as a kind of template for their word reading strategy, upon which reading in the later learned script occurs. Moreover, the pattern of findings obtained across the different biliterate subgroups tested in the present study appears to be distinct from that observed for monoliterate readers and leads one to conclude that biliterate reading occurs in a fashion that combines and scaffolds across both orthography types.

Thus, in understanding the sublexical processing of biliterate readers it is imperative that one takes note of properties of their first learned orthography, as it is likely that reading strategies and skills transferred across the languages, even when the orthographies in question are very different in their characteristics.

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