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Non-selective lexical access in different-script bilinguals

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Lexical access in bilinguals is known to be largely non-selective. However, most studies in this area have involved bilinguals whose two languages share the same script. This study aimed to examine bilingual lexical access among bilinguals whose two languages have distinct scripts. Korean–English bilinguals were tested in a phoneme monitoring task in their first or second language. The results showed a simultaneous activation of the non-target language in a monolingual task, suggesting non-selective lexical access even among bilinguals whose two languages do not share the same script. Language dominance did not affect the pattern of results.

Keywords: phoneme monitoring, bilingual lexical access, Korean, selective, non-selective, language dominance

Introduction

In bilingual language processing research, the issue of whether bilinguals are able to access their two languages selectively has received a great deal of attention. A large number of studies have been carried out to examine two competing views. The selective access view postulates that, when engaged in a monolingual task, bilingual speakers are able to selectively activate one language and keep the language not in use dormant. The non-selective access view contends that both languages of a bilingual speaker are activated on some level even when only one language is in use. A promising approach to the investigation of this issue is to determine if individuals' performance in a monolingual task, such as lexical decision or naming, is affected by the language not in use. A lack of the effect of the language not in use would provide evidence for selective lexical access. On the other hand, if bilingual speakers' performance in a monolingual task is affected by the language not involved, then it is reasonable to conclude that bilingual lexical access is not selective.

Several recent studies have found that bilingual speakers' performance in a monolingual task can be affected by their knowledge of the language not in use, and thus bilingual lexical access is not selective. For example, in a study by van Heuven, Dijkstra and Grainger (1998), the recognition of a Dutch word by high-proficiency Dutch–English bilingual speakers in a monolingual Dutch task was found to be affected not only by the number of neighbors in Dutch, but also by the number of neighbors in English. They took longer to recognize Dutch words with more neighbors in English as well as in Dutch. Similarly, in a Russian eye-tracking experiment, Russian–English bilinguals were found to fixate on a distractor picture whose English name overlapped with the Russian name of the target picture more often than on a control picture (Spivey & Marian, 1999). Similar findings were also found in Jared and Kroll (2001) and Colomé (2001). These findings suggest that bilinguals cannot completely turn off or shut down the language that is not required by a task. Instead, both languages seem to be active even in a monolingual task.

Until recently, studies investigating selectivity in bilingual lexical access have involved bilingual speakers whose two languages shared the same script. These participant groups, for example, included Dutch–English bilinguals (De Groot, Delmaar & Lupker, 2000; Dijkstra, Grainger & Van Heuven, 1999; Dijkstra, van Jaarsveld & Ten Brinke, 1998; Hermans, Bongaerts, De Bot & Schreuder, 1998; van Heuven, Dijkstra & Grainger, 1998), French–English bilinguals (Chambers & Cooke, 2009; Jared & Kroll, 2001), Catalan–Spanish bilinguals (Colomé, 2001; Costa, Miozzo & Caramazza, 1999), Spanish–English bilinguals (Schwartz & Kroll, 2006), and German–English bilinguals (Blumenfeld & Marian, 2007; Von Studnitz & Green, 2002).

In contrast, there is only one study to our knowledge that was specifically conducted to investigate the selectivity issue among bilinguals whose two languages have distinct scripts. Hoshino and Kroll (2008) explored the topic by testing Japanese–English bilinguals and Spanish–English bilinguals in a picture naming task. The critical stimuli included pictures whose names were cognates in English and Spanish or cognates in Japanese and English. The most important finding from this study is that like Spanish–English bilinguals, Japanese–English bilinguals also named cognate pictures

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faster than control pictures. The finding shows that the phenomenon of non-selectivity in bilingual lexical access exists in different-script bilinguals as well as same-script bilinguals.

One has to be cautious, however, in making generalizations about selective versus non-selective lexical access among different-script bilingual speakers based on the cognate-based findings of Hoshino and Kroll (2008). There are two reasons for caution. First, cognates usually constitute only a small percentage of vocabularies, often limited to loan words, for different-script bilingual speakers. They may not represent how lexical access occurs across the entire languages. Second, and more importantly, cognates are lexically bilingual in nature in that the related words in the two languages share a high degree of both semantic and form overlap. As a result, they may enjoy a special status in the bilingual lexicon not enjoyed by other words. Specifically, in the present discussion of bilingual lexical access, it is reasonable to suppose that encountering cognates may be more likely to lead to the activation of both languages even when one is engaged in a monolingual task.

There is indeed compelling evidence showing that the use of cognates often leads to non-selective activation of both languages. In a study by Dijkstra et al. (1999), for example, a clear cognate advantage was found in two monolingual tasks, that is, progressive demasking and lexical decision, but no such advantage was found for interlingual homographs. Similar results were found in a study by Schwartz and Kroll (2006) that was intended to explore the role of sentence context in selective lexical access in bilinguals. In a monolingual reading task, they found cognates were named faster than controls in non-restrictive contexts, but no such advantage was found for interlingual homographs, and this cognate status effect was observed in both advanced and intermediate bilingual speakers. A third study that demonstrated the special status of cognates in the context of non-selectivity research is an eye-tracking study reported recently by Blumenfeld and Marian (2007). They monitored the bilingual participants' eye-movement while following auditory instructions to move one of four pictures presented at the four corners of a computer monitor. The target pictures were divided into two groups: those whose names were cognates and those non-cognates. Among the four pictures was also a competitor picture whose name in the non-target language was phonologically similar to the name of the target picture, or a control picture whose name bore no phonological similarity. A larger number of looks at the competitor as compared to the control picture was taken as evidence for the activation of the non-target language in a monolingual task. When the participants were performing the task in their first language, English, evidence was found for the activation of their second language, German, but it was only true when the targets were cognates. No activation of the non-target language was shown with non-cognate targets. The results from these studies suggest that cognates tend to trigger the activation of the non-target language and that it is necessary to examine the selectivity issue in different-script bilinguals with non-cognate materials.

The present study

The present study attempted to accomplish this goal by testing Korean–English bilingual speakers with non-cognate words in a phoneme monitoring task. The ultimate purpose was similar to that of Hoshino and Kroll (2008), that is, to understand whether lexical access is also non-selective in bilingual speakers whose two languages have distinct scripts.

To this end, we adopted a phoneme monitoring task. In a phoneme monitoring task, a target phoneme is designated, and the participants have to decide whether the input contains the target phoneme. The task was employed by Colomé (2001) in a study of the bilingual selectivity issue among Catalan–Spanish bilinguals. In this study, she presented pictures to the participants and asked them to decide whether the Catalan name of the picture contained a target phoneme. The pictures were chosen such that they created three conditions: the target phoneme was in their Catalan names, in their Spanish names or in neither name. The participants had to provide a positive response to the pictures in the first condition, and a negative response to the pictures in the second and third conditions. Their response times (RT) for these last two conditions were assessed to determine whether the Spanish language was active in this monolingual task. If Spanish was active, the participants would take longer to respond "no" to pictures in the second condition, that is, pictures whose Spanish names contained the target phoneme, in comparison to pictures in the third condition. If the participants could completely ignore the Spanish language in the Catalan word monitoring process, no difference was expected between the second and third conditions. It was found that the participants did take longer to respond to the pictures in the second condition than those in the third condition, thus confirming the involvement of the Spanish language in the monolingual Catalan task.

Inspired by Colomé's (2001) study, we adopted the same task to examine whether lexical access is non-selective among Korean–English bilinguals whose two languages do not share the same script. Korean has a script called *Hangul*, which is a distinct writing system very different from that of English. For example, *saca* (사자), the Korean word for "lion", consists of two syllabic units each with two letters. A letter may consist of one or more strokes. We identified a set of twelve phonemes that are similar in Korean and English, and a set of pictures whose names in Korean and English may or may not

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contain the target phonemes. These pictures helped to create three conditions. In a Korean task, for example, the positive condition contained pictures whose Korean names include the target phoneme. The participants were expected to provide a positive response to items in this condition. The interference condition contained pictures whose Korean names do not have the target phoneme, but whose English names do. The control condition contained pictures whose names in either language do not include the target phoneme. The participants were expected to provide a negative response to items in the interference and control conditions.

In presenting the test items, a target phoneme first appeared on a computer monitor. It was then followed by a picture. In a Korean task, the participants were asked to decide whether the Korean name of the picture contained the target phoneme. The response times were measured as critical data. For the present research question, we were particularly interested in comparing the participants' RT in the interference and control conditions. Note that in the interference condition, the Korean name of a picture did not contain the target picture, but the English did. If English was active in a monolingual Korean task, the activated English name of the picture would cause a delay in reaching a negative decision because it did have the target phoneme. As a result, the participants would take longer to provide a negative response to the pictures in the interference condition than those in the control condition. If English was not active, no difference would be expected between the two conditions. Thus, we could determine whether the non-target language was active or not by comparing the participants' RT in the interference and control conditions.

In addition to the main manipulation of interference, we also manipulated the task language by dividing the experiment into a Korean and an English part. Half of the Korean–English bilinguals participated in the Korean experiment and the other half in the English experiment. The test materials in both parts had the same interference and control manipulation that was achieved by recombining the pictures and phonemes. As these participants were all adult learners of English as a second language (L2) whose first language (L1) remained a dominant language, their performance in the L1 Korean and L2 English allowed us to understand the role of language dominance in lexical selectivity in bilinguals. A group of English speakers who did not know Korean were also tested as controls for the English part of the experiment. They are referred to as the control group or monolingual group in this paper. A similar group of Korean controls were not included due to difficulty in finding Korean speakers who did not know English at all.

Thus, this study allowed us to examine the following research questions:

1. Are both languages active in a monolingual task involving no cognates in bilingual speakers whose two languages do not share the same script? If our Korean–English bilingual participants took longer to respond to items in the interference condition than those in the control condition, but the monolingual controls did not, a positive answer would be confirmed. Otherwise, lexical access would be selective in these bilinguals.
2. Will language dominance affect the pattern of bilingual lexical access? If language dominance plays an important role in determining the pattern of lexical activation in two languages, we would expect to see more activation and thus interference of the participants' L1 Korean in an English task than the reverse.

Method

Participants

Forty Korean–English bilinguals and twenty English controls at the University of Maryland took part in the experiment. All participants, either undergraduate or graduate students in varied programs, were recruited on campus through personal contacts and fliers. All bilinguals were prescreened to be Korean-dominant bilinguals, who were born and raised in monolingual Korean families, but exposed to English in the United States after the age of twelve. They have submitted iBT TOEFL scores of a minimum of 100 as a verification of their English proficiency on their unconditional admission to the university. Additionally, their degree of proficiency in English was relatively high based on their self-assessment of L2 oral proficiency as adapted from Kondo-Brown's self-assessment questionnaire (2005), in which they scored an average of 4.56 on a 5-point scale (1 being "cannot" and 5 being "native-like") when performing twelve oral tasks.

Further information about the participants' English use and English proficiency was obtained in a questionnaire. Their average age was 25.5 (range: 19 to 40) at the time of testing, average English learning onset age was 11.3 (range: 5 to 13), and their average length of residence in the US was 7.7 years (range: 3 to 20). On a 1 to 5 scale, with 1 representing exclusive Korean use and 5 representing exclusive English use, the average rating of their relative use of the two languages was 3.2, showing a relatively balanced use of the two languages. English controls included students of the same university who were native speakers of English with no learning experience in Korean. Half of the Korean–English bilinguals took part in the Korean task, while the other half took part in the English task.

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Materials and design

A number of steps were taken in constructing the test materials for the study. We started by constructing a set of phonemes that are largely similar in Korean and English, for example, the phonemic value of the letter ㅁ in Korean is comparable to the English phoneme /m/ (see Appendix A for twelve pairs of phonemes used for the experiment). We then looked for pictures of objects and animals whose names contained those phonemes in the two languages. These pictures were given to a group of Korean–English bilinguals in a pre-test who helped identify pictures which might be ambiguous or difficult to recognize, pictures whose names were not known, or pictures for which there were more than two names in either language. The final set of sixty pictures selected after screening all met the following criteria: (a) the pictures were all those of animals and objects highly familiar to participants; (b) the names of these animals and objects were familiar to participants in both languages; (c) the names were not cognates in English and Korean; and (d) the names were not ambiguous in either language in the sense that all informants in the pre-test provided the same name for each picture.

The twelve phonemes and sixty pictures were used to construct two experiment files for each language. Each file contained sixty items. The first thirty items included thirty pictures whose names contained the target phonemes. These were filler items used for the positive responses, and constituted the positive condition. Among the remaining thirty items, fifteen of them contained pictures whose names did not contain the target phoneme in the language of the performance but contained the target phoneme in the non-target language. The other fifteen items were pictures whose names did not have the target phoneme in either language. These thirty items formed the interference and control conditions, respectively. The two experiment files shared the same thirty items for the positive condition, but the match-ups between the pictures and the phonemes in the interference and control conditions were counterbalanced between the two files such that if a picture appeared in the interference condition on the first file, it was then presented in the control condition in the second file. We also controlled the frequency of appearance of each phoneme so that each of the twelve phonemes appeared five times among the sixty items. In order to avoid the effect of different syllabic positioning of a target phoneme, the target phoneme always appeared at the onset position in the interference condition, although participants were expected to monitor every syllable of a target item throughout the task.

The study had a 2 × 2 × 2 design, with one within-participant and two between-participant variables. The former was a picture–phoneme relationship which had two levels (interference and control), and the latter were performance language (Korean and English) and participant group (monolingual and bilingual) each with two levels.

Procedure

The participants were randomly assigned to the four experimental files (two for each language) and tested individually. Effort was made to present the experiment as a monolingual one by exclusively using the target language in instructions and interactions between the experimenter and the participants. The experimental session began with a training session in which the participants were trained and tested on the phonetic symbols to be used in the experiment. English letters put in a pair of slashes were used to represent target phonemes in the English part of the experiment. For example, /t/ was used to represent the first sound in *tiger*, and /d/ represented the first sound in *dog*. In the Korean part, Korean letters were used to represent the target phonemes. It was particularly easy because Korean has a shallow orthography with consistent letter–sound correspondence. With the use of flash cards, explanations were first given about the sound each of the twelve symbols represented, with words from the target language as examples, but not the names of the pictures to be used. The participants had to demonstrate perfect accuracy in deciding whether a word contained a target phoneme represented by a symbol before moving to the practice session, which was then followed by the test session.

Each test item began with the presentation of an English letter between slashes or a Korean letter at the center of the screen, designating the phoneme to be monitored. It was replaced 1000 ms later by a picture. All pictures were 430 by 430 pixels in size and presented against a white background. The participants were instructed to decide whether the name of the picture in the target language contained the target phoneme. They responded by pressing one of two buttons on a computer keyboard, one for a positive response and the other for a negative response. Feedback was provided upon each response regarding response correctness. The software program DMDX (Forster & Forster, 2003) was used for presenting test materials and collecting data.

A post-experimental test was also done in which the participants were asked to name the pictures in the target language to confirm their knowledge of the target words. It was done after the experiment, not prior to it, as was the case in Colomé (2001), to avoid any undesirable effects of pre-activated lexicons in the bilinguals' minds.

Results

In analyzing the data, the error rates (ERs) of individual participants were first checked. A participant was

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excluded if he or she had an ER of 20% or higher. Six participants were thus excluded and were replaced by additional participants. All incorrect responses were excluded from the analysis, so were responses to pictures that individual participants failed to name correctly in the post-experimental test. Two test items, namely, *ginger* and *walnut*, were removed from the analysis because more than 30% of the participants failed to provide a correct name for them in the post-experimental test. Outliers were defined as any RT that was shorter than 200 ms or longer than 2500 ms, or any with a RT that was not within 2.5 standard deviations of the mean of individual participants. These outliers, equal to 2.75% of all trials, were also removed in analysis. The mean latency and accuracy after data treatment are summarized in Table 1. The RT data for the two critical conditions (interference and control conditions) from the two participant groups are also shown in Figure 1.

The statistical analyses were focused on the interference and control conditions only. Filler items were not included.

Table 1. *Monolingual and bilingual participants' RT (in ms) and ER (in percentage) for Korean items and English items in the three conditions (standard deviations in parentheses).*

		RT	ER
Bilingual	Filler	1012 (157)	11.3 (7.8)
(Korean)	Interference	1216 (239)	11.9 (8.6)
N = 20	Control	1157 (223)	9.1 (6.1)
	Difference*	59**	2.8
Bilingual	Filler	1110 (197)	14.0 (6.1)
(English)	Interference	1300 (293)	11.1 (9.1)
N = 20	Control	1240 (266)	14.7 (8.1)
	Difference*	60**	3.6
Monolingual	Filler	1054 (239)	16.3 (7.1)
English	Interference	1145 (318)	11.4 (9.4)
N = 20	Control	1158 (303)	12.1 (7.3)
	Difference*	−13	0.7

NOTE: * Difference between interference and control conditions.
** Difference significant in both participant and item analyses.

English controls

Paired-samples *t*-tests were done on English controls' RT and ER data to determine if the test items in the interference and control conditions were adequately constructed. If they were, no difference between the two conditions should be expected when testing monolingual English speakers who did not know Korean. The 13 ms of difference in RT was not significant in either participant or item analysis ($t_1(19) = -.804$, $p = .43$; $t_2(28) = .157$, $p = .88$), neither was the difference in ER ($t_1(19) = .27$, $p = .79$; $t_2(28) = .17$, $p = .87$). The results showed that the monolingual speakers produced similar RTs and ERs on the items in the interference and control conditions. Thus, any differences observed between these conditions among bilingual speakers were likely to be related to the fact that they knew both Korean and English.

Korean-English bilingual speakers

Reaction time

To analyze the bilingual speakers' RT data, a two-way ANOVA was conducted with two independent variables, item condition and response language. There was a significant main effect of item condition in both subject and item analyses ($F_1(1,38) = 14.62$, $p < .05$; $F_2(1,56) = 13.67$, $p < .05$). The main effect of response language on latencies was significant only by items ($F_1(1,38) = 1.09$, $p = .30$; $F_2(1,56) = 8.97$, $p < .05$). There was no significant interaction between item condition and response language (both Fs < 1). Two paired-samples *t*-tests were also done to examine the data in the two languages separately. The difference of 59 ms between the two conditions in Korean was significant by subjects ($t_1(19) = 2.64$, $p < .05$) and by items ($t_2(28) = 2.42$, $p < .05$); so was the 60 ms difference in the English

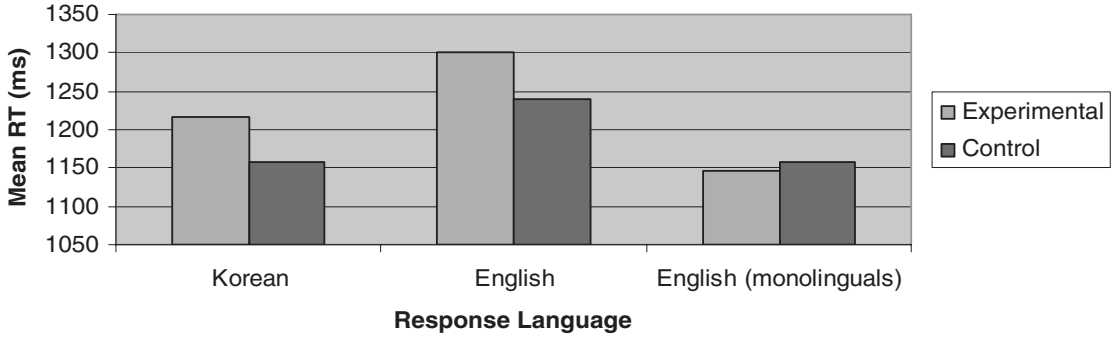


Figure 1

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part of the experiment ($t_1(19) = 2.77$, $p < .05$; $t_2(28) = 2.80$, $p < .05$). The analyses showed that Korean–English bilinguals showed a delay in responding to items in the interference condition compared to those in the control condition. This delay occurred when they responded in both their L1 and L2.

Error rates

Similar analyses were done on the Korean–English bilinguals' ER data. The main effect of item condition was significant in neither subject nor item analysis (both Fs < 1). There was only a marginally significant effect of response language on ER ($F_1(1,38) = 2.09$, $p = .15$; $F_2(1,58) = 2.10$, $p = .15$), where bilinguals made errors at the rate of 12.95 in English and 10.55 in Korean. The interaction between item condition and response language also only approached significance by subjects ($F_1(1,38) = 2.77$, $p = .10$) and by items ($F_2(1,58) = 2.49$, $p = .12$). They tended to make more errors on control items while responding in English, but they made more errors on interference items while responding in Korean. Pairwise comparisons of the mean error rates between the interference and control conditions were conducted in each output language. The difference was significant in neither Korean ($t_1(19) = 1.297$, $p = .210$; $t_2(28) = 1.106$, $p = .278$), nor English ($t_1(19) = -1.133$, $p = .271$; $t_2(28) = -1.132$, $p = .267$).

Discussion

The present study set out to determine whether non-selective activation of two languages observed in earlier studies involving same-script bilinguals, or involving cognates, applies to different-script bilinguals processing non-cognates. A phoneme monitoring task was adopted to examine this issue, in which Korean–English bilingual speakers were asked to decide whether the name of a picture contained a specific phoneme. The task was a monolingual one in the sense that the bilinguals were asked to consider the names in one language only, either English or Korean, but not both.

The study produced two important findings. First, we found that the performance of bilinguals, but not English controls, was affected by the non-target language. Specifically, when the name of a picture in the tested language did not contain the target phoneme, but its name in the non-target language did, the bilingual participants took longer to reject the item, compared to items whose names did not contain the phoneme in either language. We interpret this delay as reflecting the activation of the language not involved in the task. When a picture was presented following the target phoneme, even though the participants were asked specifically to determine whether the English name, for example, had the target phoneme, the name in the other language, that is, Korean, was also activated. Because the Korean names of the pictures in the interference condition contained the target phoneme, a Korean-based positive response may compete with the correct negative response, thus causing the delay.

Second, our results suggest that language dominance does not seem to affect such non-selective activation of two languages, at least within the proficiency range of the participants involved in the present study. The bilingual participants showed the same interference from the non-target language while processing both their L2 English and their L1 Korean. These results may appear to contradict those of two previous studies that considered language dominance or L2 proficiency in relation to the selectivity issue. In one of them, Blumenfeld and Marian (2007) examined the role of language dominance in bilingual lexical access by comparing eye-movements in an English task by English–German and German–English bilingual speakers. If language dominance played a role, it would be more likely for German-English speakers to display the activation of German, their L1, in the monolingual English task than English-German speakers. This was exactly what they found. When asked to click on a target picture, only German-English bilinguals, not English-German bilinguals, had a higher percentage of looks at a competitor picture whose German name was phonologically similar to the non-cognate English name of the target picture, as compared to a control picture whose German name had no phonological overlap. Their results showed that an L1 is more likely to be automatically activated in L2 processing than the reverse.

The role of proficiency was also considered in a study of the effect of sentence context on non-selectivity by Schwartz and Kroll (2006). They asked Spanish–English bilinguals to name English words that were presented in sentence context. They manipulated the proficiency variable by testing Spanish–English bilinguals who were highly proficiency in English (Experiment 1) and those who were less proficient (Experiment 2). The manipulation allowed them to examine the extent to which L2 proficiency affects the role of L1 in L2 processing. The reaction time data showed little interference from the non-target L1 in processing L2 interlingual homographs in sentence context, but the error rate data showed a different pattern. When analyzed together, the error rate data from the two groups showed a main effect of homograph status, with higher error rates made on interlingual homographs than on control words. But more importantly, intermediate Spanish–English bilinguals showed a stronger homographic interference effect while processing L2 English than the advanced group. These results suggest that L1 is less likely to be active or play a role in a monolingual L2 task when bilinguals are highly proficient in L2.

The main difference in results between the present study and the study by Blumenfeld and Marian (2007)

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is that only L1 German affected the processing of L2 English in a monolingual English task in their study, but both L1 Korean and L2 English seemed to affect the processing of the target language in a monolingual task in the present study.[1] There are two possible reasons for the discrepancy between the studies. The first has to do with the L2 proficiency of the participants. It is possible that the L2 German proficiency of the English–German bilingual speakers in Blumenfeld and Marian's study was not as high as the L2 English proficiency of the Korean–English bilinguals involved in the present study. One indication of this possibility lies in the length of residence in the target language area. The participants in the Blumenfeld and Marian's study had a mean length of 1.5 years; the participants in the present study had lived in the US for an average of 7.7 years.

Second, for the English–German bilinguals in Blumenfeld and Marian's study, their L2 German was a foreign language not used in the environment where they lived, but for our participants, their L2 English was the language of their daily life, work and study. Even if the L2 proficiency was comparable between the two groups, the level of L2 activation may be different because one group lived in an L2 environment and the other group in an L1 environment. Thus, the language environment may affect their relative level of activation between the two languages (Grosjean, 1998) and, as a result, the pattern of selectivity in bilingual lexical access.

The discrepancy between Schwartz and Kroll (2006) and the present study is that L1 did not seem to affect the processing of L2 among highly proficiency bilinguals in their study, but L1 interference was observed in the present study even though the participants were highly proficient in L2. The cause of this discrepancy is yet to be explored. One possibility may have to do with the task used. Schwartz and Kroll adopted a sentence processing task which had a strong semantic processing component. The phoneme monitoring task adopted in the present study is largely lexical in nature. The semantic nature of sentence processing may have placed a constraint on the extent to which the two languages interact and co-activate. This is certainly an interesting issue to be explored in future research.

Returning to the main finding of the study, that is, non-selective access of two languages in different-script bilinguals, there is already compelling evidence showing that bilingual lexical access is non-selective among bilinguals whose two language share the same script (Colomé, 2001; Jared & Kroll, 2001; Spivey & Marian, 1999; van Heuven et al., 1998) and in processing cognates among different-script bilinguals (Hoshino & Kroll, 2008). The present study showed that bilingual lexical access is non-selective even in the processing of non-cognates by different-script bilinguals. The findings of the study call for a re-examination of the role of script in bilingual lexical access. Two different approaches may be taken. One is to consider the findings from Hoshino and Kroll (2008) and the present study as evidence against any significant role that script plays in bilingual lexical organization and access. In this approach, bilingual lexical organization is more integrated than separate, and bilingual lexical access more interactive than independent, regardless of whether the two languages share the same script or have distinct scripts.

Alternatively, one can attribute these findings to the fact that both Hoshino and Kroll (2008) and the present study employed a phonology-based task, that is, picture naming and phoneme monitoring, respectively. One may argue, as Dijkstra (2005) does, that there may be a high degree of integration and interaction at the phonological level between two languages even when they do not share the same script. Thus, the non-selective finding is specific to tasks that involve phonological activation. In the case of two languages that do not share the same script, their activation can be selective in visual word recognition, as envisioned in the BIA model (Dijkstra & van Heuven, 1998). In addition, there is recent evidence that processing a second language activates the sound, but not the spelling, of native language translations. Wu and Thierry (2010) used event-related potentials to demonstrate how advanced Chinese–English bilinguals have unconscious access to the sound form of Chinese words when reading or listening to English words. When participants were asked to decide whether English words presented in pairs were related in meaning, they were unaware of the fact that the unrelated pairs concealed a spelling repetition in their Chinese translations, but were unconsciously affected by the pairs with a sound repetition in their Chinese translations.

It is yet to be determined whether the findings from the present study reflect non-selective lexical access in phonology-based lexical access alone among different-script bilinguals, or reveal a more general non-selective nature of bilingual lexical access among these bilinguals,

[1] A reviewer suggested that because of the between-participant design, it is necessary to compare the background of the two groups who performed the task in English and Korean. We compared the information obtained from the two groups of participants and found that the two groups were comparable in all indications of language background. The Korean task group and the English task group had an average of age of arrival of 11.75 and 10.75 years ($t_1(19) = 1.19$, $p = .25$), mean length of residence of 7.78 and 7.70 years ($t_1(19) = .06$, $p = .95$), self-rating scores of 3.11 and 3.29 for the relative use of two languages (1 = L1 only, 2 = mostly L1, 3 = equal amount of L1 and L2 use, 4 = mostly L2, 5 = only L2 ($t_1(19) = -.99$, $p = .33$), average score of 4.51 and 4.62 for L2 proficiency ($t_1(19) = -.62$, $p = .54$), and an average score of 5 for both groups for L1 Korean (where 1 = minimal, 2 = difficult, 3 = OK, 4 = fluent, 5 = native-like; see the section on participants for information about the L2 proficiency test).

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including visual word recognition. The answer will ultimately come from studies that examine bilingual lexical access among different-script bilinguals in visual word recognition. However, we face a methodological challenge in this endeavor, because manipulations that have been used successfully with same-script bilinguals, such as neighborhood size and homographs, do not apply to bilinguals whose two languages do not share the same script.

Appendix

Twelve paired-phonemes used as target phonemes in the Korean and English parts of the experiment and examples of pictures used.

Phonemes	*Korean etters*	*Picture examples*	*English letters*	*Picture examples*
1 /g/	ㄱ	bear [gom]	g	garlic
2 /n/	ㄴ	butterfly [na.bi]	n	knife
3 /d/	ㄷ	moon [dal]	d	dog
4 /m/	ㅁ	hat [mo.ca]	m	milk
5 /b/	ㅂ	soap [bi.nu]	b	ball
6 /s/	ㅅ	deer [sa-sum]	s	sun
7 /c/	ㅈ	house [cip]	j	giraffe
8 /ch/	ㅊ	window [chang.mun]	ch	chair
9 /k/	ㅋ	elephant [ko.k'i.ri]	k	cat
10 /t/	ㅌ	rabbit [to.k'i]	t	tiger
11 /p/	ㅍ	balloon [pung.sən]	p	potato
12 /h/	ㅎ	walnut [ho.du]	h	horse

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