Implicit Translation during Second Language Lexical Processing*

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Abstract

Most previous studies in psycholinguistics investigating whether bilingual lexical access is non-selective have employed experimental tasks which require the bilingual participant to explicitly activate their two languages or routinely switch between the two. The present study examines bilingual lexical processing through a semantic association task which includes stimuli in only one language and therefore avoids creating an artificial bilingual context. The bilingual participants were unconscious of a hidden character repetition when the English words are translated into their native language, Korean. Results showed significant interference effects of the hidden character repetition in the behavioral data reflected as both longer response times and higher error rates. These findings support and extend the findings of previous studies showing significant ERP modulations due to implicit activation of the first language and suggest that bilingual lexical processing is nonselective: bilingual speakers unconsciously and automatically activate their native language when reading words in their second language.

Keywords: *bilingualism, non-selectivity, lexical access, Korean-English bilinguals, semantic association*

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1. Introduction

The question of whether bilingual speakers activate their native language during second language processing has been the topic of lively debate in the field of psycholinguistics. Some studies have suggested that bilinguals are capable of selectively activating their two languages, by suppressing their first language when processing in their second language (Gerard & Scarborough, 1989; Ju & Luce, 2004; Scarborough, Gerard & Cortese, 1984). Other studies have argued for a non-selective view of bilingual processing, providing evidence that suggests that the two languages of a bilingual are constantly active, even when processing in only one language (Dijkstra, Timmermans & Schriefers, 2000; Dijkstra & van Heuven, 2002; Kroll & de Groot, 2005; Kroll & Stewart, 1994).

Psycholinguistic studies in the ongoing debate regarding the language (non-)selectivity of bilingual processing have employed various experimental tasks. For example, studies using cross-linguistic priming tasks have found priming effects between languages in the form of reduced reaction times (Gollan, Forster, & Frost, 1997; Hoshino & Kroll, 2008; Kim & Davis, 2003). Other studies have used an overt translation recognition task, in which bilingual participants are presented with a pair of words from each language and asked to decide whether the second word is the correct translation of the first. Previous studies have shown that longer response times are obtained for incorrect translation pairs when the second word is phonologically, orthographically, or semantically related to the first word (Dufour & Kroll, 1995; Sunderman & Priya, 2012; Talamas, Kroll & Dufour; 1999). These results, showing interaction between the form and meaning of a bilingual's two languages, have been used as evidence in support of the non-selectivity of bilingual lexical access. While experimental tasks such as cross-linguistic priming or translation recognitionhave provided meaningful evidence supporting the non-selectivity of bilingual lexical access, there is a caveat. Overt cross-linguistic tasks, in which stimuli from both languages are used, share the risk of creating a context in which bilingual participants are likely to turn on their "bilingual mode" and activate both languages (Grosjean, 1998). [1]

By contrast, the semantic association task avoids artificially turning on

"bilingual mode" by using stimuli in one language only. Thierry and Wu (2007) provided evidence supporting implicit access and spontaneous activation of the native language by Chinese-English bilinguals when performing a task which involved stimuli in the second language only. In this study, Chinese-English bilinguals were asked to decide whether pairs of English words were related in meaning or not. Although the stimuli in this experiment were exclusively in English, they concealed a hidden factor designed to implicitly probe whether the participants were unconsciously activating their native language. When translated into Chinese, half of the English word pairs concealed a character repetition. While the behavioral data failed to show anyeffects of the hidden repetition in reaction times or accuracy, the electrophysiological data revealed a priming effect of the hidden character repetition, reflected as an amplitude reduction of the N400 component.[2] Furthermore, this pattern of event-related potentials (ERPs) was replicated with a group of Chinese monolinguals performing the task in Chinese, in which the participants were overtly exposed to the character repetition. The authors concluded that this pattern of results were strong evidence for thebilingual participants' unconscious activation of the Chinese translation of the English words.

In a follow-up study, Wu and Thierry (2010) investigated the nature of the mental representation of the Chinese translations retrieved unconsciously during the processing of English words. In this experiment, the hidden Chinese character which was repeated in the Chinese translations of the English stimuli shared either orthography or phonology, but not both. Again, behavioral results failed to show any effects due to the hidden

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[1] Grosjean (1998) notes that bilingual speakers'use of their two languages may differ depending on whether their interlocutor is monolingual or bilingual. Whereas bilinguals refrain from using their other language with monolingual speakers they will switch to 'bilingual mode' with other bilinguals, and freely switch from one language to the other, resulting in increased activation of both languages.

[2] The N400 component is known to reflect overt and unconscious semantic priming (Kutas & Hillyard, 1984; Luck, Vogel & Shapiro, 1996). However, the N400 has also been found to indicate effects of repetition priming (Liu, Perfetti & Hart, 2003; Osterhout & Holcomb, 1995).

repetition in the behavioral data. The ERP data, however, revealed significant repetition priming effects. When the hidden repetition involved shared phonology, the participants' ERP data showed an amplitude reduction of the N400, similar to the results of the earlier study in which both sound and spelling were shared (Thierry & Wu, 2007). However, no effects of hidden repetition were found when the hidden characters shared orthography only. These results reflected a pattern similar in magnitude and duration to the electrophysiological data obtained from a monolingual Chinese group reading Chinese words, suggesting that the reduced N400 in the bilingual participants was a reflection of repetition priming. Wu and Thierry (2010) suggest that the nature of cross-linguistic interaction in bilingual processing is limited to phonology, andthat when reading in the second language, bilinguals activate the sound, but not the orthography of native language translations.

The results of these previous studies (Thierry & Wu, 2007; Wu & Thierry, 2010) provide evidence in support of non-selective lexical access for bilingual speakers. Furthermore, they were the first studies (to our knowledge) to provide evidence of implicit activation of the first language even when processing stimuli in the second language only. Wu and Thierry noted that while both semantic relatedness and hidden character repetition resulted in significant modulations of the N400, the effects on the N400 due to hidden repetition primingwere of smaller magnitude and shorter duration than the N400 modulation for to semantic relatedness (Wu & Thierry, 2010: 7650). The weaker effects in the N400 range due to repetition priming compared to the stronger semantic effects suggest that the effects of thehidden character repetition may have been too subtle to be reflected in the behavioral data as longer reaction times or higher error rates.

2. The Present Study

The present study aims to further investigate implicit activation of the native language when bilinguals read words in the second language, through a semantic association task with low-intermediate level Korean-English bilinguals. In this study, we focus on two potential factors of previous studies which may have resulted in weaker effects of spontaneous activation

of the native language during second language processing and examine whether modulation of these factors may yield stronger evidence in support of the non-selectivity of language during bilingual processing.

Chinese is a logographic language, whose writing system does not have a systematic correspondence between orthography and phonology. Therefore, it is possible for two Chinese characters to share spelling, but be pronounced differently, as shown in Table 1. The Bilingual Interactive Activation Plus (BIA+) model (Dijkstra & van Heuven, 2002) is an interactive connectionist model which was developed to account for non-selectivity in the bilingual lexicon. The BIA+ model consists of network of interconnected nodes, including orthography nodes, phonology nodes, and semantic nodes. According to the BIA+ model, strong connections between orthography and phonology are predicted to result in stronger activations of the lexical nodes, while weaker correspondence between spelling and sound will result in weaker activations of the higher level lexical nodes.

According to the BIA+ model, the dissociation between spelling and sound which is a characteristic of the Chinese language may have been one of the reasons underlying the relatively weak effects of implicit L1 translation in the previous studies employing Chinese-English bilinguals (Thierry & Wu, 2007; Wu & Thierry, 2010).

Table 1. Different sound-spelling correspondence in Chinese

Word (meaning)	还 (*still, to return, to rotate*)
Pronunciation	[hái] [huán] [xuán]

In contrast with logographic languages such as Chinese, most European languages such as Dutch or Spanish, use an alphabetic writing system with a systematic grapheme-phoneme correspondence, where the spelling of a word largely reflects its pronunciation, and vice versa. However, a potential problem exists when investigating the issue of non-selective bilingual access with languages sharing the same alphabet, such as Dutch and English. Previous studies employing two languages with overlapping orthography have shown interlingual cognate or homograph effects, and

claimed these results support non-selective bilingual processing (Dijkstra, Timmermans & Schriefers, 2000; Dijkstra, Grainger & van Heuven, 1999; Kerkohfs, Dijkstra, Chwilla & de Bruijn, 2006; Sunderman & Schwartz, 2008). It is not clear whether these effects stem from the shared orthography between the two languages, or whether these results can be taken as support for non-selectivity in the bilingual lexicon in general. Therefore, an ideal language pair to provide evidence in support of non-selective bilingual lexical access would be two languages which do not share the same writing system, but have relatively strong correspondence between orthography and phonology.

Korean is an alphabetic language with strong spelling-sound correspondence, but which at the same time does not share the same writing system as English. Therefore, an experimental task investigating the effects of implicit activation of the native language withKorean-English bilinguals may yield stronger effects of implicit activation compared to Chinese, due to the systematic grapheme-phoneme connections of the Korean language. At the same time, we can avoid the risk of unwanted priming due to interlingual cognate or homograph effects, which was a potential confound of previous studies with languages such as Dutch or Spanish.

A second factor which may have resulted in implicit L1 effects which were too subtle to be reflected as differences in the behavioral data is the relatively high English proficiency of the Chinese-English bilingual participants in the previous studies (Thierry & Wu, 2007; Wu & Thierry, 2010), who were undergraduate and master students studying at a British university at the time of testing, and reported using English their everyday life.

The Revised Hierarchical Model (RHM) proposed by Kroll and Stewart (1994) is a developmental model of the bilingual lexicon. In this model, the nature of the links between concept and form in a bilingual's two languages are hypothesized to vary depending on the proficiency of the second language (L2). As shown in Figure 1, for a bilingual with low L2 proficiency, the conceptual links connecting an L2 word with its concept are relatively weak, and are represented with dotted lines. By contrast, the conceptual links between words in the native language (L1) and concepts are stronger, as shown by the solid lines. Due to the weaker connections

between concept and L2 word form, Kroll and Stewart (1994) predict that bilinguals with relatively low L2 proficiency will rely on the stronger lexical connections between words in the L1 and L2 lexicon, rather than associating L2 words directly with their concepts. As L2 proficiency develops, the conceptual links between L2 words and concepts is predicted to grow stronger, so that highly proficient bilinguals no longer need to rely on the L1 translations of L2 words to access meaning, but may directly utilize the conceptual links between L2 words and concepts.

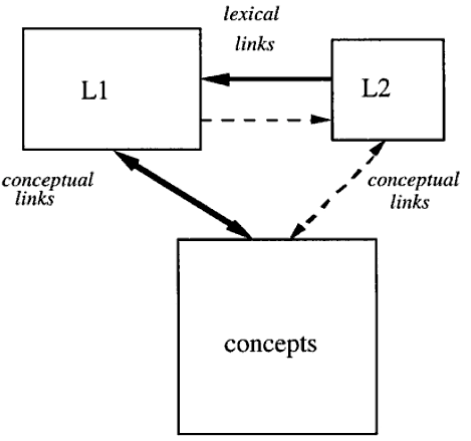

Figure 1. The Revised Hierarchical Model (RHM)
(Kroll & Stewart, 1994)

In the previous studies showing implicit activation of the native language during lexical access in the second language, the bilingual participants were immersed in an English-speaking environment, and were at a highlevel of English proficiency (Thierry & Wu, 2007; Wu & Thierry, 2010). According to the predictions of the RHM, it is possible that high L2 proficiency may have resulted in these bilinguals relying less on the lexical links between the L2 and L1, and more on the conceptual linkswhen processing words in English. A weaker degree of reliance on the lexical connections between L2 and L1 may have resulted in less activation of L1 translations. By contrast, if the participants had been less proficient in English, the RHM predicts they

would have relied more on the lexical connections from the L2 to L1. This stronger activation of the L1 translation equivalent may be reflected as significant effects in the behavioral data, which were not found in the previous studies with more proficient bilingual participants.

In this study, we investigate whether low-intermediate Korean-English bilingual participants spontaneously activate Korean translations while performing a semantic association task in English. The predictions are that the relatively strong grapheme-phoneme correspondence of the Korean alphabet, along with the lower level of English proficiency of the bilingual participantswill result in stronger effects of implicit L1 translation, reflected as longer reaction times and higher error rates in the behavioral data.

3. Experimental Procedure

3.1. Participants

Twenty-nine participants were tested, including a group of eighteen Korean-English bilinguals and a group of eleven Korean monolingual speakers. Both groups of participants were undergraduate students attending a large Korean university. Upon entrance to the university, all students were required to take an English placement test which included reading, grammar and listening sections. Based on their scores to this placement test, the students were assigned a level of English proficiency from 1 to 5, from highest to lowest. In order to ensure that the Korean-English bilingual participants in the present study were at a low-intermediate level of English proficiency, the participants in the bilingual group were recruited only from the English classes for students who were assigned levels 4 and 5 (low and low-intermediate proficiency), which consisted of the lower thirty percent of the entire student population.

When a separate English proficiency test and language background questionnaire was administered to these participants at the time of testing, the mean score was 15.27 (SD=3.98) out of a total of 25 points, and mean self-rated proficiency in English was 2.38 (SD=0.77) on a scale of 1 to 5, confirming that the English proficiency of these bilingual participants was at a low-to-intermediate level. None of the participants reportedresiding in an English-speaking country for more than twelve months, and participants

were controlled for age and level of education across groups. Detailed demographic information of the participants is presented below in Table 2.[3]

Table 2. Bilingual participant information

	Proficiency test	Vocabulary test	Self-rated proficiency scores	Length of residence (months)
Mean	15.27	146.66	2.38	0.66
SD	3.98	7.73	0.77	2.82
Range	8-20	130-157	1-3	0-12

3.2. Stimuli

The experimental stimuli consisted of pairs of English words which were controlled for two factors: semantic relatedness and hidden character repetition. In order to exclude English words with multiple Korean translations, an initial set of 120 English word pairs (240 words) was generated. A group of eleven Korean-English bilinguals who did not participate in the semantic association task completed a norming test in which the 240 English words were translated into Korean and rated for semantic relatedness.

The translation normingtest was conducted in order to exclude English words that had multiple Korean translations, as implicit translation effects are predicted to be observed in the semantic association task only if the Korean-English bilingual participants activate identical translations for each English word across participants. Pairs of stimuli in which at least one word did not meet a cutoff criterion of 80% for identical translations into Korean across participants were excluded, which resulted in the removal of thirty word pairs.

The remaining word pairs were rated for semantic relatedness through a binary semantic relatedness task, and only word pairs which received

[3] The vocabulary test was administered after the main task to confirm that the participants were familiar with the words used as experimental stimuli. More information about the vocabulary test can be found in section 3.3.

unanimous ‘yes’ or ‘no’ judgments for semantic relatedness were included in the final set of stimuli, resulting in a final set of eighty English word pairs: forty word pairs in which the two words were semantically related, and forty word pairs which were semantically unrelated. Four experimental conditions were designed by crossing the factors of semantic relatedness (related vs. unrelated) and hidden character repetition in Korean (repeated vs. unrepeated): semantically related with hidden character repetition (+S +R), semantically related with no character repetition (+S -R), semantically unrelated with hidden character repetition (-S +R), and semantically unrelated with no characer repetition (-S -R). The eighty word pairs were distributed evenly across these four conditions, with twenty word pairs per each condition. The word pairs were matched across experimental conditions for length measured in number of letters (M = 6.08, SD = 1.72) and word category (nouns). The hidden character repetition was always in the same position (first syllable) of the Korean translations of both words in each pair. Sample word pairs for each of the four conditions are presented below in Table 3.

Table 3. Sample items per condition

Semantic relatedness	Character repetition	Experimental items	Translations in Korean
Related (+S)	Repeated (+R)	Umbrella - Raincoat	우산[usan] - 우비[ubi]
	Non-repeated (-R)	Leg - Knee	다리[dari] - 무릎[mureup]
Unrelated (-S)	Repeated (+R)	Scissors - Chest	가위[gawi] - 가슴[aseum]
	Non-repeated (-R)	Soap - Roof	비누[binu] - 지붕[cibung]

3.3. Tasks

The semantic association task was designed and conducted on Paradigm software. In the semantic association task, participants were required to make semantic relatedness judgments on English word pairs presented in a pseudo-randomized order on a computer screen. Participants were instructed to indicate whether the second word in each pair was related in meaning to the first by pressing a ‘YES’ or ‘NO’ key as quickly and

accurately as possible. Each trial began with a fixation point in the middle of the screen for 200 ms. The fixation point was then replaced by the first word in the word pair for a duration of 700 ms, followed by an interstimulus interval of 700 ms, and then the presentation of the second word. The second word in each pair was presented on the screen until the participant responded, up toa maximum of 3,000 ms.

After completing the semantic association task, participants completed a language background questionnaire and English proficiency test designed to evaluate English proficiency. An offline vocabulary test asking participants to provide Korean translations of the 160 English words used as experimental stimuli was also administered. The purpose of the English vocabularytest was to confirm that the participants knew the correct Korean translations of the English words used as experimental stimuli for the semantic association task. If the participants were not familiar with the English words or their Korean translations, the hidden repetition factor in the semantic association task would be ineffective. In order to prevent possible priming effects due to preview of the experimental stimuli, the offline vocabulary test was administered to participants after completion of the semantic association task. The results showed a mean accuracy score of 91.66% (SD=4.83%), suggesting that the bilingual participants had sufficient knowledge of the English words used as experimental stimuli, so that none of the participants' data were excluded from further analysis.

At the end of each experiment, the participants were asked if they had noticed any associations between the English words in each pair other than semantic relatedness. None of the participants were aware that the Korean translations of the English word pairs concealed a repeated character in first syllable. The entire procedure took about thirty minutes, and the participants were paid for their participation.

3.4. Data Analysis

Experimental trials with incorrect answers were excluded from further analysis of response times, accounting for 11.13% of the data. The remaining behavioral data were trimmed for outliers through the following procedures. Response times more than 2.5 standard deviations from the mean response time of each condition for each participant were excluded,

which resulted in the removal of 2.68% of the data. Response times shorter than the absolute values of 100 ms and those longer than 3,000 ms were also excluded, resulting in the removal of 1.97% of the data. The remaining response time and accuracy data were submitted to a two-way repeated measures ANOVA with semantic relatedness (related/unrelated) and character repetition (repeated /unrepeated) as independent factors.

4. Results

The behavioral data for the semantic association task across the two groups of participants is presented in Table 4. In the semantic association task, the Korean-English bilingual participants responded faster to semantically related (1021.82 ms) than semantically unrelated (1149.83 ms) word pairs ($p < .0005$, $F(1,17) = 44.12$). The factor of hidden Korean character repetition also had a significant effect on response times, with longer response times for word pairs with hidden character repetition (1178.99 ms), compared to word pairs with no hidden repetition (1127.66 ms) ($p = .007$, $F(1,17) = 9.34$). The interaction between the two factors of semantic relatedness and hidden repetition was not significant ($p = .43$, $F(1,17) = .65$). Error rates were unaffected by semantic relatedness ($p = .34$, $F(1,17) = .96$), but showed significant effects of hidden repetition ($p = .01$, $F(1,17) = 7.92$), with higher error rates for experimental stimuli concealing a hidden character repetition in Korean translations (mean error rate: 14.43 %), compared to the word pairs with no hidden character repetition (mean error rate: 10.43%).

Table 4. Mean RTs and Accuracy rates (%) for each condition

	+S+R	+S-R	-S+R	-S-R
Bilingual group	1056.57 (85.85)	987.06 (86.65)	1301.41 (85.30)	1268.25 (92.50)
Monolingual group	837.18 (85.90)	794.33 (95.00)	922.12 (97.75)	824.4 (96.35)

A similar effect of repetition was also found with the monolingual Korean

participant group, who were exposed to Korean stimuli with overt character repetition. In the response time data, character repetition resulted in marginally longer response times, $F(1, 10) = 3.76$, $p = .08$. Response times for semantically related word pairs (879.65 ms) were longer than unrelated pairs (809.37 ms), but this difference was not statistically significant, $F(1, 10) = 2.32$, $p = .15$. The interaction between semantic relatedness and character repetition was not significant, $F(1, 10) = .79$, $p = .39$. The accuracy data for the monolingual Korean group was significantly affected by both factors of semantic relatedness $F(1, 10) = 5.28$, $p = .04$ and character repetition ($F(1, 10) = 6.14$, $p = .03$. Monolingual Korean participants showed higher error rates for word pairs which were semantically related (mean error rate: 9.55 % vs. 2.95%), and word pairs with overt character repetition (mean error rate: 8.18% vs. 4.33%). A significant interaction between the two factors was also found, $F(1, 10) = 26.73$, $p = .005$ with a larger effect of hidden character repetition in the semantically related conditions.

5. Discussion

In this study, we examined whether Korean-English bilinguals with a low-intermediate level of English proficiency unconsciously activated the Korean translation equivalents of English words while performing a monolingual semantic association task involving experimental stimuli exclusively in English. We predicted that Korean-English participants with a lower degree of English proficiency would result in stronger and more salient effects reflecting implicit first language activation during second language reading compared to previous studies with proficient Chinese-English bilinguals (Thierry & Wu, 2007; Wu & Thierry, 2010).

According to the RHM (Kroll & Stewart, 1994), the route of lexical access of words in the L2 lexicon is predicted to differ depending on a bilingual's level of L2 proficiency. Therefore, the bilingual participantsin the present study were recruited from a group which was predicted to rely more on the lexical links between the L1 and L2 lexicon, as opposed to directly activating the conceptual links between L2 words and concepts, due to their low-intermediate level of L2 proficiency. This implicit activation of

L1 translations was predicted to be manifested as significant interference effects of the hidden character repetition in the behavioral data.

In order to obtainstronger behavioral effects of implicit activation of first language translations, the present study chose Korean and English as the experimental languages. Previous studies obtained ERP data as evidence of implicit translation with Chinese-English bilinguals (Thierry & Wu, 2007; Wu & Thierry, 2010). However,connectionist models such as the BIA+ model (Dijkstra & van Heuven, 2002) predict that the dissociation between orthography and phonology of Chinese may have resulted in weaker activations of the Chinese translation equivalents. In contrast, Korean was an ideal language with which to examine implicit effects of first language activation while reading in English for two reasons. First, Korean is also a language which does not share the writing system of English. Second, in contrast to Chinese, Korean is an alphabetic language which has relatively strong grapheme-phoneme correspondence. The strong connections between orthography and phonology are predicted to result in stronger activations of the lexical nodes in an interactive connectionist model, such as the BIA+ model (Dijkstra & van Heuven, 2002).

Therefore, the investigation of Korean-English bilingual participants who were at a level of English proficiency which was sufficiently high enough so that they were able to perform the task at hand (as evidenced by the high accuracy rates), but low enough so that they were predicted to rely more on the lexical links between the L1 and L2, was predicted to result in significant behavioral effects of implicit L1 activation, which failed to be obtained in previous studies.

The results of the semantic association task in the present study yielded significant effects of hidden character repetition in the behavioral data, reflected as both longer response times and higher error rates for word pairs concealing an identical character in Korean translations. The spontaneous activation of the L1 translations was unconscious on the part of the participants, as all of the participants reported no awarenessof the concealed repetition during debriefing sessions at the end of the experimental sessions.

The effects of hidden repetition obtained from the bilingual group patterned similarly with data from the monolingual Korean participants, who were overtly exposed to the repeated character condition in a semantic

association task using the Korean translations of the English word pairs as stimuli. The monolingual participants showed marginally longer response times and made a significantly higher proportion of errors when making semantic relatedness judgments on the word pairs in the repeated character condition. The strikingly similar pattern of behavioral data across the two groups of participants, reflected as longer response times and higher error rates for conditions with hidden and overt character repetition, suggest that the Korean-English bilinguals in the present study were indeedspontaneously and unconsciously activating Korean translations while reading English words.

The significant effects of hidden character repetition obtained for the Korean-English bilinguals in the present study are contrastive with the absence of any significant behavioral effects of hidden character repetition in similar studies employing with Chinese-English bilinguals (Thierry & Wu, 2007; Wu & Thierry, 2010). Although these studies obtained evidence supporting non-selective activation of the first language while reading words in the second language, Thierry and Wu (2007) suggested that the smaller, less durable N400 modulations attributed to hidden character repetition may be an indication that the effects of implicit translation activation, though stable, may be too subtle to be reflected as significant effects in the behavioral data.

The present study revealed significant behavioral effects of hidden character repetition in a semantic association task by Korean-English bilinguals. These results are consistent with the ERP data obtained fromChinese-English bilinguals, and suggest that bilinguals spontaneously activate their nativelanguage even when processing words exclusively in the L2. Taken together, the behavioral data combined with the ERP data from previous studies supporta non-selective view of bilingual word recognition. Bilinguals may not selectively activate one of their languages, or consciously suppress their first language when processing the second language, as has been claimed in previous studies. (Gerard & Scarborough, 1989; Ju & Luce, 2004; Scarborough, Gerard & Cortese, 1984). In addition, wesuggest that the degree of first language activation during second language lexical processing may be modulated by the relative level of L2 proficiency and degree of correspondence between orthography and

phonology inthe first language.

6. Conclusion

The question of whether bilingual speakers can consciously activate or suppress one of their two languages has been the center of debate in the field of bilingual lexical processing. Evidence for non-selective activation of a bilingual's two languages has been reported in various behavioral (Dijkstra & van Heuven, 2002; Dimitropoulou, Duñabeitia & Carreiras, 2011; van Hell & de Groot, 1998) and neurolinguistic studies (Chee, Soon & Lee, 2003; Frenck-Mestre, Anton, Roth, Vaid & Vaillet, 2005; Kim, Relkin, Lee & Hirsch, 1997). However, most of these studies have been criticized for employing experimental methodologies which requires the participants to explicitly activate or switch between their two languages, which may artificially increase activation of the other language. The present study obtained results supporting automatic and implicit activation of the first language while performing a task which involved stimuli exclusively in the second language. The significant behavioral results obtained in the present study support and complement the neurophysiological data obtained in previous studies, and provide evidence in support of nonselective activation in the bilingual lexicon. Bilinguals unconsciouslyand automatically activate their first language during second language lexical processing. Future studies involving bilingual populations at varying levels of L2 proficiency and various combinations of different-script languages are expected to shed more light on this issue and provide a window in the language processing mechanisms of bilingual speakers.

References

Chee, M. W., Soon, C. S., & Lee, H. L. 2003. Common and segregated neuronal networks for different languages revealed using functional magnetic resonance adaptation. *Journal of Cognitive Neuroscience* 15(1), 85-97.

Dimitropoulou, M., Duñabeitia, J. A., & Carreiras, M. 2011. Masked translation priming effects with low proficient bilinguals. *Memory and Cognition* 39(2),

260-275.

Dijkstra, T., Grainger, J., & van Heuven, W. J. 1999. Recognition of cognates and interlingual homographs: The neglected role of phonology. *Journal of Memory and Language* 41(4), 496-518.

Dijkstra, T., Timmermans, M., & Schriefers, H. 2000. On being blinded by your other language: Effects of task demands on interlingual homograph recognition. *Journal of Memory and Language* 42(4), 445-464.

Dijkstra, T., & van Heuven, W. J. 2002. The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition* 5(3), 175-197.

Dufour, R., & Kroll, J. F. 1995. Matching words to concepts in two languages: A test of the concept mediation model of bilingual representation. *Memory & Cognition* 23(2), 166-180.

Frenck-Mestre, C., Anton, J. L., Roth, M., Vaid, J., & Viallet, F. 2005. Articulation in early and late bilinguals' two languages: evidence from functional magnetic resonance imaging. *Neuroreport* 16(7), 761-765.

Gerard, L. D., & Scarborough, D. L. (1989). Language-specific lexical access of homographs by bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 15(2), 305-315.

Gollan, T. H., Forster, K. I., & Frost, R. 1997. Translation priming with different scripts: Masked priming with cognates and noncognates in Hebrew-English bilinguals. Journal of Experimental *Psychology-Learning Memory and Cognition* 23(5), 1122-1139.

Grosjean, F. (1998). Studying bilinguals: Methodological and conceptual issues. *Bilingualism: Language and Cognition* 1(2), 131-149.

Hoshino, N., & Kroll, J. F. 2008. Cognate effects in picture naming: Does cross-language activation survive a change of script? *Cognition* 106(1), 501-511.

Ju, M., & Luce, P. A. 2004. Falling on sensitive ears: Constraints on bilingual lexical activation. *Psychological Science* 15(5), 314-318.

Kerkhofs, R., Dijkstra, T., Chwilla, D. J., & De Bruijn, E. R. 2006. Testing a model for bilingual semantic priming with interlingual homographs: RT and N400 effects. *Brain Research* 1068(1), 170-183.

Kim, J., & Davis, C. 2003. Task effects in masked cross-script translation and phonological priming. *Journal of Memory and Language* 49(4), 484-499.

Kim, K. H., Relkin, N. R., Lee, K. M., & Hirsch, J. 1997. Distinct cortical areas associated with native and second languages. *Nature* 388(6638), 171-174.

Kroll, J. F., & de Groot, 2005. *Handbook of bilingualism: sycholinguistic approaches*. Oxford University Press, New York.

Kroll, J. F., & Stewart, E. 1994. Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language* 33(2), 149-174.

Kutas, M., & Hillyard, S. A. 1984. Brain potentials during reading reflect word expectancy and semantic association. *Nature*, 307(5947), 161-163.

Liu, Y., Perfetti, C. A., & Hart, L. 2003. ERP evidence for the time course of graphic, phonological, and semantic information in Chinese meaning and pronunciation decisions. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 29(6), 1231.

Luck, S. J., Vogel, E. K., & Shapiro, K. L. 1996. Word meanings can be accessed but not reported during the attentional blink. *Nature* 383(6601), 616-618.

Osterhout, L., & Holcomb, P. J. 1995. Event-related potentials and language comprehension. *Electrophysiology of Mind*, 171-215.

Scarborough, D. L., Gerard, L., & Cortese, C. 1984. Independence of lexical access in bilingual word recognition. *Journal of Verbal Learning and Verbal Behavior* 23(1), 84-99.

Sunderman, G. L., & Priya, K. 2012. Translation recognition in highly proficient Hindi-English bilinguals: The influence of different scripts but connectable phonologies. *Language and Cognitive Processes* 27(9), 1265-1285.

Sunderman, G., & Schwartz, A. I. 2008. Using Cognates to Investigate Cross-Language Competition in Second Language Processing. *TESOL Quarterly* 42(3), 527-536.

Talamas, A., Kroll, J. F., & Dufour, R. 1999. From form to meaning: Stages in the acquisition of second-language vocabulary. *Bilingualism: Language and Cognition* 2(1), 45-58.

Thierry, G., & Wu, Y. J. 2007. Brain potentials reveal unconscious translation during foreign-language comprehension. *Proceedings of the National*

Academy of Sciences 104(30), 12530-12535.

van Hell, J. G., & de Groot, A. M. 1998. Conceptual representation in bilingual memory: Effects of concreteness and cognate status in word association. *Bilingualism: Language and cognition* 1(3), 193-211.

Wu, Y. J., & Thierry, G. 2010. Chinese-English bilinguals reading English hear Chinese. *Journal of Neuroscience* 30(22), 7646-7651.