CROSS-SCRIPT COGNATE PRIMING EFFECTS ON VISUAL WORD RECOGNITION: EFFECTS OF JAPANESE LOANWORD COGNATES IN L2 JAPANESE LEARNERS

By

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ABSTACT

Research in bilingualism has shown that translation pairs that look or sound similar across languages (e.g., English-Spanish *rich-rico*) are easy to recognize for the speakers of the two languages. Such translation pairs are called *cognates* and the processing advantage of cognates is known as *cognate facilitation effect*. This thesis investigated cognate facilitation effect in visual word recognition by examining masked priming effects in beginning English-Japanese bilinguals, namely late second language (L2) learners of Japanese whose first language (L1) is English. More specifically, the current study examined (i) what constitutes cognate facilitation effect in visual word recognition in bilinguals whose two languages share no orthographic similarity and (ii) whether the facilitation effect would be modulated by L2 proficiency by testing two proficiency groups of L2 learners of Japanese. The results from masked priming experiments using English (L1) primes with Japanese (L2) targets showed that priming effects for cognate pairs (e.g., *card*-カード/ca:do/) were larger than for translation pairs (e.g., *desk*-つくえ/tukue/) and the effect was smallest for word pairs similar only in sound (e.g., *nail*-メール/me:ru/,*mail*). The same patterns of results were obtained for Japanese (L2) primes with English (L1) targets. The size of priming effects did not differ across the two proficiency groups, but significantly larger priming effects were observed in L1-L2 priming direction than in L2-L1 priming direction. These findings indicate that (i) cognate facilitation effect in visual word recognition can be obtained without shared orthography, and shared semantics and phonology underlie the cognate facilitation effect. Further, (ii) the asymmetry in the size of the priming effects in beginning bilinguals may be due to their low L2 proficiency and the fact that sufficient L2 proficiency is required to utilize cognate information from L2 primes in the process of recognizing L1 targets. The findings are discussed in regard to cross-language co-activation and interaction during bilingual lexical processing within the framework of the Bilingual Interactive Activation (BIA+) model. The role of L2 proficiency in bilingual lexical processing is also considered.

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Chapter 1. Introduction

The present study investigates the effect of cross-language similarities in the recognition process of printed words in late second language (L2) learners whose two languages have different writing systems (i.e., orthography). More specifically, this study investigated the effect of cross-language similarities in Japanese loanwords from English and their original English words in visual word recognition with American college students learning Japanese as a second language.

A person who possesses knowledge of two languages, be it a balanced bilingual with equal fluency in two languages or an unbalanced bilingual who is more proficient in one language than the other (i.e, a late L2 learner), sometimes encounters words which look and/or sound similar to those in their first language (e.g., Spanish-English *papel-paper*) and these cross-language similarities are typically observed among *cognates*. Cognates are translation pairs that share a similar spelling or sound in same-script languages (e.g., Spanish-English *rico-rich*) or that are similar phonologically in different-script language pairs (e.g., Japanese-English クラス/kurasu/ -*class*). Translation pairs that are dissimilar in either spelling or phonology, on the other hand, are called *noncognates* (e.g., Spanish-English *mujer-woman*, Japanese-English つくえ/tukue/ -*desk*) and studies have shown the processing advantage in cognates, which is known as *cognate facilitation effect*. For instance, a number of studies have shown that cognates are recognized faster and with greater accuracy than noncognates in a variety of experimental tasks such as visual word recognition, auditory word recognition and spoken word production (Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010).

Many studies have been done to investigate why cognates behave differently from noncognates in bilingual word processing and the special status of cognates has been examined extensively in the context of visual word recognition using priming experiments (De Groot & Nas 1991; Sánchez-Casas, Davis & García-Albea, 1992; Dijkstra, Grainger, & van Heuven, 1999; Lemhöfer & Dijkstra, 2004). These studies have shown that a target word was responded to significantly faster and more accurately when primed by its cognate than when it was primed by its noncognate or unrelated word. This indicated that cross-linguistic similarity in cognates (orthography, phonology, and semantics) is an important determining factor of response time in bilingual word recognition process.

Studies on the cognate facilitation effect have shown that cross-language similarities in cognates facilitate bilingual word processing and that orthographic, phonological, and semantic information from a word in one language influences the recognition of a word in the other language (Brysbaert, Dyck, & Poel, 1999; Dijkstra, Grainger, & van Heuven, 1999; Lemhöfer & Dijkstra, 2004; Nakayama, Sears, Hino, & Lupker, 2012, 2013). However, there are still some issues that need more attention. First, previous studies on cognate facilitation effect in bilingual visual word recognition have been predominantly about same-script bilinguals whose two languages use the same scripts such as Dutch-English (De Groot & Nas 1991; Dijkstra, Grainger, & van Heuven, 1999; Dijkstra et.al, 2010) and Spanish-English (Sánchez-Casas et.al, 1992; García-Albea, Sánchez-Casas & Valero, 1996; Davis, Sánchez-Casas, García-Albea, Guash, Molero, & Ferré, 2010). One problem with these studies is that it is difficult to determine the locus of cognate facilitation effect in same-script languages. When the scripts of the two languages are the same, it is difficult to distinguish the contribution of shared orthography and phonology in cognate facilitation effect. By using different-script bilinguals, orthographic similarity can be eliminated and that allows us to focus on phonological and semantic similarity in cognates, but there have been very few studies on cognate facilitation effect in different-script bilinguals. As for Japanese-English cognates, to my best knowledge, there have been no studies that investigated cognate facilitation effect in English speakers learning Japanese, although several studies have investigated the effect in Japanese-English bilinguals (Finkbeiner, Forster, Nicol, & Nakamura, 2004; Hoshino & Kroll, 2008; Nakayama et al., 2012, 2013). Second, whether or not L2 proficiency affects the degree of cognate facilitation effect is underresearched. Previous studies have constantly reported the asymmetry of cognate facilitation effect in bilingual visual word recognition using priming experiments, in which the priming effect is always larger for L1-L2 priming direction when the prime is in L1 and the targets are in L2.

Symmetric priming effect was observed only in highly proficient or simultaneous bilinguals (Sánchez-Casas et.al, 1992; Duñabeitia, Perea, & Carreiras, 2010; Nakayama et.al.,2013) with inconsistent results in highly proficient different-script bilinguals (Korean-English, Kim & Davis, 2003; Arabic-French, Bowers, Mimouni, & Arguin, 2000). In addition, almost all of the participants in previous cognate studies were highly proficient bilinguals and there have been a very few studies that examined the effect in low proficient or beginning bilinguals (i.e., late L2 learners).

Based on the observations above, this thesis investigated these issues by examining masked priming effects in visual word recognition in two proficiency groups of English speakers who had studied Japanese at college level for a year (Basic group) and for more than two years (Post-basic group). The present study is theoretically guided by the Bilingual Interactive Activation Model (BIA+ model; Dijkstra & van Heuven, 2002) that postulates an integrated bilingual lexicon and parallel activity of the two lexicons in visual word recognition and *the temporal delay* in L2 word recognition process due to the individual difference in L2 proficiency. Prior to the review of the existing studies of cognate facilitation effect in bilingual visual word recognition, the architecture of bilingual lexical representation (how the information of two languages are stored) and lexical access (how bilinguals access the information to retrieve the meaning of a word) will be discussed in order to provide a bilingual language processing mechanism that underlies the cognate facilitation effect.

1.1.1 Bilingual lexical representations and lexical access

Bilinguals have knowledge of two languages and two sets of language representations (orthographic, phonological, and semantic information of a word) for an item or concept in their mind. In bilingual research, how bilinguals control their two language systems has been a central question. Although the term *bilingual* is generally used to refer to a person fluent in two languages, it does not only apply to those who speak two languages equally well (Desmet & Duyck, 2007). The broader view of *bilingual* includes those individuals who are fluent in one language but can produce complete meaningful utterances in the other language (Haugen, 1953) or those who have various levels of proficiency in both languages (Butler & Hakuta, 2004). The present study follows the broader view of *bilingual* because it allows even L2 learners in the process of acquiring L2 at various levels to be classified as bilinguals (Butler & Hakuta, 2004).

As bilinguals outnumber monolinguals worldwide, research on bilingualism has attracted the attention of psycholinguists because bilinguals, more than monolinguals, will provide a genuinely universal account of the cognitive mechanisms that underlie language processing (DeBot & Kroll, 2002). The focus of bilingual research has been on two issues: the organization of bilinguals' mental lexicon and the procedure involved in lexical access. Mental lexicon refers to the storage of the language a person knows that contains all information of the language (e.g., orthography, phonology, semantics, syntax, and so on), while lexical access refers to the process of accessing the mental lexicon to retrieve that information (Cergol Kovacevic, 2012). There have been two specific questions asked concerning these issues. First is about whether the language representations (information of the languages) of bilinguals' two languages are stored in two separate systems or in a single shared system. And second is about whether their lexical access is restricted to the language in use (target language) or both of their language representations are accessed simultaneously upon the presentation of a word in language processing. These two questions have been hotly debated in bilingual research as they predict very different consequences on the cognitive mechanisms that underlie bilingual language processing. That is, if information from two languages is stored in two separate systems independently, it is unlikely that the two language representations interact. If two language representations are stored in an integrated fashion, however, there might be an interaction during lexical processing between the two languages. Likewise, if lexical access is specific to the target language, only the lexical representations of the target language would be activated. And if bilinguals access both language representations upon the presentation of a word, regardless of the language currently in use, the language representations of their two languages would both be activated.

1.1.2 Language selective view (the Reversed Hierarchical Model)

In early studies of bilingualism, most research has addressed the issue of how the two languages of a bilingual are represented and focused on the organization of the lexicon, that is, whether there is one versus two separate stores of bilingual lexicon (Weinreich, 1953; Kolers, 1963). Several experimental studies provided supporting evidence for the separate lexicons and the language selective access, which assumes bilinguals' lexical access is restricted to the target language (Macnamara & Kushnir, 1971; Soares & Grosjean, 1984; Gerald & Scarborough, 1989).

The language selective access view is based on the idea that bilinguals have two mental dictionaries for their two languages where words of the two languages are stored separately with each word having its own specific meaning (Weinreich, 1953). Therefore, this view assumes that bilinguals' lexical access is specific to the target language and that only the lexical candidates of the target language are activated at the presentation of a word in the target language. The two lexicons do not interact with each other as they are stored separately. Gerald and Scarborough (1989) obtained supporting evidence for this view in their experiments with Spanish- English bilinguals. In an English lexical decision task, the participants were presented English words and Spanish- English homographs (words spelled the same in two languages but with different meanings; eg., '*red*' means 'a color red' in English while in Spanish '*red*' means 'net'). They were asked to respond 'yes' only to English words and there was no reaction time difference between homographs and English words. The results showed the bilinguals recognized the homographs as English words without being affected by their L1 (Spanish) knowledge, indicating that the bilinguals were accessing only their English lexicon and their Spanish lexicon was not activated during the task. If the bilinguals accessed both Spanish and English lexicon upon the presentation of a homograph, the reaction time to the homographs should have been slower than to English words, as they need some time to decide which language the homographic word belongs to. This finding is consistent with the claims of the language selective access view (Weinreich, 1953), which assumes two separate lexicons for each language and that bilinguals access only the target language lexicon in language processing.

The most well-known bilingual word processing model that assumes separate lexicons is the Revised Hierarchical Model (the RHM) proposed by Kroll and Stewart (1994) illustrated in Figure 1. In this model, lexical (orthographic and phonological) representations for each language are stored in two separate systems, while conceptual (semantic) representations are shared by the two languages. As can be seen in Figure 1, the strength of these connections is asymmetric. The connections between the L1 lexicon and the conceptual system are stronger than those between the L2 lexicon and the conceptual system. In contrast, the lexical links between L2 to L1 were stronger than those from L1 to L2, because L2 words are usually learned via L1 translations. The RHM assumes that these asymmetries will disappear as a bilingual becomes more proficient in L2. That is, as L2 proficiency increases, the connection between L2 lexicon and the concept will become stronger and a bilingual will be able to access to the conceptual system directly without relying on the L1 translation.

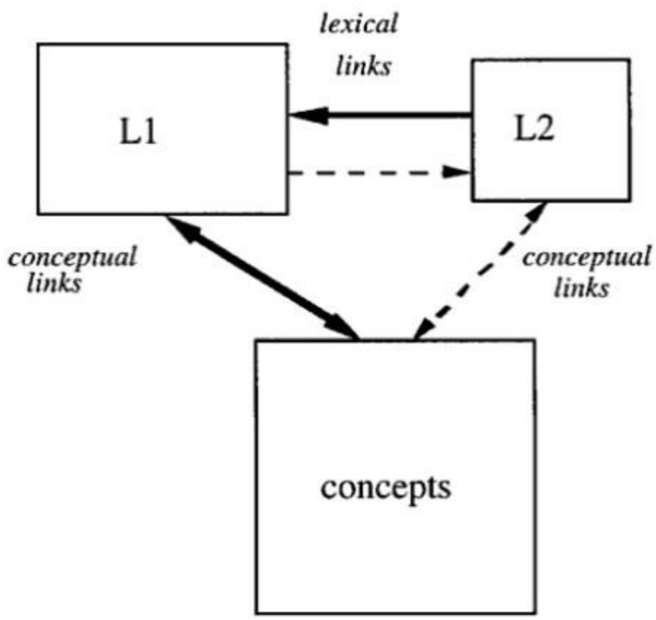

Figure 1. The Revised Hierarchical Model. Adapted from Kroll and Stewart (1994).

Although the model does not explicitly refer to the language selective access, one implication of this model is that lexical access is language selective, as the model assumes two distinct lexicons for each language. No interaction between the lexical representations of the two languages is expected as they are stored in two separate containers, and this assumption can account for why bilinguals do not show intrusion from the other language when one language is in use, as Gerald and Scarborough (1989) found in their experiments with Spanish- English bilinguals.

The RHM is an influential model of bilingual word processing in that it offered a clear model of interaction between the semantic and lexical levels by separating lexical and conceptual representations into distinct levels. The distinction between lexical representations (form) and concept (meaning) makes sense if we consider that the concept of a pet animal *dog* does not differ much across languages, while most words have different orthography in each language (e.g., English – French *dog* – *chien*) (Desmet & Duyck, 2007). In addition, the model offered an explanation for the 'one versus two separate stores' issue by presenting that language representations are stored separately at the lexical level but concepts are shared between the two languages. However, the focus of the RHM is on the interaction between the semantic and lexical systems, rather than the interaction between bilinguals' two lexicons, that is, at the lexical level. Besides, findings from recent bilingual word recognition studies such as cognate facilitation effect studies provide little support for the model (De Groot & Nas 1991; Sánchez-Casas et.al, 1992; Gollan et al., 1997; Kim & Davis, 2003; Nakayama et al., 2012, 2013). These studies have shown that cognates are recognized quickly because the cross-language similarities in orthography and phonology as well as semantics in cognates facilitate the word recognition. This means that there is an interaction between the two languages at the lexical level. However, the RHM does not predict any interaction as two separate lexicons imply the lexical access is language selective. That is, lexical properties (orthography and phonology) of one language do not have any consequences on the other in bilingual word processing because the lexical access is restricted to the language in use and there is no interaction between the lexical properties of the two languages during bilingual lexical processing.

1.1.2 Language nonselective view (the Bilingual Interactive Activation Model: BIA+ model)

Bilingual research has begun to shift its focus on the process of lexical access rather than on 'one versus two separate stores' for language representations, as evidence against the language selective access view accumulates, which in turn supports the language nonselective access view. (Dijkstra et.al., 1998, 1999, 2002, 2005, 2010; Brysbaert et al., 1999; Van Wijnendale & Brysbaert, 2002, De Groot & Nas, 1991; Sánchez -Cazas et al., 1992; Gollan et al., 1997; Kim & Davis, 2003; Voga & Grainger, 2007; Nakayama et al., 2012, 2013). The language nonselective access view assumes a single storage for words from two languages and that bilinguals nonselectively activate lexical representations in both languages, regardless of the language currently in use. In the language selective access view, only the lexical candidates of the target language are activated. In this view, when a Spanish-English bilingual is reading in English, the letter string *red* activates only the "color red" meaning (Figure 2 a). In the language nonselective access view, upon the presentation of a word *red*, both the "color red" meaning associated with the word *red* in English, and the "net" meaning associated with the Spanish word *red* are activated. In this view, the activation of lexical candidates from both languages occurs in parallel (Figure 2 b).

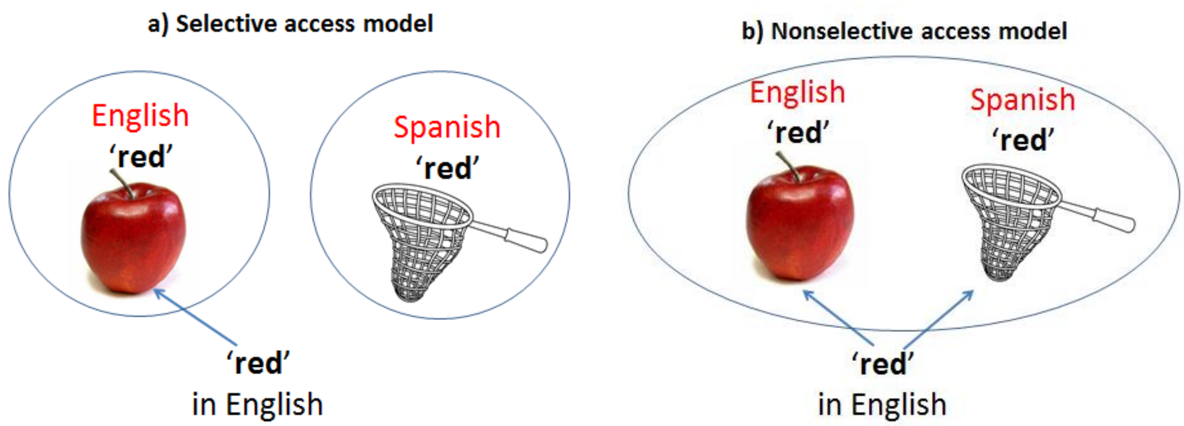

Figure 2a and 2b. Selective and nonselective lexical access of the homograph *red* while reading in English. 'red' means 'a color red' in English while in Spanish 'red' means 'net' (Gerald & Scarborough, 1989).

The representative model of the language nonselective access is the Bilingual Interactive Activation Model (BIA + model) proposed by Dijkstra and van Heuven (2002). There are two main assumptions in this model. First, the model assumes that L1 and L2 words are represented in a single integrated lexicon. Second, it assumes that word recognition process is language-nonselective, which means that representations from both languages (orthographic, phonological, and semantic representations) become activated in parallel upon the presentation of a word in either of the two languages. The word recognition process proceeds in a bottom-up manner from the orthographic level to the semantic level in the word identification system (Figure 3).

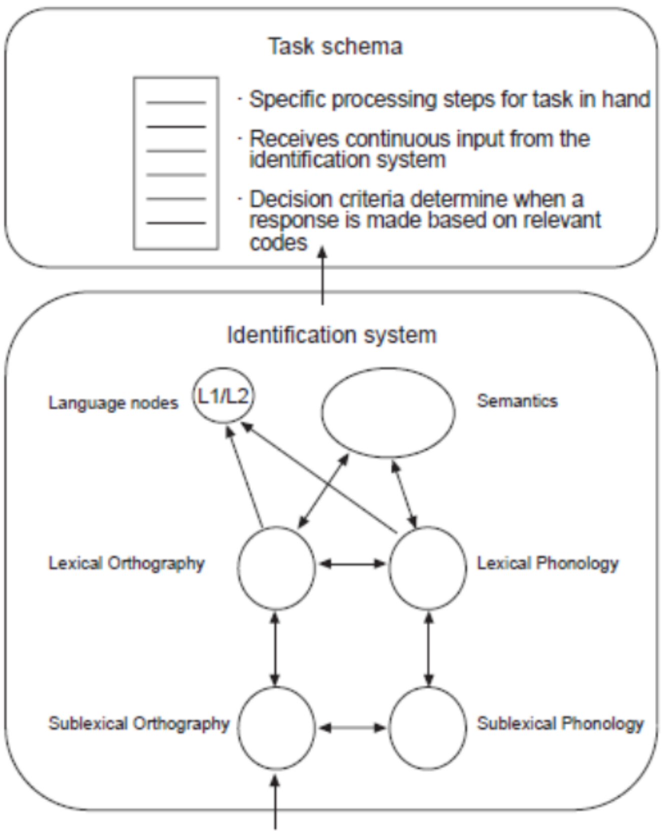

Figure 3. The BIA+ model for bilingual word recognition. Adapted from Dijkstra and van Heuven, 2002)

First, when an input letter string is presented to the BIA+ model, sublexical orthography (letters) and sublexical phonology (phonological units) are activated. Next, the activation spreads to the lexical orthography and phonology, and a number of lexical orthographic candidates are activated in parallel depending on their similarity to the input string. Then, activated orthographic word candidates activate their corresponding phonological, semantic representations and language nodes which indicate the word's language membership. All of this information is then used in the task/decision system to carry out the task in hand (e.g., recognition or production of a word).

According to the model, the activation of lexical representations depends on proficiency and subjective frequency. For low proficient bilinguals, L2 representations are generally of lower subjective frequency than L1 representations. Therefore, they are activated more slowly than L1 representations. The model calls this *temporal delay assumption*. A consequence of the temporal delay assumption is that cross-linguistic effects will generally be larger from L1 to L2 rather than L2 to L1 and this has been observed in many cognate priming effect studies in word recognition (Gollan, et al., 1997; De Groot & Nas, 1991; Jian, 1999; Davis et al., 2010; Nakayama et al., 2013).

The architecture of the BIA + model allows simultaneous activation of lexical properties from both languages in the word identification system and provides possible explanation for the language nonselective access view. A number of studies have provided supportive evidence for the predictions of the model. That is, lexical information is activated in a language nonselective manner, regardless of the language currently in use. The clearest evidence for language nonselective access comes from studies in which bilinguals were asked to perform a task in one of their language that does not need any knowledge of the other language. For example, evidence comes from a neighborhood effect study on Dutch-English bilinguals (van Heuven, Dijkstra, & Grainger, 1998). Neighborhood effect means that reaction times for words that have many neighbors (i.e. words that differ in one letter or sound from the target word such as WORK and WORD) are longer than for words that have few neighbors. For instance, the English word *lame* has many neighbors (e.g., *lace, lade, lake, dame, fame, game, name)* while *sly* has few neighbors (e.g., *sky, spy, ply*). Many neighbors means that there are many competing candidates for the target word and thus slows down the recognition process. van Heuven et al., (1998) conducted an English lexical decision experiment in which participants had to decide whether a presented word is an English word or not. So participants did not need to use their L1 (Dutch) knowledge during the task. However, the result showed that reaction times to English words slowed down as the number of Dutch neighbors increased, indicating that the knowledge of Dutch was activated during the task even though the participants were told to perform an English lexical decision (e.g., Dutch word *wolk* has English neighbors such as *walk* and *work*). Their finding is supportive for non-selective access because if lexical access was selective, that is, restricted to one language, neighbors from another language should have no impact on reaction times.

Evidence also comes from a study on the influence of phonological activation in bilingual word recognition. Van Wijnendale and Brysbaert (2002) conducted a word recognition experiment with French-Dutch bilinguals. The participants were asked to identify the French word that appeared on a computer screen and type it in. So the participants did not need any knowledge of L2 (Dutch) while they were engaged in the task. French words were preceded by briefly presented homophonic Dutch primes, which had similar sound to the French words. The results showed that the recognition of French targets (e.g., *faim*) was facilitated by homophonic Dutch primes (e.g., *fain*). The results indicated that phonological representations of French and Dutch were co-activated during the task, namely, activation of phonological representations occurred language nonselectively.

Findings from these two studies are consistent with the prediction of the BIA+ model that orthographic and phonological representations of both languages become activated in parallel at the presentation of a word in one of their languages. These findings suggest that the language selective access view with separate-lexicon assumption is inadequate to explain the accumulating evidence that have shown co-activation and interaction of two lexicons in bilinguals at lexical level (orthography and phonology) as observed in cognate facilitation effect. Such interaction between the lexical properties is indeed not possible if they are represented in two separate lexicons. The integrated lexicon assumed in the BIA + model, however, allows such interaction. As cognate facilitation effect indicates that information from one language influences the language processing in the other language in bilinguals, interaction between the bilingual lexicons and non-selective lexical access to the lexicons during the language processing could be assumed. The present study thus takes the BIA + model as the guiding model to give a possible explanation for the cognate facilitation effect in different-script bilinguals. The mechanism of the cognate facilitation effect based on the BIA+ model will be laid out in the following section.

1.2 Cognate status and cognate facilitation effect

Cross-language similarities in orthography, phonology and semantics are typically observed among *cognates*. Cognates are translation pairs that share a similar spelling and/or pronunciation such as Spanish-English *rico-rich* and Japanese-English ガイド/gaido/ -*guide* (Sunderman & Schwartz 2008). Cognates have been important sources of stimulus materials in psycholinguistic studies attempting to investigate whether cross-linguistic similarities observed in cognates have any consequences on bilingual word recognition process (Lemhöfer & Dijkstra, 2004). These studies have investigated whether words sharing semantic, orthographical, and phonological representations (cognates) are processed differently from those sharing only semantic representations (noncognates, which are translation pairs not similar either in orthography or phonology, such as Spanish-English *mujer-woman*).

Previous studies that used cognates and noncognates as stimulus materials have shown the processing advantage in cognates. Cognates are recognized more quickly and with greater accuracy than noncognates in visual word recognition (De Groot & Nas 1991; Gollan, Forster, & Frost, 1997; Kim & Davis, 2003; Nakayama, Sears, Hino, & Lupker, 2013; Duñabeitia, Perea, & Carreiras, 2010; Davis, Sánchez-Casas, García-Albea, Guash, Molero, & Ferré, 2010), and auditory word recognition (Marian & Spivey, 2003). Cognates are produced faster than noncognates in spoken production (Hoshino & Kroll, 2008) and are translated more quickly than noncognates in translation tasks (Sánchez-Casas et.al, 1992; Friel & Kennison, 2001). Cognates also yield a larger priming effect than noncognates in cross-language priming studies using translation pairs as primes and targets (De Groot & Nas 1991; Sánchez-Casas et.al, 1992; Kim & Davis, 2003; Voga & Grainger, 2007, Gollan et.al., 1997, Nakayama, Sears, Hino, & Lupker, 2013).

The processing advantage for cognate words over noncognate words observed in these studies is known as *cognate facilitation effect* (Dijkstra et al., 1999; Lemhöfer & Dijkstra, 2004, Dijkstra, Miwa, Brummelhuis, Sappelli, & Baayen, 2010). Cognate facilitation effect suggests that cross-language similarities facilitate bilingual word processing and that orthographic, phonological, and semantic information from a word in one language influences the recognition of a word in the other language. Cognate facilitation effect thus has often been taken as evidence for a bilingual lexicon that stores words of two languages in an integrated fashion and for a nonselective lexical access procedure that activates word candidates in two languages in parallel

(Dijkstra et al., 2010). For instance, when a Dutch-English bilingual reads the English word *police*, the Dutch word *politie* (police in English) is also activated in that person's mind due to the orthographic similarity between the two words, which leads to a faster recognition and retrieval of the meaning of the English word *police*.

One theoretical model that can account for such facilitation effect of cognates is the BIA+ model (Dijkstra & van Heuven, 2002). As reviewed in the previous section, the model assumes that the language representation of L1 and L2 are stored in a single system and that language representations from both languages become activated in parallel in the word recognition process. According to this model, the cognate facilitation effect in reading (visual word recognition) can be explained as a semantic, orthographic, and phonological priming effect driven by the co-activation of the L1 and L2 language representation. That is, upon being presented with one of the cognates, overlapping semantic, orthographic, and phonological representations of both languages become activated. Since cognates not only share meaning but also orthography and phonology, the convergent activation of these three codes in cognates leads to a facilitated recognition of cognates relative to noncognates which share only meaning (Van Hell & Dijkstra, 2002; Dijkstra et al, 2010). The recognition level is thus reached more quickly in cognates than in noncognates because the activation of both language representations increases the overall activation (Cergol Kovačević, 2012).

An example of how the BIA + model would process the visual recognition of the English word *tomato* by a Dutch-English bilingual follows (Figure 4). If this person sees the L2 word *tomato*, it activates its form similar word in Dutch, which is *tomaat* ('tomato' in Dutch). This orthographic activation then spreads to the phonological and semantic levels. The activated L1 word *tomaat* then activates its meaning. As *tomato* and *tomaat* are cognates, the shared semantics of *tomato* and *tomaat* are co-activated, and it sends feed-back activation to the orthographic representations, thus strengthening both *tomato* and *tomaat*. The activated orthographic representations also activate language nodes, which indicates which language the word *tomato* belongs to (Dijkstra et al., 2010). This example shows the retrieval of the L2 word meaning is made faster via the form-similar L1 word form and this results from the co-activation of L1 and L2 lexical representations, which is the central claim of the BIA + model (Figure 4).

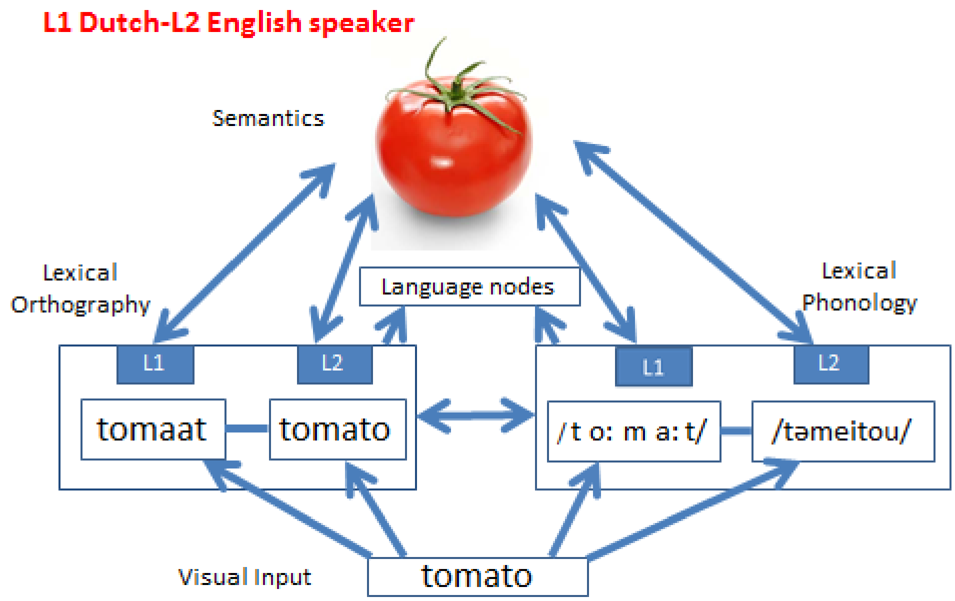

Figure 4. Graphical illustration of recognition of English word ‘tomato’ by a Dutch-English bilingual in the BIA+ model. This figure is adapted from Miwa, Bolger, Dijkstra & Baayen (2010). Sublexical orthography and phonology have been omitted.

The model generally assumes bilingual lexical processing to be language nonselective, but it also predicts the lexical access can be selective under certain circumstances. When the two languages do not share orthography, such as English and Chinese or Japanese, the model predicts language selective access at the orthographic level. With no orthographic similarity, it is unlikely that word candidates are activated in these language pairs at orthographic level. So at this point, lexical access could be language selective. However, the model notes that the effects of phonological similarity might still occur for such language pairs and thus it accommodates nonselective lexical access at the phonological level in different-script bilinguals. For example, when an English-Japanese bilingual sees the Japanese word トマト/tomato/, it is unlikely Japanese *katakana* script, which is used to write foreign loanwords in Japanese, activates English letter units as they share no orthographic similarity. At this point, therefore, co-activation of L1 and L2 words is not expected at orthographic level. However, it is still possible that the sound of L2 word トマト/tomato/ activates similar sounding L1 word *tomato* /təmeitou/. In this case, co-activation of L1 and L2 lexical representations occurs at phonological level. The activated L1 sound /təmeitou/activates its meaning and then the activated shared meaning of トマト/tomato/ and *tomato* sends feed-back activation to the orthographic level. The activated orthographic representations also activate language nodes, which indicates which language the word トマト /tomato/ belongs to. The retrieval of the L2 word meaning トマト*/tomato/* is thus speeded up via phonological similarity between L1 word *tomato* and L2 word トマト/tomato/.

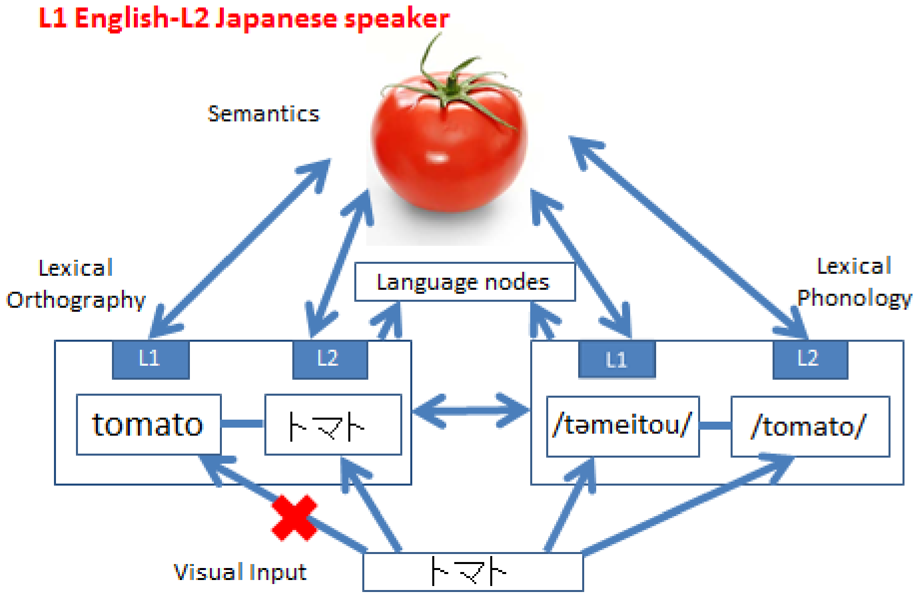

Figure 5. Graphical illustration of recognition of Japanese word 'トマト/tomato/' by a English-Japanese speaker in the BIA+ model. This figure is adapted from Miwa, Bolger, Dijkstra & Baayen (2010). Sublexical orthography and phonology have been omitted.

The BIA+ model claims that bilinguals access the lexicons of their two languages nonselectively during word processing and that orthographic and phonological representations of both languages become activated in parallel at the presentation of a word in one of their languages. The lexical activation at the phonological level predicted by this model accommodates cognate facilitation effect in different-script bilinguals; it allows cognate facilitation effect to emerge in visual word recognition without shared orthography in different-script bilinguals whose two languages share no orthographic similarity. In the following section, previous studies on cognate facilitation effect using a cross-language priming paradigm in visual word recognition will be reviewed with regard to the script type of the language pairs (i.e., same vs. different script) and the possible influence of L2 proficiency on the degree of the facilitation effect in order to provide an overview of the findings from cognate facilitation effect studies.

1.3 Cross-language cognate priming studies

Cross-language priming is a widely used experimental paradigm in cognate facilitation effect studies in bilingual visual word recognition. In this paradigm, translation equivalents (cognates or noncognates) are used as primes and targets. Participants are required to give a timed response to the task (i.e., lexical decision in which participants make a decision whether a presented word is a word or nonword) and the reaction times to the targets are measured to determine whether a target word primed by a translation equivalent is responded to faster than when primed by an unrelated word in the other language (Jian, 1999). A faster response to a target word is considered to be a result of facilitation caused by the prime-target relationship (e.g., cognate pairs). When a forward mask (e.g., a string of hash marks #####) is presented before the presentation of a prime, the paradigm is called a masked priming paradigm (Forster & Davis, 1984), which has been widely used to investigate orthographic and phonological activation in visual word recognition. The details of this paradigm will be provided in the section on experimental design.

1.3.1 Same-script cognate priming studies

The majority of cognate facilitation studies have been done with same-script language pairs (eg., alphabetic languages such as Dutch-English, French-Dutch) and same-script cognate studies have suggested that cognate facilitation effect is due to the contribution of orthographic and semantic overlap in cognates (Cristoffanini, Kirsner, & Milech, 1986; Sánchez-Casas et.al, 1992; García-Albea et al., 1996; Lemhöfer & Dijkstra, 2004; Davis et al., 2010). An example of empirical evidence for this assumption comes from a study by Lemhöfer & Dijkstra (2004). They investigated how cross-linguistic overlap in semantics, orthography, and phonology affects bilingual word recognition using three types of Dutch-English cognates with different levels of overlap in orthography and phonology (Table 1).

Table 1. *Cognate types in same-script and different-script languages*

Cognate Types	Same-script languages (Dutch-English)	Different-script languages (Japanese-English)
Orthography + phonology	hotel-hotel [ho:tɛl] - [həʊtɛl] sport-sport [spɔrt] - [spɔ:rt]	N/A
Phonology only	enkel-ankle [ɛnkəl] - [æŋkl] koord-code [ko:də] - [kəʊd]	ガイド - guide [gaido] - [gaid] チーズ - cheese [ti:zu] - [tʃi:z]
Orthography only	fruit-fruit [frœyt] - [fru:t] oven-oven [o:və] - [əvən]	N/A

* The examples of Dutch-English cognates were taken from Dijkstra et al., (1999).

The participants performed English lexical decision tasks and generalized lexical decision tasks. The authors found significant priming effect for cognates that share orthography and phonology (e.g., *hotel-hotel*) and for cognates that share orthography (e.g., *fruit-fruit*), whereas no facilitation effect was found for cognates that share phonology (e.g., *enkel-ankle*). They found the largest priming effect for orthographically similar cognates and that facilitation effect was considerably reduced for phonologically similar cognates. Based on their findings, they concluded that orthographic and semantic overlap as critical in obtaining cognates facilitation, with a suggestion for further study on the role of phonology in word recognition.

However, it is difficult to distinguish the contribution of orthography and phonology in cognate facilitation effect when the scripts of the languages are the same. Moreover, several cognate facilitation studies with different-script bilinguals have shown that cognate facilitation effect can be obtained without shared orthography (e.g., Gollan et al., 1997; Hebrew-English, Kim & Davis, 2003; Korean-English, Voga & Grainger, 2007; Greek-French). The fact that cognate facilitation effect was observed in different-script bilinguals stands indeed in contrast with the results and assumptions from same-script cognate studies. As noted, Lemhöfer and Dijkstra (2004) found cognate facilitation effect in Dutch-English cognates that were orthographically and phonologically similar (e.g., *hotel-hotel*) and orthographically similar (e.g., *fruit-fruit*) but not in phonologically similar cognates (e.g., *enkel-ankle*). This suggests that orthographic similarity was the contributing factor to the cognate facilitation effect and phonological similarity might not contribute to the facilitation effect. However, orthographically similar cognates are practically impossible for different-script language pairs such as Japanese and English (Table 1). Therefore, the explanation for cognate priming effect among same-script bilinguals may not be the best explanation for the cognate priming effect because it cannot incorporate the observed cognate facilitation effect in different-script bilinguals.

Cognate priming studies with same-script bilinguals have constantly reported that priming effect was larger for cognates than noncognates, and that the effect was larger when the primes were in L1 and the targets were in L2 (L1-L2 priming direction) than the opposite direction (Sánchez-Casas et.al, 1992; De Groot & Nas 1999; García-Albea, Sánchez-Casas &

Valero, 1996; Davis, Sánchez-Casas, García-Albea, Guash, Molero, & Ferré, 2010; Duñabeitia, Perea, & Carreiras, 2010). The participants in these studies were all highly proficient bilinguals except for the beginning Spanish-English bilingual group in Davis et.al (2010). Although a bidirectional priming effect was observed in the studies with highly proficient bilinguals, the effect was found only in L1-L2 priming direction in the beginning bilinguals group in Davis et.al (2010). Findings from these studies indicate that cognate priming effect is modulated by the L2 proficiency of the participants. However, the effect of L2 proficiency still remains in question as there have been a few studies that either investigated cognate priming effect bidirectionally or examined the effect in beginning or low proficient bilinguals.

1.3.2 Different -script cognate priming studies

Although there have been fewer studies on different-script cognates compared to same-script cognate studies, the existing studies have provided evidence for cognate facilitation effect in different-script bilinguals such as Hebrew-English (Gollan et al., 1997), Arabic - French (Bowers, Mimouni, & Arguin, 2000), Korean-English (Kim & Davis, 2003), Greek-French (Voga & Grainger, 2007), Persian-English (Fotovatnia & Taleb, 2012) and Japanese-English (Hoshino & Kroll, 2008, Nakayama et al., 2013). Using different-script bilinguals in cognate priming studies allows researchers to focus on the contribution of semantic and phonological similarities in cognates because the orthographic similarity is not available in different-script cognates. These studies overall replicated the results from those of same-script bilinguals but some studies with different-script bilinguals have shown that cognate priming effect was less robust (Kim & Davis, 2003) or not observed (Bowers et al.,2002) and yielded mixed results in terms of priming direction and the L2 proficiency of the participants. For instance, bidirectional cognate priming effect was observed in highly proficient Japanese-English bilinguals (Nakayama et al., 2013) but not in highly proficient Hebrew-English bilinguals (Gollan et al., 1997), in which the effect was observed only in L1-L2 priming direction.

Gollan et al. (1997), who was among the earliest to investigate cognate facilitation effect in different-script bilinguals, tested Hebrew-English and English-Hebrew bilinguals in masked priming lexical decision tasks. The critical finding from their study is that they found significant facilitation effect not only in cognates but also in noncognates. The authors suggested that semantic overlap is an important factor in cross-script priming and that shared phonology plays an important role for cognate facilitation effect to be observed when there is no orthographic similarity between a cognate pair.

Kim and Davis (2003) conducted studies on Korean-English bilinguals using three different types of stimuli: cognates, noncognates, and homophones (words in two languages which have similar sounds but with different meaning, e.g., Dutch-English kou ('cold')-*cow*).

Their study was among the earliest that investigated phonological priming effect in different-script bilinguals. They found facilitation effect in homophone priming in naming task, and the important implication from their finding is that phonological overlap may play an important role in bilingual language processing. Unlike the results from previous studies, they did not find larger cognate priming effect than noncognates in visual word recognition. However, their findings provided supporting evidence that bilinguals employ phonological coding in visual word recognition.

Nakayama et al. (2012) also examined the role of shared phonology in bilingual visual word recognition with Japanese-English bilinguals. English words were primed by three different types of Japanese primes (cognates, primes which are similar only in phonology to the targets and unrelated control primes). They observed significant priming effect not only for cognates but also for the primes similar only in phonology, which provided evidence that phonological similarity facilitates bilingual word recognition and their findings are in line with Kim and Davis (2003) and Gollan et al. (1997). Several studies in bilingual visual word recognition with different-script bilinguals have provided results in line with Nakayama et al.'s (2012) findings which claim that phonological similarity survives script difference and different-script bilinguals can utilize phonological similarity between a prime and a target in making lexical decision tasks (e.g., Dimitropoulou et al., (2011a) with Greek-Spanish bilinguals; Zhou, Chen, Yang & Dunlap

(2010) with Chinese-English bilinguals).

Voga and Grainger (2007) was the first and only study that investigated whether shared phonology across different-script can affect cognate facilitation effect. They conducted priming experiments with French-Greek bilinguals. The participants were French-Greek bilinguals and performed masked lexical decision tasks. There were two target conditions (cognates and noncognates) and three prime conditions (translation equivalents of the targets, phonologically related prime and unrelated). They found that priming effect for cognate was larger than for noncognates when the effect was measured against unrelated prime condition. However, when the priming effect was measured against phonologically related prime condition, the cognate priming effect was about the same size as that of noncognates (26 ms vs. 27ms effect). That is, there is no difference between the degree of priming effect in cognates and that of noncognates when phonological priming effect was taken out. They argued that cognate facilitation was caused by *additional* facilitation due to shared phonology and the core component of translation priming, cognates and noncognates alike, is shared semantics. Their study was able to find that facilitation effect in translation priming is produced via shared semantics by separating phonological priming effect from cognate priming effect. However, the language pairs they tested were French and Greek, which do not share the same script but they are both alphabetic languages and belong to the family of Indo-European languages. Therefore, whether their findings are compatible with completely different-script language pairs, such as Japanese and English or Korean and English, is an open question.

1.4 Role of language proficiency in bilingual language processing

The BIA + model (Dijkstra & van Heuven, 2002) claims that lexical access is delayed in bilinguals' L2 compared to in their L1 because generally L2 proficiency is lower than L1. They call this *temporal delay assumption* in bilingual language processing and the underlying rationale of this assumption is that bilinguals process L2 words more slowly than their L1 because more activation is needed to recognize L2 words that are used less frequently. This means bilinguals' L2 proficiency influences the interaction of bilinguals' two languages and it modulates bilinguals' L2 performance.

The influence of L2 proficiency in bilingual language processing can be observed in the results from cognate facilitation effect studies on bilingual word recognition in both same-script and different script bilinguals (Sánchez-Casas et.al, 1992; De Groot & Nas 1999; Gollan et al., 1997; Nakayama et al., 2013). One of the critical findings from these studies was that cognate priming effect was often larger in L1-L2 priming direction, when L1 words were the primes and L2 words were the targets. This asymmetry can be explained considering the possible influence of L2 proficiency claimed in the BIA+ model (Dijkstra et al., 2010; Davis at al., 2010; Comesaña, Sánchez-Casas, Soares, Pinheiro, Rauber, Frade, & Fraga, 2012; Dimitropoulou et al., 2011b). L1 primes are easier to process than L2 primes as they need less activation than L2 and thus a larger priming effect is observed in the L1-L2 priming direction. This even applies to individuals with relatively high L2 proficiency considering that L1 primes might still be easier to process than L2 primes as their dominant language is still L1 unless they are perfectly balanced bilinguals. In fact, cognate priming effect was observed in both priming directions in highly proficient bilinguals (Sánchez-Casas et.al, 1992; García-Albea et al., 1996; Davis et al., 2010; Duñabeitia et al., 2010; Nakayama et al., 2013) but the magnitude of the priming effect in these studies was still larger in L1-L2 direction. In low proficient bilinguals, cognate facilitation effect was observed in L1-L2 priming direction but either little or null effect was found in L2-L1 direction. This also reflects the influence of their L2 proficiency as L2 processing is slower in less proficient bilinguals than more proficient bilinguals.

The asymmetry observed in the magnitude of cognate facilitation effect indicates that L2 proficiency influences bilingual language processing. However, this is still underresearched as there have been few studies on low proficient bilinguals and the existing studies have shown mixed results. For instance, Dimitropolou et al. (2010) and Davis et al. (2010) found cognate priming effect in late and low proficient bilinguals only in L1 –L2 priming direction (Greek-Spanish and Spanish-English bilinguals respectively), whereas Duyck and Warlop (2009) found symmetric cognate priming effect in both L1-L2 and L2-L1 priming direction in low proficient Dutch-French bilinguals. Moreover, with highly proficient English-Hebrew and Hebrew-English bilinguals, Gollan et al. (1997) found cognate priming effect only in L1-L2 priming direction.

The mixed results in the aforementioned studies could be attributed to the variability in L2 proficiency assessment. The measures to assess L2 proficiency vary across studies and popular measures are self-evaluation of their language skills (i.e., reading, writing, listening comprehension, and speaking), self-reporting of language experience (e.g., age of acquisition, frequency of use, and number of hours of formal instruction) and standardized tests. Although these assessments allow researchers to capture bilingual's language profiles, the lack of uniformity in assessment makes it difficult to know the extent to which the findings can be generalized to other samples and populations (Norris & Ortega, 2012). The present study followed the assessment in Dimitropolou et al. (2010) and Davis et al. (2010) to group as low proficient bilinguals those subjects with less than three years of L2 learning experience in an L1 dominant environment.

To summarize, cognate facilitation effect studies in bilingual visual word recognition provided supporting evidence for the language nonselective view which claims bilinguals' two lexicons are integrated and information from one language activates both lexicons simultaneously. The representative model of language nonselective access is the BIA+ model (Dijkustra & van Heuven, 2002). The theoretical accounts for cognate facilitation effect in word recognition can be provided by this model which proposes a bottom-up processing of word recognition from lexical level (orthographic/phonological level) to semantic level and the co-activation of lexical representations of two languages that speed up the word recognition process.

Previous studies of cognate facilitation effect have investigated the effect both in same-script and different-script bilinguals and provided important characteristics of cognates and shown the advantage of cognate status in bilingual word recognition. Important findings from these studies are as follows. First, the facilitation effect was larger for cognates than noncognates, which indicates that multiple levels of overlaps in cognates (semantic, orthographic and/or phonological overlap) facilitated word processing. However, the locus of cognate facilitation effect still remains in question because (1) same-script studies maintained that orthographic and semantic overlap induce cognate facilitation effect, while (2) different-script studies showed that the facilitation effect was obtained in the absence of shared orthography and suggested that phonological overlap was an contributing factor of cognate facilitation effect when the two languages do not share orthography.

Second, previous studies have found that cognate facilitation effect was always larger in

L1-L2 direction and generally observed in both L1-L2 and L2-L1 priming directions with highly proficient bilinguals but not in low proficient bilinguals. These findings imply that L2-L1 priming effect could be obtained when a bilingual has sufficient L2 proficiency to utilize linguistic information of L2 primes and that L2 proficiency impacts cognate priming effect. However, it remains in question as the existing studies yielded mixed results and there are only a few studies that investigated bidirectional cognate priming effect in low proficient bilinguals.

1.5 Acquisition of Japanese-English cognates in L2 Japanese learners

The Japanese-English cognates used in the present study are loanwords from English (e.g., ガイド /gaido/ - *guide*). These words are written in *Katakana* script in Japanese, which consist of 46 phonetic symbols primarily used for writing foreign origin words (Tamaoka& Miyaoka, 2003). Japanese has a large number of loanwords from English and the majority of them have similar sounds to English. Loanwords are used regularly in everyday life and 90 % of the 23,000 loanwords in the 5th edition of the Kojien(1998), a comprehensive Japanese dictionary, are borrowed from English (Kawaguchi & Tsunoda, 2005; Shinnnouchi, 2000; cited in Allen & Conklin, 2013). One might think these loanwords are easier to process for English speakers as many of them are derived from English. However, English speakers learning Japanese seem to have difficulty in learning these loanwords even advanced learners (Hatta, Katoh & Kirsner, 1984; Maciejewski & Kang, 1994; Komendzinska, 1995; Esther, 2011).

One of the factors that makes the learning of English loanwords difficult for English speakers is the phonological structure of English loanwords in Japanese (Maciejewski & Kang, 1994; Nishi & Xu, 2013). In fact, these words are often phonologically similar to the original English words (e.g., バス /basu/ - *bus*, スプーン /supu:n/ - *spoon*). However, it is also often the case that the pronunciation is quite different from the original English words (e.g., ビタミン /bitamin/ - *vitamin*). This is because English words must go through a phonological transformation when transcribed into Katakana script, which often results in different pronunciation because of the difference between the Japanese and English phonological systems. For instance, Japanese has only five vowels in contrast to English which has twelve vowels. English has consonants that do not exist in Japanese phonology (e.g., /r/, /l/, /ð/, /Θ/, /f/, /v/) and Japanese does not allow consonant clusters and consonants may not appear in the end of a word. To avoid consonant clusters, vowels are inserted after consonants and thereby an English word '*driver*' is pronounced /doraiba/, which results in different pronunciation from the original English word. In transcribing English words into Katakana script, English phonetic sequence is modified to conform to the rule of Japanese phonology and this modification seems to make it hard for English-speaking learners of Japanese in identifying Japanese loanwords written in Katakana script (Maciejewski & Kang, 1994).

For native Japanese speakers with English knowledge, many of the Katakana loanwords may be easy to process as they are modified by the conversion rules they know intuitively. However, for English-speaking Japanese learners, it may not be the case as they are not familiar with the rules. In fact, it seems that they do not receive enough instruction of the actual conversion process judging from the contents of major Japanese textbooks used in the United States (Nishi & Xu, 2013). Although マザー /maza:/ (conversion of *mother* in Katakana) and *mother* /ˈmʌðə / sound similar to a native Japanese speaker, they may sound differently to a native English speaker. Japanese speakers are familiar with English-derived Katakana loanwords as they are so prevalent in their everyday life. Daulton (2008) even argues that Katakana loanwords are part of their native lexicon and Japanese learners of English are aided by these loanwords in learning English. However, for English-speaking learners of Japanese, loanwords may not be easy to learn due to the phonological modification when Japanese phonological rules are applied to English words (Esther, 2011; Hatta, Katoh & Kirsner, 1984; Maciejewski & Kang, 1994). Katakana loanwords seem to be easy to process for Japanese-English bilinguals because to them, they sound similar. An example of a robust phonological facilitation effect of Katakana loanwords in recognizing English targets in Japanese-English bilinguals was provided by Nakayama et al. (2012). They found that the recognition of L2 English target *guide* was significantly faster when it was primed by its loan word cognate ガイド /gaido/ than when they were primed by an unrelated word (e.g., コール/ko:ru/,*call*). They also found that L2 English target *guide* was responded to faster when it was primed by the similar sounding Katakana loanword サイド/saido/, *side*, indicating that there was phonological facilitation across languages. However, whether or not the shared phonology in Katakana loanwords and English counterparts facilitates the recognition of Japanese-English cognates in English-speaking Japanese learners is unknown. To my best knowledge, there has been no study published that investigated whether a Katakana loanword primes its English counterpart or vice versa for English-speaking learners of Japanese. In the present study, the phonological similarity in Katakana loanwords and English counterparts were normed by native English speakers and the stimuli were selected based on their phonological similarity ratings.

1.6 Rationale for the study and research questions

Although previous studies on cognate facilitation effect in bilingual word processing revealed the special status of cognates and the manner in which the facilitation effect emerges, there are some gaps in the literature. First, there have been a smaller number of studies on different-script language pairs. Moreover, existing studies have shown mixed results and it seems that more empirical studies are needed. Basically, previous studies have shown that only highly proficient bilinguals showed a cognate priming effect in both priming directions (L1 prime-L2 target and vice versa). However, inconsistent results were observed in different-script bilinguals (Gollan et al., 1997; Nakayama et al., 2013). Considering that there have been very few word recognition studies on English-Japanese bilinguals, the findings from the present study will specifically contribute to an understanding of the cognate facilitation effect in Japanese learners with L1 English.

Second, the majority of cognate facilitation effect studies have tested highly proficient bilinguals or even simultaneous bilinguals who have been exposed to two languages since early childhood (Duñabeitia et al., 2010) and only a few studies tested low proficient bilinguals, namely, late L2 learners with clear dominance in their L1. Cognate facilitation effect indicates that L2 learners can benefit from the existence of formal and conceptual overlap that is shared between pairs of cognates. Therefore, studies on cognate facilitation effect and how L1 and L2 representations interact in late L2 learners may provide practical benefits for educational purposes such as second language teaching and acquisition especially for L2 learners whose L1 and L2 have distinct orthographies, as they cannot benefit from orthography in learning their L2.

Based on the observations above, the present study addresses the following research questions: (1) What constitutes a cognate facilitation effect in different-script bilinguals? When cognate pairs do not share orthography, does the combination of shared phonology and semantics, shared phonology, or shared semantics guide cognate facilitation effect? (2) Is there any proficiency effect? Does L2 proficiency modulate the cognate facilitation effect?

Chapter 2. The present study

2.1 The present study

In order to answer these research questions, the present study investigated whether a cognate facilitation effect is observed in low proficient bilinguals whose two languages do not share orthography in visual word recognition. The participants were two groups of beginning to intermediate American college learners of Japanese from different Japanese course levels. Lexical decision experiments using masked priming paradigm were conducted to examine whether the semantic and/or phonological similarity between the prime and the target influences the processing of visually presented word in the absence of shared orthography. The participants make lexical decisions to Japanese targets primed by English primes (L1-L2 direction) and to English targets primed by Japanese primes (L2-L1 direction).

Two groups of learners from different course levels were selected in order to examine whether L2 proficiency measured by Japanese learning experience (1 to 3 years of learning experience at college level) would modulate the priming effect in visual word recognition. The participants who had received an academic year length of Japanese language instruction (two semesters of instruction) and finished the elementary level are referred to as “Basic group” and those who had received more than two academic years of instruction (four semesters or more) and finished the intermediate level are referred to as “Post-basic group.” The participants were tested in both priming directions in order to determine whether priming directions influence word recognition performance. Specifically, the purpose of the bidirectional priming was to examine whether the priming effect would be modulated when the prime was in their more proficient (L1) or in less proficient language (L2). Native speakers of Japanese living in the northeast Kansas area participated in the same experiments as a comparison group.

The types of the prime – target relationship were manipulated in order to determine whether the relationship affected the priming effect. Three types of prime-target pairs were used: (1) cognate pairs which are phonologically similar to the targets (2) translation pairs which do not share phonological similarity with the targets (3) word pairs phonologically similar but semantically unrelated. Word pairs made up of a word prime and nonword target were used to provide a baseline for comparison. These prime-target relationships were used as independent variables. The L2 proficiency level determined by the amount of Japanese learning experience at college level was also taken into account as an independent variable. The dependent variables were reaction times and error rates on lexical decision to the targets. Priming effects were measured by calculating the mean lexical decision latencies for correct responses to the targets and mean error rates.

2.2 Theoretical framework

The present study will be theoretically guided by the claims of the BIA+ model (Dijkstra & van Heuven, 2002). The model assumes that the language representation of L1 and L2 are stored in a single system and that language representations from both languages become activated in parallel in the word recognition process. As the model predicts co-activation of lexical representations at both orthographic and phonological level upon presentation of a word, it can account for a cognate facilitation effect observed in different-script bilinguals without shared orthography.

The BIA+ model also assumes that activation of language representation is generally moderated by language proficiency. The model claims that lexical access is delayed in bilinguals' L2 compared to their L1 because generally L2 proficiency is lower than L1 and this is called temporal delay assumption in L2 word processing. This assumption can account for why a bidirectional cognate priming effect was observed in highly proficient bilinguals but not in low proficient bilinguals. In low proficient bilinguals, a cognate priming effect was not observed in L2-L1 priming direction because L2 primes were less available for processing due to their lower accessibility to L2 words. In highly proficient bilinguals, on the other hand, cognate priming effect was found in L2-L1 priming direction because they were more capable of processing L2 words than low proficient bilinguals.

Aided by the claims of the BIA+ model, the predictions were as follows: (1) shared semantics and phonology in cognates facilitate word recognition in different-script bilinguals even in the absence of shared orthography. Therefore, a cognate facilitation effect should be observed in English-Japanese bilinguals. If a cognate facilitation effect is solely due to shared semantics, the effect should be observed equally for both cognates and noncognates. However, if the facilitation effect is larger for cognates than for noncognates, it would be due to an additional facilitation effect of shared phonology that is only available in cognates. If a cognate facilitation effect is due to the joint effect of shared semantics and phonology, the effect should not be observed for noncognates. (2) The cognate facilitation effect should be smaller for the L2-L1 priming direction, if low proficient bilinguals were not capable of processing L2 primes due to their lower L2 proficiency than that of their L1. Also, the effect should be larger for Post-basic group than for Basic group, if L2 proficiency level determined by L2 learning experience (course level) influences the degree of priming effect.

2.3 Experimental design

In order to answer the research questions, two priming experiments were designed using lexical decision tasks with masked priming. Experiment 1 is designed for L2 learners of Japanese with L1 English from different course levels (second-year, third-year and fourth-year Japanese) and Experiment 2 is for native Japanese speakers living in the northeast Kansas area (adults including college students). Experiment 1 had two parts (Experiment 1A and 1B). In Experiment 1A, the priming direction was L1-L2 with English primes and Japanese targets. The priming direction in Experiment 1B was L2-L1 with Japanese primes and English targets. In Experiment 2, the materials were the same as in Experiment 1 and the lists of the stimuli were switched such that the primes in Experiment 2A were Japanese with English targets and vice-versa in Experiment 2B. Both L1-L2 and L2-L1 priming direction were tested in order to examine whether the priming effect would be modulated by L2 proficiency.

Masked priming paradigm (Forster & Davis, 1984) was used in all four experiments. The paradigm has been extensively used as a suitable method in the study of bilingual visual word recognition for its proven effectiveness in examining rapid and automatic processing of visually presented words (Sánchez-Casas et.al, 1992; Gollan, et al. 1997, Kim & Davis, 2003; Davis et al., 2010; Duñabeitia et al., 2010; Nakayama et al., 2013). In a cross-language lexical decision experiment with a masked priming paradigm, a forward mask (####) is presented before the presentation of words from one of the participant's languages (primes) followed by the presentation of words in the other language (targets) and participants have to decide whether a presented letter string is a word or not by pressing a button or a key (e.g., Y for a word and N for nonword) (Figure.6).

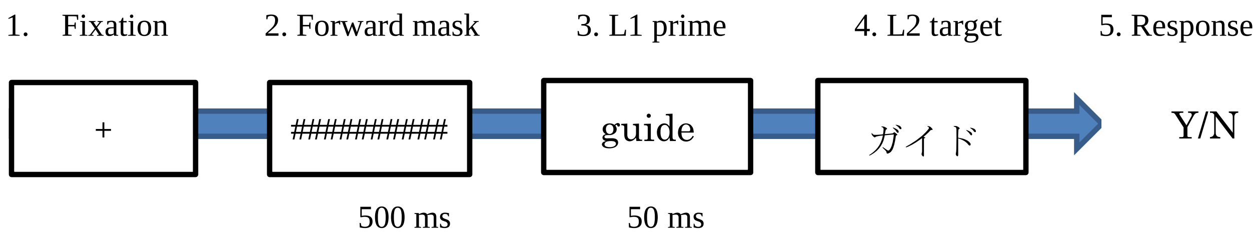

Figure 6. Example of masked lexical decision task for English speakers (L1-L2 direction)

The primes are presented for a very short duration (20-67 milliseconds: Forster, Mohan & Hector, 2003) and participants are physically unable to identify the prime. Therefore, it allows us to investigate the effect of a particular prime-target relationship without participants' awareness of the nature of the task. If primes are visible in cross-language priming, participants are aware that they are being tested on their bilingual knowledge and may develop response strategies. Also, the priming effect can be assumed to be the result from an episodic memory trace rather than a pure priming effect if participants are aware of the primes (Gollan, et al. 1997). The masked priming paradigm can reduce the contamination of the priming effect by the participants' response strategy or episodic memory trace by making the primes invisible - unavailable to consciousness. The priming effect obtained in this paradigm thus reflects more automatic and strategy-free lexical processing (Forster, 1998; Forster & Jian, 2001).

Chapter 3. Experiments

3.1 Masked priming lexical decision task with English-speaking learners of Japanese

The same groups of L2 Japanese learners with L1 English participated in Experiment 1A and 1B. In Experiment 1A, the participants were tested in L1-L2 priming direction (i.e., English prime-Japanese target). In Experiment 1B, the participants were tested in L2-L1 priming direction (i.e., Japanese prime – English target).

3.1.1 Participants

A total of 48 undergraduate students (18 male, mean age = 22.2, 30 female, mean age = 20.6) enrolled in the first semester of second-year Japanese, the first semester of third-year Japanese, and the first semester of fourth-year Japanese at the University of Kansas participated in the experiments. All participants' native language was English and the proficiency levels of participants are considered elementary to intermediate, classified as 'basic' (Basic group) and 'post-basic' (Post-basic group) based on the amount of Japanese learning experience measured by the amount of formal Japanese language instructional hours they had received at college level. The participants who had received an academic year length of Japanese language instruction (two semesters of instruction) and were enrolled in second-year Japanese are referred to as the Basic group and those who had received more than two academic years of instruction (four semesters or more) and were enrolled in third- or fourth-year Japanese are referred to as the Post-basic group. Thus, the Basic group was composed of the students enrolled in second-year Japanese (*N*=25, 11 males and 14 females) and the Post-basic group was made up of the students enrolled in third- or fourth-year Japanese (*N*=23, 7 males and 16 females). There was a one to two-year difference in the Japanese learning experience between the two groups.

The Basic group participants had completed two semesters of first-year Japanese at the University of Kansas. Some participants had not taken first-year Japanese at the University of Kansas but it was assumed that they had received equivalent instruction elsewhere to be enrolled in second-year Japanese. This also applied to the Post-basic group. In first-year and second-year Japanese, students receive a total of 5 hours of instruction per week for two semesters. The Post-basic group participants had completed four to six semesters of instruction or the equivalent. The instruction hours of third-year Japanese is 5 hours per week and 2.5 hours for fourth-year Japanese.

Each participant filled out a questionnaire about their Japanese language experience before the experiment. Forty four percent of the Basic group had studied Japanese in high school (*M*=1.5 years) and 30% of the Post-basic group had studied Japanese in high school and middle school (*M*=3.1 years). Forty seven percent of all participants had been to Japan for pleasure, on cultural exchange programs or on study abroad programs. The length of stay varied from ten days to a year. Twenty seven percent of them had stayed for more than a month while two of them stayed for a year on study abroad programs (both of them were from the Post-basic group). They rated their proficiency levels in speaking, listening, reading and writing on a 1-5 Likert scale (1=poor and 5=very good) and frequency of using Japanese in an average month on a 1-5 Likert scale (1=not at all/never and 5= every day) The mean rating score and standard deviation (SD) in parentheses were listed in Table 2.

Table 2. *Language background information of the L2 Japanese learners with L1 English.*

Self-rated Proficiency levels of Japanese		
	Basic group	Post-basic group
Speaking	2.7 (0.74)	3.0 (0.7)
Listening	3.0 (0.88)	3.2 (0.9)
Reading	3.4(0.9)	3.6 (0.7)
Writing	3.1(0.7)	3.3 (0.6)

*1-5 Likert scale (1=poor and 5=very good).

Frequency of using Japanese on an average month		
	Basic group	Post-basic group
Speak Japanese with Japanese people	2.0 (1.1)	2.5 (1.3)
Exchange e-mails in Japanese	1.2 (0.5)	1.8 (0.8)
Read Japanese (comic) books, magazines, website, newspaper	1.4 (0.9)	3.4 (1.2)

Watch Japanese films/TV programs	3.0 (0.9)	3.3 (1.1)
Listen to Japanese music	2.9 (1.4)	3.0 (1.5)

*1-5 Likert scale (1=not at all, 2= Once or twice, 3=Several times, 4= Almost every day, 5=every day).

3.1.2 Materials and design

A total of 138 Japanese words were selected from the glossary list of the textbook used in first-year Japanese at the University (*Nakama I a, b*, Hatasa, Hatasa Abe & Makino 2011) to make sure the Japanese words were familiar to the participants. All the words were nouns and 75 Katakana loanwords from English were chosen for cognate and phonologically similar pairs and 63 words written in Hiragana were chosen for noncognate pairs. The English translation of each word was also taken from the glossary list. The mean word length of Japanese word was 3.6 characters in length for cognates, 3.5 characters for noncognates and 3.4 characters for phonologically similar pairs (range=3-5). The word frequency of the Japanese words in each group of pairs was closely matched using *Balanced Corpus of Contemporary Written Japanese* (National Institution of Japanese Language and Linguistics). The mean written word frequency of Katakana words was 3366.7 (*SD*=4034.1) for cognate pairs, 3493.6 for phonologically similar pairs (*SD*=3043.0), and the frequency of Hiragana words for noncognate pairs was 3390.8 (*SD*=3205.9) occurrence per 105 million.

Three prime-target conditions were designed to tease apart the effects of sound similarity and semantic similarity, as well as the combined effect of these similarities (1) cognate pairs (e.g., *game* – ゲーム/ge:mu/) (2) noncognate translation equivalent pairs (e.g., *desk* - つくえ/tukue/) (3) phonologically similar but semantically unrelated pairs (e.g., *cart* - カード /ka:do/) (Table 2). Phonologically similar pairs were made by pairing an English word with a Japanese word that had sounds similar to the English word. The English word and Japanese word differed from each other by one syllable. The Japanese words used in the phonologically similar pairs were selected from the list of cognates. The purpose of using phonologically similar pairs was to examine the effect of phonological priming, which would allow us to determine whether phonological overlap between the prime and the target would have any impact on the priming effect as phonological overlap exists in cognate pairs but not in noncognate pairs.

Table 3**.** *An example of the stimulus list in the experiment in L1-L2 direction (English prime - Japanese target)*

Prime-target conditions	Cognate pair		Noncognate pair		Phonological pair	
	Prime	Target	Prime	Target	Prime	Target
stimuli	game	ゲーム /ge:mu/	desk	つくえ /tukue/	cart	カード /ka:do/

To ensure the phonological similarity between Katakana loanwords and the original

English words in cognates and phonologically similar pairs, a norming study was conducted before finalizing the stimuli. A total of 182 word pairs were used for the norming study (74 cognates, 63 noncognates, and 45 phonologically similar but semantically unrelated word pairs). The Japanese words for phonologically similar word pairs were taken from cognates and the English words that had a similar sound to these words were selected by a native English speaker. Each word pair (a Japanese word followed by an English word) was recorded by a native Japanese speaker and a native English speaker. Twenty four native speakers of English who had not studied Japanese listened to the recorded word pairs and rated how similar two words sounded on a 1-5 point scale with 1 means very different and 5 means very similar (8 male and 16 female, mean age = 32.0). The mean similarity rating was 3.8 for cognate pairs (SD=0.7), 1.2 for noncognate pairs (SD=0.3) and 2.9 for phonologically similar pairs (SD=0.8). The main effect of condition was significant (F (2,179) =273.1, p<.001). The mean difference of the rating between cognate pairs and noncognate pairs (M=3.8, SE=.112, p<.001; M=1.2, SE=.124, p<.001) and cognate and phonological pairs were significant (M=3.8, SE=.112, p<.001; M=2.9, SE=.128, p<.001). The difference between noncognate and phonological pairs was also significant (M=1.2, SE=.124, p<.001; M=2.9, SE=.128, p<.001). Important findings from the results of the norming study were that native English speakers perceived the phonological similarity of cognates and of phonologically pairs to be greater than that of noncognates and that the mean rating was higher for cognates than for phonological pairs. Based on these ratings, 40 noncognates, 40 Japanese-English cognates and 40 phonologically similar pairs were selected according to the order of mean average ratings from the highest to the lowest. The mean phonological similarity ratings for the finalized stimuli were 4.4 (cognate pairs), 1.3 (noncognate pairs), and 3.1(phonologically similar pairs) respectively. Half of these 120 word pairs were used as stimuli for Experiment 1A (L1-L2 priming) and the other half was used for Experiment 1B (L2-L1 priming). The word pairs were divided so that each list of stimuli for the two experiments had the equivalent mean phonological similarity ratings. The mean phonological similarity ratings for Experiment 1A (L1-L2 priming) were 4.4 (cognate pairs), 1.3 (noncognate pairs), and 3.1(phonologically similar pairs), F (2,59)= 165.1, p<.001; M=4.4 SE=.17, p<.001; M=1.3, SE=.17, p<.001; M=3.1, SE=.17, p<.001. and 4.4 (cognate pairs), 1.2 (noncognate pairs), and 3.0 (phonologically similar pairs), F (2,59)= 209.6, p<.001; M=4.4 SE=.15, p<.001; M=1.3, SE=.15, p<.001; M=3.0, SE=.15, p<.001for Experiment 1B (L2-L1 priming).

Forty Japanese and English word-nonword pairs were created to be used as a baseline for comparison. This baseline condition was selected based on the findings from previous studies that obtained no priming effect for nonword targets primed by word primes (Forster, 1987; Gollan, et al, 1997). The nonwords were always used as targets preceded by word primes. The nonwords were made by manipulating a letter or a syllable of the word prime to mimic the sound of the prime (e.g., tennis – トニス* /tonisu/, ビデオ/bideo/ - gideo*). Half of the nonword-target pairs were made from cognates and the other half were made from noncognates. Eighty Japanese and English nonword pairs were made as fillers. The English nonwords were taken from The ARC Nonword Database (Harrington & Coltheart, 2002). The Japanese nonwords were made by manipulating a letter or syllable of words and the original words were taken from the same glossary list used to select the cognates and noncognates. Forty nocognates written in Kanji from the glossary list were also included in fillers. Half of the Kanji words were correct and the other half was incorrect and these words were paired with English nonwords. Two counterbalanced lists of test items were constructed so that no participants would see the same or similar target twice. The stimuli in the list were randomized for each trial. The finalized two lists of test items therefore contained 200 pairs each; 20 cognates, 20 noncognates, 20 phonological pairs, 20 word-nonword pairs and 120 fillers.

The properties of the stimuli are listed in Table 4. The English word frequency is based on an occurrence per 100 million in print (Mark, 2007, TIME Magazine Corpus) and per 105 million (Balanced Corpus of Contemporary Written Japanese). The mean target frequency was higher for English target in Experiment 1B (*M*=5796) than for Japanese targets in Experiment 1A (*M*=3757) but the mean difference of target frequency was not statistically different, $t(86.83) = 1.61$, $p=.111$.

Table 4. *The properties of the stimuli in the masked priming lexical decision task*

Experiment 1A (L1-L2 priming)

Prime-target conditions	Mean phonological similarity ratings	Mean word length (range=3-5)		Mean target frequency
		E-prime	J-target	J-target
cognates	4.4 (0.4)	5.6 (1.9)	3.8 (0.8)	4180 (6303.8)
noncognates	1.3 (0.4)	5.4 (1.4)	3.5 (0.6)	4157 (4433.4)
phonological	3.1 (0.7)	4.3(1.0)	3.4 (0.6)	2935 (1708.2)

Experiment 1B (L2-L1 priming)

Prime-target conditions	Mean phonological similarity ratings	Mean word length (range=3-5)		Mean target frequency
		J-prime	E-target	E-target
cognates	4.4 (0.4)	3.8 (0.8)	5.2 (1.5)	6328 (11837.0)
noncognates	1.2 (0.3)	3.5 (0..8)	5.2 (1.7)	6080 (5918.8)
phonological	3.1 (0.7)	3.5 (0.5)	4.6 (1.1)	4981 (7445.1)

* SD is in parentheses

3.1.3 Procedure

The participants were tested individually in a quiet room. They were first given a consent form to read and sign, and were given verbal instructions to confirm their knowledge of the tasks they will be participating in and were asked to fill out the questionnaire on their language background. The experiment was programmed using E-Prime (Psychological Software Tools, 2000). The participants were seated in front of a computer screen. The experiment began by pressing the space key. Each trial began with a fixation cross + which appears at the center of the computer screen. A forward mask (##########) was presented on the center of the computer screen for 500 ms followed by a 50 ms presentation of a prime. A target was presented immediately after the prime and the target remained on the screen until the participants made a response. The task was a lexical decision task in which participants made a decision whether the target was a word or nonword. The participants were instructed to make their decisions as quickly as possible by pressing "F" key for "Yes" and "J" key for "No" on the keyboard. The F and Y key were marked “Y” and “N” with stickers to avoid mistakes. There were 200 trials and each trial began with 10 practice trials so that the participants could familiarize themselves with the task. The whole procedure took approximately 20 minutes on the average.

The participants took part in Experiment 1A (L1-L2 priming) and Experiment 1B (L2-L1 priming) on different days with at least a week interval between the two experiments to avoid fatigue and practice effects on performance. Also, half of the participants participated in Experiment 1A first and the other half participated in Experiment 1B first to avoid order effects on performance.

3.1.4 Data treatment

Participants who made more than 25 % errors (averaged over the three prime-target conditions) were discarded (N=1). Mean response times (RTs) and error rates were calculated only for correct responses (88.5 % and 97.7% of all the responses in Experiment 1A and 1B respectively) for each subject and each item in each experiment. The RTs less than 300 ms or greater than 1500 ms were discarded as outliers. The RTs more than two standard deviations away from the mean for each item were also discarded. The total data loss after the treatment was 54.2 % and 8.8% of all correct responses in Experiment 1A and 1B respectively. For nonword targets, RTs less than 300 ms or greater than 3000 ms were discarded (56 % and 4.4 % of all correct responses in Experiment 1A and 1B respectively). The cut-off value for the nonword targets was set at 3000 ms as the mean RTs for nonword targets were considerably slower than that of word target conditions (4161 ms for the Basic group and 3447 ms for the Post-basic group). The mean RTs for nonword targets served as the baseline and the priming effect was calculated by subtracting the mean RTs of each prime-target conditions from the RTs of nonword targets.

Separate ANOVAs were conducted for both subject analysis (*F1*) and item analysis (*F2*) on RTs and error rates. The course level (Basic and Post-basic) was a between-subject factor in the subject analysis and a within-item factor in the item analysis. The prime-target condition was a repeated measures factor in the subject analysis but not in the item analysis. The mean RTs and the mean error rates were analyzed using 2 (course level: ‘Basic’, ‘Post basic’) × 3 (prime-target condition: cognate, noncognate, and phonological pairs) mixed ANOVA.

3.1.5 Results and discussion from Experiment 1A (L1-L2 priming) English prime - Japanese target

For Basic group, the mean RTs was1062 ms (*SD*=130.7) for cognate pairs, 1103 ms (*SD*=118.7) for noncognate pairs and 1213 ms (*SD*=112.3) for phonologically similar pairs. For Post-basic group, the mean RTs was 1053 ms (*SD*=148) for cognate pairs, 1104 ms (*SD*=121.7) for noncognate pairs and1159 ms (*SD*=150.2) for phonologically similar pairs (Figure 7).

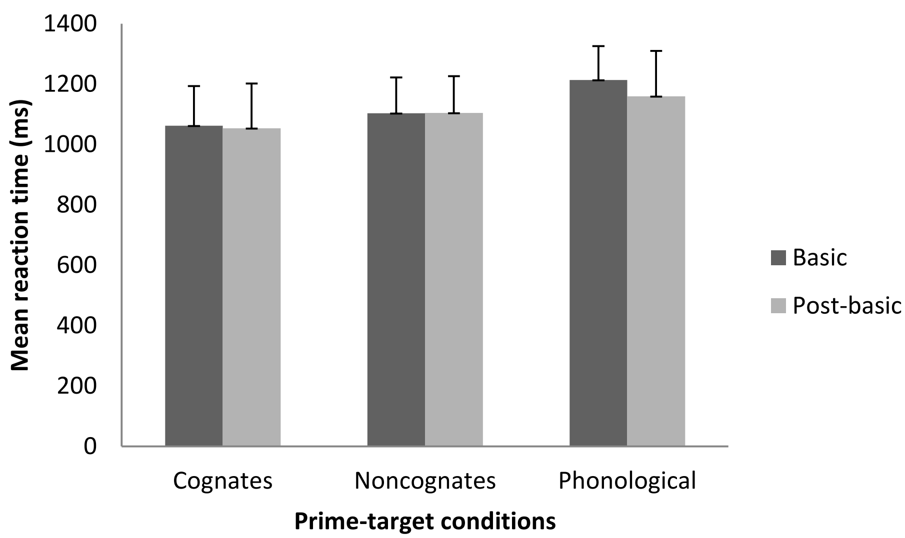

Figure 7. Experiment 1A. Mean reaction time in milliseconds in L1-L2 priming direction in subject analysis.

For RTs, there was an interaction between the course level and prime-target conditions only in the item analyses, but not in the subject analysis, *F1*(2,84)=1.58, *p* =.212, partial η^2 =.036; *F2*(2,54)=3.97, *p*=.025, partial η^2=.128. The main effect of course level was significant for the item analysis, not in the subject analysis, *F1*(1,42)=.365, *p* =.549, partial η^2 = .009; *F2*(1,54)=10.57, *p*=.002, partial η^2=.164. A pairwise comparison for the item analysis showed that Post-basic group made faster responses than Basic group. (*M*=1136.6, *SE*=15.38, *p*=.002; *M*=1070.9, *SE*=14.16, *p*=.002). There was a significant main effect of prime-target conditions in both analyses, *F1*(2,84)=31.9, *p*<.001, partial η^2=.432; *F2*((2,54)= 9.04, *p*=.002, partial η^2 =.251. Post-hoc tests indicated that mean RTs in all three conditions were significantly different from each other (cognate pairs and noncognate pairs, *M*=1057.6, *SE*=11.9, *p*<.001; *M*=1103.5,*SE*=18.12, *p*<.001, cognate and phonological pairs, *M*=1057.6, *SE*=11.9, *p*<.001; *M*=1186.4, *SE*=19.9, *p*<.001, and noncognate and phonological pairs, *M*=1103.5,*SE*=18.12, *p*<.001; *M*=1186.4, *SE*=19.9, *p*<.001). In the item analysis, the mean differences between cognate and phonological pairs (*M*=1042.3397, *SE*=26.8, *p*<.001; *M*=1155.1, *SE*=26.8, *p*<.001) and between cognate and noncognate pairs was significant (*M*=1042.3397, *SE*=26.8, *p*<.001; *M*=1113.8, *SE*=26.8, *p*=.027) (Figure 8).

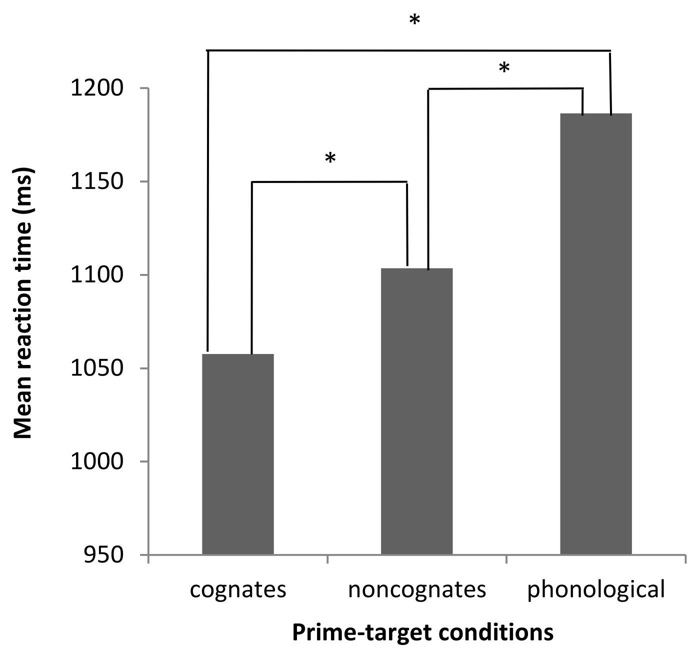

Figure 8. Experiment 1A. The effect of prime-target conditions on mean reaction time in milliseconds in L1-L2 priming direction in subject analysis. * shows significance at *p*=.05 level.

For error rates, Post-Basic group made numerically fewer errors than Basic group (6.7 % for Post-basic group and 7.9 % for Basic group) but the main effect of course level was not significant in either subject or item analyses, $F1(1,39)=.907$, $p=.347$, partial $\eta^2=.023$; $F2(1,53)=1.00$, $p=.321$, partial $\eta^2=.019$. There was no interaction between course levels and prime-target conditions, $F1(2,78)=1.14$, $p=.324$,partial $\eta^2=.028$; $F2(2,53)=.125$, $p=.883$, partial $\eta^2=.005$. The participants in both groups made the fewest errors for cognate pairs (4.1 % in Basic group and 2.4 % in Post-basic group). For noncognate pairs, Basic group made more errors than Post-basic group (11.1% vs. 8.2%). For phonologically similar pairs, however, Post-basic group made more errors than Basic group (8.6% vs. 9.5 %) (Figure 9).

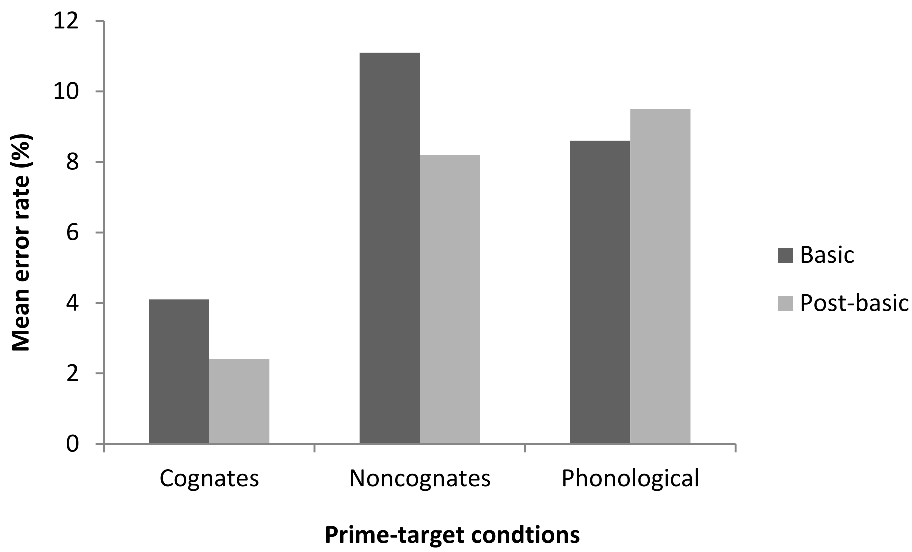

Figure 9. Experiment 1A. Mean percentage error rate in L1-L2 priming direction in subject analysis.

There was a significant effect of prime-target conditions in both subject and item analyses, *F1*(2,78)=15.2, *p*<.001, partial η^2=.128; *F2*(2,53)=11.04, *p*<.001, partial η^2=.294. In the subject analysis, a post-hoc pairwise comparison showed that the mean difference of error rate was significant between cognate and nocogonate pairs (*M*=3.2, *SE*=1.2, *p*<.001; *M*=9.6, *SE*=1.2, *p*<.001) and between cognate and phonological pairs (*M*=3.2, *SE*=1.2, *p*<.001; *M*=9.1, *SE*=1.1, *p*<.001). In the item analysis, the mean difference of error rate was significant between cognate and phonological pairs (*M*=2.6, *SE*=1.57, *p*<.001; *M*=9.9, *SE*=1.6, *p*<.001) and between cognate and noncognate pairs (*M*=2.6, *SE*=1.57, *p*<.001; *M*=7.4, *SE*=1.6, *p*=.010) (Figure 10).

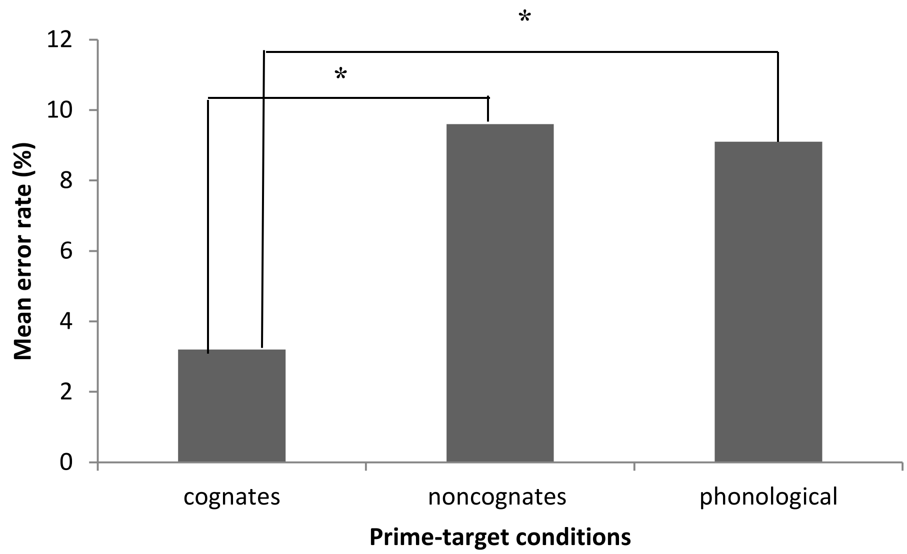

Figure 10. Experiment 1A.The effect of prime-target conditions on mean percentage error rate in L1-L2 priming direction in subject analysis. * shows significance at p=.05 level.

The mean RTs and error rates for nonword targets were 2061 ms and 28 % for Basic group (*SD*=358.5) and 2079 ms and 15 % for Post-basic group (*SD*=307.9). The mean RTs for nonword-targets were significantly slower than for the mean RTs of word targets in the three conditions (2070 ms vs.1116 ms, $t(18.07)=7.09$, $p<.001$), and the mean error rates were significantly higher for nonword targets than for word targets (22% vs. 9.1%, $t(29.9)= -9.88$, $p<.001$). The results indicated that there was null, or very small if any, priming effect for nonword targets when primed by word primes and this finding was in line with the findings from previous studies that found no priming effect for nonword targets (Forster, 1987; Gollan, et al, 1997). The RT difference across Basic and Post-basic group was 999 ms between nonword targets and cognates, 958 ms between noncognates and 848 ms for phonologically similar words, indicating that the priming effect was the largest for cognates and the smallest for phonologically similar words.

Discussion

The results from L1-L2 priming (English primes to Japanese targets) showed that the mean RTs did not significantly differ across Basic and Post-basic groups. The mean RTs and error rates did not reach significance. The results indicated that the proficiency level measured by the amount of Japanese language learning experience (a year experience of learning vs. more than two year experience of learning) did not affect the priming effect in these two particular groups. In fact, the effect of proficiency was observed in the item analysis only and this might be because there were several items in phonological pairs to which Post-basic group responded 150 to 500 ms faster than Basic group (e.g., *browse*-ブラウス/burausu/, *cant*-キャンプ/campu/, *rot*-ロック/rokku/, *past*-ポスト/posuto/, and *wide*-ワイン/wain/), which resulted in 65.7 ms difference in mean RTs between Basic and Post-basic groups in the item analyis (p=.002)

However, significant effects of prime-target conditions were observed. The mean RT and error rate differences were significant across the three prime-target conditions. Cognates were responded to fastest and with fewest errors among the three conditions, with phonologically similar targets responded to slowest with highest error rates in both groups. The fact that the smallest priming effect was for the phonological target item and that the larger priming effect was for cognates and noncognates indicates that semantic similarity was a determining factor for priming effects to emerge. Indeed, the mean RT difference between translation pairs (cognate and noncognate) and phonological pairs was significant (cognate and phonological, *M*=128.7 ms; noncognate and phonological, *M*=82.9 ms) and the mean error rate difference was also significant between cognates and phonological item (*M*=5.8%). The smallest priming effect for phonological pairs indicates that phonological similarity alone did not facilitate the recognition of a target and that shared semantics was required for the facilitation effect to emerge.

Another finding is that the mean RT difference and error rates between cognates and noncognates were also significant. Even though both cognates and noncognates shared semantics, cognates yielded faster response and fewer error rates than noncognates. This indicates that the priming advantage for cognates over noncognates is due to their dual overlap in semantics and phonology in cognates. Considering noncognates overlap in semantics as cognates do but not in phonology, the larger priming effect for cognate pairs can be attributed to the additive effect of shared phonology.

In sum, the results from Experiment 1A (lexical decision task with masked priming in L1-L2 priming direction) showed that (i) the proficiency level in the two groups of beginning bilinguals (Basic and Post-basic group) did not affect the degree of priming effects and (ii) lack of priming effect in phonological pairs compared to that of cognates and noncognates indicated that shared semantics is required for the priming effect to emerge and phonological overlap alone does not induce facilitation effect and (iii) that the advantage of cognates over noncognates for processing could be due to an additive effect of shared phonology which was available for cognates but not for noncognates.

3.1.6 Experiment 1B (L2-L1 priming) Japanese prime - English target

In this experiment, the participants made lexical decision to English targets (L1) primed by Japanese primes (L2). The materials were the second set of the stimuli list composed of different stimuli from those in Experiment 1A. The participants took part in this experiment at least a week after they had taken Experiment 1A. The data treatment and procedures were the same as Experiment 1A.

Results

For Basic group, the mean RTs was 606 ms (*SD*=81) for cognate pairs, 594 ms (*SD*=57) for noncognate pairs and 630 ms (*SD*=73) for phonologically similar pairs. For Post-basic group, the mean RTs was 631 ms (*SD*=85) for cognate pairs, 646 ms (*SD*=95) for noncognate pairs and 659 ms (*SD*=77) for phonologically similar pairs (Figure 11).

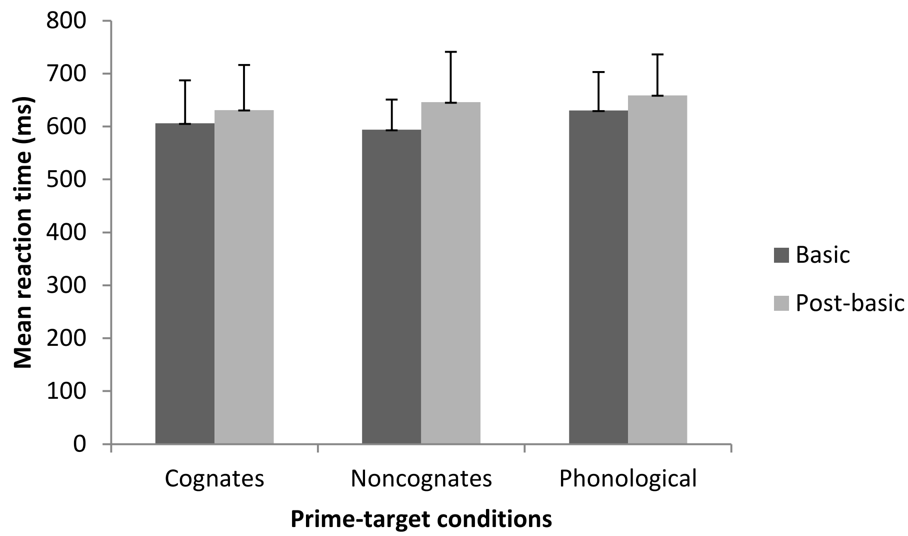

Figure 11. Experiment 1B. Mean reaction time in milliseconds in L2-L1 priming direction in subject analysis.

For RTs, unlike the result from Experiment 1A, Basic group made faster responses (*M*=610 ms) than Post-basic group (*M*=645 ms). There was no interaction between the course levels and prime target condition either in the subject or item analysis, *F1*(2,82)=1.54, *p*=.220, partial η^2=.036; *F2*(2,50)=2.08, *p*=.135, partial η^2=.077. The effect of course level was significant in the item analysis but not in the subject analysis, *F1*(1,41)=2.6, *p*=.113, partial η^2=.060; *F2*(1,50)=4.63, *p*=.036, partial η^2=.085. In the item analysis, a post-hoc pairwise comparison showed that Basic group made significantly faster responses than Post-basic by 16.8 ms (Basic, *M*=625.9, *SE*=7.8, *p*=.036; Post-basic, *M*=642.7, *SE*=7.8, *p*=.036).

The main effect of the prime-target condition was significant in both subject and item analysis, *F1*(2,82)=607, *p*=.003, partial η^2=.129; *F2*(2,50)=4.19, *p*=.021, partial η^2=.144. In the subject analysis, a post-hoc pairwise comparison showed that the mean difference of RTs was significant between cognate and phonological (*M*=618.8, *SE*=7.9, *p*=.002; *M*=644.6, *SE*=7.9, *p*=.002) and noncognate and phonological pairs (*M*=620.2, *SE*=7.6, *p*=.002; *M*=644.6, *SE*=7.6, *p*=.002). In the item analysis, the mean difference was significant only between cognate and phonological pairs (*M*=624.6, *SE*=9.5, *p*=.028; *M*=650.4, *SE*=9.5, *p*=.028). The pattern of results for RTs was the same as those observed in Experiment 1A for Post-basic group; the mean RTs were smallest for cognates and the largest for phonological pairs. However, for Basic group, the RTs were the smallest for noncognates and the largest for phonological pairs (Figure 12).

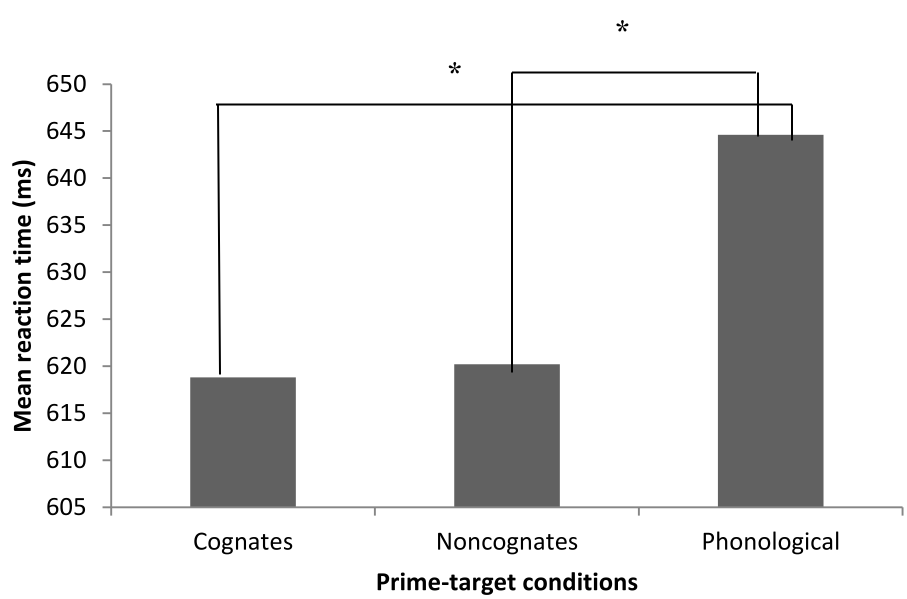

Figure 12. Experiment 1B.The effect of prime-target conditions on mean reaction time in L2-L1 priming direction in subject analysis. * shows significance at *p*=.05 level.

The mean error rates for Basic group were 0.8 % for cognate and noncognate pairs and

5.5% for phonologically similar pairs. For Post-basic group, the mean error rates were 0.8% for cognates, 0.5% for noncognates and 5.4% for phonologically similar pairs. There was no interaction between course level and prime-target conditions either in the subject or item analysis, $F1(2,90)=.104$, $p=.901$, partial $\eta^2=.002$; $F2(2,53)=.980$, $p=.382$, partial $\eta^2=.036$. Although the mean error rate was smaller for Post-basic group than Basic group (2.2 % vs.2.4 %), the main effect of course level did not reach significance in either analysis, $F1(1,45)=.039$, $p=.844$, partial $\eta^2=.001$; $F2(1,53)=.376$, $p=.543$, partial $\eta^2=.007$ (Figure 13).

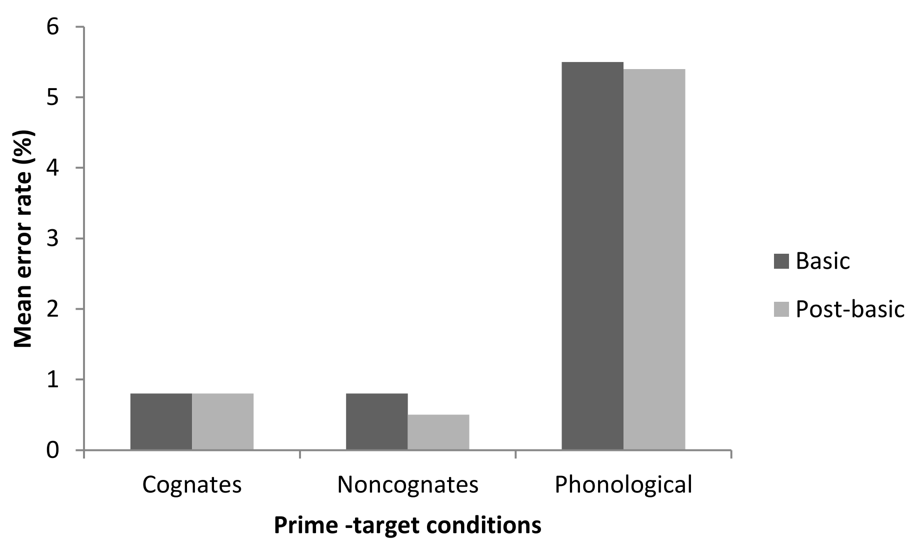

Figure 13. Experiment 1B. Mean percentage error rate in L2-L1 priming direction in subject analysis.

The main effect of prime-target conditions was significant in the subject analysis, but not in the item analysis, $F1(2,90)=59.7$, $p<.001$, partial $\eta^2= 5.70$; $F2(2,53)=1.64$, $p=.203$, partial $\eta^2=.058$.

A post-hoc pairwise comparison in the subject analysis showed that the mean error rate difference was significant between cognate and phonological pairs (*M*=.855, *SE*=.554, p<.001; *M*=5.49, *SE*=.554, p<.001) and noncognate and phonological pairs (*M*=.627, *SE*=.534, p<.001; *M*=5.49, *SE*=.554, p<.001) (Figure 14).

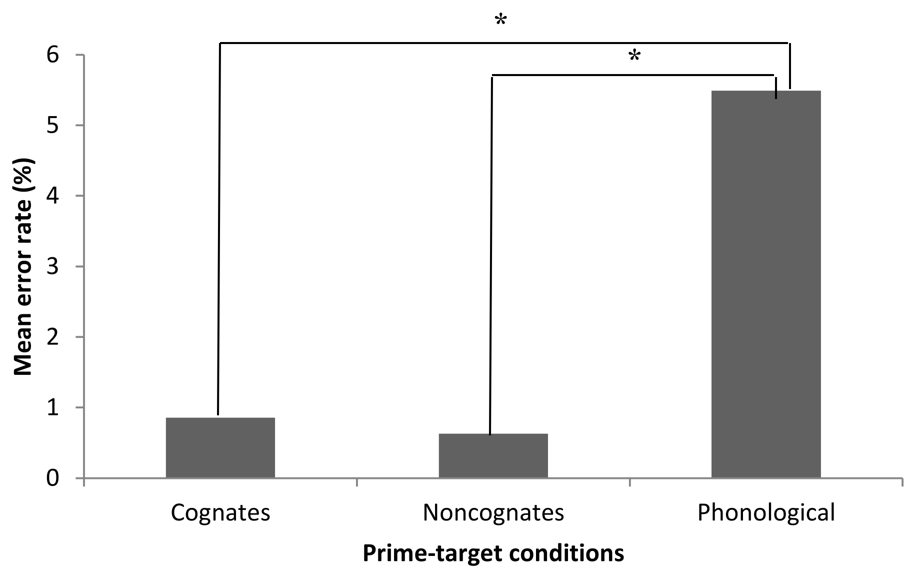

Figure 14. Experiment 1B.The effect of prime-target conditions on mean percentage error rate in L2-L1 priming direction in subject analysis. * shows significance at p=.05 level.

For nonword targets, unlike the results from L1-L2 priming, the mean difference of RTs and error rates between word targets and nonword targets were not significant. The RTs for nonword-targets were numerically slower than the mean RTs of word targets in the three conditions but the mean difference was not significant (628 ms vs.753 ms, t (40.6) =2.0, p=.051). For error rates, it was higher for word targets but the mean difference did not reach significance

(2.3% vs. 1.0%, $t(38.4)=.248$, $p=.805$). As the RTs and error rates for nonword targets were used as a baseline (null priming effect), lack of significance in the mean difference between the RTs of word targets and nonword targets implied that there was very small priming effect in the L2-L1 direction. The mean RT difference between nonword targets and cognates across Basic and Post-basic groups was 134 ms, 133 ms between noncognates and 108 ms between phonologically similar word. The mean difference between word targets and nonword targets was 125 ms, which was considerably smaller than that of Experiment 1A (M=935 ms).

Discussion

In this Experiment 1B, the participants made lexical decision to English targets (L1) primed by Japanese words (L2). Switching the priming direction from L2 to L1 yielded different results from Experiment 1A in which the priming direction was from L1 to L2. First, unlike the results from Experiment 1A, the mean RTs were faster for Basic group than for Post-basic group (610 ms vs. 645 ms). The error rates, however, were higher for Basic group than for Post-basic group, which was the same pattern as the results from Experiment 1A (2.4% vs. 2.2 %). The mean RT and error rate difference did not reach significance across the two groups except for the item analysis in which the mean RT difference was significant (16.78 ms). Over all, the results indicate that there was no effect of proficiency on the priming effect.

This pattern of results (faster RTs to L1 targets in less proficient bilinguals) was in line with the findings from Davis et al. (2010) who tested groups of beginning and balanced Spanish-English bilinguals. They found faster RTs to L1 targets with more errors in beginning bilinguals than in balanced bilinguals and they assumed that there was a speed-accuracy trade-off while the participants were making lexical decisions to the targets. They further argued that beginning bilinguals might have felt more motivated to respond to L1 targets than to L2 targets. Speedy responses thus resulted in more errors and this may apply to the participants in Basic group in the present study.

As for the effect of prime-target conditions, the effect was significant only between translation pairs (cognates and noncognates) and phonologically similar pairs. Unlike the results from Experiment 1A, the mean RT and error rate difference was not significant between cognates and noncognates, showing that cognates did not have a processing advantage over noncognates when the primes were in L2 and targets were in L1. However, the significant mean RT and error rate difference between translation pairs and phonologically similar pairs indicated that shared semantics was a required condition for a priming effect to emerge. Another implication from this lack of cognate advantage over noncognates was that the participants did not utilize phonological information in L2 cognate primes for processing L1 targets. In Experiment 1A, cognates showed an advantage over noncognates in processing and the advantage was attributed to phonological similarity in cognates. However, such similarity did not affect the priming effects in L2-L1 priming direction.

Another finding that was different from Experiment 1A was that the mean RT and error rate difference was not significant between word-pair conditions (cognate, noncognate, and phonologically similar word pairs) and nonword-target condition. In Experiment 1A, the mean RT difference between word-pair conditions and nonword- target conditions (baseline) was 954 ms. This mean difference indicates the presence of a priming effect as this difference between the baseline and the observed mean RTs was significant (2070 ms vs.1116 ms, $t(18.07)=7.09$, $p<.001$). However, in Experiment 1B, the difference was not significant (628 ms vs.753 ms, $t(40.6)=2.0$, $p=.051$). Indeed, the mean difference was 125 ms, which was considerably smaller compared to the 954 ms difference in Experiment 1A. This finding indicates that observed RTs for word-pair conditions were not significantly different from those of the nonword target condition. In other words, the priming effect was very small in the L2-L1 priming direction and the current results were consistent with the results of previous studies that found either a null or very small priming effect in different-script bilinguals in the L2-L1 direction (Gollan et al. 1997; Jian, 1999; Kim & Davis, 2003; Finkerbeiner et al., 2004). One possible reason for the insignificant priming effect in L2-L1 direction is the effect of L2 proficiency. That is, certain level of L2 proficiency is required in order to process L2 primes for rapid recognition of a L1 word. If a bilingual has a clear dominance in L1, such as beginning bilinguals or late L2 learners, the processing of the L1 target overtakes the processing of the L2 prime and thus no priming effect can be obtained (Gollan et al., 1997). This point is especially relevant to the current results as the participants in the present study were groups of beginning English-Japanese bilinguals with a relatively short period of Japanese learning experience (from one to three years) and were clearly L1 dominant.

To sum up, the results from Experiment 1B (lexical decision task with masked priming in L2-L1 priming direction) showed that (i) there was no effect of proficiency on priming effect as the mean difference of RTs and error rate between the two groups was not significant and that (ii) shared semantics was an important factor for a priming effect to emerge as the mean RT and error rate difference between translation pairs (cognate and noncognate) and phonologically similar pairs was significant and that (iii) priming effects were insignificant in L2-L1 priming direction compared to those in L1-L2 priming direction, indicating that the participants did not benefit from the linguistic information in L2 primes in processing L1 targets. This also indicates the participants' L2 proficiency was not sufficient enough to process L2 primes.

3.2 Experiment 2: Masked priming with Native Japanese speakers

In Experiment 2, a group of native Japanese speakers with L2 English were tested on the same materials used in Experiment 1 except that the primes and targets in the lists of stimuli were reversed.

3.2.1 Participants

A total of 19 native Japanese speakers (3 male, mean age = 31.3, 16 female, mean age=40.1) living in the northeast Kansas area. They were all adults including 6 college students. They had studied English for an average of 9.8 years at schools (*SD*=2.2). All the participants completed a questionnaire to assess their length of stay in the United States, frequency of usage of English and Japanese, and self-rating of English proficiency (Table 5). They were all born and grew up in Japan and came to the United States after graduating from high school or college except for two of them who had spent a few years (2-3 years) in English-speaking countries before puberty. These native Japanese speakers were considered moderately to highly proficient Japanese-English bilinguals considering the amount of formal English language education they had received in schools (*M*=9.8 years) and frequency of usage of English on a daily basis, nearly half of them answered that their usage of English in daily life was more than 80 %.

Table 5. *Language background information of the native Japanese speakers*

Length of stay in the United States		
1 -5 years	5 (26 %)	
6-9 years	5 (26 %)	
More than 10 years	10 (48 %)	
Frequency of usage of English and Japanese on a daily basis		
	English	Japanese
100-80 %	9 (47.4 %)	4 (21.1%)
79-50 %	5 (26.3 %)	4 (21.1%)
49-30 %	1 (5.3%)	2 (10.5%)
less than 20%	4 (21.1 %)	9 (47.4%)
Self-rated Proficiency levels of English (1 = poor ~ 5 = very good) *SD in parenthesis		
Speaking	3.4 (1.1)	
Listening	3.5 (1.0)	
Reading	3.3 (0.9)	
Writing	3.3 (1.1)	

3.2.2 Materials and design

The materials and design were the same as in Experiment 1, except that the list of stimuli was switched to create L1-L2 /L2-L1 prime-target relationship for Japanese-English speakers.

3.2.3 Procedure

The procedure was identical to the one used in Experiment 1.

3.2.4 Data treatment

The data treatment was identical to the one used in Experiment 1. No participant was discarded due to their high error rates. Mean reaction times and error rates were calculated only for correct responses (95 % of all the responses) for each subject and each item. The total data loss after the treatment was 12.5 % of all correct responses. For nonword targets, RTs less than 300 ms or greater than 3000 ms were discarded (4.2 % of all correct responses).

Mixed ANOVAs was conducted for both subject analysis (*F1*) and item analysis (*F2*) on RTs and error rates. The mean RTs and the mean error rates were analyzed using 2 (priming direction: L1-L2 and L2-L1) × 3 (prime-target condition: cognate, noncognate, phonological) mixed ANOVA.

3.2.5 Results from Experiment 2 (L1-L2/L2-L1 priming direction)

The mean RTs in L1-L2 priming direction for cognate pairs was 743 ms (*SD*=105), 774 ms (*SD*=127) for noncognate pairs and 839 ms (*SD*=146) for phonologically similar pairs. In L2-L1 priming direction, the mean RTs were 710 ms (SD=119) for cognate pairs, 756 ms (SD=130) for noncognate pairs and 718 ms (SD=115) for phonologically similar pairs. The participants made the fastest responses to cognate pairs in both priming directions (743 ms and 710 ms for L1-L2 and L2-L1 direction respectively) but different patterns were observed for the RTs of noncognates. In L1-L2 direction, phonological pairs caused the slowest responses (839 ms) but in L2- L1 direction, noncognates caused the slowest responses (756 ms) (Figure 15).

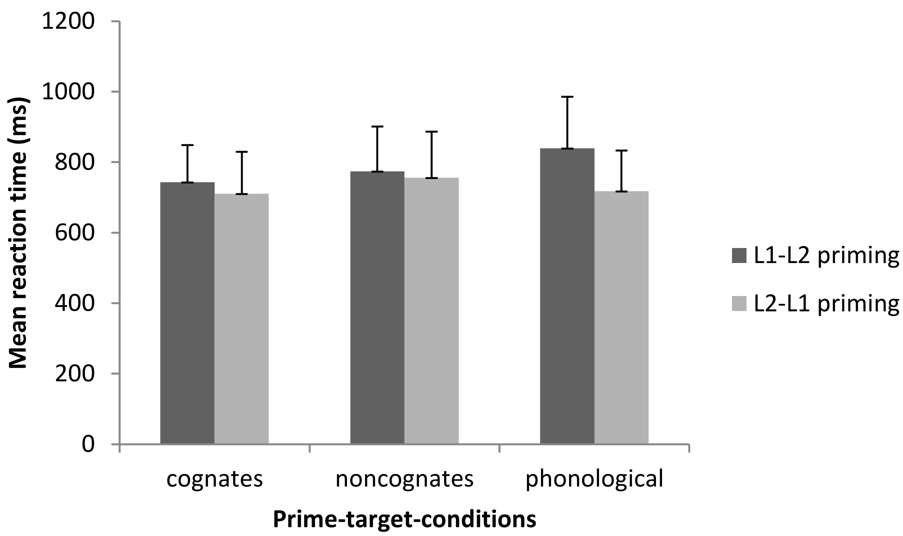

Figure 15. Experiment 2. Mean reaction time in milliseconds in L1-L2 and L2-L1 priming direction in subject analysis.

For RTs, there was a significant interaction between priming direction and prime-target condition in both subject and item analysis, $F1(2,70)=15.05$, $p<.001$; $F2(2,52)= 3.58$, $p=.035$, partial $\eta^2=.121$. The effect of priming direction was significant in item analysis but not in subject analysis, $F1(1,35)=2.15$, $p=.151$, partial $\eta^2=.058$; $F2(1,52)= 9.07$, $p=.004$, partial η^2

=.148. A pairwise comparison showed that the mean RT difference between L1-L2 direction and L2-L1 direction was significant and that the participants responded more quickly in the L2-L1 direction in the item analysis (*M*=733.7, *SE*=12.4, *p*=.004; *M*=771.2, *SE*=12.4, *p*=.004). The effect of the prime-target condition was significant both in subject and item analysis, *F1* (2,70)=14.2, *p*<.001, partial η^2=.289; *F2* (2,52)= 4.7, *p*=.013, partial η^2=.153. In the subject analysis, a significant difference in RTs were observed between cognates and noncognates (*M*=727.0, *SE*=8.27, *p*<.001; *M*=765.2, *SE*=8.27, *p*<.001) and cognates and phonological pairs (*M*=727.0, *SE*=11.3, *p*<.001; *M*=.778, *SE*=11.3, *p*<.001). In the item analysis, the difference was significant only between cognates and phonological pairs (*M*=721.9, *SE*=18.9, *p*=.004; *M*=779.6, *SE*=18.9, *p*=.004). (Figure 16).

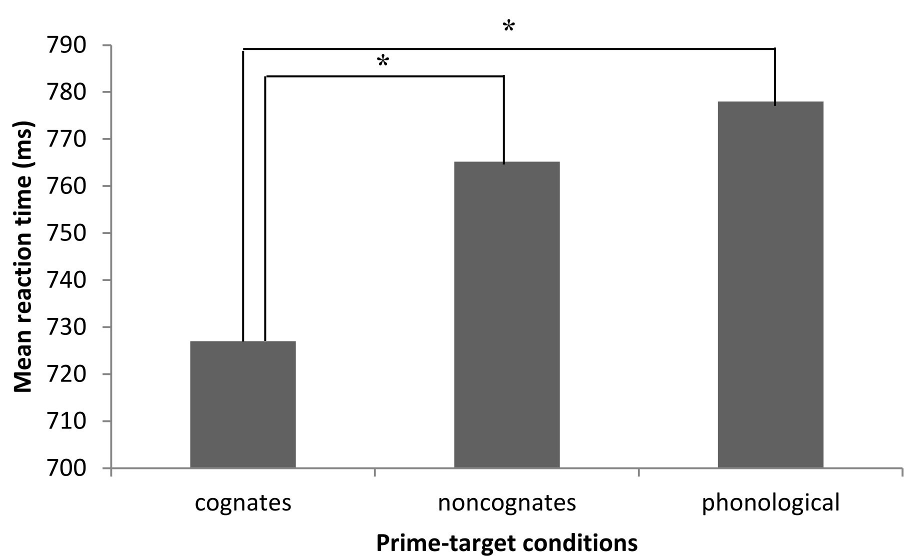

Figure 16. Experiment 2. The effect of prime-target conditions on mean reaction time in milliseconds in subject analysis.

The mean error rates in L1-L2 priming direction for cognate pairs was 0.8%, 1.9% for noncognate pairs and 8.5% for phonologically similar pairs. In L2-L1 priming direction, the mean error rates were 0.6% for cognate pairs, 2.2% for noncognate pairs and 0.5% for phonologically similar pairs (Figure 17). For error rates, there was a significant interaction between priming direction and prime-target conditions, *F1* (1,49)=16.64, *p*<.001, partial η^2=.404; *F2* (2,56)=5.15, *p*=.009, partial η^2=.156. There was a significant effect of priming direction in both subject and item analysis, *F1* (1,49)=16.8, *p*<.001, partial η^2=.255; *F2* (1,56)=6.23, *p*=.016, partial η^2=.100. The mean error rates were higher for L1-L2 direction than L2-L1 direction in both analysis (*M*=3.8, *SE*=.647, *p*<.001; *M*=1.1, *SE*=.647, *p*<.001 in subject analysis and *M*=4.64, *SE*=1.39, *p*=.016; *M*=1.2, *SE*=1.39, *p*=.016 in item analysis respectively).

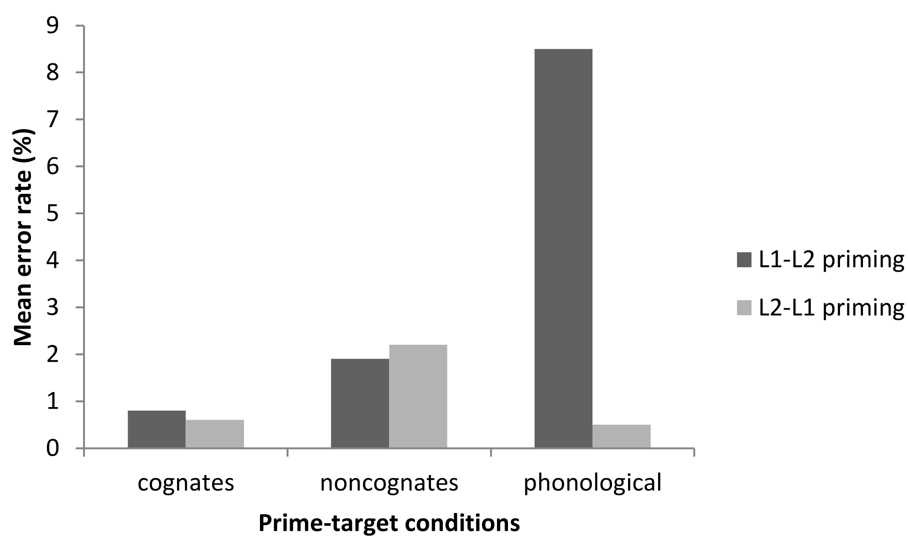

Figure 17. Experiment 2. Mean percentage error rate in L1-L2 and L2-L1 priming directions in subject analysis.

The main effect of prime type was significant in both subject analysis and in item analysis, *F1* (2,49)=58.03, *p*<.001, partial η^2=.542; *F2* (2,56)=2.91, *p*=.063, partial η^2=.094. The difference was significant between cognates and phonological pairs in subject analysis (*M*=.765, *SE*=.798, p<.001; *M*=4.56, *SE*=.798, *p*<.001) and in item analysis (*M*=.816, *SE*=2.0, *p*=.022; *M*=5.6, *SE*=2.0, *p*=.022) (Figure 18).

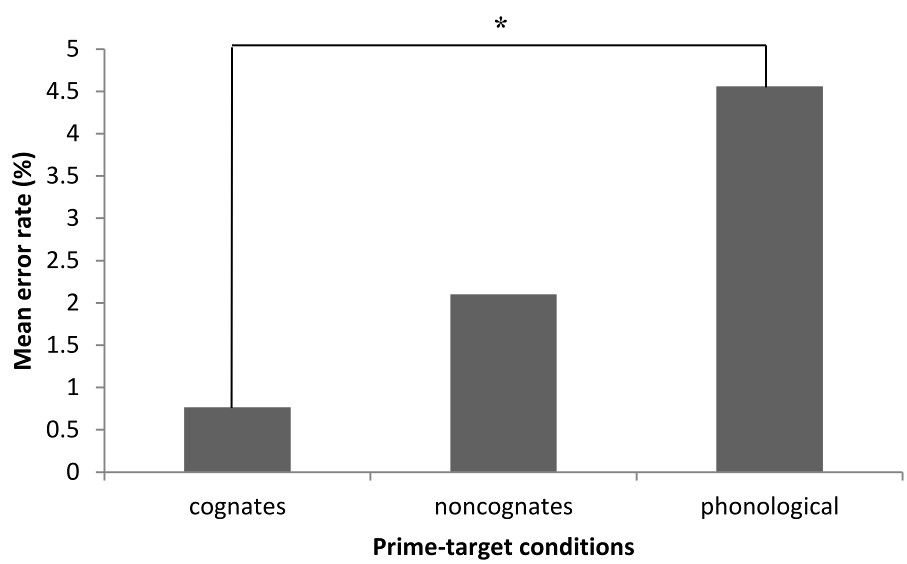

Figure 18. The effect of prime-target conditions on mean percentage error rate in subject analysis. * shows significance at *p*=.05 level.

The RTs for nonword targets were slower than those of word targets (812ms vs. 728 ms and 874 ms vs.785ms for L2-L1 and L1-L2 direction respectively) but the mean RT difference between word targets and nonword targets in each priming direction did not reach significance (84 ms vs. 89 ms, *t*(4)=.-405, *p*=.706). The observed insignificant mean difference indicated that there was no significant difference in the size of priming effects in the two priming directions. Moreover, the small difference indicated the priming effect itself was very small in this population, considering the larger priming effect observed in Experiment 1 with Japanese learners (935 ms and 125 ms for L2-L1 and L1-L2 direction respectively).

Discussion

The results from Experiment 2 with Japanese-English bilinguals provided similar results in one domain and a different pattern of results in another domain from Experiment 1 which tested English-Japanese bilinguals. First, in moderately proficient Japanese-English bilinguals, the priming effect was not modulated by the priming direction. The RTs in the subject analysis clearly showed that there was no statistical difference in the observed RTs in the two priming directions (728 ms vs. 785 ms, p=.151), although item analysis showed a significant effect of priming direction on error rates. The symmetric priming effects observed in Japanese-English bilinguals in the present study is consistent with the previous study that tested highly proficient Japanese-English bilinguals and observed bidirectional priming effects in both L1-L2 and L2-L1 priming directions (Nakayama et al., 2013). The priming effect was smaller than for beginning bilinguals, however, as more proficient bilinguals can access the meaning of L2 words without relying on the information from L1 words (Kroll & Stewart, 1994; Gollan et al., 1997; Dijkstra et al., 2010; Dimitropoulou et al., 2010). As a result, a smaller priming effect is observed for more proficient bilinguals. Previous studies have obtained a larger priming effect for less proficient bilinguals as they are more likely to rely on L1 information in processing L2 words (Gollan, et al., 1997). Second, as for the effect of prime-target conditions, the results were similar to those in Experiment 1. The results from Experiment 2 showed that the mean RT and error difference were significant between cognate and noncognate, or translation pairs (cognate and noncognate) and phonological pairs. This was the same result pattern observed in Experiment 1, which lends further support for the importance of shared semantics and phonology for a facilitation effect to emerge.

Another finding that was different from Experiment 1 was that the RTs were the slowest for noncognates and the mean RTs were about the same for cognates and phonological pairs in L2-L1 priming direction. This finding could be because of the script type used in these primes; Katakana and Hiragana scripts. In Experiment 1, noncognate pairs were all written in Hiragana even in the case of ones normally written in Kanji to make it easier for the Japanese leaners to recognize. However, for the native Japanese speakers, this resulted in longer response times and more errors due to the unfamiliarity of the words. In fact, some of the participants mentioned after the experiment that it would have been easier if the target words had been written in Kanji. Because of the issue of script type, noncognate pairs yielded significantly slower RTs and high error rates.

In sum, Experiment 2 with moderately proficient Japanese-English bilinguals showed that (i) the priming effect was not modulated by priming direction in more proficient bilinguals and (ii) the results showed a cognate advantage over noncognates and phonologically similar words, providing further support for the importance of shared semantics and phonology in cognates for a facilitation effect and (iii) the priming effect was smaller for more proficient bilinguals than for beginning bilinguals.

Chapter 4 General Discussions

4.1 Summary of Findings

The present study examined cognate facilitation effect in visual word recognition in beginning bilinguals, namely late L2 Japanese learners with L1 English with limited L2 learning experience. Lexical decision experiments were conducted using masked priming paradigm to test two predictions based on the claims of the BIA+ model. The first prediction was that shared semantics and phonology in cognates facilitate word recognition in different-script bilinguals even in the absence of shared orthography. The second prediction was that the cognate facilitation effect would be modulated by L2 proficiency. Specifically, the facilitation effect would be larger in the L1-L2 priming direction than for the opposite direction and that the facilitation effect would be larger for Post-basic than for Basic group. The results from the current study supported these predictions except for the last prediction regarding the influence of L2 proficiency on the facilitation effect.

With regard to the first prediction, translation pairs (cognates and noncognates) showed a processing advantage over phonologically similar pairs in almost all analysis. This result indicates that shared semantics was a determining factor for a priming effect to emerge and that phonological similarity alone was unlikely to induce a facilitation effect in visual word recognition. In addition, the observed processing advantage of cognates over noncognates, determined by faster RTs and fewer error rates, showed that beside shared semantics, shared phonology was also an important factor for the facilitation effect to emerge and that shared phonology in cognates had an additive effect on the priming effect. If the cognate facilitation effect is solely due to shared semantics, the effect should be observed equally for both cognates and noncognates. However, the priming effects were always larger for cognates than for noncognates. Therefore, it can be said that the cognate facilitation effect is semantic in nature and shared phonology in cognates has an additional facilitation effect in bilingual lexical processing. The observed cognate facilitation effect in L2 Japanese learners showed that different-script bilinguals can benefit from phonological information even when orthographic information is not available due to the script difference. The results thus provided supporting evidence for the BIA+ model that allows the co-activation of lexical candidates in both languages at the phonological level when bilinguals see a word in one of their languages.

With regard to the second prediction, the results from the current study showed that cognate priming effect was larger in the L1-L2 priming direction in beginning English-Japanese bilinguals than in the L2-L1 priming direction. The L2-L1 priming direction results showed very small priming effects compared to those in L1-L2 priming (407 ms vs.91 ms), which indicates that the bilinguals did not benefit from the linguistic features in L2 primes. This also implies that certain level of L2 proficiency is required to be able to process L2 primes for a rapid recognition of L1 targets. The results can be explained by *the temporal delay assumption* in the BIA+ model which claims the activation of L2 lexical properties is slower than that of L1 due to lower proficiency of L2 than L1. As a result, in less proficient bilinguals, the activation of L1 word overtakes the processing of L2 primes and thus very small or null effect is obtained in L2-L1 priming direction (Gollan et al., 1997). The results from current study did not support the prediction that the priming effects should be larger for Post-basic than for Basic group. There was no effect of course level in either priming direction, showing that L2 proficiency determined by the amount of L2 learning experience at the college level (Basic and Post-basic group) did not affect the priming effect. This indicates that one to three years of L2 learning experience did not have any impact on the priming effect across these two particular groups. For future studies, the effect of L2 proficiency needs to be examined with more advanced learners who have a longer L2 learning experience.

4.2 Limitations of the current study

Although the current study provided additional evidence for cognate facilitation effect in low proficient bilinguals whose two languages have different-scripts, there are some limitations. First, although most of the previous studies on lexical priming used a prime word that is unrelated to the target word as baseline conditions (e.g., Japanese-English ガイド/gaido/ -*call* vs. ガイド/gaido/-*guide*), the current study chose nonword-targets with word primes as baseline condition against which lexical priming is compared. Previous studies have shown that no priming effects are obtained when a prime and a target word are unrelated and thus this condition has been used widely as baseline in lexical priming studies. Using nonwords as targets may limit the scope of interpretation of the current results. However, researchers have used non-lexical items as baseline conditions such as a string of symbols (e.g., asterisks) besides nonwords (Adelman, 2012) and found no priming effects (e.g., Gollan et al, 1997; Forster, 1987 in nonword targets). In addition, the word pool for the stimuli was very limited in the current study as the words were selected strictly from the textbook used in the Japanese course the subjects were enrolled, which made it difficult to construct word pairs unrelated to each other. In fact, it was extremely difficult to pair words unrelated to each other within a limited word pool as the judgement of the unrelatedness is subjective if not normed or quantified. For these reasons, word pairs made up of a word prime and nonword target were used in the current study. For future studies, however, word-word pairs can also be included in order to support the validity of the results.

Second, although the results from the experiments with native Japanese speakers provided informative results regarding the L2 proficiency effect in cognate priming and bilingual language processing and made an interesting contrast to the results with Japanese learners, their L2 proficiency effect should not be confused with that of the Japanese learners. The between-subject variable in the current study is the course level of the Japanese learners (Basic vs. Post-basic) and the results showed there was no effect of L2 proficiency on the priming effects between these two groups. The results from the native Japanese speakers, however, did provide additional evidence that more proficient bilinguals yielded symmetric priming effect in both priming directions (L1-L2 and L2-L1 directions) compared to the asymmetric priming effect in less proficient bilinguals (Japanese learners), in which the effect was robust in L1-L2 priming direction only. Another limitation regarding the native Japanese speakers is that their L2 proficiency is not measured adequately. Although they are referred to as more proficient bilinguals in the current study but their proficiency measure was solely based on their L2 learning experience (length of formal English language education) and exposure to L2 (length of stay in the United States) and may not be defined as highly proficient or balanced bilinguals as were the subjects in previous studies. Environmental factors should have been taken into account as they live in L2 dominant environment, whereas the Japanese learners at the University of Kansas are learning their L2 in L1 dominant environment. For future studies, if native Japanese speakers are tested as a control group in the current study, the matching subjects will be beginning L2 learners of English with L1 Japanese.

4.3 Pedagogical Implications

The present study tested L2 Japanese learners with L1 English to investigate cognate facilitation effect using Katakana loanwords. The observed facilitation effect showed that the learners could benefit from semantic and phonological information shared between cognates, namely between Katakana loanwords and the English counterparts. Their reaction time in making lexical decisions was quite slow, which resulted in high rates of discarding data (55% of the correct responses). However, considering their high accuracy (95%) in the lexical decision task, they were able to decide whether the presented Japanese words were real word or nonword if they were given a certain amount of time. The results from the current study is promising as it showed that L2 Japanese learners with L1 English could utilize their knowledge of English language to recognize Katakana words and it will lead to faster recognition of words written in Katakana scripts. One suggestion for the classroom instruction is to provide the learners with repeated exposure to Katakana loanwords in written and spoken form. The cognate facilitation effect indicates that learners employ phonological coding in reading Katakana words. That is, when reading a Katakana word, learners search their L1 lexicons for phonologically similar sounds. Familiarizing learners with spoken form of Katakana words is thus beneficial as phonological similarity in cognates assists the retrieval of meaning, which leads to a faster recognition of a written word. This is especially optimal for learners whose L1 and L2 do not share a writing system as the facilitation effect cannot be expected in written word recognition in the absence of shared orthography. Also, the instructors can use supplementary materials such as websites, newspapers and magazines to familiarize the learners with Katakana loanwords. One problem with the Japanese textbooks used in the United States is that they do not contain enough Katakana loanwords (Nishi & Xu, 2013). For instance, Nakama 1 and 2 (Makino et al, 1998) contain 188 Katakana loanwords with 122 of them in Nakama 1 and 66 of them in Nakama 2. Considering the large number of English-derived Katakana loanwords found in modern Japanese texts, using authentic supplementary materials help learners extend their vocabulary. Teaching cognates is a way to relate words in L2 to the learners’ L1 and this can be done by giving learners more exposure to the written and especially to spoken form of Katakana loanwords. For L2 Japanese learners with L1 English, the vocabulary base of cognates that derived from their L1 has the potential to be a useful tool to enrich their vocabulary and facilitate subsequent L2 acquisition

4.4 Conclusion

The present study provided additional evidence that beginning bilinguals whose two languages do not share script and who have acquired their L2 late in life showed robust masked translation priming effects in visual word recognition, suggesting that cross-language co-activation and interaction during bilingual lexical processing are active and functional even at early stages of L2 acquisition. The lack of a priming effect in the L2-L1 priming direction was consistent with previous findings that beginning bilinguals showed priming effect only in L1-L2 priming direction and provided supporting evidence for the influence of L2 proficiency on the cognate facilitation effect. The Japanese learners in the present study did not benefit from phonological similarity alone in making lexical decisions, which is different from the studies that found robust phonological priming effect in native Japanese speakers learning English with relatively high L2 proficiency (Nakayama et al.,2012, 2013, 2014). It might be interesting to do the same study with highly proficient English-Japanese bilinguals (i.e., English-Japanese bilinguals living in Japan) to examine whether the phonological similarity alone in loanwords induce facilitation effect in visual word recognition. However, the results from current study did show that English speakers learning Japanese employed phonological coding in recognizing loanword cognates and the phonological similarity in the original English words and Katakana loanwords facilitated the recognition of the loanword cognates written in Katakana scripts. For future studies, issues to be explored include the assessment of L2 proficiency and the degree of phonological priming effect in visual word recognition in L2 learners whose languages do not share scripts compared to those languages share the same scripts.

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Appendix A: Word Stimuli List 1. English prime to Japanese target

Cognates		**Noncognates**		**Phonological**		**Nonword target**	
earrings	イヤリング	cloudy	くもり	arrange	オレンジ	banana	バシナ
Canada	カナダ	season	きせつ	cart	カード	concert	コリサート
camp	キャンプ	walk	さんぽ	buffet	カフェ	video	ギデオ
cookie	クッキー	clock	とけい	trolley	カロリー	milk	ケルク
coat	コート	classroom	きょうしつ	case	ケーキ	jeans	ウーンズ
cola	コーラ	climate	きこう	gain	ゲーム	coffee	ナーヒー
jacket	ジャケット	center	まんなか	beans	ジーンズ	dessert	ムザート
shower	シャワー	evening	ゆうがた	shy	シャツ	lunch	ラネチ
soup	スープ	watch	うでどけい	jute	ジュース	date	デーハ
sofa	ソファ	bag	かばん	soup	スーツ	skirt	ネカート
taxi	タクシー	egg	たまご	stage	ステーキ	fat	あどら
cheese	チーズ	semester	がっき	stain	スペイン	rest	ろすみ
chicken	チキン	meal	ごはん	spoke	スポーツ	bath	けふろ
test	テスト	bike	じてんしゃ	cable	テーブル	magazine	ずっし
tomato	トマト	desk	つくえ	terrace	テニス	English	えけご
necklace	ネックレス	letter	てがみ	coast	トースト	shrine	じのじゃ
pants	パンツ	festival	まつり	beat	ビーフ	carrot	にめじん
business	ビジネス	trip	りょこう	nail	メール	Saturday	どぬうび
present	プレゼント	food	たべもの	mice	ライス	major	せるこう
wine	ワイン	cleaning	そうじ	rat	ラップ	hat	ぼにし

Appendix A. Word Stimuli List 2. Japanese prime to English target

Cognates		**Noncognates**		**Phonological**		**Nonword target**	
アメリカ	America	あぶら	fat	キャンプ	cant	ジャズ	sazz
カフェ	café	えいご	English	クッキー	kooky	メール	makl
カロリー	calorie	えんぴつ	pencil	クラス	clad	テーブル	bable
クリスマス	Christmas	おふろ	bath	コート	cord	マイナス	qinus
ケーキ	cake	かようび	Tuesday	コーヒー	corgi	セール	sile
ゲーム	game	きっぷ	ticket	コーラ	coma	ビデオ	gideo
コンサート	concert	くだもの	fruit	ジャズ	jam	ポスト	yost
ジーンズ	jeans	くつした	socks	シャワー	tower	オレンジ	okange
ジュース	juice	こうえん	park	スープ	suit	ランチ	wunch
スキー	ski	ざっし	magazine	スカート	scarf	デート	dyte
ステーキ	steak	しゅみ	hobby	チーズ	cheat	りょうしん	karent
スパゲティ	spaghetti	じんじゃ	shrine	デート	bait	さかな	zish
スペイン	Spain	せんたく	laundry	テスト	pest	くもり	kloudy
スポーツ	sport	たんす	chest	パーティー	thirty	てがみ	lekter
テニス	tennis	てんき	weather	ブラウス	browse	としょかん	pibrary
ハイキング	hiking	べんきょう	study	ベッド	bet	にんじん	darrot
バナナ	banana	やすみ	rest	ポスト	past	ひこうき	wlaine
ビデオ	video	ゆびわ	ring	ロック	rot	きって	ctampu
マイナス	minus	りょう	dorm	ランチ	lunge	ごはん	medl
レストラン	restaurant	りんご	apple	ワイン	wide	さんぽ	wahk

Appendix B. Language background questionnaire

English Language Questionnaire (for norming studies)

1. Gender: M / F

2. Age: __________

3. Year in School (if applicable):

freshman / sophomore / junior / senior / graduate

4. Is English your native language? Yes / No

5. How long have you lived in the United States? ____________________

6. Are you currently enrolled in any language courses or any courses instructed in a second language?

Yes / No

If YES, in what language? ___________________

Self-ratings of English skills

On a scale from 1-5, please rate your level of English proficiency in speaking, understanding spoken languages, reading, and writing.

	poor				very good
1. Speaking	1	2	3	4	5
2. Listening (speech comprehension)	1	2	3	4	5
3. Reading	1	2	3	4	5
4. Writing	1	2	3	4	5

Thank you very much for your participation.

Language History Questionnaire (for Japanese learners)

1. Gender: M / F
2. Age: ___________
3. Year in School: freshman / sophomore / junior / senior / graduate
4. Native language: ______________________

5. Have you ever been to Japan? Yes / No
   If yes, when? __________________How long?_________________Purpose? ________________

6. I am **currently** enrolled in JPN 204 JPN 306 JPN 504 JPN562

7. I have completed JPN 104 JPN 108 JPN 204 JPN 208 JPN 306 JPN 504 at KU.

Self-ratings of Japanese skills

On a scale from 1-5, please rate your level of Japanese proficiency in speaking, understanding spoken languages, reading, and writing.

	poor				very good
1. Speaking	1	2	3	4	5
2. Listening (speech comprehension)	1	2	3	4	5
3. Reading	1	2	3	4	5
4. Writing	1	2	3	4	5

Educational background of Japanese as a foreign language.

If you have studied Japanese as a foreign language, please give details.

Institutional settings	**Length**
1. Self-study	_____________years _____________months _____________hour / week
2. Private tutor	_____________years _____________months _____________hour / week
3. Middle school	_____________years _____________months _____________hour / week

4. High school	_____________ years _____________ months _____________ hour / week
5. College	_____________ years _____________ months _____________ hour / week

Frequency of using Japanese

Please answer the following questions using 1-5 scales below.

1 (Not at all) **2** (Once or twice) **3** (Several times) **4** (Almost every day) **5** (Everyday)

In an average month, how often do you….

1. Speak Japanese with Japanese people?	1	2	3	4	5
2. Exchange e-mails in Japanese?	1	2	3	4	5
3. Read Japanese books/manga/ newspapers/magazines / websites?	1	2	3	4	5
4. Watch Japanese films/TV programs/anime?	1	2	3	4	5
5. Listen to Japanese music?	1	2	3	4	5

Foreign language learning background

If you have learned any foreign language other than Japanese, please give details.

Language	**Length**	**Purpose**
	_____________years _____________months _____________weeks _____________days	
	_____________years _____________months _____________weeks _____________days	
	_____________years _____________months _____________weeks _____________days	

Thank you very much for your participation.

言語学習歴等についてのアンケート

1. 性別:　男性　/　女性

2. 年令: __________

3. 現在学生でいらっしゃいますか。　　　はい / いいえ

はい、と答えた方は学年をお答えください。

freshman / sophomore / junior / senior / graduate

4. 母語: ____________________

5. 米国滞在歴： ___________________

6. 今まで米国以外の英語圏に滞在、居住されたことはありますか。(1 ヶ月に満たない旅行は含みません)　　　はい / いいえ

はい、と答えた方：

国名 _________________________期間_____________________________

7. １−５の尺度で、日本語能力を現してください。

1: 非常に劣っている	2:劣っている	3: 平均的だ
4: 優れている	5: 非常に優れている。	

1　2　3　4　5　話すこと

1　2　3　4　5　書くこと

1　2　3　4　5　聞くこと

1　2　3　4　5　読むこと

8. 正規教育をどの言語で受けられましたか。該当する言語と期間をお答えください。

			その他の言語
小学校	日本語　(　　　)年	英語　(　　　)年	
中学校	日本語　(　　　)年	英語　(　　　)年	
高校	日本語　(　　　)年	英語　(　　　)年	
短大、専門学校	日本語　(　　　)年	英語　(　　　)年	
大学	日本語　(　　　)年	英語　(　　　)年	

大学院	日本語　（　　　）年	英語　（　　　）年	

9.　現在生活の中で日本語と英語に触れる頻度はどのくらいですか。

言語	日本語	英語	その他
頻度(%)	%	%	%

10.　次の質問に１－５の尺度で答えてください。

1: 全然しない　2: あまりしない　3: 時々する　4: よくする　5: いつもする

1　2　3　4　5　アメリカ人と英語でだけ話す。

1　2　3　4　5　英語で Email のやり取りをする。

1　2　3　4　5　英語のテレビテレビ番組（映画なども含む）を見る。

1　2　3　4　5　英語の歌を聞く。

1　2　3　4　5　英語の本、新聞（インターネットを含む）を読む。

11.　英語運用能力の自己評価を 5 段階でお答えください。

	poor				**very good**
1. 話すこと	1	2	3	4	5
2. 聞くこと	1	2	3	4	5
3. 読むこと	1	2	3	4	5
4. 書くこと	1	2	3	4	5

12.　英語学習歴についてお分かりになる範囲でお答えください。

Institutional settings	**期間**
1. Self-study　自学自習	__________年 __________ヶ月
2. Private tutor　家庭教師	__________年 __________ヶ月
3. Middle school　中学校	__________年 __________ヶ月
4. High school　高等学校	__________年 __________ヶ月
5. College　大学	__________年 __________ヶ月
6. Graduate School　大学院	__________年 __________ヶ月