Doctoral Dissertation Abstract

Phonological Processing in Visual Word Recognition with Chinese-Japanese Bilinguals

（中国語–日本語後期バイリンガルの視覚的単語認識における音韻の役割）

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1. General Introduction

Many past bilingual studies have investigated how bilinguals process words in their second language (L2). Previous studies have indicated that bilingual visual lexical processing is *language non-selective* (e.g., Dijkstra et al., 1999; Dijkstra & Van Heuven, 2002), meaning it allows for the activation of the non-target language even when reading in a monolingual context. That is, when bilinguals process a word in one language, the lexical representations of that word in the other language are also automatically activated.

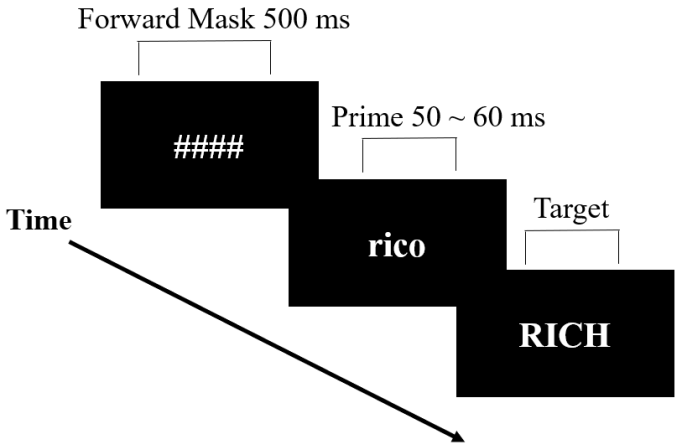
1.1 Methodology of the Present Study

The main experimental paradigm used to examine bilingual lexical processing in the present study is the masked priming paradigm (Forster & Davis, 1984; Kinoshita & Lupker, 2003). As shown in Figure 1, in this paradigm, a prime (often a word) is presented for a very short duration (about 50 to 60 ms) before the target stimulus is presented. The masked priming paradigm has been suggested to be able to tap into an early, unconscious stage of visual word recognition because most participants are not aware of the prime's presence, allowing for an automatic response process rather than strategic processing by the participants (Kinoshita & Lupker, 2003). The assumption behind the masked priming paradigm is that the prime's unconscious processing activates its own representations, while also pre-activating the target's representations before the target is actually presented. The paradigm involves assessing the influence of

the masked prime on the processing of the subsequent target. A *priming effect*, which refers to a difference in the speed (and accuracy) of target recognition in controlled versus manipulated conditions, arises only when the prime is in some way related to the target, suggesting that related primes typically facilitate target processing. Significant priming effects across different language prime-target pairs are interpreted as behavioral evidence of cross-linguistic connectivity of word representations in the bilingual's mental lexicon.

Figure 1

A Typical Trial Sequence of the Masked Priming Paradigm



Note. The arrow represents the direction of the passage of time. The black boxes represent the computer screen.

In the present research, a naming task combined with the masked priming paradigm was used to investigate L2 Japanese processing in Chinese-Japanese bilinguals. In the naming task, participants read targets aloud as quickly and as accurately as they could. The response times and the accuracy of participants'

performances were the dependent measures.

1.2 Literature Review

Translation equivalents are often employed in bilingual word recognition studies. Examining how their interlingual overlap in orthography, concepts, and phonology affect L2 word processing, helps researchers understand how the bilingual mental lexicon is organized and accessed (Dijkstra, Grainger, & Van Heuven, 1999). There are two types of translation equivalents: cognates and noncognates. Cognates are words that share form (orthography and/or phonology) and meaning across languages (rich-RICO in English and Spanish). Noncognates are words that share only a core meaning across languages (dog-PERRO in English and Spanish). For bilinguals whose languages employ different scripts, cognates share phonology and meaning only (e.g., バス-BUS, *bus*).

Previous translation priming studies have shown that cognates produce larger priming effects than noncognates (e.g., Gollan et al., 1997; Nakayama et al., 2013; Voga & Grainger, 2007). The priming advantage for cognates (over noncognates) is typically interpreted as being due to cognates' cross-language phonological similarity. Previous masked translation priming studies using cognates have typically shown an added benefit of phonological similarity in cognate translation priming effects in L2 visual word recognition (e.g., Nakayama et al., 2014), further indicating that the phonological representations of cognates are represented in an integrated fashion in the bilingual's mental lexicon, as is assumed by the language non-selective view.

1.3 Research Gap

If the effect of cross-language phonological similarity is a universal phenomenon, Chinese-Japanese cognates that are phonologically more similar to each

other should also exhibit a processing advantage. However, it is worth noting that in all of the above-cited papers, phonological facilitation was demonstrated in bilinguals whose languages included at least one alphabetic language, often English (e.g., Nakayama et al., 2013, 2014, Japanese-English bilinguals; Gollan et al., 1997, Hebrew-English bilinguals; Voga & Grainger, 2007, Greek-French bilinguals). For alphabetic languages, phonological activation is relatively automatic during the word recognition process (e.g., Berent & Perfetti, 1995; Van Orden, 1987). On the other hand, previous word recognition studies involving logographic words have shown mixed results as to the effects of phonology: while some studies have found phonological priming effects, indicating that phonological similarity does facilitate target retrieval (e.g., Kusunose, Nakayama, and Hino, 2013; Perfetti & Tan, 1998), others have not (e.g., Chen, Yamauchi, Tamaoka, & Vaid, 2007). It was therefore unclear as to whether phonology played an important role in the processing of logographic words, including Chinese-Japanese cognates. If the typical cognate priming advantage was due to phonological similarity, cognate priming for bilinguals of logographic languages may be unaffected by such cross-language phonological similarity.

1.4 Aims and Research Questions

The current study aimed to address the lack of bilingual word recognition literature centered on logographic bilinguals (i.e., Chinese-Japanese bilinguals) by evaluating the impact of phonology in the processing of Chinese-Japanese cognates. More specifically, the present study investigated the effects of cross-language phonological similarity on Chinese-Japanese bilinguals' cognate priming by manipulating the degree of phonological similarity between cognate pairs (similar vs. dissimilar).

2. Data and Findings

2.1 Experiment 1 (1A and 1B)

The goal of Experiment 1 was to investigate the effects of phonological similarity on the processing of Chinese-Japanese cognates that were also virtually identical in orthography (i.e., same-script cognates). In order to examine the impact of phonology, phonologically very similar Chinese-Japanese same-script cognates (e.g., 信赖/xin4lai4/ and 信頼/shiNrai/) and phonologically dissimilar Chinese-Japanese same-script cognates (e.g., 保证/bao3zheng4/ and 保証/hoshoR/) were used as critical stimuli. Thirty-six proficient Chinese-Japanese bilinguals (Experiment 1A) and a monolingual control group (26 Japanese native speakers, Experiment 1B) participated in the experiment. Participants were instructed to read the Japanese target aloud as quickly and as accurately as they could.

In terms of results, cognate priming effects were observed for both phonologically similar and dissimilar cognates, with the sizes of priming effects being equivalent (69 ms vs. 63 ms effects). That is, no evidence of phonological facilitation was shown, implying either that L1 phonology was activated but did not affect the priming of L2 cognates, or that phonology was not activated by the Chinese primes at all. Interestingly, Chinese-Japanese bilinguals did name L2 Japanese targets significantly faster if the target's L1 counterpart was phonologically similar to the target regardless of whether it was primed by the cognate or unrelated prime. However, Experiment 1B, which was conducted as a control experiment, ruled out the possibility that it was some uncontrolled lexical characteristics of the stimuli that led to this overall advantage in Experiment 1A, as Japanese native participants showed no significant

differences in naming latencies and error rates between the two conditions.

2.2 Experiment 2

In order to determine whether the absence of cross-language phonological priming in Experiment 1A was due to the use of two-character stimuli, Experiment 2 used Chinese two-character homophone prime-target pairs to test for the involvement of phonology in L1 Chinese word reading. In addition, Experiment 2 also added tone types as a factor in its investigation of how mismatches in tonal information affect the amount of homophone priming effects that are observed. Specifically, 54 same-tone homophone pairs (e.g., 守卫/shou**3**wei**4**/, *guard*-首位/shou**3**wei**4**/, *first place*) and 54 different-tone homophone pairs (e.g., 使命/shi**3**ming**4**/, *mission*-失明/shi**1**ming**2**/, *blindness*) were used. In order to have a participant pool parallel to that used in Experiment 1A, 32 Chinese-Japanese bilinguals participated in this Chinese naming experiment. The experimental procedure was identical to that used in Experiment 1A, except for that in Experiment 2, the participants named Chinese targets rather than Japanese targets, and that the same font type was used to present both primes and targets (i.e., SimSun).

According to the results, priming effects were observed only for homophone pairs that also matched in tone (25 ms effects for same-tone pairs and -4 ms effects for different-tone pairs). The results of Experiment 2 were consistent with the finding of Zhou and Marslen-Wilson's (2000) masked priming naming study using one-character Chinese stimuli (Experiment 3), in that significant priming was observed only when the primes had the same syllable segments and same lexical tones as the target (e.g., 独 /du2/ primed 读/du2/ but 度/du4/ did not). The significant homophone priming effect for the same-tone pairs meant that phonological activation occured when reading two-

characters Chinese words, thereby indicating that the absence of phonological facilitation in Experiment 1A was not due to the fact that two-character words were used as stimuli. Further, the results of Experiment 2 suggest that in cases where prime-target pairs have substantial phonological overlap (i.e., they are homophones), the match/mismatch in tone of the pair is critical in determining whether there will be significant phonological facilitation or not.

2.3 Experiment 3

The purpose of Experiment 3 was to determine whether high similarity in suprasegmental level information, a factor that was not considered in Experiment 1A, in addition to segmental phonological similarity, was needed to observe phonological-based facilitation in Chinese-Japanese cognate priming. For that purpose, tone-accent highly similar pairs (e.g., 关心/guan1xin1/-関心/kaNsiN/ [LHHH], *concern*) and tone-accent less similar pairs (e.g., 满足/man3zu2/-満足/maNzoku/ [HLLL], *satisfaction*) were used as stimuli. Thirty-nine Chinese-Japanese bilinguals participated in this experiment. The procedure was identical to that used in Experiment 1A.

Significant cognate priming effects were confirmed using a different group of bilinguals and set of stimuli, demonstrating the robustness of this priming effect with Chinese-Japanese cognates. In regard to the main issue investigated in Experiment 3, the sizes of cognate translation priming effects were numerically virtually identical (66 ms vs. 65 ms effects for tone/pitch-accent similar pairs and less similar pairs, respectively), suggesting that (additive) cross-language suprasegmental similarity does not at all boost the magnitude of priming effects for (segmentally) phonologically similar cognate pairs.

2.4 Experiment 4

The purpose of Experiment 4 was to test whether cross-language phonological priming with Chinese primes and Japanese non-logographic targets (i.e., Japanese Katakana words) could be observed. This notion was conceivable because phonological facilitation has largely only been observed when L1 logographic primes and L2 non-logographic targets were used, such as English alphabetic targets (e.g., Ando et al. 2014) and moraic/syllabic Kana targets (Nakayama et al. 2013).

The critical stimuli in Experiment 4 were Chinese-Japanese cognates that are logographic in L1 Chinese and syllabic Kana in L2 Japanese (e.g., 巴士/ba1shi4/-バス /basu/ and 瓦斯/wa3si1/ -ガス/gasu/). The cross-language phonological similarity was manipulated between these cognate pairs (phonologically similar vs. less similar). Forty-four Chinese-Japanese bilinguals participated in this experiment. The procedure was identical to that used in Experiment 1A.

In terms of results, although there was a significant cognate priming effect, there was no difference in effect sizes between phonologically more and less similar cognates (107 ms vs. 101 ms effects). This indicates that there is no phonological-based facilitation for Chinese-Japanese different-script cognates (i.e., logographic and non-logographic pairs).

3. General Discussion

The present study first proposed two potential reasons for the lack of phonological facilitation observed with Chinese-Japanese logographic same-script cognates. One possibility was based on an additive view; given the large overlaps in orthography and semantics in same-script cognate pairs, those factors may have essentially dominated the priming effect. That is, in Chinese-Japanese same-script

cognate priming effects, facilitation due to orthographic and semantic similarity may dominate, leaving little room for phonological facilitation to emerge. The other possible reason was derived from a representation-based explanation, which states that same-script cognates may be represented in essentially the same way that morphologically related words are often assumed to be, through a shared root (e.g., Davis et al., 2010; Sánchez-Casas & García-Albea, 2005). The lack of phonological facilitation found in the present study may, therefore, be explainable by adopting a morphological view of cognates. This means that Chinese-Japanese same-script cognate priming reflects how morphological representations that are shared between languages are accessed. In this process, reduced form overlap is tolerated. Based on these two possible explanations, two versions of the modified BIA+ model (e.g., Dijkstra & Van Heuven, 2002) were proposed to account for Chinese-Japanese bilinguals.

For the lack of phonological facilitation observed with Chinese-Japanese logographic-syllabic different-script cognates, an explanation might be that when Chinese readers learn to read in a second language, they try to apply the same general principles that they apply when reading Chinese. That is, they attempt to learn to read in their L2 using an orthographic-semantic route (e.g., Katz, & Frost, 1992). Furthermore, given that Katakana words account for only a small proportion of words in the Japanese vocabulary, applying the same reading process to Katakana words as they do to Hanzi/Kanji words may just be the most efficient way for them to learn to read Japanese. As such, phonological connections between Chinese words and Japanese Katakana words likely may not develop, leading to the data pattern found using Chinese-Japanese different-script cognates in the present study.

What should be noted is that the two potential reasons for the null phonological-

based facilitation in Chinese-Japanese same-script cognate priming, derive from the fact that the cognates are both written in logographic script. Thus, phonological facilitation should be observed if cognates written in different scripts across these two languages are used. However, as mentioned earlier, in the present study, a phonological-based effect was not observed even when using these logographic-syllabic Chinese-Japanese cognates, even though Japanese Katakana targets tend to be read using an orthography-phonology procedure. These results suggest that it is unlikely that either the additive view or the morphological view could adequately account for the lack of phonological-based priming in Chinese-Japanese cognate priming. The findings observed with different-script cognates, considered together with the results of obtained from the same-script cognates, suggest that representations of Chinese-Japanese cognates are characterized by a distinct lack of phonological-based connectivity.

4. Conclusion

The present study investigated the impact of cross-language phonological similarity on cognate priming effect with Chinese-Japanese bilinguals. The sizes of the cognate priming effects were equivalent regardless of the phonological similarity between cognates, both when processing Chinese-Japanese logographic same-script cognates and logographic-syllabic different-script cognates, which indicated that the lack of phonological-based facilitation in the processing of cognates is likely a general characteristic of Chinese-Japanese bilinguals. These results collectively suggest that Chinese cognate primes do not activate Japanese targets based on phonological similarity. The theoretical implication is that any phonological connections between the representations of Chinese and Japanese cognates, if they exist, are so weak that they do not activate to any degree when a cognate is visually presented.

5. Originality and Significance

The present study was novel in that it investigated whether phonological-based facilitation, which has been reliably observed with cognates in many language combinations, could be expanded to include Chinese-Japanese cognates. To my knowledge, the present study was among the first to examine Chinese-Japanese same-script and different-script cognates using the masked priming paradigm. The present study showed completely different findings from what previous studies' results have shown. This implies that how phonology is connected in the lexicon of Chinese-Japanese bilinguals may be somewhat different from what has been thus far assumed by current leading bilingual visual word recognition models.

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論文審査の結果の要旨

学位の種類	博士（国際文化）	氏　名	劉楚心
学位論文の題　　名	Phonological Processing in Visual Word Recognition with Chinese-Japanese Bilinguals (中国語-日本語後期バイリンガルの視覚的単語認識における音韻の役割)		

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論文審査の結果の要旨（1,000 字内外）

本論文は、中国語を母語とする日本語学習者が、中国語と日本語の同根漢字語をどのように認識するかを、心理言語学の実験的手法を用いて実証的に明らかにしたものである。バイリンガルの言語処理の研究においては、２つの言語が話者の脳内でどのように結びついているかという問題の解明が重要な目的の一つである。単語レベルでは、同根語とよばれる音韻、意味、形態レベルで類似した語が強いつながりを持つことが明らかにされている。その中でも、音韻情報を介したつながりは、英語などのアルファベット言語や、日本語のカタカナ語を用いた実験研究において支持されてきたが、漢字を使用するバイリンガルの脳内においても同様のつながりがあるかどうかは明らかではなかった。本論文の著者は、日中バイリンガルを対象として、同根語を刺激に用い、計６つの実験を行い、心的辞書内の音韻情報による結びつきを検証した。実験には、マスク下のプライミング手法を用いた音読課題を用い、反応時間及び正答率を分散分析および線形混合モデルにより分析した。

一連の実験の結果、中国語を母語とするバイリンガルの脳内における同根語のつながりは、言語間で共有される意味と形態によるものが支配的であり、音によるつながりは非常に弱いということが示された。この結果は、音韻情報による同根語のつながりの強さを実証した従来の研究と異なるものであり、本研究の独自の発見である。さらに、著者は、この音によるつながりの弱さは、漢字表記の同根語のみでなく、表音文字を含む同根語においても見られることを明らかにした。このことは、音韻的つながりの弱さは、漢字という特殊な表記形態によるものではなく、日中バイリンガルの語彙表象の一般的特徴であることを示している。

審査会では、本論文が、的確にデザインされた実験を通して、従来とは異なる結果を提示したことを高く評価した。本研究の独創性は、これまでほとんどなかった日中バイリンガルを対象に研究を行い、現行の心理学的モデルで想定されている音韻情報による語彙の処理が言語普遍的な構造ではないことを明らかにした点である。さらに著者は、本研究の知見をもとに、現行のモデルをどのように改良するべきであるかを示しており、審査会では、この点も研究領域の学術的な発展に重要な理論的貢献をするものと評価した。また、本論文の成果から、日本語教育において、中国語母語話者には音声面の教育を強化する必要性が明らかになるなど、実用的な面での示唆も評価に値する。

審査会では、今後は同根語以外の単語を用いてさらなる検証を行う必要性が指摘されたが、最終試験の質疑で、著者はその点も十分認識しており、今後の発展の方向性として検討していることが確認された。

以上、審査会は、本研究の成果が、論文執筆者が自立して研究活動を行うに必要な高度の研究能力と学識を有することを示していると判断した。よって、本論文は、博士(国際文化)の学位論文として合格と認める。