中国語話者の日本語学習者における日本語漢字認知過程に関する研究 －音韻的プライミングによる検討－

Japanese *Kanji* Word Recognition Processing for Chinese Learners of Japanese: A Study of Phonological Primed Lexical Decision Tasks

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Japanese *kanji* words, bilingual, phonological activation, cognate, frequency

ABSTRACT

本研究は，中国語話者の上級日本語学習者が日本語漢字を処理する際に，日本語の音韻情報は自動的に活性化するのかを検討した。中国語話者の上級日本語学習者に語彙性判断課題を課した。その結果，反応時間において，音韻的プライマーの主効果及び日中形態類似性の主効果が見られた。プライマーと同じ音韻情報を持つターゲット語は，プライマーと異なる音韻情報を持つターゲット語より反応時間が短かった。同形同義語は異形同義語より反応時間が短かった。また，音韻的プライマーと日中形態類似性の交互作用が見られた。異形同義語における音韻的プライマーの主効果が見られたが，同形同義語における音韻的プライマーの主効果は見られなかった。この結果から，学習者が日中同形同義語を処理す

る際に日本語の音韻情報は活性化していないこと及び，中国語に存在しない日中異形同義語を処理する際に日本語の音韻情報が活性化していることが分かった。

This study addresses the question of whether recognition of a Japanese *kanji*, which originates in Chinese, for semantic representation is performed without phonological mediation by advanced Chinese learners of Japanese. In this study, we examined phonological processing in Japanese *kanji* recognition by comparing the response time (RT) to a two-*kanji* compound word presented after a phonological prime that had the same phonological information from the first *kanji* and to the two-*kanji* compound word presented after a phonological prime which had a different phonological information from the first *kanji*. The results in RTs showed that there were significant effects on phonological prime (target words with related phonological prime had shorter RTs) as well as lexical similarity (cognates had shorter RTs than non-cognates). Besides, there was an interaction between phonological prime and lexical similarity. The related phonological prime facilitated the non-cognate recognition process, but the facilitation effects did not occur when the target word was a cognate. From the results, we argue that advanced Chinese learners of Japanese tend to activate phonological representation in the word recognition process for non-cognates whereas they tend to use the orthographical representation to access the meaning directly for cognates in Japanese. That is, the cognate effect can also be seen in affecting the phonological activation in the Japanese two-*kanji* compound word recognition process.

1. Introduction

How second language learners recognize words in different languages has been a major topic in research on the mental lexicon and vocabulary development learning. Substantial amount of studies on word recognition have been done on learners of alphabetic languages (e.g., Dijkstra, 2005; van Heuven, Dijkstra, & Grainger, 1998), but there are few experimental studies on learners of non-alphabetic languages, such as Chinese and Japanese.

A significant discovery in the past decades is that word recognition in one language may be affected by the knowledge of words from another language (see Kroll & de Groot, 2005, for a review). Numerous studies on European languages have indicated that bilinguals recognize cognates (i.e., words that are identical or similar in semantic and orthographical representations between languages) faster than non-cognates (i.e., words sharing the same semantic representations but have different orthographical representations) (e.g., de Groot, Delmaar, & Lupker, 2000; Dijkstra, Walter, & van Heuven, 2002; Kroll & Stewart, 1994; van Heuven et al., 1998; van Heuven, Schriefers, Dijkstra, & Hagoort, 2008).

Although Chinese and Japanese belong to different linguistic families, both of them use *kanji* characters as logographic representations. Chinese and Japanese share a number of cognates. There are some studies that showed that the cognate status facilitates the word process in Chinese learners of Japanese (Cai, 2009; Kayamoto, 2002; Tamaoka, Miyaoka, & Matsushita, 2002).

Although words are mainly represented on three different representational levels (i.e., orthographic representation, phonological representation, and semantic representation), research has mainly focused on orthographic representations (e.g., de Groot et al., 2000; Dijkstra et al., 2002). With respect to the phonological representations, the bilingual research is scarcer.

Some studies on alphabetic bilinguals showed that the phonological representations of both languages were activated during the visual word recognition process (e.g., Duyck, 2005). Duyck (2005) conducted a study on Dutch-English bilinguals. The study showed that the visually presented second language (L2) words (English) were always automatically processed through grapheme-to-phoneme conversion (GPC) rules in the lexical access. However, the Japanese *kanji* readers cannot use GPC rules during word recognition process. The *kanji* character does not have separable phonemic components and cannot be decomposed phonemically in the way that an alphabetic word can be. Because of that, the role of phonological representation in the Japanese *kanji* word recognition process maybe different than that in alphabetic word recognition process.

Recently, the phonological activation of Japanese *kanji* words in the recognition process for bilinguals has become a topic of research. Komori (2009) conducted a phonological priming experiment employing a lexical decision task by the learners of Japanese who have phonographic first language (L1) backgrounds (namely, English). In the experiment, participants were shown a phonological prime and then a two-*kanji* compound word on a computer screen display. Participants were requested to promptly judge whether or not the two-*kanji* compound word was a real word existing in the Japanese language. The results showed that the English-speaking Japanese learners would retrieve phonological representation before accessing semantic representation during the Japanese *kanji* recognition process. The explanation for the results given by the researcher is that the learners with the English background depended on phonological information since their L1, English, is a phonographic language and the word recognition process of the L1 should affect that of the L2 as well.

The question arises here concerning whether the phonological representation of L2 is automatically activated during the word recognition process for both alphabetic bilinguals and non-alphabetic bilinguals. In order to investigate the issue, we used a priming paradigm similar to that used by Komori (2009) to investigate whether phonological mediation occurs in the lexical process for Chinese learners of Japanese. There is a possibility that when the Chinese learners of Japanese encounter a cognate, they can use only Chinese knowledge of the *kanji* word to process the word without activating the phonological representation of Japanese, so the RTs of non-cognate targets that are related to phonological primes were faster than the ones that are unrelated to phonological primes. Conversely, because the non-cognate words do not exist in Chinese, the Chinese learners of Japanese cannot use Chinese knowledge to process the word so that it is necessary to activate the phonological representation of Japanese to access the semantics, therefore no difference could be seen when the targets were non-cognates.

In addition, many studies showed that high-frequency words were responded more quickly than low-frequency words (e.g., McRae, Jared, & Seidenberg, 1990; Monsell, Doyle, & Haggard, 1989). However, there are few studies concerning the word frequency effect in word recognition process for Chinese learners of Japanese. Therefore, in our study, we also took words frequency into consideration to investigate the Japanese *kanji* recognition process for Chinese learners of Japanese. Because high frequency words have a higher resting-level activation than low frequency words, we assumed that there would be a difference in the RTs between high frequency words and low frequency words.

2. Method

2.1 Participants

A total of 25 (16 females and 9 males) graduate students studying in Japan participated in the experiment. All were native speakers of Chinese (Mandarin) who were studying Japanese as a second language. The present study intended to focus on the advanced learners, so we set two requirements to evaluate their proficiency. The first requirement was that they had passed the first level, which was the highest level, of the Japanese Language Proficiency Test (JLPT). The second requirement was that they should demonstrate over 80% accuracy rate in the Proficiency Level Test that was designed by Miyaoka, Tamaoka, and Sakai (2011).

2.2 Stimuli Materials

The stimuli consisted of 20 cognates (10 high-frequency words, 10 low-frequency words) and 20 non-cognates (10 high-frequency words, 10 low-frequency words), which were all two characters long. The stimuli were collected from the cognates and non-cognates employed by Hayakawa and Tamaoka (2012). The first type of prime was a phonologically related prime (e.g., しょう) that had the same phonological representation as the first *kanji* (e.g., 少) of the target word (e.g., 少女). The second type of primes was a phonologically unrelated prime (e.g., ちゃん) that has different phonological representation with the first *kanji* (e.g., 少) of the target word (e.g., 少女). In addition to the experimental word stimuli, 40 non-word stimuli were prepared. There were two types of non-word stimuli. The first one does not exist in either Chinese or Japanese, which was created randomly by pairing two *kanji* characters. The second type does not exist in Japanese but exists in Chinese. Therefore, a total of eight word groups were created by crossing three factors, namely lexical similarity (cognate vs. non-cognate), phonological prime (phonologically related vs. phonologically unrelated) and frequency (high vs. low).

2.3 Procedure

Participants were tested individually. The participant first had 10 practice trials and then 160 experimental trials. As shown in Figure 1, each trial began with the presentation of a fixation point "+" at the center of the screen for 800 milliseconds (msec) and then a blank screen for 200 msec. After that, a phonological prime written in *hiragana* was presented for 400 msec and then another blank screen for 200 msec. Then, the target word consisting of two *kanji* characters was presented. The participant was instructed to respond to the target word as quickly and accurately as possible by pressing either the "yes" key ("F" key on the keyboard) if they thought that the target word was existing in the Japanese language, or the "no" key ("J" key on the keyboard) if they did not think so. The computer recorded RTs and the response key ("yes" or "no").

The same *kanji* target word was presented twice, once with the phonologically related prime and once with the phonologically unrelated prime. The order of presentation within each block was randomized, with the two constraints that same target word should not appear consecutively and that no more than 20 "yes" or 20 "no" trials appeared consecutively. The 160 trials were grouped into four blocks. The order of each block was constant, with the consideration that the same target word would not appear consecutively. An interval rest was given between blocks to reduce the burden of participants in the test.

3. Results

The participants whose accuracy rate in the Japanese Proficiency Test was lower than 80% were

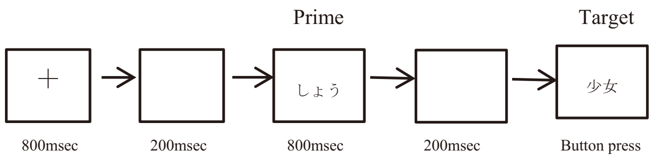


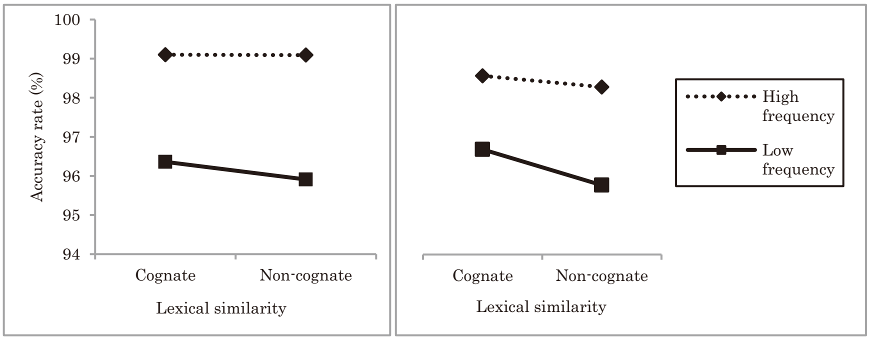
Figure 1. The procedure of the lexical decision task excluded from the analysis. After this adjustment had been made, the number of participants whose data were submitted to the analysis was 24. In the present study, we only used the data for real words (cognates and non-cognates). The RT data and accuracy rates were analyzed separately.

For each participant, mean RTs (for correct "yes" responses) and accuracy rates (for correct "yes" responses) were calculated for each of the lexical categories (cognates and non-cognates) by phonological primes (phonologically related and phonologically unrelated) and frequency conditions (high and low). The RTs of correct responses that were more than 2.5 standard deviations away from the condition mean were eliminated as outliers. The percentage of the outliers was 4.8%. The mean accuracy rates and RTs for real words are presented in Figure 2 and Figure 3.

The mean RTs and accuracy rates were submitted to three-way analyses of variance (ANOVA). The independent variables were lexical similarity (cognate or non-cognate), phonological prime (related or unrelated) and frequency (high or low).

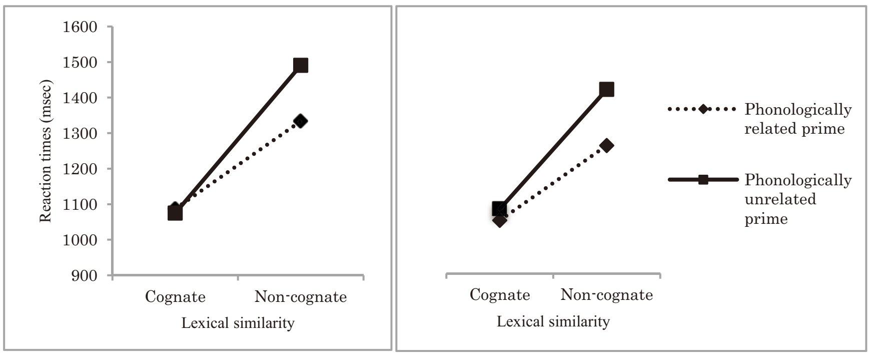
The ANOVA for accuracy rate showed that there was a significant main effect for frequency ($F(1, 23) = 15.83$, $p < .01$). The participants made more errors on the low frequency words than high frequency words. But there was no significant main effect of lexical similarity and phonological prime.

The ANOVA for RTs revealed that there was a significant main effect for lexical similarity ($F(1, 23) = 110.79$, $p < .001$). Correct RTs for cognate words were shorter than those for non-cognate words. The main effect of phonological prime was also



Phonologically related primes | Phonologically unrelated primes

Figure 2. Means of accuracy rate (%) for real words



High frequency | Low frequency

Figure 3. Means of reaction times (msec) for real words significant ($F(1, 23) = 28.96$, $p < .001$). Correct RTs for phonologically related primes were shorter than those for phonologically unrelated primes. However, there was no significant main effect for the frequency.

Most importantly, the ANOVA for the RT data yielded a significant interaction between the lexical similarity and phonological prime ($F(1, 23) = 17.99$, $p < .01$). A simple effects analysis indicated that the 171.91 msec of difference due to phonological primes in the non-cognate condition was significant ($F(1, 23) = 24.83$, $p < .001$). However, the effect of phonological prime was not significant in the cognate condition. The results showed that responses to non-cognates were significantly facilitated by the phonologically related prime while the facilitation effect of primes could not be seen when the target words were cognates.

4. Discussion

In the current study, we examined whether L2 *kanji* recognition is affected by whether a Japanese *kanji* word is shared with Chinese, and causes different word processing routes for Chinese learners. Learners with the Chinese L1 background were expected to use the *kanji* knowledge of L1 (Chinese) to access the meaning of L2 (Japanese) cognate words.

The results showed the correct RTs for cognate words were shorter than those for non-cognate words. What is more, the results indicated that in comparison with the unrelated prime, the related prime had no significant effect on cognate word recognition by the Chinese speakers. That is, the participants were not affected by the preceding phonological information.

The learners processed non-cognate words with the related phonological prime significantly faster than words with unrelated phonological prime. This result showed that the phonological representation activated by the phonological prime speeded up the recognition process of non-cognates.

These results suggest that the learners activate phonological representations to access corresponding meaning when encountering non-cognates. These results can be interpreted as being consistent with the phonological-mediation view. In our experiment, for example, when participants saw the phonological prime “さい”, the phonological information [sai] , which is same as the pronunciation of the first word “財” of the target word “財布”, would be activated and stored in the phonological loop. Thus, when the phonological information matches the phonology of the first character, this match facilitates the word recognition process. When the participants saw the phonological prime “きょく”, the phonological information [kyoku], which is not related to the phonological representation of the target word “財布”, would be activated and stored in the phonological loop. Thus, this phonological representation unrelated to the target word could not cause the facilitation.

In our experiment, we did not see a facilitation effect of frequency in RTs as we expected, while we observed a facilitation effect of frequency in accuracy rates. It seems that there are four plausible reasons for not observing an automatic effect of frequency. One is that the L2 data may be too noisy, and the limited number of items did not allow for sufficient statistical power to see a significant effect. The second reason is that the results can be explained by the phenomenon of speed-accuracy trade-off. The speed-accuracy trade-off (SAT) refers to the phenomenon where decision makers may produce faster responses but make more errors (e.g., Pachella, 1974). In the lexical decision task, the participants were asked to respond to the presentation of the target word as quickly and accurately as possible. Although the task had both speed and accuracy requirements, the participants might favor speed over accuracy. They might try to respond as fast as they can while sacrificing accuracy. The third reason is that the way to estimate frequency in our study is not appropriate. Although in many studies concerning the word recognition process for

Chinese learners of Japanese, the NTT word frequency database which contains objective count data of word frequency and character frequency in the Asahi Newspaper over 14 years (from 1985 to 1998), was utilized to control for the frequency of words in an experiment. However, these word frequencies taken from the NTT database reflect frequencies from Japanese-native speakers or balanced bilinguals living in Japan. The subjects in our study, however, have less exposure to the target language than native speakers, thus the estimates of word frequency drawn from NTT database most likely do not reflect the word familiarity of non-native speakers. The fourth reason is that the participants may not have been responding in a sufficiently automatic way for some target words. If the participants were uncertain about their judgments, then they may have been relying on a more conscious level of consideration, which would not necessarily be affected by underlying lexical frequency. In particular, the lower accuracy performance on the low frequency words may reflect participants being less likely to know these words. Thus, the frequency effect in the accuracy results may be unrelated to any frequency effects typically found in lexical retrieval.

5. Conclusion

From the results of our study, it seems legitimate to conclude that advanced Chinese learners of Japanese studying in Japan do not activate Japanese phonological representations for cognates in the word recognition process whereas they do activate Japanese phonological representations for non-cognates. However, in our experiment, we did not see a facilitation effect of frequency in RTs while a facilitation effect of frequency in accuracy rates was observed. One possibility for the lack of the frequency effect in RT may be that the effect of frequency in the accuracy data was just a reflection of participants' degree of knowledge of each of the target words in the experiment. If the participants being likely to unknown some words in the experiment, the results of the phonological priming effect might not be due to automatic phonological activation typically found in the L1/L2 lexical retrieval, which is the intended target of the study. Therefore, in a future study, it is necessary to confirm whether the participants know all the materials after the experiment, and to vary systematically intervals between the prime onset and the target onset to explore the automatic phonological activation during L2 word recognition process.

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