Two experiments examined the role of phonological overlap and form similarity on cognate status effects in Chinese-Japanese bilinguals. Experiment 1 investigated cross-script priming in word-fragment completion by subjects who were either Chinese-Japanese bilingual (22 Chinese students studying in Japan) or Japanese monolingual (56 students). The subjects studied Chinese words and then completed test fragments written in Japanese Hiragana. The transcriptions of the test fragments into Kanji characters were manipulated: identical-cognate, visually similar-cognate, or non-cognate. The results indicated that the completion rate of primed fragments increased for the identical-cognates only. A Chinese lexical decision task was carried out by bilingual subjects (18 Chinese students) in Experiment 2. The decision that items were Chinese was made faster for identical-cognates than it was for visually similar-cognates and non-cognates. The results indicate that phonological overlap is not indispensable for cognate status effect and they are consistent with the non-selective access view of bilinguals.

Key words: lexical processing, Chinese-Japanese bilingual, cognate status, word-fragment completion

One of the main questions concerning bilingual research is how lexical entries are stored in bilinguals’ mental lexicons and how they are accessed when reading. Much research has suggested that bilinguals’ two languages are represented as separate, language-specific lexicons at the lexical level (e.g., Kroll, 1993). At the same time, it has been suggested that the word memories of individual bilinguals need not contain just one type of representation structure, but a mixed structure; some types of words are represented in a different way from other words.

One factor that indicates the presence of a mixed structure is the cognate status effect. Most of the previous bilingual studies have been carried out on languages with roman scripts, such as English or Spanish, and cognates are defined as translation-equivalents that share spelling, sound, and semantic properties across languages. In cross-language repetition priming studies, a significant facilitation was produced by cognate primes, but non-cognate primes produced smaller effects (e.g., Sanchez-Casas, Davis, & Garcia-Albea, 1992). It is suggested that there is a different lexical structure depending upon the cognate status of the lexical entries; that is, cognate translations share common representations in memory whereas non-cognates do not.

The present study is concerned with the nature of the lexical systems of Chinese-
Japanese bilinguals, which have so far not been examined, using Chinese-Japanese cognates. The cognate status effect can be examined in relation to the extent of form similarity and the necessity of phonological overlap. In most cases in Chinese and Japanese, the pronunciation of the shared characters is different and only a few have similar pronunciations. Thus, the necessity of phonological overlap in the cognate status effect can be examined by using Chinese and Japanese\(^1\). In addition, the effects of cognate status and the similarity of form of characters in Chinese and Japanese were focused on. More than 50% of the items in Chinese-Japanese dictionaries are identical-cognates (Araya, 1983), but over a long period the forms of the Chinese characters and the Japanese Kanji characters have changed. The identical-cognates counted by Araya (1983) included words that shared the same form when Chinese was written in the old-style characters. Because the modern Chinese language uses simplified characters, the cognate characters have different, but similar, forms.

In the previous studies using roman scripts, the cognates have shared some letters (e.g., rico-RICH; in Sanchez-Casas et al., 1992) or have had the same stems and different suffixes (e.g., observacion-observation; in Cristoffanini, Kirsner, & Milech, 1986). In other words, the form similarity was defined by the extent of overlap of letters. In contrast to this, in this study, a different type of form similarity, i.e., the similarity of the characters alone, can be manipulated between Chinese and Japanese instead of an overlap of letters.

Two tasks were employed to examine lexical processing by bilinguals. In Experiment 1, the cognate status effect was examined in cross-script repetition priming using the word-fragment completion task (WFC task), which has been used as a data-driven, implicit memory task (i.e., Roediger, 1990), in order to examine lexical processing without the contamination of episodic processing. Moreover, because study- and test-items were completely different scripts (i.e., Chinese characters and Japanese Hiragana characters), the lexical activation could be examined without perceptual repetition.

The subjects studied Chinese words (study-items), and then completed Japanese word fragments written in Hiragana (test-items). The test-items were translations of the study-items. The transcriptions of the Hiragana test-items into Kanji were: (a) identical cognates which had the same forms as the Chinese words which were studied; (b) cognates which were visually similar to those studied; or (c) non-cognates which consisted of different characters to those which were studied. A Hiragana word corresponding to a Kanji word is unique because the Hiragana characters each have a single pronunciation and the Hiragana words represent the pronunciations of the Kanji words.

In this experiment, the subjects read Chinese words and studied them implicitly. If the connections between the translation equivalents are strong, Japanese Kanji words corresponding to study-items (translation equivalents) are activated, and then the activation of Kanji yields responses in Hiragana in WFC tasks. Because study-items (Chinese) and test-items (Japanese Hiragana) were totally different script, the extent of the

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\(^1\) In this study, the words that share the same form in Chinese and Japanese are called “cognates”, regardless of their phonological overlap.
activation of translation equivalents could be examined without perceptual overlap between study- and test-items. The following two propositions were examined: (1) If phonological overlap is necessary for the cognate status effect, the effect is not found in Chinese-Japanese bilinguals. However, if phonological overlap is not necessary, it is expected that cognates yield the repetition priming effect. (2) If identical cognates and visually similar cognates are stored in the same manner, the same extent of repetition priming effect is expected.

EXPERIMENT 1

Methods

Subjects: The subjects were separated into either of two groups (two experimental conditions) according to their language background: bilingual or monolingual. The bilingual subjects were 22 Chinese students (10 males and 12 females) who studied at Osaka City University and participated in the experiment as paid volunteers. All of them were native Mandarin speakers and late beginning Chinese-Japanese bilinguals. They had an average of 3.4 years of training in Japanese. They had learned English as L2 during primary education in China and then learned Japanese as L3. When they participated in the experiment, all of them were studying at the university with total immersion in Japanese. They stated that their Japanese language ability was better than their English.

The monolingual subjects were 56 students (16 males and 40 females) of Osaka University who had not learned Chinese. The experiment was carried out as part of an introductory course in psychology.

Materials and design: All of the study-items were Chinese words, each consisting of two simplified Chinese characters. The test-items ranged in length from four to six Hiragana characters and one of the characters was represented by a space. Each test-item was chosen so that the missing character could be replaced with at least one other character that would still create a word.

There were three types of cognate status associated with the study-items and the transcription of the test-items into Kanji. The transcriptions were: (a) the same forms as the study-items (identical-cognate); (b) items consisting of visually similar characters to those which were studied (similar-cognate); or (c) items consisting of characters different to those studied (non-cognate). In the similar-cognates, the two characters were different but visually similar, or one character was similar and one was the same. In the non-cognates, the two characters were different. The familiarity of three types of test-items for monolinguals is almost the same in the Japanese database (Amano & Kondo, 1999): identical cognates; 6.12, similar-cognates; 5.97, non-cognates; 6.06. Examples of the stimuli are shown in Table 1.

A total of 60 pairs of Chinese and Japanese translations were prepared and there were 20 items in each of the stimulus types mentioned above. In the bilingual condition, to counterbalance the items across subjects, the list of 20 items for each type was partitioned into two sub-lists of 10 items each. One of the sub-lists provided the Chinese words used as the study-items in the study task. The other sub-list was used as a no-study condition (baseline). Consequently the study list for each subject included 30 of the 60 Chinese words. The WFC task contained a total of 60 word fragments. The monolingual condition and the bilingual condition had the same materials and design, except that the items were not counterbalanced in the monolingual condition because all the subjects were tested at the same time and in a group.

Procedure: In the bilingual condition the Chinese subjects were tested individually. They were told that they were participating in research about the Chinese and Japanese languages. They were asked to read aloud a series of Chinese words and to judge the familiarity of each word on a five-point scale. Each item was presented for about 3 sec. The items presented during the study task included 30 of the 60 study-items and the words were presented in a different order for each subject.

After the study task all the subjects performed filler tasks, which were similar to those in the experiment of Basden, Bonilla-Meeks and Basden (1994), for about 10 minutes. They rated their preference for the two-Kanji Japanese words that were listed, completed a list of Chinese word fragments, and completed a list of famous Japanese names written in Hiragana. Finally, they were asked to complete
fragments of the test-items. The test list consisted of 60 items written in Hiragana. The subjects were asked to complete each fragment to form the first meaningful word that came to their mind by filling the space with a Hiragana character. The test-items were individually presented on a computer screen and the subjects wrote down a Hiragana character that could be inserted into the space.

In the monolingual condition all of the stimuli were presented on a screen at the front of a classroom with a projector. In the study task, 30 items of the 60 study-items were presented, including 10 identical-cognates, 10 similar-cognates, and 10 non-cognates. The subjects silently read a series of words and were required to judge the familiarity of each word on a five-point scale. Each item was presented for about 3 sec.

After the same filler tasks that were used in the bilingual condition were completed, the subjects were asked to fill 60 test fragments which were written in Hiragana in printed booklets at their own pace. Five items were printed on a page and the order of the test-items was counterbalanced across subjects.

The WFC task has been criticized on the basis that it is similar to problem solving and it relies on processes that are not typically involved in normal reading (Rueckl, Mikolinski, Raveh, & Miner, 1997). To prevent subjects using a strategy similar to that used in problem solving, the subjects were allowed to complete the task at their own pace and instructed that if they could not think of a character they could pass it by using a check mark.

Results

Three pairs of stimuli were excluded from the analyses because one pair of words in the identical-cognates shared a slightly different form and the other two pairs could produce the same test fragments.

The percentage of word-fragment completion is shown in Table 2. The data were examined by using a 2 (study condition) × 3 (stimulus type) × 2 (subject group) Analysis of Variance (ANOVA). This analysis revealed that the main effects of study condition
and stimulus type were significant: $F(2,152)=3.94, p<.05$; $F(1,76)=17.18, p<.001$, respectively. The interaction between stimulus type and study condition was also significant: $F(1,76)=3.58, p<.05$.

In both subject groups more words were completed in the studied items than in the unstudied items. This means that cross-script priming effects were discovered. Separate one-way ANOVAs were carried out for stimulus type and showed that only identical-cognates yielded a significant priming effect: $F(1,77)=20.48, p<.001$. The difference between studied and unstudied items in similar-cognates was not statistically significant. The other interactions were not significant.

**Discussion**

The reason for employing a cross-script WFC task in this experiment was to prevent episodic memory trace. From the reports by subjects after the experiment, it was found that none of them realized the aim of the experiment. That is, they did not expect that they would take the memory test and consequently none of them tried to memorize the study-items. Moreover, there was no perceptual overlap between study- and test-items. Thus, the repetition priming effect obtained here was lexically based.

The effect of stimulus type on repetition priming was found in both subject groups, possibly in different mechanism. In the bilingual subject group, the effect of stimulus type suggests that the manner of connection of the translation equivalents differed, depending upon the cognate status. If the study-items directly activated the Hiragana translations (test-items), then cognate status effects would not occur, because study- and test-items were completely different scripts and there was neither form nor phonological overlap. But cognate status effects would be caused by the different degrees of activation of the Kanji translations. It could be considered that, in the case of cognates, the study-items activated the Kanji translations and then the corresponding Hiragana words were activated. The large priming effect of the identical-cognates indicates that the identical-cognates could be stored in a single lexicon, or could be closely connected.

As stated earlier, two propositions were formulated about the role of phonological overlap and visual similarity on the cognate status effect. Chinese-Japanese cognates do not necessarily share the same phonology. However, even in this case, identical cognates produced a large cognate status effect. The result indicates that the overlap of phonological information is not indispensable for cognate status effect, but the form overlap is essential for cognate status effect.

Although it is plausible that non-cognates are stored separately, the status of similar-cognates is not clear. An inspection of Table 2 indicates that for similar-cognates the percentage of word fragments completed by bilingual subjects increased for studied items, but the difference was not statistically significant. One possible reason was the large individual differences in the rate of completion.

The monolingual subjects were told that Chinese stimuli were included in the study-items, and only identical-cognates yielded the cross-script (i.e., Kanji-Hiragana) repetition priming effect. It is speculated that the monolingual subjects processed identical cognates as Japanese and processed similar-cognates and non-cognates as Chinese, because they
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did not have knowledge of Chinese. The monolingual subjects were tested in a group and the study task was to read stimuli silently, whereas the bilingual subjects had to read aloud the study-items. The effects of these differences in procedure need to be examined further.

In Experiment 1, identical-cognates showed large priming effects and the cognate status effect was obtained with the WFC task. The importance of form overlap was also indicated regardless of the extent of phonological overlap. Although the WFC task has been considered to be a data-driven, implicit memory task, the possibility that the priming effect obtained here was caused by the concept-mediated route could not be excluded completely. In addition, the measure of lexical activation concerning cognate status was indirect; that is, test-items were Hiragana transcriptions of Kanji translation equivalents of study-items. In order to examine the robustness of the cognate status effect at a lexical level, a lexical decision task for single items was employed in Experiment 2. The subjects were asked to decide whether the presented items were, or were not, Chinese words. If the cognate status effect is caused in the lexical level mechanism, the effect should be obtained without priming.

**EXPERIMENT 2**

**Methods**

**Subjects:** A total of 18 Chinese students (7 males and 11 females) at Osaka City University participated in the experiment as paid volunteer subjects. All were native Mandarin speakers with an average of 4.1 years of Japanese language training and were late beginning Chinese-Japanese bilinguals.

**Materials and design:** A total of 120 stimulus words, each consisting of two characters, were used. One half of the stimuli were Chinese words (yes-trial) and the remainder were not (no-trial). The set of 60 Chinese words (yes-trial) contained 20 items each in three different stimulus types: (a) the same forms as the Japanese translations (identical-cognate); (b) items consisting of visually similar characters to Japanese translations (similar-cognate); or (c) items consisting of characters different to Japanese translations (non-cognate). The set of 60 non-Chinese words (no-trial) also contained three different stimulus types: 20 similar-cognates; 20 non-cognates; and 20 control words. Similar-cognates and non-cognates were Japanese words. The control stimuli were written in Chinese simplified characters and were not Chinese or Japanese words. Some examples of the stimuli are shown in Table 3.

**Procedure:** All of the subjects were individually tested and each stimulus was shown on a CRT display under computer control (Iwatsu Isec, AV Tachistoscope IS-701D). A single stimulus consisted of two characters, which subtended a horizontal visual angle of approximately 2.0° and a vertical visual angle of approximately 1.0° at a normal viewing distance of 60 cm. After the instructions and practice trials were completed, 120 experimental trials were conducted. Each trial began with a plus mark (+) at the center of the screen as a fixation point and was immediately followed by the test-items. The subjects were asked to decide whether the presented item was, or was not, a Chinese word. The instruction was to respond as accurately and as quickly as possible by pressing either a “yes” button with the right hand or a “no” button with the left hand. After the subjects' responses there was an interval of 1 sec and then the next trial began.

**Results**

The mean lexical decision times and the percentage of errors are given in Table 4. Separate one-way ANOVAs for stimulus type were performed on the data for Chinese words (yes-trials) and non-Chinese words (no-trials).

**Lexical decision times:** Data analysis revealed that the stimulus type was a significant
NAKAYAMA

Table 3. Examples of Stimuli in Experiment 2

<table>
<thead>
<tr>
<th></th>
<th>identical-cognate</th>
<th>similar-cognate</th>
<th>non-cognate</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>宇宙</td>
<td>创作</td>
<td>公司</td>
</tr>
<tr>
<td>similar-cognate</td>
<td>non-cognate</td>
<td>control</td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>性質</td>
<td>放送</td>
<td>環状</td>
</tr>
</tbody>
</table>

Table 4. Mean Correct Lexical Decision Times (Milliseconds), Standard Deviations and Errors (Percentages) According to the Stimulus Type in Experiment 2

<table>
<thead>
<tr>
<th></th>
<th>identical-cognate</th>
<th>similar-cognate</th>
<th>non-cognate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes RT</td>
<td>707</td>
<td>766</td>
<td>784</td>
</tr>
<tr>
<td>SD</td>
<td>234</td>
<td>264</td>
<td>224</td>
</tr>
<tr>
<td>Error</td>
<td>4.5</td>
<td>1.4</td>
<td>6.5</td>
</tr>
<tr>
<td>No RT</td>
<td>922</td>
<td>993</td>
<td>872</td>
</tr>
<tr>
<td>SD</td>
<td>233</td>
<td>288</td>
<td>299</td>
</tr>
<tr>
<td>Error</td>
<td>37.3</td>
<td>29.9</td>
<td>8.3</td>
</tr>
</tbody>
</table>

RT=Mean correct lexical decision times  
SD=standard deviations  
Error=error rates

main effect for Chinese word targets (yes-trials): $F(2, 34)=10.59, p<.001$. In addition, Newman-Keuls tests ($p<.05$) indicated that stimuli that were identical-cognates were categorized as Chinese words faster than similar-cognates and non-cognates. As shown in Table 4, no-responses were faster for control stimuli than they were for non-cognates, but the difference was not statistically significant.

Error rates: For Chinese word targets (yes-trials), there was a significant main effect of stimulus type: $F(2, 34)=8.09, p<.005$. Also, Newman-Keuls tests ($p<.05$) indicated that the error rates for similar-cognates were lower than for the other two types of stimuli. The error rates for non-Chinese words (no-trials) were higher than those for Chinese words and for non-Chinese words there was also a significant main effect of stimulus type: $F(2, 34)=15.5, p<.001$. The error rates for control stimuli were indicated by Newman-Keuls tests ($p<.05$) as lower than for the other two types of stimuli.

Discussion

In the same manner as Experiment 1, an effect of cognate status was observed; identical-cognates were accepted faster than non-cognates or similar-cognates as Chinese.
This indicates that cognate status effects are not caused by semantic or conceptual-mediation, but are lexically based. As previous research has indicated, identical-cognates are privileged in terms of lexical structure or processing.

The effect of visual similarity was not found in Experiment 2 either; identical-cognates were determined to be Chinese significantly faster than similar-cognates. A possible reason why the effect of visual similarity was not obtained is that the cognates caused the subjects to become confused. In yes-trials, the difference in lexical decision time between similar-cognates and non-cognates was not statistically significant. On the other hand, similar-cognates yielded significantly lower error rates than the other types. These results may have been indicative of a “speed-accuracy trade-off” and the subjects might have deliberately made a yes-response for similar-cognates. In no-trials, similar-cognates and non-cognates that were Japanese words produced more errors than the control stimuli that were not Chinese or Japanese words. It may have been difficult for the subjects to categorize Chinese similar-cognates (Chinese words) and Japanese similar-cognates (non-Chinese words) by utilizing any information about the form of the characters, and consequently Japanese similar-cognates were likely to be accepted, in error, as Chinese.

Because the subjects were requested to make a Chinese lexical decision, the decision could be made without processing the Japanese words. However, the lexical decision times were affected by the lexical relationship between Chinese and Japanese; cognates or not. Obviously, the Japanese lexicon was accessed automatically in making a Chinese lexical decision and the present results support the non-selective access view (see Smith (1997) for more discussion).

**General Discussion**

This study was designed to examine the role of form similarity and phonological overlap on cognate status effects in lexical access by Chinese-Japanese bilinguals. In Experiment 1, Chinese and Japanese identical cognates yielded cross-script priming effects with a WFC task. The study-items (Chinese characters) and test-items (Japanese Hiragana characters) were totally different scripts and did not have a perceptual overlap. The priming effect was therefore caused by a close connection between the Chinese and Japanese cognates and not by perceptual repetition. However, the possibility that conceptual processing was involved could not be entirely ruled out.

To examine the robustness of the cognate status effect at a lexical level, a lexical decision task for single items was used in Experiment 2. The task in Experiment 2 did not involve semantic or conceptual processing and again a cognate status effect was observed. The result also indicated that lexical access by bilinguals is carried out non-selectively. With respect to the identical-cognates, the results are consistent with other studies that have proposed a privileged processing or storage of cognates. It is assumed that identical-cognates are stored in a shared lexicon of Chinese and Japanese, or are closely linked if they are stored separately.
It is interesting that in this study there are indications that the cognate status effect is caused at least by an overlap of form information, regardless of the extent of phonological overlap. The present study examined limited conditions, that is, priming from L1 to L2 (Experiment 1) and Chinese lexical decision making (Experiment 2) by Chinese-dominant bilinguals. More studies are needed to examine the necessity of phonological overlap for cross-language repetition priming.

One purpose of this study was to examine the effect of visual similarity on lexical processing by using visually similar-cognates, but the characteristics of this effect remain unclear. From the “speed-accuracy trade-off” in similar-cognates in Experiment 2, some subjects were considered to have become confused when attempting to distinguish visually similar Chinese and Japanese. Because the subjects were asked to decide whether the stimuli were, or were not, Chinese words it was not necessary to access a Japanese lexicon. It is possible, however, that the confusion or response conflict occurred because lexical access was carried out non-selectively and both the Chinese and the Japanese lexical representations were activated automatically.

In summary, the results indicate a sharing, or close connection, of the representations of Chinese and Japanese identical-cognates in lexical memory. In addition, the results are consistent with the non-selective manner of lexical accessing by bilinguals. However, the characteristics of processing of visually similar-cognates remain unclear. Further studies are required on visually similar cognates and to define the structure of the lexicons of Chinese-Japanese bilinguals.

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