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Language-Non-Selective Lexical Activation without Its Use for Sentential Interpretation: An Event-Related Potential (ERP) Study on the Processing of L1 Chinese and L2 Japanese Sentences

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Abstract

An event-related potential (ERP) experiment was conducted to examine how native Chinese speakers with highly advanced Japanese language skills would process a sentence of a targeted language with no activation of an embedded word of an untargeted language. For the second language (L2) of Japanese in Experiment 1, three incorrect conditions were prepared for sentence correctness decisions: a Japanese sentence, including 1) a Chinese word (not existent in Japanese) semantically matched for the context, 2) a Chinese word (not existent in Japanese) semantically mismatched for the context, and 3) a nonword. For the first language (L1) of Chinese, sentences and target words were reversed (i.e., Chinese/Japanese respectively) for Experiment 2. The P200 peak appeared only for semantically mismatched L1 Chinese words embedded in L2 Japanese sentences compared to sentences containing a nonword. This P200 peak does not appear in the processing of L1 Chinese sentences compared to sentences containing a nonword. This result suggests extra attention to orthography is required at the early stage of processing. This reduces the activation of irrelevant information from the non-targeted language, in this case L1 Chinese. The N400 component was elicited in processing both L2 Japanese and L1 Chinese sentences with nonwords against L2 and L1 sentences with semantically matched and mismatched words of an untargeted language. These findings suggest that, regardless of whether there is a sentential semantic match in a targeted language, Chinese and Japanese bilinguals activate lexical concepts non-language-selectively.

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Although the nontargeted lexical concepts are non-selectively activated, they do not seem to be used for sentential interpretation for L2 Japanese and L1 Chinese.

Keywords

Language-Non-Selective, Language-Selective, Chinese-and-Japanese Bilinguals, ERP, N400, P200

1. Introduction

Two conflicting processing models have been presented for bilingual lexical access, a language-selective lexical access model and language-non-selective model. Language-selective access models (e.g., Gerard & Scarborough, 1989; Rodriguez-Fornells, Rotte, Heinze, Nösselt, & Münte, 2002) suggest that bilinguals can process the meaning of words in a targeted language with no activation from a non-targeted language. In contrast, language-non-selective access models (e.g., Colomé, 2001; Costa, Caramazza, & Sebastián-Gallés, 2000; de Groot, Delmaar, & Lupker, 2000; Dijkstra & van Heuven, 2002; Green, 1998; Hermans, Bongaerts, De Bot, & Schreuder, 1998; Kroll & Curley, 1988; van Heuven, Dijkstra, & Grainger, 1998; van Heuven, Schriefers, Dijkstra, & Hagoort, 2008) assume that lexical items with same semantics are tied to a single concept in the lexicon, and that these concepts can be activated by either language. A majority of studies contrasting these two processing models have been conducted in alphabetic languages.

Chinese and Japanese scripts share very similar morphemic units, known as *hanzi* characters in Chinese, or *kanji* characters in Japanese. Comparing Chinese and Japanese, only 36 of the 1945 basic kanji do not have an orthography correlate in the 3500 modern most commonly-used Chinese characters. In other words, 1909 kanji (98.2%) are included in the core set of Chinese characters (Hishinuma, 1989). Chen (2002) counted 4600 Japanese kanji-compound words, and noted that 54.5% of those compounds can be written with same orthographic shape to denote the same meaning in Chinese. Furthermore, among the basic 2060 two-kanji compound words used in levels 4 to 2 of the Japanese proficiency test (Japan Foundation and Association of International Education, Japan, 2004), 1509 words (73.25%) are orthographically and conceptually similar across Chinese and Japanese (Park, Xiong, & Tamaoka, 2014; Xiong & Tamaoka, 2014). A database of kanji compounds is available at http://kanjigodb.herokuapp.com; Yu and Tamaoka (2015) provide an explanation of how to use this website and search engine.

These Chinese characters and Japanese kanji share conceptually dense elements, so that the processing of compound words is likely to be highly dependent upon the conceptual lexicon attached to both Chinese and Japanese morphemic representations. Because of these orthographic similarities, Chinese and Japanese can be used to help differentiate between language-selective and language-non-selective models of processing. The present study further asked whether these concepts were used for sentential interpretation of the targeted language. In order to investigate language-selective or language-non-selective activation of lexical concepts, and their use for sentential interpretation of non-targeted language, the present study investigated whether or not Chinese-and-Japanese bilinguals activate a word of an untargeted language embedded in a sentence of the targeted language, and furthermore, whether a untargeted word would be activated for sentential interpretation of targeted language.

2. Assumptions of Non-Language-Selective and Language-Selective Access in N400

The present study focuses on conceptual activations of both Japanese and Chinese words in the sentential context. The negative 400 (N400) component in an ERP is a major concern. N400 is recognized as a reliable index of semantic context integration (e.g., Brown & Hagoort, 1993; Friederici & Kotz, 2003; Hahne & Friederici, 2002; Hagoort, 2003; Kutas & Federmeier, 2000; Kutas & Hillyard, 1980), which appears when a word in a sentence does not make sense, as in "He drank tea with sugar and socks." The N400 is not observed when a sentence makes sense, as in "He drank tea with sugar and milk." (Kutas & Hillyard, 1980). According to the language-selective lexical access model, bilinguals process a word from another untargeted language embedded in a sentence of the targeted language should be understood as a nonword. In such a case, the application of

N400 should be observed. In contrary, if bilinguals use language-non-selective lexical access model, the untargeted, but semantically-matched word in the sentence of the target language should be understood as a real word, at least during the very early stage of sentence processing. This may elicit an N400. The semantically-matched lexical activation of untargeted language will stop eliciting N400 for sentence processing of the target language.

The present study contrasts three conditions exemplified as follows:

(1) A Chinese word (CH, not exist in Japanese) semantically-matched in a Japanese sentence

友達からのプレゼントは手表でした.

Tomodatyi-kara-no purezento-wa shoubiao (CH) desita.

The present from my friend was a watch (CH).

NP (my friend-from)-GEN NP (present)-TOP NP (watch, CH) V(be)-PAST.

(2) A Chinese word (CH, not exist in Japanese) semantically-mismatched in a Japanese sentence

友達からのプレゼントは公里でした.

Tomodatyi-kara-no purezento-wa *gongli* (CH) desita.

The present from my friend was a kilometer (CH).

NP (my friend-from)-GENNP (present)-TOP NP (kilometer CH) V(be)-PAST.

(3) A nonword (NW) in a Japanese sentence expecting the amplitude of N400

友達からのプレゼントは戸治でした。

Tomodatyi-kara-no purezento-wa huzhi (NW) desita.

The present from my friend was hushi (NW).

NP (my friend-from)-GENNP(present)-TOP NP (huzhi, NW) V(be)-PAST.

Instead of the proper Japanese two-kanji compound word for *tokei* "a watch" written as 時計 a Japanese, a Chinese equivalent word, *shoubiao* written 手表 (a watch), is inserted into sentence (1). Thus, the condition involves a Japanese sentence containing a semantically-matched Chinese word. Chinese-and-Japanese bilinguals should reject this sentence as incorrect because the Chinese word for a watch does not exist in Japanese. However, if they activate the Chinese word for "a watch" during the processing of Japanese sentence, this sentence must be understood as a correct sentence at the early stage, according to the language-non-selective lexical activation model. Then, the N400 component should not be elicited. Bilinguals will be able to recognize that this embedded word "watch" is Chinese at the later stage of sentential interpretation. Sentence (3) was created by inserting a nonword *huzhi* instead of *tokei* (a watch) in Japanese. This condition is the baseline, which we expectwill to produce the N400 component. Furthermore, sentence (2) was created by inserting a real Chinese word, 公理 meaning "a kilometer", into the same sentence. Here, not only it does not exist in Japanese, but it is not matched with the semantics of the targeted Japanese sentence.

Based on these three sentence conditions, the following assumptions are made regarding bilingual lexical access and sentential interpretation under the two different models of language-selective and non-language-selective lexical activation. If Chinese-and-Japanese bilinguals can select only the targeted language (i.e., language-selective activation), the Chinese word for "a watch" as in sentence (1) would not be activated when processing the Japanese sentence. Likewise, the Chinese word *gongli* (a kilometer) in sentence (2) would be understood as containing a nonword. This results in the appearance of the N400 component as with the baseline sentence (3). In other words, if the N400 is observed under all the three conditions, (1) to (3), the language-selective model of the bilingual lexicon is supported.

On the contrary, Chinese-and-Japanese bilinguals could activate the Chinese word *shoubiao* (a watch) and appropriately integrate its meaning into the context of the Japanese sentence, understanding (1) as "the present from my friend was a watch.", even though they are required to process the sentence in Japanese. In such a case, the amplitude of N400 will not appear in sentence (1). In other words, the baseline sentence (3) will elicit N400, but the condition in (1) will not. This contrasting result between sentences like (1) and (3) would supports a language-non-selective activation model. Yet, if sentence (2) does not elicit an N400, it could be interpreted that both Chinese words in sentences (1) and (2) would be language-non-selectively activated, but that these activated Chinese words would not be used for interpreting the sentential meaning of targeted sentence in Japanese. These assumptions were tested in Experiment 2 using an untargeted Chinese word in a targeted Japanese sentence as exemplified in sentences (1) to (3). Furthermore, the result of Experiment I would be confirmed by reversing the conditions for Experiment 2, using an untargeted Japanese word embedded in a targeted Chinese sentence.

3. Experiment 1—Processing Second Language (L2) Japanese Sentence

3.1. Method

3.1.1. Participants

Ten Chinese students at the graduate level in Hiroshima University, Japan who are fluent in spoken and written Japanese (L1 Chinese and L2 Japanese bilinguals) participated in the experiments (6 females and 4 males). They were so fluent in Japanese that some of them might not be recognized as a L2 Japanese speaker by native Japanese speakers. Ages ranged from 24 years and 5 months to 29 years and 10 months, with the average age being 26 years 6 months, and a standard deviation of 1 year and 9 months on the day of the experiments.

3.1.2. Materials of Experiment 1 (L2 Japanese)

For the L2 Japanese speakers, as described in the previous section, the three incorrect conditions were created by placing a Chinese word in a Japanese sentence. These inserted Chinese words do not exist in Japanese, so they should be judged as incorrect words when the Japanese sentence is being processed. The three types of incorrect sentences (1)-(3) were experimental conditions, used for an analysis of ERPs. As shown in **Table 1**, a Chinese word 手表 meaning "a watch" is inserted in the Japanese sentence such as 友達からのプレゼントは手表でした. (The present from my friend was a watch.), where the order in which the three blocks were presented was

Table 1. A set of Japanese sentences used for the experiment.

Three presentation blocks of sentences		
1st block	2nd block	Target block
1. Correct "No" responses (incorrect sentences)		
(1) Semantically matched Chinese words which do not exist in Japanese		
友達からの	プレゼントは	*手表*でした.
tomodati-kara-no	purezento-wa	*Shoubiao* (CH) desita.
my friend-from-GEN	present-TOP	*watch* (CH) be-PAST.
(2) Semantically mismatched Chinese words which do not exist in Japanese		
友達からの	プレゼントは	*公里*でした.
tomodati-kara-no	purezento-wa	*gongli* (CH) desita.
my friend-from-GEN	present-TOP	kilo (CH) be-PAST
(3) Nonwords which do not exist either in Japanese or in Chinese		
友達からの	プレゼントは	*戸治*でした.
tomodati-kara-no	purezento-wa	*huzhi* (NW) desita.
my friend-from-GEN	present-TOP	huzhi (NW) be-PAST.
2. Correct "Yes" responses (correct sentences)		
友達からの	プレゼントは	*万年筆*でした.
tomodati-kara-no	purezento-wa	*man'nenhitu* desita.
my friend-from-GEN	present-TOP	*pen* be-PAST.
友達からの	プレゼントは	*時計*でした.
tomodati-kara-no	purezento-wa	*tokei* desita.
my friend-from-GEN	present-TOP	*watch* be-PAST.
友達からの	プレゼントは	*かばん*でした.
tomodati-kara-no	purezento-wa	*kaban* desita.
my friend-from-GEN	present-TOP	*bag* be-PAST.

Note: CH = Chinese words. NW = nonwords. TOP = topics. GEN = generative. CNs and NWs are described in pinyin.

"from my friend", "the present" and the target block "was a watch". In the head-final language of Japanese (the verb comes at the end of sentence), the target block including a Chinese word is always presented with a simple (or a light) verb. The Chinese word "a watch" fits semantically within the Japanese sentence context. However, this word does not exist in Japanese. Thus, this sentence must be rejected as an incorrect Japanese sentence.

The second condition used a similar context 友達からのプレゼントは公里でした. (The present from my friend was a kilometer.). Here, the targeted word does not only exist in Japanese (it is a Chinese word), it does not make semantic sense when used in this sentence (one cannot five "a kilometer"). Bilinguals could reject this sentence either because of the incongruence in semantic context or the target item's none existence in Japanese. The third condition includes a nonword in a sentence such as 友達からのプレゼントは戸治でした. (The present from my friend was *huzhi*). Fifty Japanese sentences with Chinese words were created for each condition of Experiment 1, resulting in 150 sentences. All sentences containing a Chinese word (or nonword) were considered to be incorrect. In addition, as shown in **Table 1**, an equal number of 150 correct sentences (containing all Japanese words) were prepared. A total of 300 sentences consisting of 150 incorrect and 150 Japanese correct sentences were used for Experiment 1.

3.1.3. Stimulus Presentation

Stimuli were presented to participants as follows: Sentences were presented in blocks of three. Incorrect sentences for "No" responses (Japanese sentences containing Chinese words) were shown to participants phrase-by-phrase. The first Japanese phrase 友達からの *tomodachi-kara-no* "from my friend" was presented for 600 milliseconds (ms). After aninterval of 600 ms, the second Japanese phase プレゼントは *purezento-wa* "a present" was also shown for 600 ms. After another 600 ms, the target verb phrase was presented in three different ways, first with Chinese words (1) "was a watch" 手表でした, (2) "was a kilometer" 公里でした and (3) "was a + [nonword]" 戸治でした. After the target phrase in the third block was presented, ERPs were continuously measured for 800ms. The same presentation procedure was used for a correct "Yes" response (sentences only containing Japanese words). "No" and "Yes" responses were presented to each bilingual participant in a random order.

3.1.4. ERP Measuring Instrument

As shown in **Figure 1**, an electroencephalogram (EEG) was recorded from nineteen scalp electrodes corresponding to the International 10/20 system located in FP1, FP2, F7, F3, Fz, F4, F8, T7, C3, Cz, C4, T8, P7, P3, Pz, P4, P8, O1 and O2. These were amplified by a Nihon Kohden Digital EEG-1100 with a bandpass of 0.03 - 30 Hz. ERPs were sampled at a rate of 1000 Hz before 100 ms between the verb phrase presentation (third stimulus) onset to 800 ms after the presentation.

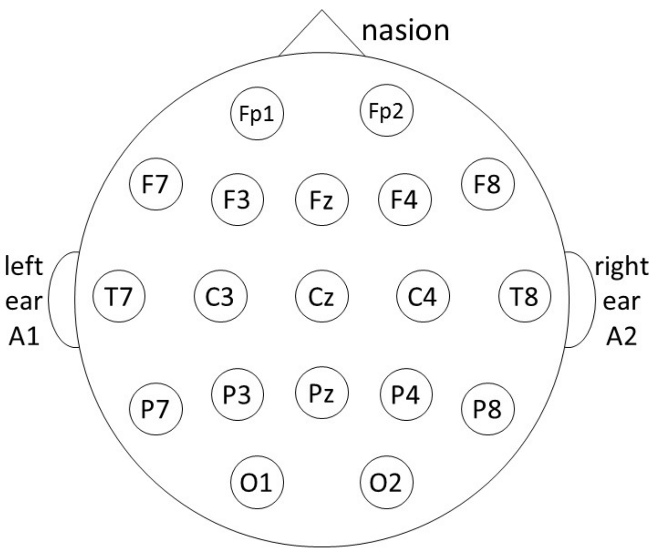

Figure 1. Schematic diagram of electrode montage used in the study.

3.2. Data Analysis and Results

3.2.1. ERP Data for the Processing of L2 Japanese Sentences

Average ERP amplifications ($N = 10$) in four intervals of 180 - 240 ms, 320 - 400 ms, 400 - 480 ms, and 550 - 700 ms were analyzed by the same 3 (three incorrect stimulus conditions) ×19 (locations) ANOVAs repeated measures. The ERPs in the Cz position are depicted in **Figure 2**. For the 180 - 240 ms interval, there was a significant main effect of incorrect stimulus conditions [$F(2,18) = 6.95$, $p < .05$]. ERPs showed increasingly positive amplitudes in the order of semantically matched Chinese words, semantically mismatched Chinese words and nonwords, but multiple comparisons by the Ryan method showed a significant difference only between semantically matched Chinese words and nonwords. For the 320 - 400 ms interval, the main effect was significant in the incorrect stimulus condition [$F(2,18) = 5.56$, $p < .05$]. Multiple comparisons revealed that nonwords were associated with greater negative amplitudes than the other two semantically matched and mismatched Chinese words conditions. There was no significant interaction. For the 400 - 480 ms interval, the main effect of the incorrect stimulus conditions was significant [$F(2,18) = 13.28$, $p < .01$]. Multiple comparisons by the Ryan method showed that nonwords were associated with a greater negative amplitude than the other Chinese words conditions. The interaction was also significant [$F(36, 324) = 2.57$, $p < .05$]. With the exception of three locations of FP1, F7 and P7, all other locations showed significant main effects of incorrect stimulus conditions. Semantically mismatched Chinese words were associated with a greater negative amplitude than semantically-matched Chinese words in C3, Pz, O1 and O2. For the 550 - 700 ms interval, there was no significant main effect, but the interaction was significant [$F(36, 324) = 3.11$, $p < .05$]. In the five locations of FP2, Fz, F4, F8, and Cz, nonwords were associated with a greater negative amplitude than both semantically matched and semantically mismatched Chinese word conditions, while no difference was detected between semantically matched and semantically mismatched Chinese word conditions.

3.2.2. Discussion

In the 180 - 240 interval, the P200 amplitude was observed in L2 Japanese sentence processing. Since the P200 was elicited during the processing of L2 Japanese sentence with a semantically mismatched Chinese word (semantically matched Chinese word also showed this tendency, but it was not significant), the P200 may imply extra orthographic attention at the early processing stage (Hackley, Woldorff, & Hillyard, 1990; Liu, Perfetti, & Hart, 2003; Luck & Hillyard, 1994). Both Japanese sentences with semantically matched and semantically mismatched Chinese words did not amplify the N400. Chinese-and-Japanese bilinguals must activate lexical concepts from the non-target Chinese, even though they were processing Japanese (e.g., Brown & Hagoort, 1993;

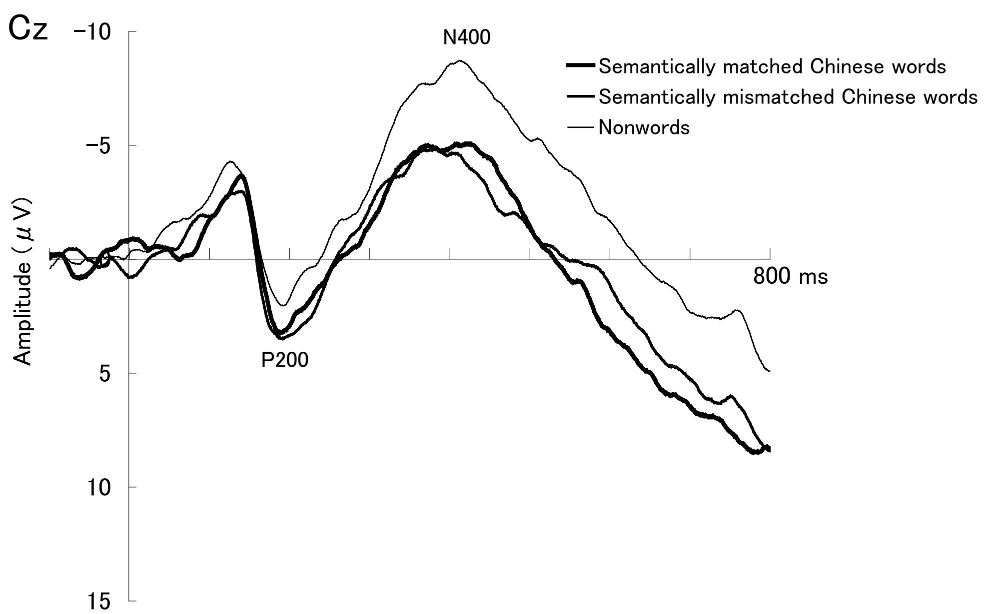

Figure 2. ERPs of Japanese sentences with Chinese words and nonwords.

Friederici & Kotz, 2003; Hahne & Friederici, 2002; Hagoort, 2003; Kutas & Federmeier, 2000; Kutas & Hillyard, 1980). This result supports the model of non-language-selective activations of L1 and L2 lexical items (e.g., Brown & Hagoort, 1993; Friederici & Kotz, 2003; Hahne & Friederici, 2002; Hagoort, 2003; Kutas & Federmeier, 2000; Kutas & Hillyard, 1980). However, the same tendency was observed both the semantically matched and semantically mismatched conditions. Therefore, although the fluent bilinguals cannot avoid lexical activations of their untargeted Chinese words, they do not seem to use these activated Chinese words for Japanese sentential interpretation.

4. Experiment 2—Processing First Language (L1) Chinese Sentence

4.1. Method

4.1.1. Participants

Participants were the same as Experiment 1.

4.1.2. Materials of Experiment 2 (L1 Chinese)

Stimulus items were reversed for Experiment 2, which used Chinese sentences containing a Japanese word, as shown in **Table 2**. The measurement of ERPs focused on decisions related to incorrectness. As shown in **Table 2**, three incorrect conditions were prepared for the sentence correctness decision task. A Chinese sentence including one of the following: (1) a semantically matched Japanese word, (2) a semantically mismatched Japanese word, or (3) a nonword.

Table 2. A set of Chinese sentences used for the experiment.

Three presentation blocks of sentences		
1st block	2nd block	Target block
1. Correct "No" responses (incorrect sentences)		
(1) Semantically matched Japanese words which do not exist in Chinese		
这位是	我的	友达
zhe wei shi	wo de	*tomodati* (JP).
this be	my	*friend* (JP).
(2) Semantically mismatched Japanese words which do not exist in Chinese		
这位是	我的	风邪
zhe wei shi	wo de	*kaze* (JP).
this be	my	*cold* (JP).
(3) Nonwords which do not exist either in Japanese or in Chinese		
这位是	我的	中克
zhe wei shi	wo de	*zhong ke* (NW).
this be	my	*zhong ke* (NW).
2. Correct "Yes" responses (correct sentences)		
这位是	我的	老师
zhe wei shi	wo de	*lao shi.*
this be	my	*teacher.*
这位是	我的	同事
zhe wei shi	wo de	*tong shi.*
this be	my	*workmate*
这位是	我的	父亲
zhe wei shi	wo de	*fu qin.*
this be	my	*father.*

Note: JP = Japanese words. NW = nonwords. NWs are described in pinyin.

For example, the first condition is a Chinese sentence such as, 这位是我的友达. (This is my friend.). Although the word "friend" fits semantically within the sentence context, it is a Japanese word. This word is represented in Chinese characters, but does not exist in Chinese. Thus, this sentence must be rejected as an incorrect Chinese sentence. The second condition also employ as similar context such as 这位是我的风邪. (This is my cold.). However, the word "cold" does not fit within the sentence context (one cannot show his/her "cold"). While this word exists in Japanese, it does not exist in Chinese. Bilinguals can reject this sentence because of either the none-existence of the word in Chinese or the semantic mismatch of the targeted word. The third condition includes a nonword in a sentence such as "这位是我的中克". (This is my *zhongke*.). For correct sentence conditions, we used sets of three sentences such as "这位是我的老师". (This is my teacher.). 这位是我的同事. (This is my workmate.), and "这位是我的父亲". (This is my father.), all of which are correct Chinese sentences. Fifty sentences with Japanese words in each condition (a total of 150 sentences) were created for Experiment 2. These sentences were incorrect sentence which should be responded "No". In addition, as shown in **Table 2**, an equal number of 150 correct Chinese sentences were prepared. A total of 300 sentences consisting of 150 incorrect and 150 correct sentences were used for Experiment 2.

4.1.3. Stimulus Presentation

The stimulus presentation in Experiment 2 was the same as in Experiment 1.

4.1.4. ERP Measuring Instrument

The ERP Measuring Instrument in Experiment 2 was the same as in Experiment 1.

4.2. Data Analysis and Results

4.2.1. ERP Data for the Processing of L2 Japanese Sentences

Average ERP amplitudes ($N = 10$) for five intervals, 180 - 240 ms, 280 - 360 ms, 360 - 450 ms, 500 - 640 ms and 640 - 800 ms, were analyzed by 3 (three incorrect stimulus conditions) ×19 (locations) ANOVAs repeated measures using Greenhouse-Geisser Epsilon to identify the significance level. There were no significant main effects or interaction in the 180 - 240 ms interval. For the 280 - 360 ms interval, the main effect was significant in the three different incorrect stimulus conditions [$F(2,18) = 10.03$, $p < .01$]. Multiple comparisons by the Ryan method ($p < .05$) revealed that nonwords were more negatively amplified than the two real Japanese words conditions. For the 360 - 450 ms interval, the main effect of verb phrase was significant [$F(2,18) = 21.82$, $p < .0001$]. Multiple comparisons by the Ryan method showed that nonwords were more negatively amplified than the other two real Japanese word conditions. The interaction also approached a significant level [$F(36, 324) = 2.37$, $p < .07$].

A clear picture of the ERPs in the Cz position in **Figure 3** indicates the N400 component except in F7, P7 and

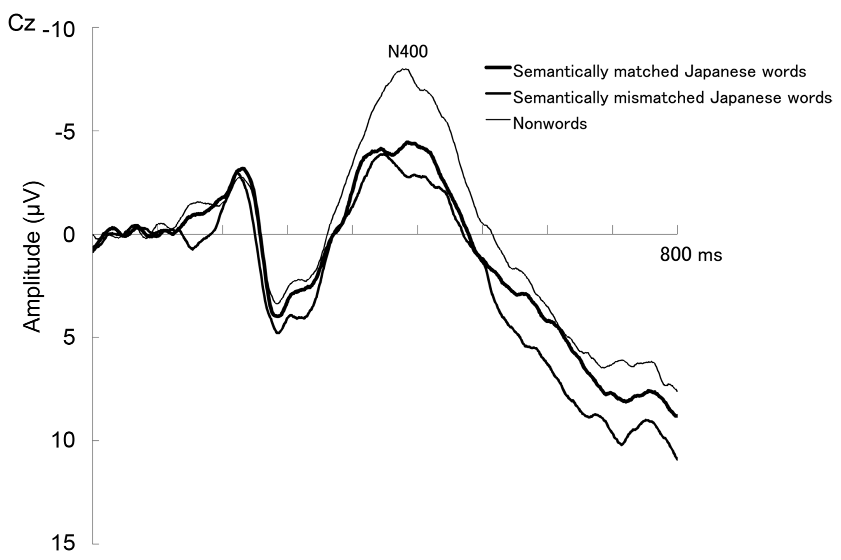

Figure 3. ERPs of Chinese sentences with Japanese words and nonwords.

O1. For the 500 - 640 ms interval, the interaction was significant [$F(36, 324) = 3.72$, $p < .01$]. Significant main effects of incorrect stimulus conditions were found in the locations of PF1, PF2, Fz, F4, F8 and Cz. Semantically-mismatched Japanese words were more negatively amplified than matched Japanese words in the locations of FP1 and F8. For the 640 - 800 ms interval, there were no significant main effects or interactions.

4.2.2. Discussion

Unlike L2 Japanese sentence processing in Experiment 1, the P200 amplitude was not observed in L1 Chinese sentence processing in in the 180 - 240 interval. This might be related to the ease of early orthographic processing (Hackley, Woldorff, & Hillyard, 1990; Liu, Perfetti, & Hart, 2003; Luck & Hillyard, 1994). As with Experiment 1, the N400 component was observed in the condition of nonwords in L1 Chinese sentence processing. Once again, both L1 Chinese sentence types with a semantically-matched and a semantically-mismatched Japanese word did not show the elicitation of N400 (e.g., Brown & Hagoort, 1993; Friederici & Kotz, 2003; Hahne & Friederici, 2002; Hagoort, 2003; Kutas & Federmeier, 2000; Kutas & Hillyard, 1980). Therefore, lexical items of non-target language must be activated non-language-selectively under the sentence processing condition of either L1 or L2 (e.g., Colomé, 2001; Costa, Caramazza, & Sebastián-Gallés, 2000; de Groot, Delmaar, & Lupker, 2000; Dijkstra & van Heuven, 2002; Green, 1998; Hermans, Bongaerts, De Bot, & Schreuder, 1998; van Heuven, Dijkstra, & Grainger, 1998; van Heuven, Schriefers, Dijkstra, & Hagoort, 2008). However, these lexical activations do not involve sentential interpretation since the N400 was not found in Chinese sentences with either semantically-mismatch Japanese words or semantically-matched Japanese words.

5. General Discussion

In order to clarify whether a lexical concept from the untargeted language was activated while processing a sentence of the targeted language, the present study measured ERPs of highly advanced Chinese-and-Japanese bilinguals during the processing of L1 Chinese and L2 Japanese sentences. The two major amplitudes of P200 and N400 were observed in Experiments 1 and 2.

In the 180 - 240 interval, the P200 amplitude was observed in L2 Japanese sentence processing, but not in L1 Chinese sentence processing. A previous study by Hackley, Woldorff and Hillyard (1990) interpreted the P200 as reflecting selective attention. Similarly, Luck and Hillyard (1994) provided an explanation for the P200 as a visual feature detection processes. In a language related ERP study by Liu, Perfetti and Hart (2003), the P200 component was found in Chinese processing of graphically similar characters such as 零 and 雪, or 池 and 他. It seems that the P200 component reflects early orthographic activation before concepts are accessed. In the present study, the P200 was observed only in L2 Japanese sentence processing, but not in L1 Chinese sentence processing. This early P200 indicated the asymmetric performance between L1 Chinese and L2 Japanese. L2 Japanese words presented in Japanese script, *kanji* were embedded in L1 Chinese sentences. Japanese *kanji* characters resemble to the Chinese *hanzi* characters. In fact, previous experimental studies showed that L1 Chinese speakers learning L2 Japanese can process L2 Japanese *kanji*-compound words more quickly and accurately than other L2 learners with different language backgrounds (Tamaoka, 1997, 2000, 2014, 2015; Yamato & Tamaoka, 2013). In the present study, L1 Chinese *hanzi* orthography was processed with a lower cognitive load than L2 Japanese even though L1 Chinese words in Japanese sentences were also presented in Japanese *kanji* characters. This finding provides further support for the asymmetric model of bilingual lexical access (e.g., Chen & Leung, 1989; Chen & Ng, 1989; Kroll & Curley, 1994; Kroll & Sholl, 1992; Kroll, Michael, Tokowicz, & Dufour, 2002; Sholl, Sankaranarayanan, & Kroll, 1995) which suggests the activation level of words from the dominant L1 (Chinese) is much stronger than that of words from the non-dominant L2 (Japanese).

The N400 component appears when semantic violations are processed in a sentence (e.g., Brown & Hagoort, 1993; Friederici & Kotz, 2003; Hahne & Friederici, 2002; Hagoort, 2003; Kutas & Federmeier, 2000; Kutas & Hillyard, 1980), suggesting that the N400 is sensitive to conditions requiring semantic integration processes. In the present study, the N400 component was observed in the nonword condition in both L1 Chinese and L2 Japanese sentence processing. The N400 component appeared approximately 40 ms later in the L2 Japanese sentences, compared to L1 Chinese sentences. A delay of about 40 ms also observed between overall "Yes" responses in L1 Chinese and L2 Japanese processing. Previous studies (Ardal, Donald, Meuter, Muldrew, & Luce, 1990; Hahne, 2001; Ojima, Nakata, & Kakigi, 2005) have also shown that semantic anomalies often elicit slight delays in the non-dominant L2 language.

The semantically matched conditions did not amplify the N400. That the N400 did not appear suggests that bilinguals activate lexical concepts from the untargeted language even though they were processing targeted language. Therefore, the Chinese and Japanese fluent bilinguals cannot avoid conceptual activations of their L1 Chinese and L2 Japanese lexical items. Non-language-selection lexical activation (e.g., Colomé, 2001; Costa, Caramazza, & Sebastián-Gallés, 2000; de Groot, Delmaar, & Lupker, 2000; Dijkstra & van Heuven, 2002; Green, 1998; Hermans, Bongaerts, De Bot, & Schreuder, 1998; van Heuven, Dijkstra, & Grainger, 1998; van Heuven, Schriefers, Dijkstra, & Hagoort, 2008) was supported by the N400 patterns in the present study.

However, in the present study, both L1 and L2 sentences with semantically mismatched words of untargeted languages did not elicit an N400. In other words, a sentence context of the targeted language was not influenced by activation of words from the untargeted language. Therefore, bilinguals seem not to use these activated untargeted words for sentential interpretation of the target language. Since this tendency was observed in the both L1 and L2 processing condition, it is quite possible to have the cut-off mechanism of lexical activation in the untargeted language from sentence processing of the targeted language. This cut-off mechanism should be investigated in future studies on bilingual sentence processing.

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