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The cognitive processing of Japanese loanwords in katakana

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Abstract: The present study examined two questions concerning the cognitive processing of Japanese loanwords borrowed from English and written in katakana. The first question was whether "interlexical activation" occurs between Japanese and English. Results from a lexical decision task showed that loanwords phonetically similar to the original English words were judged with the same speed and accuracy as those being phonetically dissimilar to their original English words. The study further examined the cognitive processing of unadopted loanwords (i.e., words unlisted in a Japanese loanword dictionary). Reaction times displayed the shortest mean for non-words, followed by pseudo-loanwords, and finally unadopted loanwords. Thus, the only time the lexical representation of an original English word was possibly activated was when native Japanese speakers had seldom seen the word in katakana. The second question was what creates the "lexical mental boundary" between adopted and unadopted loanwords. A questionnaire showed that native Japanese speakers are likely to use decision-making strategies for determining lexicality of loanwords in Japanese based on their daily experience of exposure to katakana words in print.

Key words: Japanese loanwords, interlexical activation, lexical mental boundary, phonetic similarity and dissimilarity, katakana.

Throughout the last three decades, Japanese, which has a long history of borrowing linguistic elements from other languages, has adopted many alphabetic loanwords from English. In fact, this trend has steadily accelerated over the years, particularly in the areas of popular culture and scientific study. Loanwords (called *gairaigo* in Japanese) are printed in the script called *katakana*, which consists of Japanese phonetic symbols used specifically for the phonetic transcription of foreign words. Due to the relative ease with which katakana can phonetically transcribe loanwords, more and more are seen making their way into Japanese, especially from English. This being the case, the question arises as to how Japanese native speakers determine the meaning of a loanword when they see it for the first time. Since Japanese people, especially the younger generation, usually study English for at least six years from Grades 7–12, it could be the case that they use their knowledge of English to understand newly created Japanese loanwords.

Numerous loanwords are found in Japanese fashion magazines, which target younger women. Because of the popularity of American and European fashions in Japan, the market is saturated with magazines such as

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AnAn, *Cosmopolitan*, *Elle*, *More*, *Non-Non* and *Voce*. Loanwords are very often a combination of multiple words such as ドメスティックムーブメント (domestic movement) and シンプルライフ (simple life). Some loanwords found in such types of Japanese magazines do not even exist in English. Instead, Japanese speakers have coined them as a way to provide a cachet of authentic English words. As such, loanwords in Japanese fashion magazines seem impossible to understand without reasonable English knowledge.

In order to investigate the cognitive processing of Japanese loanwords, the present study classified these words into three types. The first type was those loanwords listed in the Japanese dictionary, which could be considered as standard Japanese words. These loanwords are frequently used in various texts, so native Japanese speakers are likely to see them very often (i.e., high frequency loanwords). The second type of loanwords consisted of those not appearing in the Japanese dictionary, but included in specialized Japanese loanword dictionaries. These loanwords are occasionally seen in magazines devoted to fashion, cooking, sports, computers, and academic studies. Thus, these words could be considered as newly adopted loanwords, which may not be seen so often (i.e., low frequency loanwords). The third type of loanwords was comprised of those having appeared in some publications, but which have not yet achieved the status of inclusion in either a general use or a specialized loanword dictionary. This type of loanword was thus called an "unadopted" loanword.

With regards to these three types of loanwords, the first question posed was whether native Japanese speakers make use of their English knowledge when they come across loanwords originating from English words (i.e., "interlexical activation"). Using the assumptions of cognitive processing, this question is rephrased as "Do native Japanese speakers activate lexical representations of English words while processing Japanese loanwords?" If Japanese loanwords automatically cause such activation, representations for original English words having much the same pronunciation as their loanword counterpart should be more easily activated. Therefore, using the lexical decision task, the present study compared the speed and accuracy of phonetically similar and dissimilar loanwords, forming two stimulus groups. In addition, as high frequency loanwords are assumed to have a lower threshold in reaching lexical activation, the present study selected loanwords with phonetic similarity/dissimilarity using a cross-section of both high and low frequency words.

The second question put forward in the present study was if and why a "lexical mental boundary" exists between newly adopted and unadopted loanwords. Is it possible that native Japanese speakers make judgments as to whether or not they have previously seen the same loanword in katakana? If this is so and they have not seen the word before, it may be that they check to see if they know it in English. However, some native Japanese speakers may have seen these "unadopted loanwords" in trendy magazines. Thus, the present study examined whether native Japanese speakers could reject unadopted loanwords ("No" responses for lexical decision) more easily than nonsense non-words and even pseudo-loanwords (created by changing a single mora from real loanwords). Results were further examined with a short questionnaire whereby native Japanese speakers were asked if they had seen the unadopted loanwords in question, written in katakana. If the correlation between the data (i.e., error rates and reaction times) from the lexical decision task and that from the questionnaire on seeing unadopted loanwords in katakana is high, this would show that the lexical mental boundary is established by previous exposure to loanwords in katakana.

The correlation result will provide some indication as to the first question as well. If a high correlation found between the frequency of seeing unadopted loanwords in katakana and the data of the lexical decision task is high, subjects may be able to respond "No" for unadopted loanwords by simply asking themselves whether they have seen these stimuli in katakana before. In this way, all three types of loanwords aforementioned would then need to be examined according to the cognitive model

of automatic "interlexical activation" between Japanese and English.

Through the investigation of these two questions, the present study provides an explanation of the cognitive processing of Japanese loanwords in katakana.

Experiment: The Lexical Decision Task

Method

Subjects

Twenty-four undergraduate and graduate students, all native Japanese speakers, participated in the study. The subjects consisted of 20 females and 4 males. The overall average age of the 24 subjects was 23 years and 10 months (SD = 23 months). Because all the subjects in the present study were enrolled in a prestigious Japanese university requiring a high level of English ability, they were assumed to have a good knowledge of English.

Stimulus items

An equal number of 96 stimulus items each from the "Yes" and "No" responses were selected for the experiment (a total of 192 items). As shown in Table 1, Japanese loanwords with high and low word frequencies of occurrence in printed texts were selected for the correct "Yes" responses. Each loanword frequency was taken from the index established by the National Institute for Japanese Language (1973). This word frequency index was calculated from the words printed in the three major *Asahi*, *Yomiuri*, and *Mainichi* newspapers during 1966. Forty-eight high frequency loanwords and 48 low frequency loanwords were selected on the basis of this index. Loanwords were also divided up according to whether or not their pronunciations were similar to or dissimilar to the original English words. For example, the loanword "レモン", meaning "lemon" in English, is pronounced in Japanese as "remoN" (N refers to nasal). This sound is relatively similar to the English sound for "lemon," except that the English consonant of "l" is replaced by "r." The second condition was loanwords which were

Table 1. Japanese loanwords used as stimulus items for the lexical decision task

Type of response Correct "Yes" responses	Number of items	Examples Loanwords in katakana	Phonetic transcription	Original English words
High frequency: Similar to English sounds	24	レモン, トランプ, プレゼント	"remoN", "oranpu", "purezento"	lemon, trump, present
Dissimilar to English sounds	24	ラジオ, トンネル, レストラン	"rajio", "toNneru", "vresutoraN"	radio, tunnel, restaurant
Low frequency: Similar to English sounds	24	ギフト, ピストル, アナウンス	"gifuto", "pisutoru", "anaunsu"	gift, pistol, announce
Dissimilar to English sounds	24	スリル, オムレツ, バクテリア	"suriru", "omuretu", "bakuteria"	thrill, omelet, bacteria
Correct "No" responses	Number of items	Stimuli in katakana	Phonetic transcription	Original English words
Nonwords	48	クネサ, ノフレチ, メクホナソ	"kunesa", "nohureti", "mekuhonaso"	–
Pseudo-loanwords	24	ガルホ, セタレオ, プロガラム	"garuho", "setareo", "purogaramu"	–
Unadopted loanwords	24	ソイル, サルート, アブロード	"soiru", "saruRto", "aburoRdo"	soil, salute, abroad

Table 2. Indexes of word frequency and phonemic similarity for Japanese loanwords used as stimuli for the correct "Yes" responses

Type of loanword	1966 freq. index (times)	2000 freq. index (times)	Textbook freq. index (times)	Number of Japanese phonemes	Number of different phonemes	% of phoneme difference
High frequency:						
Similar to English sounds	29.38	2353.63	5.83	7.58	3.83	50.18%
Dissimilar to English sounds	36.04	3467.71	6.08	7.75	5.00	65.86%
Low frequency:						
Similar to English sounds	12.25	949.71	1.08	7.83	3.50	45.37%
Dissimilar to English sounds	8.83	715.67	1.00	7.79	4.54	59.17%

pronounced differently from their English counterparts. The English word "thrill," which is presented in Japanese as "スリル", is pronounced as "suriru" in Japanese. The phonemes of "スリル" in Japanese differ from the English phonemes for "thrill," except for "r" and "i". In this manner, we chose 24 phonetically similar and dissimilar items for each condition of high and low word frequency for the correct "Yes" responses.

The means of high/low word frequencies and phonetic similarity/dissimilarity for the selected loanwords are reported in Table 2. In order to examine the two independent values of the stimulus items, a 2 (high and low word frequency) × 2 (phonetically similar and dissimilar) analysis of variance (ANOVA) was performed on the data from each index shown in Table 2. The difference between the means of the high frequency loanwords and the low frequency loanwords was significant [$F_{(1,93)} = 7.08$, $p < 0.01$]. As we expected, the mean difference between the phonetically similar and dissimilar loanwords was not significant.

The index of word frequency in three 1966 newspapers (National Institute for Japanese Language, 1973) was established over 30 years ago, so there was a concern that the frequency of the loanwords from this index could have changed over time. Amano and Kondo (2000), having used 1985–98 editions of the *Asahi* newspaper, produced a very large lexical corpus of 341,771 words (i.e., type frequency) having a frequency of occurrence of 287,792,797 times (i.e., token frequency). Thus, this newly created index of word frequency was used to calculate the word frequency of chosen stimulus items.[2] The means of word frequency are shown in Table 2. A 2 (high and low word frequency) × 2 (phonetically similar and dissimilar) ANOVA was performed for word frequencies. The results showed that there was a significant difference between high and low frequency of loanwords [$F_{(1,95)} = 13.49$, $p < 0.001$] while there was no significant difference between loanwords having phonetic similarity or dissimilarity. Interaction of these main effects was not significant. Consequently, loanwords chosen on the basis of word frequency in 1966 were still reasonably viable as stimulus items in light of the newest index of word frequency by Amano and Kondo (2000).

The loanword frequency index provided by Quackenbush, Fukada, and Kobayashi (1993), which calculated frequency of occurrence for loanwords in Japanese language textbooks for international students, was also used in this study, with the result being the same as for the word frequency index from the newspapers. There was a significant difference in the frequency of word usage in textbooks between the stimulus loanwords with high and low frequencies [$F_{(1,93)} = 35.34$, $p < 0.0001$], but no difference between the phonetically similar and dissimilar loanwords. Thus, the variable of

[2] When this experiment was conducted in the early part of 2000, the database of Amano and Kondo (2000) was not yet available. Therefore, a newer index was used to examine loanwords with high and low frequency selected for stimuli in the lexical decision task after the experiment was completed.

word frequency was not considered to have an effect on the results of the experiment using the phonetically similar and dissimilar loanwords as stimulus items.

For the variable of phonetic similarity and dissimilarity, the number of phonemes used to construct the Japanese loanwords was counted. The phonemes in each loanword were compared to the phonemes of each English counterpart. Based on the Japanese phonemes of each loanword, the number of phonetic differences was recorded and used as a basis for creating the two stimulus groups of loanwords. Each stimulus item selected for phonetic similarity and dissimilarity was constructed from the same number of Japanese phonemes. The means concerning the number of phonemes in the loanwords are shown in Table 2. The same two-way ANOVA was used for testing these differences. Results showed no significant main effects of either phonetic similarity/dissimilarity or high/low word frequencies on the number of phonemes. The index of phonemic differences was then tested using the same two-way ANOVA. The results indicated a main effect of phonetic similarity/dissimilarity [$F_{(1,93)} = 9.76$, $p < 0.0001$], but a main effect of high/low word frequency was not significant. To confirm the viability of the grouping for phonetic similarity and dissimilarity, the percentage of phonetic differences was calculated by taking the number of different phonemes in each loanword as compared to the original English word and dividing it by the total number of phonemes constructing each loanword. The average percentages of phonetic differences for the two variables of high/low word frequencies and phonetic similarity/dissimilarity are reported in Table 2. The same two-way ANOVA was performed to examine its effect. As expected, there was a significant main effect of phonetic similarity and dissimilarity of phonetic differences [$F_{(1,93)} = 25.35$, $p < 0.0001$], but no difference between high and low word frequencies. Therefore, the effects of phonetic similarity and dissimilarity can be examined using these two groups of stimulus items.

As shown in Table 1, there were three stimulus conditions for the correct "No" responses for the lexical decision task. First, 24 real English words, which had not been adopted as Japanese loanwords, were chosen. As mentioned in the earlier part of this paper, a typical Japanese dictionary is rather conservative in terms of the number of loanwords it lists, and because a loanword dictionary (e.g., Sanseido, 1991; Kaieda, 1996) contains a greater number of loanwords, a loanword dictionary edited by Kaieda (1996) was used for this study. This loanword dictionary collected 22,000 words from a wide range of genres, and was therefore considered to be an adequate indicator for judging adopted or unadopted Japanese words. The loanword dictionary of Kaieda (1996) was used as the sole criterion for the unfamiliarity of a word in Japanese texts. For example, since the English word "soil" is not listed in the loanword dictionary, it can be then regarded as not being used in Japanese written texts. It should, however, be noted that some native Japanese speakers might have previously seen this word somewhere presented in katakana. This served as a basis for the need of performing additional research using a questionnaire.

In the second category, we created 24 pseudo-loanwords by altering a few phonemes in existing Japanese loanwords with a relatively high word frequency. For example, from Table 1 "セタレオ" "setareo" was created from the existing Japanese loanword of "ステレオ" "sutereo" ("stereo" in English), by changing the first vowels of "u" to "e", and "e" to "a". For the third category, 48 non-words, which did not sound like any loanword, were created as a control stimulus group for the unadopted loanwords and pseudo-loanwords. The average number of morae in the three stimulus categories was the same. Since the only possible variable to control for the three categories was this phonetic factor, we did not conduct any analysis for the stimulus items of the correct "No" responses.

Instruments and procedure

Existing words as well as non-words were randomly presented to subjects in the center of a computer screen (Toshiba, J-3100 Plasma display, Tokyo, Japan) 600 milliseconds after

the appearance of an eye fixation point marked by an asterisk "*" The subjects were instructed to respond as quickly, but as accurately, as possible in deciding whether the item was a Japanese loanword or not. Responses were registered by pressing a "Yes" or "No" button. Twenty-four practice trials were given to the subjects prior to commencement of actual testing.

Results

Only correct responses were used for the calculation of mean reaction times. Responses with reaction times slower than 2000 ms or faster than 200 ms were recorded as incorrect. Only 13 responses fell into this category. Before performing the analysis, reaction times outside of 2.5 standard deviations in both the high and low range were replaced by the boundaries indicated by 2.5 standard deviations from the individual means of subjects. The mean reaction times and error rates for the lexical decision task are presented in Table 3. The statistical tests which follow analyze both subject (F_1) and item (F_2) variability.

Analysis of reaction times for the correct "Yes" responses

According to the data of the "Yes" responses, native Japanese speakers made lexical decisions for loanwords with high word frequency faster than for loanwords with low word frequency. A 2 (high and low word frequency) $\times$ 2 (phonetically similar and dissimilar) ANOVA for repeated measures showed a significant difference for reaction times in subject means [$F_{1(1,23)} = 42.76$, $p < 0.0001$] and item means [$F_{2(1,93)} = 7.59$, $p < 0.001$]. This finding of a word frequency effect on lexical decision was predicted in previous studies (e.g., Balota & Chumbley, 1984; Forster, 1976; Whaley, 1978; Taft, 1979, 1991; Grainger, 1990). These studies suggested that the latency of lexical decision and naming of a word with high frequency of usage was shorter than that of a word with low frequency. Another variable intended for investigation was the phonetic similarity of loanwords. The difference in reaction times was significant in subject means [$F_{1(1,23)} = 4.33$, $p < 0.05$], but not significant in item means [$F_{2(1,93)} = 0.66$, $p = 0.42$]. In that the item analysis did not show a significant main effect on reaction time, some specific loanwords may have influenced the significant result of subject analysis concerning the variable of phonetic similarity and dissimilarity.

Analysis of error rates for the correct "Yes" responses

The same two-way ANOVA showed that the difference between low and high frequency loanwords was significant in both subject means [$F_{1(1,23)} = 54.31$, $p < 0.0001$] and item means [$F_{2(1,93)} = 8.45$, $p < 0.005$]. A word frequency effect was apparent in the lexical decision task for loanwords. The difference in error rates regarding loanwords phonetically similar and

Table 3. Reaction times and error rates of lexical decisions for Japanese loanwords

Type of response	Reaction times (ms)	Error rates (%)
Correct "Yes" responses		
High frequency: Similar to English sounds	575 (62)	1.91 (3.68)
Dissimilar to English sounds	577 (65)	2.43 (3.87)
Low frequency: Similar to English sounds	603 (63)	8.68 (6.26)
Dissimilar to English sounds	621 (68)	11.81 (6.34)
Correct "No" responses		
Nonwords	603 (91)	0.69 (1.18)
Pseudo-loanwords	679 (101)	3.99 (5.56)
Unadopted loanwords	757 (172)	27.95 (16.60)

Figures in parentheses indicate standard deviations.

dissimilar to their original English words was significant in subject means [$F_{1(1,23)} = 4.29$, $p < 0.05$], but not significant in item means [$F_{2(1,93)} = 0.43$, $p = 0.51$]. As observed in the analysis of reaction times, the stimulus items of loanwords affected the significant result of the subject analysis. Consequently, it was concluded that phonetic similarity of loanwords to their English originals had no effect on lexical decisions for the correct "Yes" responses as measured by reaction times and error rates.

Analysis of reaction times for the correct "No" responses

As shown in Table 3, the mean reaction times for the correct "No" responses displayed a clear trend of non-words having the shortest mean, followed by pseudo-loanwords and the unadopted loanwords. A one-way ANOVA for repeated measures on reaction times of the correct "No" responses showed a significant main effect on processing the three types of stimuli in both subject analysis [$F_{1(2,46)} = 43.28$, $p < 0.0001$] and item analysis [$F_{2(2,93)} = 62.76$, $p < 0.0001$]. Further analysis with an orthogonal polynomial comparison was carried out to isolate the main effect on the stimulus conditions. The mean reaction time in lexical decisions for the unadopted loanwords was slower than for the pseudo-loanwords. This difference was significant [$F_{1(1,23)} = 16.71$, $p < 0.001$]. The mean reaction time for pseudo-loanwords was slower than for the nonwords. This difference was also significant [$F_{1(1,23)} = 119.72$, $p < 0.0001$]. The largest difference in reaction times between unadopted loanwords and non-words was also significant [$F_{1(1,23)} = 58.41$, $p < 0.0001$]. These differences among the three stimulus conditions for the correct "No" responses were also confirmed by using the analysis of Duncan's multiple range comparison test applied on item means.

For the correct "No" responses, pseudo-loanwords were created by slightly altering original loanwords. For example, as shown in Table 1, プロガラム, pronounced as "purogaramu" in Japanese, was produced by changing a single vowel from the original Japanese loanword of プログラム "puroguramu" (meaning "program" in English). A previous study by Tamaoka and Taft (1994) found that such pseudo-loanwords (e.g., コメラ "komera" from カメラ "kamera" meaning "camera" in English) took longer to correctly reject in a lexical decision task than loanwords which had two morae altered from the original loanwords (e.g., リマル "rimaru" from ホテル "hoteru" meaning "hotel" in English). Once the two morae of the original loanwords were changed, the loanwords lost their "word-likeliness." These altered strings of morae can hardly be termed loanwords, but rather as non-words which do not activate any other entries within the Japanese lexicon. Tamaoka and Taft proposed that Japanese pseudo-loanwords activated their original counterpart loanwords because they still kept the "word-likeliness" of the original counterparts. These authors showed that pseudo-loanwords were rejected more slowly in the lexical decision task than non-words. The present study also obtained the same results that Tamaoka and Taft found in their study. In addition to this, results from the experiment found that unadopted loanwords required even longer latencies for lexical decision than pseudo-loanwords. This result implies that the processing of unadopted loanwords may be subject to more than just the effects of loanword-likeliness in katakana found in the processing of pseudo-loanwords.

Analysis of error rates for the correct "No" responses

As observed from the analysis performed on the mean reaction times, mean error rates for correct "No" responses shown in Table 3 also exhibited the same results as reaction times. The one-way ANOVA for repeated measures revealed a significant main effect of the three stimulus conditions in both subject means [$F_{1(2,46)} = 55.89$, $p < 0.0001$] and item means [$F_{2(2,93)} = 77.13$, $p < 0.0001$]. Furthermore, an orthogonal polynomial comparison was carried out to isolate the main effect on the stimulus conditions. The unadopted loanwords were rejected as existing Japanese loanwords less accurately than were the pseudo-loanwords [$F_{1(1,23)} = 53.29$, $p < 0.0001$]. Needless to say, the unadopted loanwords were also rejected less accurately than non-words [$F_{1(1,23)} = 63.5$,

$p < 0.0001$]. Furthermore, the pseudo-loanwords were significantly less accurately rejected than the non-words [$F_{1(1,23)} = 8.77$, $p < 0.01$]. These differences among the three stimulus conditions for correct "No" responses were confirmed by the analysis of Duncan's multiple range comparison tested on item means of error rates.

Discussion

The present experiment has attempted to answer the two questions posed in the introduction of this study. Subjects showed no difference in speed and accuracy when making "Yes" responses in the lexical decision of phonetically similar and dissimilar loanwords with both high and low frequency, although loanwords with high frequency were processed faster and more accurately than loanwords with low frequency. Thus, "interlexical activation" between the lexicons of Japanese loanwords and English words does not happen during the processing of loanwords with both high and low frequency.

An interesting finding concerned the results of the "No" responses. The unadopted loanwords such as ソイル ("soil"), サルート ("salute"), and アブロード ("abroad") were commonly seen in English texts. As calculated from the means of reaction times in Table 3, the difference of 154 ms as rejection time for lexical decisions between non-words and unadopted loanwords implied that native Japanese speakers viewed unadopted loanwords as something more than just a nonsense string of morae in katakana. Furthermore, the difference of 76 ms between pseudo-loanwords and unadopted loanwords implied that some extra processing activity was involved in correctly rejecting the unadopted loanwords. Because the present study used university students as subjects, it was assumed that they had gained sufficient English knowledge during their high school years to guess the meanings of these unadopted loanwords. Therefore, this result suggests the possibility that "interlexical activation" between Japanese and English is involved in arriving at a correct lexical decision for unadopted loanwords.

However, a possible alternative explanation for the long reaction times for "No" responses to unadopted loanwords is related to the second question of "lexical mental boundary." Subjects may have made a decision based upon their exposure to unadopted loanwords printed in katakana. For example, the unadopted loanword ソイル "soil" may have been seen in katakana among some subjects who are interested in ecology. Likewise, アブロード "abroad" is frequently printed in katakana in journals related to study abroad, although this word is not listed in the katakana loanword dictionary of Kaieda (1996). Naturally, native Japanese speakers who have seen these unadopted loanwords in katakana will judge them as existing Japanese loanwords. In this sense, subjects utilized their daily experience to katakana exposure without using their knowledge of English. Therefore, the additional questionnaire study which asked native Japanese speakers whether they had ever seen the unadopted loanwords before was necessary in order to investigate relations between previous exposure to unadopted loanwords in katakana and the data (error rates and reaction times) from the lexical decision experiment.

Additional Research: The Study Done by Questionnaire

Method

Subjects

Twenty undergraduate and graduate students, all native Japanese speakers, participated in this study. Subjects consisted of 8 females and 12 males. The overall average age of the 20 subjects was 29 years and 1 month (SD = 8 years, 3 months).

Stimulus items

The 24 unadopted loanwords used in the lexical decision task were used to create a questionnaire. As mentioned in the previous experiment, the chosen unadopted loanwords existed in English but were unlisted in a Japanese loanword dictionary (Kaieda, 1996).

Questionnaire and calculation

In the questionnaire, subjects were asked if they had previously seen the 24 unadopted

Table 4. Correlations among previous exposure to unadopted loanwords, error rates and reaction times

	1	2	3
1 Reaction times	–		
2 Error rates (%)	0.662*	–	
3 Previous exposure (%)	0.149	0.649*	–

*$p < 0.01$.

loanwords in katakana. Previous exposure to each unadopted loanword was calculated by the number of "Yes" answers divided by the total of the 20 subjects.

Results

The overall mean of "Yes" answers regarding previous exposure to the 24 unadopted loanwords was 28.54% with a standard deviation of 17.27%. Pearson's correlation coefficients were reported in Table 4. Results from the analysis of these correlations showed a significance between error rates and reaction times in the lexical decision task ($r = 0.662$, $p < 0.01$). The lower the error rates, the faster the reaction times. There was also a high correlation between previous exposure to the unadopted loanwords and error rates in the lexical decision task showed significantly high correlation ($r = 0.649$, $p < 0.01$). From among the 24 unadopted loanwords used as stimulus items, those that had previously been seen in katakana were likely to be given a correct "Yes" response as existing Japanese loanwords. There was, however, no significantly high correlation found between reaction times and previous exposure ($r = 0.149$, *ns*). Speed of lexical decision had no relation to one's exposure to unadopted loanwords.

Discussion

In addition to the lexical decision task, the present study conducted additional research providing the 20 native Japanese speakers with a questionnaire to fill out. Previous exposure to the 24 unadopted loanwords in katakana listed in the questionnaire was highly correlated with error rates from the lexical decision task. This high correlation indicates that unadopted loanwords, which have been previously seen in katakana, are likely to be perceived as existing Japanese loanwords. Consequently, this suggests that subjects made a "Yes" or "No" final decision in the lexical decision task not based upon "interlexical activation" but upon their previous exposure to the provided stimuli in katakana. This formed the basis for arriving at the second question regarding a "lexical mental boundary."

The correlation between previous exposure to the 24 unadopted loanwords in katakana and reaction times for lexical decision of these loanwords was not significantly high. Thus, speed of lexical decision was not related to previous exposure. On the other hand, reaction times for lexical decision of these loanwords showed much longer latencies than those of both non-words and pseudo-loanwords. This result suggests that lexical decision of unadopted loanwords is not only a more complex cognitive process than the one required for simple rejection of non-words, but it is also affected by more than just orthography, which is seen as a hindrance in the process required for lexical decision using pseudo-loanwords. Although previous exposure to unadopted loanwords in katakana was related to error rates, it is quite possible that subjects in this study may have activated lexical representations of original English words in the process of lexical decision.

General Discussion

Japanese loanwords are created by simply transforming the original sounds of alphabetic foreign words into those of the Japanese phonetic system. In the process of this phonetic transformation, some loanwords are pronounced very differently from the original English words. If the native Japanese speakers are able to recognize the differences between Japanese and English sounds when processing loanwords, it was expected that their English knowledge would help to facilitate their cognitive processing for lexical decision of phonetically similar loanwords in the experiment used

in the study. Consequently, as related to the concept of "interlexical activation," it was also assumed that the loanwords which were phonetically similar to the original English words would be judged as existing Japanese loanwords (a "Yes" response) faster than the counter stimuli of loanwords which were phonetically dissimilar. Despite this expectation, the present study indicated no differences between the reaction times and error rates for lexical decision of both types of loanwords where a correct "Yes" response was concerned.

Loanwords such as ギフト (gift), トランプ (trump), and アナウンス (announce), which retained much of their original English pronunciation, were judged no faster in lexical decisions than loanwords such as ラジオ (radio), オムレツ (omelet), and レストラン (restaurant), which have pronunciations dissimilar to their original English words. This "no influence" tendency was observed among both loanwords with high and low frequencies. Therefore, the lack of a phonetic similarity effect for existing loanwords suggests that native Japanese speakers do not activate lexical representations of English words while processing Japanese loanwords adopted from English; at least the phonetic cues of the loanwords do not create enough activation to make use of the original English words.

In previous studies (e.g., de Groot, 1992; de Groot, Dannenburg, & van Hell, 1994; Kroll & Stewart, 1994; Sholl, Sankaranarayanan, & Kroll, 1995; Chen, Cheung & Lau, 1997; Cheung & Chen, 1998), the stream of activations for lexical items from the first language (L1) to the second language (L2) (i.e., forward processing from L1 to L2) was found to be stronger than in the reverse direction (i.e., backward processing from L2 to L1). These studies on the direction of activations during translation between two languages revealed different types of processing of lexical entries in the "asymmetry model" of the first and second languages. In accordance with this model, the fact that there was no effect of phonetic similarity in our study on lexical decision of loanwords with high and low frequencies suggests that native Japanese speakers were able to process loanwords with little or no activation of lexical representations of the original English words. Instead, they just relied on their knowledge from previous exposure to loanwords in katakana. Thus, this result did not support "interlexical activation" between Japanese and English.

There was, however, evidence from the results of the experiment performed in this study which shows that interlexical activation may occur when rejecting unadopted loanwords as existing Japanese loanwords. The lexical decision task using unadopted loanwords incurred much longer reaction times and higher error rates than did both non-words and pseudo-loanwords. Because all subjects in the study were native Japanese speakers, they had seldom or never before seen the unadopted loanwords in katakana that they had to lexically verify as existing Japanese loanwords. Thus, in this lexical verification process, subjects may have had to activate lexical representations of the original English words for the unadopted loanwords. As a result, this process created an inhibitory effect. Therefore, not only the slow processing speed, but also a high error rate of 27.95% for rejecting the unadopted loanwords also helped support concept of "interlexical activation."

There may be an alternative process for lexical decision of loanwords which do not involve "interlexical activation." Subjects may have used a strategy of rejecting unadopted loanwords by simply asking themselves whether they had seen those loanwords in katakana before. In order to investigate this possibility, an additional study by questionnaire was conducted whereby subjects were asked if they had seen the 24 unadopted loanwords in katakana before. Previous exposure to each unadopted loanword by the subjects turned out to be 28.54% on average, calculated by the number of "Yes" answers divided by the total of 20 subjects for each of the 24 unadopted loanwords. The correlation between previous exposure and error rates in lexical decision was significantly high. Thus, the alternative explanation of previous exposure to the 24 unadopted loanwords in katakana by subjects was supported by this result. Therefore, the

second concept of a "lexical mental boundary" was created on the basis of these findings.

The correlation between previous exposure to unadopted loanwords and reaction times for lexical decision was nevertheless not high enough to support the "lexical mental boundary" theory as a sole strategy for lexical decision. As mentioned before, latency for lexical decision of unadopted loanwords was much longer than that of non-words and pseudo-loanwords. Due to the longer latency required for "No" responses in lexical decision, there is still a possibility that lexical representations of original English words were activated in the cognitive processing of unadopted loanwords. Thus, although the present study provided strong evidence that native Japanese speakers utilize the processing strategy of previous exposure to loanwords in katakana for lexical decisions, in the process of rejecting unadopted loanwords, it is quite possible that native Japanese speakers activate lexical representations of original English words as well.

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