都留文科大学研究紀要　第85集（2017年３月）
The Tsuru University Review, No.85（March, 2017）

An Association between Script-Type Conventionality and Prosodic Congruency in Lexical Access

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Introduction

A “multiplier effect” of factors responsible for acceleration of lexical access speed in Japanese was studied by means of a lexical decision experiment through cross-modal priming. Two factors were examined: script-type conventionality of the target word and prosodic (pitch-pattern) congruency of the target word to the prime. Previous experiments (Hirose, 1984, 1985, 1992) suggested that script-type conventionality (i.e., orthographic familiarity) highly involves the facilitatory effect in lexical access. That is, words written in conventional script (e.g., loanwords written in katakana, Sino-Japanese words written in kanji) are accessed to the lemmas faster than words written in unconventional script (e.g., Sino-Japanese words written in katakana).[1] Other experiments (Sekiguchi & Nakajima, 1999) suggested that prosodic congruency, that is, the same pitch-pattern relationship between the auditory prime word and the visual target word triggers faster lexical access than the different pitch pattern relationship, if both words are segmentally the same (i.e., homophones). Suppose these suggestions hold true, then, does the summation of both factors simply cause much faster lexical access speed (which I call multiplier effect) than only one factor either conventional script or prosodically congruent pitch pattern? Does each factor contribute to the same degree of facilitatory effect in lexical access? A crucial question that needs to be answered is, thus, whether or not a multiplier effect occurs when the input stimuli have both script-type conventional and prosodically congruent features, because the effect resulting from association between script-type conventionality and prosodic congruency is not known. If the multiplier effect exists, which factor, script-type conventionality or prosodic congruency will contribute to faster lexical access? Besides, one problem in the previous experiment conducted by Sekiguchi and Nakajima (1999) would be solved. That is, in the experiment, real words were employed as auditory primes. This may indicate that it is quite likely that not only a prosodic factor but also a semantic factor facilitated lexical access in the target words. Thus, in the present experiment, nonword auditory primes that cannot be recognized as words but as pitch patterns were employed.

To summarize, it has already been suggested that both script-type conventionality and prosodic congruency facilitate lexical access separately (Hirose, 1984, 1985, 1992; Sekiguchi

& Nakajima, 1999). It is unknown, however, whether or not a multiplier effect occurs when both factors are applied at the same time, and to what extent each factor of them plays a role of acceleration of lexical access speed. In addition, there seems to be room for methodological improvement in the experiment. In order to explore the answers to these questions, it is speculated that the present lexical decision experiment through cross-modal priming is necessary, where auditory primes are nonwords so that the pitch patterns, but not the meaning of words, can be the priming stimuli to the participants. Four sets of factors (auditory prime－visual target) were employed as input stimuli: (1) prosodically congruent－script-type conventional (PC-SC), (2) prosodically congruent－script-type *unconventional* (PC-SuC), (3) prosodically *incongruent*－script-type conventional (PiC-SC), and (4) prosodically *incongruent*－script-type *unconventional* (PiC-SuC). Note that both auditory prime pitch patterns and visual target words were considered to be the simultaneous input stimuli in this experiment because the visual target words were presented to the participants right at the offset of the auditory prime (i.e., Interstimulus Interval［ISI］＝0ms), as the experiment by Sekiguchi and Nakajima (1999) adopted.

Background

Script-Type Conventionality and Lexical Access Routes

Theoretically, at least two models of lexical access were proposed: serial search model (e.g., Forster, 1976) and parallel access model (e.g., McClelland & Rumelhart, 1981). Suppose that we follow the parallel access model, one of the issues to be solved on lexical access may be whether or not different scripts in a given language undergo similar processing. When we recognize visually presented words, it is required for the lexically described representation to be coded in some way and to be identified with or retrieved from an internal representation in the mental lexicon. Thus, the process strategy in coding depends on how internal representation in the mental lexicon is presented. At least two lexical access routes/strategies for word recognition are generally accepted (e.g., Barron, 1980). One is a direct visual-orthographic route, through which the perceptual input about a word activates lemmas in the mental lexicon directly. That is, a number of potential lexical candidates are activated simultaneously, and then the stored lemma that shares the most features with the perceived input word wins (see Figure 1). Thus, a stored whole-word pronunciation is associated with each lemma.

The other is a mediated phonological coding route, where the perceptual input about a nonword or, for example, an unconventionally written word cannot activate lemmas in the mental lexicon because there are no potential lexical candidates to be activated in the lexicon. And thus the perceived input (e.g., nonword, unconventionally written word) is recognized (or at least pronounced) by means of phonological coding process, and if one of the input candidates has the phonological (i.e., segmental) features enough to match the stored lemma, the lexical access is complete. The model in Figure 1 is based on such experimental

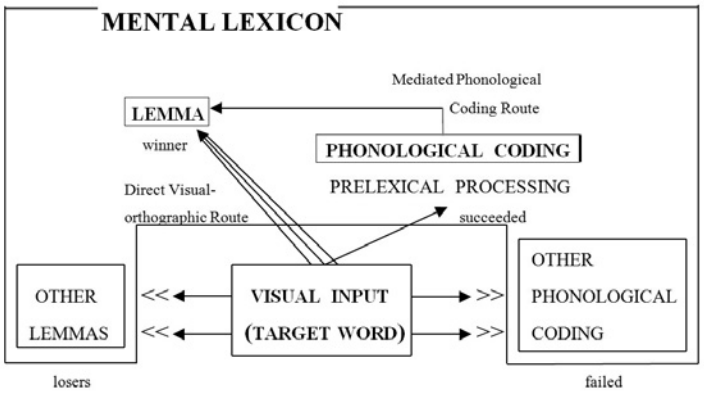

Figure 1 **. A proposed retrieving process of a lexical item based on the parallel access model, and two routes for lexical access.**

results that primed lexical decision and naming tasks on words written in some script bring about facilitatory priming effect on lexical access, whereas those tasks on nonwords or words which are written in other scripts do not bring about that effect. For example, it was reported that the Serbo-Croatian language, which has phonologically shallow orthographies (in which the Roman and Cyrillic alphabets show simple, regular letter-to-sound correspondences), is more dependent on phonological coding than English, which has a phonologically deep orthography (in which the Roman alphabet shows complex (i.e., irregular) letter-to-sound correspondences), evidenced by the lexical decision task by Serbo-Croatian bialphabetical readers (Lukatela, Popadić, Ognjenović, & Turvey, 1980). It was also reported that (1) semantically related priming facilitates lexical decision and word naming for English readers, whereas semantically related priming facilitates only lexical decision for Serbo-Croatian readers, and (2) the correlation between lexical decision and word naming is significant when there is no semantically related priming for Serbo-Croatian (Katz & Feldman, 1983). It was concluded that these results suggested that for English, lexical access is processed through the direct visual-orthographic route to the mental lexicon because a semantic facilitatory effect was found when the target is preceded by a semantically related prime, whereas for Serbo-Croatian, lexical access is mediated by the phonological coding domain because no semantic facilitatory effect was found on word naming.

In short, it was considered that when a semantic priming effect is manifested on visually presented word recognition, lexical access of the target mainly involves the direct visual-orthographic route, whereas when a semantic priming effect is not manifested as in the case of a nonword target, for example, lexical access of the target involves the mediated phonological coding route. Also, phonologically deep orthography (e.g., English) involves the direct visual-orthographic route, whereas phonologically shallow orthography (e.g., Serbo-Croatian) seems to involve the mediated phonological coding route (Lukatela et al., 1980; Katz & Feldman, 1983). Then, which route can be applied to the Japanese language?

The Japanese language has three major types of scripts: kanji, katakana, and hiragana. It

has long been a question of lexical access in Japanese whether the difference of script types causes a different process of lexical access. Saito (1981) claimed that when the same words written in kanji and in kana (regardless of either katakana or hiragana) were visually presented as target words, kanji words were recognized through the direct visual-orthographic route, whereas kana words were through the mediated phonological coding route. It is likely that kanji words were to be recognized through the visual-orthographic route, and kana words were through the phonological coding route because kanji is a logographic script and kana is a syllabic (or moraic) script. However, Hirose (1984, 1985) claimed that script frequency (i.e., script familiarity) rather than script type influences lexical access to a greater extent. In other words, the lexical access speed in words written in conventional script, such as loanwords written in katakana, conjugated words written by the combination of kanji and hiragana, and so on, is faster than that in words written in unconventional script, such as loanwords written in hiragana, Sino-Japanese words written in katakana, and so forth. He examined the effect of script frequency; that is, whether the lexical access speed of conventionally written katakana words (e.g., テニス/te.ni.sɯ/[2] 'tennis'; loanword) is different from that of unconventionally written katakana words (e.g., デンシャ/de.n.ʃa/←電車 'electric train'; Sino-Japanese word). As a result, in a category decision task, the reaction time (RT) of conventionally written katakana words was significantly shorter than that of unconventionally written katakana words, whereas there was no different RT between conventionally written katakana words and kanji words.[3] It seems to be true that this result indicates not only that the lexical access speed mainly depends on script-type conventionality (i.e., in which script a word is frequently written) rather than the property of script itself, but also that lexical access of katakana words may be achieved without recourse to mediated phonological coding. This interpretation is buttressed by the conclusions of Besner and Hildebrandt (1987) and Hirose (1992). Furthermore, Hirose (1985) found that the repetition effect (i.e., shortening of RT by means of repeated lexical decision tasks of the same word) occurred in unconventionally written katakana words, but not in conventionally written katakana words. This phenomenon may be interpreted such that the lemmas temporarily created through the phonological coding route facilitate the lexical access through the direct visual-orthographic route at the second time (repetition effect). These results may suggest that, in their mental lexicon, Japanese readers have lemmas which correspond to not unconventionally but conventionally written katakana words (e.g., loanwords), so that the lexical access speed of these words is faster than that of unconventionally written katakana words. Note that lemmas include at least visual, phonological (＝segmental), prosodic (＝suprasegmental), and semantic information; otherwise, no one can recognize visually presented words. In short, lexical access in conventionally written katakana words can mainly be processed through the direct visual-orthographic route; whereas lexical access in unconventionally written katakana words seems to be processed through the mediated phonological coding route, where only one candidate is retrieved in the lexicon and thus recognized by the participants, and other

phonological strings of segments are not recognized as words that they "know".

Prosodic Congruency and Lexical Access Routes

It has been suggested that in English, lexical prosody (i.e., primary stress) is not used for lexical access in word recognition (Cutler & Clifton, 1984; Cutler, 1986). A priming experiment conducted by Cutler (1986) showed that the lexical primary stress position plays no role in lexical access because the prime activates all word representations that are segmentally congruent to the prime, regardless of the different stress position. Although the stress-position difference in English affects word meaning and grammatical information (i.e., part of speech), it also brings about the segmental change (e.g., vowel reduction in an unstressed syllable) in many cases. Thus, lexical stress shift in English involves not solely prosody. On the other hand, the Japanese pitch pattern is a more independent factor on prosodic information. Sekiguchi and Nakajima (1999) examined whether lexical prosody (i.e., pitch pattern) would be used for lexical access in Japanese word recognition. In Japanese, a word is fundamentally distinctive by different pitch pattern, even though the segmental information is the same.[4] Mora-based different pitch patterns, such as in/a.ka/(HL; i.e., High-Low) 'red' vs. /a.ka/(LH) 'scum', and /dʑi.do.o/(HLL) 'school children' vs. /dʑi.do.o/(LHH) 'automatic', contribute to word distinction. Thus, if a prosodic information (i.e., distinctive lexical pitch pattern) is used for lexical access besides other information, word recognition may be processed more efficiently. One of the experiments conducted by Sekiguchi and Nakajima (1999) is a lexical decision task through cross-modal priming. The target words were visually presented at the offset of a segmentally identical auditory prime that was either prosodically congruent (i.e., homophones) or incongruent (i.e., pseudo-homophones) to the target. It was reported that there was a facilitatory effect in a lexical decision task when the prime-target relation was both segmentally identical and prosodically congruent (e.g., PRIME: /dʑi.do.o/(LHH)－TARGET: **自動** 'automatic'＜/dʑi.do.o/(LHH)＞[5]; but not PRIME: /dʑi.do.o/(HLL)[6]－TARGET: **自動**). Under the condition that both an auditory prime word and a visual target word are segmentally the same, if the prime is prosodically congruent to the target (i.e., homophone), the RT in a lexical decision task is significantly shorter than that in the case either where the prime is prosodically incongruent to the target (i.e., pseudo-homophone), or where the prime is segmentally unrelated to the target, regardless of its prosody.[7] They concluded that this result would suggest that, in Japanese, lexical prosody constrains the activation of potential lexical candidates on lexical access, and thus the pitch pattern was used for lexical access by Japanese readers, unlike the English primary stress not being used for lexical access by English readers. Moreover, this also can be interpreted such that prosodically congruent priming in Japanese facilitates lexical access in the target word recognition through the direct route because prosodic information must be in the lemmas.

To summarize, lexical access in English word recognition is considered to be processed through the direct visual-orthographic route, but the lexical prosody (i.e., primary stress) is

not used for lexical access. Comparatively, in Japanese word recognition, it can be suggested that only if the target word is script-type conventional, lexical access is processed through the direct visual-orthographic route. And the lexical prosody (i.e., pitch pattern) seems to be used for lexical access because prosodic congruency between the auditory prime word and the visual target word facilitates lexical access. Then, the research questions are in the next section.

Research Questions

1) Is there any relationship in lexical access speed between the prosodic congruency and the script-type conventionality?

2) In the case where the input stimuli have both prosodically congruent (PC) and script-type conventional (SC) features, is lexical access speed accelerated as a multiplier effect, as compared with the case where the input stimuli have either prosodically incongruent (PiC) or script-type unconventional (SuC) features, or both (PiC+SuC)?

3) If the multiplier effect exists, which factor, prosodic congruency or script-type conventionality, could contribute to faster lexical access?

Hypotheses

1) It was hypothesized that some kind of relationship in lexical access speed between the prosodic congruency and the script-type conventionality would exist.

2) The double employment of both factors contributes more to the facilitation of lexical access than the employment of either one individually. To put it briefly, it was presupposed that the combination of two facilitating factors of lexical access in Japanese: script-type conventionality and prosodic congruency of input stimuli, would speed up lexical access to a greater extent（multiplier effect）.

Even if the multiplier effect exists, however, we have no clue to the answer about which factor, prosodic congruency or script-type conventionality, could contribute to faster lexical access.

Method

Participants

15 native Standard Tokyo Japanese speakers (10 males, 5 females) ranging in age from late teens to early twenties, who were college sophomores, participated in the experiment. The participants voluntarily took part in the experiment. All participants stated that they lived in the area of Tokyo, Kanagawa, Saitama, or Chiba Prefecture, where people use the Tokyo pitch accent pattern. All participants reported that they had normal or corrected-to-normal vision and no hearing impairment.

Stimuli

Input stimuli consisted of a set of 12 auditory primes of a HLL pitch pattern and 12 visual target words/nonwords per participant. The HLL pitch pattern auditory stimulus was a continuously vocalized 444 ms sound recorded by the author (native Standard Tokyo Japanese speaker), and the visual stimuli consisted of 12 words/nonwords, including two kanji words, six katakana words, two kanji nonwords, and two katakana nonwords. Each of the words excluding nonwords has its intrinsic lexical pitch pattern, and the combination of the HLL auditory stimulus and a word/nonword visual stimulus made a prime (see Table 1).

Table 1.
Auditory Stimuli and Visual Stimuli

Prime Type	Auditory Stimulus	Visual Stimulus (Target Word/Nonword)				Intrinsic Pitch Pattern	Gloss
		Script-Type Conventional Word	Script-Type Unconventional Word	Nonword	Pronunciation*		
PC+SC	HLL	次回			/dʒi.ka.i/	HLL	'next time'
		ブーツ			/bɯ.ɯ.tsɯ/		'boots'
PC+SuC	HLL		タイド		/ta.i.do/	HLL	'attitude'
			ゼンブ		/dze.m.bɯ/		'all'
PiC+SC	HLL	一路			/i.tʃi.ɾo/	LHL	'one way'
		スター			/sɯ.ta.a/		'star'
PiC+SuC	HLL		カトキ		/ka.to.ki/	LHL	'transition period'
			トシブ		/to.ʃi.bɯ/		'urban area'
	HLL			語京	/ɡo.kjo.o/		
				員知	/i.n.tʃi/		
				タリカ	/ta.ɾi.ka/		
				ツンド	/tsɯ.n.do/		

Note. PC=Prosodically Congruent; SC=Script-Type Conventional; PiC=Prosodically Incongruent; SuC=Script-Type Unconventional.
*/. /=Mora boundary.

The visual stimuli (i.e., target words/nonwords) consisted of five types of words/nonwords depending on the preceding auditory stimulus: 1) PC+SC (two words that are prosodically congruent with the auditory stimulus, and are also script-type conventional), 2) PC+SuC (two words that are prosodically congruent with the auditory stimulus, but are script-type *unconventional*), 3) PiC+SC (two words that are prosodically *incongruent* with the auditory stimulus, but are script-type conventional), 4) PiC+SuC (two words that are prosodically *incongruent* with the auditory stimulus, and are also script-type *unconventional*), and 5) four nonwords that are irrelevant both to the auditory prime because they have no intrinsic pitch pattern, and to the script-type conventionality because they are nonwords (see Table 1).

The total target words/nonwords were 12 tokens per participant. Among them, all target words were common nouns. The auditory stimulus pitch pattern in this experiment was HLL only,[8] and the employed *incongruent* pitch pattern was LHL against congruent HLL. All target words/nonwords consisted of three moras. Prime types depending on the stimulus

combination are illustrated in Table 1. Note that script-type conventional HLL words, 次回/dʒi.ka.i/'next time' and ブーツ/bɯ.ɯ.tsɯ/'boots', were in the similar word frequency, referring to Tono, Yamazaki, and Maekawa (2013), so that we could avoid the deviation resulting from the word frequency effect. However, word frequency for script-type conventional LHL words, 一路/i.tʃi.ɾo/'one way' and スター/sɯ.ta.a/'star', as well as that for the other script-type *unconventional* words was uncertain due to lack of references.

Procedure

Participants performed a lexical decision task through cross-modal priming. First, they were instructed to focus on the fixation point (+) in the center of a pre-exposure field that was present at all times except during presentation of the visual target. Immediately after the offset of the fixation point display, the auditory stimulus, which was a continuously vocalized HLL pitch sound recorded by the author, was given for 444ms. Then, right at the offset of the auditory prime, a visual target word or nonword appeared by replacing the fixation point. The participants were asked to press the 1 key for 'Yes' on the computer keyboard if the target was a real word, or the 2 key for 'No' if it was a nonword, as quickly and as accurately as possible. To familiarize the participants with the experiment, they were asked to practice three times by using the practice data set. At the beginning of each trial, the fixation point was presented for 1,000ms for them to focus on the center of the display. According to the participants' response, the fixation point reappeared and one trial was completed. The total number of practice tokens was 36 (12 words/nonwords × 3 sets) per participant, and in each set two words were presented per prime type and four nonwords were presented as well. In the actual session followed by the practice sessions, the 12 visual targets were randomly presented every time. After the experiment, mean RTs were calculated for correct responses on all trials, and the RT difference given by the prime type was statistically analyzed.

Results

The number of the participants was 15, and the total number of experimental trials was 12 per participant. Because incorrect responses were excluded, the total number of experimental trials to analyze was 149. Table 2 presents the means and standard deviations of

Table 2.
Descriptive Statistics of RT

Prime Type	*M*	*SD*	Correct Response	Total Response
1. PC＋SC	498.48	77.07	29	30
2. PC＋SuC	648.93	213.18	27	30
3. PiC＋SC	535.65	153.58	26	30
4. PiC＋SuC	732.19	198.71	16	30
5. Nonword	711.73	196.77	51	60

Note. $N = 15$

reaction time (RT) by prime type.

A one-way analysis of variance was conducted to evaluate the relationship between the specific combination of prime types and the change in reaction time when the lexical decision task was conducted. The independent variable was the combination of prime types, consisting of five levels: PC+SC (Prosodically Congruent Script-type Conventional) prime, PC +SuC (Prosodically Congruent Script-type *Unconventional*) prime, PiC+SC (Prosodically *Incongruent* Script-type Conventional) prime, PiC+SuC (Prosodically *Incongruent* Script-type *Unconventional*) prime, and Nonword prime along with the same HLL auditory stimulus as in the other primes. The dependent variable was the change in the reaction time by the specific combination of prime types. Because the factor was only one (i.e., prime type), and each of the participants provided the RT data just once, a one-way between-subjects ANOVA was used for analysis. The results of ANOVA were significant at the .05 level, F (4, 144) = 10.08, p <.05. The strength of relationship between the prime types and the change in the reaction time, as assessed by η^2, was strong (η^2=.22), with the prime type factor accounting for 22% of the variance of the dependent variable.

Follow-up tests were conducted to evaluate pairwise differences among the means of the levels of the prime type. Because the standard deviations ranged from 77.07 to 213.18, the variances ranged from 5,939.78 to 45,445.71, and Levene's test of equality of error variances was not passed, the variances were different from each other. Therefore, we used the Games-Howell test that did not require the population variances to be equal. As in Table 3, there were significant differences in the means between the prime types 1) PC+SC and 2) PC+SuC; 1) PC+SC and 4) PiC+SuC; and 3) PiC+SC and 4) PiC+SuC. In other words, the RT provided by the prime type 1) PC+SC was significantly shorter than that provided by the prime types 2) PC+SuC and 4) PiC+SuC. Also, the RT provided by the prime type 3) PiC+SC was significantly shorter than that provided by the prime type 4) PiC+SuC. In addition, 1) PC+SC and 5) Nonword, and 3) PiC+SC and 5) Nonword were also significantly different as to the means.

Table 3.
The Results of Follow-up Pairwise Multiple Comparisons

Prime Type A	Prime Type B	Mean Difference (A−B)	Standard Error	*p*
1. PC+SC	2. PC+SuC	−150.44*	43.45	.01
	3. PiC+SC	−37.17	33.35	.80
	4. PiC+SuC	−233.71*	51.70	.00
	5. Nonword	−213.24*	31.05	.00
2. PC+SuC	3. PiC+SC	113.27	50.89	.19
	4. PiC+SuC	−83.26	64.43	.70
	5. Nonword	−62.80	49.42	.71
3. PiC+SC	4. PiC+SuC	−196.53*	58.09	.02
	5. Nonword	−176.07*	40.82	.00
4. PiC+SuC	5. Nonword	20.46	56.81	1.00

Note. An asterisk indicates that the mean difference is significant at the .05 level.

Discussion

Suppose that there is no evidence for a speed-accuracy trade-off, and that the error rate is not at all significant, there may be another factor to which a specific RT difference is attributed. By the presence of both prosodic congruency and script-type conventionality in the cross-modal priming experiment, we could expect the results accounting for the mean differences of RT: (1) RT is significantly short when both factors are present, (2) RT is not significantly affected by the presence of both factors in comparison with either one being missing, and (3) RT is longer when both factors are present. In the case of (1) above, it means that the multiplier effect appears. The lexical access speed is more accelerated by the presence of both factors, and this suggests that the input stimuli having both factors allow more efficient activation for lexical access. It also suggests that lexical access is complete straightforwardly by means of the activation process constraining the target lemma rapidly and effectively through the direct visual-orthographic route, in which prosodic information and script-type information may be accessed and judged by the input stimuli hierarchically as far as the target word is immediately preceded by the prosodic prime, as illustrated in Figure 2.

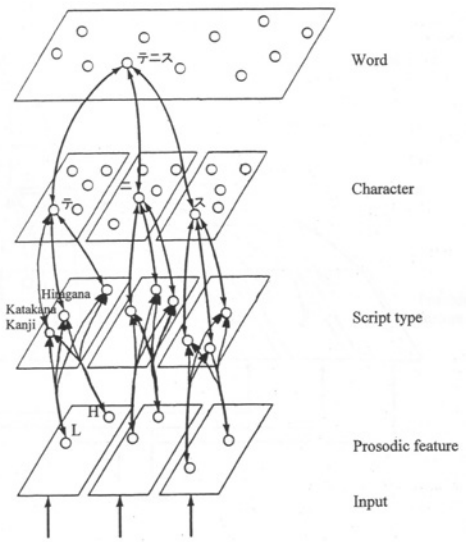

***Figure 2*. Prosodic information and script-type information accessed and judged by the input stimuli hierarchically.** （**e.g., テニス/te.ni.sɯ/（HLL）'tennis'; conventionally written katakana word.**）

In this case, it is important at which point the prosodic prime is set up. Because at the offset of the prosodic prime the target word starts to be presented in this experiment, it was assumed that both the prosodic prime and the visual target are not the separate input stimuli but the continuum of them, which may be the most effective to the multiplier effect of prosodic congruency and script-type conventionality. If the prosodic prime and the visual

target were presented simultaneously, it is presupposed that either the prime or the target would exclusively affect the speedup of lexical access, but no multiplier effect would occur; that is no acceleration of the lexical access speed would take place. Furthermore, the error rate of the lexical decision task would vary, according to the subjects' dichotic listening ability.

On the other hand, if the prosodic prime and the visual target were presented with too much interval (e.g., ISI＞1s), the prosodic prime would not affect the speedup of lexical access, regardless of which stimulus precedes the other. And, if the interval is short enough not to be dependent on the ability in an individual's working memory, the multiplier effect may occur to some extent. It will be the matter how long the interval between the two stimuli is and which stimulus precedes the other.

In the case of (2), there may be two possibilities to be assumed. (2-1) The combination of both factors does not affect the speedup of lexical access owing to some kind of "cancellation effect". Because the prosodic prime precedes the target word (with ISI＝0ms), it can be thought that the faculty in an individual's working memory responsible for prosodic information does not involve the speed of lexical access. Or, (2-2) each factor plays a role of speedup of lexical access independently, and it may suggest that prosodic information and script-type information may be accessed separately, which may mean that the domain of prosodic information is different in dimension from that of script-type information, as illustrated in Figure 3.

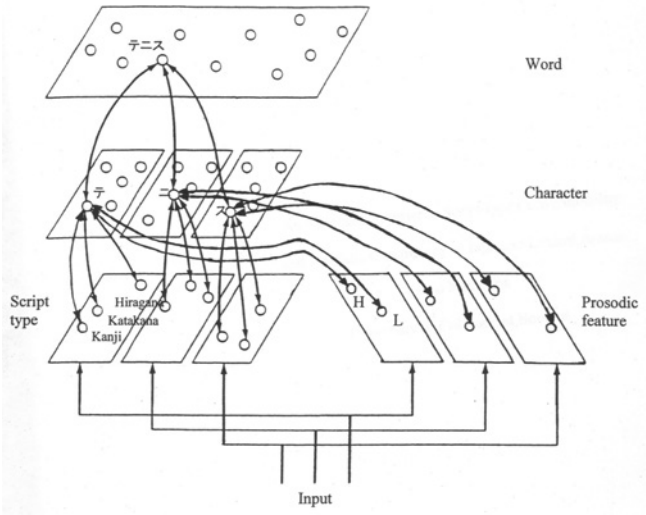

***Figure 3*. Separate domains of prosodic information and script-type information.**

Finally, in the case of (3), it can be considered that some "inhibitory effect" occurs, such that a different prelexical process works between the prosodic prime and the visual target word. This means that prosodic congruency is even a negative prime to cause the delay of lexical access. If this happens, although it may not be likely so, we have to assume another prelexical processing domain as well as the phonological coding domain.

Looking at Table 3 above, we can see that script-type conventionality plays a significant role in RT. That is, all pairs of the prime types 1-2, 1-4, 1-5, 3-4, and 3-5 showing significantly short RT involved script-type conventionality. In other words, when script-type conventional prime exists, the RT difference between the prime type and the other prime type tends to be highly significant, though there were non-significant differences between the prime types 1-3 and 2-3. As to prosodic congruency, it seems true that prosodically congruent primes may not play a significant role in RT difference in this cross-modal priming experiment because when script-type conventionality was the same in the pairs of prime types, namely, 1-3 and 2-4, no significant RT difference was found although prosodic congruency was different in these pairs. This phenomenon may show the facilitatory effect of RT only in terms of script-type conventionality, even where two prime types: auditory and visual, were presented to the participants. Thus, the existence of multiplier effect in RT was not quite clear from this result, nor was the mediated phonological route being used by native Japanese speakers.

Conclusion

The present study investigated whether or not a multiplier effect of factors occurred. That is, the relationship between script-type conventionality of the target word written in kanji or katakana and prosodic (pitch-pattern) congruency of the target word to the auditory prime was investigated. Two alternative results were assumed by the presence of both factors; RT is shorter or not affected, in comparison with the case that either one factor is missing. The data provided through the experiment showed that at least script-type conventionality played a significant role in RT even in the cross-modal priming settings. However, there was no significant effect that prosodic congruency could play a role in RT. This may suggest that lexical access is complete by means of the activation process mainly through the direct visual-orthographic route. Because the result showed that the RT was shorter particularly when script-type conventionality existed, prosodic information may not have worked or may have worked only as a supplemental resort in Japanese lexical access.

At least one problem to be solved remains. That is, the word frequency effect for script-type conventional words was partially ignored. When a more suitable target word choice is made, the present experiment should be reattempted.

Notes

[1] Sino-Japanese words are the words consisting of kanji that were originally imported from ancient Chinese and often modernized in shape and meaning in Japanese.

[2] Throughout this paper, a dot in the phonemic transcription indicates mora boundary.

[3] Kanji words were always regarded as conventionally written words in the experiment. See Hirose (1984).

[4] I call the words segmentally the same but prosodically different as pseudo-homophones since they are not strictly homophones.

[5] In this paper, / / indicates a real auditory input, while </ /> indicates the gloss information for non-Japanese readers, in order to avoid confusion between primes and targets.

[6] /dʒi.do.o/(HLL) represents 児童 'school children'.

[7] That the auditory prime word is both segmentally and prosodically the same as the visual target word does not always mean both words are identical because Japanese has a lot of homonyms; 夏季 'summer season', 火気 'fire', 火器 'firearms', and 牡蠣 'oyster' are all pronounced as /ka.ki/(HL).

[8] In Tokyo Japanese, there are at least two rules of the lexical pitch pattern: (1) The relative pitch of the first mora must differ from that of the second mora, and (2) the pitch that once falls down to L never goes up to H within a word. Thus, the possible pitch patterns for a three-mora word are HLL, LHH, and LHL (e.g., ナイフ/na.i.ɸɯ/(HLL) 'knife', 豆腐 / to.o.ɸɯ/(LHH) 'tofu', こしょう/ko.ʃo.o/(LHL) 'pepper').

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Received : October, 5, 2016
Accepted : November, 9, 2016