Raeding Wrods with Jubmled Charactres in Japnaese

Kazuo Mori

(Tokyo University of Agriculture and Technology)

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Rayner, White, Johnson, and Liversedge (2006) reported an interesting phenomenon, and dubbed it 'jumbled word effect.' They found that college students were able to read sentences in which about 40% of the words contained transposed letters ('jumbled words') relatively as easily as normal sentences. Reading speed decreased about 11% when internal letters were transposed, about 26% when ending letters were transposed, and 36% when beginning letters were transposed. (*Could you read this paragraph well?*)

Whether the 'jumbled word effect' is unique to English has not been examined yet. To begin addressing this question, we replicated the Rayner, et al. experiment with Japanese undergraduates and Japanese sentences. The Japanese language differs substantially from English in various aspects; it is an agglutinative language with subject-object-verb word order, is mora-timed with a lexically significant pitch-accent system, and has a unique orthographic system with a mixture of Chinese ideograms (*kanji* 漢字) and two types of Japanese phonograms (*hiragana* ひらがな and *katakana* カタカナ). Such differences might affect reading jumbled words.

Method

Thirty-six Japanese undergraduates, 20 male and 16 female (19 to 23 years old), participated in the experiment individually. All the participants were native speakers of Japanese.

The participants were asked to read 80 sentences aloud at normal speed, each of which included one word with *hiragana* characters transposed. The target words were selected from 4 to 6 words in *hiragana* that were easy to read and common in daily usage. Short sentences were composed (N=120) with candidate target words, then 80 were chosen by means of pilot familiarity ratings by five psychology majors. For each critical word, three types of character-transposed words were created: Beginning-transposed, interchanging the first two characters (くつりもの), Intermediate-transposed, interchanging the second and third characters (つりくもの), and End-transposed, interchanging the last two characters (つくりのも). Some unchanged words were used (No-transposition つくりもの; Table 1). Altogether, there were 320 sentences, or four versions of each of 80 sentences (17–32 characters long; $M=23.4$, $SD=4.2$). Four sets of 80 sentences were created with 20 sentences from each of the four types, balancing the four different versions.

Each participant read one of the four sets of 80 sentences aloud in random order. The reading performances were video-recorded and reading speeds were measured sentence-by-sentence from the video recording, using a stopwatch to time the reading from the outset to the end.

Table 1

Average number of characters read per minute and the decrement rates compared with the normal sentence reading

Transposition	<i>M</i>	<i>SD</i>	Decrements
No transposition (つくりもの)	526	57	--
Beginning (くつりもの)	510	61	3.2%
Intermediate (つりくもの)	521	62	1.1%
End (つくりのも)	515	63	2.1%

Results

Table 1 shows the average number of characters read per minute (cpm) for the four types of character transposition conditions. A one-way ANOVA indicated that the transposition effect was statistically significant ($F_{3,105} = 11.19$, $p < .01$; $\eta^2 = 0.3228$). Tukey's *post hoc* test ($MSe = 220.5$, $p < .05$) indicated statistically significant differences between the No-transposition condition and the Beginning- and End-transposition conditions, but not between the No- and Intermediate-transposition conditions. The difference between Beginning- and Intermediate-transposition conditions was also statistically significant.

Although the patterns of reading speed were similar to Rayner, et al.'s (2006) observations, effects were smaller. In Rayner, et al. (2006), about 40% of words were transposed, while only about 20% were transposed in the present study, as only one transposed character was inserted ($M = 4.2$ characters) into each sentence (M length = 23.4 characters). The delaying effect of character transposition seemed much smaller in Japanese than in English, even taking into account the difference in the transposition rates.

Hiragana characters consist of consonant-vowel pairs, but they cannot be separately pronounced. In this aspect, *hiragana* is more independent as opposed to the Alphabets. *Hiragana* might provide some "built-in" context that might ease reading a jumbled word. This could explain why the effects were smaller.

As described above, the Japanese language is quite different from English in many aspects, in addition to the use of *hiragana* as well as *kanji* characters. It is noteworthy that the pattern of effects of jumbling characters was found to be similar in two disparate languages. However, further examination concerning possible differentials between the delaying effects in various languages is needed.

REFERENCES

- Rayner, K., White, S. J., Johnson, R. L., & Liversedge, S. P. (2006). Raeding Wrods With Jubmled Lettres. *Psychological Science*, 17, 192-193.