Reading Processes of English Sentences in Japanese and Canadian Students*

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ABSTRACT: Native skilled, non-native skilled, and non-native non-skilled English readers read English texts and their reading times of words were measured. The results showed that reading times of native skilled readers were independent from the word length, word location, and grammatical word classification compared to non-native readers. Reading times of nouns strongly correlated with reading skill of readers. Although non-native skilled readers comprehended text meanings well, however the pattern of reading time of words was still different from those of native reader.

KEYWORDS: Reading time, skilled readers, cross-cultural comparison, word length, word location, grammatical word classification.

When native Japanese speakers read a text written in foreign language, they usually expend more time and get a poor comprehension although they can read a native text much quicker and comprehend it better. Why do these differences happen? The purpose of the present study is to shed some light upon these differences of native and non-native English readers.

As Downing and Leong (1982) wrote, reading consists of various cognitive processes and reading ability depends upon the strategy which each reader employs. A skillful reader can be regarded as the person who uses some special optimal strategy making the optimal efficiency in reading. In contrary, poor readers might be those who have not obtained the strategy yet.

Several studies have compared the reading processes of good and poor readers and have revealed: (1) good readers are able to identify words more quickly, (2) good readers possess a larger capacity of working memory, (3) good readers can recall a story more in detail than poor readers, and (4) good readers may possess more lateralized hemisphere functioning.

When considering the findings of these reports by an experimental design which aimed to compare reading processes between good and poor readers, we can not but doubt that the factors, except reading ability, were not controlled properly. For example, were not there any difference in the

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factors such as physiological development, reaction time for each word, speed of information transmission, etc.?

One of the ways to control such factors might be to compare reading processes of the readers of the first and second language in the same subjects of population such as university students, that is, to conduct cross-cultural comparision. If we compare the reading process of native readers with that of non-native readers, we may be able to clarify some differences in reading strategy between good and poor readers. Furthermore, when we compare the findings of this cross-cultural study with the findings of the study in which reading processes of good and poor readers in the same language are compared, we may be able to get some cues of reading processes in skilled readers.

Therefore, in the present study, we compared English text reading processes of Canadian University students with that of two groups of Japanese University students. For the Japanese University students, those in English Majors were used as skilled English readers, and those in Japanese Majors were used as less skilled English readers.

There are several approaches to examine the reading process. One of these is to measure reading time, which reflects some aspects of on-going reading process. Since in normal reading situation, exposure duration of words (sentence) is under the control of reader, it is important to maintain reader's own pace in examining reading process. In the present study, we employed word-by-word method where reader can present a single word in a text by his/her pace and the time consumed to process each word was measured.

In this word-by-word method, there are three different types of experimental paradigm. One is so-called the stationary-window method, where every word is presented in the center of the screen after clearing the previously presented word. That is, only one word is presented at one time. The second method is called the cumulative method in which the words are presented in the usual position from the left to right on each line, with accumulating the words on the screen. In this method, all words appeared one by one until the last word of the text has been read. The third method, the moving-window method, is the variation of the cumulative method. The words do not remain on the screen after they have read. The screen is initially filled with dashes corresponding to the positions of the words in the stimulus text. As the reader presses a button, a word is presented, replacing the dash corresponding to its own position. At the same time, the previous word is replaced with dash again. In this method, only one word is visible at one time.

Just, Carpenter and Wolley (1982) compared these three methods with eye fixation of a reader using an eye tracker. They found that the moving-window method most closely resembled a natural reading situation. However, it has been stressed that the backward saccade eye-movement in

a text reading is an indispensable factor for good readers, and poor readers sometimes lack this backward eye-movement (Pirozzolo, 1984). When we face an unknown text (particularly written in a foreign language), native Japanese readers sometimes read for meaning. So, it must be rather difficult for non-native English readers to understand the meaning of the text presented with the moving window method.

Therefore, the cumulative method was used in the present study. In the present study, we measured the reading time of each word of the text and compared consumed time for reading between groups having different reading abilities. In particular, we aimed at comparing group differences of reading time as a function of word length, word location in the text, and classified word group.

METHOD

Subject

Twelve students from the University of Saskachewan in Canada participated in this experiment as the subjects of the native English readers (CS: Canadian Students). The 12 students from the Department of English Literature at Osaka University of Education served as the skilled non-native English readers (ES: English Major student). As the less-skilled non-native English readers, 12 students from the Japanese Department at the same Japanese university also participated in the experiment (JS: Japanese Major students).

It is regarded that all the students in three groups possess similar biological characteristics (e.g., intelligence, motor skill), but they are different in English reading ability.

Apparatus

A personal computer (NEC PC-9801VM) with 14 inch CRT screen and response buttons were used to present stimulus of English texts and to measure the reading time.

Stimulus Materials

Two kinds of English texts were used as the stimuli. The one is explanatory text with logical and scientific story which consisted of 104 words, and the other was a narrative text with 125 words. Figure 1 shows the samples of the stimuli.

Procedure

All the subjects were seated facing the CRT screen in a quiet room

Explanatory story:

In the last 200 years many kinds of animals have died out. People have killed animals for their meat, oil, or feathers. People have also destroyed animals' homes when they built houses and factories in fields and woods. . . . . .

Narrative story:

When I was in the sixth grades, my class elected me president. It was a very hard job. When the students talked in class, I had to scold them. When they fought each other, I had to stop them. I didn't enjoy being president. . . . . .

Fig. 1. Samples of the Reading Texts used.

individually. The stimulus English text was presented word by word on the computer screen. When the subject pressed the button for each word after reading it, the next word in the English text appeared on the screen next to the previous words. In this manner, the English words would be controlled successively by reader's own pace and the words would be located in the natural English position, reading from the left to the right on each line. Therefore, all the words were accumulated on the screen until the entire text was displayed. Each of two texts short enough to fit on the screen.

The time interval between the presentation of one word and the appearance of the following word which initiated by the subject pressing the button was measured as the word reading time (RT). The computer measured RT in milliseconds. Each subject was given the short text which consisted of 34 words as a practice trial in advance of the test session. One half of the subjects read the explanatory text first and the narrative text second and the other half of subjects read two texts in the reversed order.

After reading each stimulus text, the subjects were given a comprehension text which required the subjects to choose the correct description as for the given two texts out of four alternatives. Five questions in total were given for each stimulus text.

RESULTS

Figures 2, 3, 4, 5, 6, and 7 show the mean RTs for length, location and classification of the three subject groups in two types of English texts.

The results were separately analyzed from the view point of three different aspects: words length, word location, and word grammatical classification.

(1) *Word Length.* Based upon the number of letter strings, all words in each stimulus text were classified into three types, Short (less than 3 letters), Medium (from 4 to 6 letters), and Long (more than 7 letters). To

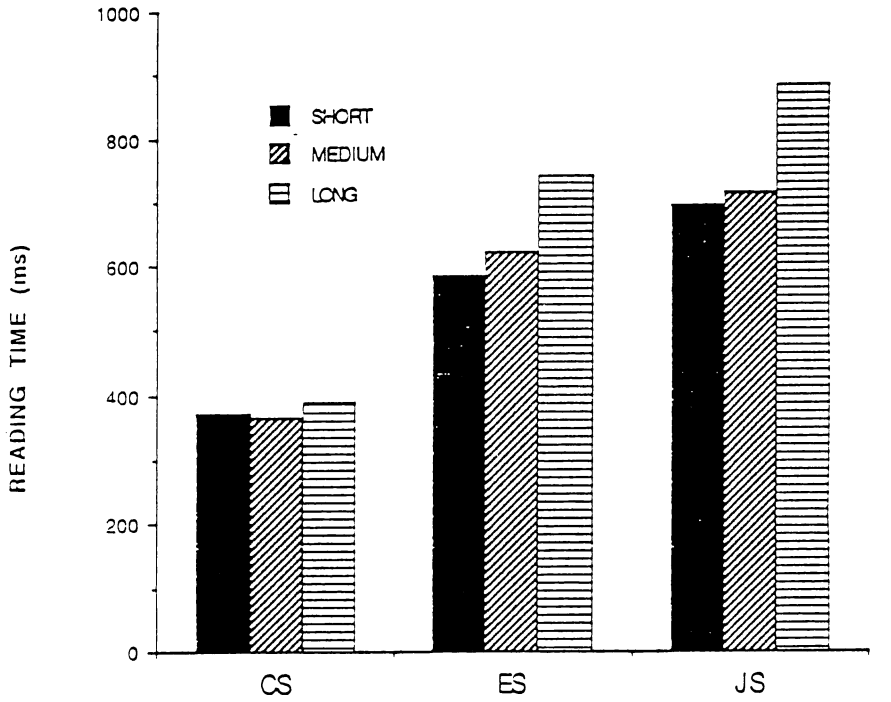

Fig. 2. Reading Times of Three Groups as a Function of Word Length (Explanatory).

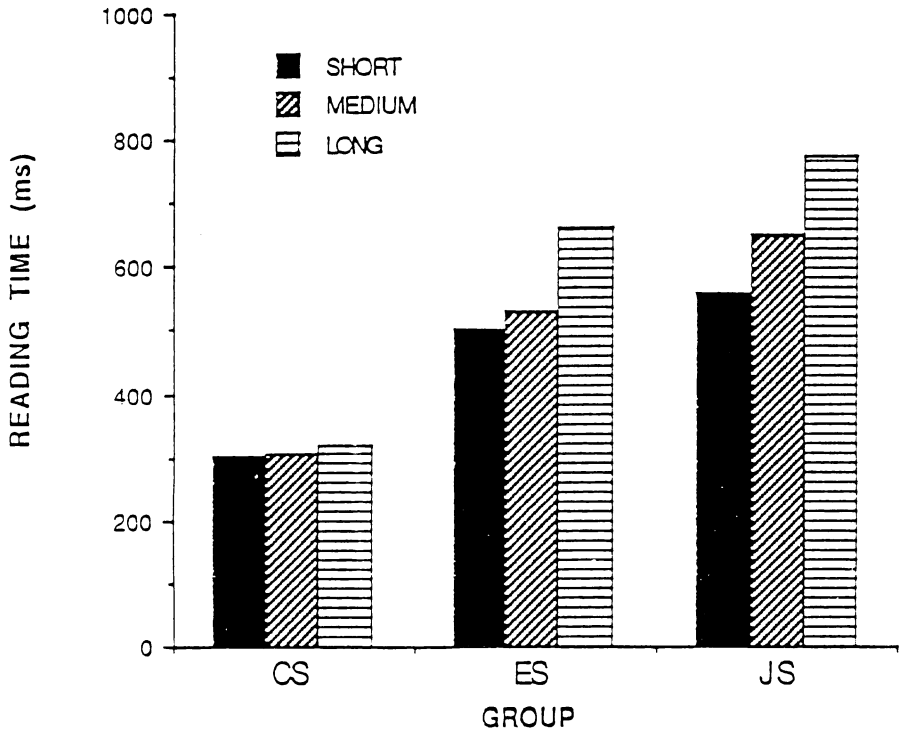

Fig. 3. Reading Times of Three Groups as a Function of Word Length (Narrative).

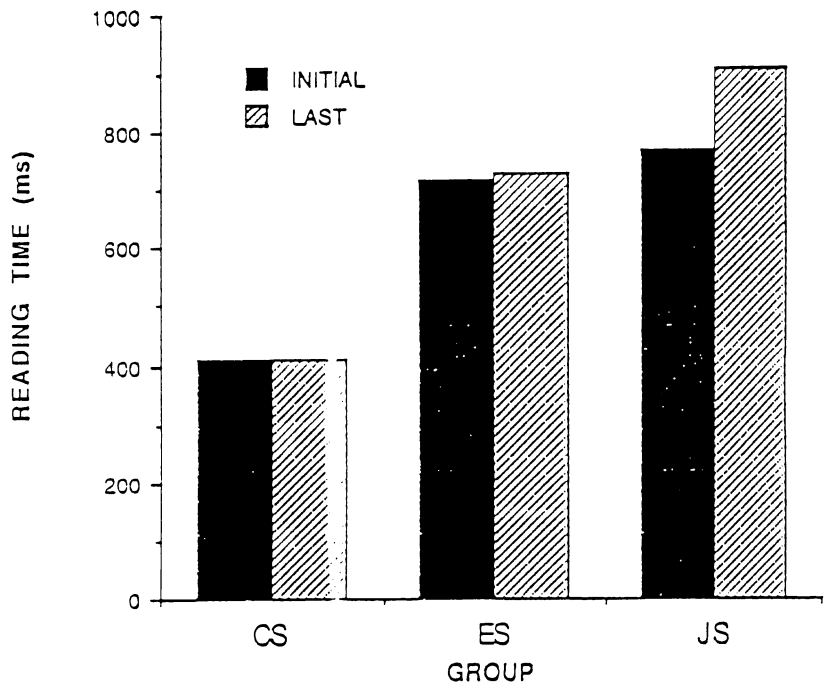

Fig. 4. Reading Times of Three Groups as a Function of Word Location (Explanatory).

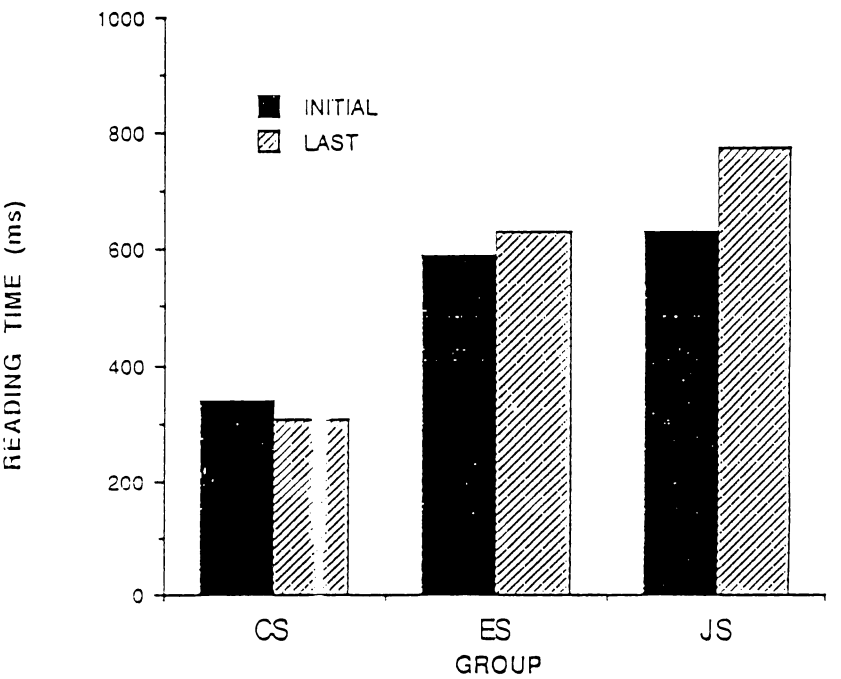

Fig. 5. Reading Times of Three Groups as a Function of Word Location (Narrative).

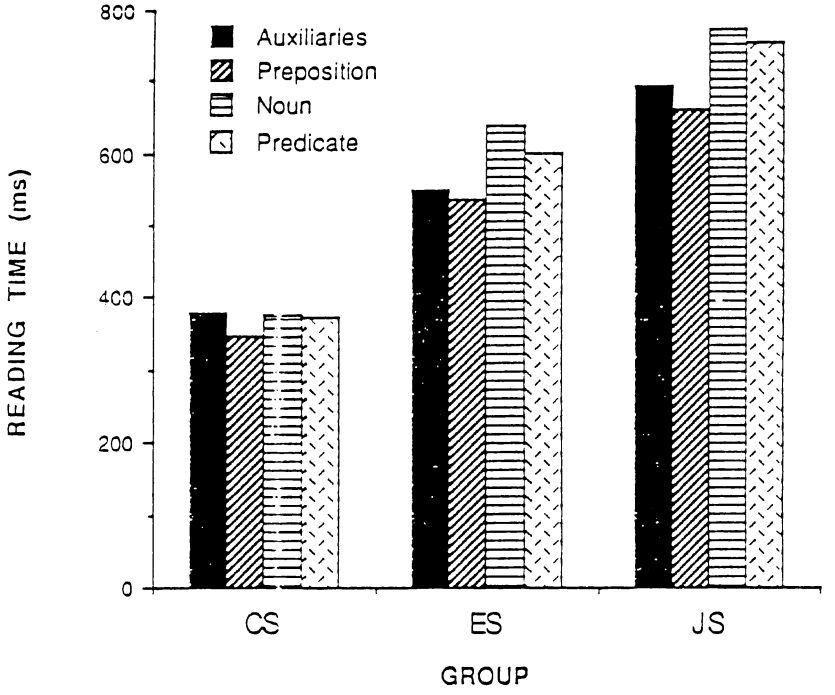

Fig. 6. Reading Times of Three Groups as a Function of Word Classification (Explanatory).

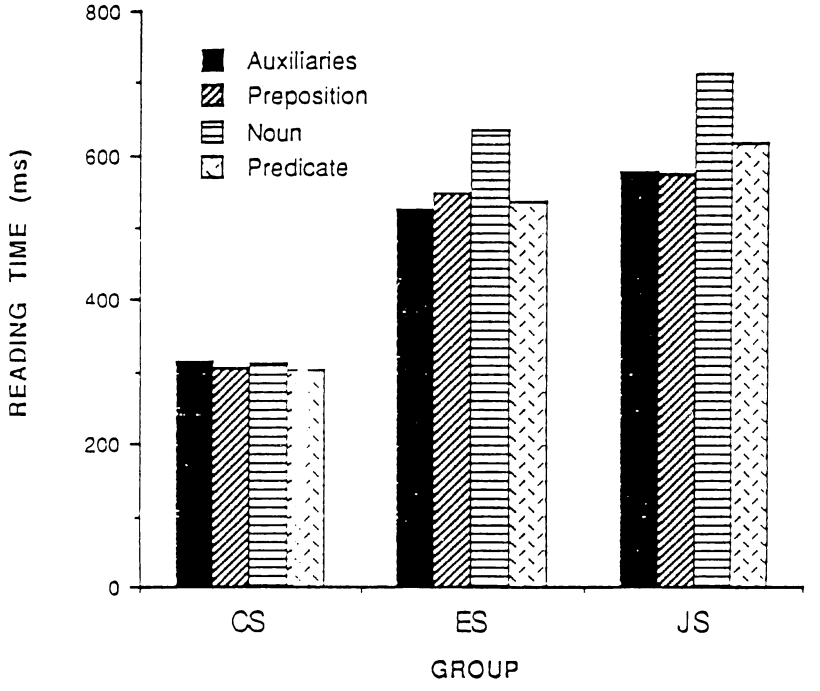

Fig. 7. Reading Times of Three Groups as a Function of Word Classification (Narrative).

examine the effects of word length on RT, an analyses of variance, (one between (group) and one within (word length) factor), was performed and revealed the followings;

(a) As for the explanatory text, both factors of group and word length were significant ($F(2,33) = 11.25$, $p < 0.01$ and $F(2.66) = 14.72$, $p < 0.01$, respectively) and the interaction between these two factors was also significant ($F(4,66) = 2.85$, $p < 0.05$). The results indicated that CS showed no difference in RT as a function of word length, while ES and JS required longer RT as the word became longer.

(b) As for the narrative text, both factors of group and word length were significant ($F(2,33) = 18.68$, $p < 0.01$ and $F(2,66) = 15.96$, $p < 0.01$, respectively) and the interaction between these factors were also significant ($F(4,66) = 3.56$, $p < 0.05$). As with the explanatory text, the results showed that CS showed no difference in RT as a function of word length, while ES and JS required longer RTs depending upon the word length.

(2) *Word Location.* The words in each text were classified into two types according to the location of the words in sentence; the initial word of the sentences (or clauses) and the last words of the sentences (or clauses). Same type of two-way ANOVA was conducted on RT data. The results indicated that;

(a) in the explanatory text, the group factor was significant ($F(2,33) = 9.35$, $p < 0.01$), suggesting that RTs of CS was significantly shorter than those of ES and JS. However, CS and ES showed no RT difference between the initial and the last words while JS showed significant difference ($F(1,33) = 4.48$, $p < 0.05$). For JS, the last word required longer reading times than the initial words.

(b) in the narrative text, the group factor was significant ($F(2,33) = 16.71$, $p < 0.01$); RT of CS was significantly shorter than those of ES and JS. CS and ES showed no RT difference between the initial and last words while JS showed significant difference ($F(1,33) = 5.11$, $p < 0.05$). Once again, JS needed a longer reading time for the last words than the initial words.

(3) *Grammatical Word Classification.* The words in each text were classified into four categories, auxiliaries, prepositions, nouns, and predicates. To examine the effect of word characteristics on RT. Same type of two-way ANOVA was conducted. The results indicated that;

(a) in the explanatory text, both factors of group and classification were significant ($F(2,33) = 15.57$, $p < 0.01$ and $F(3,99) = 5.05$, $p < 0.01$, respectively); CS required a significantly shorter RT than those of ES and JS in all the classifications of words. The results showed that CS showed no difference in RTs among word classifications and that ES and JS showed a tendency of longer RT in reading nouns.

(b) in the narrative text, both factors of group and classification were significant ($F(2,33) = 19.94$, $p < 0.01$ and $F(3,99) = 4.03$, $p < 0.01$, respectively). The results indicated that CS required significantly shorter RT than those of ES and JS, and that CS and ES showed no difference in RT depending on word classification while JS required longer RT in reading nouns than the other classifications of words.

In addition, the comprehension test was administered to every subjects. Figure 8 shows the results of the comprehension test for each text of the three groups.

The statistical analyses showed that (1) in explanatory text, JS showed a poor comprehension score than CS and ES (JS < CS: $t = 2.95$, $p < 0.01$; JS < ES: $t = 2.53$, $p < 0.05$; CS = ES: $t = 0.55$, NS), and that (2) in narrative text, JS again showed a poor comprehension score than CS and ES (JS < CS: $t = 2.50$, $p < 0.05$; JS <ES: $t = 2.24$, $p < 0.05$; CS = ES: $t = 0.19$, NS).

DISCUSSION

The present experiment was designed to examine differences in the word RTs among three groups of readers.

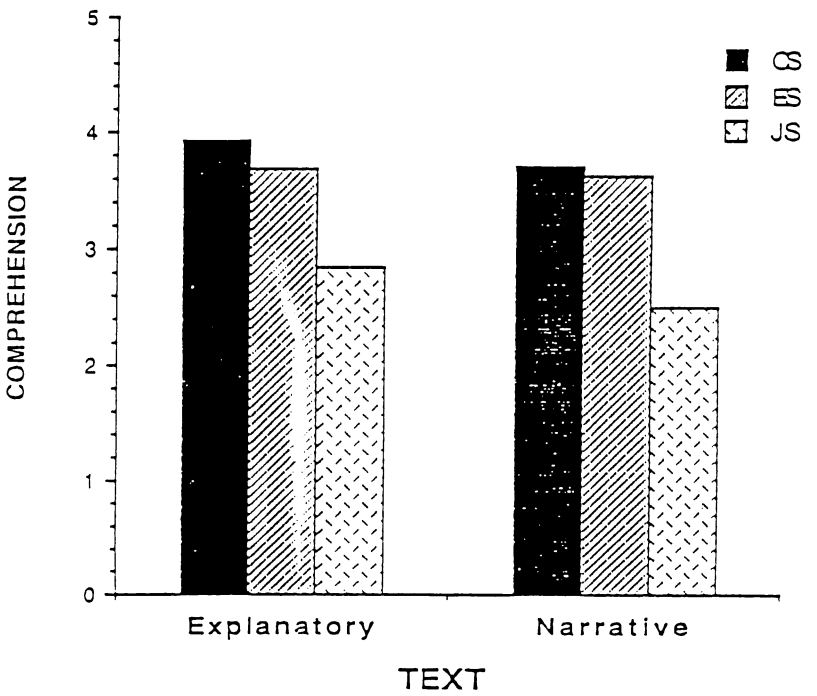

Fig. 8. The Results of the Comprehension Test of the Three Groups.

As shown in the results of the comprehension tests the ES reached to a similar level of performance to that of the CS though the results of JS were different from those. However, as described below, the results of RTs revealed some differences among three groups of subjects. This fact indicates that using of comprehension tests alone in reading research can not reveal some hidden difference in reading process. The measure of reading time seems to reveal some interesting mechanisms.

The results of RTs in both the explanative and the narrative texts generally showed similar tendencies.

The RTs of native English readers (CS) were not affected by the variables of word length, word location, and word classification. On the other hand, the RTs of non-native English readers (Japanese university students) were affected by these three variables. This tendency was observed in both skilled (ES) and less skilled (JS) non-native English readers, but more prominent in less-skilled non-native English readers.

We wish to examine more in detail the group differences depending on variables.

For the factor of Word Length, RTs changed according to reading ability; that is, skilled readers process every word in almost equal RT. Furthermore, RTs in CS are independent of the word length, but RTs in both ES and JS are strongly affected by the word length. These findings seem to suggest several things:

(1) Speed of processing each word is dependent on reading abilities. Even skilled readers in this experiment, processing speed of the second language does not reach the level of native readers.

(2) CS seems to process every long word in a Gestalt (or holistic) type of processing. That is, CS can process each word which contained plural letters as one thing. This may be reflected also on the fact that few words containing more than three morphemes appeared in the text and were easy enough for CS.

(3) Since JS showed a relatively longer reading time compared to CS, or even ES, JS could process the words analytically in the manner of grapheme-phoneme correspondence. This tendency was also observed that JS took longer RTs when the word strings became longer.

(4) As with JS, ES also showed a longer reading time compared to native English readers (CS), so ES could process the words analytically. Once again, ES took longer RTs when the word strings became longer. These results of JS and ES suggest that the non-native English readers (Japanese university students in this experiment) can employ a strategy which differed from that of native English readers.

For Word Location, JS showed longer RT for the last words than for the initial words, while both CS and ES had no difference between two locations of the words. Because the last words were located just before comma or period, JS needed an extra time at the end of clauses or

sentences probably in order to translate a set of words into meaning. JS might have to return previous words to comprehend meaning of sentence clearly, since the word order in Japanese sentences is different from English.

However, ES did not show such a difference. This seems to suggest that accessing style of meaning of each sentence by ES could be a similar one that CS used. They did not need extra time at the end of each sentence, probably becauce they could reach the meaning while they were reading the words. Of course, CS could do this automatical processing of meaning much faster than ES did.

For Word Classification, CS showed no significant difference in RT depending on the word classification, while both ES and JS did. As indicated in the Figure 4, both groups of readers, ES and JS required extra RTs in reading nouns. This tendency was observed in both the explanatory and narrative texts. This may suggest that the most important factor distinguishing non-native readers from native readers must be nouns; non-native readers have to pay extra attentions and spend more time in constructing whole meanings.

Summarizing these findings, we may reach the conclusion that there is difference in reading process between native readers and skilled foreign readers.

Why and by what factors is such difference made? As many factors seem to have been controlled in the present experiment, the most apparent factor of group differences must be caused by the difference of the amount of English learning experiences.

Then, what are brought up by the reading experience? Yorio (1971) pointed out the importance of so-called meta-strategy such as prediction or automatic selection of important words for grasping meaning. Yorio suggested that non-native readers were deficient in ability of prediction and therefore they often failed to select a correct cue. As a result of selecting incorrect cue, they have the difficulty to grasp meaning of the text. In the present experiment, though JS showed longer RTs in long words, it was not as important for cue words in the text and their comprehension of the texts was also poor. The ability of selecting correct cue words in the text may depend on the amount of learning experience.

Pirozzolo (1985) proposed that readers have two main tasks in reading, decoding and comprehending. He suggested that skilled readers can decode automatically, so readers can pay more attention in comprehending the text. The less-skilled readers decode words un-automatically, so they have to pay extra attention in the stage of decoding processes. This suggestion is consistent with our findings that JS needed an additional time to decode a long word. JS must have required a lot of extra cognitive resources in visual discrimination of each letter and word.

A lot of reading experiences seem to decrease the effort of cognitive

resources on early stage of text reading (coding) and increase the cognitive effort on the later stage of reading processes (comprehension).

In conclusion, though it is speculative, this study suggests the importance of increasing reading experience. Repetitive reading of the same kind of text, that is over-learning, may be a crucial factor in reading education. We may suggest that in English reading education in Japan, too many kinds of text are given to learners in a limited amount of school hours. It may be better to offer the pupils same kind of text repetitively and to provide ample time to construct 'prediction'.

NOTE

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