Dissociation of Reading and Writing Romanized Japanese by Japanese College Students

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Abstract. The Japanese writing system has four scripts, but the use of the fourth script, called romaji, is quite limited in an interesting way. To investigate how Japanese college students read and write romaji, we examined proficiency in this script and hiragana (a traditional syllabary) in four experiments: proficiency in writing isolated words in Experiments 1 and 2, oral reading speeds at the text level in Experiment 3, and naming latencies for syllables in Experiment 4. The results taken together showed that while writing speed is almost comparable between romaji hiragana, reading speed much slower in romaji than in hiragana. It is suggested that this dissociation can arise mainly from a differential pattern of reading and writing experiences in romaji among Japanese people. Some theoretical implications are given for the future of romaji in Japan.

Key words: romaji, dissociation between reading and writing, reading experience

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Introduction

The Japanese writing system has four scripts, logographic kanji, two kana syllabaries called hiragana and katakana, and romaji. The first three scripts are well-established in the writing system (see Appendix 2 for sentences written in hiragana, and a sample sentence composed of kanji, hiragana, and katakana in a standard way), but the fourth is not. The term of this fourth Romanized script remains ambiguous and the status of the script itself is often inaccurately described. For example, Saint-Jacques (1987) stated as follows.

> "Words which until four or five years ago used to appear in magazines and newspapers, on television, on billboards and advertisements of all kinds, in the katakana syllabary, particularly loan-words from English, French, and other languages, suddenly started to be written in Roman letters. This use was extended to Japanese names and even to Japanese words, in some cases in the middle of a Japanese sentence written in the Japanese script, presenting therefore simultaneous use of kanji, kana, and Roman letters" (pp. 91-92).

The term, Roman letters, here is not taken as the same as romaji; rather it indicates original letters such as English and French ones. This statement thus simply means that, in the writer's impression, loan words tend to be written in the original languages instead of the once commoner script, katakana. Such being the case, it does not seem correct to say that Japanese words are written in Roman letters (or in romaji) and used in the middle of a Japanese sentence. For example, the present authors have found no Japanese words in newspaper articles of the Asahi (a major

Japanese newspaper), May 8, 2004. All they have found in the main articles are <NGO, OB, AP, WTO, CIA, CPA, EU, PR, IASB, TOPIX, UFJ, IT, LAN, PC, ADSL, BB, NTT, JAL, SARS, CC, MLB, UEFA, FW>, and <NEC>. Words such as <VALUE, LE TANNEUR, JAL ACTIVE HOKKAIDO>, and <Cooking> are found in classified ads but few are embedded in normal sentences.

More recently, Kess and Miyamoto (1999) stated as follows.

> "Japanese has a fourth script which is not formally recognized as part of the traditional orthographic system. But it is omnipresent, and used in a number of interesting ways to complement the appearance of kana and kanji in printed text. This is called romaji (ローマ字), because the Japanese use 22 of the 26 letters of the Roman, or Latin, alphabet" (p. 112).

When these authors say that 22 letters are used in romaji, they seem to refer to Hepburn romanization, one of the three systems currently used (kunreishiki, nipponshiki, and Hepburn), which excludes <l>, <q>, <v>, and <x> from the English alphabet (e.g., Unger, 1987; Coulmas, 2001). This means that acronyms such as <LAN> and <TOPIX> are not written in romaji. In any event, whether the above four letters may be included or not, it is very rare for Japanese people to see romaji words in normal sentences appearing in books, journals, and newspapers. In this sense, it is accurate to state that romaji is omnipresent. However, Kess and Miyamoto correctly suggest that romaji has not been established as part of the Japanese writing system (see also Hatta, 2001). In sum, Japanese people rarely write Japanese words in romaji in their written communication. They never embed romaji words in a Japanese sentence; if they do, the sentence would look bizarre.

The status quo of romaji, however, seems to present some interesting

features because of two increasing impetuses in present-day Japanese. First, with the advent of computer communications technology including Japanese word processors and cell phones, romaji has begun to function as an instrument with which to write words in the mainstream scripts. The user of a Japanese word processor, for example, has to use romaji as a mediator to produce hiragana symbols, which, if necessary, are further converted into kanji characters or katakana symbols. Romaji letters (eiji, or English letters) on the display of a word processor, however, are "half-invisible" most of the time because vowel letters are invisible. For example, to produce a hiragana symbol with a consonant and a vowel, say <か> /ka/, the writer first presses the k key, thus producing the romaji <k>, which is visible on the display. But when he/she presses the next a key, the romaji <a> does NOT appear there, but the hiragana symbol <か> appears instead! The writer cannot see the syllable <ka>. Very few Japanese people seem to notice this phenomenon. What is going on here is that the user of a word processor always produces only consonant romaji letters but never sees syllables and syllable strings in romaji. Under this condition, Japanese people become familiar with individual romaji letters and phoneme-grapheme correspondences. In terms of romaji writing, they become proficient at converting individual phonemes into romaji.

A second impetus is the fact that children are exposed to romaji directly at one stage and indirectly at another stage, which may become more significant especially when loan words written Roman letters frequently appear in magazines and newspapers, on television, on billboards and advertisements. At the first stage, they are taught romaji-phoneme (and/or romaji-syllable) correspondences toward the end of the fourth grade. But the learning period is too short for children to be fluent readers/writers in this script; actually, children acquire no or

relatively little experience reading romaji in their fifth and sixth grades. It may thus not be an exaggeration to describe most of fourth to sixth graders as letter-by-letter readers, or illiterates in romaji. (One of the reviewers of this paper stated that despite of the insignificant use of romaji in Japanese texts, the incorporation of romaji into the school curriculum implies the existence of some specific pedagogical aims. The historical background of this socio-political and pedagogical issue, however, is beyond the present study. See Unger, 1996.) In the second stage, children learn English as a second language in the seventh through twelfth grades. Because many grapheme-phoneme correspondences (especially for consonants) are similar between English and romaji, children may relearn or overlearn sound values of romaji letters. Here again, however, what children learn is at the phoneme or (open) syllable level because romaji and English orthographies differ, and children remain poor at reading in romaji at the sentential and text levels.

Our speculation on these situations is that children may be induced to do letter-by-letter processing both in reading and in writing, but only their reading remains problematic for practical purposes. The reason is that writing is, by nature, letter by letter, but it can be relatively fast and fluent even that way as the sound value of each romaji is acquired and processed automatically through the use of a word processor and the learning of English. Reading, on the other hand, cannot be improved unless letter-by-letter reading is qualitatively changed into word-by-word or phrase-by-phrase reading. Such a qualitative change, however, is not likely to take place because children are not exposed to words in romaji. As a consequence, children would become relatively good (albeit letter-by-letter) writers but poor letter-by-letter (or syllable-by-syllable) readers in romaji.

This speculation derives from our occasional observations, and has to be subjected to experimental scrutiny. Also this speculation involves many theoretical and empirical questions concerning the status of romaji in the Japanese writing system. What if children are exposed to romaji texts? Why, at present, is romaji not used for reading? Is romaji an optimal script for Japanese? Is it theoretically plausible to replace kanji, hiragana, and katakana with romaji? What is the future of romaji?

The main purpose of this study is to investigate how Japanese college students read and write in romaji in comparison with hiragana. Experiments 1 and 2 are concerned with writing in romaji and hiragana, and Experiments 3 and 4 with reading in these scripts. We will discuss some theoretical issues of the findings from these experiments.

Experiment 1

Experiment 1 examined writing speed in romaji and hiragana. In this experiment, Japanese college students attempted to transliterate kanji words into hiragana or romaji as fast as they could. It was expected that the transliterating speed in romaji is not very slow compared to that in hiragana if there is not a large difference in processing efficiency between converting phonemes into romaji and converting syllables into hiragana.

Method

Participants. Forty-six freshman students from a national university in Japan participated in this experiment. Most of them were 19 years of age. Twenty-two students were given a hiragana transliteration task and twenty-four were given a romaji transliteration task in a classroom setting.

Materials. One sheet of paper was used as a test sheet. On the front page of the sheet, instructions were printed, and on the reverse side there were 60 basic kanji characters which all represented high frequency nouns.

There was a blank beside each stimulus kanji character, where the participant was to transliterate the target kanji into hiragana if assigned the hiragana condition, and into romaji if assigned the romaji condition. See Appendix 1 for examples of kanji stimuli and their corresponding hiragana and romaji words.

Procedure. This task was given in a regular English language class at the university. On hearing the experimenter's signal, "Start," the participant looked at the test sheet and began to transliterate each test kanji item into hiragana or romaji. When the experimenter said "Stop," they stopped the task. The time allotted was one minute as a pretest suggested that no one would be able to finish all 60 characters within one minute.

Results

The number of words transliterated in one minute, i.e., words per minute (WPM), was counted for each participant. The number of hiragana symbols transliterated in one minute, i.e., symbols per words (SPM), and the number of romaji letters per minute (LPW) were also counted for each participant. The mean WPM was 39.0 (SD = 5.3) for hiragana, and 24.6 (SD = 2.9) for romaji; the mean SPM was 79.2 (SD = 10.5) for hiragana and the mean LPM was 109.2 (SD = 13.0).

The mean WPM was significantly greater for hiragana than for romaji, $t(44) = 11.01$, $p < .001$. The mean was about 1.6 times (39.0/24.6) greater. By contrast, the mean LPM for romaji was significantly greater than the mean SPM for hiragana, $t(44) = 5.83$, $p < .01$. This time, the mean was about 1.4 times (109.2/79.2) greater for romaji than for hiragana.

Discussion

A discrepancy of transliterating speed showing that hiragana is faster at the word level but slower at the symbol/letter level can arise because

more romaji letters are needed to write a word than are hiragana symbols (e.g., <た> for <ta> and <し> for <shi>). The words written in this experiment were composed of a mean of 2.0 hiragana symbols (79.2/39.0) and a mean of 4.4 romaji letters (109.2/24.6). If the word is the basic unit for communication, we may well conclude that Japanese college students write faster in hiragana than in romaji. The difference does not appear very large, however.

A question may be raised concerning time components of writing durations. Did writing words in romaji take longer simply because many more romaji letters had to be written than hiragana symbols even though it took shorter to write a romaji letter than a hiragana symbol? (If a word were composed of a mean of 2.8 romaji letters, romaji words would be written as fast as hiragana words.) Or did it take longer to access or process the graphemic form in romaji than in hiragana? To address this issue, we need to divide the total transliterating duration into its components.

The time taken to transliterate a kanji word in the present experiment was composed of three major components: (1) time to access the phonological form of the stimulus kanji word, (2) time to access the graphemic form of the response word, and (3) time to write the sequence of symbols/letters. Because the first component was kept equal between the two script conditions, it would be reasonable to attribute the differences in word transliterating time in this experiment to the second and/or third component.

In Experiment 2, we attempted to measure the first and second component times combined (hereafter referred to as 'writing latency') and the third component time (referred to as 'writing duration') under the hiragana and romaji conditions.

Experiment 2

Glover and Brown (1994) suggested several methods to measure spelling latency and spelling response duration for English words, e.g., the spelling production time method in which oral spelling times are measured for auditorily presented words. Unfortunately, such methods are not applicable to Japanese, where the name and the sound value for each hiragana symbol are the same; for example, for <あ>, its name is /a/ and its sound value is also /a/.

What we employed in this experiment was a simpler, more naturalistic method. Stimulus kanji characters (single-kanji nouns) were presented one by one on a tachistoscope display, and the participant attempted quickly to transliterate the kanji characters into hiragana or romaji on a sheet of paper with a ball-point pen. When the experimenter pressed the starting button and the stimulus item immediately appeared on the display, the click, a short sharp sound, was audible, and on the transliterating task, the sounds produced by the ball-point pen were also made audible with the thin test sheet placed on a steel desk. These sounds were audio-taped, and the writing latencies (i.e., the durations from the onset of the stimulus items to the onset of writing) and writing durations were later measured with a speech analyzer.

Method

Participants. Six undergraduate and graduate students recruited from the same university as that used in Experiment 1 participated in the present experiment. Their ages ranged from 21 to 25 years. None of them participated in the previous experiment.

Materials. Twenty easy test kanji were selected mainly from the 60 test items used in Experiment 1 (Appendix 1). There was one test item which

was written in two letters in romaji and two symbols in hiragana (i.e., <青> /ao/ “blue” for <あお> and <ao>). In addition, two such items were included (<愛> /ai/ “love” for <あい> and <ai> and <上> /ue/ “top” for <うえ> and <ue>). If the number of letters accounts for the difference in transliterating duration between romaji and hiragana in Experiment 1, then no difference would be observed between these two-letter/symbol words.

Procedure. The participant sat at a small desk placed in front of a tachistoscope (IWASTU, ISEL 701A). When the experimenter clicked the starting button, a test item appeared at the center of the screen, and the participant attempted quickly to transliterate it into hiragana in the hiragana condition and into romaji in the romaji condition.

A set of 20 kanji for one session was used twice in both script conditions. Participants were thus given a total of four sessions, in each of which they were given the same 20 test kanji for transliteration. For half the participants, sessions 1 and 3 were the hiragana condition and sessions 2 and 4 were the romaji condition; for the other half, sessions 1 and 3 were the romaji condition and sessions 2 and 4 were the hiragana condition. The first two sessions were used as practice trials and the last two sessions as test trials.

An audio-tape recorder (Sony, TW01) was located near the participant and recorded the clicks of the starting signal and the sounds the participant made in writing. Participants were tested individually in a quiet room.

Measures. As stated above, writing latency was defined as the time from the onset of the test item to the onset of the sounds made by the participant's writing activity, and writing duration as the onset of the writing sounds to the offset of the writing sounds. Writing latency and

duration were measured to the nearest 4 msec with a speech analyzer (Kawai, KPS-110). Measurements were made twice for each response and the mean was used for analysis.

Results

Data were discarded if apparent slips of the pen (e.g., rewriting the same strokes) were observed in the final products on the test sheets, eliminating none in the hiragana condition and 1.7% in the romaji condition.

Table 1 shows mean writing latencies, writing durations, and total transliterating durations in the two script conditions for six participants.

TABLE 1 GOES ABOUT HERE

A 2×2 ANOVA with repeated measures (Time: writing latency and writing duration, and Script: hiragana and romaji) showed that all the effects were significant, $F1(1, 5) = 13.07$, $p < .01$, $F2(1, 19) = 38.38$, $p < .001$ for time, $F1(1, 5) = 325.45$, $p < .001$, $F2(1, 19) = 33.58$, $p < .001$ for script, and $F1(1, 5) = 54.47$, $p < .001$, $F2(1, 19) = 4.48$, $p < .05$ for the interaction. These results showed that the means were consistently longer in romaji than in hiragana. More important was the significant interaction between time and script. The mean difference in writing latency between romaji and hiragana was 132 msec with the ratio of romaji to hiragana being 1.1 to 1, whereas the mean difference in writing duration was 457 msec with the ratio of romaji to hiragana being 1.4 to 1.

In Experiment 1, the mean time taken to transliterate a word was 1,538 msec for hiragana and 2,439 msec for romaji, the difference being 901 msec. The ratio of the total transliterating duration in romaji to that in hiragana in Experiment 1 was thus 1.6 to 1 (2,439/1,538), which approximated the ratio for writing duration in the present experiment (i.e.,

1.4 to 1: 1,509/1,052). The ratio of the mean total transliterating duration in romaji to that in hiragana in the present experiment, however, was 1.3 to 1 (2,569/1,980), which suggests the effect of the task differences. We thus conclude that writing duration accounts for a much larger part of total transliteration duration than does writing latency. It follows, therefore, that it takes longer to write in romaji than in hiragana because there are more letters in romaji words than symbols in hiragana words.

Some subsidiary findings were also consistent with this conclusion. First, there were three two-letter words, one three-letter word, 13 four-letter words, and three five-letter words in the romaji condition. If writing duration and total transliterating duration are largely accounted for by number of letters, those measures but not writing latency should correlate significantly with word length. That was exactly the case. The mean latencies for the two-, three-, four-, and five-letter words were 1,040 msec, 1,045 msec, 1,077 msec, and 1,033 msec, whereas the mean writing durations were 766 msec, 1,253 msec, 1,639 msec, and 1,769 msec. The correlation was not significant between word length and writing latency, $r(18) = .01$, but was significant between word length and writing duration, $r(18) = .95$, $p < .01$., and was also significant between word length and total transliterating duration, $r(18) = .89$, $p < .01$. These results show that the longer the romaji word, the longer the writing duration and the total transliterating duration but that the writing latency is not affected by romaji word length.

Second, the three two-letter romaji words (i.e., <ai> “love” <ao> “blue,” and <ue> “top”) were comparable to their hiragana counterparts (<あい>, <あお>, and <うえ>) in terms of word length (i.e., two letters vs. two symbols), and thus these were picked out for further analysis. Table 2 summarizes the mean writing latencies, writing durations, and total

transliterating durations for these test items in the two script conditions. The results here were very clear; the writing latencies were shorter in hiragana (M = 908 msec) than in romaji (M = 1,046 msec), but the writing durations were much shorter in romaji (M = 786 msec) than in hiragana (M = 1,204 msec), and the total transliterating durations were also shorter in romaji (M = 1,832 msec) than in hiragana (M = 2,112 msec).

TABLE 2 GOES ABOUT HERE

Third, correlations of writing latency, writing duration, and total transliterating duration in the two scripts were computed on the basis of test items (N = 20). The following results were consistent with the conclusion that in both script conditions, transliterating duration was largely accounted for by writing duration: the high correlations between writing duration and total transliterating duration in hiragana (r = .99) and in romaji (r = .92), and nonsignificant correlations between writing latency and transliterating duration in hiragana (r = .03) and in romaji (r = .22).

Discussion

The results suggest that it took longer to transliterate kanji words in romaji than in hiragana (1,980 msec for hiragana and 2,569 msec for romaji, Table 1) mainly because there were many more letters in romaji words than symbols in hiragana words even though the effect of script on the orthographic access time (writing latency) was also significant (928 msec for hiragana and 1,060 msec for romaji, Table 1).

We thus conclude that writing in romaji is not very slow compared to writing in hiragana. In particular, we may note that two-letter words in romaji are written faster than two-symbol words in hiragana (Table 2).

This means that if a sentence is largely composed of vowels, e.g., “Ano aoi ie ga ii” (I like that blue house), it would be written faster in romaji than in hiragana.

The next question we address is whether our college students read words in romaji almost as fast as in hiragana. In Experiment 3, we examine how fast college students read sentences in romaji and hiragana.

Experiment 3

In this experiment, participants were asked to read out loud a short passage written in romaji or in hiragana. Their oral reading was audio-recorded and the reading times were measured.

Method

Participants. Eighteen university undergraduates and graduates participated in this experiment. Many were 19 years of age. Three members had taken part in Experiment 1 and one in Experiment 2 one or more weeks before; but their participation in previous experiments was considered not to affect their performance in this experiment.

Materials and Procedure.

Two continuous short paragraphs composed of two sentences each were taken from one passage that appeared in a Japanese primer for sixth graders. To make a hiragana version, all words written in kanji and katakana were transliterated into hiragana, keeping the words in hiragana as they were, and to make the romaji version (of a Hepburn type), all words were transliterated into romaji (Appendix 2). There were, thus, four short paragraphs: Hiragana paragraph 1, Hiragana paragraph 2, Romaji paragraph 1, and Romaji paragraph 2. Participants were divided into two groups. Group 1 (N = 9) was given Romaji paragraph 1 and Hiragana paragraph 2 in this order, and Group 2 (N = 9), Hiragana paragraph 1 and Romaji paragraph 2 in this order.

Participants were asked to read out loud the paragraph as quickly and accurately as they could. They were tested individually in a quiet room. Their oral reading was audio-taped. Later the oral reading time was measured twice with a stopwatch and the mean of these two measures was used for analysis.

Results

The mean words per minute (WPM) was 147.1 (SD = 24.1) for hiragana and 70.5 (SD = 16.5) for romaji. The mean WPM was 2.1 times greater for hiragana than for romaji. A two-way ANOVA with two groups of participants by two scripts showed that the effect of script was highly significant, $F(1, 16) = 422.36$, $p < .001$, the effect of group was not significant, $F(1, 16) = 1.41$, and the interaction between script and group was not significant, either $F(1, 16) < 1$.

The mean symbols per minute (SPM) was 401.9 (SD = 66.5) for hiragana and the mean letters per minute (LPM) was 340.9 (SD = 78.4) for romaji. The mean SPM/LPM was 1.2 times greater for hiragana than for romaji. The effect of script was highly significant with hiragana being faster than romaji, $F(1, 16) = 28.68$, $p < .001$, the effect of group was not significant, $F(1, 16) = 1.81$, and the interaction between script and group was not significant, $F(1, 16) = 1.12$.

Discussion

The results clearly showed that college students read romaji much slower in romaji than in hiragana. This was in marked contrast with the findings regarding writing rate in Experiments 1 and 2. Examination of oral reading performances suggested that many participants laboriously read words in romaji as if they had been novice readers in the first grade who read a hiragana sentence symbol by symbol, or syllable by syllable. Long pauses were often observed before unfamiliar words such as

"Yambaru" and "noguchigera," whose frequencies were zero to most of the participants. A remarkable case in this regard was one participant who wrote romaji words at the speed of 30 WPM in Experiment 1 and read a romaji passage at the speed of 37 WPM in this experiment. That is, his reading rate was not significantly different from his writing rate, $\chi^2(1) < 1$. (Note, however, that the mean word length is about 1.3 times longer in this experiment than in Experiment 1.) One of the author (JY) asked him why he could write words so fast although he read so slowly. He replied that he used a word processor a few hours on a daily basis (implying that he was good at converting phonemes into romaji) but never read words and sentences written in romaji.

Let us now ask more specifically how participants read the passage written in romaji. Apparently, they read like /no-gu-chi-ge-ra/, putting a pause between syllables. But what does such syllable-based reading mean? Does that mean that it takes longer to combine two letters to form a syllable? Or, does it take longer to combine syllables in succession to form a word? Or both? We attempt to answer this question in the next experiment by measuring naming latency for syllables in romaji and in hiragana.

Experiment 4

Feldman and Turvey (1980) were the first researchers to compare naming latency for words written in kanji and in hiragana and found that words are named faster in hiragana than in kanji even though the words are commonly written in kanji (but see Yamada, 1992). To our knowledge, we were the first to compare naming latency between hiragana and romaji at the syllable level. In this experiment, participants were asked to read out loud individual syllables written in romaji or hiragana, and naming

latencies were measured.

There are at least two reasons to expect that single syllables are named faster in hiragana than in romaji. First, there is the frequency effect; the frequency of hiragana is far higher than that of romaji or eiji (e.g., 35.3% vs. 0.4% according to Hayashi, 1982, p. 206). The frequency effect, whatever the stimuli type may be, is robust in general. Second, if, as metalinguistic research has shown (e.g., Mann, 1986), a syllable is easier to manipulate than is a phoneme, a syllable represented holistically by a hiragana symbol (e.g., <た> /ta/) would be easier to name than the same syllable represented analytically by two romaji letters composed of a consonant letter (<t> /t/) and a vowel letter (<a> /a/). While in the case of a syllable in romaji, the reader at a beginning level would have to recognize the constituent letters and then combine them to form a syllable; in the case of hiragana, no such two-step processing is involved. Rather, he/she would holistically recognize an overarching hiragana symbol, and thus would quickly name it. If such turns out to be the case, it could be concluded that it takes longer to read romaji words largely because it takes longer to combine two romaji letters to form a syllable.

On the other hand, a stimulus consisting of only one syllable may not be very difficult in whatever script it may be written if the syllable structure itself is simple as is the case of Japanese. This possibility is suggested by dyslexia research. Snowling (1981), for example, found that English-speaking dyslexic and non-dyslexic children were able to name one-syllable nonwords, e.g., “wut” and “steg,” equally well, but dyslexics were poorer than non-dyslexics in naming more complex two-syllable nonwords, e.g., “molsmit” and “brigbert.” It may be possible to extend this finding a little further to propose that naming latency for one-syllable nonwords does not greatly differ between dyslexics and non-dyslexics

(however, see Katz, 1986; Wolf & Goodglass, 1986). Our participants may be likened to dyslexic in reading in romaji but not in hiragana. As long as very simple one-syllable stimuli such as <ka> and <mo> are given, however, the effect of 'dyslexia' may not be strong enough to function, or may be attenuated greatly just as is the case with the dyslexic children in Snowling's study. Also, Experiment 2 showed that the difference in writing latency between hiragana and romaji was, albeit significant, small, where information processing proceeded from phonemes to graphemes. In reading, the process is reversed, going from graphemes to phonemes. Assuming that the act of reading syllables in general is more basic and easier than that of writing words, we may expect that the difference in naming latency between hiragana and romaji at the syllable level is smaller than the difference in writing latency between hiragana and romaji at the word level. If so, we should conclude that it takes longer to read romaji words not because it takes longer to combine two romaji letters to form a syllable but because it takes longer to combine syllables to form a word in romaji. In an attempt to find which view is correct, a final experiment was conducted.

Method

Participants. Nine people (six participants from Experiment 2, one new graduate student, and two Japanese staff members who taught English at the same national university) participated in this experiment. Their ages ranged from 21 to 52 years.

Materials. Twenty syllables were quasi-randomly selected from the 46 basic syllables in Japanese: /a/, /e/, /o/, /ka/, /ki/, /ko/, /ta/, /te/, /to/, /nu/, /ne/, /no/, /ha/, /ma/, /mi/, /me/, /yo/, /ra/, /re/, and /wa/. These were written in romaji and hiragana, and these 40 items were used as test stimuli. Eight practice items were made from five syllables other than those 20 test

syllables, and were used for practice trials.

Procedure. Participants were given a standard naming task. The 10 practice and 40 test items were presented one by one on the display screen of a tachistoscope (IWATSU ISEL 701). Each participant was asked to name each stimulus as quickly and as accurately as possible. The naming latency (the duration between the onset of the stimulus and the onset of the voice produced by the participant) was measured to the nearest millisecond. Test stimuli were randomly presented to each participant. The experiment was individually conducted in a quiet room.

Results and Discussion

Outlying items (2SDs or more below or above each participant mean) and error responses were discarded, eliminating 6.1% in the hiragana condition and 9.4% in the romaji condition.

The mean naming latency for the nine participants was 411 msec (SD = 44) for hiragana and 485 msec (SD = 40) for romaji, the difference being highly significant both by participants, $t1(8) = 10.07$, $p < .001$ and by items $t2(19) = 12.13$, $p < .001$. The ratio of the latency in romaji to the latency in hiragana was 1.2 to 1 (485/411), which is far smaller than the ratio of the mean WPM in romaji to the mean WPM in hiragana in Experiment 3, i.e., 2.1 to 1 (147.1/70.5).

As for the six participants who took part in Experiment 2 and this experiment, the mean difference in writing latency between hiragana and romaji in Experiment 2 (i.e., 132 msec) was significantly greater than the difference in naming latency between hiragana and romaji in this experiment (64 msec), $t(5) = 2.85$, $p < .05$. This suggests at least three possibilities which are not necessarily mutually exclusive: (1) the difference in response latency between hand movements and articulatory movements is longer for romaji than for hiragana, (2) the difference in

response latency between processing from speech to script and processing from script to speech is longer for romaji than for hiragana, and/or (3) the difference in response latency between word processing and syllable processing is longer for romaji than for hiragana. All of these possibilities are basically consistent with the results from the previous experiments in this study.

In sum, participants relatively quickly accessed the sound values of individual syllables presented in romaji in this experiment; and Experiment 3 showed that participants read orally a text in romaji very slowly. Taken together, Japanese college students reading in romaji are characterized as letter-by-letter or better syllable-by-syllable readers who access single syllables relatively fast, but laboriously read sequences of syllables. Or more generally, they may be characterized as having a temporal syllable processing deficit in romaji.

General Discussion

This study is exploratory in nature and as such needs to be replicated with larger sample sizes and more precise instrumentation. We set out to do the present study by noting two situations where Japanese people use romaji: one in using a computer (e.g., a word processor) and the other in learning romaji and English. In the former situation, the user learns phoneme-to-grapheme correspondences but not correspondences at larger linguistic units such as words and phrases. In the latter situation, the learner learns sound values of romaji in romaji learning and sound values of alphabet letters in English learning. The end product of these experiences together with virtually no romaji reading experience is what we have observed in this study: letter-by-letter or syllable-by-syllable reading and writing in romaji, which results in a dissociation between

reading and writing.

This dissociation may appear somewhat analogous to letter-by-letter reading in some neurological cases (e.g., Hanley & Kay, 1996; Patterson & Kay, 1982). As a matter of fact, the present peculiar condition with limited reading experiences in romaji gives rise to letter-by-letter reading in neurologically intact people as our students' neural structures in their brains do not seem to function as those for hiragana. If such is the case, the question arises as to whether it is possible for such people to become good readers in romaji by experiencing extensive reading activities at the sentential level in romaji. The answer seems to be in the affirmative. Romaji dose not seem difficult for children to learn, as Unger (1996) showed by recounting old documents which indicated that Japanese children easily learned to read words in romaji. Nor does it seem difficult for adults. Umesao (1987), Unger (1987; 1996), and other scholars have convincingly discussed merits of romaji and demerits of kanji from a broader perspective.

What then is the future of romaji in this information age? Will romaji words supercede words written in the other scripts? Probably not. The chances are that the present condition where romaji is primarily used in computers to produce kanji characters and kana symbols continues to exist. Japanese people would not become efficient romaji readers simply because they are not exposed to romaji texts. Kess and Miyamoto (1999) state, "Even some Japanese words and proper names have begun to appear in romaji, occasionally in the middle of a normal Japanese sentence" (p. 113), but aside from proper names, this statement is misleading r inaccurate as shown in the Introduction. The percentage of occurrences of Japanese words written in romaji in a normal text is close to zero.

Theoretically, there are two possibilities for romaji to be used in

writing Japanese. One is to use solely romaji in writing Japanese sentences. But this was and is unrealistic because it means that kanji and kana are to be abandoned. The other possibility is to write some words, mainly nouns, in romaji. For the same reason as the first one, this would also be unrealistic. There is no compelling motivation for doing so. For example, what merits do Japanese people find when they replace 机 or "desk" with "tsukue" and "desuku," respectively, from the viewpoint of written communication?

Likewise, there is no compelling reason to replace kana with romaji. Japanese is a syllable-based (or mora-based, to be more precise) language and a kana symbol generally represents a syllable (cf. Kubozono, 1989; Warner & Arai, 2001), so there is no reason to represent a syllable with the smaller linguistic unit by means of romaji. It is incumbent upon proponents of romaji to answer these questions. (As for the burden of kanji learning and its significance in Japanese society, very few educators and theorists realize the far-reading effects of this issue. See Unger, 1987.)

The effect of these negative factors seems so robust that romaji would fail to enter the Japanese writing system unless some powerful language policy is implemented to promote the use of romaji. If the vast majority of Japanese computer users prefer an alphabet input and output for linguistic data and this implies the primacy of phonetic representation, then the alphabetic code may become a more important component in Japanese literacy (Coulman, 2001; Unger, 1987). Until such time comes, romaji will remain as an instrument for producing kana and kanji with word processors in the present-day peculiar situation. This implies that many Japanese remain as demonstrated in the present study, i.e., 'dyslexia' without 'dysgraphia' in romaji.

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Table 1

Mean Writing Latencies, Writing Durations,
and Total Transliterating Durations (SDs)
in Milliseconds for Hiragana and Romaji

	Latency	Duration	Total
Hiragana	928 (122)	1052 (106)	1980 (229)
Romaji	1060 (122)	1509 (119)	2569 (363)
Difference	132	457	589
Prob 1	< .01	< .01	< .01
Prob 2	< .01	< .01	< .01

Notes. Numbers in parentheses are SD.

Prob 1: by participants, and Prob 2: by items.

Table 2

Mean Writing Latencies, Writing Durations, and Total Writing Durations In Milliseconds for Three Test Items (<ai>, <ao>, and <ue>) in Hiragana and Romaji

	Latency	Duration	Total
Hiragana			
<あい> /ai/	912	1071	1983
<あお> /ao/	908	1439	2347
<うえ> /ue/	904	1101	2005
Mean	908	1204	2112
Romaji			
<ai> /ai/	1022	783	1805
<ao> /ao/	1068	670	1738
<ue> /ue/	1049	904	1953
Mean	1046	786	1832

Appendix 1: Examples of Kanji, Hiragana, and Romaji Words

	Kanji	Hira	Romaji		Kanji	Hira	Romaji
1	森	もり	mori (forest)	11	毒	どく	doku (poison)
2	豆	まめ	mame (pea)	12	愛	あい	ai (love)
3	炭	すみ	sumi (coal)	13	陸	りく	riku (land)
4	青	あお	ao (blue)	14	上	うえ	ue (top)
5	川	かわ	kawa (river)	15	竹	たけ	take (bamboo)
6	肉	にく	niku (meat)	16	店	みせ	mise (store)
7	庭	にわ	niwa (garden)	17	虫	むし	mushi (insect)
8	城	しろ	shiro (castle)	18	鉄	てつ	tetsu (iron)
9	谷	たに	tani (valley)	19	神	かみ	kami (god)
10	指	ゆび	yubi (finger)	20	鼻	はな	hana (nose)

Note. Most of these items taken from the 60 items were used in Experiment 1 and all were used in Experiment 2.

Appendix 2: Test material 1 given to Group 1.

Romaji paragraph 1.

Kuroshio ni arawa reru daishou awase te hyakurokujuuichi no shima kara naru okinawa wa, nihon de tada hitotsu no anettaisei kikou no ken de aru. Sono naka de mottomo ookii okinawajima no hokubu ni, tochi no hitobito ga yanbaru to yobu hiroi shinrinchitai ga hirogatte iru. (No. of words = 46. No. of letters = 226.)

(Okinawa, consisting of a total of 161 large and small islands in the Japanese Current, is the only prefecture in Japan that is located in a subtropical zone. In the northern part of the Okinawa Island, the largest island there, lies a large forest which the locals call Yambaru.)

Hiragana paragarph 2.

いま から およそ ひゃく ねん まえ、この もり で しんしゅ の きつつき が はっけん され、のぐちげら と めいめい された。その ご、のぐちげら は、ちきゅうじょう で、この やんばる の もり に しか いない きちょうな とり で ある こと が あきらかに なった。 (No. of words = 40. No. of characters = 108.)

(About 100 years ago, a new variety of woodpecker was discovered on this island, and was named noguchigera. Soon after this discovery, it was found that noguchigera was a very rare kind of bird which lives only in this Yambaru forest.)

Notes. A standard way of writing the first sentence in kanji, hiragana, and kanji may be the following: 今から百年前、この森で新種のキツツキが発見され、ノグチゲラと命名された。 As for the romaji text, there does not appear to exist a standard method of putting spaces between morphemes. In this study, to make the passages readable, some function words were combined to content words. It is unknown if this differentially affected romaji and hiragana processing.

Test material 2 given to Group 2.

Hiragana paragraph 1

くろしお に あらわ れる だいしょう あわせ て ひゃくろくじゅういち の しま から なる おきなわ は、にほん で ただ ひとつ の あねったいせい きこう の けん で ある。その なか で もっとも おおきい おきなわじま の ほくぶ に、とち の ひとびと が やんばる と よぶ ひろい しんりんちたい が ひろがって いる。 (No. of words = 46. No. of characters = 127.)

Romaji paragraph 2.

Ima kara oyoso hyaku nen mae, kono mori de shinshu no kitsutsuki ga hakken sare, noguchigera to meimei sareta. Sono go, noguchigera wa, chikyuujou de, kono yanbaru no mori ni shika inai kichouna tori de aru koto ga akirakani natta. (No. of words = 40. No. of letters = 191.)