CAN EFFICIENCY OF ENGLISH WORD DECODING BE A GOOD PREDICTOR OF ENGLISH ABILITY FOR JAPANESE STUDENTS ?

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Abstract To probe the legitimacy of decoding efficiency (speed and accuracy) as a predictor of English ability, the study examined the efficiency of English word decoding among Japanese students of high and low English proficiency. Using lexical decision tasks for English words, the study found that both word frequency and string length significantly affected processing speed and accuracy. However, there was neither a significant effect of the English proficiency level on efficiency, nor a strong correlations between the students' scores on an English ability test and efficiency. In the present study, efficiency in basic English word processing was not a good predictor of the English ability of Japanese university students who were majoring in English literature. The study suggests that efficiency in the decoding of basic English words is not a reliable indicator of English proficiency, though it might be required as one of the determinants in order to comprehend English well.

1 Introduction

Various studies (i.e., Frederiksen, 1978; Golinkoff & Rosinski 1976; Perfetti & Hogaboam, 1975) has argured proficeint readers decode words more quickly than less-skilled readers. For example, Perfetti et al. (1975) who studied Grades 3 and 5 students, found major differences between skilled and less-skilled readers in the time taken to name single words. This was especially apparent in the naming of uncommon words. Perfetti (1985) further suggested that skilled readers are faster on word decoding tasks than on naming tasks. Using these findings as evidence, Perfetti (1985) argued that individual differences in comprehension are caused by efficiency of single word processing which in turn influences word decoding speed and accuracy in reading. This theory, known as the 'bottleneck' hypothesis, states that rapid decoding automatically results in good comprehension.

Fleisher, Jenkins and Pany (1979) tested the 'bottleneck' hypothesis by training poor readers

at the Grades 4 and 5 level to recognize words as rapidly as the good readers. However, although the training did increase decoding speed for single words, comprehension did not improve. This attempt was repeated by Spring, Blunden and Gatheral (1981), and it also failed to improve comprehension by increasing the rapidity of decoding. It seems that training to improve decoding speed does not improve comprehension. As Oakhill and Granham (1988) explained, "rapid decoding, though necessary for comprehension, may be only one of a number of skills required" (pp. 161-162). According to this argument, there is no direct link between decoding efficiency and comprehension. Instead, the connection between comprehension and the efficiency of decoding is probably indirect in nature.

Since all these studies were undertaken in the first language condition of English, the present study examined the efficiency of English word processing among Japanese university students of higher and lower English proficiency in order to examine the legitimacy of efficiency (speed and accuracy) as a predictor of English ability.

2 Method

2.1 Selection of Subjects

To select students of higher and lower English proficiency, the authors formulated an English ability test by combining parts of already-established English tests. The test consisted of five subsections; phonological knowledge (English pronunciation), pragmatic competence (conversational sentences), lexical knowledge (idiomatic expressions), syntax knowledge (grammatical understanding), and reading comprehension (paragraph understanding). Each subsection contained 10 questions (50 questions in total). Since each question counted as one point, 10 points was the maximum score attainable in each subsection, and the total test itself consisted of 50 points.

This English test was administered to the 49 university students who enroled in an English literature class offered by the Department of English at Matsuyama University. Based on their performance in the English ability test, 17 subjects with higher English proficiency, and 17 subjects with lower English proficiency (6 males and 28 females) were selected. The mean of the English ability test of 34 selected students for the present study was 28.06 points with a standard deviation of 5.93 points; M = 32.94 with SD = 2.73 for the 17 higher-proficiency students and M = 23.18 with SD = 3.40 for the 17 lower-proficiency students. The difference in the means between the students' groups of higher and lower proficiency was highly significant [$F(1, 32) = 74.22$, $p<.0001$]. The means and standard deviations of the subjects' ages, as adjusted for the month of experimentation (i.e., January, 1991), were 244.53 months with a standard deviation of 4.94 months, (M = 245.12 with SD = 5.78 for the students with higher English proficiency, and M = 243.94 months with SD = 4.02 for those with lower English proficiency).

2.2 Stimuli

Stimulus items for the present study were selected from the English words which appear in junior high school English textbooks. From the frequency index created by Miura (1987), 80 English words were selected with equal proportions of the two factors of word frequency and string length. Consequently, the selection consisted of 40 high frequency words (e.g., cat, telephone) and 40 low frequency words (e.g. fox, passenger), as well as 40 short string-length words (e.g. air, net) and 40 long string-length words (e.g. birthday, medicine). The means of word frequency indexes were 16.83 for the high frequency words (16.85 for the short words and 16.80 for the long words), and 2.28 for the low frequency words (2.50 for the short words and 2.05 for the long words). A difference in the means of frequency indexes between high and low frequency words is 14.55 which should be far apart from each other to examine frequency effects. As a control group, an equal number of 80 pseudo words were created to match the number of real words. Since the stimulus items were chosen from junior high school textbooks which are not difficult for university students to comprehend, we assumed that the subjects' English language skills should be sufficient enough for them to cope with the lexical decision tasks for these words.

2.3 Procedure

The 34 university students were tested individually in a quiet room on campus. Each student was seated in front of a computer screen, with the seat adjusted so that the student could view the screen at the appropriate height. A lap-top computer, the Toshiba J−3100GT, was used for the experiment. The instructions were read aloud to the student in Japanese. The session began with the presentation of 16 task familiarization trials using practice stimuli presented in each of the four stimulus types. The instructions stressed both speed and accuracy. The subjects were required to press either the right or the left key on the computer keyboard, depending on whether the word presented was a real English word or not, as quickly as possible. For example, if the real English word 'house' was displayed on the central area of the screen, the subjects had to press the left key. The stimuli were displayed at random on the screen. The presented word stayed on the screen until the subject pressed the right or the left key.

Feedback concerning correct or incorrect responses and reaction time was shown on the screen after each response to maintain the subject's motivation. The feedback for an incorrect response was "Good try! ", to avoid discouraging subjects from continuing the tasks. When the space key was pressed following each response, the next stimulus appeared after a 700-millisecond interval. During the interval, an asterisk was shown on the fixation point to indicate the center of the screen. Accuracy and the length of time between the presentation of a word and a subject's response were recorded for every stimulus.

3 RESULTS

3.1 Analysis of Accuracy in English Word Decoding

The overall mean of accuracy (percentage of correct responses) in 80 real English words for each of the 34 subjects was 85.04 percent with a standard deviation of 6.79 percent. The means and standard deviations of accuracy associated with higher and lower English proficiency are shown in Table 1. A 2 (English proficiency) × 2 (frequency) × 2 (word length) ANOVA with repeated measures on the last two factors was performed on the accuracy data. Since the pseudo words involved a negative response to the task of identifying a proper English word by pressing the left key, and may require a different type of cognitive process, they were excluded from the data analysis in the present study. Thus, the analysis of the present study dealt only with the processing of real English words.

Table 1 Means and Standard Deviations (in Parentheses) for Accuracies (Percentage of Correct Responses)

Reading Level	High Frequency		Low Frequency	
	Short	Long	Short	Long
Higher	93.53	86.76	82.65	82.65
	(7.02)	(9.83)	(13.00)	(11.60)
Lower	91.47	85.29	81.18	76.76
	(8.80)	(6.72)	(8.01)	(10.30)
Both	92.50	86.02	81.91	79.71
	(7.91)	(8.33)	(10.66)	(11.21)

Although the students of lower English proficiency scored slightly lower in the mean accuracies than students of higher proficiency (see Table 1), English proficiency had no significant effect on accuracy. Therefore, the subjects' higher or lower English proficiency did not affect accuracy in identifying common English words which appear at the junior high school level.

On the other hand, the two other factors of word frequency [$F(1,32) = 50.79$, $p<.0001$] and word length [$F(1,32) = 6.95$, $p<.05$] were significant. There was no interaction between these factors. These results indicated that the high frequency words ($M = 89.26$) were correctly identified more often than the low frequencyones ($M = 80.81$),and that short words ($M = 87.21$) were more accurately identified than long ones ($M = 82.87$).

3.2 Analysis of Speed in English Word Decoding

All incorrect responses were excluded from the analysis of lexical decision times, so that only correct responses were used for further data operation and analysis. To eliminate extremely deviant lexical decision time values, outliers with 2.5 standard deviation values of milliseconds above or below the mean were replaced by the corresponding lower or upper boundary lexical decision time values for the individuals. Again, as with the data for accuracy, the pseudo

words were excluded from the present analysis.

Means and standard deviations resulting from the modified lexical decision times are presented in Table 2. For the lexical decision time data, a 2 (English proficiency) × 2 (frequency) × 2 (word length) ANOVA with repeated measures of the last two factors was performed. As with the results of the accuracy analysis, the students' English proficiency did not significantly affect lexical decision times. This result suggests that the subjects' higher or lower English proficiency did not show any effect on lexical decision times for identifying existing English words. The speed of lexical decisions was significantly affected by the main factors of word frequency [$F(1,32) = 64.84$, $p<.0001$] and word length [$F(1,32) = 92.27$, $p<.0001$]. These results show that high frequency words ($M = 848$) were identified more rapidly than low frequency ones ($M = 946$), and short words ($M = 783$) were identified more quickly than long ones ($M = 1011$). Furthermore, there was a highly significant interaction between the with-ing-factors of word frequency and word length [$F(1,32) = 26.26$, $p<.0001$]. The frequency effects tended to be amplified when the words were longer.

Table 2 Means and Standard Deviations (in Parentheses) for Lexical Decision Times (Rounded to the Nearest Millisecond)

Reading	High Frequency		Low Frequency	
Level	Short	Long	Short	Long
Higher	752	928	817	1082
	(123)	(165)	(157)	(196)
Lower	758	951	804	1080
	(128)	(241)	(154)	(278)
Both	755	940	811	1081
	(124)	(203)	(153)	(237)

3.3 The Relation Between Decoding Speed and Accuracy

The present study defined efficiency of word processing as accurate and fast decoding. Consequently, high efficiency measured for lexical decision tasks was indicated as being faster in reaction times (milliseconds) and greater in accuracy (percentages of correct responses). Individual means of speed and accuracy are plotted in Figure 1. As shown in the figure, there is no ceiling effect in accuracy. A correlation between these two factors was ratio of 0.14 which was not significant; there was no significant correlation in every word characteristic classified by word frequency and word length, 0.26 for high frequency short words, −0.15 for high frequency long words, −0.02 for low frequency short words, and 0.10 for low frequency long words. These results suggest that accuray and speed may indicate a different perspective of word decoding.

During the experiment, some students showed a tendency known as the 'speed and accuracy trade-off', that is, their faster speed often resulted in lower accuracy and higher accuracy was often accompanied by decreased speed. As shown in Figure 1, in comparison with most of their

counterpart, two students of lower English proficiency and one student of higher English proficiency had higher speed but lower accuracy, and two students of lower English proficiency and three students of higher English proficiency showed slower decoding speed but relatively higher accuracy. These cases of 'speed and accuracy trade-off' may also indicate the existence of at least two perspective of mental ability; repid recoding and accurate processing of words.

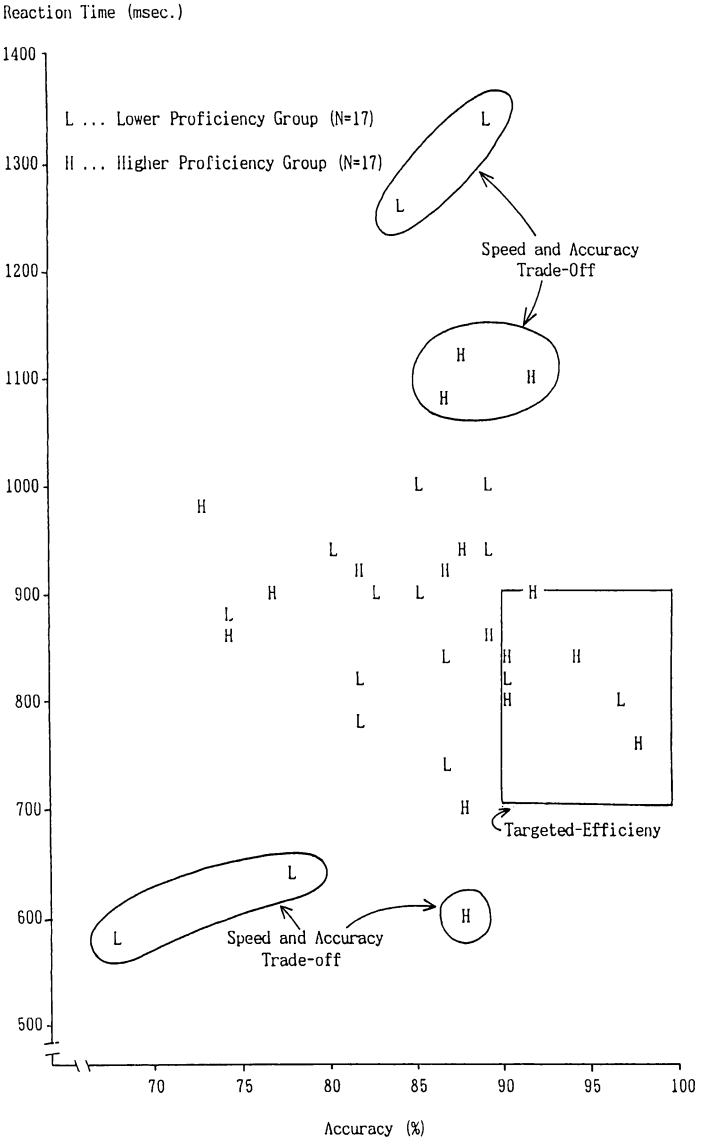

Figure 1 *Plot of Reaction Times and Accuracies*

3.4 Correlations Between Decoding Efficiency and English Ability

The correlations between efficiency (speed and accuracy) and the scores of English ability were 0.09 for reaction times and 0.22 for percentages of correct responses, indicating no significant relationships. The relation between efficiency and English ability was further probed by examining the English proficiency of the two groups on a separate basis. For the group of higher English proficiency, the correlations between decoding efficiency and English ability were 0.16 for speed and −0.23 for accuracy. The group of lower English proficiency were 0.19 for speed and 0.33 for accuracy. None of these correlations were significant. As indicated by the rectangle in Figure 1, we assumed that the 'targeted-efficiency' of English word processing among Japanese students would be between 700 to 900 milliseconds in speed and higher than 90 percent for accuracy. Five students of higher English proficiency and two students of lower English proficiency fell within this category. Indeed, more higher-proficiency students were found in the 'targeted-efficiency' area than lower-proficiency students. However, this method of estimate is too rough to draw any conclusions. As visually plotted in Figure 1, the students from the higher- and lower- proficiency groups are scattered relatively randomly throughout the field. Given all these tendencies and correlations, the present study showed no direct connection between efficiency (speed and accuracy) of word decoding and English ability.

4 Discussion

The present study examined two aspects of English word decoding by Japanese students; (1) the decoding mechanism of Japanese students as a function of word frequency and string length in comparison with native English speakers, and (2) the decoding efficiency of English words as a predictor of English ability for Japanese students.

In studies of English word processing, word frequency has often been examined to identify a word processing mechanism. McCusker, Hillinger and Bias (1981) explained the difference in lexical decision times between high and low frequency words with the theory that high-frequency words are accessed via a visual representation, while low-frequency words require the use of a phonological recoding process. In addition, Barron and Baron (1977) suggested that even children can generally access meaning directly from printed words without the use of an intermediate phonemic code. To extrapolate from these studies of native English speakers, Japanese university students learning English as a second language could process words on the basis of orthographic representations when the words are often seen in written contexts. If this is true, even in the ESL (English as a second language) situation, a mechanism for the holistic and orthographic approach to the decoding of English words must be developed among Japanese university students, as well as among native English speakers.

Like previous findings concerning the effect of high and low frequency words in the English alphabetic script (e.g., Barron & Baron 1977; Gardner, Rothkopf, Lapan & Lafferty, 1987;

Scarborough, Cortese & Scarborough, 1977; Taft, 1979), the present study suggests that the Japanese university students studying English as a second language processed high and low frequency English words in much the same way as native English speakers. Thus, as was assumed by the English studies, these Japanese students may have been able to process, at least to a higher degree, high-frequency words via orthographic visual processing, whereas low-frequency English words were identified, to a greater degree, via phonological analytic processing. This tendency was amplified when the students had to process longer English words. Thus, the decoding mechanism of English lexical access used by Japanese students in terms of word frequency and string length may be quite similar to that used for lexical access by native English speakers.

The present study found that students' higher or lower proficiency level did not show any effect on the efficiency (speed and accuracy) of decoding English words. Because the words in the present study were all selected from junior high school English textbooks, they may have been too easy for Japanese students majoring in English literature at the university level. In addition, decoding efficiency (speed as milliseconds and accuracy as percentage) and the scores achieved in English ability test showed a minor correlations in both cases of the high and low English proficiency. As visually presented in Figure 1, the scores attained by students of both higher and lower English proficiency groups which are plotted by speed and accuracy on the figure, are dispersed randomly on the field. All these results indicate that the efficiency of decoding basic English words may not have a direct effect on students' English ability.

The findings of the present study did not support decoding efficiency as a good predictor of English ability for Japanese students. Nevertheless, this result contradicts the findings of previous studies (i.e., Frederiksen, 1978; Golinkoff & Rosinski 1976; Perfetti & Hogaboam, 1975) which indicated a close relationship between rapid decoding and good comprehension. For example, a series of studies on phonetic recoding conducted by the group of Haskins Laboratories in Connecticut (Mark, Shankweiler & Liberman, 1977; Shankweiler, Liberman, Mark, Fowler & Fischer, 1979) suggest that good and poor readers differ in their use of phonetic coding in working memory, and that individual variation in coding efficiency may be a relevant factor in learning to read. However, these studies on phonetic recoding as a function of good and poor readers examined beginning readers who just started to learn to read.

Ehri and Wilce (1983) investigated longitudinal changes of word identification speed (decoding speed) among skilled and less-skilled readers from Grades 1, 2 and 4. They found that the differences in decoding speed of words, pseudo-words and numerals between skilled and less-skilled readers dramatically decreased as they become older; at the Grade 4 level, the differences in decoding speed become very small between skilled and less-skilled readers, in comparison with those in Grades 1 and 2. Similarly, studies on Japanese numeral and word identifications (Tamaoka, Leong & Hatta, 1991, for numerals; Leong, Tamaoka & Hatta, accepted, for kana and kanji) as a function of skilled and less-skilled readers from Grades 4, 5

and 6 indicated the same result as Ehri and Wilce (1983) that differences in the decoding speed of numerals, kana and kanji between skilled and less-skilled readers decreased as subjects become older. Thus, at the early stage of reading, decoding speed may be an influential factor in becoming a good reader, but its effect may decrease as subjects become better readers. In addition, as explained in the introduction to this paper, training to improve decoding speed does not improve the comprehension of poor readers (Fleisher, Jenkins & Pany, 1979; Spring, Blunden & Gatheral, 1981). Thus, the decoding efficiency of basic English words may be one of determinants in becoming a good reader, but it would not have a strong predictive power of English ability for Japanese students at the university level.

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