Original Article

Reading Fluency in Young Children Who Can Read Individual Letters Fluently But Not Whole Words: A Longitudinal Study

Shino SAKONO* and Tomohiko ITO**

The purpose of the present study was to investigate longitudinally the development of fluency in reading words and nonwords in typically developing children who could read all the letters in the words but could not read the whole words fluently. The participants were 5 children aged 4 to 5. Words and nonwords were used as stimuli in a reading task. The number of correct and fluent readings increased more rapidly for the words than for the nonwords in 3 of the children. Correct and fluent readings of both the words and the nonwords by the fourth child increased rapidly. The fifth child could only 1 word and 1 nonword by the final measurement day. At the beginning of the study, the mean reading time for the words by 2 of the 5 children was shorter than for the nonwords. The present results suggest that a variety of rates or processes exist in the development of reading fluency for words and nonwords in typically developing children.

Key Words: reading, fluency, development, longitudinal study, preschool children

Introduction

The Japanese language uses two kinds of orthographic systems: kana and kanji. Each kana character represents a speech unit roughly equivalent to a syllable (Sasanuma, 1986). The relationship between orthography and phonology in kana is perfectly regular and rule-governed. Each kana character essentially always represents one and the same mora with no context sensitivity (Sasanuma, Ito, Patterson, & Ito, 1996). Therefore, accuracy of reading kana words can be acquired easily in the Japanese language by using letter-by-letter reading. As a result, in languages like Japanese in which the relationship between orthography and phonology is regular, difficulty of reading is reflected in reading fluency. Thus, in research on the development and disorders of reading in Japanese, it is important to study the development of reading fluency.

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Many researchers have studied the development of reading in typically developing children. For example, Amano (1986) conducted a series of studies on the acquisition of the reading of kana letters. Takahashi (1993, 1996) investigated the development of reading ability after children had learned the kana letters. Recently, many studies have investigated the relationship between the ability to read kana characters and phonological awareness in young children (Amano, 1970; Amano, 1986; Hara, 2001; Takahashi, 1999). In addition, numerous studies have focused on the segmentation of words into moras (e.g., Inagaki, Hatano, & Otake, 2000; Ito, 2006; Ito & Tatsumi, 1997).

However, few studies have focused on the development of reading fluency in typically developing children. In order to determine the characteristics of reading fluency in Japanese children with developmental dyslexia, we must first study the development of reading fluency in typically developing children.

In order to teach children with developmental dyslexia successfully, it is important to find deficits early. The later that deficits are identified, the more serious is the delay of learning (Shaywitz, 2003). If characteristics of the development of reading fluency could be found in typically developing children, that may provide a way to identify children who might have difficulty reading.

Children with developmental dyslexia have been shown to have difficulty reading nonwords (Rack, Snowling, & Olson, 1992; Snowling, 2000). Many studies have demonstrated that Japanese children with developmental dyslexia have difficulty reading nonwords (Matsumoto, 2006; Oishi, 2007; Tatsumi, 2007; Yamada, 1997). Shaywitz (2003) found that the results from children’s reading of nonwords were important in the diagnosis of developmental dyslexia. Therefore, the development of reading fluency should be investigated, in typically developing children, in an early stage of reading development, using nonwords to identify dyslexic children.

Sasanuma (1995) proposed that each word carries information about orthography, phonology, and semantics, and that such information and its interactive relationship are decoded in the mental lexicon. On the basis of this, we assume that it is easier for children to read real words than nonwords fluently, because they can use their mental lexicon when they read the real words. Therefore, we predict that children should be able to acquire reading fluency earlier for words than for nonwords. However, as we have indicated above, few studies have focused on the development of reading fluency in typically developing children.

The purpose of the present study was to investigate the development of fluency in reading words and nonwords in typically developing children who could read each letter in the words, but could not read whole words fluently.

Method

Stimulus Letters and Words

1) Letters used in the stimulus words. Nine letters were used as the stimulus words and nonwords. These letters were employed to determine whether participants could...
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TABLE 1 Stimulus Words

<table>
<thead>
<tr>
<th>Words</th>
<th>2 moras</th>
<th>3 moras</th>
<th>4 moras</th>
<th>5 moras</th>
</tr>
</thead>
<tbody>
<tr>
<td>kuma</td>
<td>tsusu</td>
<td>sutari</td>
<td>miritashi</td>
<td>kimamikusu</td>
</tr>
</tbody>
</table>

TABLE 2 Participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child A</td>
<td>4:4</td>
</tr>
<tr>
<td>Child B</td>
<td>4:6</td>
</tr>
<tr>
<td>Child C</td>
<td>4:11</td>
</tr>
<tr>
<td>Child D</td>
<td>5:1</td>
</tr>
<tr>
<td>Child E</td>
<td>5:2</td>
</tr>
</tbody>
</table>

Notes. Age when the present longitudinal study was started.
Child E was a boy; the other four participants were girls.

read all the letters that were used to form the stimulus words and nonwords. According to the National Institute for Japanese Language (1972), such words present the easiest and the second-easiest degree of difficulty in acquisition.

2) Stimulus words. The stimulus words, 4 words that are used frequently (Iwabuchi & Muraishi, 1976) and 4 nonwords, were from two moras to five moras in length. The stimulus words and nonwords are listed in Table 1.

Participants

The originally selected participants were eight children who could not read the stimulus words correctly and fluently in three trials from among 38 participants in an earlier study by the present authors (Sakono & Ito, 2007). We wanted to include all eight of the children as participants. However, two of the children could not participate in the present study because they had graduated from nursery school. In addition, one child was excluded because of stuttering. As a consequence, the participants in the present study were five out of the eight participants in the present authors’ earlier research (Sakono & Ito, 2007). Child E was a boy; the other four were girls. Further information about the participants is provided in Table 2.

Procedure

The children were tested individually. First, nine hiragana letters that were included in the stimulus words were presented to the children one by one on a card, and the children were asked to read each letter. Next, those children who could read all the letters were asked to read the four hiragana words and the four nonwords as fast as possible. The stimulus words were written in hiragana on cards. If the children did not notice a reading error, they were asked to read that word or nonword again. If a child read letter-by-letter, the child was then asked again to read that word, up to a total of two additional trials.

The present longitudinal study continued for about one year. The data were collected on four occasions: when the study started, and at 7, 9, and 11 months thereafter.
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The children’s responses were tape-recorded using a digital audio tape recorder (TCD-D10) and a microphone (ECM-959DT).

Method of Analysis

The children’s correct and fluent readings were analyzed. When a stimulus word was read by a child without letter-by-letter reading or disfluencies such as repetitions or revisions, the word was judged to have been read fluently. The rate of agreement between the two graduate students who judged fluency was 93.6%, calculated by dividing the number of agreements by the total of the number of agreements plus disagreements, and multiplying by 100.

In addition, reading time (the time between the presentation of a stimulus word or nonword and the end of the child’s reading of that word or nonword) was measured by a digital stop watch (WATER 5BAR RESIST, Q & Q).

Results

Developmental Change in Correct and Fluent Reading

Figure 1 shows the developmental changes in the five children’s correct and fluent reading of the stimulus words and nonwords over the year of the present study. The abscissa shows the time in months from the start of the study. The ordinate shows the number of words read correctly and fluently. The results for the four words were analyzed as a whole, as were the results for the four nonwords.

As shown in Fig. 1, three of the children, A, C, and D, showed a rapid increase in the number of words read correctly and fluently, but a slower increase in the number of nonwords read correctly and fluently. The number of words read correctly and fluently by Child B increased rapidly for both the words and the nonwords. In contrast, Child E read correctly and fluently only one word starting with the second test (at 7 months from the start of the study) and, in addition, by the final day of measurement, only one nonword. Child D was absent from the nursery school on the day of the 9-month tests, so her data for that day are missing.

Developmental Changes in the Mean Reading Time

Figure 2 shows the developmental changes in the five children’s mean time to read the words and nonwords. The abscissa shows the time in months from the start of the study. The ordinate shows the mean time to read the stimulus words and nonwords. Child D was absent from the nursery school on the day of the 9-month measurement, so her data for that day are missing.

At the start of the study, the mean reading time was quite different across the five children. However, all the children’s reading times tended to decrease up to the last day of measurement. The mean times for Child A and Child E to read the nonwords was longer than for the words on the first day of measurement. Child A’s mean time to read the nonwords was longer than for reading the words throughout the study. The difference between Child E’s mean reading time for the words and the
nonwords became smaller and smaller over the year of the study, and few differences in reading time between the words and the nonwords were observed on the last day of the study. Throughout the year, few differences were observed between Child B and Child D's mean reading times for the words and the nonwords. Curiously, at the start of the study, Child C's mean reading time for the words was longer than for the nonwords.

FIG. 1 Developmental Changes in Correct and Fluent Reading
Developmental Changes in Correct and Fluent Reading in Relation to the Number of Moras of the Stimuli

Figure 3 shows the relationship between the developmental changes in correct and fluent reading and the moras of the stimuli by the five children. The abscissa shows the time in months from the start of the study. Only one word was used as a stimulus word with 2, 3, 4, and 5 moras. The ordinate shows the total number of correct and fluent readings by the five children. The data at the 9-month assessment
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were from 4 children, because Child D was absent from the nursery school on the day of testing.

The total number of correct and fluent readings of the 2-, 3-, and 4-mora words tended to increase from the first to the last day of measurement. However, the total number of correct and fluent readings of the 5-mora words tended to be smaller and more unstable than those with 2-, 3-, and 4-moras. While the total number of correct and fluent reading of the 2-, 3-, and 4-mora nonwords increased from the first to the last day of measurement, even by that time, only one of the 5-mora words was read correctly and fluently.

![Graphs showing developmental changes in correct and fluent reading and moras of stimuli](image)

**Fig. 3** Developmental Changes in Correct and Fluent Reading and Moras of Stimuli

*Notes.* The data at 9 months are from 4 children, because one of the children was absent from the nursery school on the day of testing.
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Developmental Changes in Mean Reading Time in Relation to the Number of Moras of the Stimuli

Figure 4 shows the relationship between the developmental changes in mean reading time by the five children and the number of moras of the stimulus words and nonwords. The abscissa shows the time in months from the start of the study. The ordinate shows the mean reading times. Child D was absent from the nursery school on the day of the 9-month measurement, so her data for that day are missing.

The mean reading time for the words regardless of the number of moras gradually became shorter and shorter. The mean reading time of the words with 4 and 5 moras tended to be longer than for those words with 2 and 3 moras throughout

![Graph showing developmental changes in mean reading time and number of moras of the stimuli.](image-url)

**Fig. 4** Developmental Changes in Mean Reading Time and Number of Moras of the Stimuli

*Notes.* The data from the 9-month measurement were from 4 children, because Child D was absent from the nursery school on the day of testing.
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the study. Although the mean reading time of the nonwords with 2, 3, and 4 moras gradually became shorter and shorter, the reading time of the 5-mora words tended to be longer and unstable.

Discussion

In order to achieve early identification of children who have difficulty in reading, it is necessary to know the characteristics of developmental changes of fluent reading in typically developing children. The purpose of the present study was to investigate the development of reading fluency for words and nonwords in typically developing children who could read each letter in the stimulus words but could not read the whole words fluently. The participants were five children who could read each letter in those words but could not read the whole words fluently within three trials in the present authors’ earlier research (Sakono & Ito, 2007). The data were obtained on four occasions; viz., when the present study started, and 7, 9, and 11 months later.

Developmental Changes in Correct and Fluent Reading

Each word carries information about orthography, phonology, and semantics, and this information and its interactive relationship are decoded in the mental lexicon (Sasanuma, 1995). Therefore, it is easier for children to read words fluently than nonwords, because they can use their mental lexicon when reading words but not when reading nonwords. We could predict that the fluency of reading the stimulus words would develop rapidly, but that the fluency of reading the nonwords would develop slowly.

As expected, the number of fluently read stimuli increased faster for the words than the nonwords in 3 out of 5 children (A, C, and D). The results for these three children agreed with our prediction that reading fluency would be acquired easier for the words than the nonwords. The reason why these three children could read the words more fluently than the nonwords is, we hypothesize, that they could use their mental lexicon while reading the words.

However, the number of correct and fluent readings increased rapidly for both the words and the nonwords in one of the children (B). The development of her reading fluency was different from our expectation, probably for the following reason. For her, although, as we expected, reading the nonwords was more difficult than reading the words, she acquired both the words and the nonwords within 7 months from the start of the present study. Her results suggest that some children can acquire fluent reading of both words and nonwords in a period of less than 7 months, so that it is necessary to examine developmental changes within shorter intervals than 7 months when the development of reading fluency in typically developing children is being investigated.

Child E was able to read correctly and fluently only one word and one nonword, even by the last measurement day of the present study. The characteristics of his development in reading were also different from our expectations. Although we
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cannot explain why Child E’s fluency of reading the words did not develop within the time limit of the present study, his results suggest that there are some children of this age who cannot acquire fluent reading of words and nonwords within a year’s time. That is, Child E might have some reading difficulty.

The present results suggest that there is a variety of rates or processes from letter-by-letter reading to fluent reading. The present study should be repeated on a larger sample in future studies of the development of reading in children between 4 to 6 years old, because since only five children participated in this study, individual differences may have been an important factor.

**Developmental Changes in Mean Reading Time**

Developmental changes in reading fluency are reflected in reading time. We predicted that the time to read the words would be shorter than that to read the nonwords at the beginning of the development of reading. Although the results for Children A and E agreed with our prediction, the results from Children B, C, and D did not. As we expected, Child A’s mean time to read the nonwords was longer than the time to read the words from the first to the last day of the present study. Child E’s mean reading time for the nonwords was longer than for the words on the first day of measurement. Child E read only one word and one nonword fluently even on the last day of measurement. These results suggest that Child E’s speed of letter-by-letter reading gradually increased.

Few differences were observed between in Child B’s mean reading time for the words and the nonwords. Her reading time for both was very short, and although the number of words and nonwords read correctly and fluently was 0 on the first day of this study, her correct and fluent reading of both increased simultaneously. This may be because Child B read both the words and the nonwords at a very high speed of letter-by-letter reading on the first day of measurement.

Little difference was observed in Child D’s mean reading times between the words and the nonwords from the first to the last day of measurement. The number of words she read correctly and fluently increased faster than that did the number of nonwords, probably because her reading time in fluent reading was not very different from that in letter-by-letter reading.

Contrary to our expectations, on the first day, Child C’s mean reading time on the words was longer than on the nonwords. She was first presented with the words, followed by the nonwords, and took longer to read the words than the nonwords. One possible explanation for these results is that it took her a long time to become accustomed to the experimental task.

Taken together, the results of the present longitudinal study suggest that the decreases in reading time for words and nonwords differ among children.

**Moras of Stimuli in Relation to Reading Fluency**

In the present study, the relationship between developmental changes in correct and fluent reading and the number of moras of the stimuli was investigated. The
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correct and fluent reading of the words tended to increase from the first to the last day of the present study in the 2-, 3-, and 4-mora words. However in the 5-mora words, it tended to be smaller and more unstable. While the total number of correct and fluent reading of the 2-, 3-, and 4-mora nonwords increased from the first to the last day of measurement, even on the last day, only one of the 5-mora nonwords was read correctly and fluently. These results suggest that the developmental changes in correct and fluent reading are influenced by the number of moras in stimuli, especially with more than 4 moras.

While the mean reading time for the words gradually became shorter and shorter regardless of the number of moras, the mean reading time for the words with 4 or 5 moras tended to be longer than for those with 2 or 3 moras from the first to the last day of measurement. The mean reading time for the nonwords with 2, 3, or 4 moras gradually became shorter and shorter, whereas it tended to be longer and unstable in the 5-mora words. These results suggest that developmental changes in mean reading time were influenced by the number of moras in the stimuli, especially those with more than 4 moras.

'Note

In the Japanese literature on reading disorders, Japanese kana characters are referred to as “letters”.

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