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Original Article

Initial Syllable Weight and Frequency of Stuttering in Japanese Children

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The present study was designed to investigate the effects of phonological factors on stuttering in Japanese children. The difference in the frequency of stuttering was compared between words beginning with light syllables (i.e., syllables, which, in Japanese, are those with one mora) and those with heavy syllables (two moras). The participants were 38 elementary school students who stuttered. A non-word reading task was used. The results were as follows: (1) The frequency of stuttering was significantly higher in words beginning with light than with heavy syllables. (2) Among 4 types of heavy syllables, the frequency of stuttering was significantly lower on long vowels than on diphthongs and geminate stops. Moreover, the frequency of stuttering on long vowels tended to be lower than that on nasal consonants, although this difference was not statistically significant. These results suggest that words beginning with heavy syllables are easier for stuttering children to pronounce than those with light syllables, and that among the 4 types of heavy syllables, long vowels are the easiest to pronounce.

Key Words: stuttering, light syllables, heavy syllables, children who stutter

Introduction

The cause of stuttering has long been studied from a variety of viewpoints (Bloodstein, 1975; Curlee & Siegel, 1997; Johnson, 1959; Van Riper, 1973; Wingate, 1977), one of which is the psycholinguistic point of view, which focuses on the processing of language by people who stutter. Recent research on the brain mechanism of stuttering has produced interesting results with respect to such language processing (De Nil, Kroll, & Houle, 2001; De Nil, Kroll, Kapur, & Houle, 2000; Drokers, 1996; Fiez & Petersen, 1998; Fox, Ingham, Ingham, Hirsch, Downs, Martin, Jarabek, Glass, & Lancaster 1996; Imaizumi, 2003). The processing of language in people who stutter has become one of the more interesting themes in current research on stuttering.

In the study, we focused on the phonological aspects of language in children who stutter. Which phonetic and phonological factors affect stuttering? Brown (1945), who studied the loci of stuttering, found that stuttering in adults was most likely to occur

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(1) in the first, second, or third words of a sentence; (2) in nouns, verbs, adverbs, or adjectives, (3) in words of five letters or more, and (4) in words beginning with consonant phonemes.

Sasanuma (1968) and Williams, Silverman, and Kools (1969) did research with children which examined Brown's (1945) four characteristics of stuttering loci. The participants in Sasanuma's (1968) research were Japanese-speaking children, whereas those in Williams et al.'s (1969) study were English speaking. From the phonological point of view, interest has focused on whether stuttering is likely to occur on consonants. Williams et al. (1969) found in English speakers that stuttering was predominate on consonants, whereas in Sasanuma's (1968) research in Japanese speakers, it occurred most often on the vowels. These results suggest that the likelihood of stuttering occurring on consonants or vowels is determined by the phonological structure of the language being spoken.

Kim and Ito (2004) recently analyzed stuttering in the spontaneous utterances of Korean and Japanese children, in order to investigate differences in the frequency of stuttering between words beginning with consonants and those beginning with vowels. They found that, in both Korean and Japanese children, the frequency of stuttering for words beginning with vowels was slightly higher (although not statistically significant) than it was for words beginning with consonants. These results differed from those of the previous studies on English-speaking children.

Ohashi (1984) analyzed the free-conversation utterances of children who stuttered, and found that initial phonemes were most likely to be stuttered. Ohashi's (1984) study demonstrated that the order in which phonemes might affect stuttering was /n/, /k/, /a/, /o/, /t/, /h/, /m/, /i/, and /b/. She also suggested that the root cause of the difficulty in speech production might arise from the phonetic characteristics of the initial phonemes.

In contrast, Ujihira (2000), studying stuttering from the standpoint of phonetic transition, focused on the relation between the initial core vowels and the phonemes that followed them, and suggested that the phonetic characteristics of such phonemes were crucial factors in stuttering. In addition, Ujihira (2000) proposed that stuttering is triggered by stops or plosives that follow initial core vowels.

Although previous studies have investigated phonetic and phonological factors likely to cause stuttering, few studies examining factors that facilitate the production of fluent speech have been reported. What are the phonological factors that promote such fluency? In the present study, we chose to investigate the effect of syllable weight on the frequency of stuttering.

According to Kubozono & Ota (1998), syllable weight equals syllable length. Since moras are units of length in Japanese, syllable weight can be counted by counting the number of moras. According to Kubozono (1998), syllable weights can be divided into light, heavy, and superheavy syllable types. In Kubozono's (1998) classification system, light syllables are composed of one mora, heavy syllables of two, and superheavy syllables of three.

In the present study, we compared two types of typical Japanese syllables, a light

TABLE 1 Stimulus Words

Words beginning with light syllables	Words beginning with heavy syllables			
	Diphthongs	Long vowels	Nasal consonants	Geminate stops
kapina	kaipina	kaapina	kanpina	kappina
kabumo	kaibumo	kaabumo	kanbumo	kabbumo
katosu	kaitosu	kaatosu	kantosu	kattosu
kadaru	kaidaru	kaadaru	kandaru	kaddaru

syllable composed of one mora, and a heavy syllable composed of two. In Japanese, there are four types of heavy syllables, i.e., diphthongs, long vowels, nasal consonants, and geminate stops (Kubozono & Ota, 1998). According to Kubozono (1998), many words in the utterances of young children who are in the one-word stage begin with heavy syllables, suggesting that words beginning with heavy syllables would be easier for children who stutter to pronounce than those beginning with light syllables.

Ujihira (2000) investigated the effect of syllable weight on the frequency of stuttering in Japanese and American adults. He reported that the frequency of stuttering was significantly lower on words beginning with heavy syllables than on those beginning with light syllables.

The effect of syllable weight on the frequency of stuttering in children has not yet been reported. Moreover, differences in that effect among the four types of heavy syllables have also not been reported.

The purpose of the present study was to investigate whether the frequency of stuttering in Japanese children would differ between words beginning with light syllables and those beginning with heavy syllables, and whether there are differences in the frequency of stuttering among the four types of heavy syllables.

Method

Stimulus Words

To exclude the influence of prior habits of word usage, non-word stimulus words were created, all of which were composed of three syllables. The stimulus words all began with /k/, because it has often been said that stuttering is most likely to occur on stops, and /k/ has been reported to be one of the phonemes likely to be stuttered (Ohashi, 1984).

The stimulus words were divided into 2 groups, the first consisting of words beginning with light syllables, and the second of words beginning with heavy syllables. The second group was further divided into four types of words: words with diphthongs, words with long vowels, words with nasal consonants, and words with geminate stops. The first group and the four subgroups of words in the second group were each composed of four words, thus comprising a total of 20 words. Table 1 shows the 20 stimulus words.

Participants

Participants were 38 children (31 boys, 7 girls) who stuttered. Stuttering is said to affect four times as many males as females, and the ratio of 31 to 7 males to females in the present study reflected that gender disparity.

The children were attending a Japanese elementary school in Tokyo. Two were first graders, 8, second-graders, 9, third-graders, 8, fourth-graders, 7 fifth-graders, and 4 were sixth-graders.

Procedure

Stimulus words were presented to each child with the explanation that they were the names of "monsters" depicted on 20 picture cards. The name of each monster was written in katakana at the bottom of each card.

The children were tested individually in a room at their school. Picture cards were presented one by one to each participant, who was then asked to read the stimulus word written on each card. We found 5 children who had difficulty in reading katakana, of whom two were first-graders and three, second-grade children. Those children were asked to read the stimulus words written in hiragana.

The cards were presented in a pseudo-randomized order to avoid immediate repetition of the same type of initial syllable. The stimulus words were presented to half the children in the reverse order from the other half.

Responses were tape-recorded using a digital audio tape recorder (TCD-10 (Sony)) and microphone (ECM-959DT).

Results

The measures of stuttering were repetitions, prolongations, and blockings occurring on the initial syllables.

Frequency of stuttering was calculated by dividing the total number of words stuttered by the total number of words spoken, and multiplying the result by 100.

Reliability was scored by the Sander Agreement Index (Sander, 1961), that is, the rate of agreement was calculated by dividing the number of agreements by the total of the number of agreements plus disagreements, and multiplying by 100. The rate of agreement was 93.0%.

The frequency of stuttering was highest on the light syllables, and lowest on the long vowels. As shown in Fig. 1, the mean frequency of stuttering on the light syllables was significantly higher than on any of the heavy syllables ($Mse=315.9$, $p<.05$). Among the four types of heavy syllables, a significant difference was observed between long vowels and diphthongs, and between long vowels and geminate stops ($Mse=315.9$, $p<.05$). Although the frequency of stuttering for long vowels tended to be lower than that for nasal consonants, that difference was not significant ($Mse=315.9$, $.05<p<.10$).

Individual differences were observed in the frequency of stuttering among the 5 types of syllables. Figure 2 shows the frequency of stuttering in each child on the

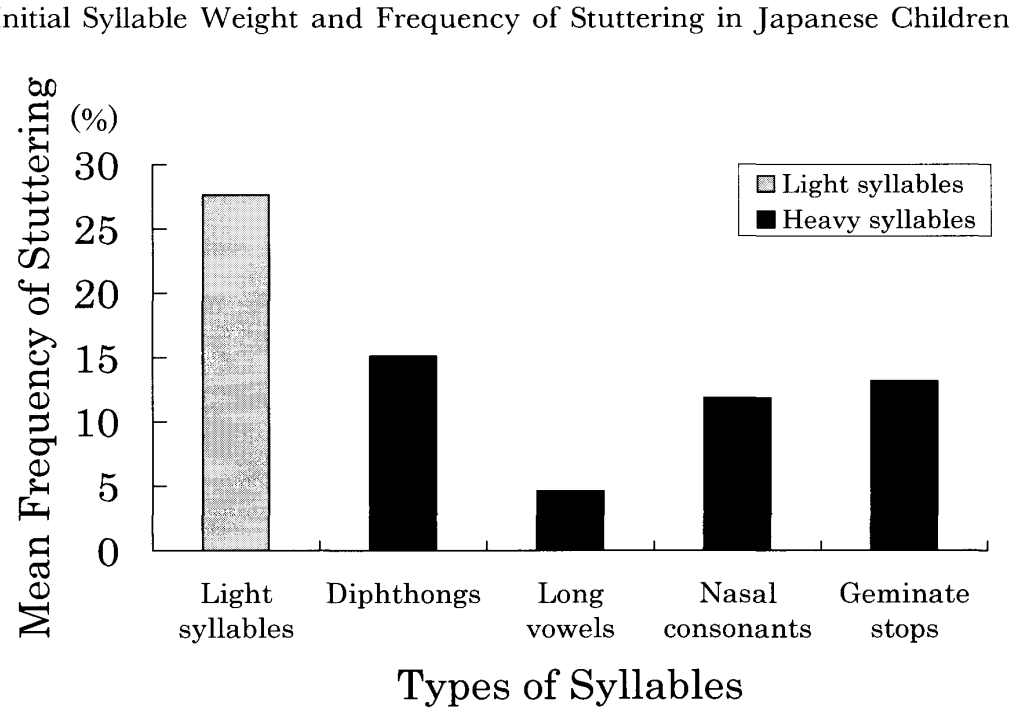

FIG. 1 Mean Frequency of Stuttering: Comparison Between Light Syllables and Four Types of Heavy Syllables

words beginning with light syllables and the words beginning with the four types of heavy syllables. The participants' data are arranged in order according to the frequency of stuttering on the words beginning with light syllables. Twenty-three of the 38 children stuttered on the words beginning with light syllables. In contrast, only 4 children (participants number 1, 8, 10, and 24) stuttered on the words with long vowels. Eleven children (participants 28 through 38) did not stutter during the tests for the present experiment.

Discussion

The present study investigated the effect of syllable weight on the frequency of stuttering in Japanese children. Whereas Ujihira (2000) analyzed spontaneous utterances in adults' natural conversation, we conducted an experimental study with children. A non-word reading task was used to enable a focus on syllable weight.

Ujihira (2000) found that the frequency of stuttering was significantly lower on words beginning with heavy syllables than those with light syllables, in both Japanese and American adults. The results of the present study with Japanese children coincided with those of Ujihira (2000), in that the frequency of stuttering was significantly lower on words beginning with heavy syllables compared to those with light syllables.

Unlike Ujihira (2000), the present study examined differences among the four types of heavy syllables. Among the four types of heavy syllables, the frequency of stuttering was lowest on those with long vowels. The four types of heavy syllables all

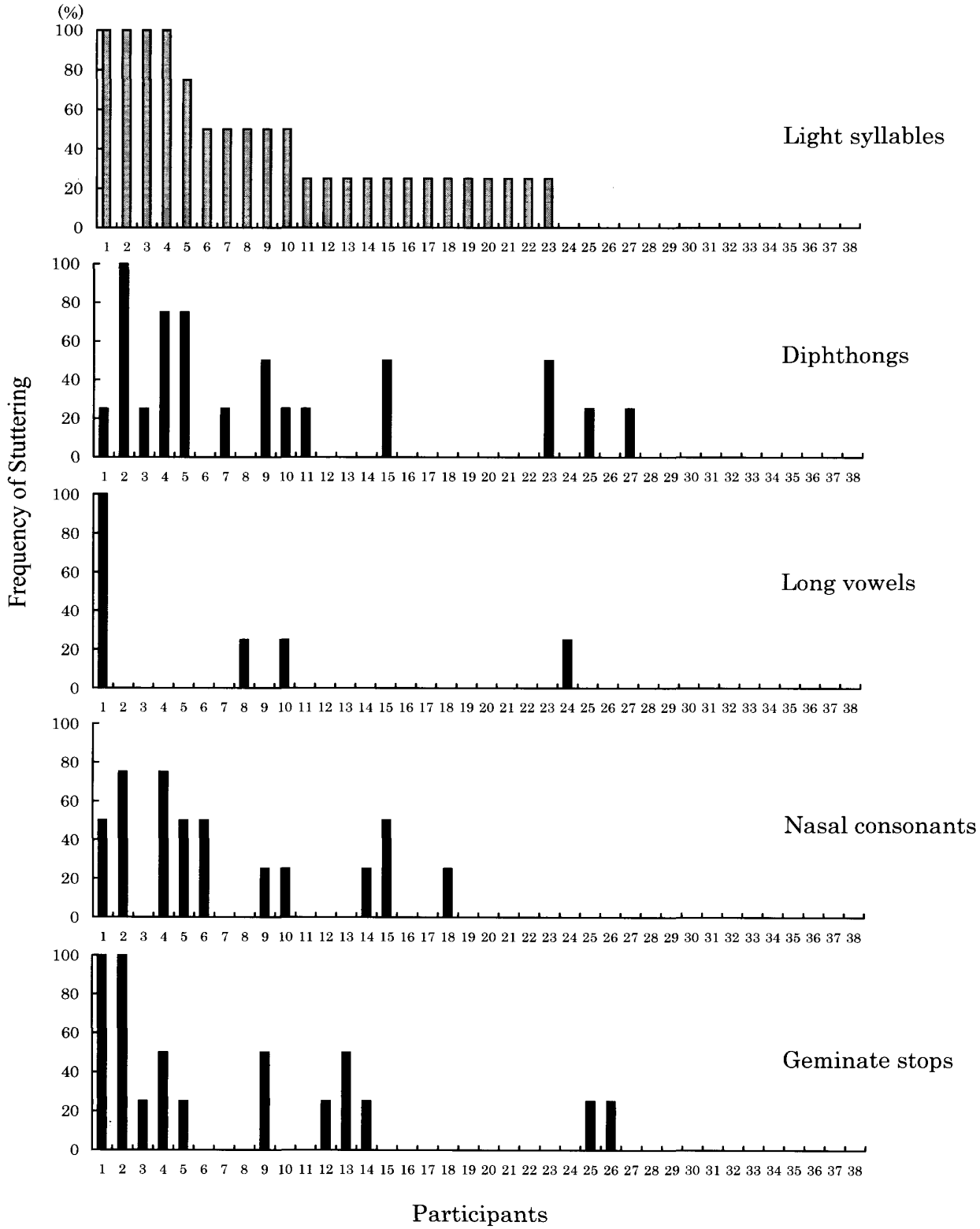

FIG. 2 Frequency of Stuttering in Each Child: Comparison Between Light Syllables and Four Types of Heavy Syllables

require a transition from the second to the third phoneme, but three of the four types of heavy syllables, diphthongs, nasal consonants and geminate stops, require a transition to a different phoneme. For example, in a diphthong, a transition from the initial vowel to a different vowel is needed. In contrast, long vowels do not require a transition to a different phoneme. For long vowels, the transition is to the same vowel.

Kolk hypothesized that stuttering is caused by an adaptation to the difficulty of phonological encoding (Kolk; 1991; Kolk & Postma, 1997). This hypothesis has been called the covert repair hypothesis. A transition to a different phoneme is thought to require more complicated phonological encoding than one to the same phoneme. Therefore, diphthongs, nasal consonants, and geminate stops, all of which involve a transition to a different phoneme, require more difficult encoding than do long vowels. This may be related to the observation in the present study that the frequency of stuttering was lowest on the long vowels.

One participant in the present study did not stutter during his participation, but he used many insertions in his responses. In psycholinguistics, insertions are interpreted as filled pauses (Ito, 1994). Tanaka (1982) points out that filled pauses play both an interpersonal and a cognitive role, and that the cognitive role involves delaying the flow of utterances to help the speaker cope with difficulties in information processing. Based on the covert repair hypothesis (Kolk & Postma, 1997), it is thought that such insertions facilitate phonological encoding by slowing down the processing of speech, which may explain why stuttering was not observed in this participant.

Further, eleven of the 38 children in the present experiment did not stutter. We can posit at least two reasons for this. The first lies in the nature of the task assigned. Moriyama (1979) noted that some people who stutter who have no problems in reading have difficulty in natural conversation, whereas others have no problems in natural conversation but have difficulty in reading. It might simply be that these eleven children were the type that has no problems in reading. A second possible reason for the present findings lies in the characteristic of the initial sound of the stimulus words. In the present study, the initial phoneme of all stimulus words was /k/. It is possible that the phonemes that are likely to be stuttered may differ from child to child. That is, it is possible that some children who stutter may have no problem in producing the /k/ sound.

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