



THE PHONETIC VALUE OF THE DEVOCALIZED VOWEL IN JAPANESE -IN CASE OF VELAR PLOSIVE-

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ABSTRACT

This study investigates how the native speakers of Japanese tell the differences of the words containing the devocalized vowels. The close vowels [i] and [ɯ] devocalize in Japanese when they are situated between voiceless consonants and between pause and voiceless consonant. In this paper, we verify the hypothesis that the devocalized vowels are the voiceless

fricatives. [k^jɪtto], [k^jɯtto], [k^jatto] and [k^jotto] were used for three experiments as the stimuli. The close vowels that follow the voiceless velar plosives devocalize in [k^jɪtto] and [k^jɯtto], on the other hand, the open vowels in [k^jatto] and [k^jotto] don't devocalize. The first experiment studied whether the native speakers of Japanese could distinguish the four stimuli. The second experiment studied whether the clue with which the native speakers of Japanese hear the differences of the words are the devocalized vowels or not. The stimuli of which the parts of the devocalized vowels were replaced with band limited noise were used. In the final experiment, the manipulated stimuli, in which the voiceless fricatives were inserted instead of the vowel.

These results indicate that the parts of the devocalized vowel have the voiceless fricatives when the vowels follow the voiceless velar plosives, and that the native speakers of Japanese can hear the differences of the words containing the devocalized vowels through the differences of the values of the voiceless fricatives.

1. INTRODUCTION

Usually the vocal cords vibrate when we utter /eki made/ (to the station), however, they don't vibrate when we utter /eki kara/ (from the station). In Japanese language, the close vowels [i] and [ɯ] might be devocalized in the following cases:

1. They are situated between the voiceless consonants [k, k^j, s, ʃ, t, ts, tʃ, h, ç, φ, ç, p, p^j].

(e.g., /asita/ (tomorrow) >> [a^ʃta],

/gakuseR/ (student) >> [gakse:].)

2. They are situated between the voiceless consonant and pause.

(e.g., /tabemasu/ (eat) >> [tabemas].)

3. They occur initially and followed by a voiceless consonant.

(e.g., /ikimasu/ (go) >> [kimas].)

In case of "ikimasu" (go), "kimasu" (come) and "kikimasu" (listen), "ikimasu" loses the first [i] between pause and [k], and "kikimasu" loses the first [i] between [k]s. When they devocalized, all of these three words are pronounced as [kimas], and it becomes very difficult for L2 learners of Japanese to tell the differences between them.

The previous researchers have proposed that the parts of devocalized vowels have no phonetic values, and so native speakers of Japanese can tell the differences of the words through the voiceless consonants (Shibata, 1978_[1]; Saito, 1998_[2]), and the devocalized vowels are the "voiceless" vowels (Kawakami, 1977_[3]; Maekawa, 1988_[4]). In this paper, we verify the hypothesis that the devocalized vowels are the voiceless fricatives (Baba, 1997_[5]).

These phenomenon are generally called *voiceless*. To avoid confusion with the whisper, however, we will use the term *devocalized* in this paper.

2. EXPERIMENTAL METHODS

Stimuli processing

[k^jɪtto], [k^jɯtto], [k^jatto] and [k^jotto] which have same pattern except the first vowels of each two were used for the experiments as the sound stimuli. [ʲ] means palatalization in the International Phonetic Alphabet (IPA). The close vowels [i] and [ɯ] devocalize when they situate between the voiceless velar plosive [k^j] and the voiceless alveolar plosive [t]. These were uttered with the same accent pattern by an adult male speaker of Japanese major dialect. The original sounds were recorded into a digital audiotape, and they were sampled 11kHz and quantized with 16-bit resolution.

Participants

Twenty university students participated in the study. All of them were native speakers of Japanese who have not lived in any foreign country. Sixteen participants were speakers of the Kumamoto dialect in which the devocalization of vowels sometimes occur, and four were

speakers of the Kansai dialect in which they don't occur very often (Sugito 1998a₁₆).

Stimuli presentation

The stimuli were presented at a comfortable listening level (adjusted by the participants and us) through headphone to individual situated in a quiet room. The participants were asked to choose the answer from the choice "kyatto", "kitto", "kyutto" and "kyotto" on the answer sheet. In these experiments, the stimuli were repeated 10 times, and were randomly interspersed on 4 sets. (A set has 10 items.)

3. PERCEPTION OF THE DEVOCALIZED VOWELS (EXP.1)

This experiment studied whether native speakers of Japanese could distinguish the four stimuli.

Stimuli

The four original sound stimuli [k^jatto], [k^jitto], [k^jutto] and [k^jotto] were presented.

Result and discussion

As the percentage of answers in Figure 1 indicates, the performances were accurate when [k^jatto] and [k^jotto] which have the non-devocalized vowels were presented, and when [k^jitto] and [k^jutto] which have the devocalized vowels were presented, the performances were highly accurate. From this, we can observe that the stimuli [k^jatto] and [k^jotto] whose vowels were not devocalized could be perceived never a mistake. In the similar way the stimuli [k^jitto] and [k^jutto] whose vowels were devocalized can be perceived at large percentage ([k^jitto] 98% and [k^jutto] 99.4%).

This experiment indicates no significant difference between the native speakers of the Kumamoto dialect and the natives of the Kanasai ($F(19,60) = 2.22, p > .01$). It was found that native speakers of Japanese could tell the difference of the parts of the devocalized vowels.

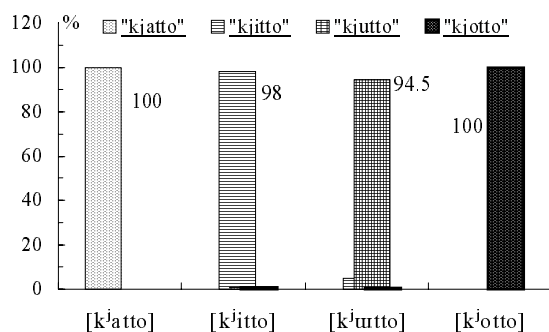


Figure 1: The percentages of the answers in Exp.1 Y- axis shows the percentages of responses, and X-axis shows the stimuli. It shows that the percentages of the words which is chosen for the stimuli.

4. PERCEPTION OF THE VOICELESS CONSONANTS (EXP.2)

This experiment studied whether the clue with which native speaker of Japanese hear the differences of the words are the devocalized vowels or not.

Stimuli

The original sound stimuli were analyzed using Multi-Speech by KAY Elemetrics Corp., and the vowels were decided from a dual spectrogram and waveform. The parts of the vowel were replaced with white noise. Figure 2 shows the waveforms of the original sound [k^jitto] and the manipulated sound.

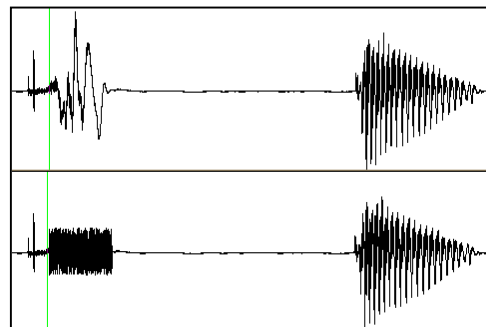


Figure 2: The waveforms of the original sound [k^jitto] (top) and the manipulated sound (bottom).

Result and Discussion

As figure 2 shows, the participants chose "kitto" for each stimulus. The participants could not tell the difference of the stimuli. It was expected that there would be no perceptive differences among the stimuli when the parts of the vowels were replaced with white noise. This experiment indicated no significant differences among the four stimuli ($F_{(3,76)} = 4.05, p < .01$). It was found that native speakers of Japanese perceived the stimuli through the sounds of the parts of the vowels and not through the voiceless consonants.

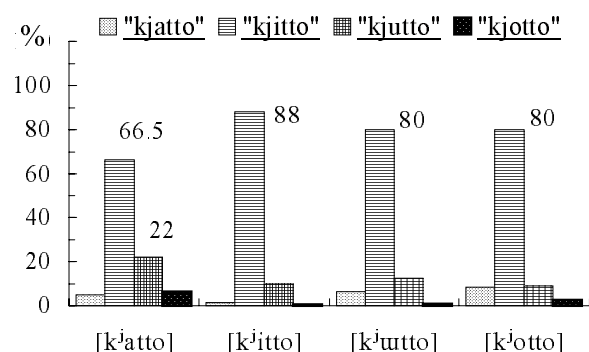


Figure 2: The percentage of the answer in Exp.2

| Stimulus | [k ^j] | Vowel | [tt] | [o] | Duration |
|-------------------------------------|-------------------|-------|------|-----|----------|
| [k ^j atto] | 24 | 129 | 339 | 193 | 730 |
| [k ^j i _i tto] | 19 | 99 | 391 | 160 | 719 |
| [k ^j u _i tto] | 40 | 116 | 358 | 171 | 721 |
| [k ^j otto] | 14 | 138 | 401 | 142 | 744 |

Table 1: the duration of the vowel and consonants

After the presentation, we had interviewed the participants. Some participants distinguished the vowels by means of the differences of the duration of the vowels, which replaced with white noise. They answered that the stimulus with the longest vowel (noise) was [k^ju_itto], and the stimulus with shortest vowel (noise) was [k^ji_itto] with confidence. As table 1 shows, in practice, the stimulus which was the longest vowel is [k^jotto]. It is assumed that the duration of the devocalized vowels are perceived differently from the physical duration by participants.

5. PERCEPTION OF THE VOICELESS FRICATIVE (EXP.3)

Baba (1997) showed that /ki/ is pronounced as [k^jç] when the vowel was devocalized, and /kyu/ pronounced as [k^jç^y]. [ç^y] means velarization in the IPA. In this experiment, we verified Baba's hypothesis: the phonetic value of the devocalized vowels are the voiceless fricatives.

Stimuli

The part of [a] in [k^jatto] of the original was cut off. Then the voiceless fricatives [ç] and [ç^y] were uttered by an adult male speaker of Japanese standard dialect was inserted. Each of the vowel [a] and [o] which were uttered by the same pattern were inserted.

All of these fricatives and vowels had the same duration, and the experiment was not affected by the differences between the duration of the sounds. Figure 4 shows the SPG of the manipulated stimuli.

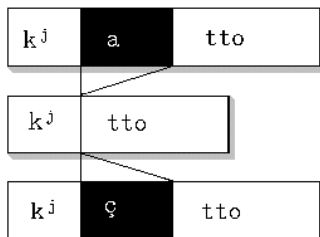


Figure3: The image of the manipulate.

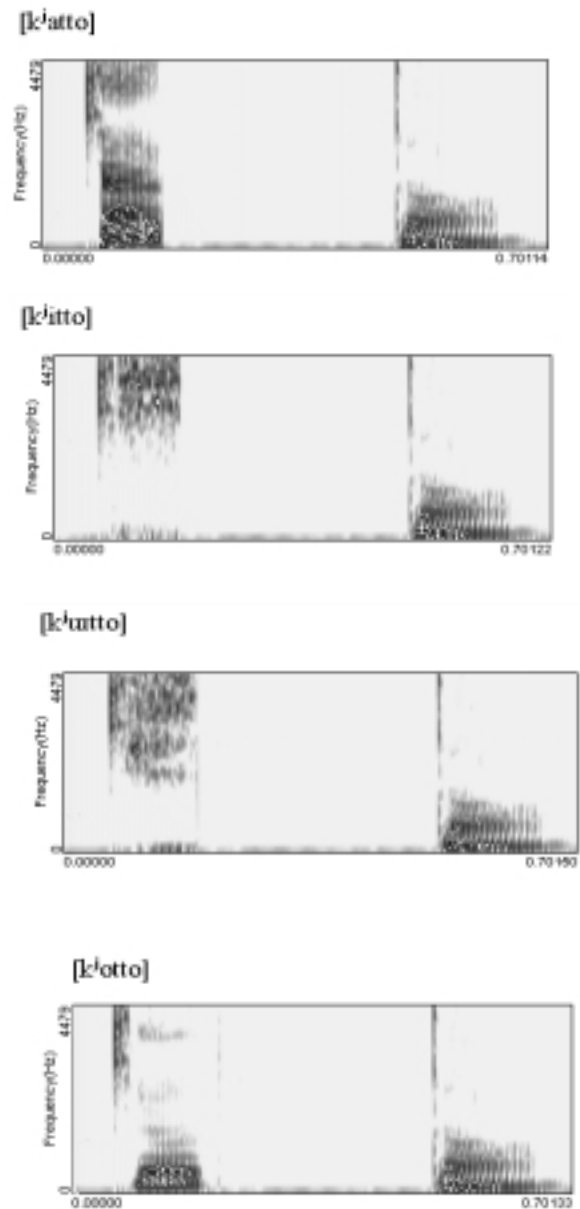


figure 4: The SPG of the manipulated stimuli

Result and Discussion

As the figure 5 shows, the manipulated stimuli were perceived at a large parentage as the original stimuli, even though the devocalized vowels were replaced by the voiceless fricatives. The stimulus with the voiceless fricative [ç] was perceived as “kitto” at 99% and the stimulus with [ç^y] was perceived as “kyutto” at 97%. The result of experiment showed that the participants could tell the differences of the manipulated stimuli just like the original stimuli.

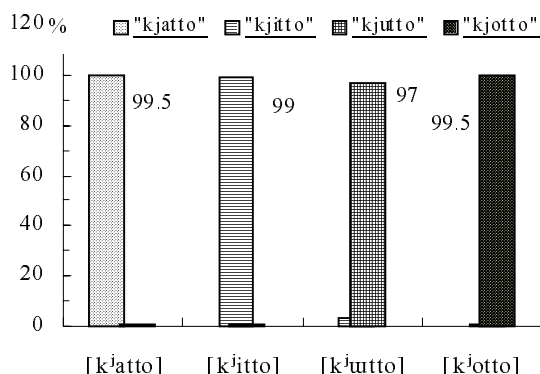
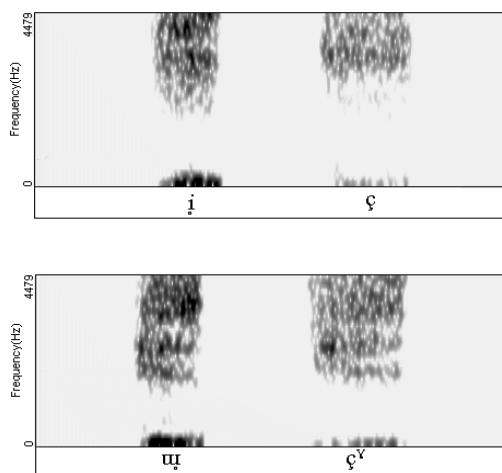


Figure 5: The percentage of the answer in Exp3

Figure 5 shows the spectrograms of the devocalized vowel [i̥] of [k^jittto] and [u̥] of [k^juttto], and the voiceless fricative [ç] and [ç^y] of the stimuli used in Exp. 3. As figure 6 shows, the devocalized vowels are very similar to the voiceless fricatives.

Figure 6: The SPG of the stimuli [i̥] and [ç] (top), [u̥] and [ç^y] (bottom).



From this experiment and fig.6, it was found that the parts of the devocalized vowels [i̥] and [u̥] were the voiceless fricatives [ç] and [ç^y]. Participants could hear the difference of the words under the situation that the acoustical information and the linguistic information was limited. This is surely due to the fact that they could heard the differences of the sounds of the fricatives.

6. CONCLUSION

The results of three experiments bear out Baba's hypothesis: the phonetic values of the devocalized vowels are the voiceless fricatives. These results indicate that the parts of the devocalized vowels have the voiceless fricatives when the vowels follow the voiceless velar plosives, and that native speakers of Japanese can hear the differences of the words containing the devocalized vowels through the differences of the values of the voiceless fricatives.

We expect that these results help the perception of the devocalized vowel in Japanese for L2 learners.

6. REFERENCES

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