

# THE PERCEPTION OF THE MORAE WITH DEVOCALIZED VOWELS IN JAPANESE LANGUAGE

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## ABSTRACT

It is difficult for the Japanese learners to perceive and produce the morae with devocalized vowels. To make it easier for the Japanese learners to acquire them, we investigate how Japanese native speakers perceive them.

Usually the first vowel of the Japanese word 'susugi'(rinse) disappears, and so the pronunciation of 'susugi' is not [susugi] but [ssugi]. We made two psychophysical experiments.

In the first one we shortened the part of [ss] of [ssugides] and [korewassugides] (This is rinse.) in 6 stages. [korewassugides] with shortened [ss] is easy to perceive as [korewasugides], but [ssugides] with shortened [ss] is not easy to perceive of [sugides]. In the case of [korewassugidesu], [korewa] helps the listener in measuring the length of morae of this sentence in order to perceive the shortened [ss] as a mora or two. The reason why [ssugides] with shortened [ss] is difficult to perceive as [sugides] is not the pitch of the first and the second mora but is the pitch of the second and the third mora. In the second experiment we changed the pitches of [sugides] and researched how Japanese perceive these sounds.

## 2. JAPANESE PHONETIC

In this Japanese language, the devocalized vowel tend to happen in the following cases. 1. When the closed vowel ([i],[u]) is between voiceless consonants ([s], [k]). For example, /gakuse:/ (student) >>[gakse:]. 2. When the closed vowel is following the voiceless consonant and there is a rest on its back word. For example, /desu/ >>[des].

The phonetic units of English are syllables, and the units of Japanese are syllables and morae. 'Japanese' and 'English' are divided into syllables as 'ja-pa-nese' and 'eng-lish'. The same meaning in Japanese 'ni-hon-go' (Japanese) and 'e-go' (English). The Japanese words are also divided into morae as 'ni•ho•n•go' and 'e•e•go'. Japanese native speakers divided the word 'nihongo' into syllables as 'ni•hon•go' and also into morae as 'ni•ho•n•go'. In the former, each syllable is the sound cluster to pronounce with ease, and in the latter each mora is the unit of time. Japanese natives perceive that each mora has the same length.

The sentences have intonations and the words have accent in the spoken languages. The functions of accent is to divided the chain of sounds into some parts that compose the sentence, and to distinguish the meanings of words composed with the same speech sounds. Japanese has pitch accent.

The Japanese sound, '\_ni~ho\_n~bu\_n-ga-ku' (the pitch of the morae 'ni', 'n' and 'n-ga-ku' which follow "\_", is low, and the pitch of the morae 'ho' and 'bu' which follow "~", is high) means 'Japan, literature' and '\_ni~ho\_n~bu~n-ga-ku' means 'Japanese literature'. We have a Japanese minimal pair: '\_a~me' (candy) vs. 'a~me' (rain). Only the difference of the accent distinguishes these two words.

## 2. THE EXPERIMENT WITH THE SOUND CONTROLLED BY THE DURATION

### 2.1. Procedure

[sugides] (Japanese cedar), [ssugides] (rinse), [korewasugides] (this is cedar) pronounced by an adult male standard Japanese speaker were used for the experiment as the sound stimuli. The original sounds were recorded into a digital audio tape.

In TEST1, the part of [ss] in [ssugides] was shortened by computer synthesizer in 6 stages by 10%. In TEST2, similarly, the part of [ss] of [korewassugides] has been shortened to 6 stages by 10%. Six kinds of the manipulated sound stimuli and two kinds of the original sounds were ordered at random comprising one set. 10 sets of these stimuli were recorded into a digital audio tape.

Stage	Short[%]	Duration[ms]	Stage	Short[%]	Duration[ms]
1*	0	308	1*	0	308
2	10	278	2	10	278
3	20	248	3	20	248
4	30	218	4	30	218
5	40	188	5	40	188
6	50	158	6	50	158
7	60	128	7	60	128
8*	0	137	8*	0	137

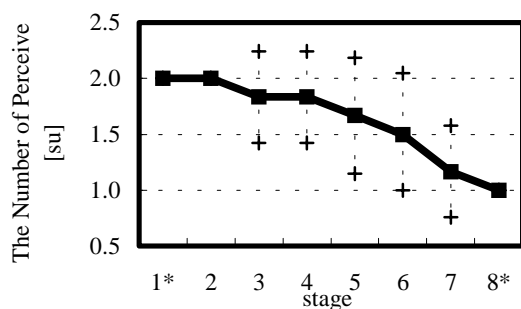
**Table1:**The manipulated stage of the sound stimuli. 'Duration' indicate the duration of [ss]. On the left table, stage1 is the original sound of [ssgides] and stage8 is the original sound of [sugides]. On the right table, stage1 is the original sound of [korewa ssugides] and stage8 is the original sound of [korewa sugides].

The subjects were divided into two groups; 20 native Japanese speakers of *mu*-accent ('mu' is non in English.) dialects, Japanese speakers that don't distinguish meaning by pitch accent (group JK), 20 native Japanese speakers who speak accent dialects Japanese (group JT). The subjects were asked to listen to the tape using headphone and to mark on the answer

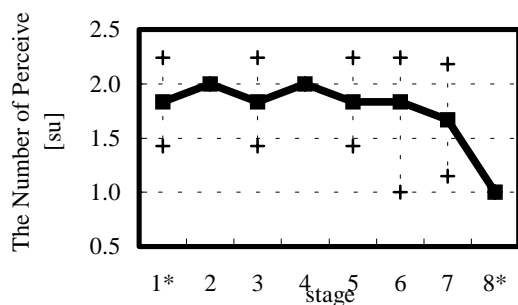
sheets the one of 2 choices closest to what they perceived : "sugidesu" and "susugidesu" (TEST1), "korewasugidesu" and "korewasusugidesu" (TEST2) written in Japanese Kanji.

## 2.2. Result

Figure 1 ,2 show the typical result of TEST1. The stimuli is the part of [ss] in [ssugides] was shortened 6 stages by 10%. Previous researchers[4] insisted that the duration affects the perception of the number of morae. Based it, it is assumed that when the duration of [ss] of [ssugides] is shortened, the sound will be perceived as [sugides]. As Fig.1 shows the subject in JK perceived a smaller number of morae when [ss] was shortened. On the other hand, as Fig. 2 shows, even when the duration of the [ss] of [ssgides] was shortened, the number of morae perceived by JT did not decrease like the subject in JK.

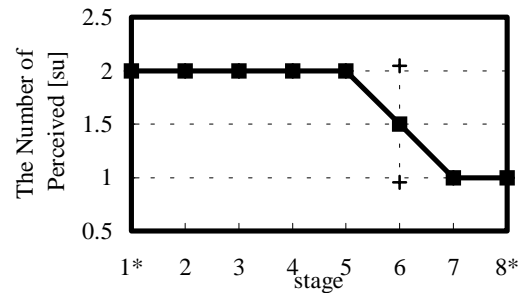


**Figure1:** The typical result of a subject of group JK in TEST1 . Stage1 is the original sound stimuli of [ssugides],and stage8 is the original one of [sugides].

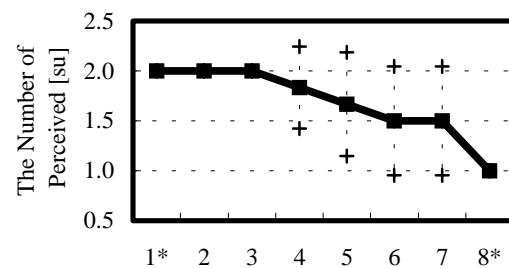


**Figure2:**The typical result of a subject group JT in TEST1.

Fig.3,4 shows the typical result of TEST2.The stimuli is the part of [ss] in [korewassugides] was shortened 6 stages by 10%. As Fig.3 shows the subject in JK perceived a smaller number of morae when [ss] was shortened. JK perceived the stimuli as [korewassugides](This is rinse) to stage5( 40% cut). As Fig.4 shows the subject in JT perceived the stimuli as [korewassugides](This is rinse) to stage3( 20% cut). In TEST2, the length of [ss] on stage5 (160ms) is almost equal to [wa] (168ms).

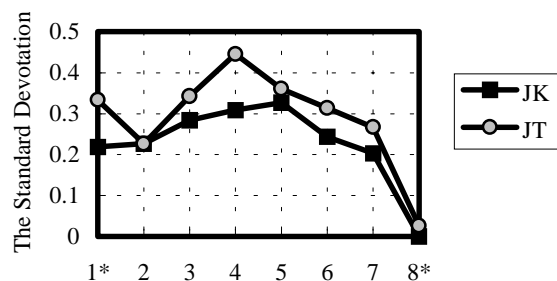


**Figure3:**The typical result of a subject group JK in TEST2. Stage1 is the original sound stimuli of [korewa ssugides],and stage8 is the original one of [korewa sugides].

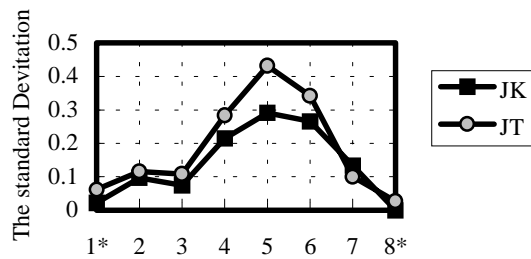


**Figure 4:**The typical result of a subject group JT in TEST2.

In the standard Japanese, the accent of the first mora must be different from the accent of the second. There was no accentual change in the shortened the [ss] of the stimuli. Thus the subjects in JT, who perceive morae by the accentual change, did not perceive the stimuli as [sugi]. On the other hand, the subjects in JK who are *mu*-accent Japanese speakers perceived it as [ssugi]. In TEST2, there was [korewa] ("This is" in English) ahead of [ssugides] in the stimuli. Fig.5,6 show the standard deviation in TEST1and TEST2. The perception of stage1-3 in TEST2 is stable compared with that in TEST1. It means that in the case of [korewassugides], [korewa] helps the listener in measuring the length of morae of this sentence in order to perceive the shortened [ss] as a mora or two. It is assumed that Japanese speakers perceive [ss] based on the length of [korewa]. Therefore as Fig.3 shows, JK is perceived up to the same length the stimuli of [ss].



**Figure5:**The standard deviation in TEST1.



**Figure6:** The standard deviation in TEST2.

### 3. THE EXPERIMENT WITH THE SOUND CONTROLLED BY THE PITCH CHANGE

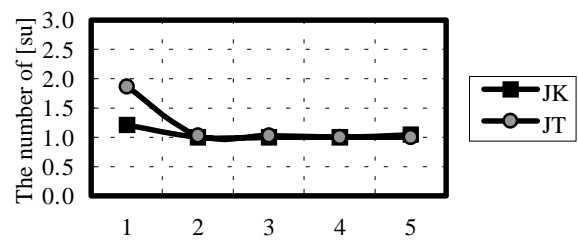
#### 3.1 Procedure

The two words [sugides](Japanese cedar) and [ssugides](rinse) pronounced by an adult male standard Japanese speaker were changed by a shift in the position of pitch and used for the experiment as the sound stimuli. The pitch has been changed by manipulating the accent ordered time (after this, it is T1) in the Fujisaki model. The T1 of two original sound stimuli ([suːgides], [sːsugides]) was shifted. It was shifted 2 stages ahead of the original sound T1's position and shifted 2 stages behind the original one. In this experiment the sound stimuli were created by PROSODY[1]. Five kinds of the manipulated sound stimuli were ordered at random comprising one set. 12 sets of these stimuli were recorded into a digital audio tape.

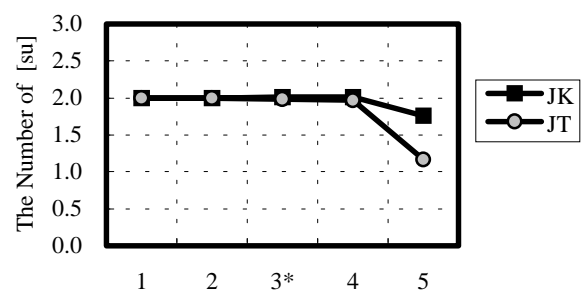
The subjects were divided into two groups; 6 native Japanese speakers of *mu*-accent dialects, Japanese speakers that don't distinguish meaning by pitch accent (group JKb), 6 native Japanese speakers who speak standard Japanese (group JTb). The subjects were asked to listen to the tape using headphone and to mark on the answer sheets the one of 2 choices closest to what they perceived: "sugidesu" and "susugidesu" written in Japanese Kanji.

#### 3.2 Result

Fig.7,8 show the result of the perception in group JTb and JKb. As Fig.7 shows the result of [sugides]. The stimuli is shifted the original sound T1's position in [sugides]. JKb rarely perceived the stimuli as [ssugides] even though T1's position shifted ahead of the original sound T1. On the other hand, JT perceived them as [ssugides] when T1's position shifted ahead of the original sound T1. It means that standard Japanese speaker subjects affect the pitch change. Fig. 8 shows the result of [ssugides].

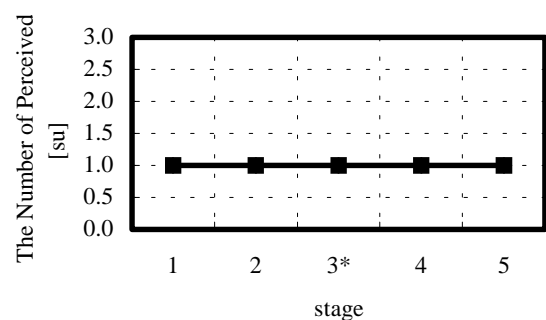


**Figure 7:** The perception of the sound stimuli [sugides].The stage3 is original sound. The stage1,2 were shifted ahead of the original sound T1's position and the stage4,5 shifted behind the original one.

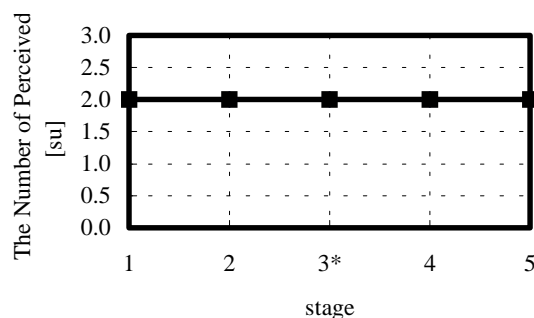


**Figure 8:** The perception of the sound stimuli [ssugides].The stage3 is original sound.

Fig. 9,10 shows the typical result of a subject of group JK. As Fig. 9 shows the result of [sugides], the stimuli were perceived as [sugides] even though the pitches were chaged. As Fig. 10 shows the result of [ssugides], similarly, the stimuli were perceived as [ssugides] even though the pitches were chaged. It means that *mu*-accent dialects of Japanese speaker subjects affect the duration.



**Figure9:** The typical of the result of a subject group JK . Stage3 is original sound of [sugides].



**Figure10:** The typical of the result of a subject group JK .  
Stage3 is the original sound of [ssugides].

## 4. DISCUSSION

In the experiment with controlled duration, the subjects of native standard Japanese speaker did not perceive the manipulated sound stimuli as [sugides] nor [korewasugides] even though they were the subjects of Japanese speakers of *mu*-accent dialects. And, in the case of [korewassugidesu], [korewa] helps the listener in measuring the length of morae of this sentence in order to perceive the shortened [ss] as a mora or two.

In the experiment with controlled the pitch change, however, they reacted to the pitch change. Thus it can be said that the standard Japanese speakers will be perceived by the pitch change, and the Japanese speakers of *mu*-accent dialects will be perceived by the duration the number of morae with devocalized vowel.

## 5.CONCLUSION

Previous researchers proposed that only the duration affects the perception of the number of morae. In this time, however, the pitch change, as well as the duration, has an important influence on perception of the number of morae with the devocalized vowel. It is difficult for the Japanese learners to perceive the devocalized vowel. It is very profitable to acquire the ability to perceive the perception of the pitch accent on a Japanese voice education. And it might be effected that not only the duration but also the pitch change is emphasized in the language of Japanese leaners.

## 6.ACKNOWLEDGMENT

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## 7. REFERENCES

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