

# WEAK BUT CONTINUOUS GEMINATE VOICING IN YAMAGATA JAPANESE

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## ABSTRACT

This study examines the phonetic realization of voicing in Yamagata Japanese, a dialect spoken in the Tohoku region. Previous literature has shown that in Standard Japanese, closure voicing of voiced geminates stops in the middle of the closure duration. The ratio of the length of closure voicing in voiced geminates in Tohoku dialects, however, is controversial. While Akita Japanese has a short closure voicing duration, Yamagata Japanese shows variation in duration. A detailed analysis of recorded materials from native speakers of Yamagata Japanese reveals that closure voicing is short in voiced geminates at a glance, but with very weak voicing; that is, voicing with small amplitude that continues up to about 80% of the closure duration. This supports the claim that speakers of Yamagata Japanese keep geminate voicing without semi-devoicing. These results imply that the phonological distribution and phonetic realization of voiced geminates in Japanese dialects interact with each other.

**Keywords:** Japanese dialects, geminate, closure voicing duration

## 1. INTRODUCTION

Much attention has been paid to geminates, or *sokuon*, in Japanese phonology and phonetics. Many studies from various perspectives, including L1 and L2 acquisition, phonological theory, speech perception etc., have tried to clarify the nature of geminates in Japanese. L2 learners of Japanese, for example, have difficulty distinguishing between singleton and geminate consonants in production, even if they have experience of studying abroad in Japan for several months [1].

The topic of geminate voicing is also one of interest in the literature. Voiced geminates are avoided in Japanese phonology. No native and Sino-Japanese words, for example, contain voiced geminates. Western loans accept them, however, as in *reddo* ‘red’ and *furaggu* ‘flag’. Avoidance of voiced geminates can also be seen in phonetics. Voicing in geminates, for example, stops at the midpoint of the interval. In other words, voicing in geminates is incompletely realized. This is known as

semi-devoicing in Standard Japanese [2]. This semi-devoicing of voiced geminates is a natural phenomenon from an aerodynamic point of view. While a speaker must keep air flowing from the lungs in order to maintain vocal vibration, obstruents require the constriction of the airflow at the point of the articulation. Therefore, speakers need to stop the vocal vibration or control the articulatory organs for a long time when they produce voiced geminates. Semi-devoicing is the result of the former.

Regional variation in the phonetic details of geminates has been identified in several studies of Japanese dialects. Vowels preceding geminates are shortened in Akita Japanese, a dialect spoken in the north-eastern part of Japan [3]. In contrast, Kagoshima Japanese, a dialect spoken in the south-western part of Japan, does not show such a tendency [4].

As for phonology of voiced geminates, it has been pointed out that many dialects in Kyushu and Tohoku accept voiced geminates not only in western loans but also in the native and Sino-Japanese lexicon. Speakers of such dialects in Kyushu, for example, say *teddo* ‘train’ for *tetudoo* and *kuzzo* ‘(something) is coming’ for *kuruzo* in Standard Japanese. The phonetic realization of voiced geminates in Kyushu is also different from Standard Japanese. Speakers maintain vocal vibration during constriction in Amakusa, a dialect spoken in western Kyushu [5]. That is, there is no semi-devoicing.

This result suggests that dialects with voiced geminates in the native and Sino-Japanese lexicon realize long closure voicing duration. To verify this hypothesis, we should look at other dialects with voiced geminates. In the Tohoku region, Yamagata Japanese is a dialect with such characteristics [6]. The progressive aspect of vowel-final verbs, for example, is realized with voiced geminates such as *middda* ‘to be seeing’, *tabedda* ‘to be eating’.

Little study has been done to measure the phonetic realization of voiced geminates in the dialects of the Tohoku region. The voicing duration of voiced geminates in Akita Japanese is shorter than that in Kumamoto Japanese, a dialect spoken in the Kyushu region [7]. In contrast, a study working on acoustic phonetic measurement of voiced geminates in Yamagata Japanese reports that the closure voicing ratio of [dd] in Yamagata Japanese

has a wide distribution, as shown in Figure 1 [8]. These results suggest that phonetic realization of voiced geminates is not straightforward. To explore the phonetic realization of voiced geminates in detail, this study analyzes the phonetic realization of voiced geminates in Yamagata Japanese and considers their articulatory background.

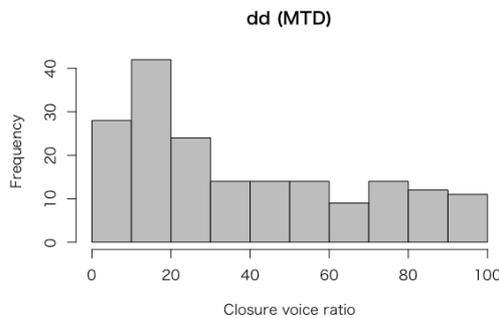


Figure 1: Closure voicing ratio in [8]

## 2. METHOD

Four native speakers of Yamagata Japanese, consisting of two males, A (born in 1952) and B (born in 1942), and two females, C (born in 1944) and D (born in 1941), participated in the recording session. Recordings were made using a ZOOM H5 PCM recorder and an AKG C520 headset microphone. The session was held in a quiet room.

The test words consisted of verbs and nouns. Verbs were derived forms such as past, continuous, desiderative, and the attributive form followed by the noun *-toki* ‘time’. All target words are voiced obstruents since voicing takes place between vowels in Yamagata Japanese native words. Speakers were instructed to translate them into Yamagata Japanese. Examples of the verbs are shown in Table 1.

verb root	tabe- ‘to eat’	mi- ‘to look’
past	<i>tabe-da</i>	<i>mi-da</i>
continuous	<i>tabe-dda</i>	<i>mi-dda</i>
desiderative	<i>tabe-ddai</i>	<i>mi-ddai</i>
V- <i>toki</i>	<i>tabe-ddogi</i>	<i>mi-ddogi</i>

Table 1: Examples of verbs

All the voiced geminates in nouns are in foreign loanwords because, as in Standard Japanese, there are no voiced geminates in native and Sino-Japanese nouns in Yamagata Japanese. All examples of the nouns are shown in Table 2.

We prepared 52 verb forms and 21 nouns. Speakers read words three to five times, translating to Yamagata Japanese for verbs. They read words both in isolation and within frame sentences. In total, 669 tokens were recorded.

<b>Foreign loanwords:</b> kataru ‘Qatar’, kattaa ‘cutter knife’, katto ‘cut’, kiddo ‘kid’, sjureddaa ‘shredder’, tomato ‘tomato’, natoriumu ‘sodium’, netto ‘net’, batto ‘bat’, baton ‘baton’, heddo ‘head’, matto ‘mat’, mitto ‘mitt’, middonaito ‘mid night’, reddo ‘red’, watto ‘watt’
<b>Sino-Japanese:</b> kattoo ‘conflict’, katoo ‘fructose’, sattoo ‘rush’, satoo ‘sugar’, nattoo ‘Natto’

Table 2: Complete list of nouns

All recorded sounds were segmented and the closure voice duration for each interval was calculated by using the voice report function of Praat. The values of voice report function were set to their defaults. We will report not only the result of the measurements, but in order to report the voicing realization in detail, also the results of visual inspection of the waveforms and spectrograms.

## 3. RESULTS

### 3.1. Acoustic phonetic measurements

Figure 2 shows closure voicing ratio in the dialect. The average value is about 20 to 30%, except for speaker B whose average value is about 90%.

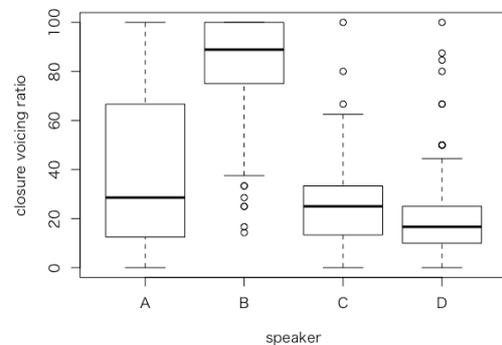
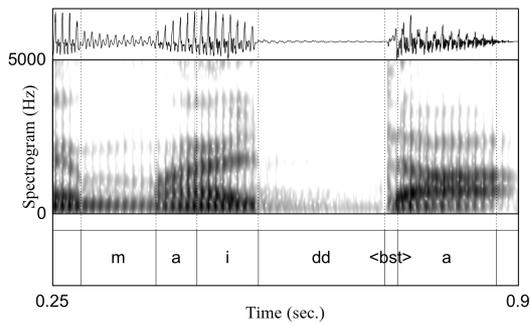


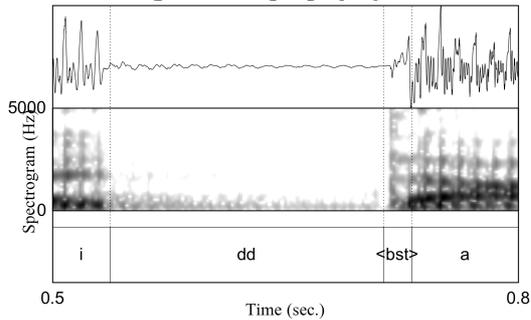
Figure 2: Closure voicing ratio of [dd]

### 3.2. Visual inspection

Waveform and spectrogram of [maidda] ‘be seeding’ are shown in Figures 3a and 3b. Although the closure voicing ratio of [dd] is only 11.11% according to the auto-calculation of Praat’s voice report function, we can observe periodic waves and a voice bar throughout [dd], as shown in Figure 3b. These demonstrate that weak voicing continues through the geminate constriction. Furthermore, the voicing declines through closure interval. This declination would mean that airpressure from lung was weakened.



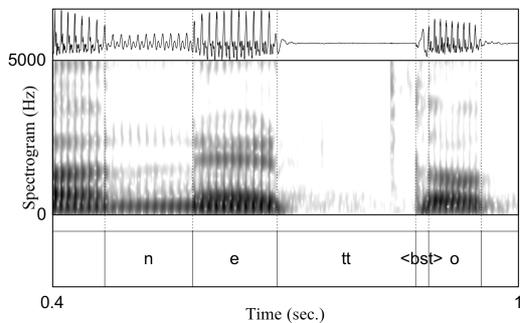
**Figure 3a:** Waveform and spectrogram of voiced geminate [dd] by speaker A



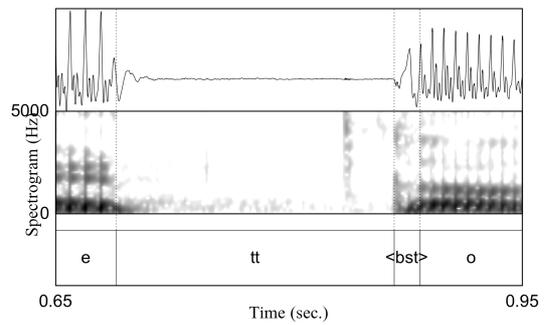
**Figure 3b:** Expansion of [dd] in Fig. 3a.

It is possible that the weak voicing is a result of reverberation. Although the session was held in a quiet room inside a building, and a headset microphone was used, the room was not a sound booth, so we cannot exclude reverberation completely. A comparison to a voiceless geminate [tt] is a meaningful way to test this possibility.

The waveform and spectrogram of a voiceless geminate [tt] are shown in Figures 4a and 4b. We cannot observe any voice bar during the geminate. The closure voicing ratio was 5.56%. There is energy in the low frequencies, but these are weaker than those in [dd]. There is also no periodic wave. This means that the phonetic realization of voiced geminates should be distinguished from voiceless geminates.

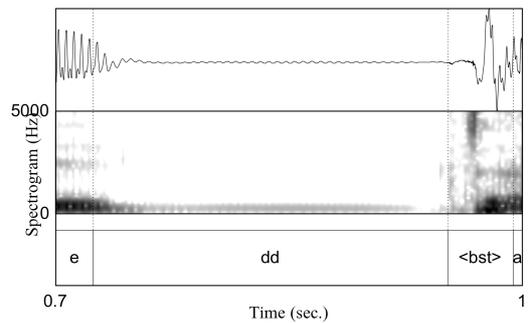


**Figure 4a:** Waveform and spectrogram of voiceless geminate [tt] by speaker A

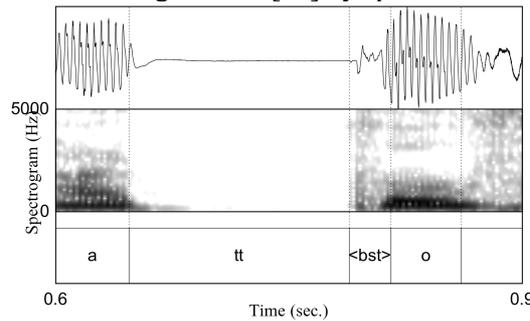


**Figure 4b:** Expansion of [tt] in Fig. 4a.

Similar results are found in the recordings of the female speakers. The waveform and spectrogram of [umedda] ‘be burying’ are shown in Figure 5a and 5b. The closure voicing ratio in [dd] of [umedda] is 17.39% according to the auto-calculation. In contrast, the ratio is 7.14% in the [tt] of [katto] ‘cut’. We can observe small periodic waves and a voice bar throughout the duration of the voiced geminate in Figure 5a. In contrast, there are no periodic waves nor voice bar in [tt], as is shown in Figure 5b.



**Figure 5a:** Waveform and spectrogram of voiced geminate [dd] by speaker D



**Figure 5b:** Waveform and spectrogram of voiceless geminate [tt] by speaker D

Weak voicing is not accidentally produced, but controlled by speakers. The figures in 6 are different utterances of [dd] in [waddogi] ‘when someone divides’ by speaker A. The closure voicing ratio varies, at 44.44%, 47.36%, 68.75%, and 78.94% in order from the top. As can be seen in the waveforms, all utterances have very small periodic waves. That is, speakers of Yamagata Japanese control vocal vibration in closure of voiced geminates.

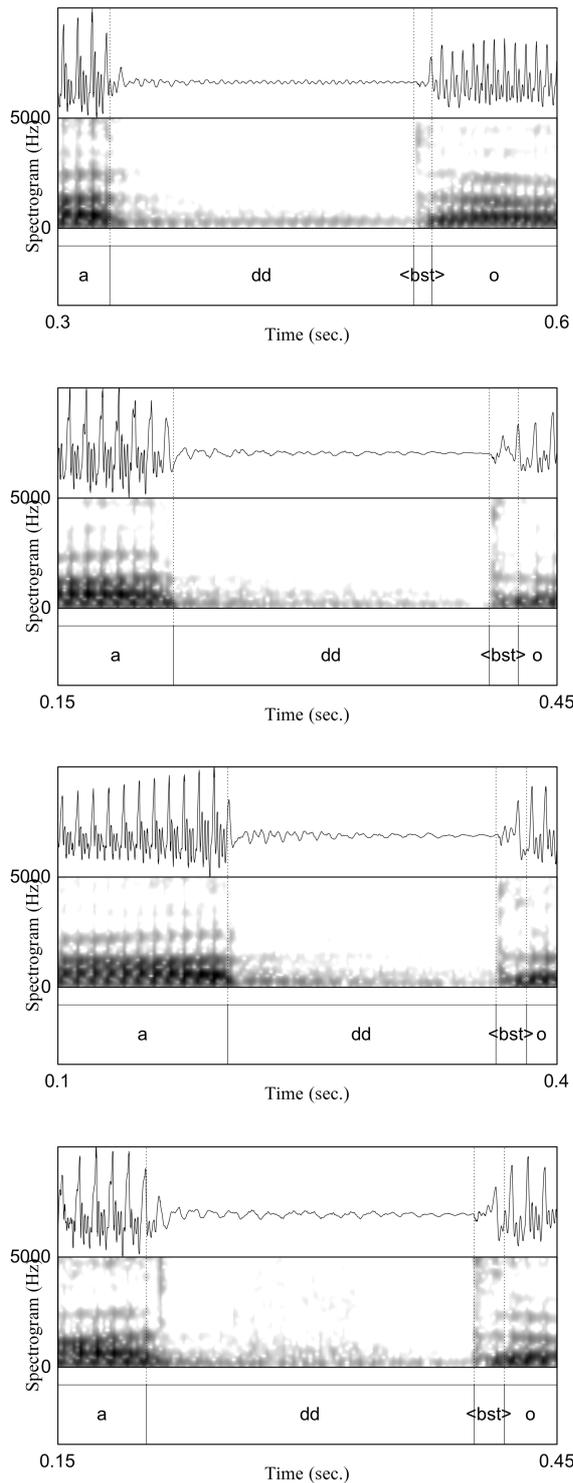


Figure 6: Utterances of [dd] by speaker A

#### 4. DISCUSSION

It is apparent that small periodic waves with small amplitude continue throughout the constriction of voiced geminates in Yamagata Japanese. Since periodic waves reflect vocal vibration, the articulation of voiced geminates in Yamagata

Japanese differs from that in Akita Japanese. The nature of voicing, however, is also different from Kyushu dialects where speakers produce voiced geminates with full voicing. The small amplitude of voicing in Yamagata Japanese was not reflected in by the voice report function. As a result, the closure voicing ratio varies widely.

Voiced geminates involve aerodynamic difficulty, as is discussed in section 1 [9]. Speakers of Standard Japanese stop voicing at the midpoint of geminate closure. In contrast, Kumamoto Japanese, speakers maintain the airflow by expanding the pharynx [10]. The results above suggest speakers of Yamagata Japanese solve this difficulty by using another strategy. While they maintain airflow from the lungs until nearly end of the closure duration, they continue to breathe weakly. In other words, they escape the aerodynamic difficulty by maintaining strength of breath.

The result supports the hypothesis that speakers of dialects which have voiced geminates in native and Sino-Japanese vocabulary keep voicing in voiced geminates. The acoustic phonetic realization of voiced geminates, however, differs by dialect. Although the present study gives an account for dialectal difference in geminate articulation, there is no aerodynamic measurement of the phenomenon. These studies will not only enrich our understanding of the phonetics of geminate voicing, but also give some phonological implications regarding the phenomenon.

This study reports only on voicing of geminates. The comparison between geminates (weak voicing) and singleton (complete voicing) will be needed. The evaluation of voicing in the current study was by visual inspection. Quantitative assessments realization will be conducted in order to support our discussion in future.

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