Phonetic Realizations in the Miyako Dialects : A Preliminary Investigation

Phonetic Realizations in the Miyako Dialects: A Preliminary Investigation

Toshio MATSUURA

1 Introduction

1.1 Research background and goals

In addition to intervocalic geminates such as those in (1a), the Miyako dialects have word-initial geminates such as those in (1b) and word-initial clusters of different consonants such as those in (1c) (in (1), dialects are indicated in parentheses).

(1) a. [avva] 'oil' (Irabu, Kugai), [mizza] 'garlic chive' (Kugai)
b. [ffa] 'child' (Kugai), [ssï] 'nest' (Kugai)
c. [sta] 'tongue' (Irabu), [mta] 'earth' (Irabu, Kugai)

Pellard (2007) and Shimoji (2008) argue that geminates such as those in (1b) are segmented into two morae, as in (2a), to avoid violating the bimoraic Minimality Constraint in the Miyako dialect. It seems appropriate to assume that consonant clusters such as those in (1c) are likewise segmented as in (2b) to avoid violating this Minimality Constraint.

(2) Segmentation avoiding Minimality Constraint violation
a. [f.fa], [s.sï]
b. [s.ta], [m.ta]

How are these consonants realized acoustically, though?

Firstly, (2) does indeed seem to be an appropriate phonological segmentation for word-initial geminates such as those in (1b). Does this mean, then, that there is a phonetic difference between word-initial geminates and single word-initial consonants? One would expect [ff] in [ffa] to be longer in duration than a single syllable-initial [f] (e.g. [fau]). The phonetic transcription does, of course, represent geminates as pronounced with a longer duration than single consonants, which matches auditory perception, as well. Moreover, it is not unreasonable to assume that the Miyako dialects are similar in this regard to Standard Japanese (the Tokyo dialect), to which they are closely related and for which the proportion of single consonants to geminates has been reported as being

around 1:2–3 (Han 1962, among others)[1]. It would seem worthwhile, however, to confirm that this is in fact the case.

Next, word-initial consonant clusters such as [m.ta] do not exist in mainland Japanese, with the exception of words with devoiced vowels, and there are as yet no data on their acoustic-phonetic realization. Among others, Shimoji (2008) argues that the first vowel in such a cluster by itself constitutes one mora. If this is the case, it seems not unlikely that [m] in [m.ta] differs acoustically from a single syllable-initial [m]. According to Sato (1993), syllable-final [n], [m], and so on (moraic nasals) are longer in duration than syllable-initial [n], [m], and so on in Japanese, while almost no such difference is observed in English and Korean, for example. Sato (1993) attributes this difference to differences in rhythmic structure among languages, Japanese having a moraic rhythm, English a stress rhythm, and Korean a syllabic rhythm; applying this to the Miyako dialects would lead us to expect a result similar to that for Japanese, assuming that the Miyako dialects have a moraic rhythm, as well.

Lastly, voiced obstruent geminates such as those in (1a) are observed only in Western loans such as *beddo* 'bed' and *kiddzu* 'kids' in Standard Japanese[2]. Moreover, as will be shown in Section 2.2, the acoustic-phonetic realization of this type of geminate in Standard Japanese cannot be described as the mere lengthening of a single consonant. Are voiced obstruent geminates realized just as they are in Standard Japanese, then, in the Miyako dialects?

In this chapter, I will investigate these kinds of issues related to temporal control and vocal fold vibration based on recorded materials from the joint survey. Data from the Irabu[3] and Kugai dialects are used, although I will also touch upon other dialects where necessary.

1.2 Method of analysis

I will use materials recorded during the joint survey of the National Institute for Japanese Language and Linguistics. I performed a spectrographic analysis on the recorded materials using *Praat* (Boersma & Weenink 2009), labeling segments by visual inspection and measuring segment durations with a self-written script. The identification of segments was largely based on formants, voice bars, noise components, and the like. There were, however, cases where identification was difficult, such as utterance-final vowels. In these cases, I set the dynamic range of the spectrogram

[1] It has been reported, however, that in syllabeme dialects such as those of Akita and Kagoshima, geminates are not as long in proportion to single consonants as in Standard Japanese.
[2] When we take Japanese dialects into consideration, they are also observed in Chinese loans and native words in the Hachijōjima (Mase 1961) and Antō (Nitta 2011) dialects, as well as in a significant part of the Kyūshū region (the Kagoshima (Kamimura 1957) and Saga (Fujita 2003) dialects as well as that of Kuchinotsu in Nagasaki Prefecture (Minami 1959)), among others.
[3] Strictly speaking, it is the dialect of the Irabu district of Irabujima, but I will use the term 'Irabu dialect' in this chapter.

to 30 dB and designated those parts in which there was a clear energy component in the 2000–3000 Hz range as vowels.

The details of the speakers of the two dialects are given in (3).

(3) Speaker details
   a. Irabu dialect: male, b. 1924
   b. Kugai dialect: male, b. 1926

When measuring consonant durations, and especially when comparing those of geminates and single consonants, it is desirable to also measure the duration of the vowels following them and the proportion between consonant and vowel durations (the normalized duration), but there were cases in the data where the length of these vowels was difficult to determine accurately because they were utterance-final. For this reason, I will consider only absolute consonant duration in this chapter. In addition, when performing an analysis of this kind, it is desirable to use averages of data consisting of a large number of utterances from multiple speakers, but as I only had data of one speaker per dialect, the analysis is in many cases based on a single recording. In this respect, this chapter constitutes a preliminary investigation; further research is therefore necessary, including in regard to reproducibility.

2 Geminates

In this section, I will examine the durations of different types of geminate in the Miyako dialects, distinguishing between intervocalic and word-initial geminates and further subcategorizing the former into voiceless and voiced intervocalic geminates. Below, I will first analyze the durations of [t] and [tt], as well as of [ts] and [tts]. Next, I will analyze voiced obstruent geminates such as [vv] and [zz], focusing on their durations, noise components, and voice bars. As regards [vv], I will also take dialects other than those of Irabu and Kugai into consideration.

2.1 Voiceless intervocalic geminates

2.1.1 [t] and [tt]

In the Irabu dialect, [bata] ‘belly’ and [batta] ‘armpit’ form a minimal pair for [t] and [tt]. Waveforms and spectrograms of these words are given in Figure 1.

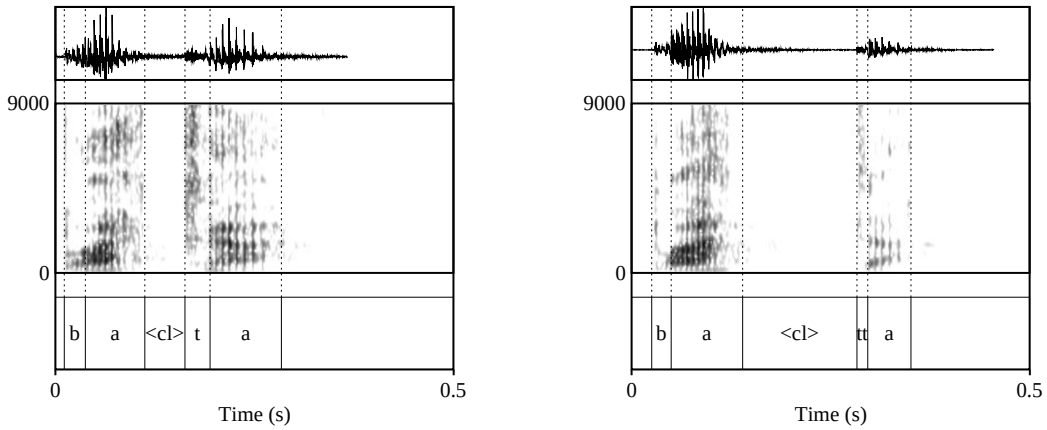

Figure 1. Waveforms and spectrograms of [bata] and [batta] (Irabu).

As is clear from Figure 1, a large difference between [t] and [tt] lies in the durations of the consonant portions. The durations of the closure portions (indicated by <cl> in Figure 1) were 50 ms for [t] and 143 ms for [tt] (a ratio of 1:2.86). Figure 1 also shows a difference in length between the following vowels (89 ms for [bata] and 54 ms for [batta]), but this is not observed in other words. Although they do not form a minimal pair, let us examine the pair of [budzati] 'uncles' and [asatti] 'the day after tomorrow'. Waveforms and spectrograms of these words are given in Figure 2.

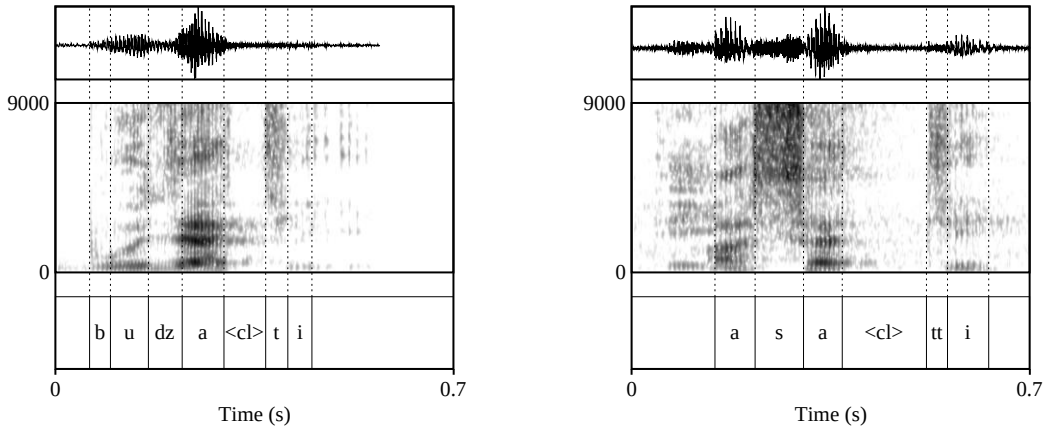

Figure 2. Waveforms and spectrograms of [budzati] and [asatti] (Irabu).

As is clear from Figure 2, the most conspicuous difference between [t] and [tt] is again the difference in duration between their consonant portions, the durations being 73 ms for [t] and 148 ms for [tt] (a ratio of 1:2.02). The duration of the following vowel was 42 ms for [budzati] and 72 ms for [asatti], however, which is the reverse of the pattern we saw for [bata] and [batta]. It therefore seems

best to view the shortening of the vowel following a geminate seen above as exceptional or incidental.

2.1.2 [ts] and [tts]

The Kugai dialect has the pair of [itsa] ‘board’ and [attsa] ‘tomorrow’. Waveforms and spectrograms of these words are given in Figure 3.

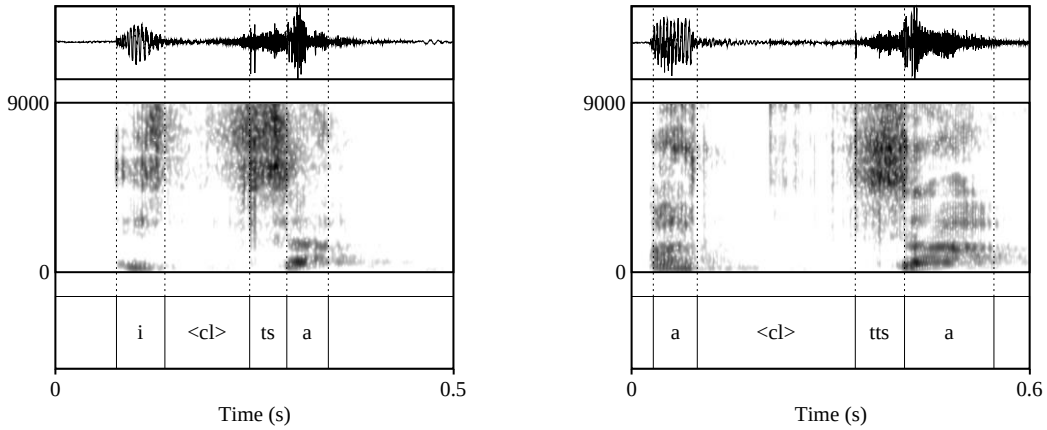

Figure 3. Waveforms and spectrograms of [itsa] and [attsa] (Kugai).

As is clear from Figure 3, the most conspicuous difference between [ts] and [tts] is the difference between their closure durations. The duration of the closure portion was 96 ms (SD = 9; n = 2) for [ts], while it was 238 ms for [tts] (a ratio of 1:2.47).

2.2 Voiced intervocalic geminates

In the Miyako dialects, voiced obstruent geminates such as [zz] and [vv] are also observed in what seem to be native words. In Western loans, they are observed in mainland Japanese, as well. Because they have the two properties in (4), however, the voiced obstruent geminates of mainland Japanese cannot strictly be described as the mere lengthening of a single consonant.

(4) a. There are no voiced fricative geminates. Even if a sound is realized as a fricative when used as a single consonant, it becomes an affricate ([dz]) or a plosive ([b, g]) when used as a geminate.
b. Vocal fold vibration is observed in the first half of the closure portion only.

Firstly, as regards (4a), while e.g. /z/ is often realized as a fricative when it appears as a single consonant in the Tokyo dialect of Japanese, such as in *kizu* 'wound'[4], it is realized as an affricate with a long closure in the case of a geminate, such as in *kiddzu* 'kids'. Waveforms and spectrograms of these words are given in Figure 4 (the recordings are of a male speaker of the Tokyo dialect in his thirties).

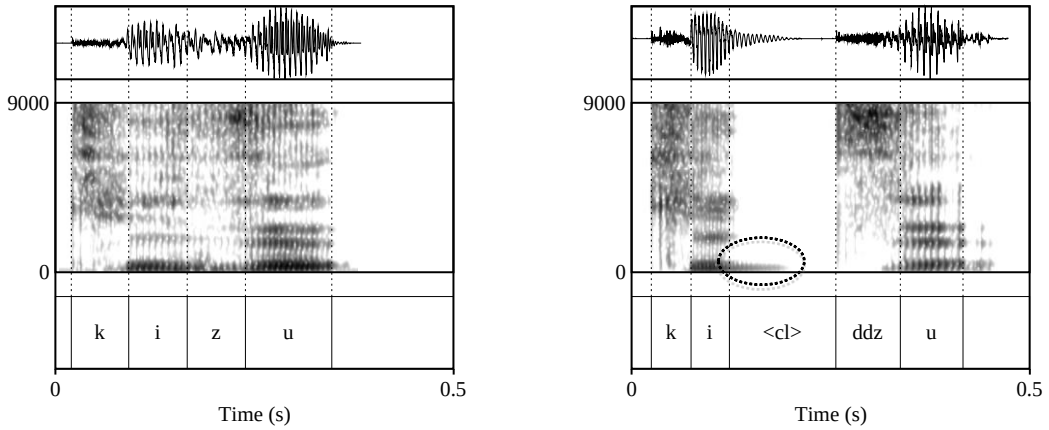

Figure 4. Waveforms and spectrograms of *kizu* 'wound' (left) and *kiddzu* 'kids' (right).

Next, as regards (4b), vocal fold vibration is often observed not over the whole consonant portion of voiced obstruent geminates in the Tokyo dialect, but only in the first half (Kawahara 2006, among others). In the right-hand part of Figure 4, too, a voice bar (energy in the low frequency region, circled) can be seen in the first half of the closure portion only.

In addition to their durations, I will examine below whether the properties in (4) can also be observed in [zz] and [vv].

2.2.1 [z] and [zz]

The Kugai dialect has an example which which intervocalic [z] and [zz] contrast such as [aːza] 'father' and [mizza] 'garlic chive'. Waveforms and spectrograms of these words are given in Figure 5.

[4] While this description cannot strictly be said to be accurate, I have described it in this way in the interest of clarity. The reader is referred to Maekawa 2010a and 2010b for details on the phonetic realization of voiced obstruents in mainland Japanese.

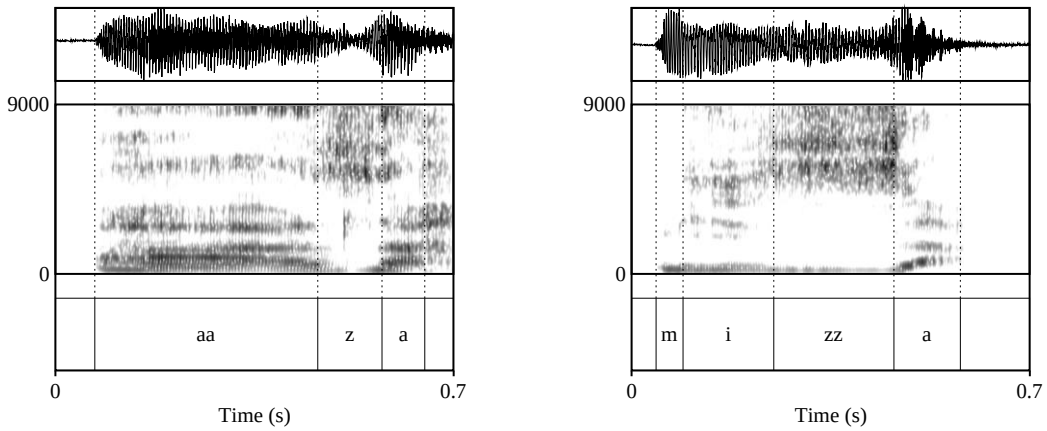

Figure 5. Waveforms and spectrograms of [a:za] and [mizza] (Kugai).

As is clear from Figure 5, the most conspicuous difference between [z] and [zz] is the difference in duration between their consonant portions. This duration was 74 ms for [z], while it was 173 ms (SD = 29; n = 3) for [zz], which gives us a ratio of 1:2.33.

Next, let us consider the noise components and voice bars. High-frequency noise components can be seen even in [zz], indicating that friction continued throughout the geminate. In addition, a voice bar is observed throughout the geminate, indicating that the vocal folds vibrated throughout its pronunciation, unlike how they vibrate only during the first half of the geminate in mainland Japanese.

2.2.2 [vv]

The Miyako dialects have the sound [vv], which does not appear in Standard Japanese. Examples of words in which it appears are [avva] ‘oil’ and [kuvva] ‘calf (of the leg)’. In the following discussion, I will consider not only the Irabu and Kugai dialects, but also those of Ikema and Bora. I will not examine duration in this section, as there are no instances of [v] contrasting with [vv] in the survey data.

Firstly, waveforms and spectrograms of [avva] and [kuvva] in the Irabu dialect are given in Figure 6.

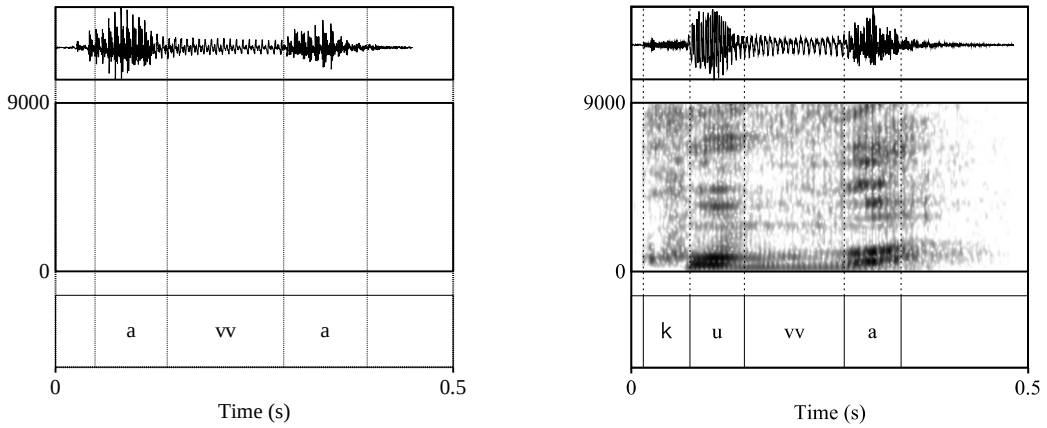

Figure 6. Waveforms and spectrograms of [avva] (left) and [kuvva] (right) in the Irabu dialect.

When looking at the friction noise components in Figure 6, they appear weak in [avva], while they appear stronger in [kuvva], indicating that friction continued. In addition, voice bars are observed throughout the consonant portion in both words, indicating that the vocal folds vibrated throughout its pronunciation.

Waveforms and spectrograms of [avva] and [kuvva] in the Kugai dialect are given in Figure 7.

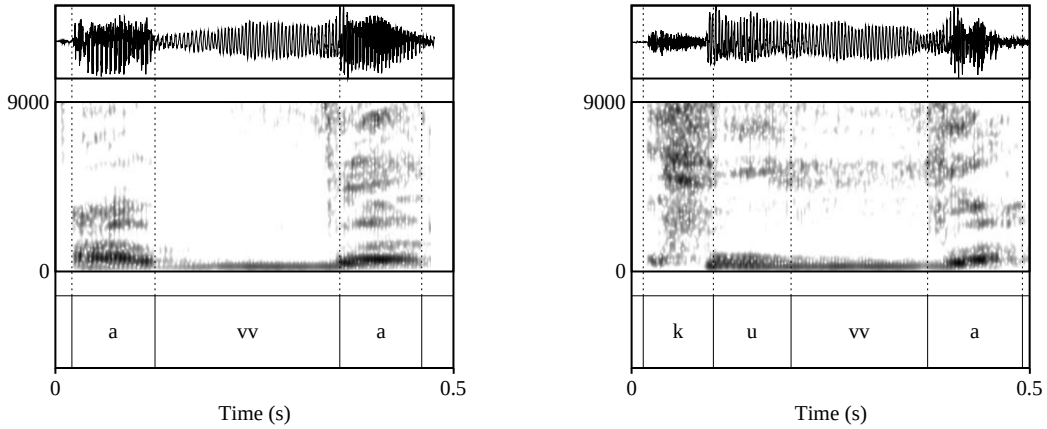

Figure 7. Waveforms and spectrograms of [avva] and [kuvva] in the Kugai dialect.

When looking at the friction noise components in Figure 7, they appear weak in [avva], while they appear stronger in [kuvva], indicating that friction continued. In addition, voice bars are observed throughout the consonant portion in both words, indicating that the vocal folds vibrated throughout its pronunciation.

Waveforms and spectrograms of [avva] and [kuvva] in the Ikema dialect are given in Figure 8.

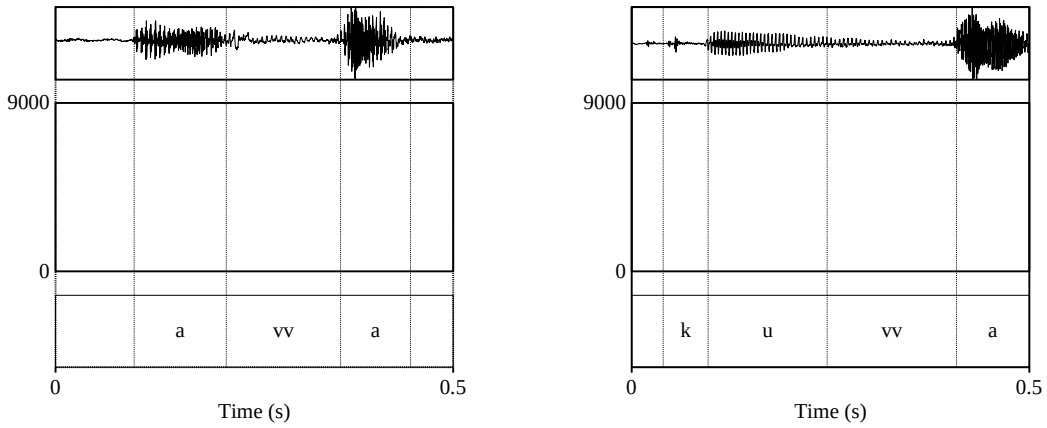

Figure 8. Waveforms and spectrograms of [avva] and [kuvva] in the Ikema dialect.

When looking at the friction noise components in Figure 8, they appear quite weak in both [avva] and [kuvva]. Voice bars, on the other hand, are observed throughout the consonant portion in both words.

Waveforms and spectrograms of [avva] and [kuvva] in the Bora dialect are given in Figure 9.

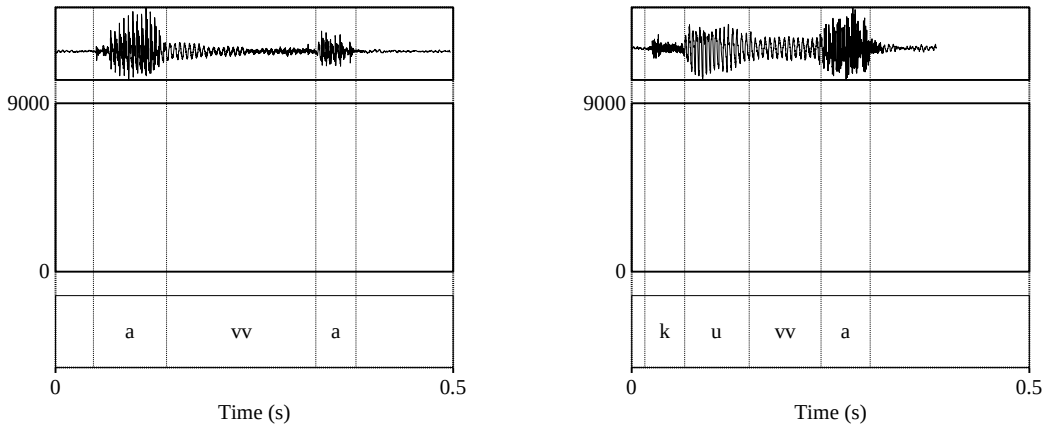

Figure 9. Waveforms and spectrograms of [avva] and [kuvva] in the Bora dialect.

When looking at the friction noise components in Figure 9, they appear strong in both words. As regards voice bars, on the other hand, one is observed throughout the consonant portion in [kuvva], while the one in [avva] weakens in the second half. This can be observed more distinctly in utterances of the word [avvamtsu] ‘grease miso’. There are three instances of [avvamtsu] in the data; the waveforms and spectrograms of all of them are given in Figure 10.

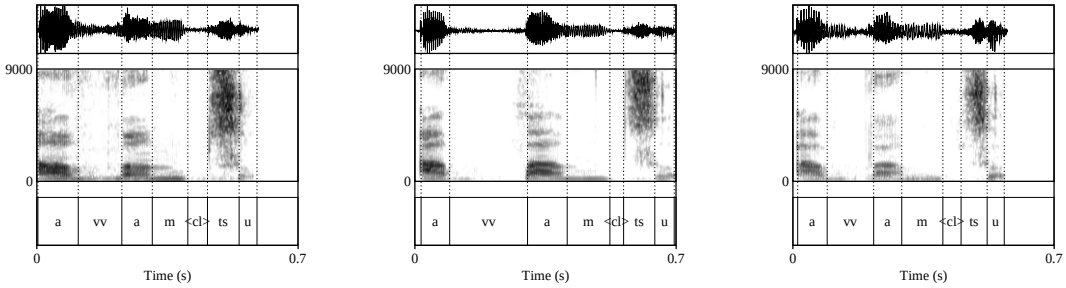

Figure 10. Waveforms and spectrograms of [avvamtsu] in the Bora dialect (left: first recording; middle: second recording; right: third recording).

Firstly, when looking at the friction noise components, the friction appears quite weak in all three instances. Next, when looking at the voice bars, one is observed throughout the consonant portion of the first instance, but the ones in the second and third instances disappear in the second half. In auditory perception, too, the geminate in the second instance sounds like [vf]. The duration of the first instance was 116 ms, that of the second one 208 ms, and that of the third one 124 ms, so the second instance also has a longer duration; the disappearance of the voice bar could be connected to this. Further research is needed, however, to determine whether this is an idiosyncrasy of the speaker or a regional characteristic.

The above observations are summarized in (5).

(5) a. The friction is continuous in all of the dialects; fricatives do not become affricates or plosives.
b. In the Irabu, Kugai, and Ikema dialects, the vocal folds vibrate throughout the consonant portion.
c. In the Bora dialect, vocal fold vibration sometimes disappears in the second half of the consonant portion.

Noise components are thus more or less consistently observed, while vocal fold vibration (voice bars) sometimes disappears in the second half of the consonant portion in the Bora dialect.

2.3 Word-initial geminates

In the Miyako dialects, there are words with word-initial geminates, such as [ffa] and [vva]. To what degree does the length of these geminates differ from that of single consonants? This question would also seem central to considering the isochrony of syllables or morae; that is, rhythm. Below, I will discuss [nn], [ff], [ss], and [vv].

2.3.1 [n] and [nn]

[nada] ‘tear’ and [nnami] ‘now’ are an example of [n] and [nn] contrasting word-initially in the Irabu dialect. Waveforms and spectrograms are given in Figure 11.

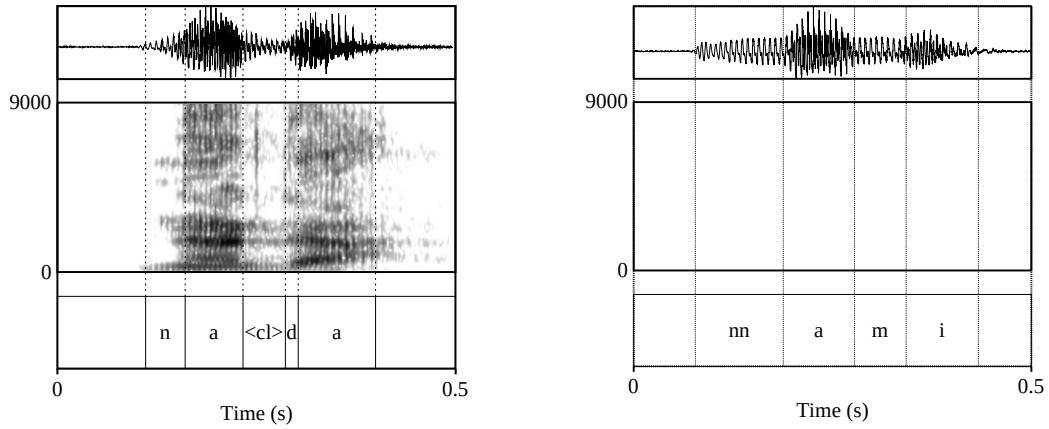

Figure 11. Waveforms and spectrograms of [nada] and [nnami] (Irabu).

As is clear from Figure 11, [nn] was realized with a longer duration than that of [n]. The duration of [n] was 49 ms, while that of [nn] was 110 ms (a ratio of 1:2.24).

2.3.2 [f] and [ff]

[funi] ‘ship’ and [ffa] ‘child’ are an example of [f] and [ff] contrasting word-initially. Waveforms and spectrograms are given in Figure 12.

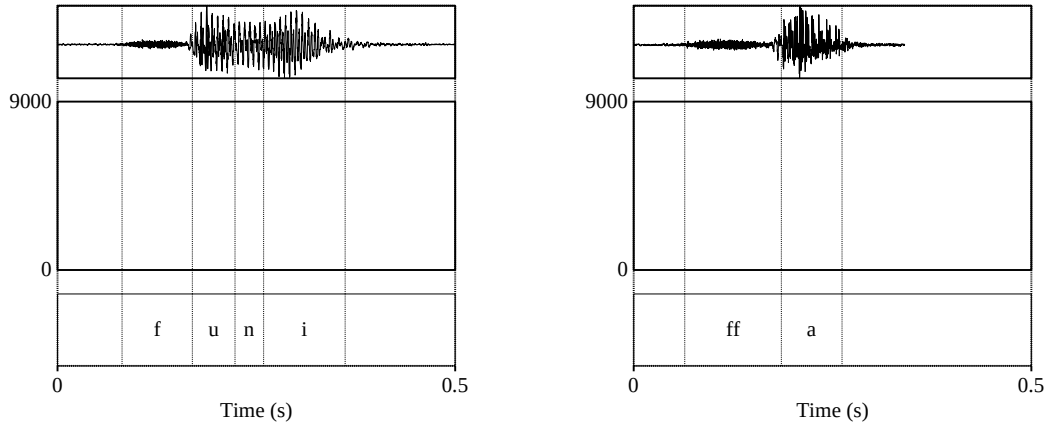

Figure 12. Waveforms and spectrograms of [funi] and [ffa] (Irabu).

As is clear from Figure 12, [ff] was realized with a longer duration than that of [f]. The duration of [f] was 92 ms (SD = 4.5; n = 2; Irabu) or 108 ms (Kugai), while that of [ff] was 135 ms (Irabu) or

143 ms (Kugai), giving us a ratio of 1:1.45 (Irabu) or 1:1.32 (Kugai) between single consonants and geminates. It is worth remarking that this difference in duration is smaller than that between [n] and [nn] and that between single intervocalic consonants and intervocalic geminates.

2.3.3 [s] and [ss]

[sïba] 'lip' and [ssï] 'nest' are an example of [s] and [ss] contrasting word-initially in the Kugai dialect. Waveforms and spectrograms are given in Figure 13.

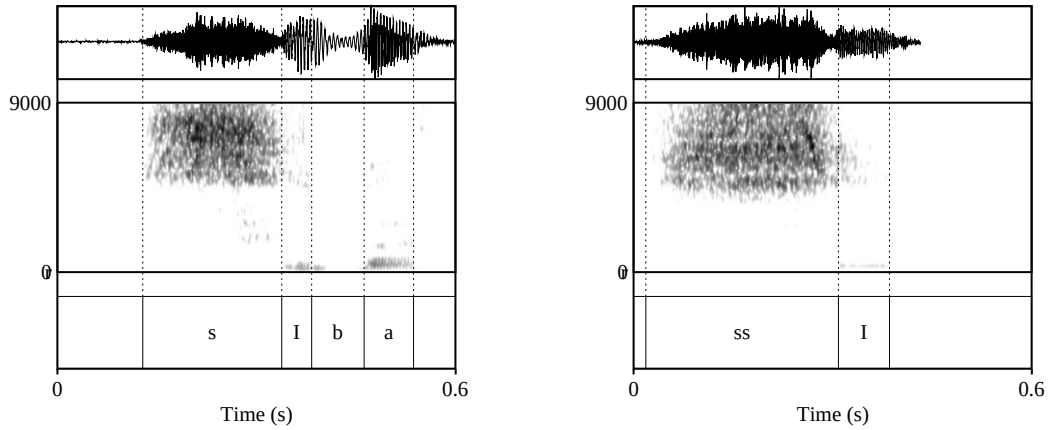

Figure 13. Waveforms and spectrograms of [sïba] and [ssï] (Kugai).

As is clear from Figure 13, [ss] was realized with a longer duration than that of [s]. The duration of [s] was 190.3 ms (SD = 16.93; n = 3), while that of [ss] was 289 ms (a ratio of 1:1.51).

2.3.4 [v] and [vv]

The Kugai dialect has a pair of examples which contrasts [v] and [vv] such as [vaa] 'pig' and [vva] 'you'. Waveforms and spectrograms are given in Figure 14.

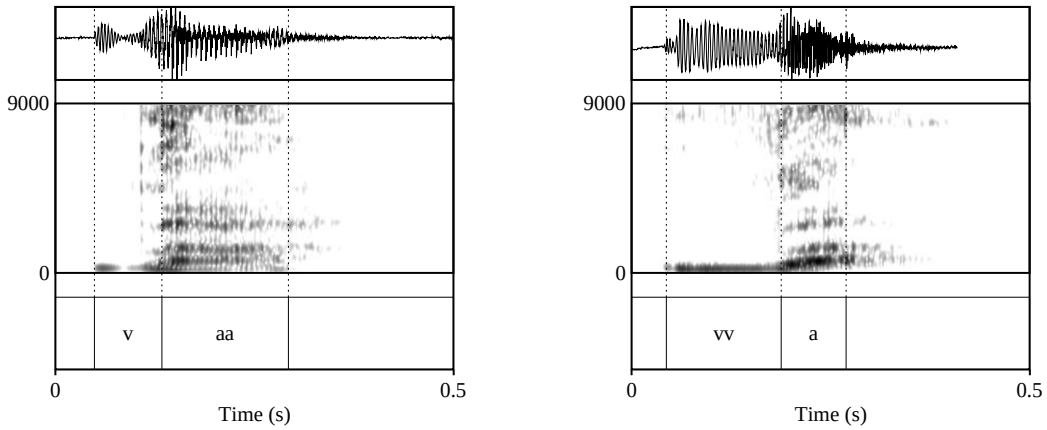

Figure 14. Waveforms and spectrograms of [vaa] and [vva] (Kugai).

As is clear from Figure 14, [vv] was realized with a longer duration than that of [v]. The duration of [v] was 84 ms (SD = 0.00; n = 2), while that of [vv] was 143 ms (a ratio of 1:1.70).

To summarize the above, each of the geminates was realized with a longer duration than the corresponding single consonant, but while the ratio was 1:2.24 for [n] and [nn], the difference in duration was smaller for [ff], [ss], and [vv], with ratios between 1:1.3 and 1:1.7. When the difference in duration between a single consonant and a geminate is small, other aspects, such as the length of the following vowel, may need to be adjusted to avoid perceptual confusion. Further research is needed to determine whether such adjustments in fact occur.

3 Consonant clusters

In the Miyako dialects, there are words with initial consonant clusters, such as [mta]. Which syllable position does [m] occupy in this word? Is it an onset like [t], a coda, or a nucleus? In order to determine this, it is necessary to consider (morpho-)phonological alternations. It seems not unlikely, however, that there are also acoustic-phonetic cues. In this section, I will consider this question by comparing occurrences of [m] in consonant clusters with occurrences as a single onset or coda consonant.

Examples from the survey data of words in which an initial [m] is followed by another consonant are given in (6).

(6) Word-initial [m]+consonant clusters (Irabu)

a. Words in which [m] is followed by a voiceless obstruent[5]:
mkiiN, mta, msu

b. Words in which [m] is followed by [n]:
mmna, mmni, mnii, mni, mnapskaï

In words in which [m] is followed by [n], likewise a nasal, double articulation sometimes occurs, making measurement of the duration of [m] difficult. For this reason, I will limit analysis and discussion to words in which [m] is followed by a voiceless obstruent in this section.

Waveforms and spectrograms of [maʊkja:] 'front' and [mta] 'earth' in the Irabu dialect are given in Figure 15.

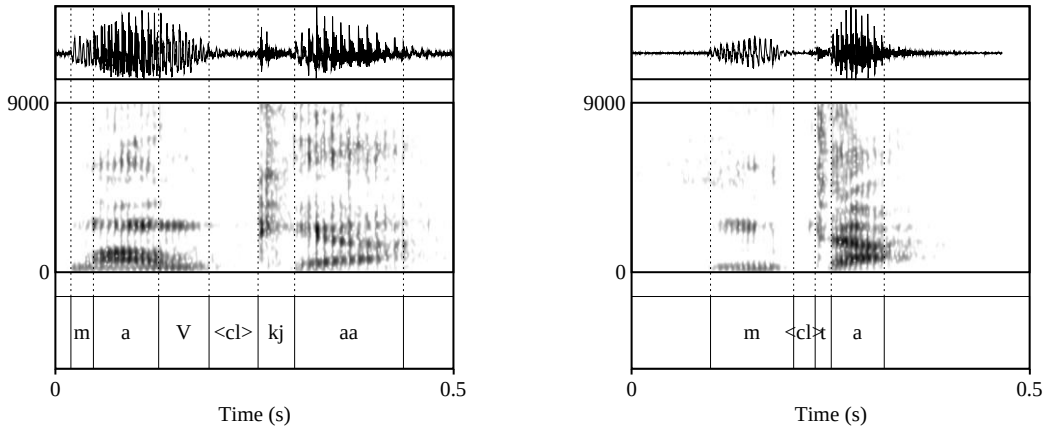

Figure 15. Waveforms and spectrograms of [maʊkja:] and [mta] (Irabu).

As is clear from Figure 15, [m] was realized with a longer duration in a consonant cluster than it was as a single consonant. In order to confirm whether this is a systematic difference, let us compare the words containing an [m] that are present in the data of which I have labeled the segments, classified according to its position within the syllable. The words to be considered are given in (7).

(7) Words from the survey data

a. Consonant cluster: [msu], [mta], [mkiiN]

b. Syllable onset: [amambuni], [maxaï], [umatsï], [nnami], [nufumunu], [ɕɕanamunu], [mizza], [midzï], [maʊkja:]

c. Syllable coda: [amambuni], [avvamtsu], [umku]

[5] [mmtsI] is an example of a word in which [m] is used as a geminate and is moreover followed by [ts], but it will not be considered here.

The durations of [m] in these words are given in (8)[6].

(8) Durations of [m]

Position	Mean (SD)	Max. value	Min. value	Sample size
Consonant cluster	77.8 (4.3)	100.3	73.5	3
Syllable onset	51.4 (15.9)	81.6	28.2	12
Syllable coda	86.7 (18.7)	114.4	57.7	6

According to this table, the duration increases in the order onset < consonant cluster < coda. When comparing the differences, that between consonant clusters and codas is smaller at 8.9 ms than that between consonant clusters and onsets, which is 26.4 ms. As the sample is small and the standard deviations are large, definitive conclusions cannot be drawn, but at this stage, the data suggest that interpreting [m] in consonant clusters as belonging to a different syllable from the following consonant is appropriate.

4 Conclusion

In this chapter, I have examined temporal control in the Miyako dialects. As a result, it has become clear that geminates are longer in duration than single consonants. The duration ratios between geminates and single consonants are summarized in (9).

[6] There was one instance of [mizza] with a duration of 177 ms, but as this exceeds the mean + 2SD, I have excluded it from consideration.

(9) Duration ratios between single consonants and geminates

a. Intervocalic

Consonants	Ratio
[t] and [tt]	1:2.02–2.86 (Irabu)
[ts] and [tts]	1.2.47 (Kugai)
[z] and [zz]	1.2.33 (Kugai)

b. Word-initial

Consonants	Ratio
[n] and [nn]	1.2.24 (Irabu)
[f] and [ff]	1.1.45 (Irabu) 1.1.32 (Kugai)
[s] and [ss]	1.1.51 (Kugai)
[v] and [vv]	1:1.70 (Kugai)

It can be gleaned from these results that there is a tendency for the difference in duration between single consonants and geminates to be smaller word-initially than intervocalically. Further research is needed to determine how stable this difference is.

Moreover, it has become clear that differently from Standard Japanese, friction continues and vocal fold vibration is maintained throughout intervocalic voiced obstruent geminates such as [zz] and [vv].

Further, consonants were realized with a longer duration in consonant clusters than as single consonants. The duration ratio is given in (10).

(10) Duration ratio between single consonants and consonants in consonant clusters

Consonant	Ratio
[m]	1:1.42 (Irabu)

Further research based on a larger data set is required to confirm these results, especially considering the fact that as noted in Section 1, the recorded data used in the present analysis consist almost entirely of single utterances, which are furthermore utterances of words in isolation rather than embedded in sentences. Consequently, improvements on these fronts are required in order to further elucidate the details of not only duration, but also articulatory dynamics. In addition, while I have focused on analyzing durations at the segmental level in this chapter, it is necessary to

investigate whether the rhythmic unit in the Miyako dialects is the mora by examining, for example, durations at the word level.

Acknowledgements

I would like to take this opportunity to thank Michinori Shimoji for the valuable advice he gave me during the writing of this chapter. I was not able to incorporate all of his advice; it goes without saying that I am responsible for any errors and misunderstandings. This research constitutes part of the results of the research project *An Empirical Study on Adaption of Standard Japanese Sound in Two-Pattern Dialects of Kyushu Japanese*, JSPS KAKENHI Grant-in-Aid for Young Scientists (B) Grant Number JP22720164.

Bibliography

Aoi, Hayato. 2012. 'Minami-Ryūkyū Miyako Hōgen no On'in Kōzō'. In: Makoto Minegishi, Osamu Hieda, Emiko Hayatsu, Yuji Kawaguchi (eds.), *Kōpasu ni Motozuku Gengogaku Kyōiku Kenkyū Hōkoku*, 8:99–113.

Boersma, Paul & David Weenink. 2009. *Praat: Doing Phonetics by Computer*, version 5.1.11. Computer program (http://www.praat.org/).

Fujita, Masayoshi. 2003. *Saga-Ken no Kotoba*. Meiji Shoin.

Kamimura, Takaji. 1957. 'Minami-Kyūshū Hōgen'on no Bunpu o Chūshin ni: Naihaon-/Bionka Sono Ta'. *Bunken Hōkoku*, 6.

Han, Mieko S. 1962. 'The Feature of Duration in Japanese'. *The Study of Sounds*, 10:65–79.

Kawahara, Shigeto. 2012 (forthcoming). 'The Phonetics of Obstruent Geminates, *Sokuon*'. Draft to appear in *The Mouton Handbook of Japanese Language and Linguistics*.

Kubozono, Haruo & Francis Michinao Matsui. 2003. 'Phonetic vs. Phonological Control of Speech: Closed Syllable Vowel Shortening in Japanese Dialects'. In: *Proceedings of the 15th International Conference on Phonetic Sciences*, Barcelona.

Maekawa, Kikuo. 1984. 'Akita Hōgen Sokuon no Jizoku Jikan: "Sunzumari" no Jittai to Seiin'. *Hōgen Kenkyū Nenpō* (*Annual Report of Dialectology*), 27:231–247. Hiroshima Hōgen Kenkyūsho.

Maekawa, Kikuo. 2010a. 'Coarticulatory Reinterpretation of Allophonic Variation: Corpus-Based Analysis of /z/ in Spontaneous Japanese'. *Journal of Phonetics*, 38(3):360–374.

Maekawa, Kikuo. 2010b. 'Nihongo Yūsei Haretsuon ni Okeru Heisa Chōon no Jakka'. *Onsei Kenkyū* (*Journal of the Phonetic Society of Japan*), 14(2):1–15.

Mase, Yoshio. 1961. 'Hachijōjima Hōgen no On'in Bunseki'. *Kokugogaku* (*Studies in the Japanese Language*), 43.

Minami, Fujio. 1959. ‘Nagasaki-Ken Kuchinotsu Hōgen no On’in Taikei’. *Kokugogaku* (*Studies in the Japanese Language*), 36.

Nitta, Tetsuo. 2011. ‘Fukui-Ken Mikuni-Chō Antō Hōgen ni Okeru *Maffa* “Makura” Tō no Jūshiin ni Tsuite’. *Onsei Kenkyū* (*Journal of the Phonetic Society of Japan*), 15(1):6–15.

Pellard, Thomas. 2007. ‘Miyako Shohōgen no On’in no Mondaiten’. Unpublished presentation materials for *The Second Research Workshop on Ryukyuan*, held at Kyoto University on September 9, 2007.

Sato, Yumiko. 1993. ‘The Durations of Syllable-Final Nasals and the Mora Hypothesis in Japanese’. *Phonetica*, 50:44–67.

Shimoji, Michinori. 2008. *A Grammar of Irabu, a Southern Ryukyuan Language*. Doctoral dissertation, Australian National University.