Articulation of voiced geminate and word-initial geminate obstruents in the Miyakojima Ikema dialect of Ryukyuan: A Real-time MRI analysis

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This paper reports on a real-time (rt) MRI study of geminate consonant articulation in the Ikema dialect spoken in Miyako island in Okinawa, Japan. Ikema has typologically rare word-initial and voiced geminate obstruents. In order to record rt-MRI data of midsagittal sections, a male speaker uttered test words: /sata/ 'sugar', /ssa/ 'grass', /ta:/ 'rice field', /tta/ 'tongue', /zII/ 'ground', /zza/ 'father', /zzu/ 'fish' (/I/ is a centralized vowel in free variation with /i/). We shall describe several articulatory characteristics observed in our data and discuss some of the phonological implications.

The results showed that 1) linguopalatal contact/constriction is not only longer in duration but larger during geminates than that for their singleton counterparts (Fig. 1 /t/ vs. /tt/). Our results are in line with observations made for Tokyo Japanese (Kochetov and Kang 2013) and for other language(s) (e.g., Ridouane 2010) confirming a universal tendency of larger contact area in geminate articulation. 2) Phraryngeal expansion occurred during voiced obstruents /z/ and /zz/ but not during voiceless ones (Fig. 2 /s/ vs. /z/). This corresponds to the fact that voiced geminate obstruents are voiced throughout in Ikema (Fujimoto and Shinohara 2013) unlike voiced geminates in Tokyo Japanese (Kawahara 2006 for loanwords). Expansion of the pharynx during articulation of single voiced obstruents is common across languages including English and Tokyo Japanese (Perkel et al. 1969 among others). It is explained that vocal-fold vibration is eased by pharynx expansion, however, more detailed studies are needed about timing between the expansion of pharynx and vocal-fold vibration. 3) In our previous acoustic analysis, we suspected nasalization of /zz/ accounted for the formant-like patterns on the spectrograms. However, rt-MRI revealed no evidence of velum lowering during /zz/. The (formant-like) pattern (or poles) may be due to the resonance of the pharynx. This speculation needs to be examined in a future study. 4) Geminate–singleton contrasts also affect the articulation of the following vowel. Lingual transition was faster after geminates so that the tongue reached a target vowel position immediately after the geminate. In contrast, vowels after singletons tended to undershoot (Fig. 3 /sa/ in /sata/, /basa/, /ssa/). The linguopalatal distance during /a/ in /sat/ was often invisible, or very small if seen at all. These findings correspond well with the acoustic findings in which formant patterns at the vowel onset were clearer after geminates and vaguer or even devoiced after singletons. Moreover, at the vowel offset, linguopharyngeal distance often rapidly approximates following geminates (Fig. 4 /a/ in /ta:/ vs. /tta/). This causes the vowel to cease, resulting in shorter duration of the vowel. When voiceless stops are uttered in phrase initial position, singleton-geminate distinction is expected to be difficult. However, a shorter vowel can serve as a cue for perception of geminates. When a CV word is uttered on its own in a phrase, the vowel is lengthened (i.e. [CV:]) to satisfy the bimoraic minimality constraint . However, CCV words show no such lengthening (i.e. [C:V]) since they have already two moras with a heavy onset. The linguopharyngeal closure/approximation may be an articulatory manifestation to assure this durational contrast here and elsewhere. Note, however, that this closure could occur involuntarily. When the broader linguopalatal contact for geminates is quickly released to an open

vowel, the back of the tongue may move backwards. In this case, shortening of the vowel after geminates is an artifact. Further examination is needed.

References

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Fig. 1 /t/ in /ta:/,/tt/ in /tta/

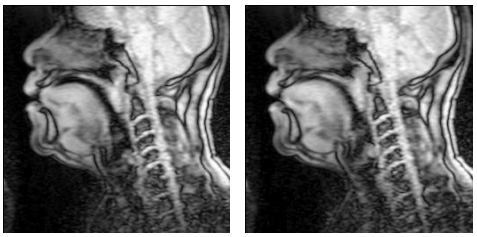


Fig. 2 /s/ in /ssa/, vs. /z/ in /zza/

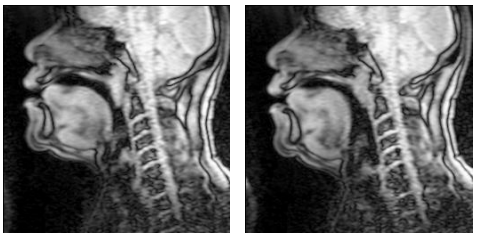
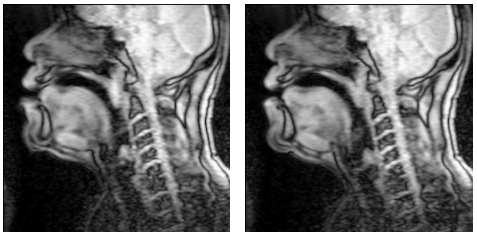
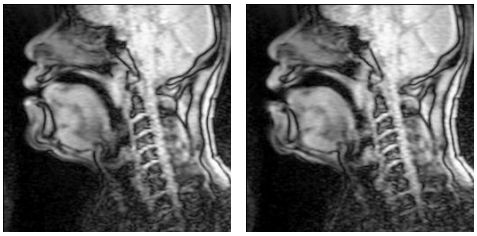


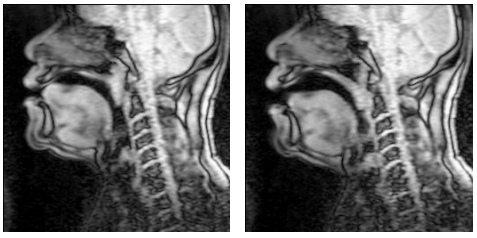
Fig. 3 First /(s)sa/ in /sata/, /basa/ and /ssa/



/sat(a)/



/(ba)sa/



/ssa/

Fig.4 /a/ in /ta:/,/a/ in /tta/