

# Acoustic correlates of word-initial singletons and geminates of endangered Ikema

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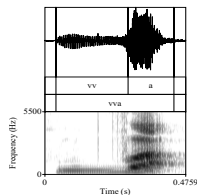
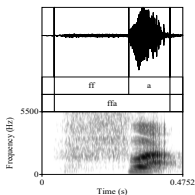
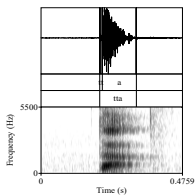
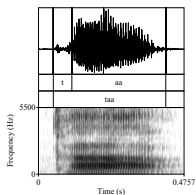
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# Introduction

- Ryukyuan languages spoken in southern islands of Japan share protolanguage with Japanese. These languages have developed a variety of geminate inventories across word-positions (Karimata, 2015)
- The endangered Ikema dialect of Miyako Ryukyuan has a typologically marked voicing and length contrasts in word-initial position (Hayashi, 2010)
- Cross-linguistically, duration is a key characteristic of geminates (Lahiri and Hankamer, 1988; Hussain and Shinohara, 2019)
- Fundamental frequency, F1, intensity, and phonation (H1-H2) have also been proposed as additional correlates of geminates. For instance, the word-initial (voiceless and voiced) geminates of Pattani and Kelantan Malay are characterized by higher f0 ratios (Abramson, 1998; Hamzah et al., 2014)
- The word-initial singleton vs. geminate contrast of Pattani Malay is also signaled by intensity onsets of the following vowels, which, regardless of voicing, are slightly lower in singletons than in geminates (Abramson, 1998)
- F1 is generally higher in singletons, compared to geminates. H1-H2 does not consistently distinguish singletons and geminates
- **The current study investigates the acoustic correlates of voicing and length contrasts in word-initial obstruents of Ikema**

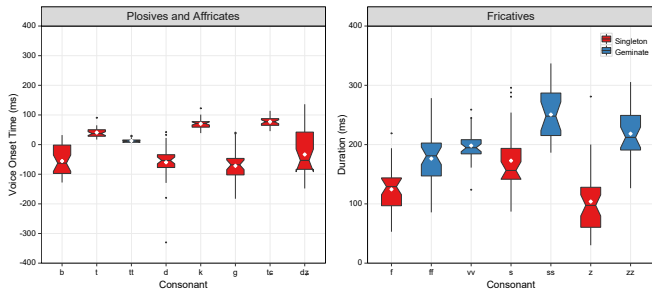
# Methods

- Ten speakers of Ikema participated in the study (three male participants were born between 1952 and 1959: mean age 61.7 years; seven females were born between 1932 and 1952: mean age 75.6 years)
- A word list of word-initial singleton and geminate obstruents was created, followed by /a/: /b t tt d k g tʃ dʒ f ff vv s ss z zz/
- **Duration** of the word-initial obstruents was measured in Praat (VOT for stops and affricates; total duration for fricatives)
- **Fundamental frequency (f0), F1, intensity, and H1-H2** were measured at the onset of following vowels
- Linear mixed effects models were conducted in *R* using the *lme4* and *lmerTest* packages (only general patterns are reported here)
- Spectrograms/waveforms of word-initial /t/, /tt/, /ff/, and /vv/:



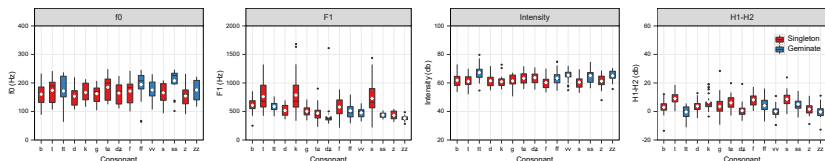
# Results: Duration

- Mean **VOT** of /tt/ is slightly shorter than singleton /t/
- For the /f/-/ff/, /s/-/ss/, and /z/-/zz/ pairs, the geminate ones are consistently **longer in duration**, compared to singletons
- Voicing effects: duration of word-initial geminate /ss/ is slightly longer than voiced geminate /zz/
- There appears to be no clear differences in /ff/ and /vv/ as the boxes show considerable overlap



# Results: f0 and spectral correlates

- **f0** onset is higher in geminates, as also noted by Abramson (1998) for Pattani Malay
- The /t/-/tt/ pair is an exception to this pattern where the **f0** onset of /t/ is slightly higher
- Minor voicing effects on **f0** onsets can also be observed
- For instance, the mean **f0** onset of the voiceless fricatives /s/ and /ss/ is higher than /z/ and /zz/
- Singletons /t f s z/ showed higher **F1** than geminates /tt ff ss zz/
- In singleton-geminate pairs (/t/-/tt/, /f/-/ff/, /s/-/ss/, and /z/-/zz/), the geminates are characterized by higher **intensity** onsets than singletons
- Geminates /tt ff ss zz/ exhibit lower **H1-H2** than singletons /t f s z/



- The findings of this study indicated that the voicing and length contrasts of Ikema are achieved by a combination of both temporal and non-temporal correlates
- Due to the absence of cues related to closure and preceding vowel, word-initial geminates can use  $f_0$ ,  $F_1$ , intensity, and H1-H2 onsets to maintain the length and voicing contrasts
- From a perceptual point of view, the VOT (and other quality) difference is particularly important for perceiving the phonological length contrast in the /t-/ /tt/ pair
- Our results will contribute to the wider literature on voicing and length contrasts as well as phonetic documentation of endangered Ryukyuan languages
- Comparative articulatory studies using ultrasound-imaging and/or electropalatography may also shed light on the correlations among articulatory gestures and their acoustic correlates
- Future studies of Ikema and other Ryukyuan languages can further explore the effect of pitch accent and other suprasegmental factors on the consonantal length contrasts

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