

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

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The Ryukyuan languages spoken in southern islands of Japan (Okinawa) 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 both word-initial and -medial positions. Word-initial obstruents which appear as geminates include /t k ts f s v z/ (/ts/ is [tɕ] before /a/; Hayashi, 2010). Previous studies have shown that duration is a key characteristic of geminates (Hankamer & Lahiri, 1988; Hussain & Shinohara, 2019). In addition to duration, 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 Malay are characterized by higher f0 ratios (Abramson, 1998). Similar patterns of f0 were observed in word-initial geminates of Kelantan Malay (Hamzah, Fletcher, & Hajek, 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.

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 all the word-initial singleton and geminate obstruents was created ([b t tt d k g tɕ dz 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. A series of linear mixed effects (LME) models was conducted in R using the *lme4* and *lmerTest* packages.

Figure 1 shows the duration of word-initial obstruents of Ikema. It can be observed that for the /t/-/tt/ pair, the mean duration (white diamonds) of the word-initial geminate /tt/ is slightly shorter than its singleton counterpart. For the /f/-/ff/, /s/-/ss/, and /z/-/zz/ pairs, the geminate ones were consistently longer in duration, compared to singletons. Minor effects of voicing were also noted. Duration of the word-initial geminate /ss/ was slightly longer than voiced geminate /zz/. There appears to be no clear differences in /ff/ and /vv/ as the boxes show considerable overlap.

Figure 2 indicates that f0 onset is higher in geminates, as noted by Abramson (1998) as well. The /t/-/tt/ pair is an exception to this pattern where the f0 onset for /t/ is slightly higher. Minor voicing effects on f0 onsets can also be observed. For instance, the mean f0 onset of the voiceless fricative /ss/ is higher than /zz/. Similar patterns hold for the singleton /s/ and /z/. The F1 onset is consistently higher in singletons (/t f s z/) than in geminates (/tt ff ss zz/). Figure 2 also shows that in singleton-geminate pairs (/t/-/tt/, /f/-/ff/, /s/-/ss/, and /z/-/zz/), the geminates are characterized by higher intensity onsets than singletons. H1-H2 is slightly lower in geminates (/tt ff ss zz/) than in singletons (/t f s z/). These results indicate that duration is not the only correlate, rather consonantal length contrasts of Ikema are achieved by a combination of both temporal and non-temporal acoustic features. In particular, the /t/-/tt/ pair, where singleton surprisingly shows longer duration (VOT) than geminate, requires non-temporal acoustic correlates to further tease apart the consonantal length contrast. Our results will contribute to the wider literature on voicing and length contrasts as well as the phonetic documentation of endangered Ryukyuan languages.

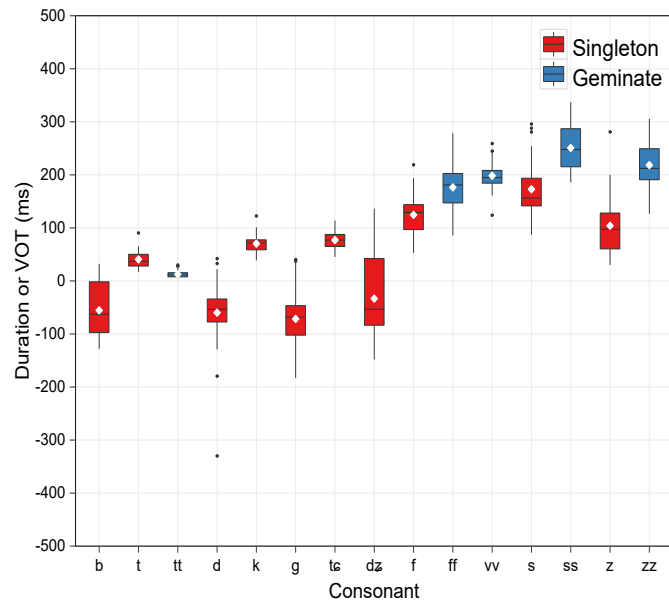


Figure 1: Duration or VOT of word-initial obstruents in Ikema (white diamonds = means).

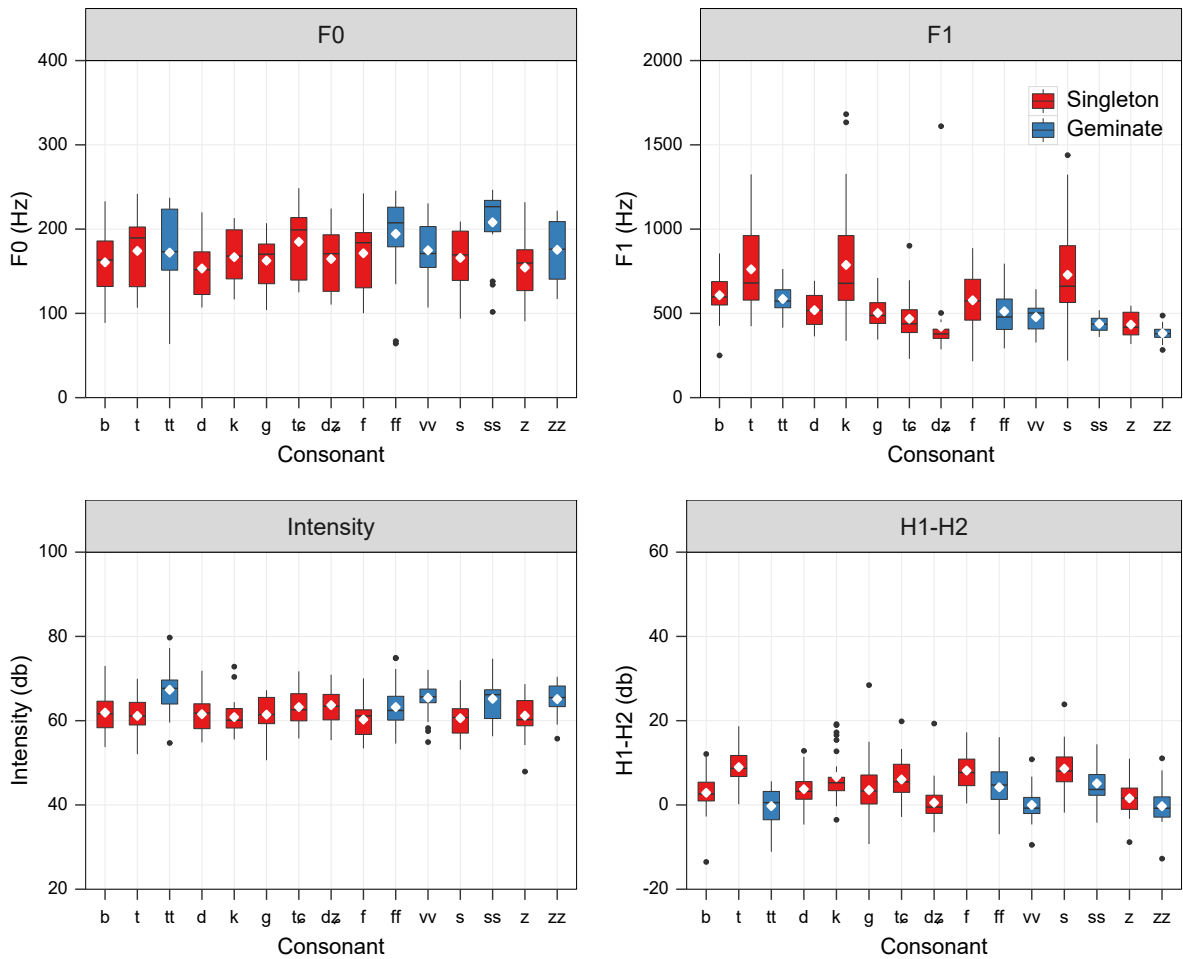


Figure 2: F0, F1, intensity, and H1-H2 at the onset of the following vowels (white diamonds = means).