# Voice quality differences in Dunan: links between gemination and fortis-lenis contrasts

Raksit T. Lau-Preechathammarach (raksit@berkeley.edu) Department of Linguistics, University of California at Berkeley, USA

## Background

- /T K/ vs. /t k/ contrast in Dunan (Southern Ryukyuan, Japonic): described as geminate (Bentley 2008) or fortis-lenis (Yamada et al. 2015)
- For comparison, also looked at /N M/ vs. /n m/ contrast
- Questions
  1. What are the acoustic correlates of this contrast?
  2. How does this contrast relate to other laryngeal contrasts?
  3. Is there tradeoff between cues in the contrast?
- Multidimensionality of phonetic cues in a phonological contrast
  - Geminates cued by more than duration (Arvaniti & Tserdanelis 2000, Abramson 2003, Idemaru & Guion 2008, Kraehenmann 2011, Ladd & Schmid 2018)
  - Overlapping cues with fortis/lenis (Kohler & Dommelen 1987, Cho et al. 2002) and register contrasts (Keating et al. 2011, Brunelle et al. 2020)

| | Geminate | Fortis | High Register |
|---|---|---|---|
| Closure duration | ↑ | ↑ | ↑ |
| VOT | - | different | ↓ |
| f0 | ↑ | ↑ | ↑ |
| F1 | ↑ | - | ↑ |
| Intensity | ↑ | ↑ | ↑ |
| Voice quality | tense/modal | tense/modal | tense/modal |

## Methods

- Data from 19 fieldwork sessions (elicitation, stories, etc.) with one speaker, force-aligned with the Montreal Forced Aligner (McAuliffe et al. 2017)
- Measured closure duration, VOT, and, for following vowel: f0, F1, energy, & voice quality (H1*-H2*, H1*-A3*), CPP averaged in 20 time bins
  - Closure duration measured only if preceded by vowel (counts in parentheses)
  - Higher H1*-H2* & H1*-A3* and lower CPP indicates breathier voice quality

| Following vowel | Stops t | Stops T | Stops k | Stops K | Nasals n | Nasals N | Nasals m | Nasals M |
|---|---|---|---|---|---|---|---|---|
| i | 79 (19) | 25 (10) | 430 (250) | 7 (6) | 150 | 134 | 272 | 27 |
| u | 415 (235) | 422 (268) | 318 (101) | 50 (14) | 361 | 103 | 312 | 6 |
| a | 170 (70) | 109 (35) | 582 (173) | 86 (36) | 445 | 110 | 517 | 67 |
| Total | 664 (324) | 556 (313) | 1330 (524) | 143 (56) | 956 | 347 | 1101 | 100 |

## Results

- Geminate consonants: higher f0, energy, and CPP
- Geminate stops: lower VOT & H1*-A3*, geminate nasals: higher H1*-H2*
- Trading relations (only shown if $p < .05$ & $|r| > .1$)
  - Duration, VOT, and f0 trade off
  - H1*-H2* trades off with VOT, f0, energy
  - In general, f0 trades off with voice quality cues
- Nasals show different voice quality patterns from stops
- Nasals show greater f0 difference than stops—noted also for voiceless & preglottalized sonorants in Eastern Khmu (Kirby 2021)

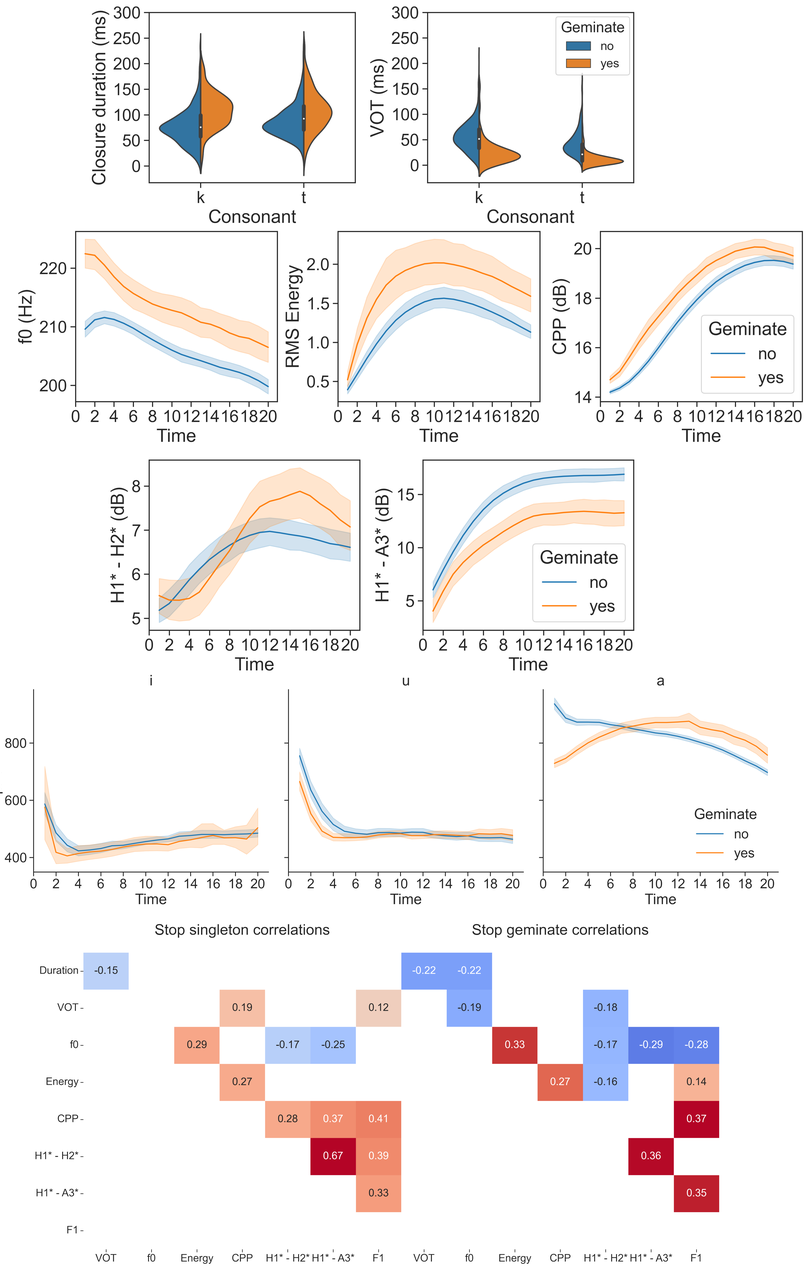
## References

Abramson, A.S., 2003. "Acoustic cues to word-initial stop length in Pattani Malay." *Proceedings of the 15th International congress of phonetic sciences*; Arvaniti, A. and Tserdanelis, G., 2000. "On the phonetics of geminates. Evidence from Cypriot Greek." *Proceedings of the 6th International Conference on Spoken Language Processing*; Bentley, J.R., 2008. A linguistic history of the forgotten islands: a reconstruction of the proto-language of the Southern Ryukyus; Brunelle, M., Tân, T.T., Kirby, J. and Giang, D.L., 2020. "Transphonologization of voicing in Chru: Studies in production and perception". *Journal of the Association for Laboratory Phonology*, 11(1); Cho, T., Jun, S.A. and Ladefoged, P., 2002. "Acoustic and aerodynamic correlates of Korean stops and fricatives". *Journal of phonetics*, 30(2), pp.193–228; Idemaru, K. and Guion, S.G., 2008. "Acoustic covariants of length contrast in Japanese stops." *Journal of the International Phonetic Association*, 38(2), pp.167–186; Keating, P., Esposito, C., Garellek, M., Khan, S. & Kuang, J., 2010. "Phonation contrasts across languages", *UCLA Working Papers in Phonetics*, 108, pp.188–202; Kirby, James, 2021. "Acoustic properties of voiceless and preglottalized sonorants in Eastern Khmu (Kmhmu' Am)." *SEALS 30 conference presentation*.; Kohler, K.J. & van Dommelen, W.A., 1987. "The effects of voice quality on the perception of lenis/fortis stops". *Journal of Phonetics*, 15(4), pp.365–381; Kraehenmann, A., 2011. Initial geminates. In *The Blackwell companion to phonology*; Ladd, D.R. & Schmid, S., 2018. "Obstruent voicing effects on F0, but without voicing: Phonetic correlates of Swiss German lenis, fortis, and aspirated stops". *Journal of Phonetics*, 71, pp.229–248; McAuliffe, M., Socolof, M., Mihuc, S., Wagner, M. & Sonderegger, M., 2017. "Montreal Forced Aligner: Trainable Text-Speech Alignment Using Kaldi". In *Interspeech 2017*, pp.498–502. Yamada, M., Pellard, T. & Shimoji, M., 2015. Dunan grammar. In *Handbook of the Ryukyuan languages* (pp.449–478).

## Acknowledgements

Many thanks to Dunan speaker 米城スエヨ Yoneshiro Sueko for working with me, to Keith Johnson and Ron Sprouse for a burst detection script, and to Sireemas Maspong and Francesco Burroni for collaboration on a related study as well as to Susan Lin and the audience of AMP 2021 for feedaback on this related study. I am honored to be learning on the traditional, ancestral, and unceded lands of the Ohlone people and to be attending a conference hosted on the lands of the Coast Salish, Stillaguamish, Duwamish, Muckleshoot, and Suquamish peoples.

## Stops




## Nasals