# And finally, no geminates!
# Pohnpeian consonantal length contrasts in initial, medial, and final position

Bradley Rentz & Victoria Anderson  University of Hawai'i at Mānoa, Department of Linguistics

## Introduction

Pohnpeian (ISO639-3 pon) is a phonetically understudied Oceanic language spoken by about 34,000 people in the Federated States of Micronesia, and 12,000 in the United States. Rehg & Sohl (1981) claim that Pohnpeian has a typologically uncommon geminate/singleton contrast in word initial, medial, and final positions.

We explored the acoustic differences between geminates and singletons by measuring the total segment durations.

## Background

According to Rehg & Sohl (1981) the following geminates occur in Pohnpeian:

- Word initially: only /m/, /mʷ/, and /ŋ/
  (Rehg & Sohl also claim initial geminates are degeminated unless prefixed)
- Word medially: all sonorant consonants
  (/l/, /m/, /mʷ/, /n/, /ŋ/, and /r/)
- Word finally: only /l/ and /mʷ/

Rehg (1993) posits that Pohnpeian has primary stress on the final mora, secondary stress on alternate preceding morae, and a high pitch on the penultimate mora. However, he does not find reliable acoustic correlates of stress.

Based on our preliminary research, we suggest that Pohnpeian marks prominence via phrasal boundary tones that are used as edge markers (see Jun 2005) and not via stress.

## Project Design

- Recorded 5 Pohnpeian L1 speakers on O'ahu (3 men, 2 women: mean age=42, range=27–51)
- Each speaker read phonetically controlled words in 3 sentence frames (each test word was repeated three times)
  1. **___ irail kin inda.** ' ___ they always say'
  2. **Irail kin inda ___.** 'They always say ___.'
  3. **Irail kin inda ___ nimenseng.**
     'They always say ___ in the morning.'
- Example test words: **Initial** /mʷus/ 'to move as a group' vs. /mʷmʷus/ 'to vomit'. **Medial** /kamʷus/ 'to jerk up' vs. /kamʷmʷus/ 'to cause to vomit'. **Final** /lɛwɛmʷ/ 'tongue.2SG' vs. /lɛmʷmʷ/ 'afraid of ghosts'. (13 pairs total)
- /ŋ/ vs. /ŋŋ/ could not be investigated here because speakers were not familiar with the geminate test word
- Measured segment duration based on time-aligned waveforms and spectrograms in Praat (Boersma & Weenink 2015) (Fig. 1)
- Results were analyzed using Bayesian Hierarchical Linear Modeling (BHLM) with a separate model for each position in the word with *R* (R Core Team 2015) package *rstanarm* (Gabry & Goodrich 2016)

## Measurement

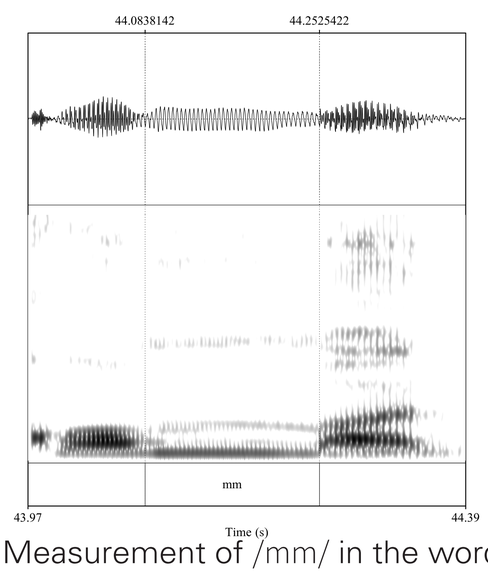
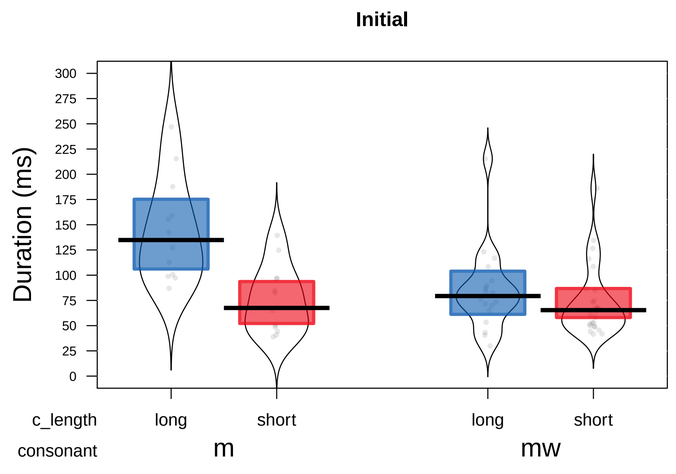
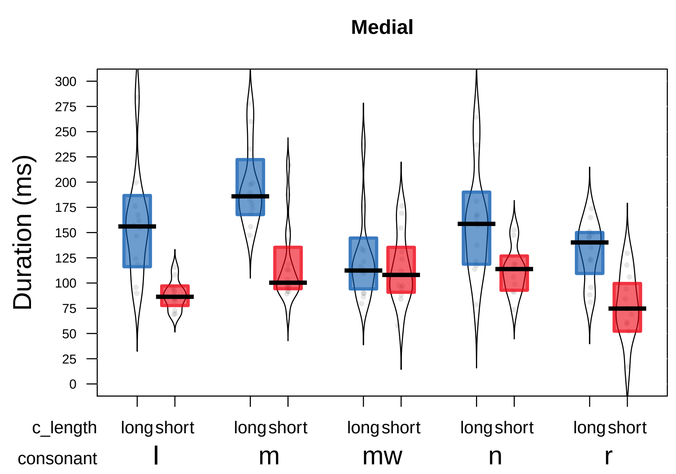



**Figure 1:** Measurement of /mm/ in the word /kommɔl/ 'to rest'

## Results



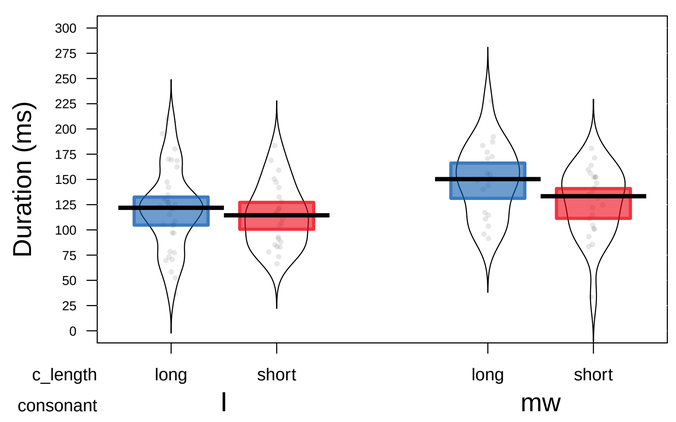




**Figure 2:** Raw (data), Description, and Inference (RDI) plot of geminate vs. singleton segments by position in word

## BHLM Design

- BHLM: duration ~ consonant length * consonant * frame + (1 + C length * consonant + frame | participant) + (1 + C length * consonant + frame | word) [same for all three models]
- Model Priors: **Intercept**: normal(0,20ms); **Fixed effects**: normal(0,40ms); **Covariance**: regularization of 2 [same for all models]

## References

Boersma, Paul & David Weenink. 2015. Praat: doing phonetics by computer (version 5.4.18). `http://www.praat.org`.

Gabry, Jonah & Ben Goodrich. 2016. rstanarm: Bayesian applied regression modeling via Stan (version 2.11.1). `http://CRAN.R-project.org/package=rstanarm`.

Jun, Sun-Ah. 2005. Prosodic typology. In Sun-Ah Jun (ed.), *Prosodic typology*, 430–458. Oxford: Oxford University Press.

R Core Team. 2015. R: A language and environment for statistical computing (version 3.2.2). `http://www.R-project.org`.

Rehg, Kenneth L. 1993. Proto-Micronesian prosody. In Jerold A. Edmondson & Kenneth Gregerson (eds.), *Tonality in Austronesian languages*, 25–46. Honolulu: University of Hawai'i Press.

Rehg, Kenneth L. & Damian G. Sohl. 1981. *Ponapean reference grammar* PALI language texts. Honolulu: University of Hawai'i Press.

## Word Initial

- No overlap of posterior 95% credible interval between geminates and singletons, which indicates a clear highly probable difference
- /mʷ/ pairs did not have observed difference
- Sentence frame had only small effect with heavily overlapping credible intervals
  - Frame 3 (sentence medial) had the strongest difference, with the target segment being on average 40ms shorter than in other frames

| | | CrI | |
|---|---|---|---|
| **Fixed effect** | **Mean (ms)** | **2.5%** | **97.5%** |
| Intercept | 158.69 | 111.49 | 203.34 |
| Length: short | –80.02 | –150.63 | –32.53 |
| Frame 3 | –40.10 | –95.05 | 12.62 |

**Table 1:** Selected fixed effects of word initial BHLM

## Word Medial

- Some overlap of posterior 95% credible interval between geminates and singletons, which indicates some probable similarity and also some probability that singletons are shorter
- /mʷ/ pairs did not have observed difference
- Sentence frame had negligible effect with heavily overlapping credible intervals

| | | CrI | |
|---|---|---|---|
| **Fixed effect** | **Mean (ms)** | **2.5%** | **97.5%** |
| Intercept | 144.60 | 78.88 | 209.83 |
| Length: short | –45.12 | –135.05 | 55.17 |

**Table 2:** Selected fixed effects of word medial BHLM

## Word Final

- Strong overlap of posterior 95% credible interval between geminates and singletons: improbable difference
- /mʷ/ pairs did not have observed difference
- Sentence frame had negligible effect with heavily overlapping credible intervals

| | | CrI | |
|---|---|---|---|
| **Fixed effect** | **Mean (ms)** | **2.5%** | **97.5%** |
| Intercept | 118.42 | 91.73 | 145.80 |
| Length: short | –6.61 | –42.85 | 30.00 |

**Table 3:** Selected fixed effects of word final BHLM

## Conclusions

- We observed geminate/singleton contrasts word **initially** and **medially**, but **not** finally, contrary to Rehg & Sohl (1981)
- /mʷ/ did not have any observed geminate/singleton contrasts

## Contact Information

**Web** http://rentz.weebly.com
**Email** rentzb@hawaii.edu, vanderso@hawaii.edu
**Data & Code** github.com/rentzb/pape

## Acknowledgments

We thank Amy Schafer, William O'Grady, Ken Rehg, Robert Andreas, and Damian Sohl for their help with this project. Most of all we thank Linda Kihleng-Albert, Maurina Ludwig, Dusty Santos, Joshua Fredrick, and Robinson Fredrick for sharing their knowledge and allowing us to write about their language. Kalahngan en kupwuromwail!