Acoustic Correlates of Stress in Tongan and Their Use in Diagnosing Syllable Fusion

James White
jameswhite@ucla.edu

Marc Garellek
marcgarellek@ucla.edu

Background

- Common acoustic correlates of stress include higher pitch and intensity, longer duration, and vowel quality differences (e.g., Gordon & Applebaum 2010).
- Greater positive spectral tilt (i.e., difference in voice quality) has also been found (Studdert-Kennedy 1985).
- Correlates of secondary stress may differ from those of primary stress (Adisasmito-Smith & Cohn 1996).
- Almost no work looking at acoustic correlates of stress in Polynesian languages.

Research Questions

1) Which acoustic measures correlate with stress in Tongan?
2) How do the acoustics of stress in Tongan compare with those reported in other languages?
3) Can we use these cues to tell us about the status of a phonological process of syllable fusion?

Tongan Basics

- Spoken in Kingdom of Tonga by about 96,000 speakers (Lewis, 2009).
- Malayo-Polynesian (Austronesian).
- Five vowels: /i, e, a, o, u/.
- Primary stress: Penultimate mora.
- Secondary stress: Depends on morphology, but in our words will always be on leftmost mora.

Procedure

- 4 female speakers recorded.
- Primary stress: CV’ CV CVV
- Sec. stress: CV CV CV CV
- 10 words/vowel, 3 tokens/word for each speaker, uttered in a carrier sentence.
- Stat. analysis: Linear mixed-effects models.

Fundamental Frequency (F0)

- Sig. higher F0 for primary and secondary stress (all vowels).
- Sig. higher overall when unstressed.
- Not consistent with commonly discussed patterns of stress-based vowel reduction (e.g., see Crosswhite 2001).
- Not tongue undershoot (should cause centralization)
- Not contrast enhancement through (near-)mergers
- Not peripheralization
- Possible explanations: jaw undershoot or enhancement of stress contrast via sonority.

RMS Energy

- Sig. higher energy for primary stress (all vowels) and secondary stress (/a, o/ only).
- Sig. higher H1*-H2* for primary stress (except /i/), but not for secondary stress.
- Taken together: stressed vowels more modal and more periodic than unstressed.
- Different than previous work on Dutch finding that stressed vowels are more tense.

Vowel Quality (F1 and F2)

- Sig. higher F1 (lower vowel) for primary stress (all vowels), secondary stress only for /a/.
- No difference in F2 for primary or secondary stress.
- Vowels higher overall when unstressed.
- Shorter vowel duration for secondary stress.
- Different than previous work on Dutch finding that stressed vowels are more tense.
- Entire system higher in the vowel space when unstressed – unlike common patterns of reduction.
- Stressed vowels more modal, periodic than unstressed – different than other languages.

Conclusions

- Primary stress marked by several cues in Tongan: higher pitch, energy, and duration; differences in vowel quality and voice quality.
- Entire system higher in the vowel space when unstressed – unlike common patterns of reduction.
- Stressed vowels /a/ are more tense and higher in the vowel space.

Syllable Fusion

- Lower-to-higher vowel sequences (ai, au, ea, ao, oe, etc.) often said to fuse into single-syllable diphthongs, but their higher-to-lower counterparts do not (Churchward 1953; Federman 1978; Fosler 1985; Schutz 2001; BUT see Taumoefolau 2002).
- Are there any acoustic differences between them?
- 2nd vowel of Fusing /VV sequences more like a stressed vowel in terms of F1.
- F0 contours show a later peak for /ai, au/ than for /ia, ua/.
- But other sequence pairs do not show such a difference.
- For other acoustic cues, the two types of sequences do not look different.
- Thus: ‘Fusing’ sequences are slightly different than ‘non-fusing’ ones (in F1), but syllable fusion seems dubious as a phonological rule – likely just how these sequences are realized phonetically.
- Could other measures reveal a difference?

References

Poser W. J. (1985). Cliticization to NP and Lexical Phonology. In J. Goldberg et al. (eds.), P.

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