5pSC24

Acoustic Correlates of Stress in Tongan

and Their Use in Diagnosing Syllable Fusion

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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 (Sluijter & van Heuven 1996)
- 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

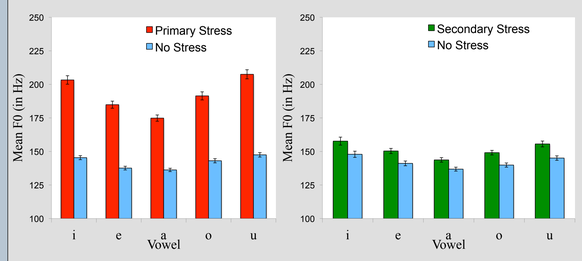
Procedure

- 4 female speakers recorded
- Primary stress: CV̲ˈCV̲CV
- Sec. stress: ˌCV̲CV̲ˈCV-CV

} V_1 compared to V_2

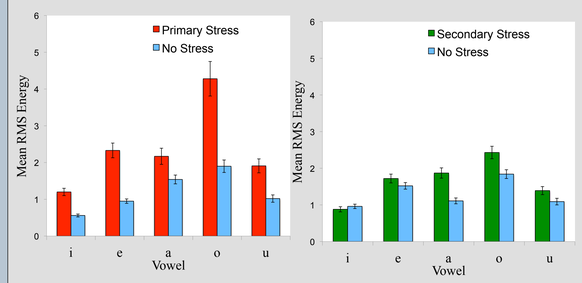
- 10 words/vowel, 3 tokens/word for each speaker, uttered in a carrier sentence
- Stat. analysis: Linear mixed-effects models

Fundamental Frequency (F0)



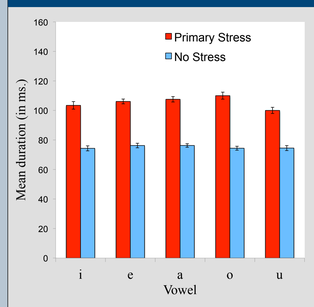
- Sig. higher F0 for primary and secondary stress (all vowels).

RMS Energy



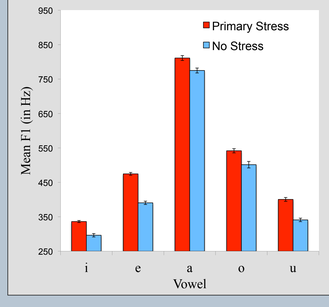
- Sig. higher energy for primary stress (all vowels) and secondary stress (/a, o/ only).

Duration

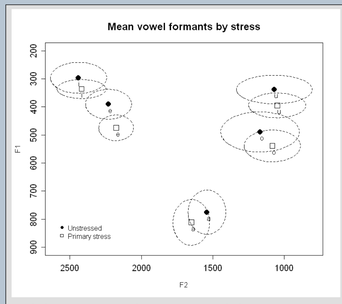


- Sig. longer duration for primary stress (all vowels), but not for secondary stress

Vowel Quality (F1 and F2)

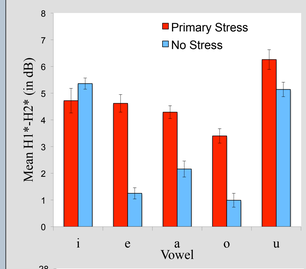


- Sig. higher F1 (lower vowel) for primary stress (all vowels), secondary stress only for /a/.
- No difference in F2 for primary or secondary stress.



- Vowels **higher** overall when unstressed.
- Distance between vowels **maintained** when stressed and 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

Voice Quality (H1*-H2* and CPP)



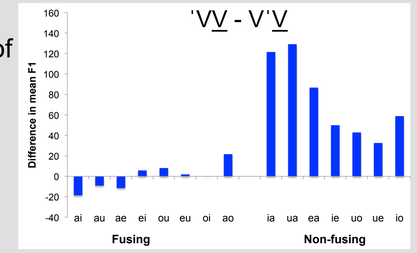
- Sig. higher H1*-H2* for primary stress (except /i/), but not for secondary stress
- Sig. higher Cepstral Peak Prominence (=less noisy) for primary stress (all vowels), but not for secondary stress
- Taken together: stressed vowels more modal and more periodic than unstressed
- Different than previous work on Dutch finding that stressed vowels are tenser (Sluijter & van Heuven 1996)

Conclusions

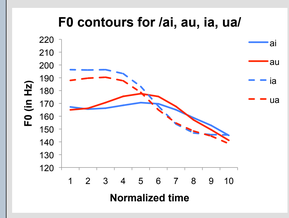
- Primary stress marked by several cues in Tongan: higher pitch, energy, and duration; differences in vowel quality and voice quality.
- Entire system higher in the vowel space when unstressed – unlike common patterns of reduction
- Stressed vowels more modal, periodic than unstressed – different than previous lgs. tested

Syllable Fusion

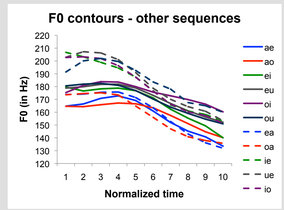
- Lower-to-higher vowel sequences (ai, au, ae, ao, ei, ou, etc.) often said to fuse into single-syllable diphthongs, but their higher-to-lower counterparts do not (Churchward 1953; Feldman 1978; Poser 1985; Schutz 2001; BUT see Taumoefolau 2002).
- Are there any acoustic differences between them?
- 2nd vowel of Fusing ˈVV 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?

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Acknowledgments

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