Gujarati Stress: A Failure to Replicate

Dustin Bowers -- University of Alberta

Introduction

Claim: Stress in Gujarati (Indo-Aryan, India) is sonority-driven (Cardona 1965, de Lacy 2002)
- Prime case for de Lacy's (2006) markedness

Problem: Prior descriptions are impressionistic and disagree

Study: Collect acoustic data for words where Cardona 1965 and de Lacy 2002 agree

Result: Little confirmation of stress contrast (see also Shih in press)

Conclusion: Effects of putative stress potentially caused by coarticulation

Prior Descriptions

De Lacy (2002): Stress [ɑ > ɔ, o, u, ɛ, e, i > ə]
- Non-[ɑ] vowels unstressable in final σ
- [ə] only stressable in penult σ
- If sonority tie: penult > initial > final

E.g. calculate sonority & position, break ties

Penult	Initial	Final	
ɑ'kaʃi	'pakistɑn	pərik'ʃɑ	'sky, Pakistan, exam'
hɔ̃'ʃilɔ̃	'ʊismərən		'eager, forgetfulness'
rə'məkɖ̃ũ			'toy'

Cardona (1965): overlaps with de Lacy (2002)
- Penult [i] is exceptional: [kə'ʊitɑ] 'poem'
- Also free variation, morphological sensitivity

Mistry (1997:660) compatible, but sparse data
Schiering and van der Hulst (2010:553-556):
- [ɑ] weaker attraction, [ə] weaker repulsion

Acoustic Correlates

Cardona (1965:21, 47):
- [i, u] more tense in open stressed σ
- Stress targeted by intonation contours
- Duration is not a stress correlate

De Lacy (2002:71, 2006:235-6):
- Raised F0 (only females), intensity
- [ə] → [ʌ] in open stressed σ
- Duration is a stress correlate

Current Study

26 native speakers living in Bangalore, India
- 17 males, 9 females

12 target words in carrier sentence (3x)
- σ position, flanking consonants controlled

Unstressed	Stressed	
nɑ'rɑdʒgi	'nɑrəŋgi	'distressed, orange'
'dɑbɔdɖi	əm'bɔdɖo	'lefty, hair bun'
'dʒɑmbuɖo	lim'buɖi	'jambul tree, lemon tree'
'sɑmbelo	tə'belo	'rod, horse stable'
'dɑginо	nə'ginо	'jewelry, jewel'
'sumət̪i	səm'mət̪i	'wisdom, consensus'

Results

Linear mixed effects models (lme4, Bates et al 2015)
- Dependent variables: F1, F2, F0 (min, max, mean, range), intensity, duration
- Speaker as random effect

Significant effects of 'stress' in all categories

But effects smaller than JNDs or contrary to expected direction

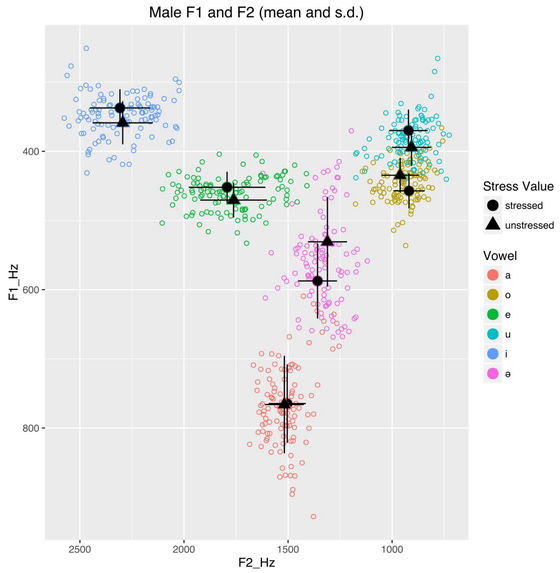
Sub-JND Effects

Intensity~stress model ΔAIC: 3.775, $p = 0.01$
- Effect: 0.46 dB (t=2.742)
- JND: 1.2-1.5 dB (Flanagan 1955)

F0~Stress*gender models:
- F0 min: ΔAIC: 3.585, $p = 0.023$
- F0 max ΔAIC: 3.334, $p = 0.026$
- F0 mean: ΔAIC: 3.976, $p = 0.019$
- Effects: 1.6-2.3 Hz (♀), 0.3-1.1 Hz (♂)
  - (t-values < 1.85)
- JND: 5-16 Hz (Harris and Umeda 1987)

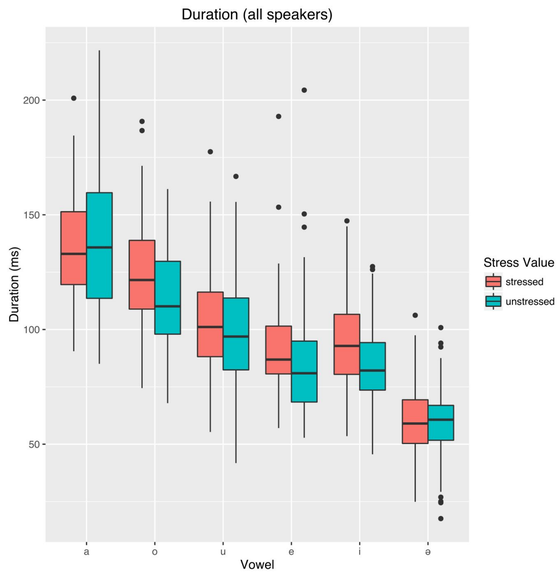
Larger Effects

F1, F2~stress*V models:
- F1: ΔAIC: 89.622 $p < 0.001$
- F2: ΔAIC: 47.76 $p < 0.001$



Vowels produced by male speakers in F1-F2 space. Putative stress effects primarily for F1 of [ə], *F1, F2 of* [ɔ].

Duration~stress*V: ΔAIC: 89.622 $p < 0.001$



Duration by vowel and putative stress value. Duration increases for [e, i, o, u] when stressed, but decreases for [ə, ɑ].

Discussion

Results do not support prior descriptions
- [i, u, ə] not more peripheral when stressed
- [ɑ, ə] shorter when stressed
- Miniscule effects of stress for intensity, F0

Alternative: coarticulation explains putative stress effects
- [ə] in ['sumət̪i] raised, backed by [u]
- [ɔ] in [əm'bɔdɖo] backed by [ɔ]
- Unstressed [o, u, e, i] lowered by [ɑ]

- Shorter [o, u, e, i] from long preceding [ɑ]
  - 2 segs between [u, e] and [ɑ] → -7 ms
  - 1 seg between [o, i] and [ɑ] → -11 ms

Conclusion

Whence sonority-driven stress?
- Perhaps illusion from duration
- [ɑ] can be quite long, [ə] is fairly short

Gujarati was positive case for de Lacy-an markedness (de Lacy 2006)
- General theory not disproven by this case
- Other potential cases of sonority-driven stress far less intricate, less well-described (Kenstowicz 1994)

Take home: stress is not a phonetic property
- It may have phonetic correlates
- Linguist can't solely trust ear
- Stress descriptions must provide correlates

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