

Does Gujarati stress avoid the lowest sonority vowel [ə]?

1. Introduction: This paper examines the acoustic realization of [ə] in Gujarati, which has been reported to be disfavored as a host for stress (e.g. Cardona 1965, de Lacy 2002): specifically, stress does not fall on the usual penultimate syllable if it contains a [ə] – it instead retracts to the antepenult, but only if that syllable contains a vowel other than [ə]. However, I will show that there is no acoustic or phonological evidence to support this claim. This finding is important because Gujarati has been presented as one of the most detailed cases of sonority-driven stress; if the Gujarati evidence is unreliable, many putative cases of sonority-driven stress may not be valid.

2. Previous Descriptions: There have been many descriptions of Gujarati stress (e.g. Cardona 1965, Adenwala 1968, de Lacy 2002, Doctor 2004). Though they vary in details, they generally agree that the default position for stress is the penult (e.g. [aw:ánã] ‘coming’), and that stress retracts from a penultimate [ə] onto a non-[ə] antepenult (e.g. [kójəldi] ‘little cuckoo’). When both the penult and antepenult contain schwa, the penult remains stressed (e.g. [rəmákqũ] ‘toy’); /ə/ is also realized as [ʌ] when stressed (Patel & Mody 1960, Lambert 1971, Nair 1979). However, these descriptions are impressionistic – no acoustic or phonological evidence is provided. This study is the first to examine the acoustic realization of stress in Gujarati to test the hypothesis that it is sonority-driven.

3. Methodology: One female and three male native speakers of standard Gujarati participated in the experiment (ages 22-25). All had recently moved to the United States from Gujarat State in India and still communicated in Gujarati daily. Forty trisyllabic nonce words with the shape [C_{ə1}.C_{ə2}C.CV] and [Cu.C_{ə3}C.CV] (where C ranges over [p, t, k]) were used to make direct comparison of [ə] in both putatively stressed and unstressed states. Closed syllables were used because words with [ə] in word-medial open syllables are rare (Cardona 1965:34). Each stimulus was placed in two frame sentences and repeated three times. Acoustic characteristics of these vowels were measured: duration, intensity, F0, F1 and F2. The results of each measure were analyzed using linear mixed effect models with speaker and item as random effects. As (1) schematizes, sonority-driven descriptions predict that [ə₃] will be unstressed, whereas [ə₂] will be stressed, because stress will retract to an antepenultimate [u] but not to the antepenult [ə₁].

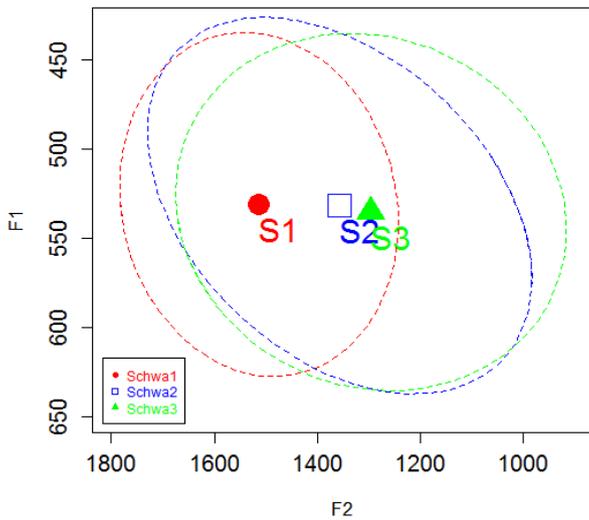
4. Results: According to previous descriptions, the formants of [ə] are crucial in distinguishing stressed from unstressed realizations. While [ə₁] seems to differ from [ə₂] and [ə₃] in F2 (see (2)), I argue that the variation is due to the influence of place of articulation of following consonants ([ə₁] didn't precede [k] in this experiment). This is borne out by looking at the distribution of [ə] in different consonant environments (see (3)). The realization of [ə] has a significantly lower F2 when preceding a dorsal, and higher F2 preceding a coronal ([ək]: 1260.1 Hz, [ət]: 1507 Hz, p<0.01); the F2 preceding a labial is significantly different from both ([əp]: 1400 Hz, [əp] vs. [ək]: p<0.01, [əp] vs. [ət]: p<0.01). Crucially, there is no evidence for stress-based [ə]~[ʌ] alternation. The sonority-driven descriptions predict that [ə₁] and [ə₃] should be shorter than [ə₂]; however, [ə₃] has the longest duration (see (4)). The same pattern is seen in intensity (see (5)). For F0, every target word was produced with a rising (LH) contour: i.e. [ə₂] and [ə₃] always have higher pitch than [ə₁]. In summary, no acoustic correlates of stress were found.

5. Implications: Evidence from other vowels indicates that Gujarati stress is generally realized on the penult. This study suggests that stress lacks phonetic realization when it would occur on [ə]. Further work on [u] in [Cu.C_{ə3}C.CV] and [Cu.CuC.CV] will help elucidate the position of stress. Why did previous investigators perceive Gujarati stress as avoiding [ə] when it was preceded by a different vowel? Perhaps they were influenced by the phonological systems of other languages; in particular, [ə] is not found in stressed syllables in English, which could bias English-speaking listeners towards not perceiving [ə] as stressed.

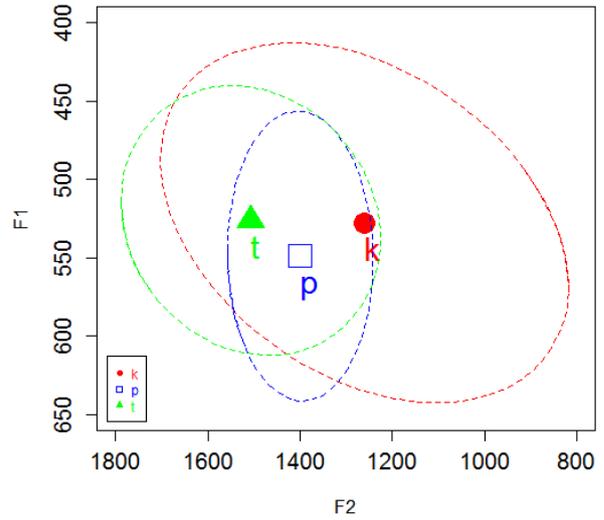
(1) Predicted sonority-driven stress pattern

Word shapes	Vowel characteristics
$C\vartheta_1.C\acute{\vartheta}_2C.CV$	$\vartheta_1 \neq \vartheta_2$
$C\acute{u}.C\vartheta_3C.CV$	$\vartheta_3 = \vartheta_1, \vartheta_3 \neq \vartheta_2$

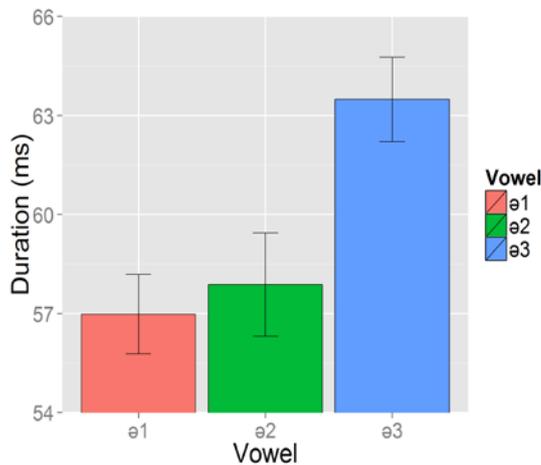
(2) Overall mean F1/F2 for [ə]



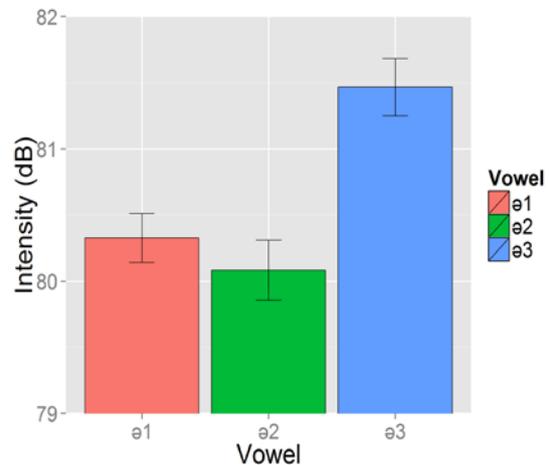
(3) The distribution of [ə] followed by [p, t, k]



(4) Overall mean duration for [ə]



(5) Overall mean intensity for [ə]



Selected References

[1] Adenwala, Mridula (1968). *The structural analysis of the phonology and morphemics of Gujarati*. PhD dissertation, State University of New York at Buffalo. [2] Cardona, George (1965). *A Gujarati reference grammar*. Philadelphia: The University of Pennsylvania Press. [3] de Lacy, Paul (2002). *The formal expression of markedness*. Doctoral dissertation, University of Massachusetts, Amherst. Amherst, MA: GLSA Publications. ROA 542. [4] Doctor, Raimond (2004). *A grammar of Gujarati*. Muenchen: LINCOM GmbH.