



Acoustic Characterization of Phonemic and Allophonic Glottal Stops in Levantine Arabic

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Introduction

- Previous studies have described two types of glottal stops in colloquial Levantine Arabic (Al-Hawamdeh et al., 2017; Watson, 2002)

(1) Phonemic glottal stops

- (a) [ʔakalat] 'she ate'
- (b) [saʔalat] 'she asked'
- (c) [raʔs] 'head'

(2) Allophonic glottal stops (/q/ → [ʔ])

- (a) /qalam/ → [ʔalam] 'pencil'
- (b) /nuqat/ → [nuʔat] 'arguments'
- (c) /sumaq/ → [sumaʔ] 'sumac'

- Watson (2000) argued that phonemic and allophonic glottal stops are qualitatively different from each other, but did not provide any phonetic evidence supporting this idea

- **Question: Are phonemic and allophonic glottal stops in colloquial Levantine Arabic fully neutralized at the acoustic level?**

Acoustic Manifestation of Glottal Stops

- Glottal stops surface in Arabic (McCarthy, 1994) and in American English (Davidson & Erker, 2014; Garellek, 2010; Redi & Shattuck-Hufnagel, 2004) as either a period of **full closure** or **voicing irregularity**
- Three main measures of voice quality on the vowel following a glottal stop: F0, H1-H2* (the corrected amplitude difference between the first and second harmonic), CPP (Cepstral Peak Prominence; measure of noise)
 - H1-H2* and CPP values were found to be lower in vowels following a glottal stop (Garellek, 2010)

References & Acknowledgements

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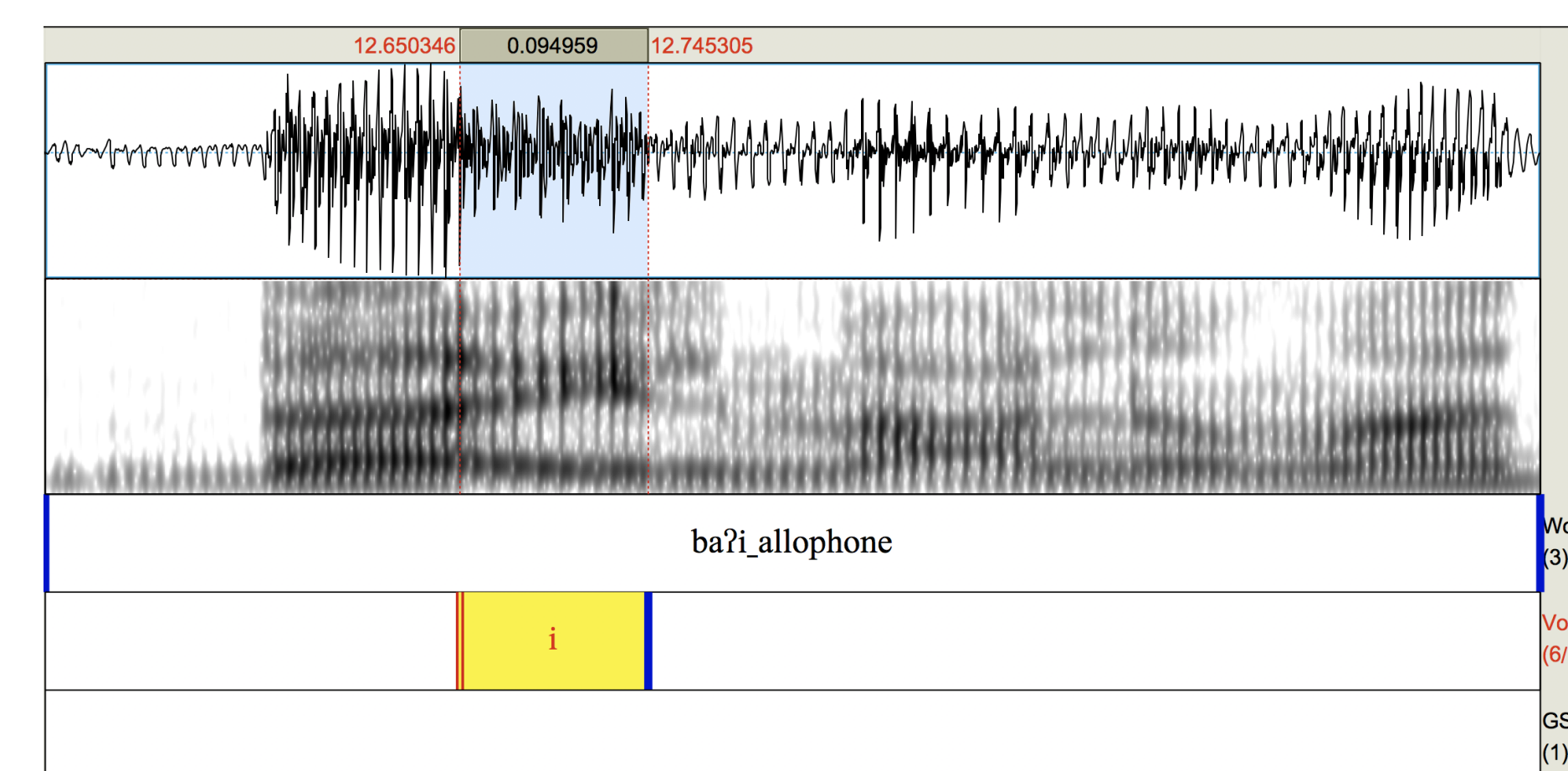
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Methods

- Speakers:
 - 5 native speakers of Levantine Arabic (2F, 3M)
 - Regions: 3 Palestine, 2 Lebanon
- Stimuli & Task:
 - 18 words: 6 phonemic glottal stop, 6 allophonic glottal stop, 6 filler words (modal)
 - Glottal stop environment: V₁ʔV₂ with V₂ = a, i
 - Words appear in sentential medial position
 - Participants read the sentences aloud (3 repetitions)

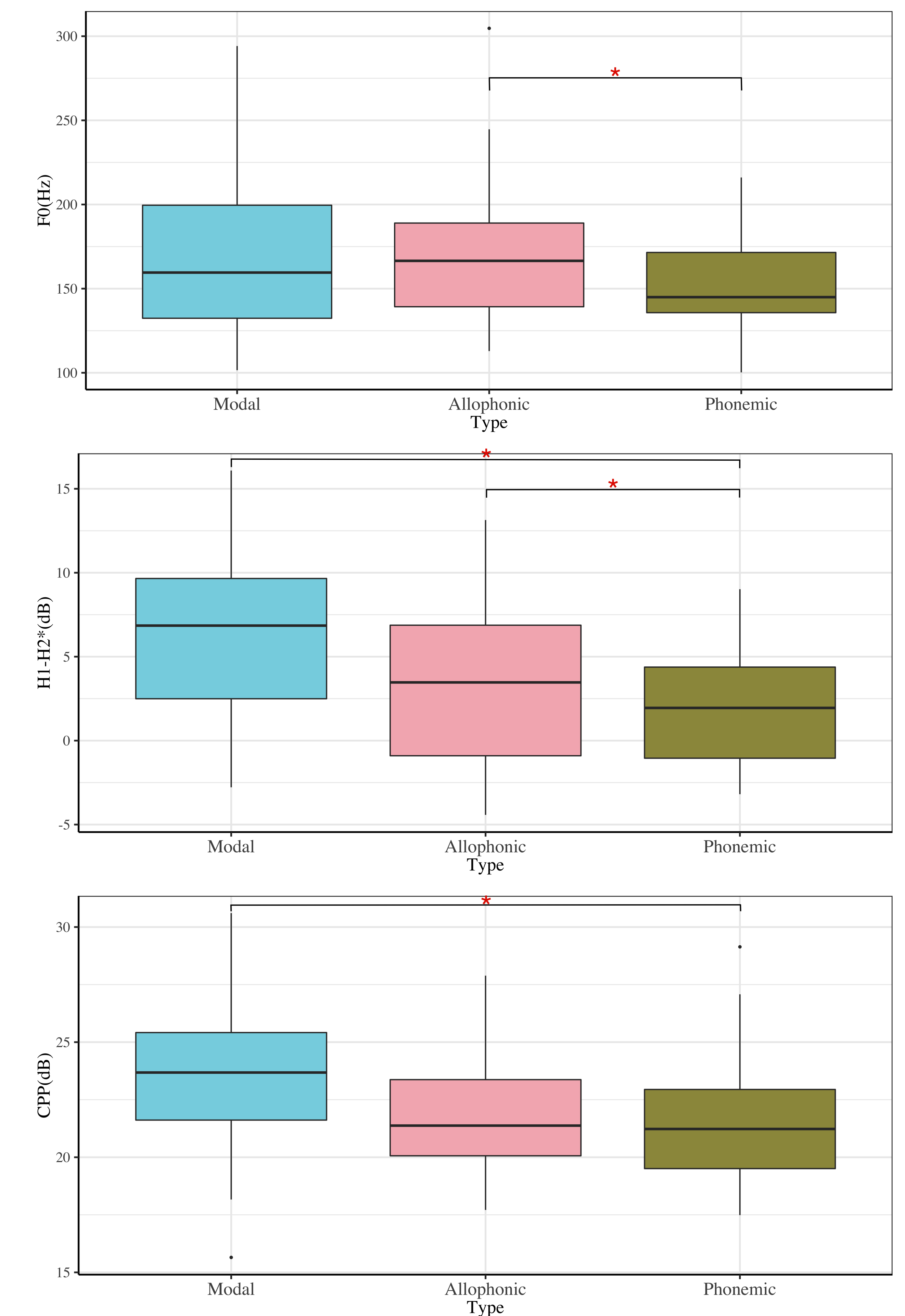
Analysis

- Vowel onset was considered as the beginning of a shift in either the first or second formant



- Glottal stops that manifested as a period of full closure were excluded from the analysis (< 1%)
- Mean F0, H1-H2*, and CPP values were obtained in VoiceSauce (Shue, 2010)

Results



Discussion & Future directions

- Voice quality of the vowel following a phonemic glottal stop is characterized by a higher degree of creaky phonation than the vowels following an allophonic glottal stop
- We found acoustic differences between phonemic and allophonic glottal stops
 - This suggests that there is an incomplete neutralization between two types of glottal stops in colloquial Levantine Arabic
- Future Directions:
 - A picture description task to remove orthographic influences
 - Include minimal pairs & glottal stops in other environments (initial and final)
 - A perception study using phonemic and allophonic glottal stops