

Palatals Incompatibility with Tongue Root Retraction: Ultrasound and Acoustic Evidence

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Introduction: Pharyngealized coronals in Arabic /tʰ sʰ dʰ ðʰ/ are phonemically distinctive from plain non-pharyngealized ones /t s d ð/. Phonemic pharyngealization involves retraction of the tongue root towards the pharynx [1, 2]. Bidirectional coarticulatory pharyngealization is realized acoustically on vowels by raising F1 and F3 and lowering F2 [3, 4] and articulatorily on consonants by retracting the tongue root [5]. It has been argued that a set of [+high] phonemes such as /i j ʃ ʒ/ block coarticulatory pharyngealization from affecting other segments in the word in Palestinian dialect [6, 7] but not in Jordanian Arabic (JA) [8].

Research Aims: The acoustic study aims to address: (1) whether /i j ʃ ʒ/ are transparent or blockers to coarticulatory pharyngealization in JA, and (2) whether blocking is caused by palatals /i j ʃ ʒ/ or by [+high] segments including /u/. The ultrasound study aims to explain the incompatibility between palatals and pharyngealization on articulatory grounds: if palatals themselves can undergo coarticulatory pharyngealization in Saudi Arabic (SA).

Method: Acoustic study. A wordlist of 70 words forms (near)-minimal pairs contrasting in pharyngealization, with a blocker /i j ʃ u/ intervening between the source consonant and the target vowel (Example 1). Six speakers of JA read the words embedded in a carrier sentence 5 times.

Ultrasound study. The wordlist consists of 30 words of the sequence C₁aC₂ where C₁ is either palatal /j ʃ/ or labial /b f/ and C₂ is either plain /t s/ or pharyngealized /tʰ sʰ/ (Example 2). Mid-sagittal ultrasound images are collected from 10 native speakers of SA using Terason t3000 operating Ultraspeech 1.2 at 60 fps while speakers read the words in a carrier sentence 5 times.

Acoustic Results: Mixed model with F2 at vowel midpoint as the dependent variable show that F2 of pharyngealized vowels is significantly lower than plain vowels (*Est.* = -366, *SE* = 78, *p* < 0.001). [+high] phonemes /i j ʃ u/ (and not only palatals) block pharyngealization from affecting other vowels. The blocking effect is stronger in progressive than regressive coarticulation.

Ultrasound Results: Smoothing-Spline ANOVA is conducted on tongue trajectories at the midpoint of coarticulated palatals and labials. Coarticulatory pharyngealization on labials caused retracting the tongue root towards the pharynx whereas palatals do not exhibit any root retraction when occurring in a pharyngealized context (Fig.1). The findings of the two studies suggest that the incompatibility between [+high] blockers and [+RTR] associated with pharyngealization is based on articulatory grounds. For example, in a word like /fa:ðʰja:t/ ‘empty, pharyngealization blockage occurs because when the tongue is not retracted in producing the palatal [j], it does not return to its retracted position when articulating the target vowel [a:] that follows the palatal.

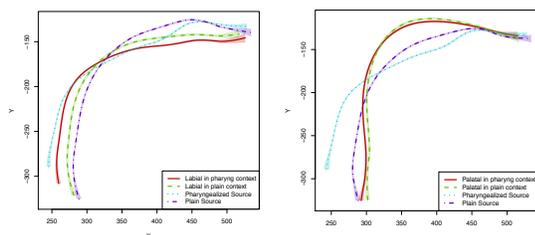


Fig.1: Tongue trajectories and 95% CI for plain and pharyngealized source (C₂), labials (left) and palatals (right) in plain and pharyngealized phonetic contexts.

Examples

1. Minimal pair of the acoustic study:
 /tartʕi:ba:t/ ‘drying’
 /tarti:ba:t/ ‘arrangements’
2. Near-minimal pair of the articulatory study:
 /fa:tʕba:t/ ‘omitting’
 /fa:tma:t/ ‘insulting’

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