

Abstract

Endoscopic, transillumination, EMA, and ultrasound study of emphatic, back and labialized consonants of Moroccan Arabic
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Introduction

In this study, we provide exhaustive physiological data from four different experiments in order to clarify four research questions related to the supralaryngeal and laryngeal adjustments of the emphatic consonants, with a focus on those of Moroccan Arabic (MA).

Questions related to supralaryngeal adjustments.

1. Are emphatic consonants pharyngealized (Ghazeli, 1977; Jakobson, 1957), velarized (Kingston & Nichols, 1987) or uvularized (Herzallah, 1990) ?
2. Are the emphatic consonants labialized as was predicted by Jakobson (1957) and observed in Egyptian Arabic by Sayed Ahmed Adem (1983) ?
3. Why do we have a co-occurrence restriction between /T/ and /k/ (McCarthy, 1994) ?

Questions related to laryngeal adjustments

1. Are the emphatic consonants glottalized as suggested in the literature (Cohen, 1988) ?

To answer these questions, we compare the articulatory properties of MA emphatic coronals /T D S/ with their non-emphatic cognates /t d s/, the uvulars, and with the “pharyngeals”. We also integrate MA “labialized” dorsal consonants, and especially “labialized” labials which are also considered by some authors as velarized (Heath, 1987) and even emphatic (Mitchell, 1993).

Method (four physiological experiments)

-Nasendoscopy: A flexible endoscope was inserted through the nostril of one MA speaker, and connected to a micro camera Olympus OTV-SF (25 frames/sec.) to observe the tongue, epiglottis and the glottis.

-Transillumination: One photosensor was placed on the external surface of the neck of one MA speaker, below the cricoid to capture the quantity of light passing through the glottis that is proportional to its degree of opening.

-Electromagnetic Articulograph: One MA speaker participated in a 3-dimensional EMA experiment (AG500, Carstens Medizinelektronik), during which, vertical and horizontal movements of the tongue (tip, mid, dorsum), lips, and the jaw were tracked at a 200 Hz sampling rate.

During these three experiments, words and nonsense words containing emphatic and back consonants were produced in different phonetic contexts.

-Ultrasound: Motion pictures of the tongue (Mindray DP 600, with fixed head) were provided for two MA speakers. For this experiment, words and nonsense words containing emphatic, back and labialized consonants were produced in different phonetic contexts.

Major results

Supralaryngeal adjustments

-Place of articulation (Endoscopy and ultrasound): The articulation in the pharyngeal cavity during emphatic coronals is more similar to that of uvulars (backward movement of the tongue towards the posterior pharyngeal wall) than of “pharyngeals” (backward movement of the tongue and the epiglottis). In fact, MA has epiglottal consonants (figure 1).

-Emphatics and labialization (EMA and Ultrasound): “labialized” geminate labials are velarized and not emphatic, while /T S/ are only emphatic.

-Emphatics and the anterior part of the tongue (EMA, Ultrasound): The anterior part of the tongue is substantially lower during /T/ (apical consonant) than during /k/ and /t/ (laminal consonant). /k/ has a front constriction before /i/ and even before /a/, probably to enhance its contrast with /q/. /T/ and /k/ have antagonist lingual gestures, which can explain their co-occurrence restriction.

Laryngeal adjustments

Emphatics and pharyngeal consonants: Posterior-anterior constriction of the aryepiglottic sphincter is observed during “epiglottal” and not emphatic consonants (Figure 2).

Emphatics and glottalization (nasendoscopy and transillumination): /T/ has a short VOT compared to /t/. /T/ has also slight opening of the membranous part of the glottis, while /t s S/ have an opening of its anterior and posterior parts mostly due to timing differences (VOT). Any clear indication of glottalization (total closing of the glottis) is observed during these four consonants.



Figure 1: Pharyngeal cavity postures during MA non-emphatic coronal /s/, its emphatic cognate /S/, the uvular and the epiglottal fricatives in two intervocalic contexts iCi and aCa.

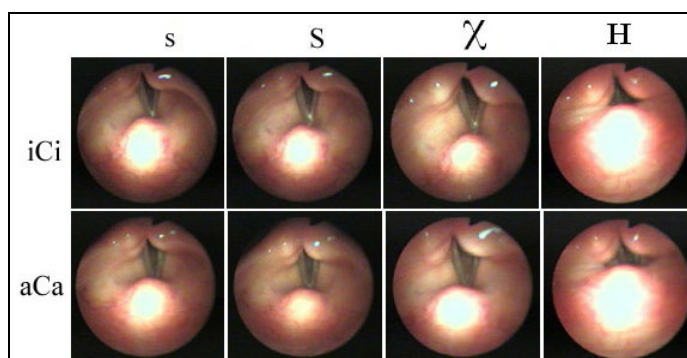


Figure 2: Laryngeal cavity postures during MA non-emphatic coronal /s/, its emphatic cognate /S/, the uvular and the epiglottal fricatives in two intervocalic contexts iCi and aCa.

Conclusion

Combining all these observations, we can deduce that MA emphatic consonants are uvularized and secondarily pharyngealized. MA has epiglottal consonants and is confirmed to have classic aryepiglottic constriction, as well as tongue retraction during these consonants (Esling, 2005).

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