

The Articulatory Appearance of Haraka in Arabic Language

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Abstract— The letter 'harf in Arabic' is the minimum segment of the Arabic spoken chain, it consists of two portions: a permanent part and a moving part. It has two qualities: a sound quality which is the stamp, and impulsive force explained by the term of "haraka"; setting in motion." The "sukun" (pause) is the opposite of haraka. In this study we try to treat the following questions: the short vowel and "haraka" are really identical in Arabic langue? What is the definition of the vowel in Arabic and how Arabic speakers product it? In Arabic language, short vowel and "haraka" are often confused. We used the x-ray images of a male speaker, who uttered sentences in morocco Arabic to highlight the articulatory aspect of the haraka. The X-ray images are an effective way to account for the internal mechanism of the "haraka/sukun" in particular and speech in general. In this work, we found that the concept of haraka is wider than that of the vowel. In fact, it included the process of anticipation of the articulators' movement. And the similarity with the vowel is limited only acoustically. The "haraka" in Arabic language would be the acoustic-articulatory movement required at the same time to the sequential production of the "harf" and the transition to the next articulation.

Keywords— Speech production, Vocal tract modelling, X-Ray images, Arabic vowels, Haraka in Arabic language

The Arabic language is a non-concatenative language. The literature says that classical Arabic word consists of two distinct parts: a basic root, generally trilateral and a vowel pattern refers to either one or more vowels or auxiliary consonants /? w j m t n h s l/.

Experimental phonetics has thrown new luminary on the hidden dimensions of speech production. It reveals the movement of articulatory operators and the different back organs acting as glottis, the laryngeal block, the hyoid bone, the pharyngeal wall, soft palate, back and root of tongue on the one hand and oral cavity on the other hand. In our work, we exploit a radiographic film, to well illustrate the articulator's shapes and movement involved in the production of the "harf" in Arabic. In this study we will address the following issues: What is the difference and the similarity between the vowel and haraka in Arabic language, how Arabic speakers subjects product it?

For this, we used X-ray image of the vocal tract. The X-ray images are an effective way to account the internal mechanism of the "haraka" and "sukun. It reveals the movement of articulatory operators and the various organs involved in the speech production.

I. INTRODUCTION

II. WHAT IS THE DEFINITION OF THE VOWEL IN ARABIC

For Sibawayh, the vowel in Arabic language is an additional tool to produce consonants. Vowels are divided into two categories: long vowels (extension letters) and short vowels (movement letters of the consonant). Sibawayh defines the letter as a sound unit of speech composed of a stable portion (the consonant) and an additional part (the vowel). The additional part determines whether the letter is in motion or not. The "sukun"; (pause) is the opposite of haraka, according to al-Rummani, the haraka allows the harf to occur while sukun does not allow.

In this study to illustrate the articulator's movements that go into the production of the harf, we use a radiographic film of the database DOCVACIM [R.Sock]. It incorporates x-ray images corresponding to a male subject production of Moroccan Arabic phrases. To well illustrate the shapes and the articulator's movement involved in the production of the "harf" in Arabic. We selected in this cineradiography film the images that correspond at the production of words / bratan / and / baraka /, to study the production of a harf sakin [b] followed by a consonant [r] at the beginning of a sequence. We compare the articulation configuration of [br] to that of [ba].

III. TOOLS AND TECHNIQUES USED FOR THE TREATMENT OF X-RAY IMAGES

X-ray images cannot be used directly, but manual, automatic or semi automatic processing is necessary. We used the software Xarticulators [Yves Laprie], for extracting, storing and processing the contour of the articulators involved during the production of speech. Xarticul designed to operate automatic monitoring tools for bone structures, semi-automatic monitoring tools for low-masked organs, and finally the manual trimming tools for the tongue. xarticul includes tools to define the contours and exploit them. The image sequences must be in PGM format (Portable Gray Map); contours are plotted point by point, they can be deleted, edited, hidden temporarily, and explored.

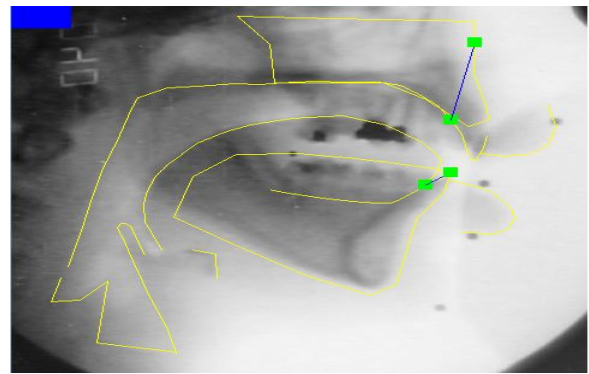
The acoustic database consists of 27 sentences spoken by a male speaker; the recording time is about 70 seconds.

We used the Praat software to segment sentences into phonemes and for the phonetic annotation. After the segmentation of the sequence sentences, we synchronized each phoneme with the corresponding X-ray images of the vocal tract.

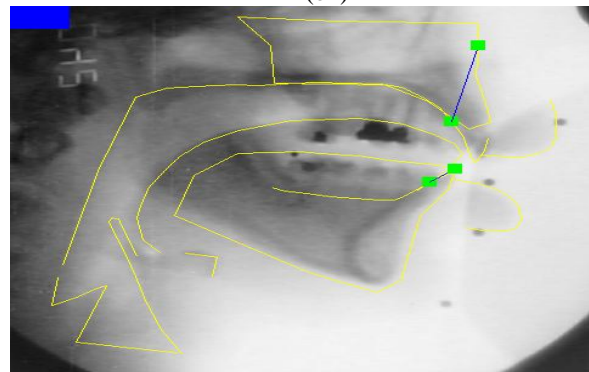
IV. RESULTS

Below we present the x-ray images of the vocal tract of a male speaker that corresponds to the production of / br /and /ba/.

(a1)



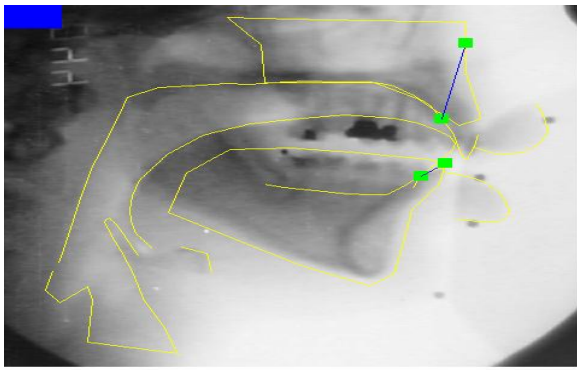
(b1)



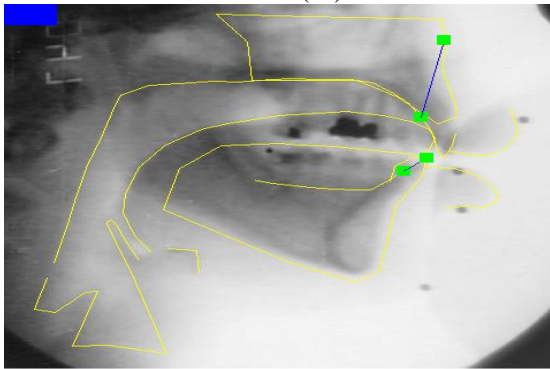
(c1)



(d1)



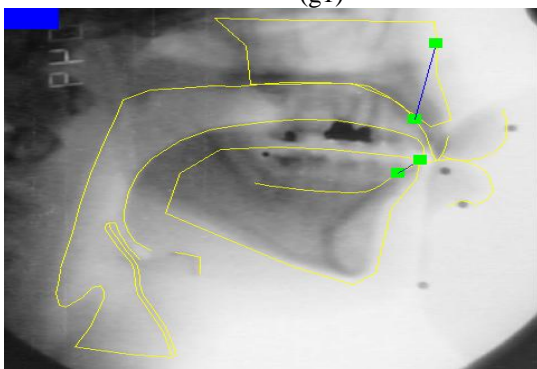
(e1)



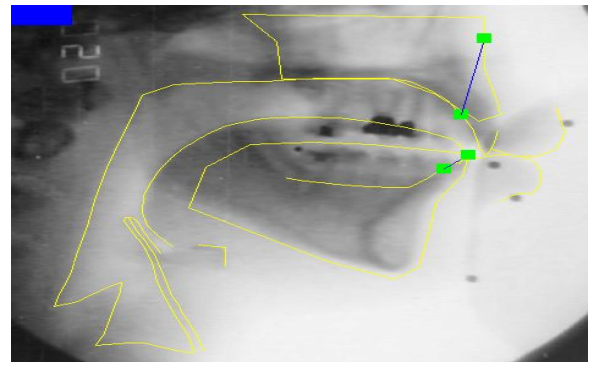
(f1)



(g1)



(h1)



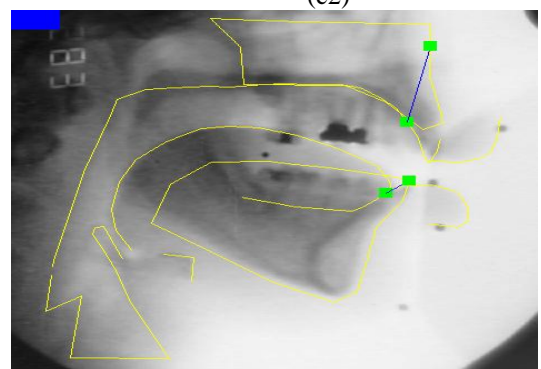
(a2)



(b2)

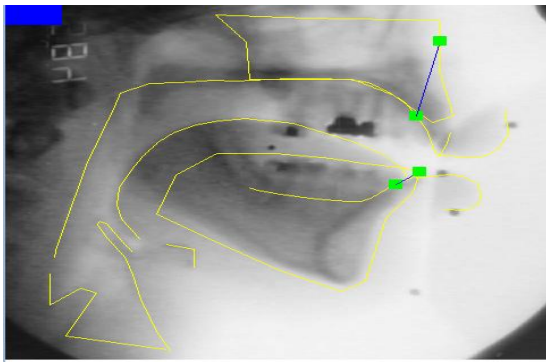


(c2)

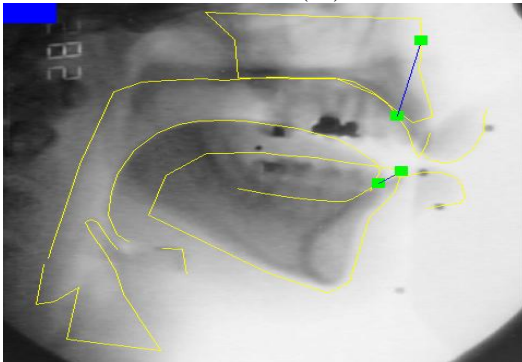


(d2)

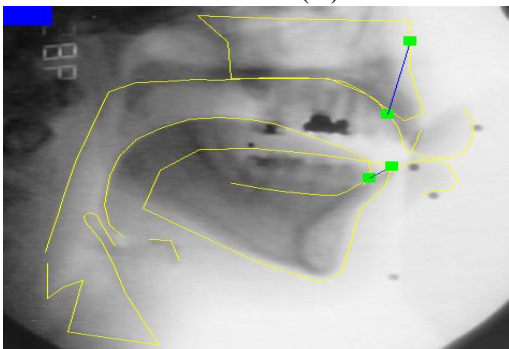
Fig. 1 Images that correspond to the production of: /b/ in the word /bratan/



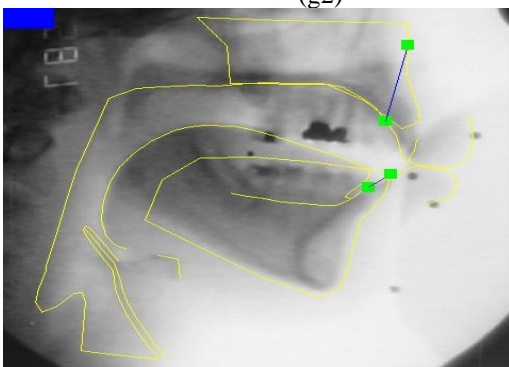
(e2)



(f2)



(g2)



(h2)

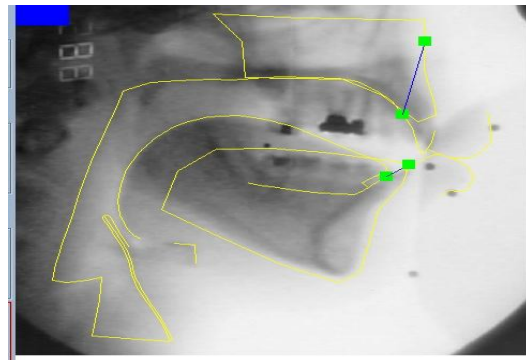


Fig. 1 The images that correspond to the production of: /b/ in the word /baraka/

V. RESULTS ANALYSIS

The figures (a1-f1) show the different articulators positions in particular that of the tongue. There is a significant tongue movement before the complete closure of the lips, to produce the plosive, [b] followed by the consonant [r] in the word /bratan/. Figures g1 and h1 show the complete closure of the lips and the tongue shape. This anticipation movement of articulators to produce the plosive [b] in sukun state (pause) is not accompanied by an acoustic signal. This confirms that 'harf sakin' must be preceded by a haraka, in our case this haraka is only the movement of organs, without a vocalic sounds production. The figures (a2-f2), show the different articulators positions in particular that of the tongue, before the complete closure of the lips to produce the plosive [b] followed by the vowel [a] in the word /baraka/. We note that the tongue in this case has a stable position compared to the first case. Figures g2 and h2 show the complete closure of the lips and the tongue shape to produce the plosive [b]. We note that for the production of /br/, the positions of the tongue are different from that taken for the production of /ba/, as in the first case the tongue has an important anticipatory movement, it started against the molar meadows while in the second case it took a lower and stable position. The figures a2, f2, g2 and h2 which correspond at the last phase of production of the plosive [b] are practically similar for /br/ and /ba/.

VI. CONCLUSION

For the production of harf sakin /b/ there is a movement of the articulator in particular that of the tongue and that without producing an acoustic sound, it is the anticipation

phenomenon of the articulators movement. Articulators start moving to position themselves well for the production of a harf sakin /b/ followed by a consonant /r/. This movement is the 'haraka' in Arabic; this confirms that a harf in sukun state is necessarily preceded by a haraka, which is in agreement with the theory of A.Hadj Salah.

This example confirms that the concept of haraka in Arabic language is wider than the vowel. The haraka as it is an aero organic movement .Which allows the production of Arabic letters.

The haraka affects the production of the harf and vowel sound is an acoustic effect that can support the development of a haraka. Producing a vowel sound is always preceded or accompanied by a haraka but the converse is not necessarily true. The "haraka" and short vowel are often confused, but it is really only acoustically. The name "haraka" shows that the

perspective of the analysis used by the Arab is otherwise wider [hadj salah].

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