

Formants as cues for pharyngealization perception in Oriental Moroccan Arabic

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Pharyngealization is manifested by a backward movement of the root of the tongue towards the pharynx. This articulatory movement has as acoustic consequences the rising of F1 and the lowering of F2 (El Halees, 1985 among others).

This work reports results from a perceptual study which aims at assessing the roles of F1 and F2 in the perception of pharyngealization for synthesized /a, i, u/ vowels in Oriental Moroccan Arabic (Hereafter OMA).

The formants of the synthesized vowels have been handled gradually from a non-pharyngealized realization to a pharyngealized one. Bearing in mind the fact that the difference observed between F1 values in a pharyngealized and a non-pharyngealized environment are less important than the differences observed for F2 (see Ghazeli, 1977; Ali et Daniloff, 1972), Klatt synthesizer (1980) was used to increase artificially F1 values by steps of 20 Hz and decrease F2 values by steps of 100 Hz. However, both of F1 and F2 values were raised and lowered, respectively, by steps of 20 Hz. Through the same synthesizer the same duration of 250 ms was provided for each stimulus (a duration that is neither too short for carrying out a vowel nor too long for making the perception task easier for listeners) and the same value of F0 with 120 Hz at the beginning and 90 Hz at the end (since the value of F0 is generally lower towards the end of the vowel).

Stimuli	F1	F1+20Hz	F1+40Hz	F1+60Hz	F1+80Hz	F1+100Hz
/a/	536	556	576	596	616	636
/i/	231	251	271	291	311	331

Tab.1 Rising of F1 by steps of 20 Hz for /a/ and /i/.

Stimuli	F2	F2-100Hz	F2-200Hz	F2-300Hz	F2-400Hz	F2-500Hz
/a/	1585	1485	1385	1285	1185	1085
/i/	2042	1942	1842	1742	1642	1542

Tab.2 Lowering of F2 by steps of 100 Hz for /a/ and /i/.

Stimuli	F1	F1+20H	F1+40Hz	F1+60Hz	F1+80Hz	F1+100Hz
/u/	363	383	403	423	443	463
	F2	F2-20Hz	F2-40Hz	F2-60Hz	F2-80Hz	F2-100Hz
	1128	1108	1088	1068	1048	1028

Tab.3 Rising of F1 and lowering of F2 by steps of 20 Hz for /u/.

Two identification tests and two discrimination tests were conducted using 'Praat' software, and for each test F1 and F2 were handled at the same time and then separately. Nine speakers, six males and three females, aged between 26 and 36 and all of them from the East of Morocco were invited for the experiment.

For identification tests a continuum of 6 stimuli for each vowel (pharyngealized and non-pharyngealized) were entered three times to get 54 stimuli, and each time stimuli were presented in a random order. The task for listeners was to identify stimuli as 'pharyngealized' or 'non-

pharyngealized'. Both choices were presented in two boxes on the screen. For responses, listeners should click on one of the two boxes which can also help to move from one stimulus to another. Just before the realization of each stimulus a small noise with a 50 ms duration and a 800 Hz frequency was inserted to serve as a preparation for listeners. After this noise a silence of 200 ms was inserted to avoid confusion between noises and vowels. Between the three sets of stimuli a break was inserted to allow listeners not only to relax but also identify the transition from one set to another. A click on the screen allowed triggering the following set.

For discrimination tests auditors were asked to discriminate vowels through an 'AXB' test where 'X' is sometimes identical to 'A' and sometimes identical to 'B' ('A' and 'B' being either a pharyngealized or a non-pharyngealized vowel).

Results indicated that the importance of formants in the perception of pharyngealization varies depending on the nature of the three vowels. Thus, auditors were sensitive to pharyngealization perception through F1 and F2 for /i/ vowel, while they were sensitive to F2 changes for /a/ vowel and F1 changes for /u/ vowel. These results can be explained by the fact that /a/ is the most pharyngeal vowel in AMO and is therefore characterized by the highest F1 which is compatible with pharyngealization articulation. A similar explanation can be applied to /u/ vowel which has the lowest F2 by definition in comparison to the one of /a/ and /i/ vowels. This may account for the slightest degree of auditors' sensitivity to F2 behaviour for /u/ vowel.

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