The Effect of Gender on the Voiceless Emphatic Stop in Arabic-French Code-Switching: An Acoustic Study on Oran Spoken Arabic.

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Abstract:

The current proposed paper is an attempt to cast light on the sociophonetic behavior of one of the emphatic sounds, the voiceless stop /tˤ/, in Oran Spoken Arabic as produced by male and female speakers. Besides, it aims to pinpoint the effect of this Arabic phonetic property on the realization of the French voiceless stop sound during the code-switching process. To this end, 10 young native speakers of Oran Spoken Arabic were recorded. The acoustic experiment drew upon various measurements including VOT, vowel duration, and vowel first three formant frequencies. The normalized data showed that, unlike many Arabic dialects where male speakers produce stronger emphasis than females, gender as a social factor does not appear to

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affect emphasis production in Oran speech community. /tˤ/ sound was produced in both male and female speech in a similar fashion. Besides, emphasis was found to disrupt the realization of the French voiceless stop in both male and female speech.

Key words: Gender, voiceless emphatic stop sound, Arabic-to-French code-switching, Oran Spoken Arabic, acoustics-based analysis

1-Introduction :

Emphatics are a set of sounds that characterize most languages of the Semitic family such as Arabic and Hebrew. These sounds, traditionally presented as /tˤ, sˤ, dˤ, ðˤ/, are phonemically distinct from their equivalent plain (non-emphatic) sounds /t, s, d, ð/ in Modern Standard Arabic and its spoken colloquial varieties. In fact, emphasis, often labeled as 'pharyngealization', refers to the process of producing some consonants "with a primary articulation at the dental/alveolar region and with a secondary articulation that involves the constriction of the upper pharynx" (Davis, 1995: 465).

This co-articulatory feature has triggered the interest of a wide number of linguists. Phonetic (e.g. Card, 1983; Al-Masri & Jongman, 2004; Al-Masri, 2009; and Al-Tamimi & Heselwood, 2011), phonological (e.g. Davis, 1995; Watson, 2002; and Youssef, 2014), and sociophonetic (e.g. Royal, 1985; Khattab et al., 2006; Abudalbuh, 2010; and Alzoubi, 2017) investigations of emphasis in different phonological contexts have been carried out in various Arabic dialects such as Palestinian Arabic, Jordanian Arabic, Cairene Arabic, and Syrian Arabic. However, very little attention has as yet been devoted to Algerian Arabic.

A number of acoustic studies have investigated the emphatic coronals and come to one hardly-disputed conclusion: the major acoustic correlate of emphasis is its effect on the formant frequencies of the contiguous vowels, raising the first formant frequency (F1) and principally lowering the second formant frequency (F2) values. In the sociophonetic realm, on the other hand, a number of researchers have examined emphatic sounds across various Arabic varieties in terms of several social varieties such as gender, age, region, and social class (e.g. Royal, 1985 for Cairene Arabic; Wahba, 1996 for Alexandrian Arabic; Almbark, 2008 for Syrian Arabic). A quick survey of the related literature shows that Jordanian Arabic has as yet received the most attention (e.g. Al-Masri & Jongman, 2004, Khattab et al., 2006, Abudalbuh, 2010, Alzoubi, 2017, and Omari & Jaber, 2019). Taken together, the results from these studies vouched for a common axiom that male speakers produce stronger emphasis than females.

Algerian Arabic (along with its spoken dialects) is also characterized by this co-articulatory feature. However, owing to its intricate sociolinguistic spoken characteristics, this phonological phenomenon may exhibit a striking behavior. Unlike the other Arabic dialects, the co-existence of multiple varieties including Standard Arabic, colloquial Arabic, Berber, French, and English has contributed to the complexity of the linguistic profile in Algeria. In particular, French which is the language of the colonizer that lasted more than 130 years still dominates a crucial part of the Algerian conversations. In fact, most of the Algerian speakers alternate between Arabic and French in their speech; a sociolinguistic phenomenon which is known as 'code-switching'. Arguably then, speakers may incorporate either consciously or

unconsciously the phonetic features of their mother tongue into a foreign spoken language.

To this end, the present study is set to explore the realization of one of the emphatic sounds, the voiceless plosive /tˤ/ among Algerian male and female speakers, focusing particularly on one of the widely spoken dialects in this country, Oran Spoken Arabic (OSA henceforth). Crucially, Emphatic coronals have been acoustically scrutinized in different Arabic dialects; however, Algerian Arabic has as yet received scant attention. Besides, due to the bilingual (also the multilingual) setting as well as the distinct cultures existent in this country, we suggest that gender as a social variable may have a distinguishable manner compared to other Arab countries, mainly Levantine Arabic, where emphasis is attributed to male speech.

Strictly speaking, the present paper seeks to put more spotlight on the acoustic behavior of the voiceless emphatic plosive /tˤ/ compared to its plain counterpart in both Arabic and French words, during the code-switching phase, as produced by male and female speakers of OSA. The study, therefore, attempts to answer the following research questions:

- What are the acoustic attributes of the emphatic voiceless stop sound in Oran Spoken Arabic?
- Does Arabic pharyngealization process affect the French voiceless stop sound in code-switching?
- Does gender affect emphasis production in Oran Spoken Arabic as in other Arab countries' dialects?

The rest of the paper is organized as follows: Section 2 presents a brief overview of the related literature; Section 3 covers the methods adopted to fulfill the objectives of the study; Section 4 reports the main results; and section 5 is devoted to interpreting these results.

2. Literature Review

2.1 The Acoustic Correlates of Emphasis

In pursuit of attaining the acoustic attributes of emphasis, the bulk of acoustic research available to date has compared emphatic sounds with their plain counterparts. Voice Onset Time (VOT) is regarded as a pivotal acoustic cue to pinpoint a stop consonant. Thereof, several researchers have drawn a comparison between VOT of the voiceless emphatic plosive /tˤ/ and that of the non-emphatic plosive /t/ where the former was found to be shorter than the latter (Khattab et al., 2006; Almbark 2008; Abudalbuh 2010; among others).

A further significant acoustic cue of emphasis is its substantial effect on the F-patterns of the neighboring vowels. More precisely, pharyngealization has been reported to affect the first three formant frequencies (F1, F2, and F3) of the vowels in the emphatic environment. There is a great consensus in the literature as regards decreasing the second formant frequency (F2) and increasing the first and third formant frequency (F1 and F3) values of the vowels in the vicinity of emphatic phonemes compared to their plain counterparts (Card, 1983; Jongman et al., 2007; Jongman et al., 2011; among others). Even more importantly, F2 is perceived as the most robust acoustic correlate for emphasis analysis.

Moreover, some studies have revealed that the secondary articulation of emphatics can also affect vowel duration. Abudalbuh (2010) and Almbark (2008) have found that vowels are longer in emphatic contexts than in plain contexts. However, Al-Masri and Jongman (2004) have reported contradictory findings in that vowel duration in emphatic and plain environments displays no significant asymmetry. Kbira (2009) has observed that despite the disparity in closure duration and vowel duration in emphatic and plain environments with noticeable length in /tˁ/ than in /t/ contexts, the total duration of consonant duration, VOT, and vowel duration has been identical for both contexts.

2.2 Gender and Emphasis Production

Broadly speaking, despite the fact that males' and females' speech is anatomically distinct, gender as a social variable does affect the acoustic cues of emphasis production. Put differently, adult males are characterized by longer vocal tract than adult females; inversely, male speakers have lower formant frequency values, about 20%, less than females have (Fant, 1966). Nonetheless, most of the socio-acoustic studies available to date have shown that the second formant frequency of the vowels in the emphatic environments is significantly lower in male's speech than in females', i.e. male speakers produce stronger emphasis than females; a pattern which was mostly attested in Levantine Arabic (Royal, 1985; Wahba, 1996; Khattab et al., 2006; Abudalbuh, 2010; Alzoubi, 2017; and Omari & Jaber, 2019). Nevertheless, there should be extensive research on North African Arabic dialects, Algerian Arabic in general, and OSA in particular, which are characterized by a distinct sociolinguistic profile capable of influencing emphasis production in an unexpected manner.

3. Methods

3.1 Subjects

Ten native speakers (five males and five females) of Oran Spoken Arabic who were born and raised in Oran, aged between 19 and 22 years old were recruited in the research experiment. All were students at the faculty of foreign languages of Oran 2 university. Crucially, this community was chosen in particular as it exhibits remarkable bilingual and multilingual proficiency. All the subjects declared to have no history of speech or hearing impairments. Ethical guidelines were rigorously adhered to.

3.2 Stimuli

The stimuli consisted of two parts, as shown in tables 1 and 2 below. The first part involved a set of four true minimal pairs from Oran dialect made of disyllabic words differing in terms of voiceless emphatic/plain stop sound. The latter occurs word-initially in the first three pairs and word-finally in the last pair. The first syllable of each word contains a long vowel: /i:/, /u:/, or /æ/ as its nucleus.

The second part of the data involved a list of French words with a voiceless stop occurring word-initially, word-medially, and word-finally. All the words chosen are frequently used by Algerian bilingual speakers when they switch to the French language in their day-to-day conversations.

Table1. ***Arabic Stimulus Words***

Plain	**Gloss**	**Emphatic**	**Gloss**
/tæbƏt/	She repented	/tˤæbƏt/	Fully cooked

/tu:rnu/	Shoot a film (second plural pronoun) borrowed from French 'tourner'	/tˤu:rnu/	Traditional cookies in Oran
/ti:ri/	Shoot the ball (second singular pronoun) borrowed from French	/tˤi:ri/	Go away (second feminine singular pronoun)
/xælət/	Maternal aunt's	/xælətˤ/	To mingle with people

Table 2. ***French Stimulus Words***

French Word	**Transcription**	**Gloss**
'Transport'	/tʁɑ̃spɔʁ/	Transportation
'vitamine'	/vitamin/	Vitamin
'photos'	/fɔtɷ/	Photos
'partager'	/paʁtaʒe/	Share
'short'	/ʃɔʁt/	shorts
'tarte'	/taʁt/	A pie
'portail'	/pɔʁtaj/	Gate

'pantalon'	/pɑ̃talɔ̃/	Trousers
'installer'	/ɛ̃stale/	install

In order to achieve an accurate performance of the data, all the stimulus words were embedded in the middle of natural spoken sentences. As regards French stimuli, the target words were presented in two different methods. First, they were embedded within sentences of Arabic-to-French code-switching to ensure a better spontaneous production. This purportedly fosters a high occurrence of pharyngealization. The second method, on the other hand, a list of the target words was presented in isolation whereby speakers are meant to pay more attention to their speech (Labov, 1966). A glance at the appendix at the end of this article will make this point clear.

3.3 Procedures and Measurements

The participants were asked to produce twice at a normal rate the carrier natural sentences with the target words and three times the French words in isolation. Arabic data were written in Arabic while Arabic-to-French/French data were written in French script. The recordings took place in an anechoic room at the library of the faculty of foreign languages at Oran 2 university. The utterances were recorded by the researcher using *Dictopro* digital voice recorder with ultra-sensitive double microphones and noise reduction quality. The sampling rate was 22 kHz. Voice Onset Time (VOT), duration and F1-F3 values of the adjacent vowels were mainly the acoustic measurements undertaken in this study by means of PRAAT speech analysis software, version 6.2.10 (Boersma & Weenink, 2022). VOT of the voiceless

stop was measured as the time between the end of the stop closure and the onset of voicing. The formant frequencies were measured at vowel's midpoint position inasmuch as it was consistently estimated as a reliable acoustic point for formant frequency values.

In order to accurately determine the potential effect of gender on emphasis production (i.e. to reduce the physiological differences between males and females), the formant frequency values were normalized by means of Nearey's (1978) formant extrinsic normalization method. All the measurements were tested for statistically significant differences using Analysis of Variance (ANOVA).

4. Results

4.1 /t/ and /tˤ/ Opposition in Arabic Stimuli

4.1.1 Voice Onset Time

Figure 1.a VOT of plain /t/

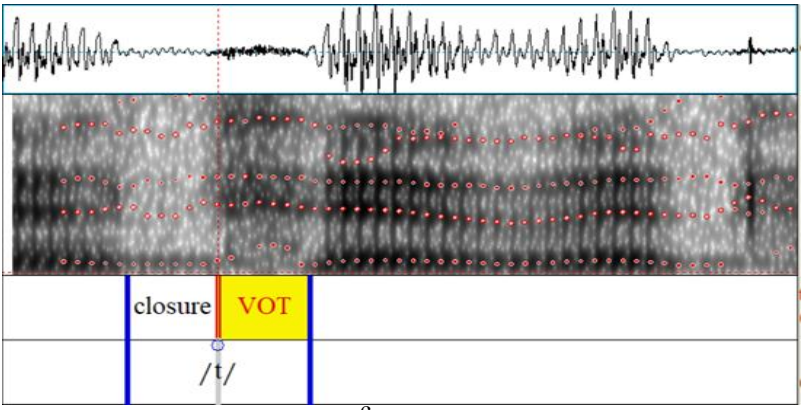
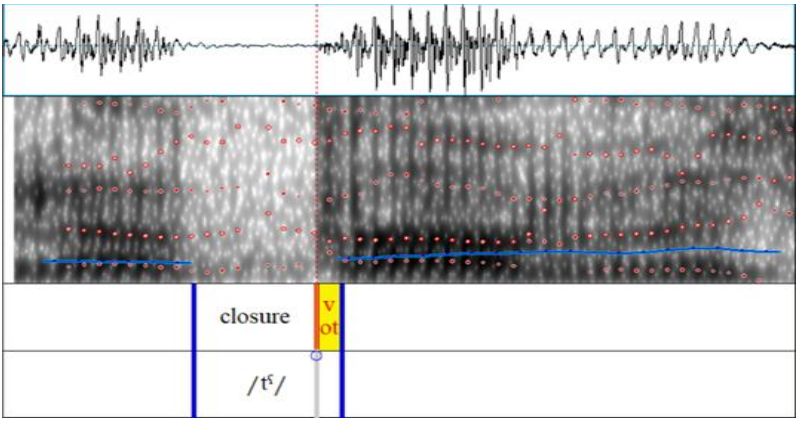
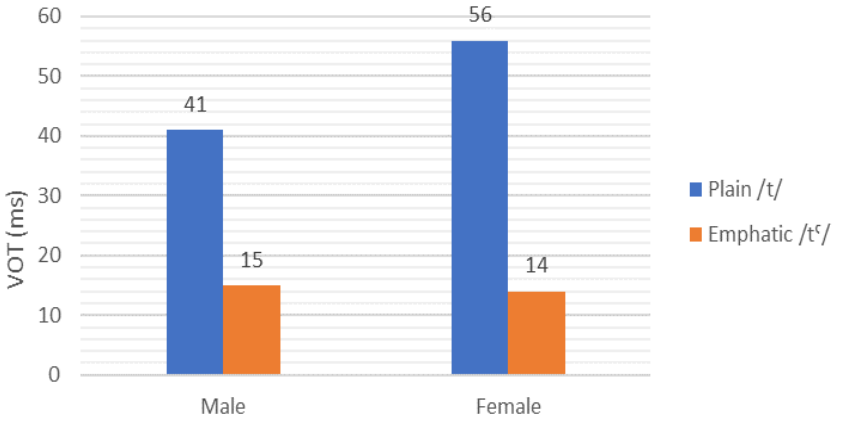


Figure 1.b VOT of emphatic /tˤ/



Results revealed a significant effect of emphasis on VOT values (p < .001). A two-way ANOVA showed that plain VOT was significantly longer than emphatic VOT (as illustrated in Figure 1 above) for both male and female participants with the females uttering longer /t/ than the males. Figure 2 below displays the obtained results:

Figure 2. Mean value of VOT for male and female participants



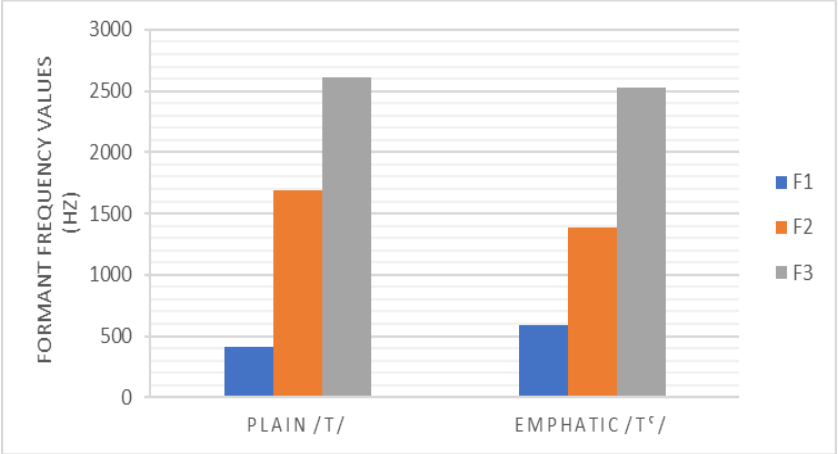
4.1.2 Vowel Duration

Results yielded no statistically significant effect of emphasis on the duration of the adjacent vowel (p = .318). What this means is that vowels maintained the same duration in both plain and emphatic contexts for both male and female participants.

4.1.3 Formant Frequencies

Starting with the first formant frequency, emphasis had a statistically significant effect on F1 values [$F(1, 78) = 58.20$, $p < .001$]. F1 of the vowels in the emphatic contexts was found to be higher than that of the vowels in the plain contexts (the mean F1 was 589 Hz and 416 Hz, respectively). As regards the second formant frequency, emphasis was found to affect F2 values ($p <$ .001) in that the vowel had considerably lower F2 when adjacent to an emphatic stop (1385 Hz) than when adjacent to a plain stop (1691 Hz). Unexpectedly, however, results showed that emphasis had no significant effect on F3 values [$F(1, 78) = 2{,}10$ $p = .151$]. Figure 3 shows the overall results for the three formant frequencies:

Figure 3. Mean F1-F3 values for the vowels after plain/emphatic stop



4.1.4 The Effect of Gender

Given that male and female anatomical differences affect formant frequency values, Nearey's (1978) formant extrinsic normalization method was adopted to decrease our speakers' physiological disparities. Thereafter, in order to find out whether male and female speakers differ in terms of emphasis production, multivariate analyses of ANOVA were conducted, concentrating on the effect of Emphasis x Gender interaction on the first two formant frequencies. F3 was excluded at this point since the preliminary findings showed that emphasis had no statistical impact on its values.

Intriguingly, no significant interaction was detected between emphasis and gender for both F1 and F2 (p = .878 and .574, respectively). This result led to the conclusion that male and female participants produced the same degree of emphatic /tˤ/ as there were no significant differences in terms of rising the first formant frequency or lowering the second one. See Figures 4 and 5 below: **Figure 4.** Mean plain/emphatic F1 for males and females

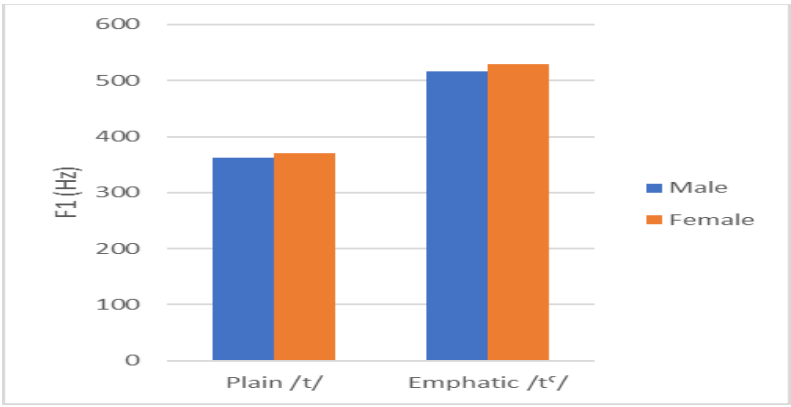
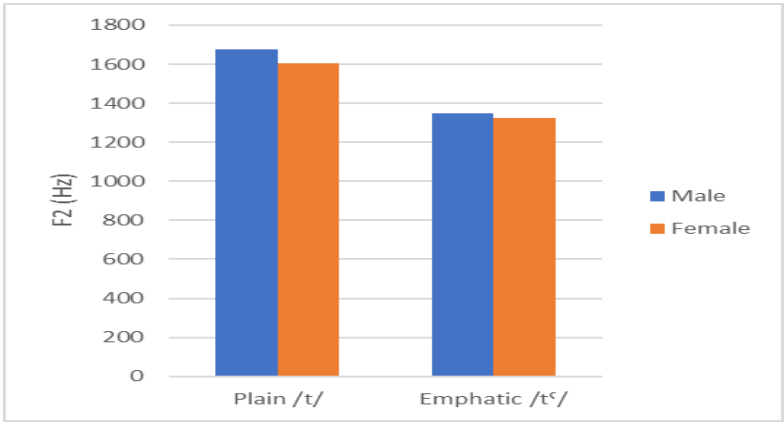


Figure 5. Mean plain/emphatic F2 for males and females



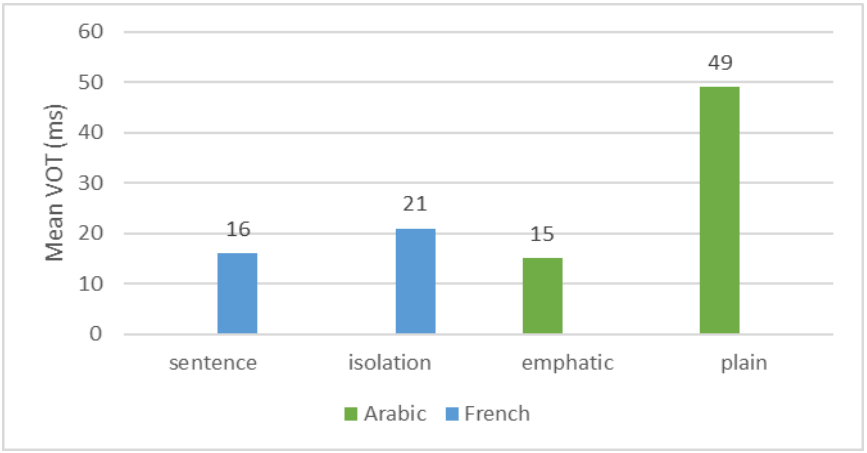
4.2 The Acoustic Behavior of /t/ in French Stimuli

4.2.1 Voice Onset Time

Comparing the utterance of the voiceless stop /t/ within an Arabic-to-French sentence to that uttered in isolation, results revealed that VOT is shorter in the former than the latter without any asymmetry between the

genders. Arguably, participants tend to produce this sound with more emphasis when code-switching between Arabic and French languages as the mean value of VOT is 16 ms which is as short as that of the emphatic stop in Arabic stimuli (15 ms, as mentioned earlier). This finding was also attested perceptually. On the other hand, when asked to pronounce the French words in isolation, in which a speaker pays more attention to his/her own speech, our participants tend to produce this sound with less emphasis (the mean value is 21 ms) compared to the emphatic /tˤ/ in Arabic. Figure 6. below demonstrates the mean value of VOT in French and Arabic words:

Figure 6. Mean value of VOT in Arabic and French stimuli



4.2.2 Vowel Duration

A two-way ANOVA showed that the context of utterance had a significant effect on the duration of the target vowel ($p < .001$). Vowels next to the voiceless /t/ pronounced in isolation are longer than those

pronounced within a sentence for both male and female speakers. However, this discrepancy is evidently affined to the speech rate which is contingent upon the speech material type (e.g., isolated words, long and short sentences, repetitions, narratives, etc.).

4.2.3 Formant Frequencies

Results revealed that whether in isolation or within a sentence, the three formant frequencies exhibited no statistical difference. Intriguingly, however, in both contexts the mean value for each formant frequency closely matches that of its counterpart in the Arabic emphatic context (i.e., higher F1 and lower F2 in particular).

4.2.4 The Effect of Gender

In much the same vein, the normalized data displayed no significant effect as regards the effect of gender on F1 and F2 of the vowels adjacent to the French voiceless stop /t/ produced in isolation or within Arabic-to-French sentence.

5. Discussion

5.1 The Acoustic Behavior of /tˤ/ in Oran Spoken Arabic

Results of the current research corroborate with the literature review in terms of the acoustic correlates of emphasis. In fact, our findings lend further weight to the assumption that VOT is considered as a significant acoustic cue to distinguish a plain voiceless stop from an emphatic one. Strictly speaking, VOT of /tˤ/ was found to be shorter than that of /t/ in Oran Spoken Arabic for both male and female speakers. This result is in great compliance with the results obtained in previous studies (Khattab et al.,

2006; Almbark 2008; Abudalbuh 2010; among others), confirming that the secondary articulation of emphasis held by a constriction at the pharynx affects the commencement of voicing (Khattab et al., 2006).

Moreover, the findings in the present study are in agreement with the previous studies as regards raising F1 and lowering F2 values of the emphatic vowels (Al-Masri & Jongman, 2004; Jongman et al., 2007; Al-Masri, 2009; Jongman et al., 2011; Al-Tamimi & Heselwood, 2011; among others). It is argued that F1 is inversely linked to tongue height while F2 is linked to tongue advancement (Kent & Read, 1992; Ladefoged & Johnson, 2010). Put another way, the F1 frequency increases when the tongue moves to a lower position, whereas the F2 frequency increases when the tongue moves to an anterior position in the mouth. This articulatory-acoustic relationship, therefore, determines that emphasis process is drawn upon tongue movement toward a low position (by virtue of F1 raising) and toward a back position (by virtue of F2 lowering). With respect to F3, though most of the previous acoustic studies have shown that emphasis caused F3 values to rise, it has also been observed that these formant alternations, particularly, might not be due to emphasis effect. Similarly, our results have revealed no significant differences in emphatic versus plain environments as far as F3 values were concerned. Hence, the present study suggests mainly F2 and secondarily F1 to be the most robust acoustic attributes for the emphaticness of the voiceless plosive in Oran Spoken Arabic.

In this respect, Jongman et al. (2007) have elucidated that a raised F1 stems from a constriction at 3-7 cm from the glottis, which is akin to a low F2 location. Thus, a high F1 accompanied by a low F2 entails a constriction at the level of the pharynx. A raised F3, on the other hand, stems from an

anterior constriction precisely located in the uvula zone, meaning that "emphasis involves a secondary constriction in the upper pharynx near the uvula" (Jongman et al., 2011: 33). However, the results of the present study have shown that emphasis was characterized by a raised F1, low F2, and non-raised F3, thus suggesting that the secondary articulation of the emphatic segments in this dialect probably emanates from a constriction at the pharynx locus.

5.2 The Emphaticness of French /t/

Results have indicated that the participants tend to emphaticize the French voiceless stop sound by virtue of the short values of VOT and the low values of F2 in addition to the perception of data. In this connection, it should be noted that the VOT of /t/ is regularly short-lag in French, ranging between 10-30 ms (Caramazza & Yeni-Komshian, 1974). Yet, it was found to be even shorter in Arabic-to-French sentences (8-19 ms) resembling the VOT of the Arabic /tˤ/. By way of illustration, words like 'installer' (install), 'photos' (photos), 'portail' (gate), and 'transport' (transportation) were pronounced as follows: [ɛ̃stˤale], [pɔrtˤaj], [tˤrɑ̃spɔr] respectively. Additionally, the experiment also revealed that the French uvular fricative /ʁ/ was realized as [r]. It could be argued then that regardless of the level of education, the bilingual speakers in this study have failed to sound native-like. This lends further weight to the assumption that bilingual's production of the second language speech is contaminated by the phonetic properties of the first language (Flege, 1987).

5.3 The Effect of Gender

The present study suggests that both Algerian male's and female's speech is characterized by tongue backing (by virtue of F1 raising and F2 lowering) after the emphatic voiceless stop vis-à-vis its plain counterpart. Nevertheless, when comparing males with females, no disparity has been detected in the degree of pharyngealization. The normalized formant frequencies indicate that both male and female participants realize emphasis in a relatively similar fashion. This result intriguingly opposes the findings of previous studies, especially those where male speakers are often found to produce stronger emphasis than female speakers in different Arabic varieties such as Egyptian Arabic and Jordanian Arabic (Royal, 1985; Wahba, 1996; Khattab et al., 2006; Abudalbuh, 2010; Alzoubi, 2017; and Omari & Jaber, 2019).

The most plausible explanation for this tendency can be associated with Labovian sociolinguistic theory of 'prestige' which stipulates that women are markedly "more sensitive than men to the prestige pattern" (Labov, 1972: 243). Accordingly, this account stands in conformity with Sadiqi's study (2005). She has examined language and gender in Morocco which has a complex linguistic profile akin to that of Algeria, where four spoken varieties are used, including Standard Arabic, Moroccan Arabic, Berber, and French. Sadiqi (2005) argues that although French carries a positive attitude in Morocco, men use French less frequently than women, generally in administrative and military positions. Women, on the other hand, use French as a social prestige indicator inasmuch as they correlate it with modernity and urbanization. Likewise, it could be argued here that Algerian Oranese women seem to reflect a similar attitude towards the French language since they consistently switch between French and Arabic

in an attempt to gain social prestige, while they seem to use Arabic without any social connotations of masculinity or stigmatization. This claim may give a plausible explanation for females' production of strong pharyngealization like males. Notwithstanding, a question which arises in the wake of this discussion is why both genders exhibited the same pattern with regard the emphaticness of the French voiceless stop during the code-switching process in conscious and unconscious settings. It should be noted, however, that all the subjects in this study share the same social bases such as locality, age, and level of education. Nonetheless, a crucial social factor, which falls out of the scope of this research, should be considered that of 'social class'. Essentially, this social factor in connection with other variables present a plausible explanation for the Arabization of French sounds vis-à-vis the native-like pronunciation.

6. Conclusion

The current research has suggested that the main acoustic cues that distinguish an emphatic voiceless stop from its plain counterpart are the short-lag VOT, raising F1 and lowering F2 values of the emphatic vowels as compared to their counterparts in the plain context. This Arabic phonetic property, however, was found to affect the production of the French voiceless stop /t/ during code-switching back and forth between Arabic and French in informal conversations. Furthermore, the study has revealed that, unlike many Arabic dialects, emphasis did not appear to act as a variable for gender speech differentiation in Algerian Arabic as spoken in Oran. In other words, both male and female speakers produce identically the emphatic /tˤ/ in Arabic speech as well as in Arabic-to-French speech.

Eventually, future research may consider other social variables such as social class, age, and region which influence emphasis realization, and thus allowing for cross-dialectal investigations. Furthermore, other features of Arabic phonemic inventory which are also noticeable in bilinguals' production of French accent might be investigated; for instance, the realization of the uvular fricative /ʁ/ as [r] and the voiced labiodental sound /v/ as /f/.

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7. Appendix

- Arabic Stimuli

ɡ ællək **tæbət** ħtə mi:n ʃebnət

ʃu:f di:k l-merɡ a ilə **tˤæbət** wellə mezæl

ru:ħu **tu:rnu** l-film tæʕkum bʕi:d

hædə **tˤu:rnu** wella sˤæbli

ɡ u:lleh **ti:ri** l-balɔ̃ bʕi:d

ɡ ulha **tˤi:ri** derwek ʒi:bi lli ɡ utlek

ʃeft **xælət** Murad l-bæreħ

ɡ ulnə **xælet**ˤ besseħ ʕref ʃe txæletˤ

- Arabic-to-French Stimuli

mekkæʃ ɡ æʕ **tʁɑ̃spɔʁ** fə di l-buqʕə

kemmletni la-ɡ ʁip / xesni ʃwijje **vitamin** C

rselli le-**fɔtɒ** qbel met-syprimihum/ ajje **paʁtaʒe** derwek

læbəs **ʃɔʁt** fəl ʒæmiʕa / nte mri:dʃwijja

kɒmɑ̃ndit yn **taʁt** mən ʕend La Rosa / besseħ meʕeʒbetni:ʃ

hædi tæqa wella **pɔʁtaj**

mi:nʃri:t hed l- **pɑ̃talɔ̃**

me ħæbes ntejə/ kliki syʁ **ɛ̃stale** beʃ tetˤleʕlək l-aplikasjɔ̃