Voice Feature Correlates of Emphatic /ṭ/ and /ṣ/ in Jeddah Arabic

Reem Maghrabi[1]

[1] Department of English, Faculty of Languages and Translation, University of Jeddah, Jeddah, Saudi Arabia

Correspondence: Reem Maghrabi, Department of English, Faculty of Languages and Translation, University of Jeddah, Jeddah, Saudi Arabia. E-mail: romaghrabi@uj.edu.sa

Received: January 9, 2022 Accepted: March 7, 2022 Online Published: March 11, 2022

doi:10.5430/wjel.v12n1p284 URL: https://doi.org/10.5430/wjel.v12n1p284

Abstract

This research examines whether emphatic /ṭ/ and /ṣ/, both voiceless in Jeddah Arabic, show in their other voice feature correlates values that differentiate them from voiceless /t s/ and from voiced /d z/. A data set of a total of 600 words (10 speakers x 6 test words of the form /CVC(C)V:C/ (e.g. /χaṭṭa:ṭ/ 'calligrapher', /χaṣa:ṣa/ 'gap, crevice') x 10 repetitions) were collected and recorded by ten adult female native speakers of Jeddah Arabic aged 40–49. Results show that, like many languages, the voiced consonants tend to be shorter than the voiceless ones and vowels tend to be longer before them (Chen 1970). Results also indicate that in this parameter, Jeddah Arabic /ṭ/ retains some evidence of its historical non-voicelessness. This could mean that /ṭ/ and /ṣ/ are well on the way to completing a historical change from ejectives to fully voiceless consonants.

Keywords: emphatic consonants, pitch, voice quality, fundamental frquency, majhuur-mahmuus sounds

1. Introduction

The voicing characteristics of the coronal emphatic consonants is an interesting issue in Arabic phonology and dialectology. Originating from the ejectives in the Proto-Semitic voiceless–voiced–ejective (emphatic) triads (Kogan 2011), they have undergone changes such that emphatic /ð̣/ (/ḍ/ in some varieties) isvoiced but emphatic /ṣ/ is voiceless, and emphatic /ṭ/ varies cross-dialectally being contextually voiced in Yemeni (Watson 2002), voiceless unaspiratedin Iraqi (Al-Ani 1979), and voiceless aspiratedin Egyptian (Rifaat 2003). The findings of Watson and Heselwood (2015), describes the phonological categories hams 'whisper' and jahr 'clear speech' of the early Arab grammarians. An interesting issue arises concerning VOT and aspiration. Zeroual (2012) has claimed that VOT is the operative phonetic parameter for the Arabic majhūr–mahmūs distinction. This study intends to investigate phonetic correlates of the majhuur-mahmuus distinction compared to those of the voiced-voiceless distinction in Jeddah Arabic. Many modern phonologists say that the voiced-voiceless distinction is universal, it just varies in how it is realized in different languages, but perhaps the majhuur-mahmuus distinction is more than just a variation on a universal voiced-voiceless distinction, it's not primarily about glottal tone but about airflow. This studyexplors if Jeddah Arabic speakers have higher F0 values after /tt/ than after /ṭṭ/ and /dd/, indicating that, in this parameter, Jeddah Arabic /ṭ/ retains some evidence of its historical non-voicelessness.

2. Literature Review

Historical derivation of emphatics from ejectives could be illustrated as follows (hypothetical, simplified – see e.g. Cantineau 1951; Heselwood 1996; Kogan 2011):

Proto-Semitic Modern Arabic variants

/ṭ/ [t'] → [ʔd̰] → [t̬ˤ~tˤ⁼] → [tˤ⁼] → [tˤʰ]

Yemeni Iraqi Egyptian

(Watson 2002) (Al-Ani 1970) (Rifaat 2003)

/ṣ/ [t͜s'] → [s'] [zˤ~sˤ⁼] → [sˤʰ] → [sʰ]

Yemeni weakening of glottal tension and secondary articulation

2.1 The Voice-Feature Correlates Investigated

2.1.1 VOT

For the /ṭ/ vs. /t/ difference – Arabic varieties differ in whether VOT has a role in this (Khattab et al, 2006). Emphasis is a promenant feature in Arabic. Of the well-known emphatics are /ṭ, ḍ, ṣ, ð̣/, and their non-emphatic counterparts /t, d, s, ð/. In some other spoken dialects of Arabic, as Jeddah Arabic, the most distiguished coronalobstruents which are /t, s,/ have emphatic counterparts /ṭ, ṣ,/ (Feghali, 2008). Most acoustic studies of Arabic emphasis focused on changes in spectral characteristics of sounds affected by emphasis spread. Very few studies investigated effects of emphasis spread on acoustic properties of emphatic consonants, e.g. Voice Onset Time (VOT) in stops. Ghazali (1977) have mentioned in his study that emphatic obstruents affect the preceding and following sounds causing empasis spread. Another study by Watson (1999) have concluded that Arabic dialects differ in the direction of emphasis spread. For instance, in southern Palestanian and Saudi Arabic the spread is rightword and it affects the follwing vowel, while in nothernPalestanian, Lybian and unrban Jordanian Arabic, emphasis is spread leftwards affecticting all preceding sounds. Most studies agreed that emphasis show stronger effect leftwards and less effect rightwrds (Zawaydeh& de Jong 2002). Emphasis intersects to some extent to VOT in Arabic as many studies have shown. Examples are the studies of Lisker& Abramson (1964) ,Feghali (2008) and Watson (2002). They found that VOT and emphasis are linked reciprocally. In their study, Khattab, Altamimi andHaselwood (2006), concluded that emphasis is lost continuously in thepeech of female speakers of Jordanian Arabic. Their results showed that lower dgrees of emphasis in emphatic /ṭ/ correlated with longer VOT values in those stops. Based on that, it could be assumed that emphasis could undergo the same process as VOT characteristics change accordingly. Other research on VOT in various languages also suggests that VOT is sensitive to vowel articulation in general. For example, (Klatt 1975, Nearey&Rochet 1994) claimed that stops showed longer VOT before English front vowels. Based on that, the question that is asked in this study is whether VOT has a role in the /ṭ/ vs. /t/ difference in Jeddah Arabic.

2.1.2 Segment Duration in Intervocalic Context

Voiceless obstruentsare are expected to be longer than voiced ones (Maddieson 1997). Several studies have found that the context of vowel affects VOT. Lisker and Abramson (1985), have found that the following vowel affects voice onset times (VOTs). Other authors including (Chang, 1999) have reported that VOTs are longer, higher, more tense before vowels that are high. Others have obsrved that VOT was longer before voiced consonants preceding high vowels, evidently as a function of larger pharyngeal cavity volume than before voiceless consonants (Mohr, 1971). It should be emphasized that there are language-specific factors that contribute to creating new contrasts out of previously established contrasts (Maddieson 1997). In Arabic for example, as far as segment duration is concerned, voiceless obstruents are expected to be longer than voiced ones (Maddieson 1997). As far as the duration of proceding voewel is concerned, vowels are expected to be shorter before voiceless obstruents (Chen 1970). F0s are expected to be higher after voiceless obstruents (Lisker& Abramson, 1964). Higher F0s indicate more open glottis for preceding obstruents. This study intends to investigate phonetic correlates of the majhuur-mahmuus distinction compared to those of the voiced-voiceless distinction. Many modern phonologists say that the voiced-voiceless distinction is universal, it just varies in how it is realized in different languages, but perhaps the majhuur-mahmuus distinction is more than just a variation on a universal voiced-voiceless distinction, it's not primarily about glottal tone, but about airflow (Haselwood&Maghrabi, 2015).

3. Research Questions

- Does langauge play a role in voiced-voiceless distiction of /ṭ/ and /ṣ/ ?
- Do VOT values show that both /tt/ and /ṭṭ/ fall well within the short lag category as opposed to /dd/?
- Do consonant and vowel durations distinguish emphatic from voiceless consonants?
- Do speakers have higher F0 values after /tt/ than after /ṭṭ/ and /dd/?
- Are Jeddah Arabic /ṭ/ and /ṣ/ fully voiceless?

4. Methods

The data of study was collected from a set of a total of 600 words (10 speakers x 6 test words of the form /CVC(C)V:C/ (e.g. /χaṭṭa:ṭ/ ‘calligrapher’, /χaṣa:ṣa/ ‘gap, crevice’) x 10 repetitions) recorded by ten adult female native speakers of Jeddah Arabic aged 40–49. The correlates measured were: 1) VOT—Arabic varieties are reported to differ in whether VOT distinguishes /ṭ/ from /t/ or not (Khattab et al. 2006: 134–5); 2) duration of intervocalic geminate stops /ttddṭṭ/ and singleton fricatives /s z ṣ/; 3) duration of the long vowel /aː/ before /t d ṭ/, and before /s z ṣ/; and 4) F0 at the onset of /aː/ after /ttddṭṭ/, and /s z ṣ/. The participants of study were 10 females aged 40-49, native speakers of Jeddah Arabic. The data consisted of 10 repetitions of each target word yielding 100 tokens of each word recorded in quiet environment at 44100Hz sampling rate. The target words were : /ṭ/ /xaṭṭaːṭ/, /t/ /ʃattaːt/, /d/ /ʃaddaːd/, /ṣ/ /xaṣaːṣa/, /s/ /xasaːsa/, /z/ /iħtizaːza/.

4.1 Analysis Procedure

- VOT is measured on waveform from burst to first voicing pulse identified by Praat.
- Consonant and vowel durations are measured on waveform using points of sudden amplitude change.
- F0 is measured at vowel-onset using Praat with cross-correlation setting, range 50-300Hz.
- Independent t-tests are used for significance.
- This was investigated by trying to find voice-feature correlates that distinguish them from voiceless (non-pharyngealized) /t/ and /s/.

5. Results and Discussion

5.1 VOT Results

Voice onset time (VOT) is a known measure of the duration from the release of a stop occlusion to the onset of vocal fold vibration (Lisker and Abramson, 1964). In aspirated stops VOT is in excess of about +25 ms, in fully voiced stops voicing begins at least 25ms before the stop release, whereas for a stop to sound voiceless and unaspirated voicing should begin within about 20ms either side of the release, voicing is then perceived to begin simultaneously with the reslease (Laver, 1994). In addition to F0, a number of durational measures were taken. For voiceless stops, VOT was measured, which was defined here as the duration of the period from stop release to the onset of periodic voicing (Lisker and Abramson 1964) .

5.1.2 Geminate Stops

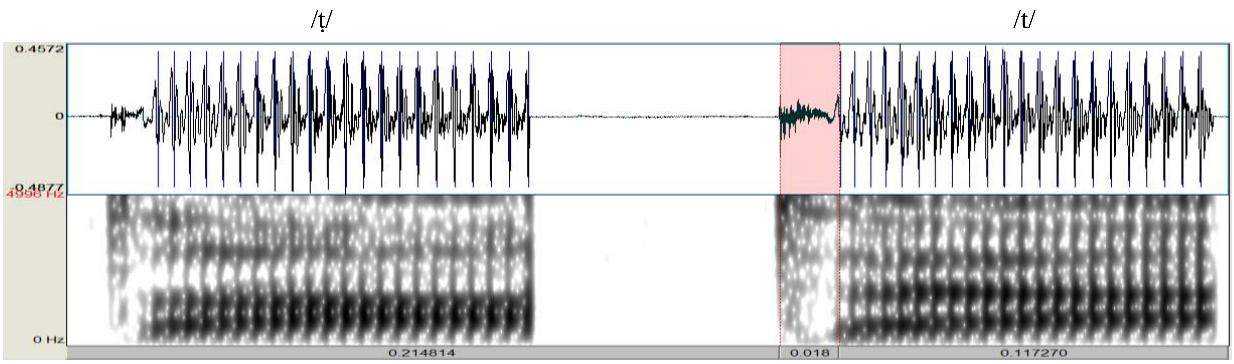

Figure 1. Extracted examples of giminate stops /ṭ /, /t/ from speaker 5

Figure 1 is an extracted example from speaker 5 that shows the effect of voicing before emphatic /ṭ/ = 14ms and voiceless /t/ = 18ms. The VOT (voice onset time) results consist with majhuur stops /ṭ/ lacking aspiration and the mahmuus stop /t/ being aspirated, as has previously been reported (Al-Ani, 1979). Lack of aspiration is further evidenced, that the glottal apeture is narrower in the majhuur stops. According to Hirose (2010), a glottal width during unaspirated voiceless stops is approximately 10% of what it is for aspirated stops at the same place of articulation. Glottal apeture is controlled by the posterior crico-arytenoid muscles, the greater their activation as measured by electromyography, the wider the glottis. They show a relatively low level of activation in the production of unaspirated stops compared to aspirated stops, though a somewhat higher level than in voiced stops (Hirose, 2010). This pattern accords well with the overall Qxreults in which the values for /ṭ/ are between those for the voiced majhuur and mahmuus consonants, but typically closer to the former. However, It is often assumed that VOT and aspiration are predictable from each other, that if there is no aspiration then the VOT will be below a certain treshhold.

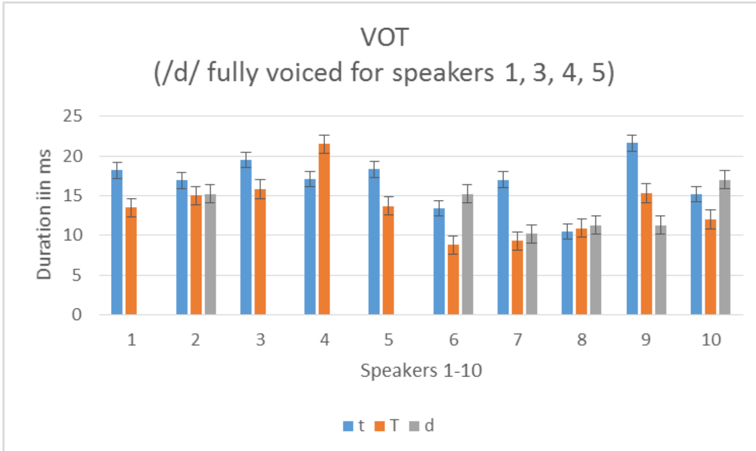

Figure 2. VOT duration before /t/,/T/,/d/ for all speakers

Figure 2 shows the effect of voicing before /t/, /T/ and /d/ for all speakers. Across all 10 speakers, VOT mean values were below 25ms with an average of 14ms for emphatic /ṭ/ and 17ms for voiceless /t/. This indicates that all VOT values fall in fall lag category, and therefore it does not distinguish these stops perceptually. It was noticed that speakers 1,3,4,5 have shown that /d/ was fully voiced.

5.1.3 Singleton Fricatives

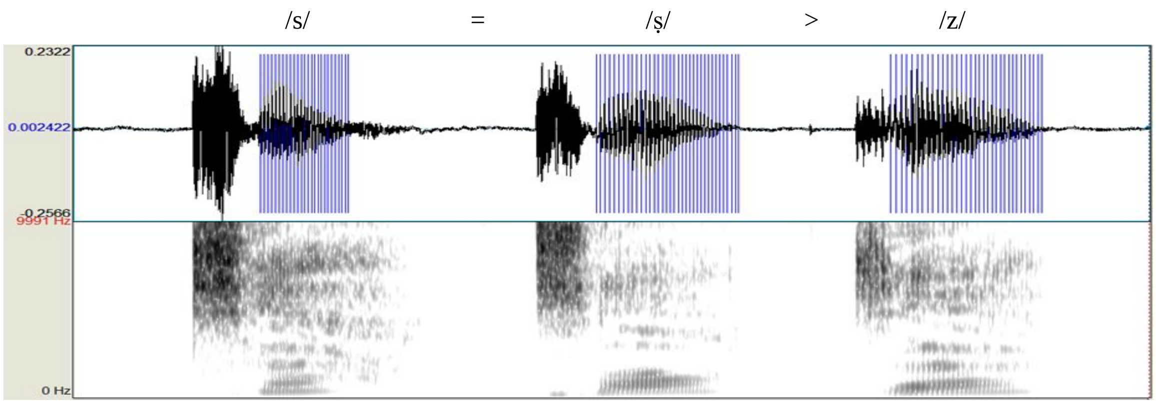

Figure 3. Extracted examples of singleton fricatives/s/, /ṣ/, /z/ from speaker 2

Figure 3 is an extracted example from speaker 2 that shows the effect of voicing before /s/ = 22ms and /ṣ/ = 21ms. Work on this is still to be completed, but so far it seems /s/ and /ṣ/ are both lightly aspirated while /z/ is (partially) prevoiced. The typically low VOT value for the realization of /ṣ/ and mahmuus /s/ shows that the momentary reduction in interior power is responsible for the reduction in airflow. VOT is the crucial distinguishing parameter of controlling airflow to severly restrict it during the release phase of majhuur /z/ compared to mahmuus /s/ in which airflow appears not to be restricted in the release phase.

5.2 Consonant Duration Results

5.2.1 Geminate Stops

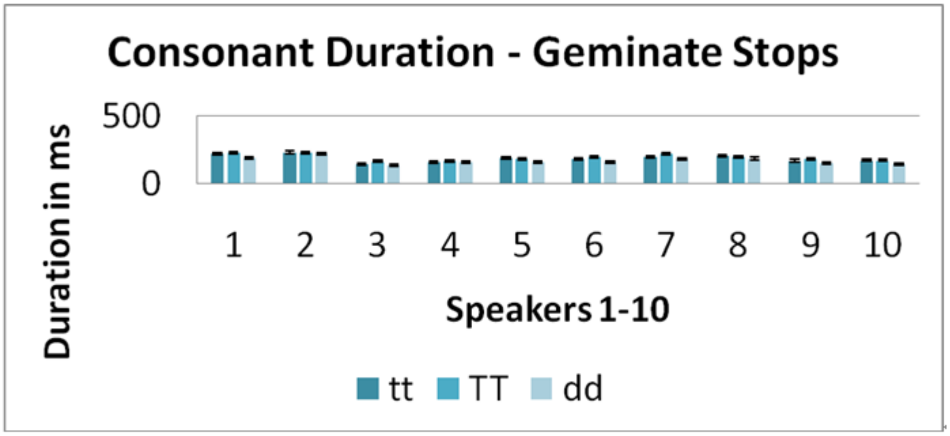

Figure 4. Geminate stops /tt/, /ṭṭ/, /dd/ duration for all speakers

Figure 4 shows t-test results of geminate stops /tt/, /ṭṭ/, /dd/ duration for all 10 speakers. /tt/ vs. /ṭṭ/ do not show much significant length difference at p=0.162. /ṭṭ/ is longer than /dd/ with significant difference at p<0.001***. Emphatic /ṭṭ/ behaves like voiceless /tt/ for intrinsic duration, in contrast to voiced /dd/.

5.2.2 Singleton Fricatives

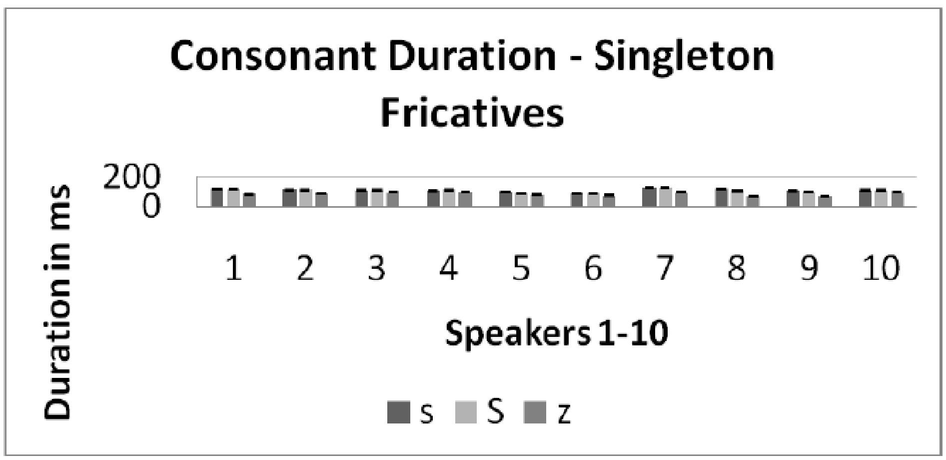

Figure 5. Singleton fricatives /s/, /ṣ/, z/ duration for all speakers

Figure 5 shows t-test results of singleton fricatives /s/, /ṣ/, z/ duration for all 10 speakers. t-test results show that there is no significan duration difference in /s/ vs. /ṣ/ with significant difference at p=0.177. /s/ longer than /z/ with significant difference at p<0.001***./ṣ/ longer than /z/ with significant difference at p<0.001***. Emphatic /ṣ/ behaves like voiceless /s/ for intrinsic duration, in contrast to voiced /z/. By comparison, the majority of the subjects show a consistent voicing effect in the pre-dental fricative environment.

5.3 Vowel Duration Results

5.3.1 Between Stops

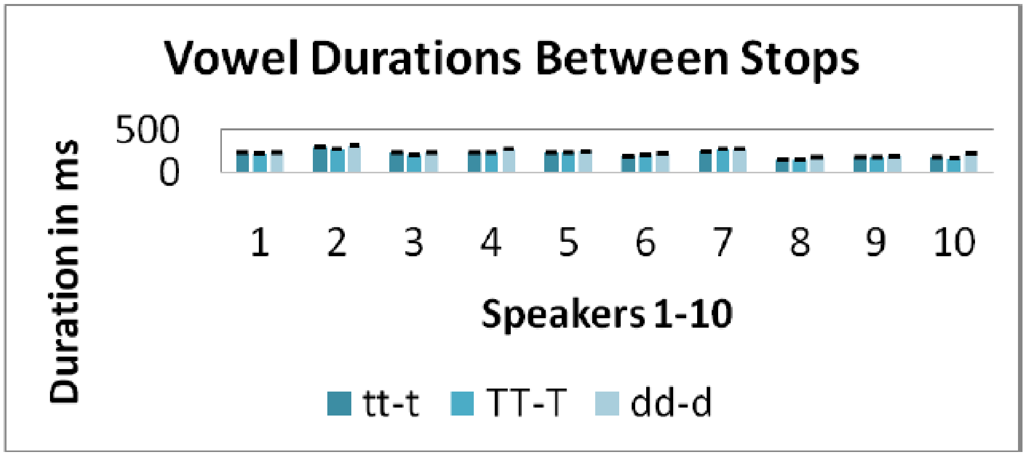

Figure 6. Vowel duration betwen stops /tt-t/, /ṭṭ-ṭ/, /dd-d/ for all speakers

Figure 6 shows t-test results of vowel duration between stops /tt-t/, /ṭṭ-ṭ/, /dd-d/ for all 10 speakers. t-test results show that there is no significant difference in /tta:t/ vs. /ṭṭa:ṭ/ as the vowel length ration is p=0.486. /tta:t / vowel length is shorter than /dda:d/ with significant difference at p<0.01**, while /ṭṭa:ṭ/ vowel length is shorter than /dda:d/ with significant difference at p<0.001***. This shows that emphatic /ṭ/ behaves like voiceless /t/ in its effect on V-duration, in contrast to voiced /d/.

5.3.2 Between Fricatives

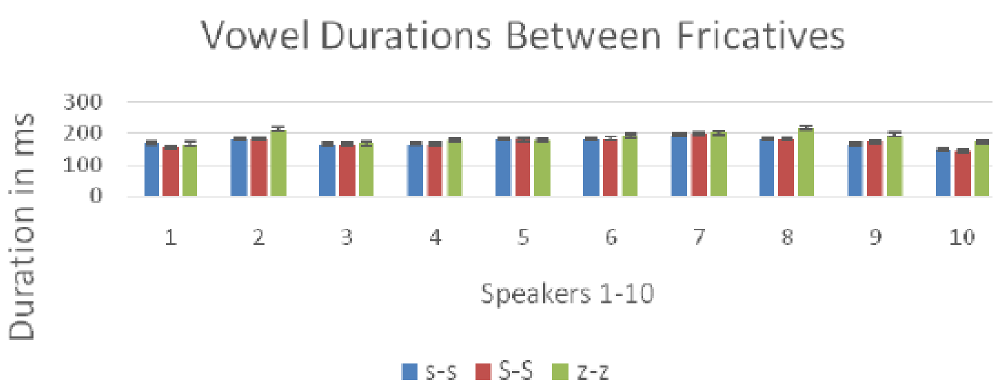

Figure 7. Vowel duration between fricatives /s-s/, /ṣ-ṣ/, /z-z/ for all speakers

Figure 7 shows t-test results of vowel duration between fricatives /s-s/, /ṣ-ṣ/, /z-z/ for all 10 speakers. t-test results show that there is no significant difference in /sa:s/ vs. /ṣa:ṣ/ , as V-length is with significant difference at p=0.924. In /sa:s/, vowel length is shorter than /za:z/ with the significant difference at p<0.001***. Vowel length in /ṣa:ṣ/ is shorter than /za:z/ with the significant difference at p<0.001***. This shows that emphatic /ṣ/ behaves like voiceless /s/ in its effect on V-duration, in contrast to voiced /d/.

5.4 F0 Results

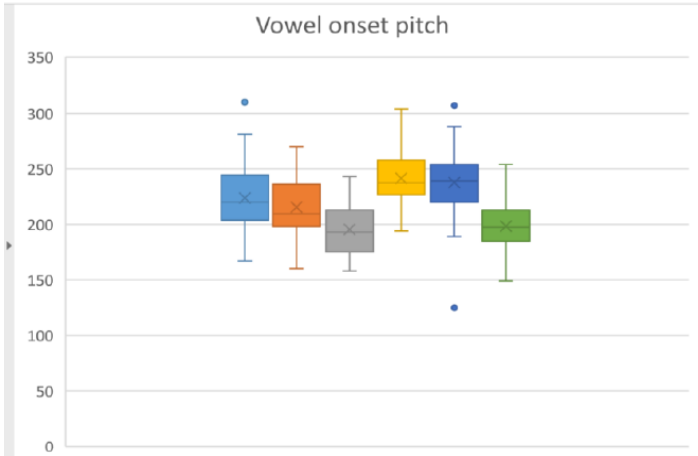

Figure 8. Vowel onset pitch

Figure 8 shows t-test results of vowel onset pitch for all 10 speakers. t-test results show higher difference between consonants. F0 is higher after /tt/ , as than after /ṭṭ/ with significat difference at p<0.05*. F0 is higher after /tt/ than after /dd/ with significat difference at p<0.001***. F0 is higher after /ṭṭ/ than after /dd/ with significat difference at p<0.001***. This shows that emphatic /ṭṭ/ behaves differently from voiceless /tt/ and from voiced /dd/. On the other hand, F0 is not significantly higher after /s/ than after /ṣ/ as significat difference is at p=0.277. F0, however, is higher after /s/ than after /z/ with significat difference at p<0.001***. Also, F0 is higher after /ṣ/ than after /z/ with significat difference at p<0.001***. Thus, emphatic /ṣ/ behaves the same as voiceless /s/ in its effect on F0, in contrast to voiced /z/.

/tt/ > /ṭṭ/ > /dd/

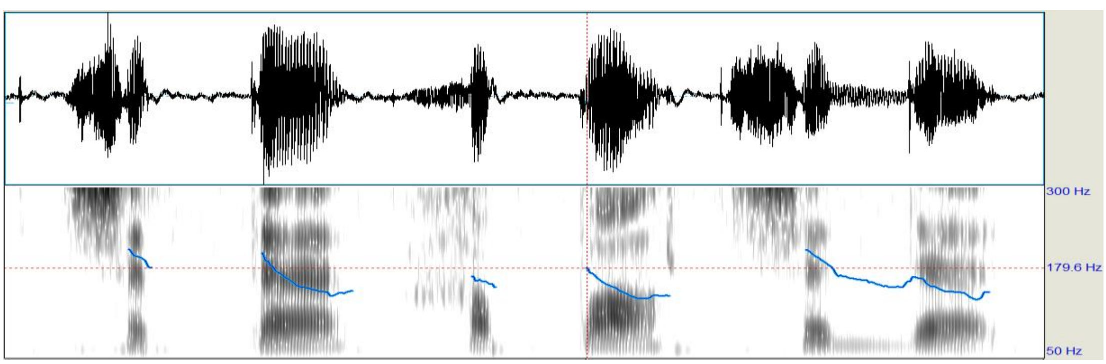

Figure 9. Examples from speaker 1 -Vowel onset pitch after /ṭ/, /t/, /d/

Figure 9.shows an extraction from speaker 1 of vowel onset pitch after /ṭ/, /t/. Results show that F0 after /t/ = 199Hz, while /ṭ/ = 179Hz, and after /d/ = 167Hz. F0 means results of all speakers show that /t/ = 224Hz, /ṭ/ = 215Hz, and /d/ = 196Hz.

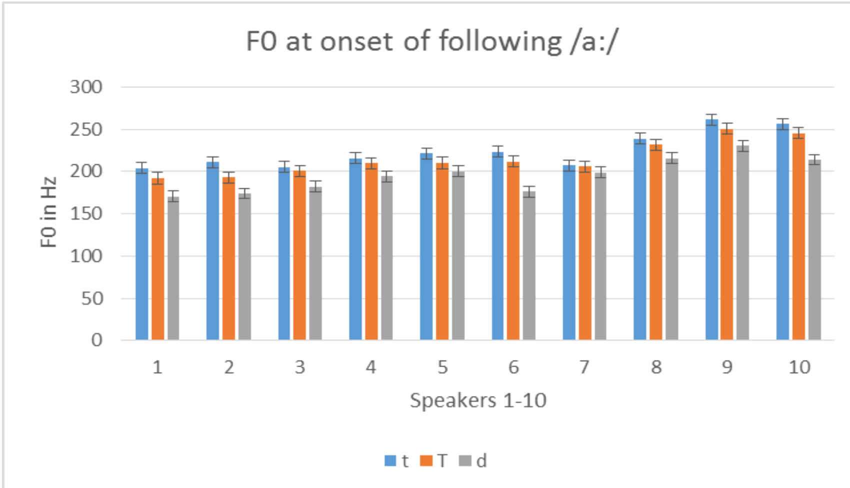

Figure 10. F0 at onset of /t/, /T/, /d/ following /a:/ for all speakers

Figure 10 shows F0 at onset of /t/, /T/, /d/ following /a:/ for all speakers. Results show that values for emphatic /ṭ/ come between those for voiceless /t/ and voiced /d/ for all speakers. This indicates that glottis is narrower for /ṭ/ ('prephonation' state)— which could be interpreted as a trace of its ejective origins.

/s/ = /ṣ/ > /z/

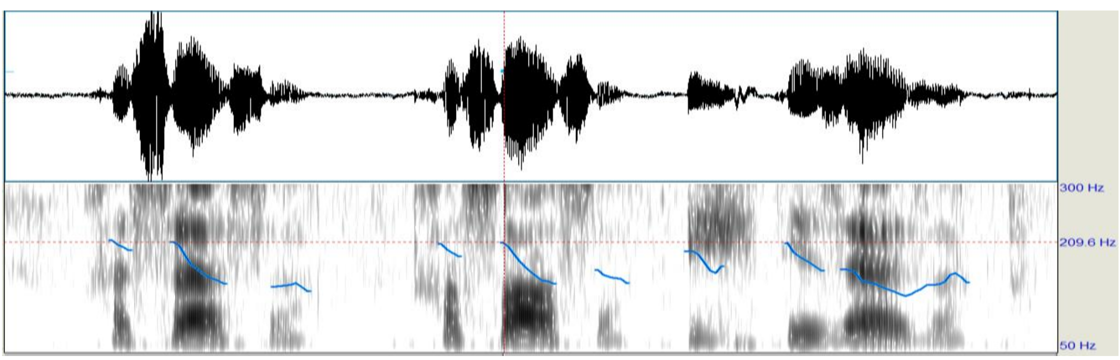

Figure 11. Examples of vowel onset pitch following /s/, /ṣ/ and /z/ from speaker 1

Figure 11 shows an extraction from speaker 1 of vowel onset pitch after /s/, /ṣ/ and /z/. Results show that F0 at vowel onset after /s/ = 210Hz, and after /ṣ/ = 210Hz, and after /z/ = 172Hz.

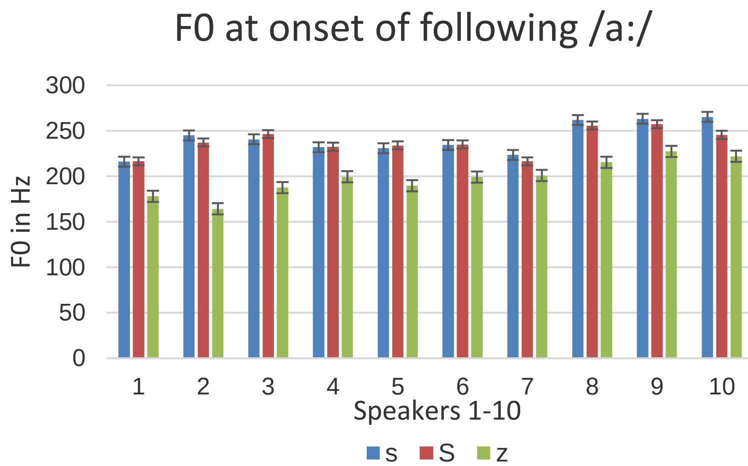

Figure 12. F0 at vowel onset of /s/ , /ṣ/ , /z/ following /a:/ for all speakers

Figure 12 shows F0 at onset of /s/ , /ṣ/ , /z/ following /a:/ for all speakers. F0 means results for all speakers show that /s/ = 241Hz, /ṣ/ = 238Hz, and /z/ = 198Hz. Values for emphatic /ṣ/ are same or similar to those for voiceless /s/, but higher than for voiced /d/ for all speakers. Emphatic /ṣ/ appears to have moved further towards a fully voiceless glottal state than has emphatic /ṭ/.

Results in summary are as follows. 1) VOT values show that both /tt/ (mean=17ms) and /ṭṭ/ (mean=14ms) fall well within the short lag category as opposed to /dd/ which is prevoiced, indicating that Jeddah Arabic does not use VOT to distinguish the voiceless stop from the emphatic stop. 2) and 3) Consonant and vowel durations indicate that, as in Jordanian Arabic (Al-Masri & Jongman 2004: 101), duration does not distinguish emphatic from voiceless consonants. They also show that, like many languages, the voiced consonants tend to be shorter than the voiceless ones and vowels tend to be longer before them (Chen 1970). 4) All speakers have higher F0 values after /tt/ than after /ṭṭ/ and /dd/, indicating that, in this parameter, Jeddah Arabic /ṭ/ retains some evidence of its historical non-voicelessness; for seven speakers the same is true of /s/ compared to /ṣ/ and /z/ but to a lesser extent. In the other correlates measured, /ṭ/ and /ṣ/ behave as do their voiceless counterparts.

6. Conclusion

The experimental results prove that as far as context is concerned, both emphatic (pharyngealized) /ṭ/ and /ṣ/ lack voicing in Jeddah Arabic. Jeddah Arabic has homorganic voiced-voiceless pairs, but also a homorganic emphatic for which voicing is not distinctive (except in some recent varieties e.g. in Cairo Arabic (Heselwood, 1996). Originally ejectives, it is interesting to see how their glottal states have changed. Emphatic /ṭ/ and /ṣ/ proved to be aligning their glottal states with voiceless /t/ and /s/. On the other hand, /ṣ/ has progressed further, with the change being almost complete. As for vowel onset timing, Jeddah Arabic does not use it for /t/-/ṭ/ distinction. This is true also of Lebanese Arabic (Yeni-Komshian, 1977), but not Iraqi or Jordanian (Al-Ani, 1979) or Egyptian Arabic (Rifaat, 2003). Ongoing work suggests it does not contribute to the /s/-/ṣ/ distinction either. Examining consonant and vowel and duration, it is found that Jeddah Arabic does not use duration for the /t/-/ṭ/ or /s/-/ṣ/ distinctions. This is true also of Jordanian Arabic (Al-Masri & Jongman, 2004). Finally, as for F0, the analysis show that Jeddah Arabic does appear to use this to contribute to the /t/-/d/-/ṭ/ triadic distinction, but not the /s/-/z/-/ṣ/ one. Lower F0 at vowel onset is consistent with a more constricted glottis (prephonation state) for the preceding obstruent. Thus, results could be interpreted to the effect that Jeddah Arabic /ṭ/ and /ṣ/ are well on the way to completing a historical change from ejectives to fully voiceless consonants.

References

Abramson & Lisker (1985). *Relative power of cues: F0 shift versus voice timing*. Oxford: Oxford Univarity Press.

Al-Ani, S. (1970). *Arabic phonology*. The Hague: Mouton. https://doi.org/10.1515/9783110878769

Al-Masri, M., & Jongman, A. (2004). *Acoustic correlates of emphasis in Jordanian Arabic*. Bloomington, IN: Indiana University Press.

Cantineau, H. (2009). *Articulatory phonetics*. Oxford: Oxfrod University Press.

Chang, M. (1999). *Arabic sounds*. New York: Greenwood Press.

Chen, M. (1970). *Vowel length variation as a function of the voicing of the consonant environment*. Cambridge: Basil Blackwell.https://doi.org/10.1159/000259312

Chen, M. (2011). *Arabic language and linguistics*.Oxfrod: Blackwell.

Demitrieva, E. (2015). *Phonetic observations*.New Haven, CT: Yale University Press.

Diehl, O. *Remarks on historical phonology*. New York: Holt, Rinehart and Winston.

Feghali, M. (2008). *A critical study of phonetics*. Cambridge, MA: MIT Press.

Ghazli, M. (1977). *Pharyngeal articulation*. Chicago: University of Chicago Press.

Haselwood, B. (1996). *The ancient Greek distinction of voiced-voicless stops*. Cambridege: Cambridge University Press.https://doi.org/10.1093/jss/fgu035

Haselwood, B., & Maghrabi, R. (2015). *An Instrumental Phonetic Justification ForSibawayh's Classification of Ta; Qah and Hamza as Majhur consonants*. Oxford: Oxford University Press

Hirose, H. (2010). *Laryngeal structures*. Oxford: Basil Blackwell.

Jessen, M., & Roux, N. (2002). *Phonemes in Arabic*. Ottawa: University of Ottawa Press.

Khattab, G., Al-Tamimi, A., & Heselwood, B. (2006). *Acoustic and auditory differences in the /t/-/ṭ/ opposition in Jordanian Arabic*. Oxford: Oxford University Press. https://doi.org/10.1075/cilt.266.09kha

Klatt, M., Nearey, L., & Rochet, N. (1975). *Emphatics*. Cambridge: Cambridge University Press.

Kogan, L. (2011). *Proto-Semitic phonology*. Oxford: Blackwell.https://doi.org/10.1515/9783110251586.179

Laver, J. (1994). *The phonetic description of voice quality*. Cambridge: Cambridge University Press.

Lisker, I., & Ambramson, A. (1964). *A study of voicing*. London: Humphrey Milford.

Maddieson, M. (1997). *Phonetic universals*.Lndon: Edward Arnold.

Mohr, A. (1971). *Arabic sound system*. Cambridge: Cambridge University Press.

Neary, M., & Roccket, B. (1994). *Principles of phonetics*. Oxford: Oxford University Press.

Ohde, L. (1984). *Latin linguistics*. New York: Foris Publications.

Rifaat, K. (2003). *VOT in Egyptian Arabic*.Capetown: Longmans Southers Africa.

Watson, J. (1999). *Elements in Arabic phonetics*. Oxford: Oxford University Press.

Watson, J. (2002). *The phonology and morphology of Arabic*.Oxford University Press.

Watson, J., & Haselwood, B. (2015). *Assimilation of /l/ to /r/ in Syrian Arabic*. Oxford: Oxford Univresity Press.

Yeni-Komshian, M. (1977). *A study of voicing in Lebanese Arabic*. New York: Harper and Row.https://doi.org/10.1016/S0095-4470(19)31112-X

Zawaydeh, M., & de Jong, B. (2002). *Reading in Arabic phonetics*. New York: Grune and Stratton.

Zeroual, C. (2012). *Voice*. Cambridge: Cambridge University Press.