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Abstract:

This acoustic study is dedicated to investigating the voice onset time (VOT) of stop consonants in Alkhomy Libyan Arabic (KLA). This paper aims to provide a better insight into the phonological and phonetic features of plosives in KLA. The results show that KLA stops have short lags and voicing leads for voiceless and voiced plosives respectively. The data for voiceless stops supports previous findings that VOT values increase as the point of constriction goes backwards from the lips to the velum. Data for voiced stops contradicts this notion as labials and alveolars have longer leads than velars. The voiceless and voiced emphatic stops have the shortest and the longest VOT values respectively. The factorial analysis shows that stops are affected differently by the vocalic context. The findings also indicate that vowel height significantly affects VOT temporal duration (most stops have their highest VOT values before high vowels and their lowest values when preceding low vowels). Vowel frontness, however, shows no significance correlation with the VOT durations.

Introduction

Previous literature shows that VOT is a highly effective feature which distinguishes phonemic categories of different languages although they have different assigned phonological and phonetic features (Khattab, 2000). In phonetics, a large number of studies have investigated the acoustic properties of stop consonants in languages around the world (for example, Nearey et al., 1994; Öğüt et al., 2006). However, a few investigators have studied VOT in Arabic compared to the studies on other languages such as English. To the best of my knowledge, there has not been a single attempt to explore VOT patterns in Alkhomy Libyan Arabic (KLA).

This paper aims to contribute to the world map of VOT. It examines VOT variation of plosives in the initial position according to factors comprising POA, emphasis and the quality of the following vowel. To explore this, the production of 52 singleton words starting with /b/,/t/,/d/,/T/,/D/,/k/ and /g/ and followed by /i/,/i:/,/a/,/a:/,/u:/,/u/, /e:/ and /o:/ are analysed acoustically to describe the voicing system in KLA.

Literature review

Standard Arabic and KLA stops

The stop consonants have been termed "*al-asswat al-infijariyya*" meaning "*explosive sounds*" by Arab linguists (Al-Jaburi, 1971: 59). These sounds are also classified by early Arab grammarians into six groups on the basis of their place of articulation (POA) (*makhraj*) in the oral cavity. These groups are bilabial (*shafawiyyah*) /b/, alveolar (*lathawiyya*) /t/ and /d/, emphatic alveolar (*al-mutbaqa)* /T/ and /D/, velar (*akssa al-hanak*) /k/, uvula (*lahawiyya*) /q/ and glottal /ʔ /. These groups can also be classified according to the voicing quality into voiced (*majhuura*) and voiceless (*mahmuusa*). Whilst /b/, /d/, /D/ and /g/ are classified as *majhuura*, /t/,/T/ and /k/ are considered to be *mahmuusa* (AlDahri, and Alotaibi, 2010). However, Sibawayh regards /T/ as *majhuura* (Al-Nassir, 1993, 37-38). In both MSA and KLA, the voiceless plosive /p/ does not exist, so they have only a single bilabial plosive /b/. The uvula stop /q/ is not very common in KLA. Instead, this uvular stop moves forward to the velar region, and is realized as /g/.

	bilabial	non-emphatic alveolar	emphatic alveolar	velar	Uvular	glottal
stops	b	t d	/t/ (T) /d/ (D)	k g	**q**	**p**

Table 1: MSA and KLA stop consonant classification based on the diagram of outlets of Arabic consonants (Heselwood and Hassan, 2011: 7).

Definition of VOT

Lisker and Abramson (1967:1) define voice onset time as “the time interval between the burst that marks the release of stop closure and the onset of quasiperiodicity which reflects laryngeal vibration". Based on the VOT values of the prevocalic stops at the initial position, VOT continuum is referred to in the literature as having four categories. When the excitation of the vocal folds starts before the release, it is referred to as pre-voiced or voicing lead (with a negative value) with a range of -125 to -75ms (e.g. -100 ms median value as in the case of voiced unaspirated stops in Italian). When voicing starts at the release, VOT is zero in this case. When voicing starts after the release, the VOT is given a positive value. If voicing begins up to 25 ms (e.g. + 10 ms median value as in the case of Italian voiceless unaspirated stops), VOT falls in the category of short lag. Finally, when voicing starts after 25 ms and up to 100 ms (+ 75 median value), VOT is described as having a long lag as in the case of voiceless aspirated stops (Lisker and Abramson, 1964: 403; Abramson, 1977: 296; Öğüt et al., 2006: 1095; Gósy, 2001: 76). However, VOT continuum is split up differently by different researchers. That is to say, each category has a number of different values related to it. Consider the following diagram adapted from Ashby and Maidment (2005: 95) where the VOT duration is indicated by arrows:

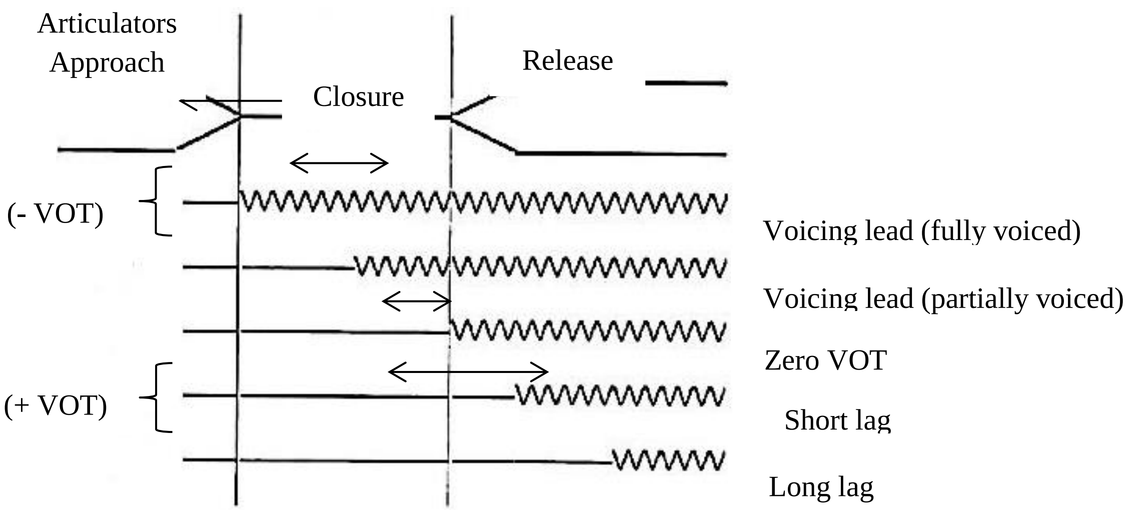

Figure 1: An illustration of the VOT possibilities for stop consonants

Factors affecting VOT

Previous studies reported that VOT values are influenced by a number of variables such as the POA, the voicing quality of the plosive sound and the effect of the following vowel.

As for POA, VOT values become greater as the point of articulation moves further back in the oral cavity from the labial towards the velar region (Lisker and Abramson, 1964; Volaitis and Miller, 1992; Cho and Ladefoged, 1997). That is to say, initial stops have longer VOT before velars than before alveolars and bilabials respectively. This is attributable to physiological or bio-mechanical factors (Chomsky and Hall, 1968).

As regard to vowel context and voicing quality, It has been found that vowel quality has a significant effect on VOT values (contradicting Lisker and Abramson (1967) who indicate that the effect of the following vowel on VOT values is not robust). Investigators have concluded that VOT durations vary as the vowel context varies (Rochet and Fei, 1991; Esposito, 2000; Docherty 1992). For example, Thornburgh and Ryalls (1998: 224) stated that voiceless stops followed by high vowels /i, u/ have longer VOT durations than stops followed by a low vowel /a/. Generally, studies concluded that voiceless stops have a shorter phonation onset before a low vowel rather than a high vowel (for example, Thornburgh and Ryalls, 1998). However, a few studies concluded that plosives have longer VOTs before low vowels (for example, Fant, 1973, cited in Cheng, 2013).

Other factors may include volume notion (see Hardcastle, 1973, cited in Abdelli-Beruh, 2009), status of the glottis (see Cho and Ladefoged, 1997), extent of articulatory contact region (Steven, 1999), mobility of the articulators notion (Kuehn and Moll, 1976, cited in Cho and Ladefoged, 1997), speaking rate (Kessinger and Blumstein, 1997; Miller and Baer 1983), the effect of the last consonant (Port and Rotunno, 1979), gender (Whiteside and Irving, 1998) and stress (Docherty, 1992).

Experimental studies on VOT

1 Cross linguistic studies on VOT

In his experiment, Klatt (1975) tested the acoustic characteristics of the English stops in monosyllabic and disyllabic words which are embedded in a carrier phrase. He investigated the effect of POA on VOT durations in singleton words in the initial position in the context of four vowels /i, ɛ , ai, u/ and noted that voiceless stops /p, t, k/ have longer VOT values (about 15 %) when they precede high vowels /i, u/ than when the following vowels are /ai, ɛ /.

Chao and Chen (2008) investigated the acoustic characteristics of Mandarin Chinese voiceless plosives. Eleven native Chinese female speakers produced 73 disyllabic words with aspirated /p’, t’, k’/ and un-aspirated /p, t, k/ in the initial position followed by two high vowels /i, u/ and a low vowel /a/. Because of Chinese phonotactics, the aspirated and unaspirated velars are only investigated in the context of /u, a/. Their findings tend to contradict the widespread belief that VOT value increases as the POA goes further back in the mouth. They found that the aspirated bilabial /p’/ has a slightly longer VOT duration than the aspirated alveolar /t’/. VOT values were 82 ms (from 35 ms to 147 ms) and 81 ms (from 45 ms to 123 ms) respectively, which is not a significant difference. However, the highest VOT values were recorded in the case of the velar /k = 27 ms, k’= 92 ms). ANOVA showed a significant influence of the vowel context except in the case of /t’/ (82, 82, 81 ms in the context of /i, u, a/ respectively). All the other stops had longer phonation onset when they preceded the two high vowels /i, u/ than when they were followed by a low vowel /a/. The VOT values for /p’, k’/ when they preceded the vowels /i, u, a/ were 90, 87, 70 ms and x, 33, 22 ms for /p’/ and /k’/ respectively.

Abdelli-Beruh (2009) examined the effect of place of occlusion on the duration of lag-VOT, stop closure and voiceless interval (closure plus VOT). Twelve monosyllabic words (CVC) produced by nine Parisian French speakers were embedded in two kinds of carrier sentences, namely post-voiced /pa/ and post-voiceless fricative /pas/ with /p, b, t, d, k, g/ in the initial position before /ɔ , ɛ /. The correlation between lag-VOT and voiceless interval were only analysed in the case of post-voiced context. Results showed that the effect of place of constriction on the short lag VOT was robust [F (2, 16) = 52.34, p<0.001]. In other words, VOT duration is significantly longer for velars (k = 32 ms), alveolars (t = 23 ms), and labials (p = 15 ms). Results showed no significance effects between POA on voiceless interval (p = 106 ms, t = 109 ms, k = 111 ms). This intimates that the correlation between VOT and stop closure is not completely governed by physiological factors in Parisian French. One limitation of this study is that the researcher ignored the vowel context in his/her data analysis although he/she lists it as one of the variables.

Öğüt (2006) studied the acoustic properties of Turkish initial stop consonants /p, t, k, b, d, g) produced by 15 female and 15 males in monosyllabic words. Each stop is examined in the context of the following vowels /ɯ, e,ɑ , i, y, ɔ , œ, u/. The difference between voiceless and voiced plosives was 107 ms, 103 ms, 79 ms for bilabials, alveolars, and velars respectively. One way ANOVA showed a statistically significant correlation between VOT and POA (p<0.001) and the results also showed velars are significantly different from bilabials (p<0.001) and alveolars (p< 0.007). However, the difference between bilabials and alveolars was not robust (p = 0.478). The context of the vowel and VOT measurements are not statistically significant.

2 Voice onset time in Arabic

Only a small number of investigators have studied VOT in Arabic compared to the studies on the other languages such as English. Yeni-Komshian et al. (1977, cited in Al-Nuzaili, 1993) conducted a study to investigate Lebanese Arabic stops in the initial stops before three vowels, namely, /i, a, u/. VOT values indicate that Lebanese Arabic stops fall into categories: VOT values for voiced plosives are in the lead, whereas VOT durations for voiceless stops occur in the short lag. They found an overlap of VOT between the plain and emphatic pairs /t, d/ and /T, D/ respectively. This overlap ranged from zero to 30 ms voicing lag in the case of /t, d/, and ranged from zero to 20 ms in the case of the two emphatic pairs, especially when they occurred before /ii/ and /uu/. Additionally, they also observed that all stops had a unified pattern in that they had longer lags and shorter leads before vowels /i, ii/ than before /aa, uu/. However, they observed that the voiced /b/ is voiceless and has its VOT in the lag time in a range between zero and twenty ms despite the following vowel.

Al-Nuzaili (1993b) analysed the acoustic correlate of eight Yemeni Arabic stop consonants in order to understand the effect of emphasis and vowel context on VOT. One speaker produced 52 singleton words with eight stops /b, t, d, T, D, k, g, q/ in initial position preceding the four high vowels /i, i:, u, u:/ and two low vowels /a, a:/ in the initial position in a CVC structure. It could be argued that one speaker participant (who is the researcher himself) does not constitute a representative sample, which casts doubt on this study and its generalizability. The results illustrated that VOT timing duration for /t/ was slightly higher than that of the emphatic /T/, with VOT values ranging from 15 to 55 ms and -30 to 25 for /t/ and /T/ respectively. Likewise, /k/ had a slightly longer VOT (ranges from 0 to 80 ms) than /q/ (ranges from 5 to 75 ms). T-test results showed that the difference between the two non-emphatic pairs and the two velars was robust (*p*< 0.01). Similarly, there was a significant difference between the emphatic alveolars (*p*< 0.05). On this basis, the researcher described Yemeni Arabic /t/ and /k/ as having a long lag, whereas /T/ and /q/ have a short lag. Voiced stops had a long voicing lead with a maximum duration of -120 ms and -130 ms for /b, D/ and /d, g/ respectively. As for the vocalic context, voiced stops had shorter voicing leads before /uu/ and /aa/ than before /i:/; with the exception of the two minimal pair tokens which had a shorter voicing lead in *Di:n* than in *Da:r* and similarly in *gi:s* than *ga:d*.

This conclusion contradicted the results from Yeni-Komshian et al. (1977) as stated above. Generally, the results indicated that voiced stops had longer VOT values before high front vowels /i, i:/ than when they preceded the high back vowels /u, u:/. Voiceless stops did not exhibit any tendency as their values varied from one vowel to another. That is to say, their values depended on the POA rather than the vowel context. For instance, /t/ exhibited a longer voicing lag (about 23.35%) when it preceded close-front vowels /i, i:/ than when the following vowel was open-front /a, a:, u, u:/. The emphatic /T/, however, had longer VOT values before back vowels /u, u:/ than before front ones /i, i:, a, a:/. The velar and uvular stops showed non-systematic VOT variation with regard to the vowel context.

The acoustic measurements of Jordanian Arabic stops were investigated in the initial position in Mitleb's study (2001) which was restricted to non-emphatic alveolar and velar stops in an environment of the short and long vowel /a/. The findings demonstrated that vowel length had a robust effect on all consonants. All stops had a longer VOT duration before a long vowel than a short one (p<.001). While /t/, /d/, /k/, /g/ had a VOT value of 37, 10, 39, 15 ms respectively in the context of a short vowel, their VOT durations were 24, 23, 60, 23 ms respectively before a long vowel.

The voicing quality of the stop consonant also affected the duration of VOT. There was a significant difference between voiced and voiceless pairs in the context of both environments of the two vowels. The durational value for /t/ was 27 % and 37 % longer than /d/ before short and long vowels respectively. There was a 40 ms contrast between /k/ and /g/ before a long vowel, which is robust.

As for place-related effects, it was found that POA had no significant effect on VOT in the context of the two vowels. For example, the difference between /t/ and /k/ was only 2 and 4 ms before the short and the long vowel respectively. These results contradicted the findings of previous studies (for example Lisker and Abramson, 1964) that VOT values increase as the POA moves further back from the lips to the velum. In their study, Lisker and Abramson (1964) reported that /t/ and /k/ had VOT values of 67 and 84 ms respectively.

In another study, the effect of close and non-close vowels on the VOT patterns of the six Mosuli Iraqi Arabic plosives /p, b, t, d, k, g/ in the initial position was examined by Rahim and Kasim (2009). This study also attempted to examine the effect of voicing on VOT measurements. To examine the effect of voicing, they used minimal pair stimuli, which controlled the effect of the last consonant on the VOT value (Docherty, 1992: 28-29). However, some methodological problems affected the validity of this study. First, only one pair of stimulus was used to test the voiced/voiceless distinction for each point of articulation namely, bilabial, alveolar and velar. Secondly, their samples were not homogenous in terms of number of participants for the two genders (6 males and 4 females). Whiteside and Irving (1998) reported that males had shorter VOTs than females. Another methodological problem was the inconsistency in age (21-52) as some previous studies have indicated that younger people usually have a longer VOT than older ones (for example, Ryalls et al., 2004).

Leaving aside these methodological problems, the results showed that the VOT of voiceless stops had shorter values when followed by a non-close vowel /a:/ than a close vowel /i:/. Also, voiceless stops exhibited a tendency of VOT duration before both vowels in which VOT values increased as the place of occlusion went backwards. On the other hand, voiced stops did not show these similarities in pattern. Voiced stops have very close VOT durations before non-close vowel, but they had different values if the following vowel was close. In addition to this, the results indicated that the distinction between voiced and voiceless stops were greatest between /t/ and /d/, intermediate between /k/ and /g/ and least between /p/ and /b/.

Alotaibi and AlDahri (2011) compared the VOT of /b/ and /k/ in Arabic to other languages. The two target stops were inserted into a carrier phrase CV-CV-CV, where the second C indicated /b/ or /k/. The other stops were carefully chosen to be identical so that they had the same environment. The native Arab and non-native Arab speakers were instructed to read the stimuli as they would read them in MSA. To ensure they did this, all participants were selected on the basis of their mastering of Qur'anic recitation. The sample selection method was somewhat problematic in this study since the participants were not homogenous with regard to their L1.

The outcomes showed that the two MSA stops always fell in the category of lag regardless of whether the stop was voiceless or voiced. The results also demonstrated that the VOT for the voiced /b/ was two times shorter than that for the voiceless /k/. The VOT durations for /b/ and /k/ were 16 (ranging from 9 to 25) and 54 ms (ranging from 34 to 80) respectively. These finding contradict other studies which found that voiced stops had a voicing lead (for example Klatt, 1975).

Research questions and hypotheses

This paper focuses on an acoustic study of VOT in Alkhomsy Libyan Arabic stop consonants. It attempts to address the following research questions:

1. Does VOT vary as a function of place of articulation (POA)? And does the voicing quality of the plosive have a robust effect on the VOT duration?
2. Is there a significant difference in VOT values between emphatic and non-emphatic sounds
3. Does VOT vary as a function of the following vowel vary?

The following null hypotheses are suggested to answer the above questions:

1. The VOT values are the same across the different places of articulation
2. The voiced and voiceless distinction of oral stops is not a significant determiner of VOT durations .
3. The VOT for each single stop consonant is the same in all vowel contexts.

Method

1 Participants

Four male participants took part in this study, and all of them were aged 30. Non-probability sampling was used in this study, that is to say, the selection of the participants was conducted by applying a convenience sampling method. Buchestaller and Khattab (2013: 74) point out that this kind of sampling is widely used in linguistics (for example, phonology) because it is presumed that the "interpersonal variation" is not significant.

The participants in this study share a number of similarities. They were all born in the same regional area of Libya (being almost neighbours) and have lived there for their entire life to date. All the members of their families speak the same dialect and they were monolinguals in their childhood. (They speak only KLA in their daily life). None of the participants reported any history of speech or listening disorders. All the information above was collected from a short questionnaire which was administered after the consent forms had been signed. Participants were compensated for their time.

2. The material

The material consisted of a sample of 52 frequently occurring words in KLA. All of these words contained one of the singleton stops /b, t, d, T, D, k, g/ in initial position followed by the vowels /i, i:, a, a:, u:, u, e:, o:/. The phonotactics of KLA do not permit some combinations; therefore, the total number of tokens totalled 52 instead of 56 (see Appendix

One). These words were embedded in the Arabic carrier sentence '*magu:li:sh* ________ *halba*' (Don't say ________ many times) and written in Arabic script on different lists. Each repetition was written in a different order in three lists. As Ladefoged (2003: 8-9) and Auzou (2000: 134) note, using a carrier sentence helps to control the effect of pitch and vowel durations on the production of each word. Words read as a list are usually produced with a lower (for example, falling) intonation and longer vowel duration than when the same words are read in a carrier sentence. This can also be helpful when determining the closure and release points of plosives. To sum up, this technique ensures that speakers have pronunciation stability and that all words have the same neighbouring rhythmic and stress position.

3. Procedure

The present study has a within-subjects design. Participants were instructed to read 52 monosyllabic words (CVC) inserted in carrier sentences from 24 lists. Each embedded word was produced three times at a normal conversational speaking rate, and recorded and then saved onto the computer. Audacity software (version 2.0.5, 2013) was used to record the samples in mono. This means a total of 612 utterances (51 words x 3 repetitions x 4 speakers). Because VOT has been found to increase as speaking rate decreases and vice-versa (Miller and Baer, 1983), participants were instructed to read the sentences as normally as possible as if they were speaking to their close friends in a natural informal conversation.

The participants were given a general description of the purpose of the study but were not informed in detail about the exact focus of this experiment in order to ensure that they did not place particular emphasis on the sounds under investigation. If this had happened, it could have led to inaccurate results. In addition to this, the tokens were randomized. One more point to bear in mind is that KLA is not usually presented in written form, being used only as a spoken form. To eliminate or control possible interference from MSA on the production of the speakers, subjects were told to read the whole list of utterances before starting to record in order to ensure that they would pronounce the target words in the usual way. This technique of testing materials beforehand and randomizing the stimuli into blocks controls the speaking rate of subjects which usually increases as the test progresses (Turk *et al.,* 2006: 20).

4. Measurements

The VOT duration measurements were taken from waveforms and wideband spectrograms simultaneously which helped the researchers to determine the onset and the offset of segments according to the procedure recommended by Ladefoged (2003: 103-138). For acoustic analysis, 624 wav-files were cut (extracted) from the recordings using the Audacity software. Praat software (version 64-bit: praat5378, 2014) was utilized to analyse each wav-file as illustrated in figure 2.

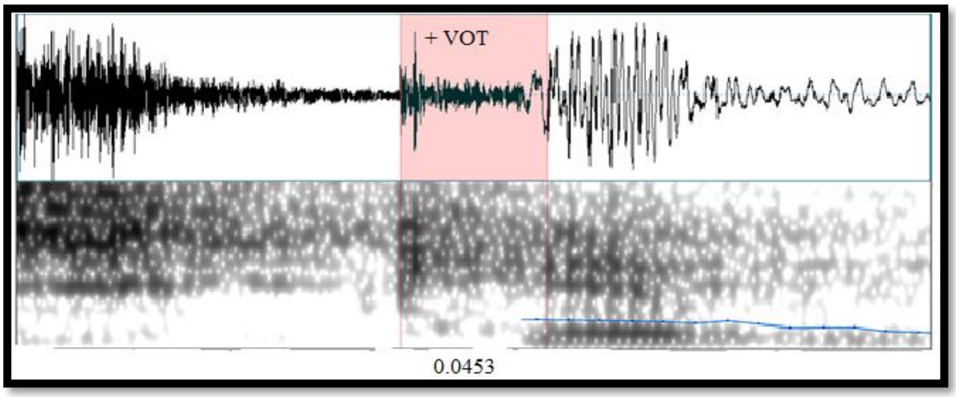

Figure 2: The word /kib/ (pour) as produced by participant one

5. Data analysis

SPSS software was used for statistical analysis. The normality test shows the VOT values were not normally distributed (*p* = 0.00) as indicated in Table 2. Therefore, the use of non-parametric tests was required. Firstly, the non-parametric counterpart of the one-way ANOVA test (i.e. the Kruskal–Wallis test) was used in order to find any statistically significant effect of POA and the vocalic context on VOT. In the case of comparing different levels of each independent variable, a Mann-Whitney independent sample *U* test was run. As stated by Field (2005: 8), this test is suitable for comparing between two categorical or binary variables when the data does not meet the assumptions of a parametric test.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
VOT	0.22	612	0	0.858	612	0

Table 2: Kolmogorov–Smirnov test and Shapiro–Wilk tests of normality

Results

The findings of this acoustic investigation of stop consonants in initial position in KLA, the effect of both the POA and vocalic context on acoustic measurements of VOT will be discussed below.

1. Results by POA

1.1. Voiceless stops

The results from the independent variable t-test illustrate that the effect of POA on the average values of VOT is significant (H (6) = 486.154, *p*<0.001). A number of previous studies have shown that the VOT values increase as the point of occlusion goes backwards (e.g. Lisker and Abramson, 1964; Abramson, 1977). Figure 3 and Figure 4 show that this notion is only true for voiceless stops. Voiceless stops exhibit a unified pattern, with VOT means decreasing as the POA becomes more interior (velar: /k/ = 34.06 ms, STD = 7.658; alveolar: /t/ = 26.56 ms, STD = 7.023, /T/ = 21. 76 ms, STD = 5.146). One more thing to report is that the values of standard deviation show that voiceless alveolars allow less variation in VOT means than in the voiceless velar plosive (see Figure 3).

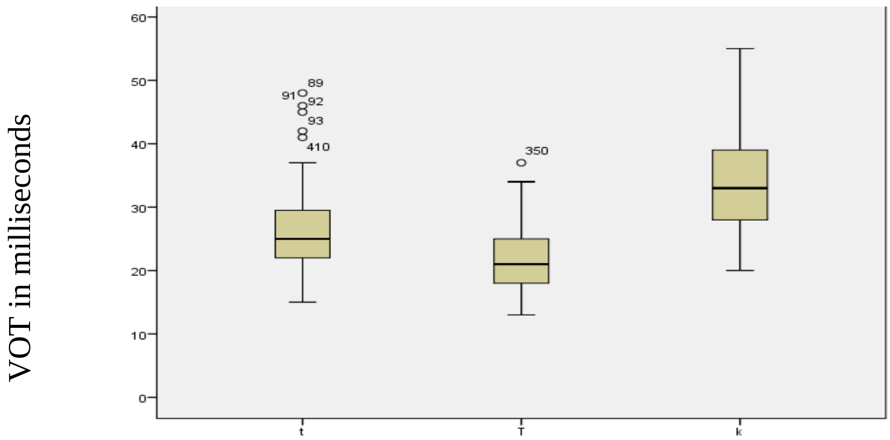

Figure 3: VOT means and standard deviations of voiceless stop consonants in all vowel contexts

The Mann-Whitney U test results indicate that VOT mean difference between /t/ and /k/ is significance (U = 1498. 50, Z = -6.280, *p*<0.001). Additionally, the differences between /T/ and /k/ tend to be robust (U = 752.00, Z = - 10.024, *p*<0.001).

1.2. Voiced stops

On the other hand, voiced stops tend not to follow the above tendency, with velars having the shortest VOT means (/g/ = -51.83 ms, STD = 21.193). Although the VOT durations for the bilabial plosive (M = -61.88 ms, STD = 20.88) are slightly shorter than the apical plain alveolar (M = -62.8, STD = 17.089), this difference does not approach significance (U = 3783.50, Z = -0.713, *p* = 0.4770). The bilabial stop is significantly longer than the velar one (U = 3112.00, U = 2.639, *p*<0.01]. The results also reveal a significant difference between /b/ and /D/, in which the latter is 10 ms longer than the former [U = 2019.50, Z = 3.572, *p*<0.01)]. The emphatic sound /D/ is also 20 ms longer than the velar /g/ [U = 1167.50, Z = -7.337, *p*<0.01)]. It is clear that the voiced emphatic alveolar stop (/D/ = -71.71 ms, STD = 11.925) has the longest VOT mean value among KLA stops.

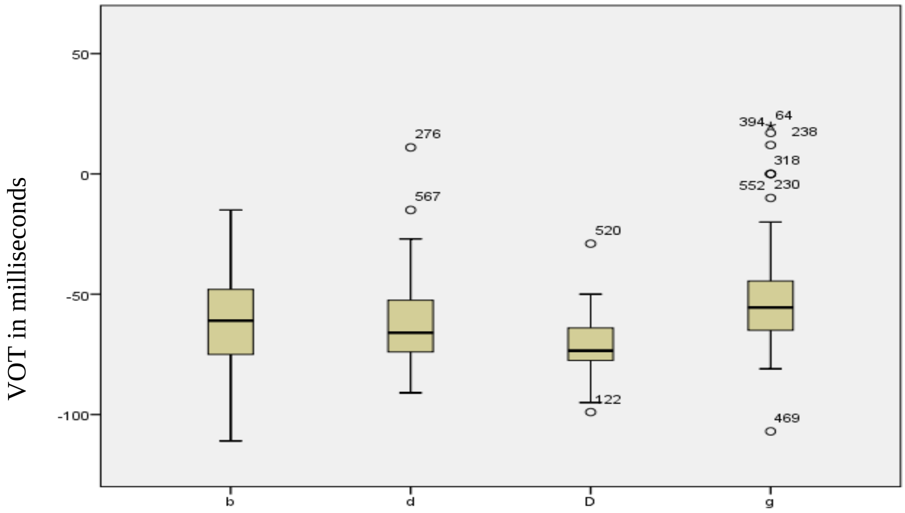

Figure 4: VOT means and standards deviation of voiced stop consonants in all vowel contexts

1.3. Emphatic stops

On average, the independent t-test shows that the voiceless non-emphatic alveolar has longer delays (M = 26.56, SD = 7.023) than its emphatic counterpart (M = 21.76, SD = 5.146). This durational difference reaches significance (U = 1989.00, Z = -4.711, *p*<0.01). However, the voiced plain dental-alveolar has shorter VOT durations (M = -62.81, SD = 17.089) than the voiced emphatic sound (M = -71.71, SD = 11.925). This difference seems to be significant (U = 2327.50, Z = -3.619, *p*<0.01). It is also clear that the VOT of the voiced emphatic alveolar is significantly longer than that of voiceless emphatic one (U = 0.00, Z = -11.08, *p*<0.001) regardless of the fact that they are produced at the same POA. This means that voicing quality of the alveolar sounds has a robust effect on VOT (see Figure 5). In addition to this, the emphatics /T/ and /D/ have the lowest and the highest VOT mean values among KLA stops, with a minimum VOT value of 18 ms and a maximum of 77 ms for /T/ and /D/ respectively (except for participant three who produces longer voicing delays for /b/ than /D/ in some of his receptions).

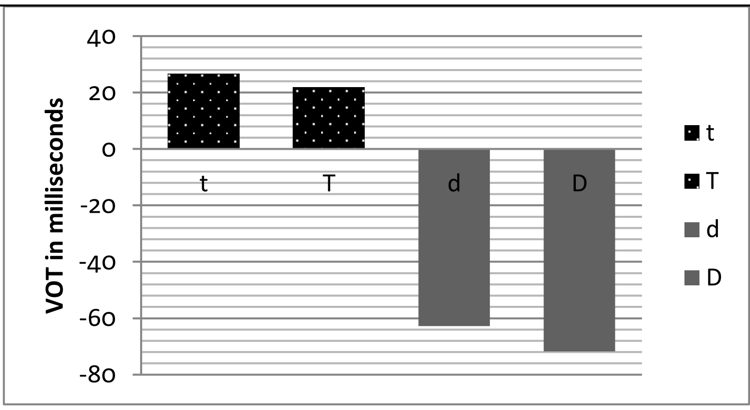

Figure 5: VOT mean values for emphatic and non-emphatic stops

2. Results by vowel context

Overall, the results show that the vowel context in which KLA stops occur does not significantly affect VOT durations (p= 0.107). As for the vowel length factor, the independent sample Kruskal-Wallis test shows that the vowel length does not have a significant effect on the VOT temporal duration (H (1)= 0.154, p= 0.695) as shown in Figure 6:

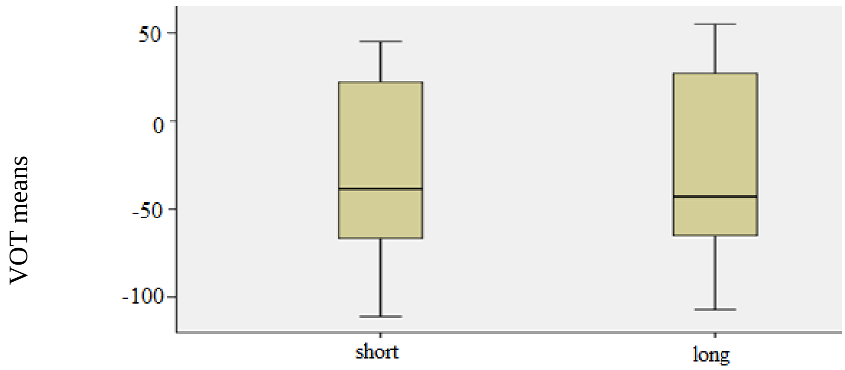

Figure 6: Mean VOT values and standard deviations according to vowel length

A single analysis of each of the three vowel pairs (namely, /i, i:/, /a, a:/ and /u, u:/) reveals similar results. In the context of the long /i:/, the VOT is slightly longer than that of its short counterpart (M= 22.29 and 20.46 respectively), but this distinction does not reach significance (H (1)= 0.281, p= 0.596). VOT mean values of plosives before /a/ and /a:/ are exactly the same (M= 23 ms; H (1) = 0.104, p= 0.747). Also, the long back vowel /u:/ results in a slightly longer VOT (about 5 ms) than its short pair. Moreover, the results show that the vowel height does not affect VOT duration significantly (H (1) =0.805, p=0.448).

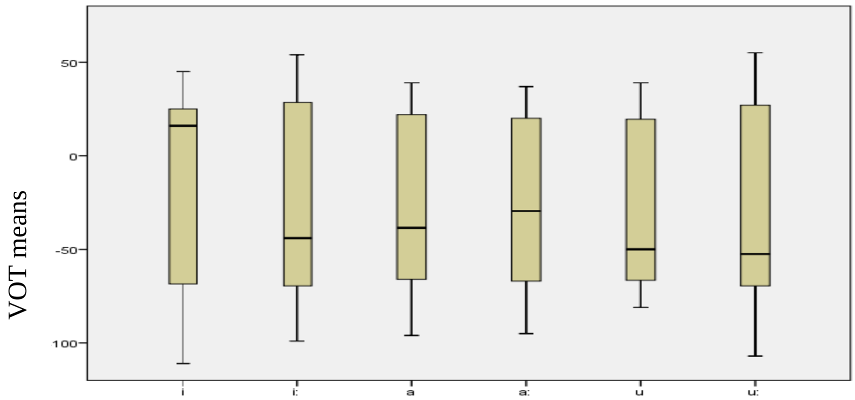

Figure 7: VOT means of stop consonants before short and long vowels

Although the results state the vocalic context does not significantly affect the temporal durations of VOT, examination of the effect of the eight vowels on the phonation onset of each single stop consonant reveals different results. It seems that KLA stops are influenced differently by the vowel which follows. The results show that the vowel context does significantly affect the VOT values of the preceding consonants /b, t, T, k/ and /g/. However, the effect of the vocalic context seems not to be robust for both voiced alveolars /d/ and /D/, as indicated in Table 3:

b	Chi-Square	26.15	g	Chi-Square	24.65
	df	6.00		df	7.00
	Sig.	0.00		Sig.	0.00
t	Chi-Square	24.04	d	Chi-Square	5.29
	df	5.00		df	7.00
	Sig.	0.00		Sig.	0.62
T	Chi-Square	30.91	D	Chi-Square	4.98
	df	7.00		df	5.00
	Sig.	0.00		Sig.	0.42
k	Chi-Square	26.01			
	df	7.00			
	Sig.	0.00			

Table 3: Kruskal-Wallis test results for the effect of vocalic context on each POA

As regards vowel length, the Kruskal-Wallis test shows that the vowel length has different degrees of effect on each POA. The front-close pair affects all stops significantly except /b/, /d/ and /g/. The speakers produced longer lags and leads for /t, T, k/ and /d, D/ before /i:/ than before /i/ respectively. However, they produced longer leads for /b/ and /g/ before /i/. The bilabial and the velar are 16 ms and 6 ms longer in the context of /i/ respectively. The low vowels pair /a/ and /a:/ display a different tendency, only having a robust effect on /b/ and /g/. It is clear that voiceless stops show a unified pattern in that they have slightly longer lags before /a/ than /a:/ (almost 3 ms). For voiced stops, /b/ and /d/ display the same tendency as voiceless stops, while /D/ and /g/ have higher mean VOT values before /a:/ than /a/. Moreover, the mean VOT values of plosives (except /d/ which exhibits nearly the same VOT in /u/ and /u:/) significantly differ when the following vowel is a back high vowel. Both voiceless and voiced stops have longer VOTs before /u:/ than /u/. For example, /T/ and /k/ have lags of 20 and 31 ms and 23 and 40 ms for /T/ and /k/ before/u/ and /u:/ respectively. Also, it is clear that the VOT values for /b/ and /g/ are 20 ms longer before /u:/ than /u/. As for the vowel frontness and backness factor (/i, i:/ vs. /u, u:/), the VOT shows that this factor does not significantly affect VOT ($p > 0.05$), except with /b/ in which the bilabial has a greater VOT (about 35 ms) before /i/ than /u/ (U = 7.00, Z = -3.75, $p<0.01$).

Furthermore, the results for voiced stops above state that bilabials are generally produced with slower glottal pulsing delays than voiced velars. However, examining the behaviour of both sounds in different vocalic contexts reveals that this tendency is not true in the context of the high back vowels, whereby the voiced velar has greater VOT values than the bilabial /b/. This difference appears to be robust before /u/ with VOT mean values of 48 ms (median = 46) and 68 ms (median = 55) for /b/ and /g/ respectively. The two stops seem to have similar mean values in the context of /u:/, with a mean of 68.5 ms. However, if the median is considered to be the basis of comparison as suggested by some researchers in the case of non-parametric data (for example, Müller and Ball, 2013: 259), it is clear that VOT median value for /g/ is 6 ms longer than that of /b/. In addition to this, by considering the closure durations of both sounds, it is evident that /b/ always has longer closure durations than /b/ except before /u/ and /u:/, which may explain why /b/ has longer VOTs than /g/. Consider Table 4:

bin	bi:r	bar	ba:b	bux	bu:m	/be:ʃ/
86	81	79	80	59	67	64
gil	**gi:s**	**gaʃ**	**ga:z**	**guʂ**	**gu:l**	**ge:s**
79	56	45	59	62	70	59

Table 4: Mean closure durations in milliseconds for /b/ and /g/ before KLA vowels

Another point to mention here is that all voiceless stops show a tendency in that they all have their lowest mean VOT values before low vowels /a, a:/ and their highest VOTs before both front-high and back-high vowels. Voiced stops, however, show a non-systematic pattern in terms of the highest VOT value. It is very clear that they have their lowest mean values before the back mid vowels /o:, e:/ (except for /g/ which has its shortest leads before low vowels). Additionally, it is evident that the vocalic context (except for /o:/) has nearly no effect on /d/ [H(1) =1.473, *p*=0.225] since the difference in mean VOT values is no more than 3 ms in all vocalic context as shown in Figure 7.

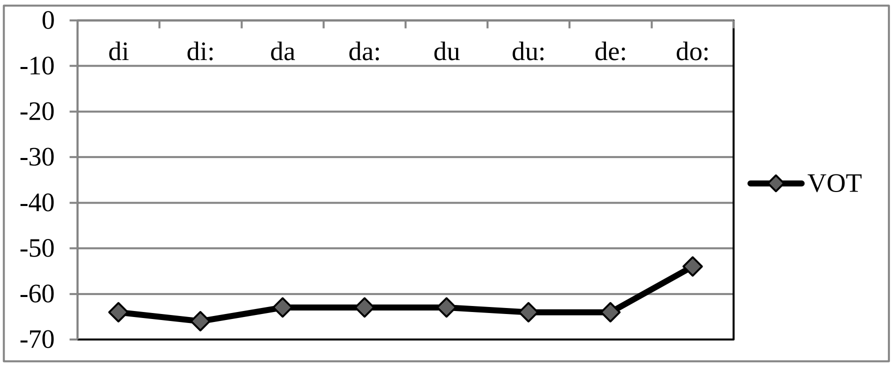

Figure 7: Mean VOT values for /d/ in different vocalic contexts

Discussion

The aim of the present study is to gain better insight into the phonetic and phonological behaviour of KLA stops by examining the effects of POA and the vowel context on VOT. Based on the results above, a discussion of the two null hypotheses and each research question will be discussed below.

1 Null hypothesis 1 and 2

The first null hypothesis proposes that neither the place of occlusion nor the voicing quality of the oral stop consonant affect the distribution of VOT durational values. The results from the Kruskal-Wallis Test reveal that this hypothesis is not correct since there is a significant durational difference of VOT measurements for different places of articulation (*p*<0.01).

1.1 Research Question 1

The first research questions relates to whether the POA has a strong influence on VOT or not. In this study, the POA effects on VOT durations have been found to be robust. These findings support previous cross-linguistic studies which found that place-related effects were a significant cue for distinguishing plosives in the languages of the word (for example, Lisker and Abramson, 1964; Cho and Ladefoged, 1997).

First, the results show that voiceless stops seem to display a tendency in that VOT becomes greater as the POA moves from the alveolar to the velar region. On the other hand, KLA speakers seem to have a slower articulatory velocity for bilabials and voiced alveolars than they do for velars which results in longer delays for bilabials and voiced alveolars. To spell out what is meant by this, the results show that the velar /g/ has the shortest voicing onset delays among the voiced stops. This stop (which has a more extended contact area and a greater pressure than other stops) was expected to have a slower intra-oral pressure drop. That is to say, glottal pulsing would be delayed and hence a longer VOT value would be obtained. However, it appears that the contact region length of a stop is not an important determiner of the temporal durational values of VOT in KLA voiced stops. This is not in agreement with explanations offered by Klatt (1975) regarding the physiological factors. In addition to this, the distinction between bilabial /b/ (or the alveolar /d/) and velar /g/ is significant (regardless of some considerable overlapping). These findings accord with the reports from previous studies on languages such Puerto Rican Spanish (see Lisker and Abramson, 1964) in which bilabials have a greater VOT than velars (/b/ = 138 ms and /g/ = 108 ms) and to a certain extent is similar to Dahalo (spoken in Kenya) in which alveolars have a longer VOT than velars (see Cho and Ladefoged, 1999). However, they do not support the findings from Mitleb's study (2001) on Jordanian Arabic as /g/ has the greatest VOT duration among voiced stops. This also contrasts with the results for English (Docherty, 2002) whereby bilabials have the shortest voicing onset delays among English plosives.

On the other hand, it has been found that /g/ always has shorter leads than /b/ except before high back vowels. This can be explained by the nature of velars. The closure location for velars is very large so that it can be articulated further forward or further backward in the velar area. Accordingly, the constriction point for velars varies as a function of the following vowel. The occlusion point of back vowels is more posterior than that of front vowels (Olive *et al.*, 1993: 140). Therefore, it could be argued that KLA speakers produce voiced velars at a more interior point meaning that the target transition for all the vowels (except /u/) becomes shorter.

Another reason for this could be the difference of the closure duration of both sounds. It has been found that /g/ has shorter closure durations before all vowels except the high-back pair (in which case the /g/ has slightly longer hold phase). This contrasts to some extent with the Keating's (1984, cited in Abdelli-Beruh, 2009) findings which state that velars have shorter closure durations than bilabials regardless of the vocalic context.

The distinction between voiced and voiceless is very clear across all KLA stop consonants. The results reveal that none of the two pairs (voiceless/voiced) has any overlap in their delays. It is evident that the greatest difference is found between /t/ and /d/, which agrees with results from the study by Rahim and Kasim (2009) of Iraqi Mosuli Arabic. The least distinction is found between /k/ and /g/. Based on this conclusion, we could infer that listener perception of the /t/ and /k/ will be higher than that for /k/ and /g/.

1.2 Research question 2

The second question aims to answer whether emphasis has a significant effect on VOT temporal durations or not. The results reveal that emphasis has a significant effect on VOT. They indicate that /T/ always occupies the voicing lag in all vocalic contexts. This is not in line with the findings of Al-Nuzaili (1993) in Yemeni Arabic, who noted that /T/ have a voicing lead before /i:/ and a short lag in the other vocalic contexts. KLA speakers make a clear distinction between /t/ and /T/ with the former having a longer VOT value than the latter regardless of the fact that they have the same MOA. As highlighted by Khattab *et al.* (2002: 137-8), this conclusion does not follow what is predicted by the Law of Aerodynamics. They demonstrated that /T/ is produced with a narrower and tenser glottal opening, which is ascribed to the fact that /T/ has two articulatory constrictions. The secondary occlusion at the pharyngeal wall causes the primary point of articulation to trap a smaller volume of air than in the case of /t/. On this basis, there is a greater pressure in the case of /T/ than /t/and hence it is supposed to have a longer VOT. They attribute the earlier glottal pulsing in /T/ to the fact that the vocal cords are very close to each other "under medial compression" during the closure, permitting less air to pass. Consequently, the vibration of the vocal folds is accelerated.

2 Null hypothesis 2

The second null hypothesis presumes that voicing onset delays are the same across all categories of the eight vowels in KLA. The statistical test has confirmed this hypothesis (*p* =0.202).

2.1 Research question 3

This question is intended to address whether the vocalic context has a robust effect on VOT values or not. The findings reveal that the vowel quality only seems to be a significant predictor of the temporal durations of VOT for certain stops. In other words, the effect of vocalic context mainly depends on the POA. Generally speaking, the results indicate that voiceless plosives exhibit a unified pattern in that they have a higher mean VOT values before high vowels /i, i:, u, u:/ than before low vowels /a, a:/. These results are in line with previous studies on British English (for example Klatt, 1975; Summerfield, 1975) and Yemeni Arabic (Al-Nuzaili, 1993). This can be traced back to the articulatory mechanism of high vowels which are uttered with a more constricted vocal cavity and a slower intra-oral pressure release than low vowels. Because the tongue is very close to the roof of the mouth (Ashby and Maidment, 2005: 73), the air-stream release (i.e. VOT) is lengthened.

Additionally, it seems that the tongue location (front vs. back) appears to play no role in the distinction of VOT produced by KLA speakers, except for /bi/ which is significantly longer than /bu/. This finding is in agreement with Cheng's study (2013) where he finds that vowel frontness has no significant effect on VOT in Hakka. However, these findings contrast with those of research by Yeni-Komshian *et al.*, (1977) on Lebanese Arabic in which vowel frontness played a significant role in VOT differences. What is more, the tongue position is higher in the articulation of /i/ than /u/ (Cheng, 2013). Therefore, whilst it is not unexpected to find that /bi/ has longer delays than /bu/, it is not obvious why no robust distinction of VOT between /i/ and /u/ exists in the other stops. Moreover, the two voiced stops /D/ and /g/ are not in line with other KLA stops in which they have their highest mean VOTs when preceding low vowels, which contrasts the articulatory mechanism of vowels explained above. Al-Nuzaili (1993) found exactly the same results in Yemeni Arabic and was unable to account for this. Fant (1973, cited in Cheng, 2013) suggested that the existence of these two phenomena namely, (1) the difference between /D/ and /g/ and other stops and (2) why only /bi/ is longer than /bu/ called for further investigation.

Conclusion

The results show that KLA stops have a voicing lead and short lag for voiced and voiceless stops respectively. This is in line with the hypothesis that languages can be categorised with regard to their VOT values. They either have a short lag and a long lag, as in the case of English, or a voicing lead and a short lag, as in the case of Spanish (Docherty, 1992).

The results show that POA significantly affects VOT temporal durations, with the VOT values having a monotonic decrease as the POA is more fronted in the case of short lag VOTs. According to the classification of voiceless sounds proposed by Cho and Ladefoged (1999), it is clear that /t/ and /T/ are un-aspirated and /k/ is aspirated in KLA. Voiced plosives, however, oppose this notion with bilabials and alveolars having longer delays than velars. This does not support the model of the passive aerodynamic mechanism presented in Chapter One. Emphatic sounds /T/ and /D/ have the shortest and the longest VOT values.

With regard to the vowel context, there is variability in the effect of the vocalic context mainly depending on POA rather than on the vowel quality. This variability is due to the fact that vowels of different qualities have different glottal settings and various degrees of stricture (Higgins et al., 1998). For instance, voiced alveolars show no significant change in VOT values across different vowel contexts. The results agree with many studies that voiceless stops VOTs are greater before high vowels than low vowels. However, voiced stops lack this tendency. This could be ascribed to a language-specificity tendency.

This study has raised a number of issues which call for further investigations. First, the reason why bilabials have longer VOT values than velars need to be investigated by choosing different tokens (minimal pairs as far as possible to eliminate the effect of the last consonant). Additionally, the correlation between the hold phase and the vowel duration with VOT values needs to be studied. Future studies should include larger samples to control for personal differences. Future research could also include repetitions of token with different speaking rates and different genders. It is hoped that this study will motivate more researchers to investigate KLA stops in greater depth.

References

Abdelli-Beruh, N. 2009. Influence of place of articulation on some acoustic correlates of the stop voicing contrast in Parisian French. *Journal of Phonetics.* **37**(1), pp.66-78.

Abramson, A. 1977. Laryngeal timing in consonant distinctions. *Phonetica.* **34**(4), pp.295-303.

AlDahri, S. 2013. A study for the effect of the emphaticness and language and dialect for voice onset time (VOT) in modern standard Arabic (MSA). *Signal & Image Processing : An International Journal (SIPIJ),* **4**(2), pp.11-29.

AlDahri, S. and Alotaibi, Y. 2010. Phonetic investigation of MSA Arabic stops (/t, d/). In: *Image and Signal Processing (CISP), 2010 3rd International Congress on*: IEEE, pp.3524-3527.

Al-Jaburi, M. 1971. *Mafhum al-quwwah wal-du'f fi alswa't al-Arabiyah*. Beirut, Lebanon: Dar Al-kotob Al-ilmiyah.

Al-Nassir, A. 1993. Sibawayh the phonologist. *A critical study of the phonetic and phonological theory of Sibawayh as presented in his treatise al-Kitab,(Library of Arabic Linguistics, 10),* London/New York: Kegan Paul International.

Al-Nuzaili, A. 1993. *Experimental study of emphasis and voicing in the plosives of Yemeni Spoken Arabic with some implications for foreign language teaching and learning*. thesis, University of Leeds.

Alotaibi, Y. and AlDahri, S. 2011. Investigating VOTs of Arabic stops/b, k/with comparisons to other languages. In: *Image and Signal Processing (CISP), 2011 4th International Congress on*: IEEE, pp.2413-2417.

Ashby, M. and Maidment, J. 2005. *Introducing phonetic science.* Cambridge: Cambridge University Press.

Auzou, P. *et al*. 2000. Voice onset time in aphasia, apraxia of speech and dysarthria: a review. *Clinical Linguistics & Phonetics.* **14**(2), pp.131-150.

Buchestaller, I. and Khattab, G. 2013. Population samples. In: Podesva, R. and Sharma, D. eds. *Research methods in linguistics.* Cambridge: Cambridge University Press, pp. 74-95.

Chao, K. and Chen, L. 2008. A cross-linguistic study of voice onset time in stop consonant productions. *Computational Linguistics and Chinese Language Processing.* **13**(2), pp.215-232.

Cheng, M. 2013. Voice Onset Time of Syllable-Initial Stops in Sixian Hakka: Isolated Syllables. *JNTNULL.* **58**(2), pp.193-227.

Cho, T. and Ladefoged, P. 1999. Variation and universals in VOT: evidence from 18 languages. *Journal of Phonetics.* **27**(2), pp.207-229.

Chomsky, N. and Halle, M. 1968. *The sound pattern of English*. New York ; London : Harper & Row.

Docherty, G. J. 1992. *The timing of voicing in British English obstruents*. New York: Fortis.

Esposito, A. 2002. On vowel height and consonantal voicing effects: Data from Italian. *Phonetica.* **59**(4), pp.197-231.

Fant, G. 1973. *Speech sounds and features*. US: The MIT Press.

Field, A. 2005. *Discovering statistics using SPSS statistics.* London: Sage.

Gósy, M. 2001. The VOT of the Hungarian voiceless plosives in words and in spontaneous Speech. *International Journal of Speech Technology.* **4**(1), pp.75-85.

Hardcastle, W.J. 1973. Some observations on the tense-lax distinction in initial stops in Korean. *Journal of Phonetics.* **1**(3), pp.263-272.

Heselwood, B. and Hassan, Z. 2011. Introduction. In: Hassan, Z. and Heselwood, B. ed. *Instrumental studies in Arabic phonetics.* Netherlands: John Benjamins Publishing, 1-25.

Higgins, M. *et al*. 1998. Vowel-related differences in laryngeal articulatory and phonatory function. *Journal of Speech, Language, and Hearing Research.* **41**(4), pp.712-724.

Keating, P. 1984. Physiological effects on stop consonant voicing. *UCLA working papers in phonetics.* **59**, pp.29-34.

Kessinger, R.H. and Blumstein, S.E. 1997. Effects of speaking rate on voice-onset time in Thai, French, and English. *Journal of Phonetics.* **25**(2), pp.143-168.

Khattab, G. 2002. VOT production in English and Arabic bilingual and monolingual children. *Amesterdam studies in the theory and history of linguistic science series 4.* pp.1-38.

Khattab, G. *et al*. 2002. Acoustic and auditory differences in the/t/-/t!/opposition in male and female speakers of Jordanian Arabic. In: Boudelaa, S. ed. *Perspectives on Arabic Linguistics XVI: papers from the sixteenth annual symposium on Arabic linguistics, Cambridge.* Amsterdam: Benjamins. pp.131-160.

Klatt, D.H. 1975. Voice onset time, frication, and aspiration in word-initial consonant clusters. *Journal of Speech, Language, and Hearing Research.* **18**(4), pp.686-706.

Kuehn, D. and Moll, K.. 1976. A cineradiographic study of VC and CV articulatory velocities. *Journal of Phonetics.*

Ladefoged, P. 2003. *Phonetic data analysis: An introduction to fieldwork and instrumental techniques.* Malden, MA: Blackwell Publishing.

Lisker, L. and A. Abramson. (1964). A cross-language study of voicing in initial stops: Acoustical measurements. Word 20, 384–422.

Lisker, L. and Abramson, A. 1967. Some effects of context on voice onset time in English stops. *Language and speech.* **10**(1), pp.1-28.

Miller, J. and Baer, T. 1983. Some effects of speaking rate on the production of/b/and/w. *The Journal of the Acoustical Society of America.* **73**(5), pp.1751-1755.

Mitleb, F. 2001. Voice onset time of Jordanian Arabic stops. *Journal of the Acoustical Society of America.* **109**(5), p2474.

Müller, N. and Ball, M. 2013. *Research Methods in Clinical Linguistics and Phonetics: A Practical Guide.* UK: John Wiley & Sons.

Nearey, T. and Rochet, B. 1994. Effects of place of articulation and vowel context on VOT production and perception for French and English stops. *Journal of the International Phonetic Association.* **24**(1), pp.1-18.

Öğüt, F. et al. 2006. Voice onset times for Turkish stop consonants. *Speech Communication.* **48**(9), pp.1094-1099.

Olive, J. et al. 1993. *Acoustics of American English speech: a dynamic approach. London:* Springer-Verlag.

Port, R. and Rotunno, R. 1979. Relation between voice-onset time and vowel duration. *The Journal of the Acoustical Society of America.* **66**(3), pp.654-662.

Rahim, A. and Kasim, Z. 2009. A Spectrographic Study of Voice Onset Time in Arabic. *J. Edu. Sci*. **16** (2), pp.28-41.

Rochet, B. and Fei, Y. 1991. Effect of consonant and vowel context on Mandarin Chinese VOT: production and perception. *Canadian Acoustics.* **19**(4), pp.105-106.

Ryalls, J. et al. 2004. Voice onset time production in older Caucasian-and African-Americans. *Journal of Multilingual Communication Disorders.* **2**(1), pp.61-67.

Sibawayh. (1898). *Kitab Sibawayh*. Baghdad: Al-Muthanna Library.

Stevens, K. 1999. *Acoustic phonetics*. Cambridge: MIT Press.

Summerfield, Q. 1975. How a full account of segmental perception depends on prosody and vice versa. *Structure and process in speech perception.* Springer, pp.51-68.

Thornburgh, D. and Ryalls, J. 1998. Voice onset time in Spanish-English bilinguals: Early versus late learners of English. *Journal of communication disorders.* **31**(3), pp.215-229.

Turk, A. et al. 2006. Acoustic segment durations in prosodic research: A practical guide. In: Sudhoff, S. et al. ed. *Methods in empirical prosody research.* **3**, pp.1-28.

Volaitis, L. and Miller, J. 1992. Phonetic prototypes: Influence of place of articulation and speaking rate on the internal structure of voicing categories. *The Journal of the Acoustical Society of America.* **92**(2), pp.723-735.

Whiteside, S. and Irving, C. 1998. Speakers' sex differences in voice onset time: A study of isolated word production. *Perceptual and motor skills.* **86**(2), pp.651-654.

Yeni-Komshian, G. et al. 1977. A study of voicing in Lebanese Arabic. *Journal of Phonetics.* **5**(1), pp.35-48.

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