دراسة صوتية لاستخدام متعلمي اللغة الانجليزية النفس الإنجليزي في الكلمات المفردة

An Acoustic Analysis of Iraqi EFL Learners' Use of English Aspiration in Isolated Words

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الملخص

تناولت العديد من البحوث ظاهرة النَفَس باللغتين العربية والإنكليزية. تبحث هذه الدراسة استفادة المتعلمين للغة الإنكليزية من ظاهرة النفس التي تعلموها في دراستهم الاكاديمية لمعرفة كيفية لفظهم للأصوات النَفَسيّة، مع الاخذ بنظر الاعتبار بعض المتغيرات التي تؤثر في هذه الظاهرة بالإضافة الى التعرف على المشاكل التي من الممكن ان تواجه المتعلم العراقي للغة الإنكليزية. شارك في هذا البحث ثمانية عشر متعلماً للغة الإنكليزية بحيث تم اختيارهم بصورة عشوائية من طلاب المرحلة الرابعة لقسم اللغة الإنكليزية في كلية التربية للعلوم الإنسانية في جامعة الموصل. تم قياس قيم بدء الصوت للأصوات الانفجارية فيما يتعلق الامر بظاهرة النفس متبوعة بثلاثة أصوات متحركة طويلة في بداية ووسط ونهاية الكلمات. أظهرت النتائج ان قيم وقت بدء الصوت للأصوات الانفجارية تزداد تدريجيا ويبدو ان قيم الجهر بالصوت لهذه الأصوات متساوية في كل المواضع حيث انها تعرض نفسا اقل من المتحدثين الاصليين للغة الإنكليزية وذلك لان قيم بدء الجهر بالصوت للأصوات الانفجارية والعائدة للمّتعلم العراقي اقل من قيم بدء الجهر بالصوت في الإنكليزية وكذلك يلفظ متعلمو اللغة الانكليزية العراقيين الأصوات الانفجارية النفسية الإنكليزية بنفس طريقة لفظهم للأصوات النَفَسيّة العربية بسبب التأثير الإيجابي والسلبي للغة الام.

Abstract

Many researches have dealt with aspiration of English and Arabic. This study investigates the utilization of aspiration in English by Iraqi EFL learners which they have attained in their academic study, to see how much aspiration they display with reference to certain theoretical aspects of aspiration (certain variables affecting aspiration) as well as the problems that may face Iraqi EFL learners in their production of English aspirated plosives. Eighteen Iraqi EFL learners randomly selected from fourth year students, English Department, College of Education for Humanities, University of Mosul have participated in this study. Voice onset time measurements of the voiceless plosives /p, t, k /, as far as aspiration is concerned, have been made followed by three long vowels /i:, u:, a:/, in initial, intervocalic and final positions in isolation. The results show that VOT averages of the plosives [p^h, t^h, k^h] in isolation increase gradually, their VOT values seem to be equal in all positions. They display less aspiration than native speakers of English due to VOT values lower than those of English. Iraqi EFL learners produce English voiceless aspirated plosives in the same manner of producing Arabic voiceless plosives in isolation due to mother tongue positive and negative transfer.

1. Introduction

Arabic is a unique and deep-rooted Semitic language. Alanazi (2017: 20) adds that Arabic language has influenced a number of languages like Persian (an official language in Iran), Kurdish (a spoken language in Kurdistan, north of Iraq), Pashto (the official language in Afghanistan) and Urdu (the official national language in South Asia especially Pakistan) etc. Arabic is the official language in Iraq as it is used by the media (on the Iraqi TV), in education and for formal ceremonies. English is regarded as a foreign language that is used in education, schools and universities. Previous English studies mention that aspiration is a feature of voiceless plosives in the sense that [p^h, t^h, k^h] are voiceless aspirated plosives, [p, t, k] are voiceless unaspirated plosives and /b, d, g/ are voiced unaspirated plosives. Thus, we can say that aspiration in English is not redundant and mutually exclusive. Previous Arabic studies mention that only [t, k] are aspirated, while [ṭ, ḍ, q, ʔ] are unaspirated (Al-Ani, 1970; Al-Bayaty, 2001). We find that the Iraqi Arabic dialect has exclusively ten plosives as the following:1- /p/, bilabial voiceless plosive as in /parda/ 'curtain'.2- /b/, bilabial voiced plosive as in /ˈba:b/ 'door'.3- /t/, dental voiceless plosive as in /ti:n / 'figs'.4- /ṭ/, pharyngealized or as Rahim (1980) states "mufaxxam", voiceless, post-alveolar plosive as in /ṭi:n/ 'mud'.5- /d/, voiced alveolar plosive as in /di:n/ 'religion'.6- /ḍ /, voiceless dental mufaxxam plosive, as in /ʔarḍ/ 'land'.7- /k/, voiceless velar plosive as in /ka:s/ 'cup'.8- /g/, voiced velar plosive as in /ga:z/ 'oil derivatives'.9- /q/, uvular voiceless plosive as in /qa:s/ 'he measured'.10-/ʔ/, glottal voiceless plosive as in /ˈma:ʔ/ 'water' (Rahim,1980; Al-Bayaty, 2001; Al-Dahri, 2013; Kasim, 2018; Al-Tai, 202١). In addition, /t/ is a voiceless dental stop not alveolar like the English /t/ (Kopczynski and Meliani, 1993). Alanazi (2017:10) adds that Arabic is a language which

has voicing lead in addition to short/long lag stops while English has only short and long-lag stops. From those differences mentioned above, we can say that there are differences between the notion of aspiration in English in isolation as well as in Arabic language in the same context.

1.1 Statement of the Problem

English is an Indo- European language and Arabic is a Semitic language, hence the two languages belong to two different families (Na'ama, 2011). Aspiration is language specific; it occurs in languages like English and Arabic (Kim, 1970: 10). Thus, there are differences between the notion of aspiration in English and Arabic. Arabic is a language which has voicing lead and short lag, while English has short and long lag. Therefore, there will be certain problems that may face Iraqi EFL learners in the production of aspirated plosives in the sense that the learner will display different amount of aspiration. In other words, the problem is whether Iraqi EFL learners whose first language is Arabic are going to produce English voiceless aspirated plosives correctly or not.

1.2 The Aims of the Research

The research aims at analyzing the English plosives produced by Iraqi EFL learners as it will be accomplished by performing an acoustic analysis of Voice Onset Time (VOT) and identifying factors that may have their own effects on the production of Iraqi EFL learners such as: place of articulation, position of the sound in a word, vowel context in isolation.

1.3 Limits of the Research

One of the limits imposed on this research is the curfew as a result of (Covid -19) and (Covid-20). Thus, there is certain difficulty in finding sufficient number of students to take part in this research. There are certain prosodic and temporal factors that might affect VOT as far as

aspiration is concerned such as, the number of syllables in the word, speech rate, speech task, fundamental frequency, stress, intonation and phoneme environment (Kessinger and Blumstein 1997 and Cohen, 2004). In addition, there are physiological differences which include the form of the glottis, the size of the vocal tract, the thickness of the vocal folds, as well as other differences like speaking styles (Shue and Iseli ,2008), and pathological status such as hearing impairment and depression (Listiana, 2019) which are all excluded.

1.4 Procedures and Data Collection

1.The subjects of this research are 18 (9 males/9 females), fourth-year students, English Department, College of Education for Humanities, University of Mosul and of Mosuli origin.

2. The test of this research examines twenty one tokens containing the three voiceless aspirated plosives [p^h, t^h, k^h], followed by the three long vowels /i:/, /u:/ and /a:/ in initial, intervocalic as well as final positions in isolation (see Tables 1 and 2).

Table 1: The different adopted patterns of test data.

Context	Initial	Intervocalic	Final
Isolation	C**plosive**VC	CV'C**plosive** VC	CVC**plosive**

3.The tokens are printed on flash cards (8cm x 12cm) with a font size of "100" by using English script printed in "Times New Romans". All words are read by all participants in isolation.

Table 2: The words of thetest in different positions and vowel context and their transcriptions.

Sounds		Vowel context					
Plosive	**Positions**	**/i:/**	**Trans.**	**/u:/**	**Trans.**	**/a:/**	**Trans.**
/p/	initial	peace	/pi:s/	pool	/pu:l/	pass	/pa:s/
	intervocalic	repeat	/rɪˈpi:t/	harpoon	/haːˈpuːn/	depart	/dɪˈpa:t/
	final	weep	/wi:p/	-------	-------	-------	-------
/t/	initial	teen	/ti:n/	tool	/tu:l/	tars	/ta:z/
	intervocalic	fourteen	/fɔːˈtiːn/	cartoon	/kaːˈtuːn/	guitars	/gɪˈta:z/
	final	feet	/fi:t/	-------	-------	-------	-------
/k/	initial	keen	/ki:n/	cool	/ku:l/	card	/ka:d/
	intervocalic	zookeeper	/zuːˈkiːpə/	raccoon	/rəˈku:n/	becalm	/bɪˈka:m/

4. The recording sessions took place in the "Multi-Media Language Lab, within the Korean Gift" which belongs to the Computer-Center in the Students-Center, University of Mosul.

5. The elicitation method, or as Lisker and Abramson (1964:389) call it "elicitation procedure", is adopted in which aspiration is measured from the release of the plosive to the beginning of the voicing of the following vowel or sonorant.

6. There is no difference in the way of analyzing as well as measuring initial and medial aspirated plosives in isolation (see Figure 1).

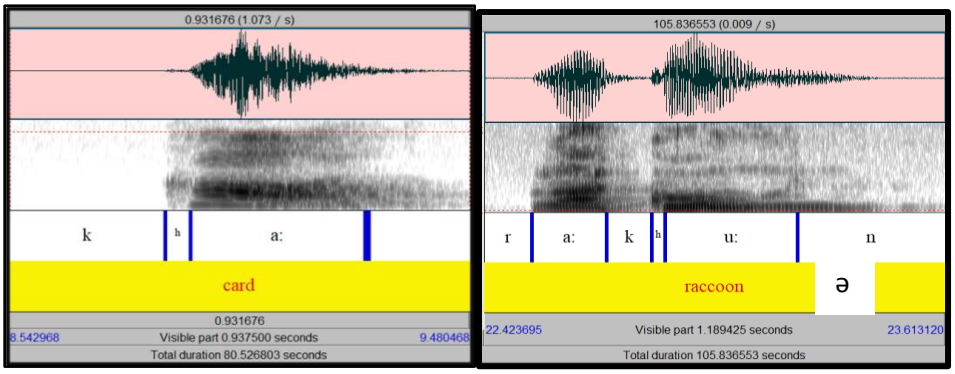


Figure 1: Waveforms of initial and intervocalic aspirated /k/ of '*card*' and *'raccoon'*.

7. In final position in isolation, VOT of aspirated plosives cannot be measured; i.e., plosives are usually not aspirated (Fry, 1979: 136). Thus, in this research the plosives in final position in isolation are either released or not released (see Figures 2 and 3) which show two instances of [p], one released and another unreleased.

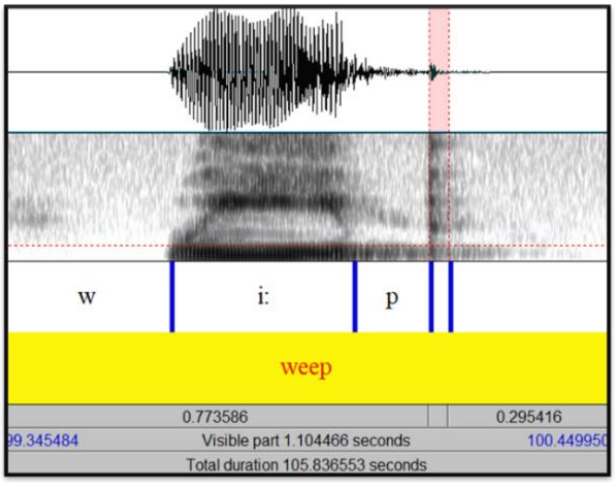


Figure 2: The waveform of isolated final released [p] of 'weep'.

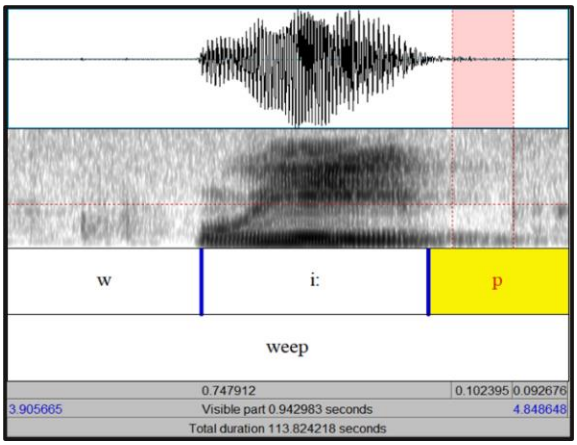


Figure 3: The waveform of isolated final unreleased [p̚] of 'weep'.

1.5 The Model Adopted

The easiest way to visualize VOT is by reference to the waveform of a sound. Since aspiration is connected with VOT, the model adopted in this research for describing and analyzing aspiration of Iraqi EFL learners will be Lisker and Abramson's (1964) study due to adopting the three criteria of VOT: voicing lead, short lag and long lag.

2. Theoretical Part

This section of the research includes linguists' various definitions of aspirations in both languages; aspiration in English as well as in Arabic and previous views on the theoretical aspect of aspiration in both languages as well as the variables affecting aspiration such as: place of articulation, vowel context, age and gender.

2.1 Definitions and Nature of Aspiration

Phonologists have different viewpoints about the production of aspiration. They state that aspiration is produced with spreading of vocal folds, while others suggest that aspiration is produced by a delay in the onset of voicing after a stop closure is released (Malmberg, 1963, Rogers, 2000). Ladefoged and Johnson (2015:159) state that "the terms aspirated and unaspirated plosives refer to the presence or absence of a period of voicelessness during and after the release of an articulation".

Besides, some researchers have defined aspiration in relation to timing. Ladefoged (2001: 120) points out that aspiration is "...a small delay of vocal cords vibration before the following vowel in which air rushes out ". Lodge (2009: 105) also states that aspiration is "a matter of timing relationship between no vibration of the vocal cords and vibration".

As to the nature of aspiration, there are two conditions for aspiration to occur. The first condition is 'the maximum opening of the vocal folds', which is regarded as an essential distinction between voiceless aspirated and voiceless unaspirated plosives (Ladefoged and Johnson, 2015:159). Thus "the greater the opening of the vocal folds during a stop, the longer amount of the following aspiration" (ibid:160). The second condition cited in (Kasim, 2018: 3) is 'the place where aspiration noise occurs'. What is important for us is the noise generated near or at the glottis which is an indication of aspiration.

2.1.1 Aspiration in English

English aspirated plosives have three oral pulmonic plosives, viz. [p^h, t^h, k^h]. They have a complete closure of the air stream, and a pressure of air in the mouth is formed which is suddenly released in a small burst of sound after the closure is opened in terms of a puff of air (Holmes and Holmes, 2001) or a period of voicelessness (Ladefoged and Johnson, 2015). Acoustically, as it is shown in the acoustic analysis of the word '*tie*' (see Figure 4), there is a spike related to the burst of noise because the plosive closure is released, followed by a period of very small semi-random variations of aspiration, and a regular, repeated wave of the vocal folds' vibration for the vowel.

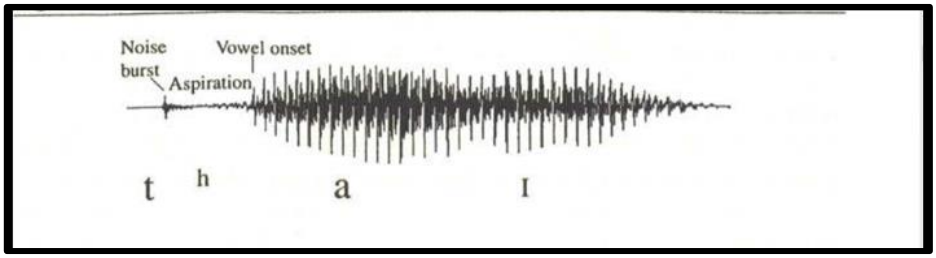


Figure 4. The acoustic waveforms of the word '*tie*' (adapted from Ladefoged and Johnson, 2015).

As for the context of aspiration, in initial position, English plosives /p, t, k /are produced with silent closure intervals that are classed as voiceless (Lisker and Abramson, 1964). In non-final position, /p, t, k/ are released with an audible explosion. In final position, /p, t, k/ in words like "nap, mat, knack" are usually un released. Voiceless plosives /p, t, k / combine with the voiced approximants /r, w, l, j/ in words such as "pray, tray, twice", the approximants are partially voiceless (Ladefoged and Johnson, 2015: 72), or the aspiration is manifested in the devoicing of complete or partial /l, w, j, r / as in [p̥leɪ], [t̥waɪs] (Bolinger ,1975).

Al-Bayaty (2001: 34) adds that replacing[t] instead of [tʰ] as well as [k] instead of [kʰ], does not change meaning only but makes the pronunciation inaccurate as in the word '*park*', it may be understood as '*bark*', hence completely different meanings. Thus, aspiration in English is not redundant. The sounds [pʰ, p], [tʰ, t], [kʰ, k] are not found in the same environment and they are not minimal pairs but they are said to be in complementary distribution, hence, [p], [pʰ] are allophones of /p/, [t] and [tʰ] are allophones of /t/, and [k], [kʰ] are allophones of /k/ (Ladefoged and Johnson, 2015).

2.1.2 Aspiration in Arabic

Al-Hamad (1986), says that one of the first Arab linguists who talked about puff of air "nafxa" that follows [t], [k], is the famous linguist Sibawaihi. Iraqi Arabic has ten plosives. The voiceless plosives found in Iraqi Arabic are /t, ṭ, ḍ, k, q and ʔ/: the dental or alveo dental /t/, the dorsal /k/, the uvular /q/, the pharyngealized, emphatic, or "mufaxxam /ṭ/, pharyngealized, emphatic or "mufaxxam" /ḍ/ and the glottal stop /ʔ/ (Rahim, 1980; Al-Dahri, 2013 and Kasim 2018). In Iraqi Arabic, the two plosives /t, d/ are described as dental by Al-Hamash (1969) and alveolar by Rahim (1980: 234). In addition, /t/ is a voiceless dental plosive not alveolar like the English /t/ (Kopczynski and Meliani, 1993). Cruttenden (2014: 311) suggests that pronouncing these two consonants as 'dental' rather than 'alveolar' will not affect their intelligibility. Previous studies mention that aspiration is a feature of voiceless plosives in which [t, k] are aspirated, while [ṭ, ḍ, q, ʔ] are unaspirated (Al-Ani, 1970 and Al-Bayaty, 2001). So, in Arabic when /t/and /k / occur at the beginning of a word, they are followed by strong aspiration, e.g. [ˈtʰabni] 'you build', [kʰura] 'ball' (Al-Bayaty, 2001). He also adds that when /t/, /k/ occur finally, they are followed by weak aspiration as in [ma:tʰ] 'he died', [ma:lɪkʰ] 'owner'. As to Arabic aspiration and distinctiveness, if a foreigner pronounces such a word with unaspirated [t] or aspirated [tʰ], the native listener of Arabic will find its pronunciation strange but will understand its meaning. Thus, aspiration in Arabic is a non-distinctive property of /t/ and /k/ (Al-Bayaty, 2001: 50). Thus, according to Lyons (1968: 112) and Hyman (1975: 5) [t], [tʰ] are allophones of the phoneme /t/ and [k], [kʰ] are allophones of the phoneme /k/. So, aspiration is said to be redundant in Arabic. Finally, Al-Bayaty (2001: 49) states that in Standard Arabic, the sounds /l, r, w/ and /j/ are devoiced after /t, k/ in words, e.g. [qatl̥] 'killing', [jatr̥uk], 'to leave', [ˈʔakl̥] 'eating', [ˈtakw̥i:], 'she is ironing'.

2.2 Factors Affecting Aspiration

There are many factors that may have their effects on the values of VOT and thus on aspiration. Some of them are related to inherent properties of sounds as the following:

2.2.1 Place of Articulation

Lisker and Abramson (1964) assert that VOT values are longer in velars than in alveolars and bilabials. Thus, English initial aspirated bilabial plosive [pʰ] has a VOT value of 58 ms., while initial aspirated alveolar plosive [tʰ] has VOT value of 70 ms. and 80 ms. for aspirated velar plosive [kʰ] in the same context (Lisker and Abramson, 1964: 410).

2.2.2 Vowel Context

Some scholars, like Lisker and Abramson (1964), state that the following vowel has no influence on the VOT values. But others like Weismer (1979) conclude that a voiceless plosive has a longer VOT when it is followed by tense high vowels /i:/, /eɪ/ and /u:/ than tense low and mid vowels /ɪ/, /æ/ and /ɛ/. Further, Rochet and Yanmei (1991) who tackles Mandarin plosives, have the same results in the sense that vowels affect the VOT values of the preceding plosive.

2.2.3 Gender

Simpson (2001: 2153) states that speech is different in men from women due to their longer vocal tract than women. Swartz (1992) notices longer VOT values in adult females, whereas Smith (1978) and Al-Malwi (2017) report longer VOT values in adult males. However, Sweeting and Baken (1982) do not find any differences in VOT values in both sexes.

2.2.4 The Subjects' Age

The age of the speakers is another factor that has an effect on VOT values. Sweeting and Baken (1982) noticed that their results revealed that with an increase in age, there was an increase in variability within the participants leading to more variability between the groups. Macken and Barton (1980) conclude that children need a longer time to master the production of voiceless plosives. Also, they conclude that at a fairly late age VOT values of English children become like adult's VOT patterns for voiceless plosives.

2.3 Previous studies on English Plosives

One of the previous significant studies which has its effects on phonetics is Lisker and Abramson's classical study (1964). It is regarded as the first study that has tackled VOT of the plosives in different languages. The values of the aspirated plosives /p, t, k / in isolation was (58, 70, 80) ms., respectively. Caruso and Burton (1987) investigated plosive-gap duration and VOT of eight English speakers. They found that the VOT values of /p/, /t/, /k/ were (63, 72, 75) ms. Docherty (1992) measured the VOT values of voiceless obstruents in Southern British English. VOT results for word-initial English plosives in isolated words were (46, 67, 66) ms. Kessinger and Blumstein (1997) examined the VOT of four English speakers and VOT values in isolation of /p/, /t/ were (85, 100) ms. Scobbie's study (2002) (as cited in Alanazi, 2017: 44) showed that VOT values of word-initial English plosives in isolated words were (56, 66, 75) ms. (see Table 3).

Table 3: Summary of English VOT values for word-initial plosives in isolated words

English Plosives in isolation	[p ʰ]	[t ʰ]	[k ʰ]
Lisker and Abramson (1964)	58	70	80
Caruso and Burton (1987)	63	72	75
Docherty (1992)	46	67	66
Kessinger and Blumstein (1997)	85	100	----
Scobbie (2002)	56	66	75

2.3 Previous Studies on Arabic Plosives

Al-Ani (1970) measured the duration of Arabic aspiration of the voiceless plosives, recording himself reading words in lists. Results showed VOT values between (30-40) ms. for /t/, (60-80) ms. for /k/. Kasim (2008) measured the VOT values of the Iraqi Arabic plosives. The VOT values for the initial /p, t, k/ in isolation were (19, 33, 35) ms. Rahim and Kasim (2009) conducted a spectrographic study of VOT of Iraqi Mosuli plosives /p, t, k / before a close vowel and non-close one. The VOT values of Mosuli Arabic plosives occurring before a close vowel in isolation were (16, 41, 49) ms. and their values occurring before a non-close vowel in isolation were (13, 19, 39) ms. Mitleb (2009) examined the VOT values of Jordanian Arabic. The VOT values for Arabic word initial plosives in isolation for / t, k / were (64, 60) ms. before long vowels and (37, 39) ms. before short vowels. Kasim (2018) examined Arabic [tʰ, kʰ] before the vowel /a:/ in two positions (initially and medially), and in two contexts, stressed syllables and unstressed ones in isolation. The VOT values for initial and medial stressed /t/

were (27, 28) and for initial and medial /k / were (42, 39) in isolation. Al-Tai and Kasim (2021) made an acoustic study describing Iraqi Arabic plosives. The VOT measurements of /p, t, d, k/ in isolation in initial position were (18, 41, 53) ms., and their VOT in isolation in medial position were (16, 51, 33) ms. (see Table 4).

Table 4: Summary of Arabic VOT values for plosives in different positions in isolations

Ar. Previous Studies	Context	[p ʰ]	[t ʰ]	[k ʰ]
Al-Ani (1970)		----	30-40	60-80
Kasim (2008)	Initial	19	33	35
Rahim and Kasim (2009)	Close V	16	41	49
	Non-close V	13	19	39
Mitleb (2009)	Long V	----	64	60
	Short V	----	37	39
Kasim (2018)	Initial	----	27	42
	Medial	----	28	39
Al-Tai and Kasim (2021)	Initial	18	41	53
	Medial	16	51	33

3. Analysis and Discussion

3.1 Analysis

Appendix 1 presents the VOT values of voiceless aspirated plosives of EFL learners followed by long vowels in the initial and intervocalic positions in isolation. And as we have mentioned before, the VOT values cannot be measured in words in final position in isolation even if they are released. In addition to these specific details of Appendix 1, Table 5 below presents a small picture which is extracted from

Appendix 1 showing each voiceless aspirated plosive followed by /i:, u:, a:/ in initial and intervocalic position in isolation.

Table 5: The averages of the VOT values of initial and intervocalic voiceless aspirated plosives after the vowels /i:,u:, a:/ in isolation.

Position	[p ʰi:]	[p ʰ u:]	[p ʰ a:]	[t ʰi:]	[t ʰu:]	[t ʰa:]	[k ʰi:]	[k ʰu:]	[k ʰ a:]
Initially	15	33	13	43	39	18	63	53	40
Intervocalically	17	29	14	48	36	19	49	47	40

3.1.1. Initially followed by Vowels

VOT averages of initial aspirated [pʰ] followed by /i:,u:,a:/ are (15,33,13) ms. The VOT averages of initial aspirated [tʰ] followed by /i:,u:,a:/ are (43,39,18) ms. While, the VOT averages of initial aspirated [kʰ] followed by /i:, u:,a:/ are (63,53, 40) ms. Figure 5 presents the numerical VOT values of EFL learners in initial voiceless aspirated plosives in isolation.

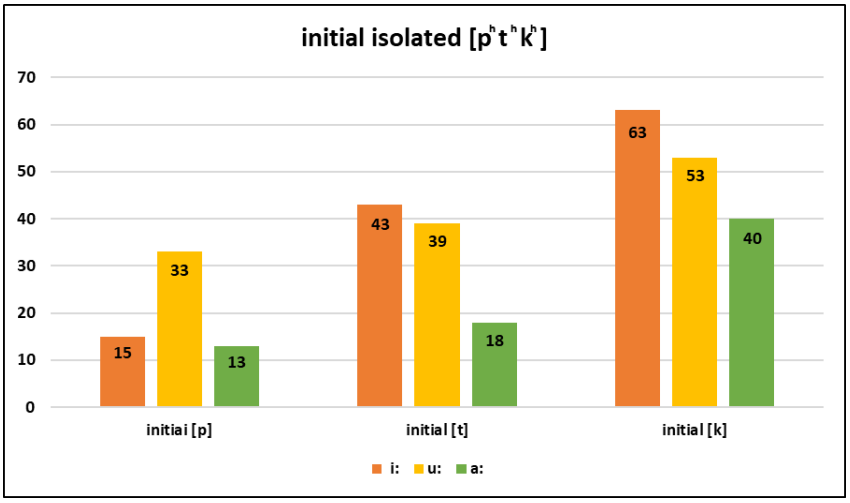
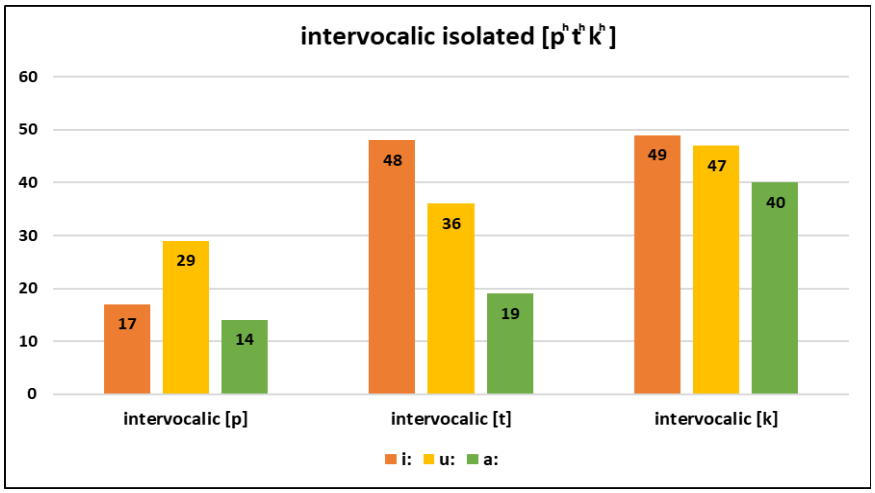


Figure 5: Results of initial isolated [p ʰ t ʰ k ʰ] followed by /i:, u:, a:/.

3.1.2 Intervocalically

VOT averages of intervocalic aspirated [pʰ] followed by /i:, a:, u:/ are (17,29, 14) ms. The VOT average of intervocalic aspirated [tʰ]



followed by /i:, u:, a:/ are (48,36,19) ms. The VOT average of intervocalic aspirated [kʰ] followed by /i:,u:, a:/ are (49, 47, 40) ms. Figure 6 presents the numerical results of EFL learners intervocalic [pʰ, tʰ, kʰ] in isolation.

Figure 6: Results of intervocalic isolated [p ʰ, t ʰ, k ʰ] followed by /i:, u:, a:/.

2.2.3 Finally

In final position, according to Appendix 1, the most frequent voiceless plosive found to be unreleased is [pˀ] in the sense that only 3 out of 18 tokens are released, while 15 tokens are unreleased. For the voiceless plosive /t/, tokens that are released and unreleased are equal which are 9 (see Appendix 1 and Figure 7). As for the final voiceless plosive /k/, all participants' results are released. Figure 7 shows the numerical ranges of released [p, t, k] and unreleased [pˀ, tˀ, kˀ] in final position in isolation.

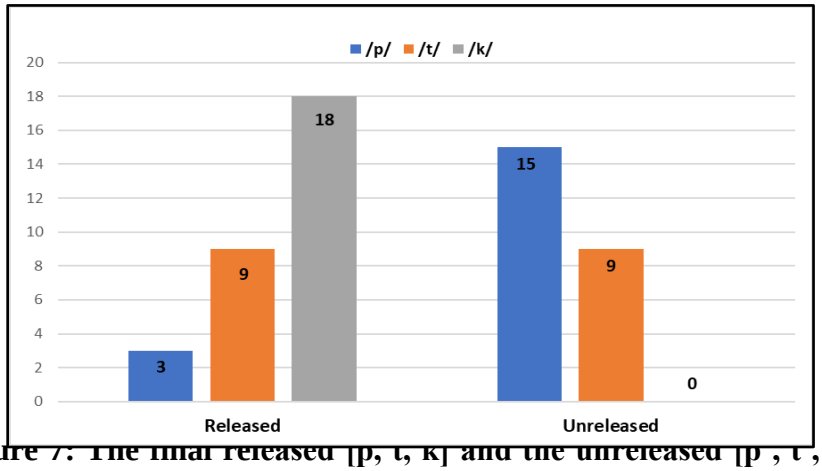


Figure 7: The final released [p, t, k] and the unreleased [p˺, t˺, k˺] in isolation.

3.2 Discussion

VOT is considered a cue that may vary according to certain factors, namely, place of articulation, position of the sound in a word, vowel context in isolation.

3.2.1 VOT Results and Place of Articulation

Results of the averages of VOT values concerning the participants' production of the voiceless plosives [p^h, t^h, k^h] in isolation show that [p^h] has the lowest results, [t^h] has the next higher results and [k^h] has the highest results (see Appendix 1 and Table 5. Accordingly, VOT averages of the plosives [p^h, t^h, k^h] in isolation increase gradually in the order labial< alveolar < velar. And, if we compare these results with previous studies such as: Lisker and Abramson (1964), Port and Mitelb (1983), Cho and Ladefoged (1999) which state that VOT values of voiceless aspirated plosives gradually increase in isolation, we find a kind of compatibility of this study and other studies which asserts the relationship between VOT values and the place of articulation (see Figure 8).

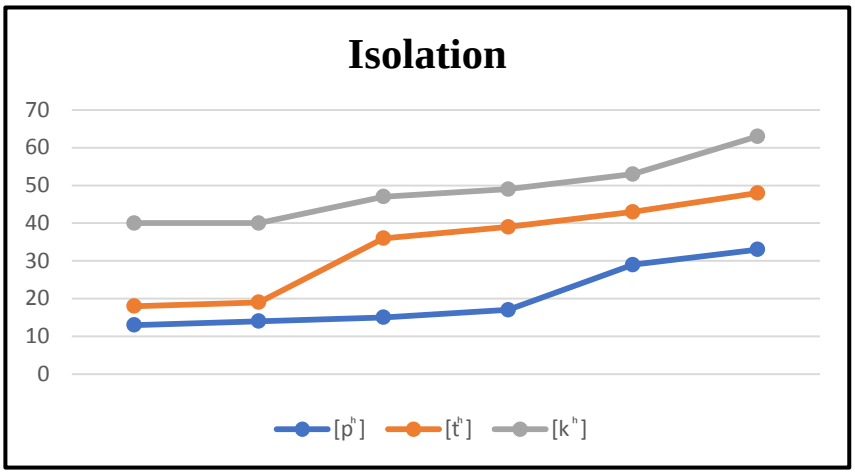


Figure 8: Gradual increase of VOT averages of [pʰ tʰ kʰ] in isolation.

3.2.2 VOT Results and Position of [pʰ, tʰ, kʰ] in a Word

Results of this research notice that the position of the sound in a word in isolation does not play a significant role as far as aspiration is concerned in the sense that VOT results of [pʰ, tʰ, kʰ] related to Iraqi EFL learners are equal in all positions, viz., initially and intervocalically. In other words, VOT values of [pʰ, tʰ, kʰ] initially in isolation seem to be equal to VOT values of [pʰ, tʰ, kʰ] intervocalically in the same context (see Table 5). Thus, we can say that there is a kind of compatibility between equal results in all positions of the present research and other Arabic studies such as: Kasim's (2018) in which results of his research showed equal values of [tʰ] and [kʰ] initially and medially in isolation and Al-Tai and Kasim's (2021) in which their results showed equal values with [pʰ] and [tʰ] initially and medially in isolation (see Table 4).

3.2.3 VOT Results and Vowel Context

VOT averages of initial and intervocalic [pʰ, tʰ, kʰ] followed by the three long vowels /i:, u:, a:/ in isolation show the following: [pʰ] has the lowest VOT values when it is followed by /a:/, higher VOT values

when it is followed by /i:/ and the highest VOT when it is followed by /u:/. While [t^h and k^h] have the lowest VOT values when they are followed by /a:/, higher VOT values when they are followed by /u:/ and the highest VOT when they are followed by /i:/ (see Figures 5 and 6). We can say that all VOT results of the present research exclusively follow the pattern /i:/> /u:/>/a:/ when they are preceded by /t/ and /k/ and /u:/>/i:/>/a:/ when they are preceded by /p/ in isolation. Lisker and Abramsons's study (1964) showed that the following vowels had no influence on VOT values, but results of the present research show an obvious influence of the following vowel on VOT values of voiceless aspirated plosive in initial and intervocalic positions in isolation. On the other hand, the results of the present research may be compatible with other studies such as Weismer (1979), Rocket and Yamni (1991) who insist on the following vowel having an obvious influence on VOT values (see 2.2.2).

3.2.4 Iraqi EFL Learners' Production of Aspirated Plosives in Isolation

An overview of the results of Appendix 1 in relation to Iraqi EFL learners' production of voiceless aspirated plosives in relation to vowel context in isolation reveals three essential points. Firstly, on individual level, it is noticed that there are some discrepancies between the individual VOT values of voiceless aspirated plosives. VOT values for [p^h] in isolation are (max = 60, min =6) ms, whereas, VOT values for [t^h] in isolation are (max = 68, min =10) ms and VOT values for [k^h] in isolation are (max = 82, min =28) ms. Accordingly, individual EFL learners tend to produce voiceless plosives either with less aspiration or much aspiration unlike native speakers of English. Such differences in the production of these sounds are due to some participants can make a

clear distinction between the production of the three voiceless aspirated plosives [pʰ, tʰ, kʰ], while others cannot.

Secondly, by comparing the VOT values of the present research with other English studies results show that only [tʰ] followed /i:/ may display equal results and that is compatible with our model; i.e, Lisker and Abramson (1964). And all other participants' averages of all aspirated voiceless plosives are lower than all the results of other studies on English aspiration such as: Lisker and Abramson (1964), Caruso and Blumstein (1987) Docherty (1992) and Scobbei (2002) (as cited in Alanazi (2017). Accordingly, another problem that is concluded is that Iraqi EFL learners do not have problem in producing such sounds, but they have problem with producing voiceless plosives with appropriate English aspiration.

Thirdly, by comparing VOT results of the Iraqi EFL learners with previous VOT results of Arabic aspiration studies in isolation (see Table 4), results show the following: VOT values of Al-Ani (1970) of initial, medial [tʰ] and initial [kʰ] are equal to VOT of English [tʰ, kʰ] related to EFL learners of the present study in the same context, while VOT value of medial [kʰ] displays higher VOT value of the present study. VOT values of Kasim (2008) of initial [pʰ, tʰ] are equal to VOT values of [pʰ, tʰ] related to Iraqi Mosuli Arabic in the same context. VOT values of Rahim and Kasim (2009) of initial [pʰ, tʰ] are equal to VOT values of [pʰ, tʰ] related to Iraqi Mosuli EFL learners in the same context. VOT values of Kasim (2018) of initial and medial [kʰ] are equal to VOT values of Iraqi Mosuli Arabic EFL learners in the same context. VOT values of Al-Tai and Kasim (2021) of initial and medial [pʰ, tʰ] are equal to VOT values [pʰ, tʰ] of Iraqi Mosuli Arabic learners in the same context (see Table 6 below for a summary). The present research concludes that Iraqi EFL learners pronounce English voiceless plosives with aspiration nearer to the Arabic one than that of

English. Accordingly, on the one hand, and as reasons for such results, mother tongue language contributes positively in learning EFL as far as aspiration is concerned in the sense that the existence of such sounds in the mother tongue of Iraqi EFL learners (similarities between L1 and L2) may ease its pronunciation. On the other hand, and according to our results, we may notice that though all participants pronounce [p^h, t^h, k^h] but some participants try to apply mother tongue rules to help them in producing aspirated plosives, hence, VOT values are nearer to Arabic aspiration.

Table 6: Equal VOT results of the present study and previous Arabic studies AR=Arabic and AV. averages

Previous Ar. Studies AV.					**Present Study AV.**		
Studies	**Context**	[p^h]	[t^h]	[k^h]	[p^h]	[t^h]	[k^h]
Al-Ani (1970)	Initial, 3 vowels, isolation	----	30-40	60-70	----	33	52
	Medial, 3 vowels, isolation	----	30-40	----	----	32	----
Kasim (2008)	Iinitial, 3 vowels, isolation	19	33	----	20	33	----
Rahim and Kasim (2009)	Initial, /i:/, isolation	16	41	----	15	43	----
	Initial, /a:/, isolation	13	19	----	13	18	----
Kasim (2018)	Initial,/a:/,isolation	----	----	42	----	----	40
	Medial, /a:/, isolation	----	----	39	----	----	40
Al-Tai and Kasim (2021)	Initial, /i:/, isolation	18	41	----	15	43	----
	Medial, /i:/, isolation	16	51	----	17	48	----

Conclusion

This research concludes the following: VOT averages of the plosives [p^h, t^h, k^h] in isolation increase gradually in the order labial < alveolar <velar. The position of the sound in a word does not play a significant role in the results of this research as far as aspiration is concerned in the sense that VOT results of [p^h, t^h, k^h] related to Iraqi EFL learners are equal in all positions, viz., initially, intervocalically as well as finally. As to the vowel context, VOT results of this research follow the pattern /i:/> /u:/>/a:/ when they are preceded by /t/ and /k/ and /u:/ >/i:/>/a:/ when they are preceded by /p/ in isolation. As for production of aspirated plosives, results show that Iraqi EFL learners may display less aspiration than native speaker of English hence their VOT values do not match: or in other words are lower than English previous VOT values. And, this study concludes that Iraqi EFL learners produce English voiceless aspirated plosives in the same manner of producing Arabic voiceless plosives due to mother tongue transfer; positively as well as negatively.

References

- Alanazi, S.M. (2017). **The Acquisition of English Stops by Saudi L2 Learners.** (Doctoral dissertation, University of Essex).
- Al-Ani, S. H. (1970). **Arabic Phonology: An Acoustical and Physiological Investigation**. The Hague: Mouton& Co. N. V.
- Al-Bayaty, R.A. (2001). **Aspiration in English and Arabic: A contrastive study.** (Unpublished M.A. Thesis) University of Mosul.
- AlDahri, S. S. (2013). **A Study for the Effect of the Emphaticness and Language and Dialect for Voice Onset Time (VOT) in Modern Standard Arabic (MSA).** arXiv preprint arXiv:1305.2680.
- Al-Hamad, G. Q. (1986). **Addirasaatus sawtiyyatu ʾinda ʾulamaa ʾittajwiid.** Baghdad: Al- Khulud Publishing House.
- Al-Hamash, K. I. (1969). **A Contrastive Study of the Sound System of Iraqi Arabic and Standard English.** Baghdad: Al-Sha'ab Press.
- Al-Malwi, I. (2017). **The Effects of Gender and Age on Voice Onset Time by Abhah Arabic Speakers**. (MA Thesis, California State University).
- Al-Tai, S. M. and Kasim, Z.R. (2021). "An Acoustic Study of the Production of Iraqi Arabic stop Consonants". **Adab al-Rafidayn**, 86, 67-98.
- Bolinger, D. (1975). **Aspects of Language.** New York: Harcourt Brace Jovanovich.
- Caruso, A., and Burton, E. (1987). "Temporal Acoustic Measures of Dysarthria Associated with Amyotrophic Lateral Sclerosis". **Journal of Speech and Hearing Research**, 30, 80 -87.

- Cho, T. and Ladefoged, P. (1999). "Variation and Universals in VOT: Evidence from 18 Languages". **Journal of Phonetics**, 27(2), 207-229.
- Cohen, G. (2004). The VOT dimension: **A Bi-directional Experiment with English and Brazilian-Portuguese Stops**. (Unpublished MA Thesis) University de Federal de Santa Catarina, Brazil.
- Cruttenden, A. (2014). **Gimson's Pronunciation of English**. (8th ed.) Routledge.
- Docherty, G. (1992). **The Timing of Voicing in British English Obstruents.** Berlin: Walter de Gruyter.
- Fry, D. B. (1979). **The Physics of Speech.** Cambridge: Cambridge University Press.
- Holmes, J. and Holmes, W. (2001). **Speech Synthesis and Recognition.** (2'd ed.) London: Taylor and Francis.
- Hyman, L. M. (1975). **Phonology: Theory and Analysis**. New York: HOLT, Rinehart and Winston, Inc.
- Kasim, Z. R. (2008). The Effect of Context on Voice Onset Time. **Buhuth Mustaqbaliya Scientific Periodical Journal**, 4(1), 21-33.
- Kasim, Z. R. (2018). "Aspiration in Arabic: A Spectrographic Study"**. Journal of Education and Science for Humanities**, 21(2), 1-32.
- Kessinger, R.and Blumstein, S. (1997). "Effects of Speaking Rate on Voice-Onset Time in Thai, French, and English". **Journal of Phonetics**, 25(2), 143–168.
- Kim, C. W. (1970). "A Theory of Aspiration". **Phonetica**, 21 (2), 107-116.
- Kopczynski, A. and Meliani, R. (1993). **The Consonants of Arabic and English.** Papers and Studies in Contrastive Linguistics.

- Ladefoged, P. (2001). **Vowels and Consonants: An Introduction to the Sounds of Languages.** Oxford: Blackwell Publishers
- Ladefoged, P., and Johnson, K. (2015). **A Course in Phonetics** (7th ed.) London: Cengage Learning.
- Listiana, N. (2019). **An Error Analysis on Adult Students' Mastery in Producing English Voiceless Plosives in Initial Stressed Syllables.** (Ph.D. Thesis, UNNES).
- Lisker, L. and Abramson, A. S. (1964). "A Cross-Language Study of Voicing in Initial Stops: Acoustical Measurements". **International Linguistic Association**, 20(3), 384-422.
- Lodge, K. (2009). **A Critical Introduction to Phonetics**. London: Continuum.
- Lyons. J. (1968). **Introduction to Theoretical Linguistics.** Cambridge: Cambridge University Press.
- Macken, M. A., & Barton, D. (1980). "The Acquisition of the Voicing Contrast in English: A Study of Voice Onset Time in Word-Initial Stop Consonants". **Journal of Child Language**, 7(1), 41-74.
- Mitleb, F. M. (2009). Voice Onset Time of Jordanian Arabic Stops. **3rd International Conference on Arabic Language Processing** (CITALA'09), May 4-5, 2009, Rabat, Morocco.
- Na'ama, A. (2011). "An analysis of Errors Made by Yemeni University Students in the English Consonant-Clusters System". **Damascus University Journal**, 27(3), 145–161. Retrieved from https://goo.gl/uLgb6v.
- Port, R. F. and Mitleb, F. M. (1983). "Segmental Features and Implementation in Acquisition of English by Arabic Speakers". **Journal of Phonetics,** 11(3), 219-229.

- Rahim, A., J. (1980). **The Phonology of Spoken Iraqi Arabic from the Functional Point of View.** (Unpublished Doctoral Dissertation). University of Leeds.
- Rahim, A. J. and Kasim, Z. R. (2009). "A spectrographic Study of Voice Onset Time in Arabic". **Journal of Education and Science**, 16(36), 28-41.
- Rochet, B. L. and Yanmei, F. (1991). "Effect of Consonant and Vowel Context on Mandarin Chinese VOT: Production and Perception"**. Canadian Acoustics**, 19(4), 105-106.
- Shue, Y. and M. Iseli (2008). The Role of Voice Source Measures on Automatic Gender Classification. **Proceedings of ICASSP**, 4493-4496.
- Simpson, A. (2001). "Dynamic Consequences of Differences in Male and Female Vocal Tract Dimensions". **Journal of the Acoustical Society of America**, 109, 2153-2164.
- Smith, B. L. (1978). "Effects of Place of articulation and Vowel Environment on Voiced Stop Consonant Production." **Glossa**, 12(2), 163-175
- Swartz, B. L. (1992). "Gender Difference in Voice Onset Time". **Perceptual and Motor Skills**, 75(3), 983-992.
- Sweeting, P. M. and Baken, R. J. (1982). Voice Onset Time in a Normal-Aged Population. **Journal of Speech, Language, and Hearing Research**, 25(1), 129-134.
- Weismer, G. (1979). "Sensitivity of Voice-Onset Time (VOT) Measures to Certain Segmental Features in Speech Production". **Journal of Phonetics**, 7(2), 197-204.

Sound	Position	Tokens	S1	S 2	S3	S 4	S 5	S6	S7	S8	S 9	S10	S1 1	S12	S13	S14	S15	S16	S17	S18	AV.
/p/	Initial	Peace	16	26	11	19	19	21	11	12	16	10	12	19	20	13	13	17	11	14	15
	Intervocalic	Repeat	16	18	16	22	24	18	20	24	11	11	14	20	21	17	10	16	15	18	17
	Initial	Pool	21	27	53	60	33	29	52	13	28	23	21	30	35	41	37	23	22	42	33
	Intervocalic	Harpoon	18	37	28	34	24	34	34	22	27	23	24	32	29	30	28	34	31	24	29
	Initial	Pass	14	16	15	13	12	14	11	10	09	13	19	14	11	18	07	25	13	08	13
	Intervocalic	Depart	13	18	17	20	13	22	14	16	07	13	14	13	13	11	11	13	20	10	14
	Final	Weep	R	U	U	U	U	U	U	U	U	U	R	U	U	U	U	R	U	U	
/t/	Initial	Teen	42	42	39	68	34	48	46	39	32	38	40	46	40	56	36	55	25	50	43
	Intervocalic	Fourteen	61	47	40	54	44	43	58	40	35	41	37	42	41	41	76	73	41	51	48
	Initial	Tool	27	35	26	66	22	40	59	39	30	31	28	37	42	31	39	63	26	54	39
	Intervocalic	Cartoon	30	27	33	41	23	32	37	38	46	25	47	31	30	33	30	28	44	75	36
	Initial	Tars	17	30	21	16	23	21	35	15	15	13	11	16	14	23	10	11	13	18	18
	Intervocalic	Guitars	21	30	16	19	17	26	24	18	10	13	14	28	28	19	12	11	18	16	19
	Final	Feet	R	R	U	R	U	U	R	U	U	U	R	U	U	R	R	R	U	R	
/k/	Initial	Keen	69	67	46	66	57	70	74	76	55	52	60	56	52	65	70	75	45	79	63
	Intervocalic	Zookeeper	40	57	49	52	44	40	38	33	42	70	52	44	50	43	53	64	40	66	49
	Initial	Cool	34	44	50	72	65	68	57	59	37	33	41	38	38	57	51	58	68	82	53
	Intervocalic	Raccoon	32	56	41	38	42	46	61	49	37	48	41	43	44	56	43	69	41	59	47
	Initial	Card	38	50	34	34	38	34	44	38	33	46	38	33	51	31	31	60	42	42	40
	Intervocalic	Becalm	28	45	38	48	39	55	61	38	28	48	36	41	36	30	31	33	37	47	40
	Final	Week	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	

Appendix1. Individual VOT values and their averages of English voiceless aspirated stops after long vowels produced by Iraqi EFLs in isolation in initial, medial and final positions. All values are in millisecond (ms) , AV. = average, R= released , U= unreleased, S =subject