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Investigating EFL Learners' Production of Pre-Fortis Clipping in English at University Level

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Abstract

It is well known that vowels are shorter before voiceless consonants than voiced ones in English, as in many other languages. The main objective of this study is to examine EFL learners' capacity to produce shorter vowels before a fortis consonant and longer vowels before a lenis consonant. Twenty EFL learners were requested to produce the English vowels / i:, α:, ɔ:, u:, ʒ:, ɪ, æ, ʊ/ and Arabic vowels / i: , a:, u: ,i , a , u /, once before the voiceless stop /t/ and once before the voiced stop /d/. The duration of each vowel was measured for each speaker. For this purpose, the quantitative approach is adopted. The recordings were analyzed using the Praat program. The results revealed that vowels preceding /t/ were shorter than those preceding /d/, confirming the presence of pre-fortis clipping in English and Arabic. The results were compared to those of the native speakers' mother tongue performance.

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مجلة التربية للعلوم الإنسانية

مجلة علمية فصلية محكمة، تصدر عن كلية التربية للعلوم الإنسانية / جامعة الموصل



بحث ظاهرة تقليص زمن أصوات العلة المتبوعة بأصوات مهموسة عند متعلمي اللغة

الإنكليزية في المستوى الجامعي

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جامعة الموصل/ كلية التربية / قسم اللغة الإنكليزية / الموصل - العراق^{1, 2}

الملخص

معلومات الارشفة

من المعروف أن حروف العلة تكون أقصر قبل الحروف الساكنة الشديدة مقارنة بالحروف الساكنة الرخوة في اللغة الإنكليزية، كما في العديد من اللغات الأخرى. الهدف الرئيسي من هذه الدراسة هو فحص قدرة متعلمي اللغة الإنكليزية (EFL) كلغة أجنبية على نطق حروف العلة أقصر قبل الحرف الساكن الشديد وأطول قبل الحرف الساكن الرخو. طُلب من عشرين متعلمًا للغة الإنكليزية نطق حروف العلة الإنكليزية /i:, a:, ɔ:, u:, ʒ:, ɪ, æ, ʊ/ والحروف العلة العربية /i:, a:, u:, i, a, u/ مرة قبل الحرف الساكن الشديد /t/ ومرة قبل الحرف الساكن الرخو /d/. تم قياس مدة كل حرف علة لكل متعلم. تم اعتماد النهج الكمي في هذه الدراسة. تم تحليل التسجيلات باستخدام برنامج Praat. أظهرت النتائج أن حروف العلة التي تسبق /t/ كانت أقصر من تلك التي تسبق /d/، مما يؤكد وجود ظاهرة تقليص زمن أصوات العلة ما قبل الحرف الساكن الشديد في كلا الجنسين الإنكليزية والعربية. تمت مقارنة النتائج بأداء الناطقين الأصليين في لغتهم الأم

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معلومات الاتصال

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1. Introduction

Several studies have indicated that the length of English vowels depends on whether the following consonant is voiced or voiceless. Many instrumental studies demonstrate that vowels preceding voiced consonants tend to be slightly longer than the same vowels spoken before unvoiced cognates. This phenomenon is called pre-fortis clipping (PFC) (Lehmann & Heffner, 1943; Peterson & Lehiste, 1960; Sharf, 1962; Umeda, 1975). Lehiste (1970) and Flemming (1997) (as cited in Oh, 2006, p. 19) explain this difference in vowel duration in that the lengths of vowels and consonants change to keep the duration of the syllable relatively constant.

1.1 Statement of problem

It is widely accepted that adults' speech production is somewhat influenced by their native language's phonological system (L1). While learning a second language (L2), learners frequently struggle with producing distinct sounds that exist only in L2 but not in L1. Many studies have demonstrated that foreign language learners and native speakers differ in their ability to produce L2 phonetic contrasts. For example, unlike in English, where vowel duration is clipped before fortis, some Arabic literature (Port et al., 1980; Munro, 1993) found significant vowel shortening depending on voicing, while other literature (Flege & Port, 1981; Mitleb, 1984) did not (Cho, 2016, p. 12).

1.2 Research questions

The current study attempts to answer the following questions:

1. How do EFL learners pronounce English vowels when they occur before voiceless stops compared to when they occur before voiced ones?
2. How do EFL learners pronounce Arabic vowels when they occur before voiceless stops compared to when they occur before voiced ones?

1.3 Aim of the study

The main purpose of this study is to investigate EFL learners' ability to produce longer vowels before a lenis consonant and shorter vowels before a fortis consonant. Additionally, their English pronunciation will be compared to their Arabic performance.

1.4 Hypotheses of the study

In light of the aims set above, it is hypothesized that :

1. EFL learners do not have the ability to distinguish between English vowel duration before voiced/voiceless consonants due to the different vowel systems of English and Arabic.
2. EFL learners have the ability to distinguish between Arabic vowel duration before voiced/voiceless consonants.

1.5 Limits of the study

This study is limited to:

- English long pure vowels / a: , i: , u: , ɜ: , ɔ: / and the three short vowels / ɪ , æ , ʊ / . Long vowels can be easily measured when they become shorter. Also, pure vowels have a steady state while diphthongs glide from one vowel into another (i.e. it is difficult to measure diphthong duration).
- English stop consonant / t , d /. Pre-fortis clipping also affects sonorant consonants but they are excluded in this study.
- Production to the exclusion of perception.
- EFL third year students of the University of Mosul/ Colleges of Education for Humanities/ Department of English for the academic year 2023/2024.

2. Theoretical Background

2.1 The Concept and Definitions of pre-fortis clipping

The concept of PFC has been approached from different angles with varying limitations. Ashby and Maidment (2005) have proposed several definitions as follows: **“Pre-fortis clipping** is a reduction in the duration of a vowel or diphthong when it is in a syllable that has one or more fortis consonants at the end” (p.100). “The duration of a vowel may be influenced by whether the following consonant is voiced or voiceless. This effect is very prominent in some accents of English and is known as **Pre-fortis Clipping**” (p.127). The last is the reduction in the duration of sonorant sounds when followed in the same syllable by a fortis consonant. For example, the vowel in the English word seat [si:t] is clipped, whereas that in seed [si:d] is not” (p.197).

The term **clipping** is defined by Colman (2009, p.138) as pronouncing a vowel more quickly than normal, without changing its sound quality, as in the pronunciation of the vowel in the word *rice* compared with the same vowel in the word *rise*. In English, a vowel is clipped when followed by a fortis consonant rather than a lenis consonant within the same syllable, and this phenomenon is called pre-fortis clipping: compare *beat/bead* , *loose/lose* , *rate/raid*.

Carley and Mees (2019, p.12) defined PFC as "voiceless (also known as fortis) obstruents shorten sonorants that precede them in the same syllable. This phenomenon is termed pre-fortis clipping and is most often discussed in relation to vowels, but it also affects sonorant consonants."

2.2 The Importance of Pre-Fortis Clipping

Pre-fortis clipping holds significance not only for the correct pronunciation and identification of vowels but also as a cue to the identity of consonants. Obstruents in English that are voiced are only potentially fully voiced - they are often only partially voiced or may even be completely devoiced. In such instances, the duration of the preceding sonorant, which includes vowels, nasals, and approximants, is a crucial indicator for distinguishing between voiced and voiceless obstruents (Carley, Mees & Collins, 2018, p.142). Pre-fortis clipping refers to the voicing feature of the consonant following the vowel in question, which is the key factor for interpreting vowel duration changes (Fejlová, 2014, p.93).

2.3 Factors Affecting Vowel Duration

The duration of a vowel is not constant and is affected by various contextual factors. Many phoneticians have studied the impact of these factors over time, including Lehiste and Peterson (1960), Wiik (1965), Luce and Charles-Luce (1985), Crystal and House (1988), and Van Santen (1992).

The initial factor is the inherent phonological duration of vowels, with the near-open front vowel /æ/ being inherently longer than the close-mid front vowel /e/ and so on. The second one refers to the difference in length between the near-close near-front vowel /ɪ/ when followed by a fortis consonant /t/ in the word "kit" and when followed by a lenis consonant /d/ in the word "kid". It also refers to the difference in length of the centering diphthong /eɪ/ in the words "late" and "laid" (Hrychová, 2015, p. 13).

Another component is the placement of vowels within the syllable and the level of stress on the syllable (vowels in stressed positions tend to have a longer duration than those in unstressed positions). Additionally, Van Santen (1992) notes that "the duration of stressed vowels in word-initial syllables decreases as the number of syllables increases" (p. 532). The position of a word within a sentence and its proximity to a syntactic boundary can affect its length, with syllables near the word boundary tending to be longer. Furthermore, monosyllabic words generally have longer vowel duration compared to polysyllabic words. Other factors that can influence word length include speaking rate, emphasis, and semantic novelty (Hrychová, 2015, p. 13).

2.4 Context of Pre-fortis Clipping

As a result of pre-fortis clipping, the /i:/ sound in "feed" and "feet" has diverse durations. According to Gimson (as cited in Ramsaran, 1990, p. 78), the terms 'shortness' and 'reduction' of sounds can lead to confusion. For example, classifying phonemically distinct vowels like /i:/ and /ɪ/ as 'long' and 'short', respectively, could be confusing. Furthermore, classifying them as 'reduced' could be problematic because this term usually implies a decrease in quality, with a 'reduced' vowel being of the [ə] type. Therefore, the phrase 'clipping' is preferred to avoid these challenges.

English vowels undergo pre-fortis clipping when a fortis consonant follows them in the same syllable. The /f/ sounds in "self," "selfish," and "dolphin" trigger clipping, while those in "shellfish" and "funfair" do not. The vowel /æ / experiences pre-fortis clipping in words like lap, lamp, happy, and hamper, but not in slab or clamber (Ramsaran, 1990, p. 78).

A non-vowel may come before a fortis consonant. This phenomenon occurs in syllables that finish with the consonant sounds l, m, n followed by a voiceless consonant such as p, t, or k. Examples include words like 'belt', 'bump', 'bent', and 'bank'. The impact on those continuous consonants is the same as on a vowel: they are significantly shortened in length (Roach, 2009, p. 56).

Vowels followed by voiced plosives had greater durations compared to those followed by voiced fricatives, whereas voiced affricates were found to have the least impact on the durations of the preceding vowel (Hrychová, 2015, p. 40).

2.5 Pre-fortis Clipping in Different Languages

Previous studies have revealed that the pre-fortis clipping is attested in English and other languages such as Korean, Russian, French, and Italian (Mack, 1982, Chen, 1970, Maddieson, 1997, Esposito, 2002). However, the voicing-dependent durational differences are much smaller in these languages than in English (Yoneyama & Kitahara, 2014, p. 30),

2.5.1 Native Korean Learners

Korean lacks a distinction in the voicing of consonants at the end of words, but maintains this distinction in the middle of words. Furthermore, it is worth noting that the Korean language does not exhibit a distinction between tense and lax vowels. As a result of these linguistic differences, Korean speakers will show distinct patterns compared to those of native English speakers. In productions, Korean speakers indicated a greater similarity to English in terms of vowel duration differences in the tense-lax distinction compared to the voicing contrast. Conversely, they performed better in perceiving the voicing contrast than in perceiving the tense-lax distinction (Chung, 2019, p.16)

2.5.2 Native Russian Learners

In Russian, the vowels were slightly longer before a voiced stop compared to before a voiceless stop. The native Russian speakers of English revealed larger differences in vowel duration for English compared to Russian. Experienced learners demonstrated a greater ability to acquire vowel duration values that resemble those of native speakers, compared to less experienced learners. This finding indicates that learning takes place gradually as learners acquire further experience with the second language (Oh, 2006, p. 31).

2.6 The Effect of First Language on Foreign Language Learning

The phonological system of the first language (L1) is believed to impact adults' speech production and perception. When acquiring a second language (L2), learners often encounter difficulties in articulating and recognizing distinct sounds that are exclusive to L2 but not present in L1. Multiple studies have revealed that there exists a difference in the ability to articulate and recognize L2 phonetic contrasts between foreign language learners and native speakers.

It could be argued that the learning of second-language vowel patterns is influenced by the vowel system of the first language, resulting in an impact on vowel length (Le, 2023, p. 94).

English language learners often struggle with pronouncing words that contain pre-fortis clipping. It has been shown that in comparable situations, many EFL students fail to notice variations in the duration of vowels (Hrychová, 2015, p.7).

2.7 Previous Studies

Several scholars have investigated pre-fortis clipping. Chen (1970) researched how vowel length changes based on the [+voice] property of the following English, French, Russian, and Korean consonants. The question was whether the difference in duration is mainly due to linguistic structure, a learned language-specific speech habit in English, or if it was influenced by an inherent physiological aspect of articulation, specifically a physio-acoustic constant that regulates vowel duration. Each language's word list contained minimal or near-minimal pairs. Pitch, stress, rhythm, and other prosodic patterns were carefully matched for each pair member to remove duration variability caused by suprasegmental features. All test words were authentic; no fabricated syllables were included. Each word was checked by a native speaker six times, with 3 repetitions in isolation and 3 in alternation with its pair, except for English, which had only 3 recordings per word. Recordings, spectrograms, and measurements were conducted only in English for comparison and control. The results indicated that vowel duration varied based on the voicing of the subsequent consonant, suggesting it was a universal feature in language. A vowel was consistently longer before a voiced consonant than an unvoiced one in all the languages studied due to an inherent articulatory component.

Munro, Fledge, and Mackay (1996) studied how learning a second language at an earlier age affected how English vowels were produced. This study looked at the vowel productions in English of 24 native English speakers and 240 native Italian speakers who had arrived in Canada between the ages of 2 and 23. Ten listeners scored the degree of foreign accent in 11 different vowel sounds. The findings indicated that every vowel showed increased perceived accentedness with increasing age of arrival. Not one of the vowels was observed to be produced in a consistently native-like manner by the latest-arriving learners, even though they had been living in Canada for an average of 32 years.

However, good intelligibility (per cent correct identification) scores were obtained for the same production set. This was true even for English vowels that have no equivalent in Italian.

Kasim (2021) examined how voiceless-voiced consonants impacted vowel duration in Arabic. The research questions were: what are the differences in vowel duration? And is there a connection in Arabic between the length of the closure duration and the preceding vowel? The study had two objectives. One approach was to analyse the lengths of the Arabic long vowels /a:/, /u:/, and /i:/ before the consonants /t/ and /d/ to determine if the vowels were shorter before a fortis stop and longer before a lenis stop. The second objective was to determine if there was a correlation between the durations of the closure of the stop consonants by comparing the final stop closure durations of the stops /t/ and /d/. The hypothesis stated that the duration of vowels before fortis stops was shorter than before lenis stops and fortis stops had longer closure durations than lenis stops. The study assessed the lengths of the Arabic vowels /a:/, /u:/, and /i:/ in a CVC context, with the last consonant being either /t/ or /d/. Ten native Arabic speakers read three minimal pairs in a carrier sentence three times each, resulting in 180 tokens. A spectrogram was generated for each token, and the duration of each vowel was quantified. Furthermore, the closure duration of the last stops, specifically /t/ and /d/, were measured to see if there was a relationship between the durations and vowel length. The study found that vowels preceding lenis consonants were longer than those preceding fortis consonants in Arabic, showing similarity to other languages. However, there were no significant variations in closure durations between fortis and lenis stops and vowel length.

3. Methodology

3.1 Data

Two lists are constructed to acquire a corpus for the study. Both lists include minimal pairs in which medial vowels occur directly before voiceless/voiced stops. The first list has 16 English words consisting of long and short vowels. The long vowels are /i:/, /a:/, /ɔ:/, /u:/, /ɜ:/ and these are selected because pre-fortis clipping is clearer with long vowels than short ones. Only three short vowels /ɪ, æ, ʊ/ are chosen from English for the reason that they correspond to Arabic /i, a, u/. The second list has 12 Arabic words also consisting of long vowels /i:/, /a:/, /u:/ and short ones /i, a, u/. The total inventory consisted of 28 words (see Appendix).

3.2 Sample

Twenty males and females were specifically selected to represent the sample of this study. These were all the EFL third-year students at the Department of English, College of Education, University of Mosul, for the academic year (2024- 2025). The reason for selecting this specific stage is that they represent a rather advanced level because they reportedly have obtained a high level of academic competency in English. The selected participants all speak Arabic as their first language and learn English as a foreign language. The 20 learners (13 males, and 7 females) were randomly selected. At the time of the test, participants were 20-28 years old. The following table (1) shows the age ranges of the study.

Table 1. Age and number of the participants

Gender	Number	Age
Males	13	20-28
Females	7	20-23

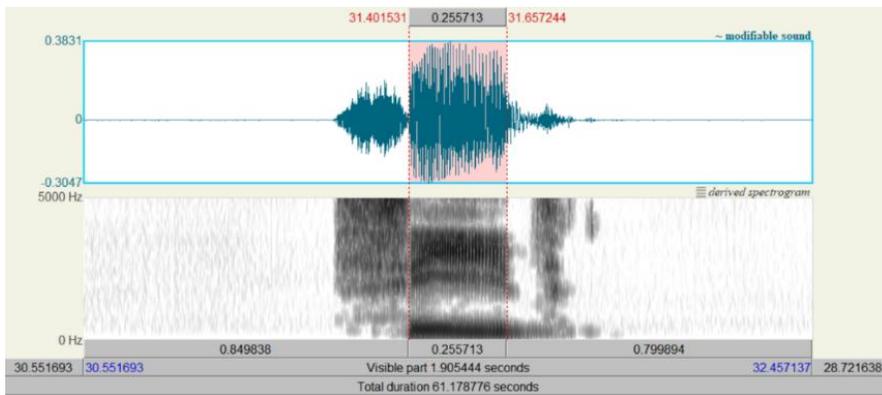
3.3 Procedure

This study aims to investigate vowel duration using data collection tools that result in numerical data. Therefore, the most appropriate research method for this research is quantitative that depends on vowel duration measurements of the pronunciation of EFL learners. Dörnyei (2007, p.24) defines quantitative research as a methodology that involves gathering data through techniques that primarily produce numerical information, which is subsequently examined primarily using statistical methods. Quantitative research involves collecting numerical data to address a specific research question (Christensen, Johnson & Turner, 2020, p. 19). Creswell (2003, p. 153) also defines it as gathering data in order to quantify and analyze it statistically, with the objective of either supporting or disproving "alternate knowledge claims".

The durational measurements to be reported are manually taken using Praat (Boersma & Weenink, 2021). The speakers' productions are processed into a digital format with a bit rate of 16 bits and a sampling frequency of 44.1 kHz. These digital files are subsequently transferred to a computer to examine their acoustic properties over time (Algethami, 2023, p. 3). The data are presented to the participants in flash cards in a random manner, with each word written in isolation. English words were initially introduced, followed by the Arabic ones.

According to Adi, Keshet, and Goldrick (2015), spectrogram and waveform cues are used to indicate the beginning and end of vowels. The energy concentration in the region of the first formant during aspiration is frequently comparable to that at other formant frequencies in vowels involving high first formants (particularly /ɑ/, /æ/, and /ɔ/). However, the onset of voicing is typically clearly distinguishable as the moment in time at which periodic striations began in the first formant frequency (Peterson & Lehiste, 1960, p. 694). Simultaneously, vowel offset criteria are established to identify the final glottal vibration of the vowel preceding a specific event linked to the arresting consonant, namely the change in waveform related to voiced and voiceless stops. The boundary placements on the oscillograms are verified using spectrograms (Allen, 1978, p. 1179). The results are displayed in milliseconds; see Figure 1.

Figure 1: The onset and offset of vowel duration in the word “seat”



4.1 Data Analysis

4.1.1 English vowels

The long vowels will be introduced first, followed by the short vowels. Table 2 below presents the durations of the English vowels in ms.

Table 2. The average Vowel Duration in English in ms.

English words	Vowel duration
seat /si:t/	224.58
seed /si:d/	266.65

cart /kɑ:t/	255.25
card /kɑ:d/	277.45
caught /kɔ:t/	240.2
cord /kɔ:d/	268.8
suit /su:t/	233.1
sued /su:d/	249.5
hurt /hɜ:t/	232.1
heard /hɜ:d/	270
hit /hɪt/	102.6
hid /hɪd/	101.2
hat /hæt/	156.3
had /hæd/	189.9
put /pʊt/	87.15
pud /pʊd/	96.35

1- /i:/

The minimal pair of this long vowel is (seat/seed). The experiment results show that the average vowel duration of the vowel in the word "seat" is shorter than the vowel duration in "seed".

2- /ɑ:/

The minimal pair for this long vowel is (cart/card). The duration of the vowel in the word "card" is longer than the duration of the vowel in the word "cart".

3- /ɔ:/

(caught/cord) is the minimal pair that used for this long vowel. In comparison to the duration of the vowel in the word "cord," the duration of the vowel in the word "caught" is shorter.

4- /u:/

The minimal pair for this long vowel is (suit/sued). The duration of the vowel in the word "suit" is shorter than the duration of the vowel in the word "sued."

5- /ɜ:/

The minimal pair for this long vowel is (hurt/heard). In comparison to the duration of the vowel in the word "heard", the duration of the vowel in the word "hurt" is shorter.

6- /ɪ/

The minimal pair for this short vowel is (hit/hid). The outcomes of the experiment are extremely close. There is a small difference in the duration of the vowels between the word "hit" and the word "hid".

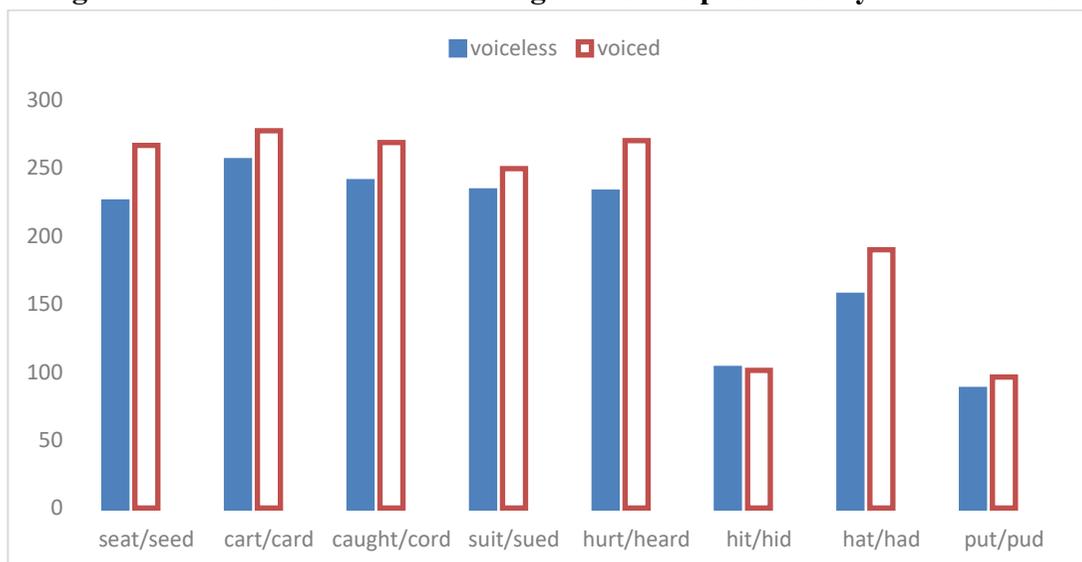
7- /æ/

The pair (hat/had) represents a type of short vowel. When compared to the duration of the vowel in the word "hat", the duration of the vowel in the word "had" is longer.

8- /ʊ/

The minimal pair for this short vowel is (put/pud). The vowel duration for the word (put) is shorter than the vowel duration of (pud).

Figure 2. Vowel durations of the English vowels produced by EFL learners



4.1.2 Arabic Vowels

The long vowels will be introduced first, followed by the short vowels. Table 3 below presents the durations of the Arabic vowels in ms.

Table 3. The average vowel durations in Arabic in ms.

Arabic words	Vowel duration
رُفَات /ru'fa:t/	277.55
رُفَاد /ru'fa:d/	277
قُوت /qu:t/	220.9
قُود /qu:d/	212.25
أَبِيْت /abi:t/	182.75
أَبِيْد /abi:d/	222.9
قَات /qat/	86.5
قَاد /qad/	96.95
عُت /ʕut/	103
عُد /ʕud/	110.25
صَائِت /'ʂa:ʔit/	91.45
صَائِد /'ʂa:ʔid/	93.95

1- /a:/

The minimal pair for this long vowel is (ru'fa:t/ru'fa:d). It appears that the outcomes of the experiment are pretty similar. The duration of the vowel for both of these words is nearly identical.

2- /u:/

The pair for this long vowel is (qu:t/qu:d). When compared to the duration of the vowel in the word (qu:t), the duration of the vowel in the word (qu:d) is shorter.

3- /i:/

The minimal pair for this long vowel is (abi:t/abi:d). The duration of the vowel in the word (abi:t) is shorter than the duration of the vowel in the word (abi:d).

4- /a/

The minimal pair for this short vowel is (qat/qad). The duration of the vowel in the word (qat) is shorter than the duration of the vowel in the word (qad).

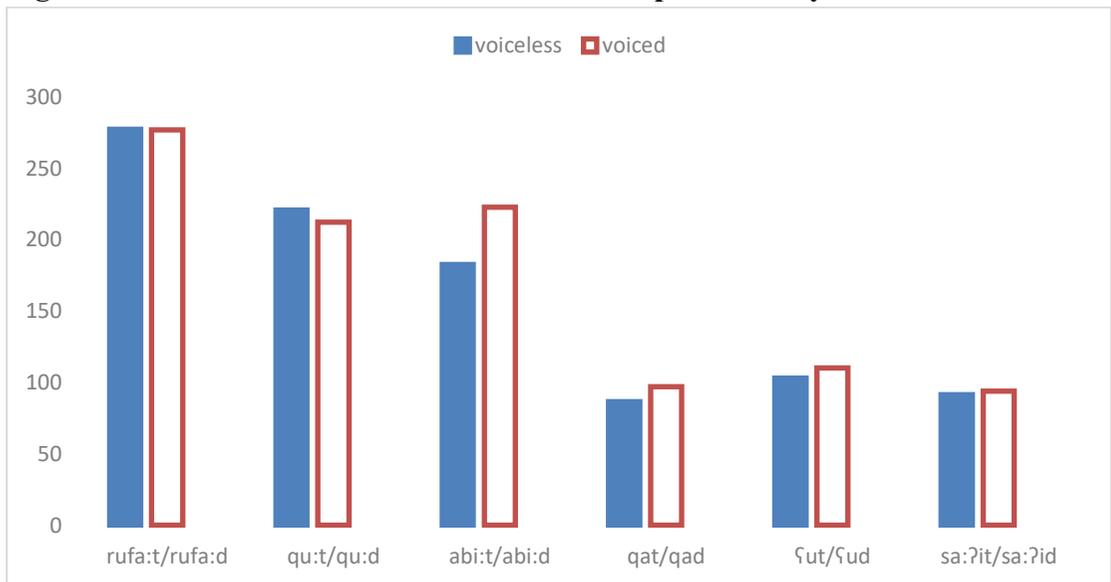
5- /u/

This particular short vowel has a minimal pair that is (ʕut/ʕud). The duration of the vowel in the word (ʕut) is longer than the duration of the vowel in the word (ʕud).

6- /i/

An example of the minimal pair for this short vowel is ('ʕa:ʔit/'ʕa:ʔid). The vowel duration for the word ('ʕa:ʔit) is shorter than the vowel duration of ('ʕa:ʔid).

Figure 3. Vowel durations of the Arabic vowels produced by EFL learners



4.2 Discussion

Data analysis has shown different results. Research question one concerns EFL learners' pronunciation of English vowels before voiceless stops compared to voiced ones. The results of the production experiment for monosyllabic words fairly support the idea that vowels are universally shorter before voiceless consonants than voiced consonants. The acoustic analysis conducted in this study revealed differences in the duration of English vowels: most vowels are shorter when followed by a voiceless consonant and longer when followed by a voiced consonant (see Table 2 and Figure 2). This result is somehow expected, as Iraqi EFL learners do have a long/short distinction between vowels. The results reject the first hypothesis, which states that EFL learners cannot distinguish between vowel duration before voiced or voiceless consonants. Similar results were obtained by Chen (1970) suggesting that pre-fortis clipping was a universal feature in language. An exception is made for the vowel (ɪ) since the duration of the vowel before the voiceless stop is slightly greater than the duration before the voiced stop (Table 2). Our results support Zhou's view (2010), in which the vowel /ɪ/ is the most problematic for Chinese EFL learners in the pre-bilabial stop context. Arabic vowels before voiceless and voiced stops are pronounced differently by EFL learners, according to the experiment results. The pre-fortis clipping phenomenon, was seen in all short vowels and /i:/, according to the acoustic analysis. The result shows that the second hypothesis is accepted. Our results support Faraj's view (1987) in which voiced consonants had a slightly longer effect on vowel duration than voiceless consonants did. An exception is the two long vowels /a:, u:/ which are longer before a voiceless consonant and shorter before a voiced consonant (see Table 3 and Figure 3).

5 Conclusion

The current study reached multiple results in relation to the aims and research questions that were attempted.

1. The phenomenon of pre-fortis clipping exists in both English and Arabic.
2. As far as EFL learners' performance, the duration of vowels preceding voiceless stops is shorter than that of vowels preceding lenis stops. Pre-fortis clipping is present in the EFL learners' English performance.

3. As far as EFL learners' Arabic performance, the duration of vowels preceding voiceless stops is shorter than that of vowels preceding lenis stops. Pre-fortis clipping is generally present in Arabic, except for two vowels.
4. EFL learners struggled to accurately pronounce all English vowels, including difficulties with certain vowels.

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Appendix

Vowel Duration

Subject Word	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
seat /si:t/	164	248	199	204	189	244	224	181	166	197	292	222	220	200	279	272	201	195	238	342
seed /si:d/	246	261	259	200	193	206	344	192	165	203	247	267	247	206	257	275	192	203	264	392
cart /ka:t/	286	288	250	214	216	191	292	296	216	252	294	206	248	225	320	291	254	261	296	209
card /ka:d/	281	307	304	288	203	277	256	277	241	287	359	225	266	240	305	309	264	278	284	298
caught /kɔ:t/	293	290	243	216	221	278	190	236	222	183	326	204	215			281	178	211	251	287
cord /kɔ:d/	275	324	278	291	156		244	283	230	266	304	299	297	219	286	291		213	286	297
suit /su:t/	187	273	231	206	145	217	230	200	204	277	289	294	224	229	246	254	201	204	244	307
sued /su:d/	257	221	283	226	208	244	292	233	255	260	247	214	258	259	192	293	211	219	255	363
hurt /hɜ:t/	148	154	261	215	200		238	258	171	270	288	263	227	215	281	262	194	201	273	289
heard /hɜ:d/	250	275	252	255	217	311	260	341	229	204	332	279	229	271	324	285	247	235	292	314
hit /hɪt/	90	125	123	58	110	82	96	64	97	91	152	145	113	80	110	113	98	80	132	93
hid /hɪd/	75	75	139	70	69	88	114	79	84	97	147	126	128	102	116	134	121	72	97	92
hat /hæt/	118	154	149	125	119	100	91	111	145	125	269	115	198	146	261	232	161	133	177	198
had /hæd/	147	247	266	185	149	188	224	153	161	122	251		199	158	216	226	170	168	195	184
put /pʊt/	97	95	101	49	83	60	72	63	78	105	111	98	91	82	72	92	111	104	91	88
pud /pʊd/	66	103	149	59	90	155	116	77	102	106	89	67	112	111	88	68	103	59	99	108
/ru'fa:t/ رُفَات	266	202	230	231	199	276	235	243	173	214	264	209	228	195	235	257	204	250	289	251
/ru'fa:d/ رُفَاد	246	194	263	221	164	241	241	209	193	219	306	204	180	251	231	234	197	238	263	245
/qu:t/ قُوت	148	219	205	224	138	267	192	203	206	272	284	190	192	215	254	289	230	231	218	242
/qu:d/ قُود	196	187	284	138	142	255	180	251	160	232	286	245	206	243	236	225	190	186	215	188
/abi:t/ أْبِيْت	149	140	198	166	152	163	221	185	162	192	264	199	146	203	178	227	147	183	160	220
/abi:d/ أْبِيْد	253	230	234	220	202	243	208	227	172	183	257	224	240	243	209	226	203	224	207	248
/qat/ قَات	85	101	124	59	83	77	77	66	67	98	78	96	96	70	106	79	92	103	87	86
/qad/ قَاد	92	104	145	76	84	81	93	103	75	102	96	95	97	79	107	72	120	115	108	95
/ʕut/ عُت	79	115	118	82	100	167	111	106	93	86	116	75	88	97	113	91	151	78	90	106
/ʕud/ عُد	94	124	123	92	136	114	109	97	104	122	103	119	99	99	103	114	131	101	113	108
/ʕa:ʔit/ صَائِت	97	89	105	90	98	78	105	85	69	99	97	91	98	82	89	74	90	109	74	110
/ʕa:ʔid/ صَائِد	91	97	110	88	70	116	118	99	86	116	88	83	97	102	82	88	80	84	98	86