The Articulatory Timing of the English Supee-heavy Syllable as Produced by Iraqi EFL Postgraduate Students: An Acoustic Study

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Abstract:

The current study investigates the phenomenon of articulatory timing and its variation between native speakers and foreign language learners. More specifically, the study focuses on the articulatory timing of heavy syllables in four multi-syllabic words produced by 36 Iraqi EFL postgraduate students. The study aims to answer the questions:(1) what are the differences in the AT of the four selected words between the standard native articulation and the articulatory of Iraqi EFL under study (2) What are the factors causing such articulation timing variance? The researcher adopts the Moraic Theory and the PRAAT software to analyze the data. The analysis has revealed that Iraqi EFL postgraduate students, as non-native speakers of English, produce (super-heavy syllables) with variant AT compared to the standard AT produced by the English native speaker. Additionally, it is concluded that the pronunciation of Iraqi EFL under study is mainly affected by the factor of vowel modification. This factor was registered with high percentages in the items (herbicide, entertain, proverbial and amazing). The students often modify the vowel sounds more than they do with the consonant sounds. Furthermore, the AT variance is less when the token is familiar, while the AT is more variant when the token is unfamiliar to the students.

Keywords: Articulatory Timing, Syllable, Stress, The Moraic Theory.

* The present study is extracted from an M.A. thesis written by the first author and supervised by the second one.

التوقيت اللفظي لمقاطع اللغة الانكليزية كما يلفظها طلبة الدراسات العليا العراقيون من متعلمي اللغة الانجليزية كلغة اجنبية: دراسة صوتية ـفيزيائية

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الملخص:

تبحث الدراسة الحالية في ظاهرة التوقيت اللفظي وتباينه بين المتحدثين الاصليين ومتعلمي الغة الانجليزية كلغة أجنبية. وبشكل أكثر تحديدا، تركز الدراسة على التوقيت اللفظي للمقاطع فوق الثقيلة في أربع كلمات متعددة المقاطع نطقها ٣٦ طالب دراسات عليا عراقي في اللغة الإنجليزية كلغة أجنبية. تهدف الدراسة إلى الإجابة على الأسئلة: (١) ما هي الاختلافات في الكلمات الأربع المختارة بين التوقيت الأصلي القياسي للمقاطع وتوقيت النطق لدى طلاب الدراسات العليا قيد الدراسة؟ (٢) ما هي العوامل التي تسبب هذا التباين في توقيت النطق؟

يتبنى الباحث نظرية المورا وبرنامج PRAAT لتحليل البيانات كشف التحليل أن طلاب الدراسات العليا العراقيين في اللغة الإنجليزية كلغة أجنبية، بصفتهم غير متحدثين أصليين للغة ، ينتجون (مقاطع فوق الثقيلة) مع AT متباين مقارنة ب AT القياسي الذي ينتج المتحدث الأصلي باللغة الإنجليزية. بالإضافة إلى ذلك، استنتج الباحث أن نطق طلاب الدراسات العليا قيد الدراسة يتأثر بشكل أساسي بعامل تعديل حرف العلة. تم تسجيل هذا العامل بنسب عالية في العناصر غالبا ما يقوم الطلاب بتعديل أصوات المعتلة أكثر مما يفعلون مع الأصوات الساكنة. علاوة على ذلك، يكون تباين AT أقل عندما تكون الكلمة مألوفة، بينما يكون AT أكثر تنوعا عندما يكون الكلمة غير مألوفة لدى الطلاب. الكلمات المفتاحية: التوقيت اللفظي، المقطع لفظي، التشديد، نظرية المورا .

1.Introduction

Timing plays a crucial role in the creation of spoken sounds, including the synchronized muscular activity of the rib cage, mouth articulators, and larynx structures as well as the individual motions of these structures (Abed & Abdulmajeed ,2021, p416). The scheduling of a speech allows the speaker to perform controlled trials in which the component of interest is methodically changed while all other variables are held constant. Numerous variables that influence speaking cadence were identified through extensive experimental work performed between the 1950s and 1980s. Such examples include i) global factors such as speech pace and speech style (e.g., clear versus relaxed), vowel and consonant type; and ii) contextual factors such as prominence (word stress, phrasal stress), syntax, predictability, and neighboring segment type (Lehiste, 1960; Klatt, 1976, associated in Turk & Shattuck-Hufnagel, 2014).

Articulatory timing (henceforth, AT) patterns are language specific. Thus, foreign language learners' difficulties in the management of non-native AT may be due to the articulatory habits of their native languages. Sole (1997) affirms the influence of a native language on a foreign AT reporting that "One of the essential characteristics of the phonology of human languages is the arrangement of phonetic units into syllables with

an internal constituency of onset consonants, a nucleus (vowel), and coda consonants.

The Iraqi higher educational system recognizes English as a Foreign Language (EFL)(Ministry of Higher Education)(Jaaar,2022,p867).Iraqi Students seem to have their production difficulties and problems with the AT of the heavy English syllables .The difficulty in mastering foreign language timing patterns derives from the fact that timing habits in the L1 get fossilized as articulatory subroutines (sequences of articulatory instructions that operate together) in adult speakers, and new phasing relations between articulators within and across segments have to be learned and automized" (Sole, 1997, p. 540). The AT can be a critical factor that leads to unexpected sounds or incorrect pronunciation. And for foreign language learners, the unfamiliarity of the target timing patterns may result in mistiming gestures, which can be the reason for foreign accents. Moreover, and to the researcher's knowledge, AT has only been investigated concerning polysyllables. Accordingly, the current study attempts to bridge this gap by measuring the variance in the AT elicited from Iraqi EFL postgraduate students as they exhibit their production difficulties and problems with the AT of the English super-heavy syllable.

2.Literature review

2.1 the Concept of the Syllable

Linguistic sounds are studied by two branches: phonetics and phonology. The orientations have studied Arabic phonemes and their phonetic variance like slanting in the field of phonetics (Al-Fadhli,2017, p345). In both phonetics and phonology, the syllable is regarded as a very important unit. This word is derived from the Greek term 'syllambanein', which means "to assemble" (Hartman, 1998). Different perspectives have been taken by phoneticians and phonologists about the importance of the concept of the syllable. Some of them have seen it as a significant unit, while others have advocated ignoring it and seeing it as something

abstract. According to O'Connor (1973, p. 201), a syllable is a significant unit because "it exists in the language whether we like it or not." Roach (1999, p. 73) verifies this viewpoint by adding that an English poem rhymes by matching the last syllable of one line with that of the next line. Phonetically, syllables "are often defined as having a centre that has little or no blockage to airflow and sounds relatively loud; before and after the centre, there will be more obstruction to airflow and/or lower volume" (Roach, 2000, p. 70). In the monosyllable (one-syllable word) cat / kæt/, the vowel /æ/ is the "core" or "peak" where no blockage occurs, but the surrounding plosives /k/ and /t/ completely restrict the airflow.

According to Finch (1997, p.66 "phonology is concerned with the sound structure of the language, in particular with the way in which sounds can form word's structure". (Rezqallah,2020, p.96). Phonologically, the syllable is a unit of spoken language consisting of at least a single uninterrupted sound. Laver (1994, p. 114) defines the phonological syllable as "a complex unit made up of nuclear and marginal elements". Nuclear elements are the vowels or syllabic segments; marginal elements are the consonants or non-syllabic segments. Blevins (1995, p. 76) argues that the English syllable is seen as a "phonological constituent", representing a speech unit which is larger than a segment, smaller than a word and having "exactly" one peak of sonority.

The English syllable is linguistically dealt with as a phonological unit, but also there are attempts to count for the concept of the linguistic syllable phonetically, whether or not it can be defined physically. It is not an easy task to state an "agreed [upon] phonetic definition" for a syllable, though people may "identify individual syllables" in words or phrases they say. There is no "objective phonetic procedure", by which one can identify how many syllables are there in a word or can judge the exact place of the boundaries between syllables in a word or a phrase in all languages (Ladefoged & Johnson, 2011, pp. 243-244).

2.2 The Syllable Structure and its Types

Phonological perspectives on syllables emphasize how sounds mix in different languages to form characteristic sequences. Here, two groups of sounds are often distinguished: vowels, such as /i, a, e, u, o/ and consonants, including /p/, /g/, /k/, /t/, etc. Every syllable must have a vowel component, which is known as the nucleus. The optional starting consonant or consonants are referred to as the onset, while the optional ending consonant or consonants are referred to as the coda. The rhyme is composed of the syllable's nucleus and coda.

There are also some other terminologies for syllable types in accordance with its structure including light, heavy, and superheavy syllables. A **light syllable** is a syllable with a short vowel as the nucleus and there is no coda (a CV syllable). **A heavy** syllable is a syllable with a branching nucleus or a branching rime, although not all such syllables are heavy in every language. A branching nucleus generally means the syllable has a long vowel or a diphthong; this type of syllable has the structure 'CVV'. A syllable with a branching rime is a closed syllable, one with a coda (one or more consonants at the end of the syllable); this type of syllable is abbreviated as 'CVC' (Carr, 2013).

Super- Heavy syllables are syllables like CVVC with both a branching nucleus and a coda and CVCC syllables with a coda consisting of two or more consonants (Carr, 2013).

In English speech, various syllable types are not equally frequent. Dauer (1983) declares that almost CVC (34%) and CV (30%) are the most common syllable structures, followed by VC (15 %), V (8%), and CVCC (6%). Gut (2005) maintains that 43% of all English syllables are open syllables. In addition, their distribution is constrained: stressed syllables are always heavy, unstressed syllables are always light, and unstressed syllables cannot occur alone. Yet, the current study is mainly concerned with investigating the AT of super- heavy syllables in multi-syllabic words.

2.3 The Moraic Theory

The concept of the syllable is investigated phonetically and phonologically, and theories in both domains have been produced. Concerning the current study, the Moraic Theory is the most applicable approach to studying the AT of the syllable. Accordingly, the next paragraphs discuss the theory in details.

Hayes (1989, p. 254) states that the internal structure of the syllable is analyzed under the principle of the moraic theory, suggested by Hyman (1985) and McCarthy and Prince (1986). The key element in this theory is the weight of the syllable. They represent the segment by the conventional "notion of mora".

A mora (plural: morae) is a fundamental temporal unit in the phonology of various spoken languages, equal to or shorter than a syllable. The word is derived from the Latin word meaning "linger, delay," which was also used to render the Greek word "χρόνος: chrónos" (time) in its metrical sense. Moraic theory proposes a parallel of relationships between weight and length; and between weight and syllable position (Ham, 2001, p. 10). In other words, a mora is the amount of time required to articulate one segment. Each mora is spoken in the same length of time; longer sounds are represented by two or even three morae since they need more time to articulate.

A short/light syllable, such as /ba/, has one mora (monomoraic), whereas a long/heavy syllable, such as /baa/, contains two (bimoraic); extra-long/super-heavy syllables with three morae (trimoraic) are rather uncommon. These measurements are often known as syllable weight.

The weight is in the rime of a syllable, and is measured, as mentioned above, by a unit called mora, represented by the symbol (μ). Depending on the number of morae available in a syllable, it is judged whether the syllable is light, heavy or super-heavy. Not all syllable segments contribute to its weight. Only the centre and the coda determine its weight, while the onset has no effect on syllable weight (Browman & Goldstein, 1988, p. 98).

According to Hayes (1989, p. 254), long vowels and diphthongs have two morae, whereas short weak vowels and coda consonants each have one. The mora serves several functions in moraic theory. It alludes, on the one hand, to the difference between light and heavy syllables. On the other hand, it takes phonological position into account. Under the conception of mora, the main generalizations are the following:

    a. **Light syllables consist of one mora**
    b. **Heavy syllables consist of two morae**
    c. **Super-heavy syllables consist of three morae**

According to the moraic theory, the monosyllabic word "the" /ðə/, 'though' /ðəʊ/ and "this"/ðɪs/ are analysed as indicated in Figure (2); the onset has no contribution to the weight of a syllable (Browman & Goldstein, 1988, p. 98).
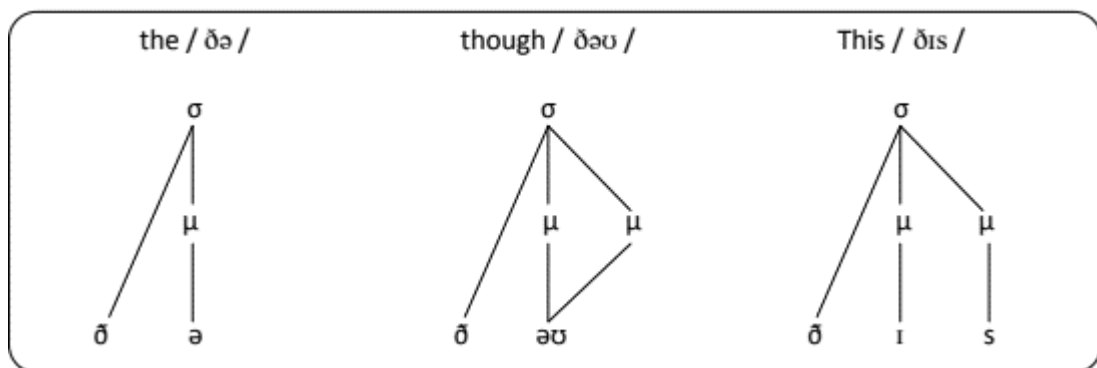

Figure 2: *The Moraic analysis of the English Syllables*

3. Methodology

3.1 Sample and Population

To carry out the analysis, the population and sampling are a must. The selected population comprises 'postgraduate students. Thus, the study is restricted to 36 postgraduates of English from the Colleges of Arts and of Education, University of Baghdad. The following table shows the stimuli words (Roach,2009) selected for the analysis and their standard AT:

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Table (1) *The Words Selected for the Analysis*

No.	Word	Phonemic Transcription	Syllabification
1.	stalactite	/ˈstæləktaɪt/	/ˈstæ.lək. taɪt/
2.	architect	/ˈɑːkɪtekt /	/ˈɑː.kɪ. tekt /
3.	Portuguese	/ˌpɔːtʃəˈgiːz /	/ ˌpɔː.tʃə. ˈgiːz /
4.	anthropoid	/ˈænθrə pɔɪd/	/ ˈæn. θrə. pɔɪd/

Table (2): The AT, transcription and syllabification of the standard research items

#	Word	light	heavy	Super - heavy	Timing in (ms)
1	stalactite	stæ	lək	taɪt	0.982
2	architect	kɪ	ɑː	tekt	0.719
3	Portuguese	tʃə	pɔː	giːz	0.929
4	anthropoid	θrə	æn	pɔɪd/	0.776

Tables (1) and (2) show the research items according to the type of syllables that compose them (light, heavy, and super-heavy) syllables. Their standard AT is measured in millisecond (ms), and their syllabification is given. It is worthwhile to mention that these pieces of information about the research items are taken from English Phonetics and Phonology: a practical course / Peter Roach. -4th ed (2009) The following figures display the spectrographs of the study items (tokens) :

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ISSN (Print): 1994-8999, ISSN (online): 2664-469X. DOI Prefix: 10.36317
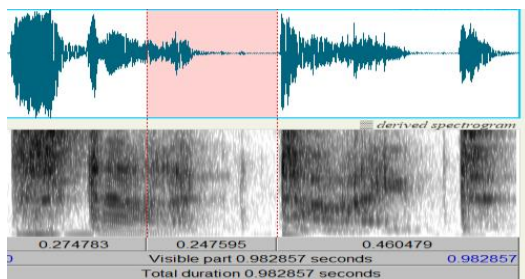
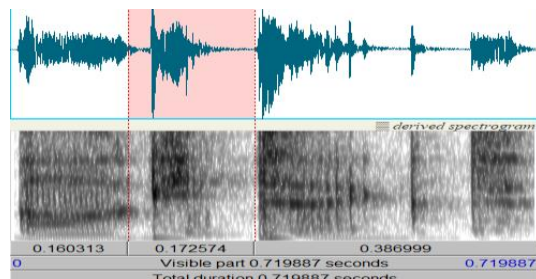Figure (1) the token stalactite
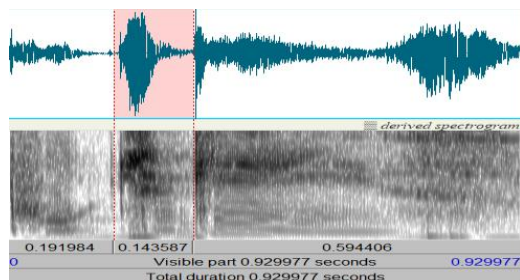

figure (2) the token Portuguese
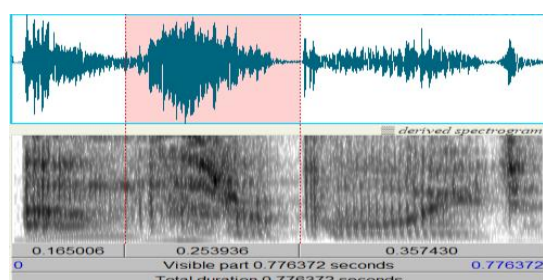

Figure (3) the token Portuguese

Figure (4) the token anthropoid

3.2 The Model Adopted

To carry out the analysis, the researcher has selected one approach that enables her to recognise the syllable structure (thus weight) of syllables in the words selected (stimuli items). Many approaches have been proposed to investigate the syllable weight. However, the researcher has chosen the Moriac Theory by (Hyman, 1985; McCarthy & Prince, 1986). This theory is more related, comprehensive, and workable since it directly measures weight through structures of the syllables and that the 'mora' unit is a timing unit (the focal point of the study is timing). The syllable of one mora is considered a light syllable, while a syllable of 2 morae is a heavy syllable, and the super heavy syllable is that with three morae.

After analysing the types of syllables according to the Moriac theory, the PRAAT software is used to analyse the timing used by the respondents to

articulate each type of syllable when it forms a full word and when it is one of the multiple syllables in a multi-syllabic stimuli item.

PRAAT is a free computer software that is suitable for phonetic voice analysis

4. Data Analysis

4.1 The token (stalactite)

The standard AT of the word (stalactite) is (0.982ms). Table (3) shows the sample's AT of this word, and of its super- heavy syllable

 The ATs of the token (stalactite) varied between the shortest one which is (0.812ms) by S23,and the longest one which is (1.520ms)by S35,only four subjects (henceforth S (s))succeeded in the articulation of the token (stalactite) and thirty-two subjects failed in the articulation .This large number of failure cases of articulation is due to many reasons .Some subjects failed because they produced new words that are totally different from the original word ,and some other subjects articulated it with hesitation because the word was not quite familiar to them.

Regarding the influential articulatory factor of vowel modification, the subjects' cases listed below were affected by this factor, and this modification made the AT somewhat longer or shorter than the standard one:

S9, S23 their AT is shorter than the standard one.

S35 their AT is longer than the standard one

Moreover, the AT of the syllables was also affected by the AT of the word concerning the outcome of the influential articulatory factor of vowel modification. Some subjects articulated the super-heavy syllable / -taɪt/ as /- teɪt / or /-tɪt /, and this modification made the AT of the syllable longer or shorter than the standard one, as shorter in the following figures (spectrographs):
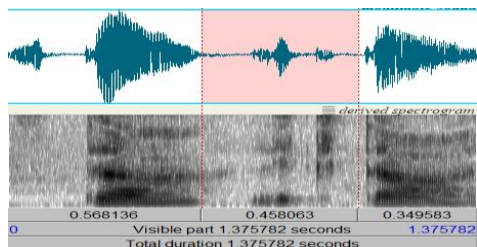
S7
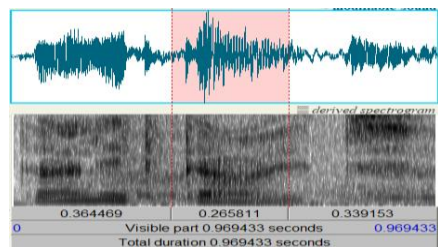
S9
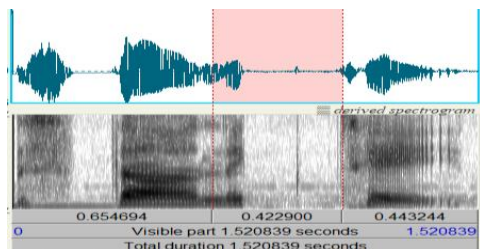
S35
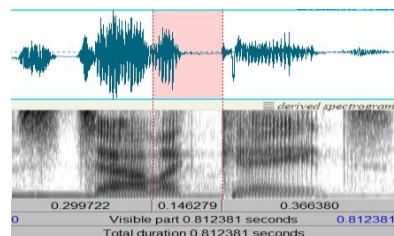
S23

Table (3) *The AT of the Super-heavy Syllable of the Research Item (stalactite)*

#	Subject	Total AT	AT (super-heavy) *syllable*	Failure case
1	S1			✓
2	S2			✓
3	S3			✓
4	S4			✓
5	S5			✓
6	S6			✓
7	S7	*1.375*	*0.349*	
8	S8			✓
9	S9	0.969	0.339	
10	S10			✓
11	S11			✓
12	S12			✓

13	S13			✓
14	S14			✓
15	S15			✓
16	S16			✓
17	S17			✓
18	S18			✓
19	S19			✓
20	S20			✓
21	S21			✓
22	S22			✓
23	S23	0.812	0.366	
24	S24			✓
25	S25			✓
26	S26			✓
27	S27			✓
28	S28			✓
29	S29			✓
30	S30			✓
31	S31			✓
32	S32			✓
33	S33			✓
34	S34			✓
35	S35	*1.520*	*0.443*	
36	S36			✓

4.2 The token (architect)

The research item (architect) is a tri-syllabic word, it consists of three syllables (light, heavy, and super-heavy), and the standard AT of the word is (0,719ms).

Some subject articulated the token (architect) under the influence of the influential articulatory factor of vowel modification. They articulated the super-heavy syllable / -tekt / as /ta:kt/, and this modification made the AT of the syllable longer than the standard one as in S12(0.373ms), S17 (0.409ms), as displayed in the following figure (spectrograph):
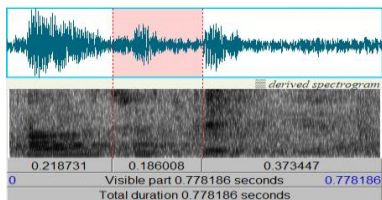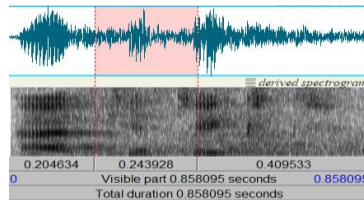
S12   S17

The following table shows the AT of the super-heavy syllable /-tekt/ in the item (architect):

Table (4) *The AT of the Super- heavy Syllable of the Research Item (archi**tec**t)*

#	Subject	Total AT	AT (super-heavy) *syllable*	Failure case
1	S1			✓
2	S2			✓
3	S3	*0.683*	*0.254*	
4	S4	*0.835*	*0.393*	
5	S5	*0.754*	*0.365*	
6	S6			✓
7	S7	*0.653*	*0.230*	
8	S8	*0.862*	*0.328*	
9	S9	0.626	0.245	
10	S10	*0.622*	*0.276*	
11	S11	*0.622*	*0.276*	
12	S12	*0.777*	*0.373*	
13	S13			✓
14	S14			✓
15	S15			✓
16	S16	*0.728*	*0.279*	
17	S17	*0.858*	*0.409*	✓
18	S18			✓
19	S19			✓

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| 20	S20			✓
21	S21			✓
22	S22	*0.686*	*0.387*	
23	S23	*0.850*	*0.360*	
24	S24	*0.682*	*0.290*	
25	S25	*0.650*	*0.290*	
26	S26	*0.654*	*0.285*	
27	S27	*0.535*	*0.210*	
28	S28	*0.840*	*0.390*	
29	S29	*0.670*	*0.250*	
30	S30	*0.780*	*0.330*	
31	S31	*0.604*	*0.271*	
32	S32	*0.793*	*0.311*	
33	S33	*0.787*	*0.315*	
34	S34	*0.683*	*0.288*	
35	S35	*0.697*	*0.314*	
36	S36			✓

4.3 The token (Portuguese)

This research item is a tri syllabic word. The most significant influential articulatory factor that impacted the articulation of the token (Portuguese) is vowel modification. Some subjects articulated the super-heavy syllable /-gɪːz/ as /-gɪz /, and this modification made the AT of the syllable shorter than the standard one which is (0.594ms) as in the following cases:
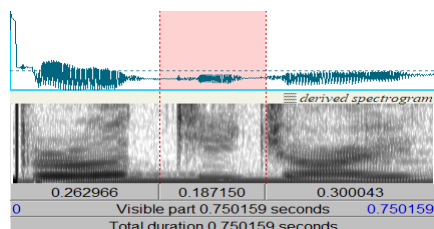
S (10) AT's is (0.260ms)
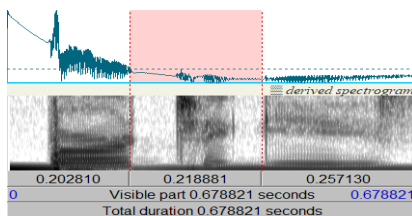
S (18)'S is (0.300ms)

S (27)'s is (0.257ms)

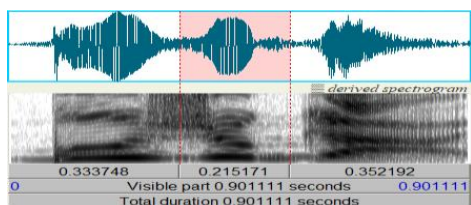The following are the related spectrographs:
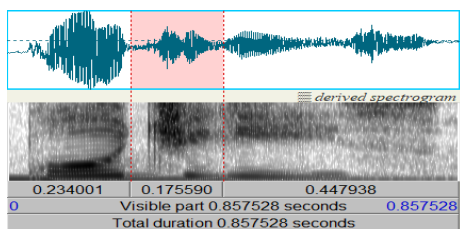
S10

S18

S27

Some subjects articulated the super -heavy syllable /-gɪːz / without placing stress on it which is in the standard word placed on the super-heavy syllable as shown in the following cases and spectrographs:

S (1)'s AT is (0.901ms)

S (29)'s AT is (0.582ms)

S1
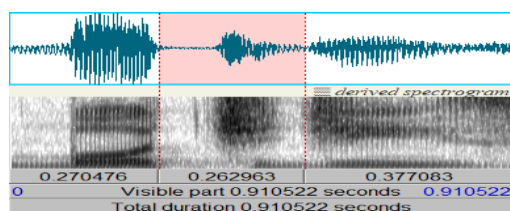
S29

Thirteen subjects failed in the articulation of the token (Portuguese), while twenty-three subjects succeeded in articulating it.

Table (5) *The AT of the Super- heavy Syllable of the Research Item (Portuguese)*

| #	Subject	Total AT	AT (super-heavy) *syllable*	Failure case
1	S1	0.901	0.352	
2	S2			✓
3	S3	0.957	0.455	
4	S4	0.913	0.510	
5	S5	0.995	0.565	
6	S6			✓
7	S7	0.944	0.511	
8	S8	0.967	0.493	
9	S9	0.960	0.466	
10	S10	0.620	0.260	
11	S11			✓
12	S12			✓
13	S13	0.796	0.371	
14	S14			✓
15	S15	0.766	0.380	
16	S16	0.780	0.360	
17	S17			✓
18	S18	0.750	0.300	
19	S19			✓
20	S20			✓
21	S21	0.860	0.451	
22	S22	0.777	0.358	
23	S23			✓
24	S24			✓
25	S25	0.839	0.489	
26	S26			✓
27	S27	0.678	0.257	
28	S28			✓
29	S29	0.582	0.319	
30	S30			✓
31	S31	0.949	0.549	
32	S32	0.691	0.410	
33	S33	0.769	0.440	

34	S34	*0.812*	*0.433*	
35	S35	*0.793*	*0.508*	
36	S36	0.793	0.402	

### 4.4 The token (anthropoid)

The token (anthropoid) is a tri-syllabic word, Concerning the influential articulatory factors, some subjects articulated the super-heavy syllable /-pɔɪd// by producing /p/ as /b/ because some subjects faced a problem in producing the sound /p/ and this deviation in pronunciation gave a longer duration to the syllable, because the duration of the sound /b/ is longer than the duration of the sound /p/ as in S (35) as shown in the spectrographs below:
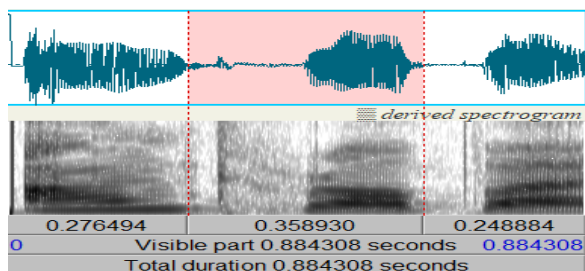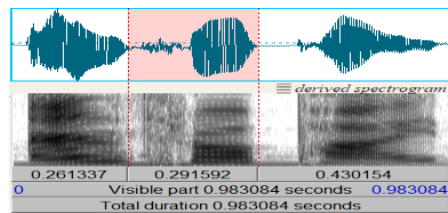

S35

Some subjects articulated the super-heavy syllable / -pɔɪd/as /- pɪ: d /, this influential articulatory factor of vowel modification made the AT of the syllable longer than the standard one as shown in the following cases and figures:
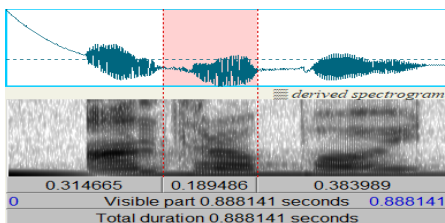
S (1)'s AT is (0.388ms)
S (5)'s AT is (0.430ms)
S (22)'s AT is (0.383ms)
S (26)'s AT is (0.374ms)
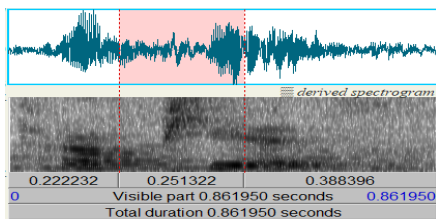
S1

S5

S22
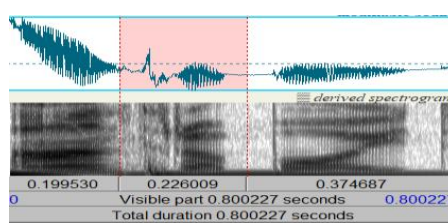
S26

Table (6) *The AT of the Super- heavy Syllable of the Research Item (anthropoid)*

#	Subject	Total AT	AT (super-heavy) *syllable*	Failure case
1	S1	0.861	0.388	
2	S2			✓
3	S3	0.758	0.288	
4	S4	0.876	0.359	
5	S5	0.890	0.411	
6	S6	0.732	0.329	
7	S7	0.817	0.313	
8	S8	0.841	0.360	
9	S9	0.910	0.385	
10	S10	0.768	0.302	
11	S11	0.696	0.299	
12	S12	0.690	0.303	
13	S13	0.827	0.278	
14	S14	0.823	0.360	
15	S15			✓
16	S16			

17	S17	0.706	0.299	
18	S18	0.698	0.251	
19	S19	0.670	0.297	
20	S20			✓
21	S21			✓
22	S22	0.888	0.383	
23	S23	0.646	0.269	
24	S24			✓
25	S25	0.637	0.262	
26	S26	0.800	0.374	
27	S27	0.669	0.292	
28	S28	0.691	0.290	
29	S29	0.798	0.341	
30	S30			✓
31	S31	0.688	0.312	
32	S32	0.678	0.300	
33	S33			✓
34	S34			✓
35	S35	0.884	0.248	
36	S36	0.845	0.350	

5.1 Discussion of Results

The study examined the AT of the (super-heavy syllables) in four words by 36 Iraqi EFL postgraduate students. The analysis of the words according to PRAAT software revealed that:

Timing is one aspect of pronunciation that gives accurate or near to the standard timing. Speakers of language do not add up the seconds of the words being articulated.

Considering the following details:

5.2 The token (stalactite)

The standard AT of the token (stalactite) is (0.982ms), and the standard AT of the super-heavy syllable is (0.460ms) while the average AT of the super-heavy syllable that was produced by the subjects is (0,483ms). The token (stalactite)was produced by the subjects S7, S9,

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S23 shorter than the standard one, whereas S35 is longer than the standard one. Consequently:

- The number of the subjects who succeeded in articulating it is =4
- The number of failure cases is =32
- The percentage of the factor of vowel modification is =100%
- The longest AT of the word (entertain) is (1.520ms) made by S36
- The shortest AT of the word (entertain) is (0.812ms) produced by S 23

5.3 The token (architect)

The standard AT of the token (architect)is (0.719ms), and the standard AT of the super-heavy syllable is (0. 386ms), while the average of the syllable that was produced by the subjects is (0.308ms). Twenty-five subjects succeeded in the articulation of the token (architect), and eleven subjects failed. One subject S (17) was affected by the influential articulatory factor of vowel modification.

- The number of the subjects who succeeded in articulating it is =25
- The number of failure cases is =11
- The percentage of the factor of vowel modification is =4%
- The longest AT of the word (amazing) is (0.862ms) made by S8
- The shortest AT of the word (amazing) is (0.535ms) made by S27

5.4 The token (Portuguese)

The standard AT of the token (Portuguese) is (0.929ms), and the standard AT of the super-heavy syllable is (0.594ms), while the average AT of the syllable that was produced by the subjects is (0.424ms). Some subjects produced the token (Portuguese) was shorter than the AT of the English native speaker (S1, S10, S18, S27, S29) because they were affected by the influential articulatory factors of stress pattern and vowel modification. Accordingly:

- The number of the subjects who succeeded in articulating it is =23
- The number of failure cases is =13
- The percentage of the factor of vowel modification is =13%

- The percentage of the factor of stress pattern is =7%
- The longest AT of the word (amazing) is (0.995ms) made by S5
- The shortest AT of the word (amazing) is (0.691ms) articulated by S32

5.5 The token (anthropoid)

The standard AT of the token (anthropoid) is (0.776ms), and the standard AT of the super heavy syllable is (0.357ms), while the average AT of the syllable is (0.318ms). Some subjects produced the token (anthropoid) longer than that produced by the English native speaker because they were affected by the influential articulatory factor of vowel modification as in S1, S5, S22, S26.

- The number of the subjects who succeeded in articulating it is =28
- The number of failure cases is =8
- The percentage of the factor of vowel modification is =14%
- The percentage of the factor of production /p/ as /b/is =4%
- The longest AT of the word (amazing) is (0.983ms) articulated by S5
- The shortest AT of the word (amazing) is (0.637ms) made by S25

There are differences in AT between the English native speaker and non-native speaker (students), which vary from one subject to another, depending on certain influential factors. The token (stalactite) was articulated by the native speakers in AT (0.982ms), while it was articulated by the non-native speaker in AT which varied from (0.637ms) to(0.983ms), and this variation was due to the influence of the influential articulatory factors.

The token (architect) is articulated by the native speakers in the AT(0.719ms), while it was articulated by the non-native speakers in AT which varied from (0.535ms) to (0.862ms). Moreover, the token (Portuguese) is articulated by native speakers in AT (0.929ms), while articulated by the non-native speaker in AT which varied from (0.691ms) to (0.935ms). Furthermore, the token(anthropoid) articulated by the

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native speakers in AT (0.776ms), while it was articulated by the non-native speakers in AT, which varied from (0.637ms) to (0.9983ms).

The percentage also varied from one token to another, and this variation is shown in the following tables. The following tables (8) and (9) include all the statistical data concerning the AT of the research items as produced by the Iraqi EFL postgraduate students:

Table 8 *The Acceptable and Failure cases*

#	The Word	Acceptable cases	Percentage	Failure cases	Percentage
1.	**stalactite**	4	11%	32	89%
2.	**architect**	25	69%	11	31%
3.	**Portuguese**	23	64%	13	36%
4.	**anthropoid**	28	78%	8	22%

Table 9 The *Influential Factors of the AT of the research items*

#	word	Vowel modification	/p/ as /b/	Stress pattern
1.	stalactite	100%		
2.	architect	4%		
3.	Portuguese	13%	17%	
4.	anthropoid	14%	4%	

Conclusions

The following points are drawn up from the previous findings and their discussions:

1- There are differences in the AT of the selected words between the native speaker and the Iraqi EFL students. Accordingly, the first research question, *"What are the differences in the AT of the four selected words between the standard native articulation and the articulation of the Iraqi EFL postgraduate students?* has been answered.

2- There are three factors causing variance in the AT (vowel modification, stress pattern, and producing /p/ as /b/). Accordingly, the

second research question is, "What are the factors causing such articulatory timing variance? has been answered.

3-Iraqi EFL postgraduate students, as non-native speakers of English, produce (super-heavy syllables) with variant AT compared the standard AT produced by the English native speaker.

4-The pronunciation of Iraqi EFL postgraduate students is affected mainly by vowel modification, and this factor was registered with high percentages in the items ('stalactite, architect, Portuguese, and anthropoid). They often modify the vowel sounds more than they do with the consonant sounds.

5-The familiarity degree relating to the token that has a super- heavy syllable is also an influential factor. That is to say, the AT variance is less when the token is familiar, while the AT is more variant when the token is unfamiliar to the students.

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