Articulatory Timing of English Polysyllabic Words As Produced By Iraqi EFL Learners: An Acoustic Study

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Abstract

This paper acoustically scrutinizes the variant articulatory timing of English polysyllabic words produced by Iraqi learners of English as a foreign language. sixteen Iraqi students, from the 2nd and 4th stages at the department of English, pronounced words of 2-7 syllables that were later analyzed acoustically. They produced these words with variant timing. Variation was proportional to syllables number in a word.

Key words: Articulatory Timing, Polysyllabic Word, Adjacent Vowels, Consonant Cluster.

التوقيت اللفظي للكلمات الإنجليزية متعددة المقاطع كما يلفظها المتعلمون العراقيون للغة الإنجليزية كلغة أجنبية: دراسة فيزيائية- صوتية

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الملخص:

قامت بعض الدراسات السابقة التوقيت بإحصاء التوقيت اللفظي للكلمات الإنجليزية متعددة المقاطع التي ينطقها متعلمو الإنجليزية كلغة أجنبية، أما البحث الحالي فإنه يوثق توقيت هذا النوع من الكلمات كما ينطقها المتعلمون العراقيون. تم أخذ أصواتٌ لستة عشر طالباً من المرحلتين الثانية والرابعة لكلماتٍ تحتوي على ٢–٧ مقاطع؛ لغرض تحليلها فيزيائياً. وأثبت البحث الحالي أن الطلبة العراقيين يلفظون هذه الكلمات بتوقيت مغاير لتوقيت المتحدث الإنجليزي الأصلي، وأن الاختلاف في التوقيت يتناسب طردياً مع عدد المقاطع في الكلمة.

الكلمات المفتاحية:التوقيت اللفظي، الكلمات متعددة المقاطع، تجاور الأصوات المتحركة، إلتقاء الأصوات الساكنة.

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1- Introduction

Timing is an unavoidable characteristic of language because speech takes place in time (Xu, 2009: 906). Non-native speakers encounter problems in the processing phases of phonological encoding. As they successfully retrieve a certain lexeme, and accomplish its 'grammatical phase', they need the phonological encoding, so that they can articulate it physically in the surface structure. Non-native speakers may encounter difficulties in these processing phases when the retrieval of the lexeme is troubled for any cause (Kormos, 2006: 147). Levelt (1993: 5) assures that these problems are faced in building the metrical frames, in determining the suitable segments represented by the phonemes in order to project them onto those frames, and in drawing the phonological strings, which are syllabified and metrically specified, on the articulation phase. Phonetics and phonology are both concerned with the nature of speech sounds. Phonetics studies the actual nature of speech, while phonology deals with the "apparently categorical representations" of the phone structure, that are managed and processed in the mind during the process of speech production. These two disciplines are extremely connected. It can be adopted that in any phonetic research, the phonological statements, "implicitly or explicitly", serve in guiding the tasks and the stimuli, defining the measured subjects and data analysis (Goldsmith and Pierrehumbert, 1992: 1).

2. Literature Review

Ladefoged (2011: 252) assures that speech timing, in general, is a concept counted in all languages, which means that it can be studied universally. Languages provide the impression of variability of timing. The position of stress in a word is very important in perceiving timing of a language. Consequently, languages are either syllable-timed, when all syllables in a language are isochronous in length, i.e., with the same time-duration, like Spanish and French, or stress-timed, when stressed syllables are in systematic boundaries, like English and German. Abercrombie (1967: 97) agrees that syllable-timed languages have syllables with the same length, whereas stress-timed ones have the capacity to compress syllables when required to make feet occurring at the same duration. The term 'timing' is sometimes referred to as 'duration' in other related studies, such as Bond and Fokes (1985) and Fan (2009). This linguistic phenomenon is discussed through many different orientations, though it is mainly investigated in phonetics.

Previously, Bond and Fokes (1985) compared between the AT of English base words with and without suffixes as produced by non-native speakers. They made use of a set of only four English base words: (*shade, speed, sleep* and *stick*), and the derived forms by adding one-syllable suffixes (*-y, -er, -ing*), and two-syllable ones, (*-ily* and *-iness*). Compression of syllables in the base words was observed with respect to the syllable(s) in the added suffixes (Bond & Fokes, 1985: 407). The researchers concluded that all non-native speakers had the same attitude in making compression for the words after being suffixed, justifying this compression as a "by-product" in the process of

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lengthening words that are not final utterance, but "pre-boundary". The second conclusion was that non-native speakers shows similar slower speaking rates for the "imperfect control of English", or language deficiency.

Byrd (1996) experimentally studied the factors that affect AT of consonant sequences. He considered factors, such as place and manner of articulation and syllable structure, to see their effects on "reduction and temporal overlap" within the consonant clusters. Electro-palatography (EPG)(*) was employed in this study. The study presented physical evidence, by its findings, of the reduction of some consonants in coda position. It showed that stops in coda are reduced more than fricatives, coronal consonants overlap by a following velar stop more than a velar stop does by a following coronal, stops overlap by a following consonant more than fricatives do, and an onset cluster both overlaps and varies in its timing less than coda clusters and heterosyllabic sequences.

Fan (2011) conducted a contrastive and comparative analytical study that employed "Articulatory Phonology as a theoretical framework to investigate the AT of English consonant clusters". Under the umbrella of acoustic phonetics, he attempted to discover the "overlap" within coda consonants when produced by native and non-native speakers of English. By using ANOVA, it was shown that three factors played a significant role in the articulatory timing of consonant cluster codas: place of articulation, manner of articulation and the vocal folds status, which is, the voicing, though the third was not expected as an influential factor. Concerning the relationship of overlap, as an articulatory phenomenon, to duration consumed in producing the coda clusters, the researcher demonstrated that there was a difference between the counted overlapping made by the native speakers and that overlapping performed by the non-native ones. Additionally, there were statistic tests applied in order to show the considerable influence that proficiency has on proper overlap. The overlap performed by the advanced group was the closest one, among the three groups, to that of native speakers, while intermediate and low groups performed similarly.

Windmann, Simko and Wagner (2011) studied how "polysyllabic shortening" affects in three fields, the word, the inter-stress interval and the narrow rhythm unit. They stated that polysyllabic shortening referred to a feature in the syllable or vowel duration, that it is in reverse to the number of syllables in a larger unit. They presented an example, "/i:/ is shorter in *speedy* than in *speed*, and shorter still in *speedier*". The results of this study "confirm and extend" previous results, like a suggestion that such polysyllabic shortenings have impacts and they have certain interpretations as word-final lengthening. The researchers uncovered "large and reliable" influences of lengthening in prominence and constituent-final position. As well, they noticed "contrastive rhythmic effects" in keeping alternating long-short duration

(*) It is an artificial palate of thin acrylic implanted with electrodes to record the tongue touches during articulation.

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patterns. The findings agreed with the idea stating "prosodic timing in English is restricted to localized lengthening effects", and with models that suggest "underlying periodicities in speech timing".

Mok (2012) examined the effects of many syllable "affiliations of intervocalic /st/ cluster" on vowel-to-vowel coarticulation in English. It was assumed that onsets are stronger and more noticeable than codas. Codas are less controlled, this is why there was a hypothesis that "coda /st./, (the dot stands for the boundary), would allow more vowel-to-vowel coarticulation than onset /.st/". The researcher used three vowels /i/, /ɑ/ and /u/ in order to make the wanted sequences containing the /st/ cluster in English: "onset /CV.stVC/, heterosyllabic /CVs.tVC/, coda /CVst.VC/". It was shown that coda /st./ appeared to provide more allowance of vowel-to-vowel coarticulation than onset /.st/, while heterosyllabic /s.t/ was seen as the hardest one among the syllable forms. On the other hand, vowels in heterosyllabic /s.t/ were noticed as "more extreme" than themselves in the other syllable forms in the "carryover direction". The results of this study proposed that "vowel-to-vowel coarticulation is sensitive to different syllable structure with the same segmental composition" (Mok, 2012: 946). The researcher found that the structure of a syllable has impact on the patterns of coarticulatory, contributing more insights to understand the connection between the structure of a syllable and coarticulation.

3. Syllable, Polysyllable and Syllabification

It is definitely known that an English word is either composed of one syllable or more. The meaning of the term polysyllable is not firmly agreed upon. Some linguists, such as Wehmeier, McIntosh, Turnbull and Ashby (2005: 1167), regard it as referring to a technical word which comprises several (usually more than three) syllables, and the adjective is polysyllabic. Others have another idea. Carr (2008:133), for instance, asserts that a polysyllabic word consists of more than two syllables; Cambridge online dictionary (2019) emphasizes that it refers to three or more syllables, which means more than two. Crystal (2008: 374) defines it (polysyllable) as a term that indicates any word containing more than one syllable. Moreover, he uses *or* when he contrasts Polysyllabic or multisyllabic with monosyllables, considering the former as an equivalent term.

Some consonant sequences may occur as syllable-final and syllable-initial sequences of a PSW, but they are impossible to be an onset cluster for a monosyllabic word, though some of them may suit its coda. For example, the consonant sequences [ŋk], [tl] or [dl] never occur as a consonant cluster in the onset of a mono-syllable, while they are altogether possible as coda-onset sequences within PSWs, such as *link* or *handle*. The second way of segments permutation is the VCV sequence, such as the sequence /ɪmɪ/ in the word *similar*, that is distributed over the edges of syllables within PSWs, but not in a mono-syllable. The third way is the vowel sequence VV, when a zero-coda syllable is followed by a zero-onset syllable within a PSW, like the vowel

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sequence /əʊ.ɪ/ in the word *showing* (Clark and Yallop, 2007: 70). In English, there is some disagreement on the number of syllables in some words. For example, dialectal differences is one source of such a disagreement, which is, the variant ways in which a word is pronounced. The word *predatory*, for instance, is pronounced with two different ways, /pred.ə.tri/, then it has three syllables, or /pred.ə.tɔ:r.i/ comprising four syllables. Similarly, many English words are dealt with likewise (Ladefoged and Johnson, 2011: 244).

Duanmu (2008: 1) agrees that there is no complete clarity concerning the number of syllables in some words. Moreover, this clarity can be deceptive for many individuals to count the syllables number. The words *hour* and *shower*, for instance, are considered as monosyllabic by some linguists, while for others, these words are bi-syllabic. Therefore, in analyzing syllables of a word, it is very important to agree upon the number of syllables in that word. Here comes the importance of syllabification.

3-1 Syllabification

Roach (2009: 72) considers the case of the previous word *extra* as a more difficult case, for having five possibilities of syllabification, as stated above. The majority of English speakers disagree to regard /s/ between /k/ and /t/ as a separate syllable. They agree that *extra* has two syllables, but what controversially matters is the boundary position. Furthermore, the case of 'ambisyllabicity' could be another source for disagreement on the exact positions of syllable boundaries. When it is probable to suggest more than one possible syllabification for a word, then this word is ambisyllabified. For example, the English word *happy* is, for many speakers, syllabified as [hæ.pi], but others syllabify it as [hæp.i]. Then the boundary of the syllables in this word would be ambiguous, to consider the [p] as a final consonant in the penultimate syllable and simultaneously as an onset of the final syllable. Thus, the word *happy* falls under the rubric of ambsyllabicity (Carr, 2008: 12). There is no single rule that will tell us what to do without bringing up problems. Maximal onsets is the most commonly conventional procedure, which is adopted to unravel such a conundrum (Roach, 2009: 72). However, in speech technology, when a polysyllable is ambiguous to syllabify, the algorithm of maximizing the onset rather than the coda is applied. Therefore, the word *happy* is preferred to be [hæ.pi] not [hæp.i]. Maximal Onset Principle serves to avoid ambisyllabic segments to be suggested in the process of syllabification (Ladefoged and Johnson, 2011: 248).

3-2 Maximal Onset Principle

Ngala (1994: 5) explains this principle as a very effective factor in solving the issue of ambi-syllabification. It identifies the assignment of the C-elements in the polysyllabic words, especially when the case is ambiguous. That is to say, by which syllable node C-elements is dominated. According to generative CV-phonology, "syllable-initial consonants are maximised". In other words, onset consonant clusters have priority over the coda consonant clusters. For example, the ambiguous word *extra* is syllabified as [ek.stra] rather than

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[eks.tra], or [ekst.ra]. Carr (2008: 98) states that when a consonant can be affiliated with both onset and coda in a syllable, it is preferred to be syllabified in the onset position. For example, the word *appraise* is preferred to be divided as /ə.preɪz/ rather than /əp.reɪz/, though the latter is acceptable as well, simply because the former syllabification maximizes the onset content.

3-3 Syllable structure

Languages are not the same in their syllable structures. English syllables may be composed of both consonants and vowels. Some syllables may contain only a vowel, such as the syllables in the words *eye* /aɪ/, *owe* /əʊ/, *are* /ɑː/ or others (Ladefoged and Johnson, 2011: 243). Roach (2009: 67) refers to such a syllable as a minimum syllable, when he lists the four forms of the English syllable, minimum syllable (V), syllable with only onset (CV), with only coda (VC), and syllable having both onset and coda (CVC). Additionally, some consonants can occur as central and as a whole content of a syllable. For example, the alveolar lateral /l/ and the nasals /n/ and /m/, at the end of the words *bottle*, *button*, and *blossom*, are successively pronounced as [bɒt.l̩], [bʌt.n̩] and [blɒs.m̩] (Clark and Yallop, 2007: 67). Some English native speakers deal with stops and fricatives in certain words as syllabic consonants, like /t/ in the word *today* [t̩^{h}.ˈdeɪ] and /s/ in *suppose* [s̩.ˈpəʊz] (Ladefoged and Johnson, 2011: 244). Carr (2008: 32, 171) adds that these consonants are so-called syllabic consonants, that fill the position of the nucleus of a syllable. They are represented in the narrow transcription with the subscript diacritic [̩] placed under them. These syllabic consonants are opposed with what are referred to as semiconsonants, like the glides /w/ and /j/, that do not come as the head of a nucleus in a syllable, though they are like vowels in having open airstream.

Segments are combined into what is called phonological constituents, which are not necessarily words. Any constituent of these segments is called a syllable (Carr, 2013: 53). In a syllable, as well as across syllables, segments are ordered depending on the principles of sonority. Sonority is a scale along which segments are ranked from most sonorous to least sonorous. The sonority itself is a controversial concept, but the uncontroversial scale orders stops, fricatives, nasals, liquids, glides, and vowels according to their increasing sonority order, scaled as: Stops < Fricatives < Nasals < Liquids < Glides < Vowels (Morelli, 2003: 356).

4. Significance and Hypotheses

This study contrasts the articulatory timing (AT) of English polysyllabic words PSWs, produced by Iraqi learners of English as a foreign language (EFL) as non-native speakers, with their corresponding counterparts as produced by English native speakers. It is the first study that formally document AT produced by Iraqi EFL Learners. In this paper, it is hypothesized that:

1-1 Iraqi EFL learners, as non-native speakers, produce English PSWs with longer duration than that produced by native English speakers.

1-2 The Academic Level is not the main cause of this additional AT.

1-3 The difference in timing of the two productions (native and non-native

pronunciations) is not constant — the more syllables words have the more different timings of PSWs are registered by Iraqi EFL learners.

5. Theory and Model

The present study depends on CV phonology rules in analysing the sound tracks of the stimuli items captured from native and none-native speakers of English. Such rules as consonant cluster rules by which the researchers can test the effect of consonant cluster production deficiency, (henceforth CoCluProciency). The researchers also examine the difficulty that none-native speakers of English encounter in producing V-to-V co-articulation, adjacent vowels production deficiency, (henceforth AdjaVoProciency), resulting in shortening the durations of the two adjacent vowels. Another concept is considered in this study is syllabic consonant production deficiency, (henceforth SyCoProciency), resulting in lengthening AT, by adding certain short vowels after a syllabic consonant.

6. Methodology

6-1 Stimuli

The following random research items (*empty*, *euphony*, *variation*, *communication*, *revolutionary*, *oversimplification*) are typed clearly on an A4 paper, and the research items are requested to say them in isolation form. In examining AT of the research items in isolation, rather than in connected speech, the researcher agrees with (Roach, 2009: 86) when he emphasizes that isolated forms of words serve in knowing the place of stress, "[l]ooking at words in isolation does help us to see stress placement and stress levels more clearly than studying them in the context of continuous speech". Additionally, in observing sounds articulation, it is not always necessary to examine the production of connected speech within linguistic contexts, yet in many situations, it can be the opposite, that is to say, the single-word test is the best means to observe sounds articulation (Pinkerton, 1991: 16). Furthermore, Hodson, (1986: 105) supports this notion, that the single-word test is considered as the only means to successfully elicit the erroneous articulation of words. The research items are chosen randomly, but with a consideration of the number of the syllables within them. The number of syllables are determined by Cambridge On-line Dictionary.

6-2 Procedure

The research items are categorized according to their syllables number, in seven categories, beginning from di-syllabic, tri-syllabic, quadri-syllabic, penta-syllabic, hexa-syllabic and hepta-syllabic words. In order to practically assert accurate and reliable generalizations of the findings from the sample to the population, the sample selection was arbitrary, choosing 16 students from 2nd and 4th stages in both College of Education for Human sciences and Shatt Al Arab University College, equally four from each. Data are classified into two groups depending on the academic stage, so that the voice tracks would be accordingly analyzed.

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6-3 Tools

The present research utilizes PRAAT software (version 6.0.52) to acoustically measure the AT of English PSWs as produced by Iraqi EFL learners, students of second-stage and fourth-stage from the departments of English in the College of Education for Human Sciences, and Shatt Al-Arab University College. AORY Melody Microphone, with high sensitivity to treat noisy atmosphere was used, directly connected to the laptop during running praat software in order to record the students' articulation of PSWs.

6-4 Why PSWs

PSWs are subjected in the present research because they serve as a means for observing certain phonological respects, like phonological processing (Gathercole and Baddeley, 1990: 351), speech variability (Larrivee and Catts, 1999: 120-121) and complex sound sequences (Leitao, Hogben and Fletcher, 1997: 91). In the production process, PSWs are more problematic than mono-syllabic words. That is why they are used to assess, diagnose and treat cases of some speech disorders, such as, ***apraxia*** or ***dyspraxia***(*). For example, when the speakers produce PSWs with clear "pauses", to make them phrase-like utterances, or when they produce them with equal levels of stress. This is called "poor" or "erroneous" production of PSWs (ASHA, 2007: 32). Furthermore, Gathercole and Baddeley, (1990: 345) concentrate on the "faster rehearsal" which can be performed with shorter words, and even in the tasks of recalling words, PSWs involve longer periods, in relation to that involved to recall short words. This is demonstrated for both children and adults.

6-5 Data Analysis

The researchers analyzed and calculated AT produced by native speakers of English, so that they would be the reference in contrasting the variant AT produced by Iraqi EFL learners, as shown below in table (1). Worthwhile to mention that the pronunciation of the research items are taken from Cambridge online dictionary.

Table (1): The research items AT, transcription and syllabification

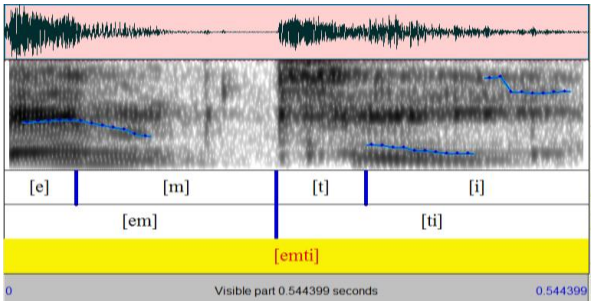
Category	Word	Syllabification(*)	Timing (ms)
Di-syllabic	Empty	/ˈemp.ti/	0.5444
Tri-syllabic	Euphony	/ˈjuː.fə.ni/	0.5748
Quadri-syllabic	Variation	/ˌveə.riˈeɪ.ʃn̩/	0.8022

(*) Motor speech disorders caused by damages in some areas of the brain. Affected by apraxia, a speaker face difficult articulation while initiating speech, or with a lot of "false starts" and "self-corrections". Affected by dyspraxia, a speaker has perceptual problems and "kinaesthetic motor difficulties" (Brendel & Ziegler, 2007: 77-78); (Lundeborg & McAllister, 2007: 71); (Gibbs, Appleton & Appleton, 2007: 534).

(*) Cambridge Online Dictionary (2019).

Penta-syllabic	Communication	/kəˌmjuː.nɪˈkeɪ.ʃn̩/	0.8884
Hexa-syllabic	Revolutionary	/ˌre.vəˈluː.ʃn̩.ɹ.i/	0.8507
Hepta-syllabic	Oversimplification	/ˌəʊ.vəˌsɪm.plɪ.fɪˈkeɪ.ʃn̩/	1.2842

AT is measured for all the research items, as well as the wave form (amplitude) and the spectrogram of every word. The following figures are the sound images that show the AT of each segment within the syllables, AT of each syllable within the PSW, and then the AT of the entire word, beginning from the di-syllabic word *empty* to the hepta-syllabic word *oversimplification*. The sound images below contain five tires: the upper tire is of the wave form, i.e., the amplitude tire, under which the spectrum tire occurs. The lower three tires are arranged by the researcher, down-up, as PSW tire (where the total AT appears), syllables tire and phonemes tire. Below each sound image, there is micro-detailed information about the AT, taken from the text grid file established and saved previously after splitting the PSWs and annotating on



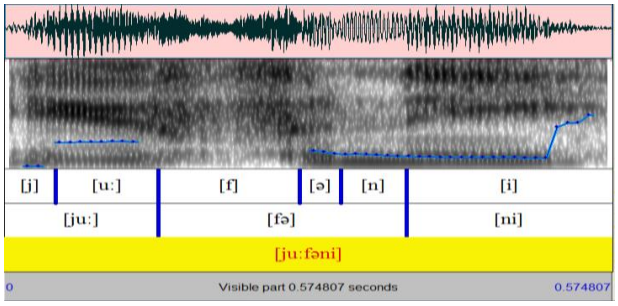
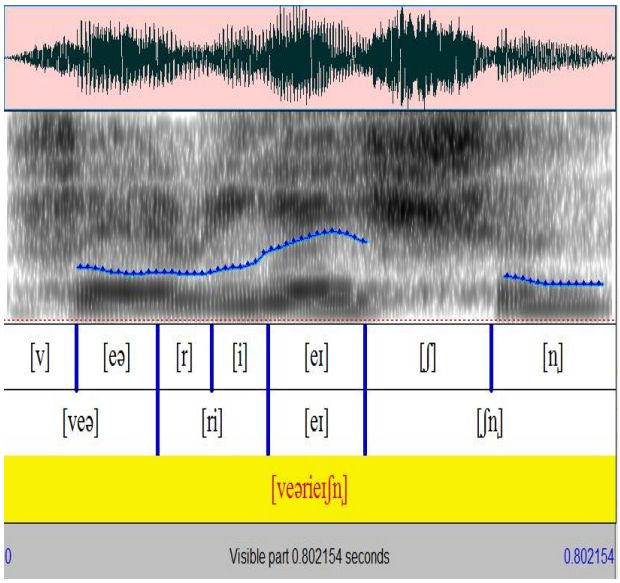


Table (2): AT of the token *Empty*

Tier	Interval	Duration (ms)		Timing (ms)
		From	To	
PSW	[emti]	0.0000	0.5444	
Syllables	[em]	0.0000	0.2536	0.2536
	[ti]	0.2536	0.5444	0.2908
Phonemes	[e]	0.0000	0.0792	0.0792
	[m]	0.0792	0.2536	0.1744
	[t]	0.2536	0.3369	0.0833
	[i]	0.3369	0.5444	0.2075

Table (3): AT of the token *Euphony*

Tier	Interval	Duration (ms)		Timing (ms)
		From	To	
PSW	[juːfəni]	0.0000	0.5748	
Syllables	[juː]	0.0000	0.1453	0.1453
	[fə]	0.1453	0.3797	0.2344
	[ni]	0.3797	0.5748	0.1951
Phonemes	[j]	0.0000	0.0483	0.0483
	[uː]	0.0483	0.1453	0.0970
	[f]	0.1453	0.2792	0.1338
	[ə]	0.2792	0.3180	0.0388
	[n]	0.3180	0.3797	0.0617
	[i]	0.3797	0.5748	0.1951



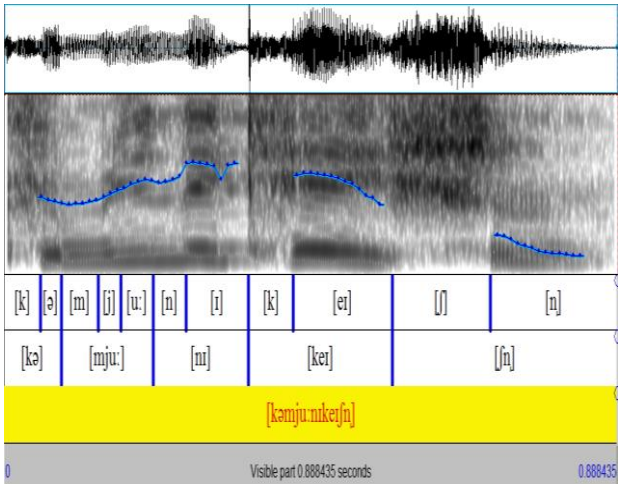


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Figure (3): token Variation

Table (4): AT of the token *variation*

Tier	Interval	Duration (ms)		Timing (ms)
		From	To	
PSW	[veəriei̯ʃn̩]	0.0000	0.8022	0.8022
Syllables	[veə]	0.0000	0.2018	0.2018
	[ri]	0.2018	0.3461	0.1443
	[eɪ]	0.3461	0.4738	0.1276
	[ʃn̩]	0.4738	0.8022	0.3284
Phonemes	[v]	0.0000	0.0953	0.0953
	[eə]	0.0953	0.2018	0.1066
	[r]	0.2018	0.2729	0.0710
	[i]	0.2729	0.3461	0.0733
	[eɪ]	0.3461	0.4738	0.1276
	[ʃ]	0.4738	0.6392	0.1654
	[n̩]	0.6392	0.8022	0.1630

Figure (4): the token Communication

Table (5): AT of the token *communication*

Tier	Interval	Duration (ms)		Timing (ms)
		From	To	
Syllables	[kə]	0.0000	0.0827	0.0827
	[mju:]	0.0827	0.2157	0.1331
	[nɪ]	0.2157	0.3534	0.1377
	[keɪ]	0.3534	0.5615	0.2081
	[ʃn̩]	0.5615	0.8884	0.3269
Phonemes	[k]	0.0000	0.0528	0.0528
	[ə]	0.0528	0.0827	0.0299
	[m]	0.0827	0.1364	0.0537
	[j]	0.1364	0.1689	0.0325
	[u:]	0.1689	0.2157	0.0468
	[n]	0.2157	0.2632	0.0475
	[ɪ]	0.2632	0.3534	0.0902
	[k]	0.3534	0.4187	0.0653
	[eɪ]	0.4187	0.5615	0.1428
	[ʃ]	0.5615	0.7035	0.1420
	[n̩]	0.7035	0.8884	0.1849

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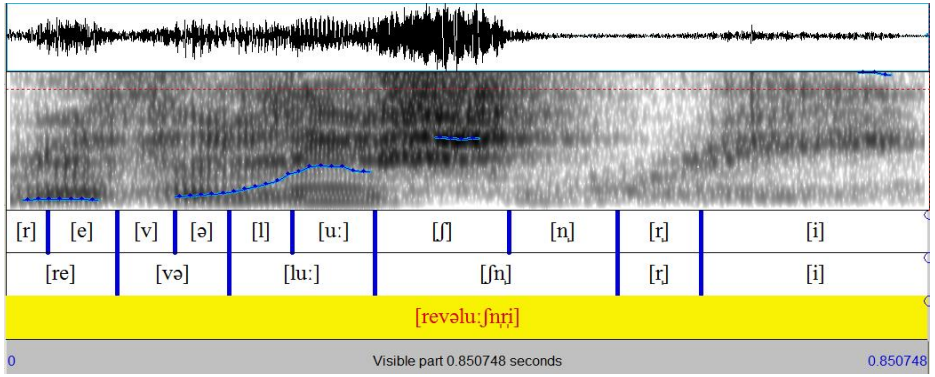

Figure (5): the token *Revolutionary*

Table (6): AT of the token *Revolutionary*

Tier	Interval	Duration (ms)		Timing (ms)
		From	To	
PSW	[revəlu:ʃn̩ri]	0.0000	0.8507	0.8507
Syllables	[re]	0.0000	0.1025	0.1025
	[və]	0.1025	0.2 056	0.1031
	[lu:]	0.2056	0.3399	0.1342
	[ʃn̩]	0.3399	0.5633	0.2234
	[r̩]	0.5633	0.6402	0.0769
	[i]	0.6402	0.8507	0.2105
Phonemes	[r]	0.0000	0.0387	0.0387
	[e]	0.0387	0.1025	0.0638
	[v]	0.1025	0.1557	0.0532
	[ə]	0.1557	0.2056	0.0499
	[l]	0.2056	0.2637	0.0581
	[u:]	0.2637	0.3399	0.0761
	[ʃ]	0.3399	0.4634	0.1236
	[n̩]	0.4634	0.5633	0.0998
	[r̩]	0.5633	0.6402	0.0769
	[i]	0.6402	0.8507	0.2105

Tier	Interval	Duration (ms)	Timing

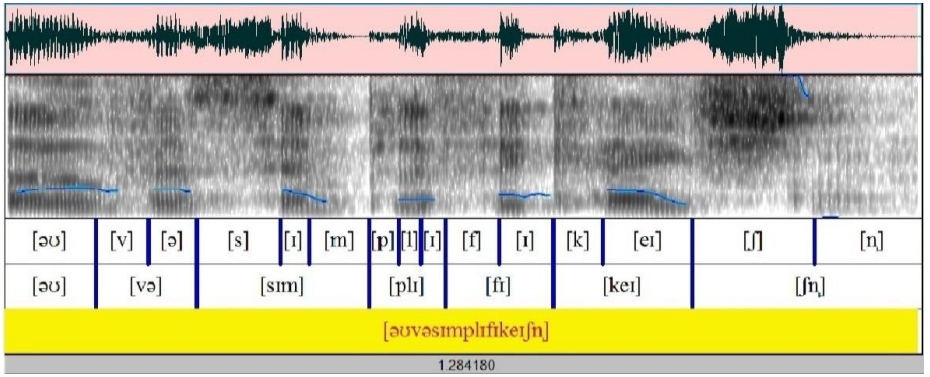

Figure (6): the token *Oversimplification*

Table (7): AT of the token *Oversimplification*

		From	To	(ms)
Syllables	[əʊ]	0.0000	0.1265	0.1265
	[və]	0.1265	0.2663	0.1397
	[sɪm]	0.2663	0.5059	0.2396
	[plɪ]	0.5059	0.6114	0.1055
	[fɪ]	0.6114	0.7613	0.1499
	[keɪ]	0.7613	0.9540	0.1927
	[ʃn̩]	0.9540	1.2842	0.3302
Phonemes	[əʊ]	0.0000	0.1265	0.1265
	[v]	0.1265	0.1992	0.0726
	[ə]	0.1992	0.2663	0.0671
	[s]	0.2663	0.3823	0.1160
	[ɪ]	0.3823	0.4221	0.0398
	[m]	0.4221	0.5059	0.0838
	[p]	0.5059	0.5464	0.0405
	[l]	0.5464	0.5773	0.0309
	[ɪ]	0.5773	0.6114	0.0341
	[f]	0.6114	0.6865	0.0751
	[ɪ]	0.6865	0.7613	0.0749
	[k]	0.7613	0.8295	0.0682
	[eɪ]	0.8295	0.9540	0.1245
	[ʃ]	0.9540	1.1243	0.1703
	[n̩]	1.1243	1.2842	0.1599

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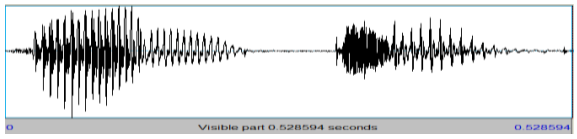
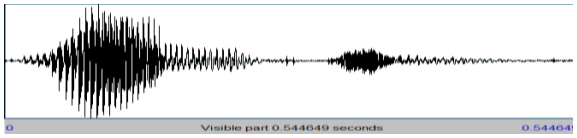
After analysing the research items, it was found that the AT of the word *empty* was (0.544 ms), seeing the AT of its two syllables, (0.253 ms) for [em] and (0.290 ms) for [ti]. The AT of the word *euphony* was (0.574 ms). The recorded AT of the word variation was (0.802 ms), the AT of the word communication was (0.888 ms), AT of the word revolutionary was (0.850 ms), and AT of oversimplification was (1.284 ms). To contrast the AT produced by Iraqi students with that by the native speakers, the images of the sounds recorded by Iraqi students, for the research items, will be listed as taken from praat. AT magnitudes are given in the tables after the word-images, as follows:

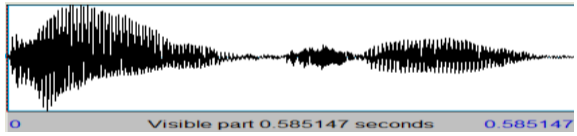
***A.2.Sh*(*)**



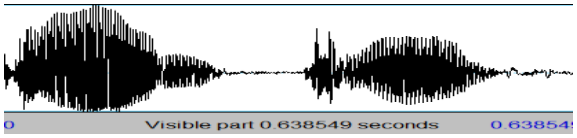
B.2.Sh



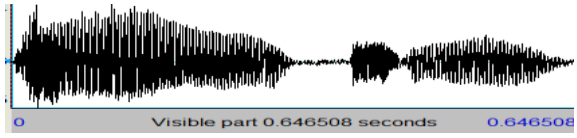
C.2.Sh



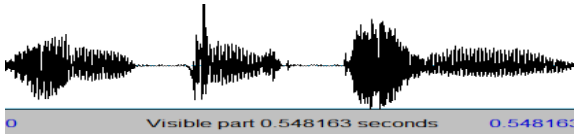
D.2.Sh



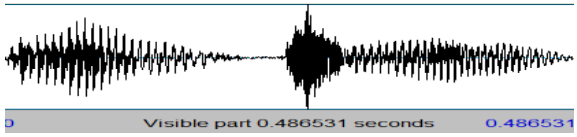
A.4.Sh



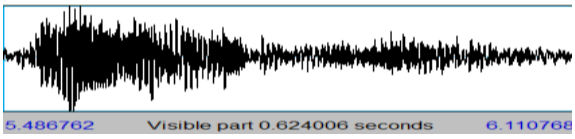
B.4.Sh



C.4.Sh



A.2.Ed



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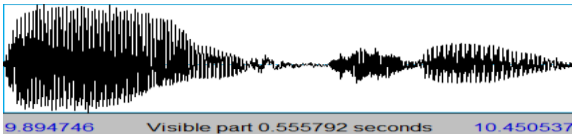
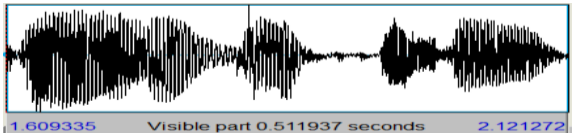
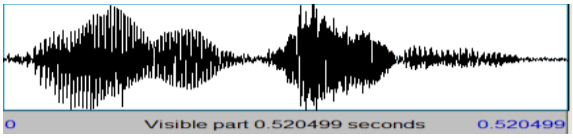


C.2.Ed



D.2.Ed



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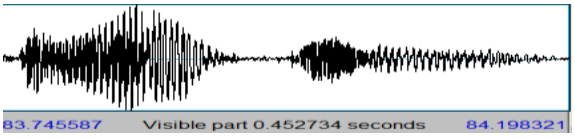

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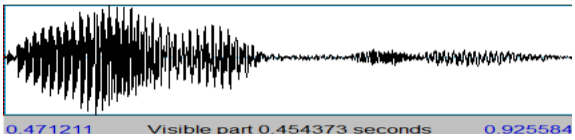
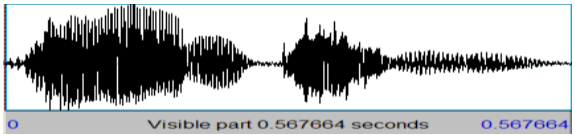


C.4.Ed



(*) Henceforth, the letters ***A-D*** refer to ***student*** number 1-2; the number ***2*** or ***4*** after the letter refers to the academic stage; ***Sh*** is short of Shatt Al Arab University College; and ***Ed*** is short of College of Education for Human Sciences.

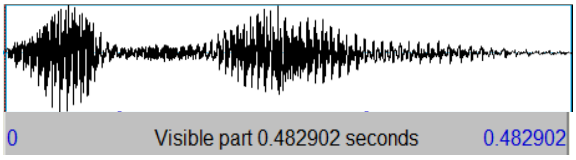
D.4.Sh ***D.4.Ed***

Figure (7): The token *Empty*

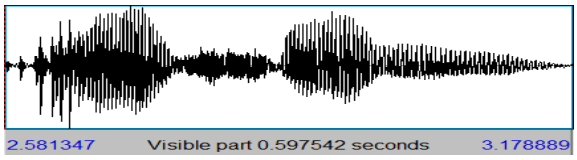
Table (8): AT of the token *Empty* measured in milliseconds (ms).

Stage \ Student	1	2	3	4	5	6	7	8	Average
Second	0.512	0.528	0.544	0.585	0.543	0.624	0.555	0.511	0.550
Fourth	0.638	0.646	0.548	0.486	0.520	0.452	0.454	0.567	0.539

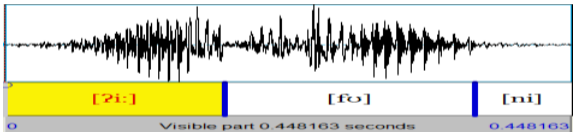
It is documented that the PSW ***empty*** is produced by the second stage students in an AT average (0.550 ms). In comparing it with AT of the native English speaker (0.544 ms), the AT variation is (+ 0.006 ms). This AT variation is resulted from some factors, i.e., articulatory behaviours, like production deficiency of CoClu, AdjaVo, SyCo, timing distribution within a PSW, etc. For example, ***A.2.Sh*** produced this PSW as a tri-syllabic word, inserting [pʊ], which is very overt even visually by noticing the wave form, timed as: [em] 0.2526; [pʊ] 0.1252; [ɪ] 0.134. Although, the entire word duration was around the same as that of the native, the timing distribution was of a big difference. Statistically, the timing of the final syllable, made by the English native speaker was (0.29 ms), whereas ***A.2.Sh*** gave it only (0.134 ms), that means (- 0.03 ms)(*) is shorter. Three from sixteen students, ***A.2.Ed***, ***C.2.Ed*** and ***A.4.Sh*** add such a syllable. These variation factors, CoClu, AdjaVo, SyCo, will be statistically added up then.



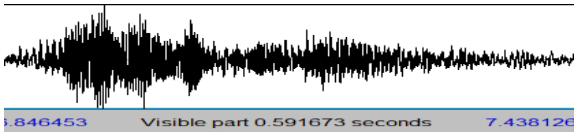
A.2.Sh



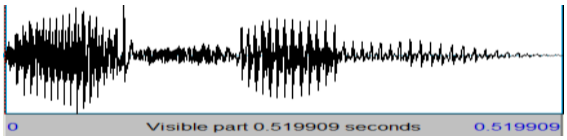
A.2.Ed



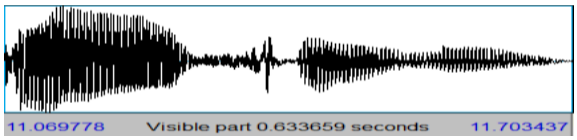
B.2.Sh



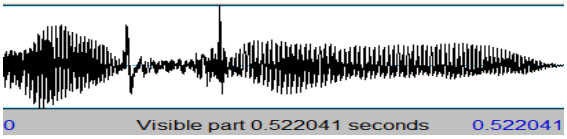
B.2.Ed



C.2.Sh



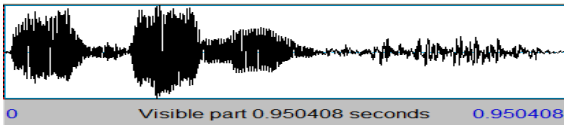
C.2.Ed



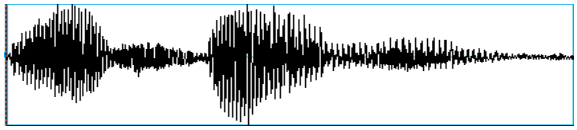
D.2.Sh

She failed to produce it.

D.2.Ed



A.4.Sh



A.4.Ed

(*) The symbol [-] indicates the case of shorter timing, and vise versa for [+].

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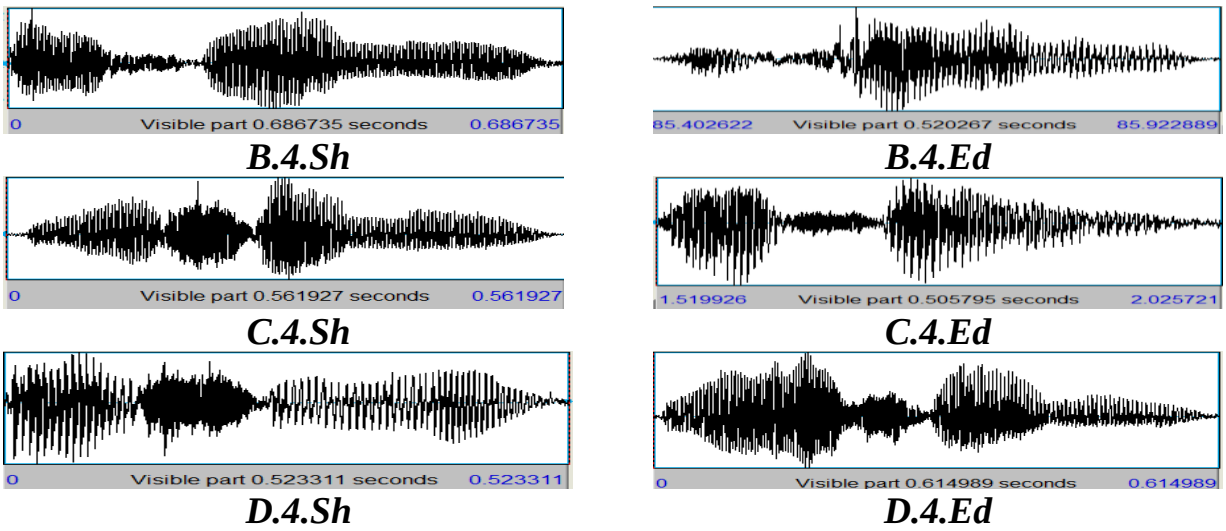
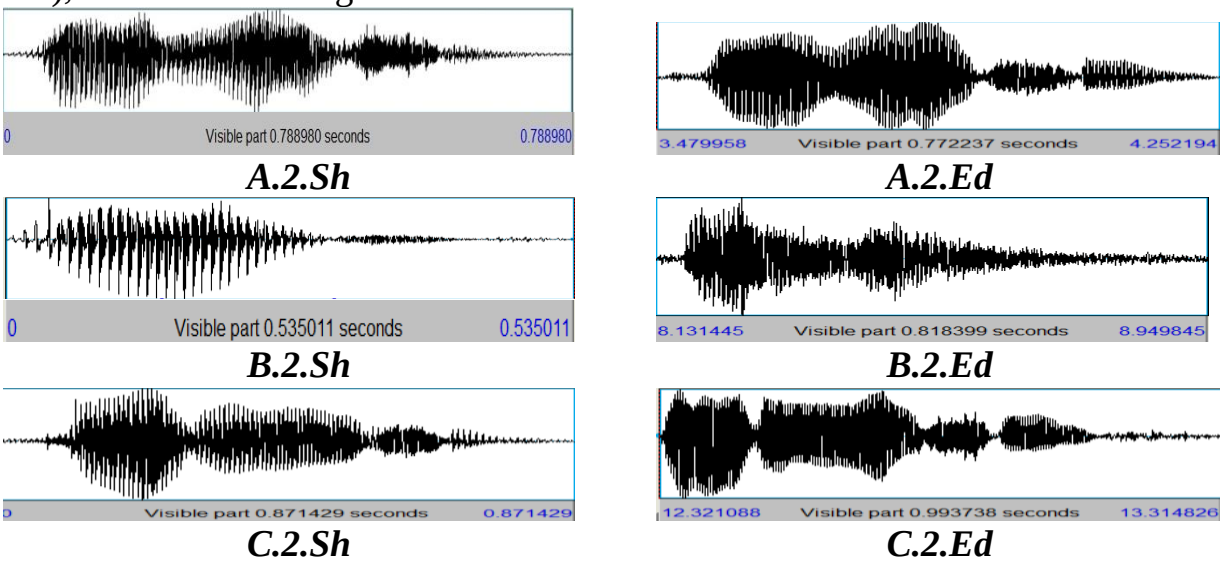


Figure (8): The token *Euphony*

Table (9): AT of the token *Euphony* measured in milliseconds (ms)

Stage \ Student	1	2	3	4	5	6	7	8	Average
Second	0.482	0.448	0.519	0.522	0.597	0.950	0.633	*Failure*	0.593
Fourth	0.950	0.686	0.561	0.523	0.529	0.520	0.500	0.614	0.610

In this PSW, although the second stage students are nearer to the native in their AT than the fourth stage students, there is a production failure case elicited in second stage students performance, as shown in table (9), and many of them shortened the first syllable, initiating it with the glottal stop [ʔ], rather than the [j] – The latter is longer than the former in around (0.048 ms). ***A.2.Sh*** timed this word as follows: [ʔə] (0.0952 ms); [fʊ] (0.2074 ms); [ni] (0.1803 ms). To contrast AT of ***A.2.Sh***, with AT of the English native speaker, already shown in figure (2), the differences were (-0.11 ms) for [juː]; (-0.03 ms) for [fə]; and (-0.01 ms) for [ni]. The average of the entire word timing variation is (0.574) - (0.593) = (- 0.019 ms), for the second stage; and (0.574) - (0.610) = (- 0.036 ms), for the fourth stage.



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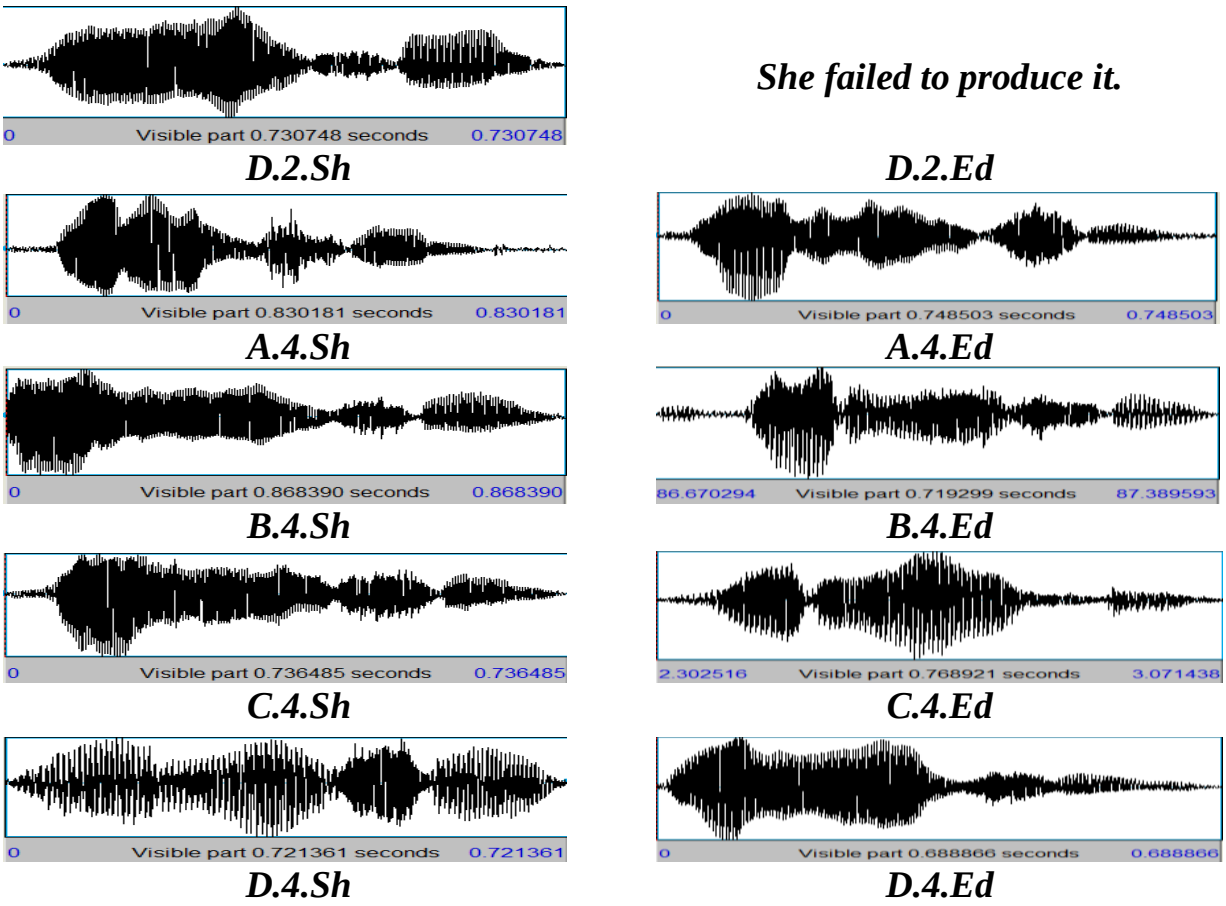

Figure (9): The token *Variation*

Table (10): AT of the token *Variation* measured in milliseconds (ms).

Stage \ Student	1	2	3	4	5	6	7	8	Average
Second	0.788	0.535	0.871	0.730	0.772	0.810	0.993	*Failure*	0.786
Fourth	0.830	0.868	0.736	0.721	0.748	0.719	0.768	0.688	0.760

Contrasted with AT of the English native speaker, (0.802 ms), the students from both stages produced this word with a shorter timing, but the fourth stage students are nearer than the second stage students to native speakers' AT— the timing difference of the second stage students is (0.760 ms) - (0.802 ms) = (- 0.042 ms), while the fourth stage students made the difference as (0.786 ms) - (0.802 ms) = (- 0.16 ms). There is also a production failure case registered in the second stage students performance when the student could not produce the word. This shortening variation is attributed to some factors, like the wrong production of V-to-V co-articulation made by some students, e.g., *C.4.Sh*, *A.4.Sh*, *D.2.Sh*, *D.4.Ed* and others. *B.2.Sh*, produced the word *variation* as a tri-syllabic word, rather than a quadri-syllabic one. *B.2.Sh* produced the first syllable [veə] as [vɑːr], shortening it to (0.147 ms), rather than (0.201 ms), to make it (- 0.054 ms) shorter. The entire word timing variation is (0.534) - (0.802) = (- 0.260 ms). AT of this word was measured as in table (11):

Table (11): Calculation of the token *Variation*

Native		*B.2.Sh*		Timing difference	
[veə]	0.201	[vɑːr]	0.147	(0.054	ms)

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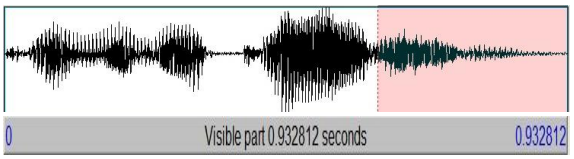
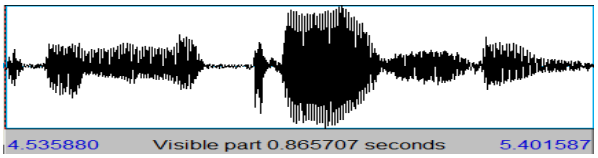
[ri]	0.144	---	0	(	0.144	ms)
[eɪ]	0.127	[eɪ]	0.161	(	0.034	ms)
[ʃn̩]	0.328	[ʃn̩]	0.226	(	0.102	ms)
Total	**0.802**		**0.534**	**(**	**- 0. 260**	**ms)**



A.2.Sh



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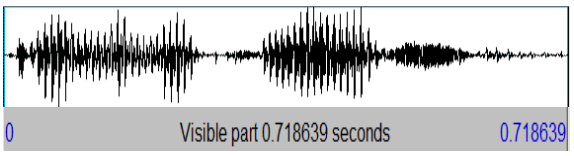
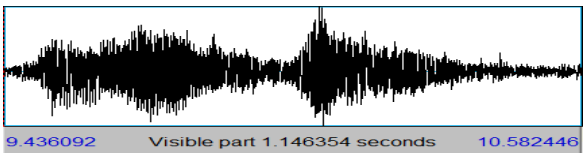


B.2.Sh



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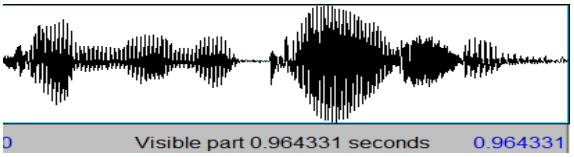
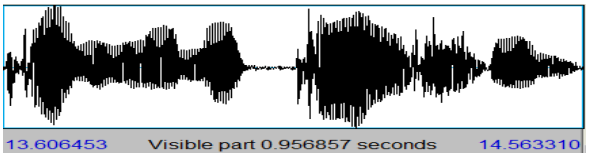
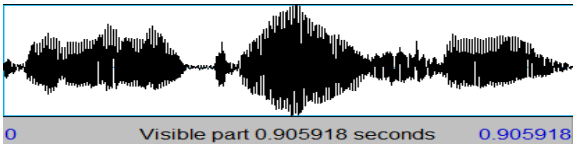


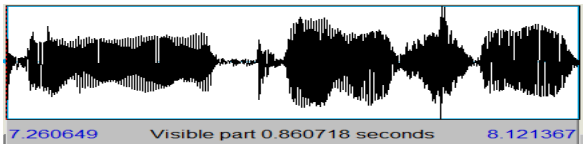
C.2.Sh



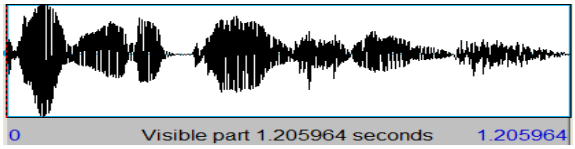
C.2.Ed



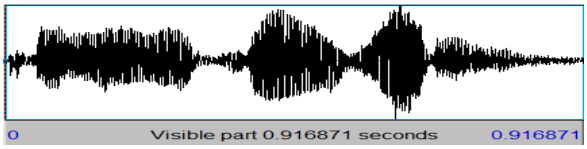
D.2.Sh



D.2.Ed

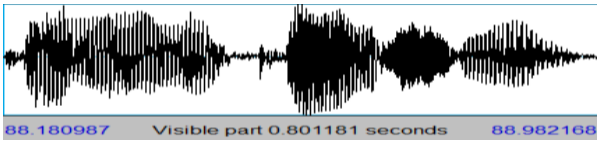


A.4.Sh

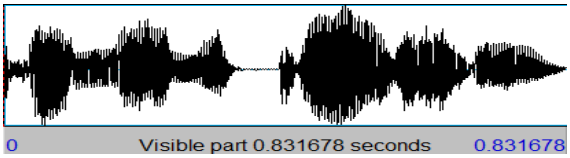


A.4.Ed

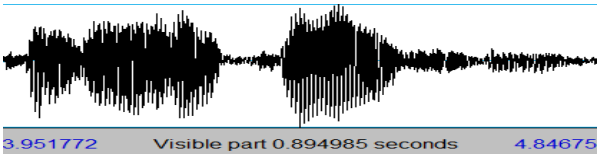
B.4.Sh



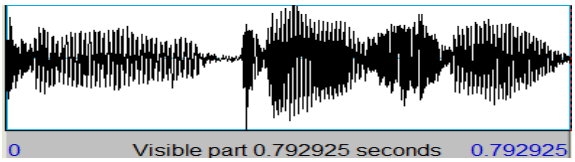
B.4.Ed



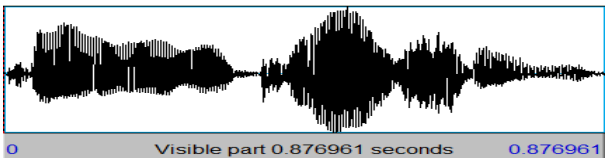
C.4.Sh



C.4.Ed



D.4.Sh



D.4.Ed

Figure (10): The token *Communication*

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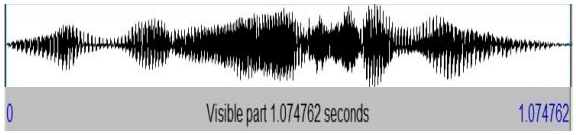
Table (12): AT of the token *Communication* measured in milliseconds (ms).

Stage \ Student	1	2	3	4	5	6	7	8	Average
Second	0.932	0.718	0.964	0.905	0.865	1.140	0.956	0.860	0.918
Fourth	1.205	0.962	0.831	0.792	0.916	0.800	0.894	0.876	0.910

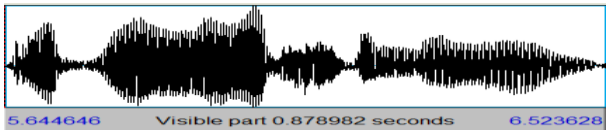
As it is hypothesized in this study, the variation of AT is proportional to the number of syllables within a PSW. The students from both stages lengthened this PSW. The entire word timing variation, for the second stage, is (0.918 ms) - (0.888 ms) = (+ 0.044 ms), while for the fourth stage, it is (0.910 ms) - (0.888 ms) = (+ 0.022 ms). The variant timing is caused by some phonetic behaviours, e.g., ***A.2.Sh*** produced it longer than the native does, lengthening all the syllables of this PSW. ***A.2.Sh*** made the first syllable [kə] as [kɒ], lengthening it for around (+ 0.024 ms). AT of the rest of the syllables, was measured as shown below in table (13):

Table (13): Calculation of the token *Communication*

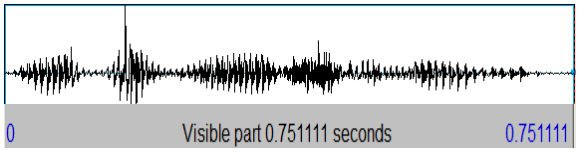
	Native	*A.2.Sh*	Timing difference
[mən]	0.1331	0.1413	(0.0082 ms)
[ʌ]	0.1377	0.1461	(0.0084 ms)
[keɪ]	0.2081	0.2236	(0.0155 ms)
[ʃn̩]	0.3269	0.3141	(0.0128 ms)
Total	**0.8885**	**0.9325**	**(+ 0.0440 ms)**



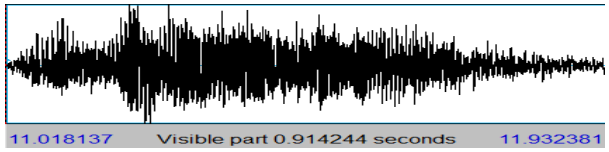
A.2.Sh



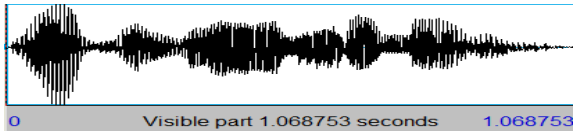
A.2.Ed



B.2.Sh



B.2.Ed



C.2.Sh

She failed in producing it.

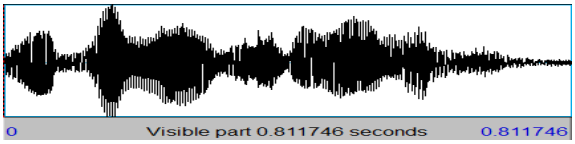
C.2.Ed

D.2.Sh

She failed to produce it.

D.2.Ed

A.4.Sh



A.4.Ed

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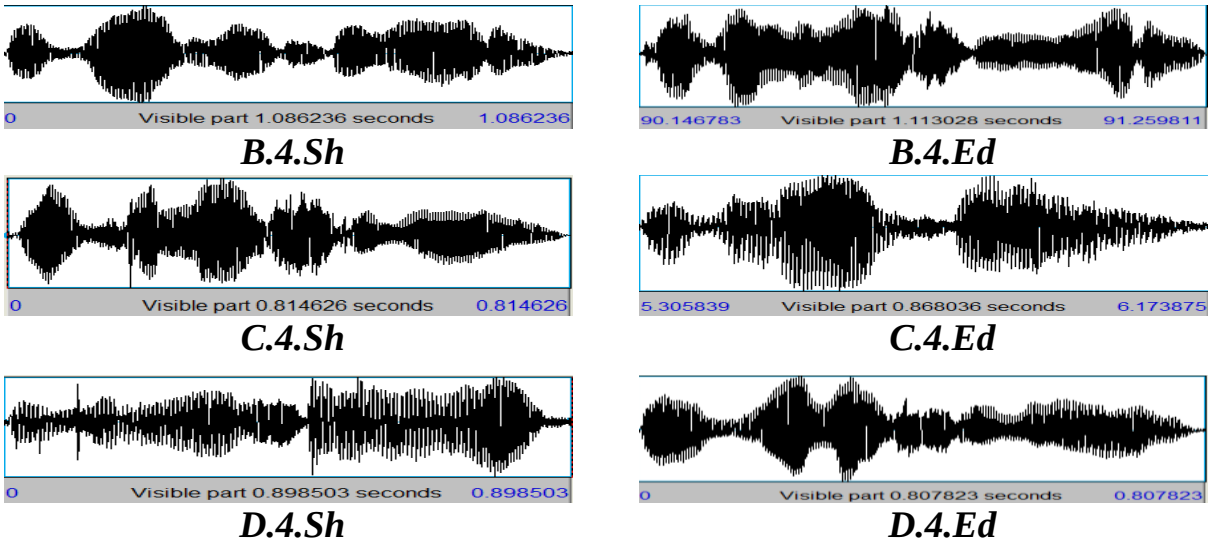

Figure (11): The token *Revolutionary*

Table (14): AT of the token *Revolutionary* measured in milliseconds (ms).

Stage \ Student	1	2	3	4	5	6	7	8	Average
Second	1.074	0.751	1.068	0.973	0.878	0.914	*Failure*	*Failure*	0.943
Fourth	1.632	1.086	0.814	0.898	0.811	1.110	0.868	0.807	1.003

The two cases of production failure, the students of second stage showed, indicate that the academic level affects the process of PSWs production, so does the syllables number within PSWs. All the research items consumed longer time producing this word, but the fourth stage students made it (1.003 ms) - (0.850 ms) = (+ 0.153 ms). For the second stage students, it is (0.850 ms) - (0.943 ms) = (+ 0.093 ms).

There are many reasons for producing such AT variations. For example, ***A.2.Sh*** showed an attention-worthy case in pronouncing it, which is the deficiency of producing SyCo [n̩] and [r̩]. This means preceding them by a short vowel, specifically one of [ə], [ɪ] or [e]. This categorically results in lengthening AT of a word. Looking as the third syllable, ***A.2.Sh*** inserted [j] before [uː], lengthening it from (0.134 ms) to (0.223 ms). In the fourth syllable [ʃn̩], the same student inserted a [ə] after [ʃ]; and [e] after [n] in the fifth syllable. This resulted in producing the word longer than that of the native speaker, not only lengthening, but modifying some syllables in this PSW as well, as listed below in table (15):

Table (15): Calculation of the token *Revolutionary*

Native		*A.2.Sh*		Timing difference		
[rɪ]	0.102	[rɪ]	0.150	(	0.047	ms)
[və]	0.103	[vəl]	0.198	(	0.094	ms)
[luː]	0.134	[juː]	0.223	(	0.088	ms)
[ʃn̩]	0.223	[ʃə]	0.209	(	-0.014	ms)
[r̩]	0.076	[ne]	0.102	(	0.025	ms)
[i]	0.210	[ri]	0.192	(	-0.018	ms)
Total	0.850		1.074	**(**	0.224	**ms)**

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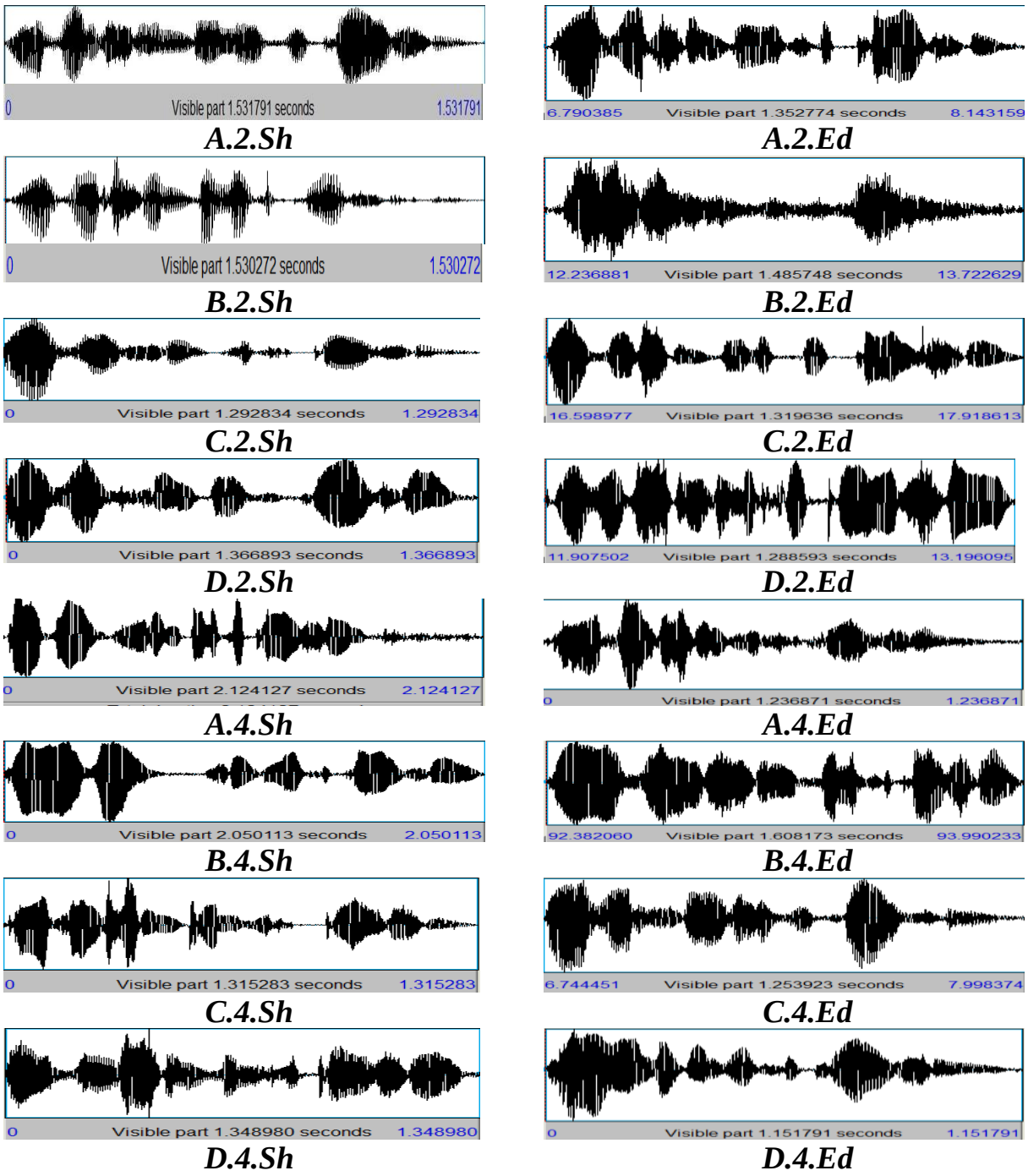

Figure (12): The token *Revolutionary*

Table (16): AT of token *Oversimplification* measured in milliseconds (ms)

Stage \ Student	1	2	3	4	5	6	7	8	Average
Second	1.531	1.530	1.292	1.366	1.352	1.485	1.319	1.288	1.395
Fourth	2.124	2.050	1.315	1.348	1.236	1.608	1.253	1.151	1.511

Another interesting result was observed in analysing this PSW *Oversimplification*, which is the deficiency of producing [p] and making it [b]. The English native speaker spends (1.284 ms) in saying it, while the AT average of the second stage students was (1.395 ms), and that of the fourth stage students was (1.511 ms) — they all made it longer. Such a difference in AT is attributed to many phonetic aspects. See, for instance, ***B.2.Sh***, ***A.2.Sh***, ***A.4.Sh***, ***C.4.Ed***,

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B.4.Ed, ***D.2.Ed***, and ***C.2.Ed***, who produced this PSW as an octa-syllabic rather than a hepta-syllabic and for the same reason, which is the CoClu production deficiency. They all inserted a [ə] after [b] in the fourth syllable [bə]. Additionally, they produced this PSW longer than that of the native speaker, lengthening and modifying some syllables. ***B.2.Sh*** is a good example, as listed in table (17):

Table (17): Calculation of the token *Oversimplification*

Native		*B.2.Sh*		Timing difference		
[əʊ]	0.126	[əʊ]	0.158	(	0.032	ms)
[və]	0.139	[vər]	0.141	(	0.002	ms)
[sɪm]	0.239	[səm]	0.318	(	0.079	ms)
[plɪ]	0.105	[bə]	0.072	(	0.033	ms)
		[lɪ]	0.092	(	0.092	ms)
[fɪ]	0.149	[fɪ]	0.139	(	0.01	ms)
[keɪ]	0.192	[keɪ]	0.172	(	0.02	ms)
[ʃn̩]	0.330	[ʃn̩]	0.438	(	0.108	ms)
Total	**1.284**		**1.530**	**(**	**+ 0.246**	**ms)**

However, the following two tables (18) and (19), include all the statistical data concerning the AT of the research items produced by the subject students. The last column in each table of them is the average of AT of the research items, done by the subject students.

Table (18): AT of the research items made by the second stage students

Student / PSW	1	2	3	4	5	6	7	8	Average
Empty	0.512	0.528	0.544	0.585	0.543	0.624	0.555	0.511	0.550
Euphony	0.482	0.448	0.519	0.522	0.597	0.950	0.633	*Failure*	0.593
Variation	0.788	0.535	0.871	0.730	0.772	0.810	0.993	*Failure*	0.786
Communication	0.932	0.718	0.964	0.905	0.865	1.140	0.956	0.860	0.918
Revolutionary	1.074	0.751	1.068	0.973	0.878	0.914	*failure*	*Failure*	0.943
Oversimplification	1.531	1.530	1.292	1.366	1.352	1.485	1.319	1.288	1.395

Table (19): AT of the research items made by the fourth stage students

Student / PSW	1	2	3	4	5	6	7	8	Average
Empty	0.638	0.646	0.548	0.486	0.520	0.452	0.454	0.567	0.539
Euphony	0.950	0.686	0.561	0.523	0.529	0.520	0.500	0.614	0.610
Variation	0.830	0.868	0.736	0.721	0.748	0.719	0.768	0.688	0.760
Communication	1.205	0.962	0.831	0.792	0.916	0.800	0.894	0.876	0.910
Revolutionary	1.632	1.086	0.814	0.898	0.811	1.110	0.868	0.807	1.003
Oversimplification	2.124	2.050	1.315	1.348	1.236	1.608	1.253	1.151	1.511

7- Results and Conclusions

Timing is one aspect of pronunciation, that is, good pronunciation gives proper, or very near to the proper, timing. Speakers of a language does not add up the seconds and minutes of the words being articulated. That is to say, proper

timing is an accidental, subsidiary product of correct pronunciation. In this paper, it is concluded that AT variation is highly affected by some articulatory behaviours. Below are the main phonetic factors that participate in varying AT of English PSWs:

Table (20): The main influential factors in AT variation

Lengthening Factors	Occurrence No.
[p] as [b]:	18
SyCoProciency:	34
CoCluProciency:	13

Shortening Factors	Occurrence No.
[j] as [ʔ]:	5
AdjaVoProcienct:	9

It is noted that the average of AT of PSWs uttered by Iraqi EFL learners is longer than that of the native English speaker, and for both stages. This corroborates the hypothesis that Iraqi EFL learners produce English PSWs with longer duration than that produced by native English speakers. However, the AT variation produced by second stage students is nearer to the native speakers' productions than that produced by the fourth stage students. This is obvious from seeing the average of the variant AT of both stages, and contrasting it with that of the native English speaker, as shown below in figure (13), supporting that the academic level is not the main cause of this additional AT. Average AT of the native is (0.824 ms), average AT of 4th stage is (+ 0.888 ms) and average AT of 2nd stage (+ 0.864ms).

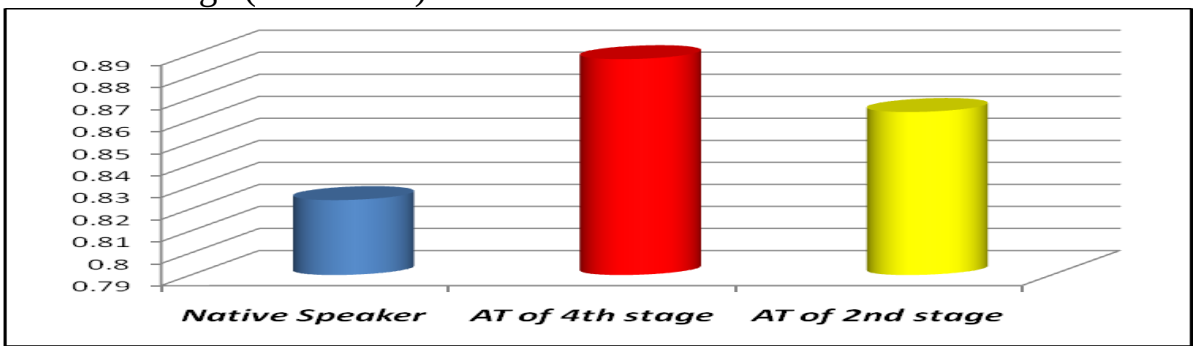

Figure (13): The Difference in the production of AT

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