Arab World English Journal
INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327
مجلة اللغة الانكليزية في العالم العربي

Arab World English Journal (AWEJ) Volume.7 Number.2 June, 2016

Pp.394-416

DOI: https://dx.doi.org/10.24093/awej/vol7no2.27

English Pronunciation Errors by Jordanian University Students

Raya Kalaldeh
Department of English Language and Literature
Faculty of Foreign Languages, The University of Jordan
Amman, Jordan

Abstract

This paper presents some of the major English pronunciation errors made by Jordanian students at the University of Jordan. The corpus is designed to investigate the production of English consonants, vowels, consonant clusters, and word stress by informants. The tested consonants are /p - v - ʧ - ʤ - ŋ - ɹ - ɬ/. The tested vowels are /ɪ - ɛ - ɑ - ɔ: - oʊ - ə /. Words containing consonant clusters; *square - explain* or across words; *best friend - ride and swim* are tested for epenthetic vowels. The stress pattern is investigated in words such as *isn't- unfortunately.* It is found that informants frequently confuse the following phonemes /p - ŋ - ɹ - ɬ/ with /b - ng - ɾ - l/ respectively. Moreover, informants frequently insert an epenthetic /ɛ/or /ɪ/ in consonant clusters whether within words; /sɪkɾi:m/ for /skɹi:m/ or across words; /bɛst ɪ frɛnd/ for /bɛst fɹɛnd/. Regarding vowels, informants commonly confuse the KIT-DRESS vowels produceing both as /e/. The realization of the schwa /ə/ is greatly influenced by spelling. The LOT vowel is produced similar to its RP /ɒ/ realization as [ɞ]even though most informants adopt a General American accent and should therefore produce the vowel as /ɑ/. The THOUGHT-GOAT vowel distinction is missing; both vowels are often merged as [o:]. Finally, the informants very often shift the stress pattern from its trochaic English stress pattern; /ɪ'zɪnt/ for /'ɪzɪnt/.

Keywords: Arabic L1, carryover, consonants-clusters, English L2, vowels

Cite as: Kalaldeh, R. (2016). English Pronunciation Errors by Jordanian University Students. *Arab World English Journal,7* (2). DOI: https://dx.doi.org/10.24093/awej/vol7no2.27

Introduction

Mastering English is viewed globally as an indication of good education and professionalism in different walks of life. As an international language, English has received a lot of attention in the Arab World. For over the past thirty years, many Arab and Arabic speaking linguists have researched the teaching of English to Arab speakers. In particular, the pronunciation of English has taken the lion's share of research in that field, and rightly so. It is the speaking skill of English that many Arabs aspires to prefect in order to enhance their job opportunities and impress their potential employers with their communication skills in English, not least in the realm of business.

Many Arab and non-Arab researchers have worked on errors of English pronunciation by Arab speakers and remedial strategies to enhance Arab learners' spoken English, notably (Mitchell, T, F. & Hassan, S. 1989; Kharma, N. & Hajjaj, A. 1997). This trend has increased in recent years as Arab English language teachers and Arab linguistics frequently produce work on English pronunciation errors by Arabic speakers.

Many Arab linguists attribute the common English pronunciation errors to the differences of the sound systems of English and Formal Arabic (FA), often referred to as Modern Standard Arabic (MSA). Linguists who solely attribute such errors to influence of the mother tongue, First Language (L1), Arabic in this case, commonly follow the approach of Contrastive Analysis (CA) where the errors can be predicted based on comparing and contrasting the systems of the L1 and Language 2 (L2). However, those who analyze the produced errors themselves without particular reference to L1 often adopt an Error Analysis (EA) approach, where sources of errors might not always necessarily stem from a particular aspect or carryover effect from L1.

There are shared pronunciation errors among Arab speakers. It has been reported that some of the most common English pronunciation errors by Arabs are the consonantal phonemes /p/, /v/ and /ɹ/ (El Zarka 2013; Binturki 2008). However, due to the different Colloquial varieties of spoken Arabic, it is inevitable that different Arab speakers would have different errors. For example, Arabic speakers from Egypt and Syria usually mispronounce /θ/ as /s/ so that *sin* is produced as [sɪn] and /ð/ as /z/ so that *this* is produced as [zɪs]. This difficulty in producing dental fricatives; however, does not exist for Jordanian, Palestinian or Gulf speakers of Arabic when they speak English (Mitchell, T, F. & Hassan, S. 1989, 96).

Types of pronunciation errors can be classified into three categories; segmental, stress related errors, and prosodic errors. Segmental pronunciation errors are manifested mainly in the realization of some 'problematic' consonants and vowels. These types of errors have been the most researched so far, as they can be easily pointed out perceptually as well as acoustically (e.g. El Zarka 2013; Binturki 2008; Al Saidat. E.M. 2010; El Khair M.I. 2014). Segmental errors represent the most obvious aspect of 'foreignness' in the speech of a non-native speaker of English. Very often segmental errors are attributed to direct influence from L1.

Table (1) presents the IPA consonantal phonemic inventory of English and Arabic; bracketed phonemes are found only in Arabic, highlighted phonemes are found only in English. The phonemes /p, v, ɹ, ŋ, ʧ, ʤ/ exist only in English, and are more likely to be problematic for

native speakers of Arabic. Similarly, the bracketed phonemes that are specific to Arabic can be problematic for native speakers of English when learning Arabic.

Table 1 *IPA chart of Arabic and English consonants combined; bracketed phonemes are found only in Arabic, highlighted phonemes are found only in English*

Place→ ↓Manner	Bilabial	Labiodental	Dental	Alveolar	Post-alveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b	f v		t d (tˤ dˤ)				k g	(q)		(ʔ)
Nasal	m			n				ŋ			
Tap/flap				(ɾ)							
Fricative			θ ð (ðˤ)	s z (sˤ)	ʃ ʒ				(χ ʁ)	(ħ ʕ)	h
Lateral				l							
Approximant	w			ɹ			j	w			
Affricates					ʧ ʤ						

Another problem related to consonant production is consonant clusters. English is a language that allows for a wide variety of clusters in onset (0-3) and coda (0-4) position. Formal Arabic, on the other hand, only allows for two-consonant clusters in coda position. Table (2) summarizes the syllable structures in FA and English. The scarcity of consonant clusters in FA creates great difficulty for Arabic speakers who would likely change the structure of the English syllable using epenthetic vowels, a problem Japanese learner of English also encounter.

Table 2 *Syllable structures in Formal Arabic and English; syllables with consonant clusters are shaded*

Formal Arabic		English	
Syllable Structure	**Example**	**Syllable Structure**	**Example**
CV	/wa.lad/ ‘boy’	V	/aɪ/ ‘eye
CV:	/ʒa.di:da/ ‘new’	CV	/wæ.təɹ/ ‘water’
CVC	/mak.ta.ba/ ‘library’	VC	/ɑn/ ‘on’
CV:C	/ka.bi:ɾ/ ‘big’	CVC	/kæt/ ‘cat’
CVCC	/nasɾ/ ‘eagle’	CCV - CCVC	/steɪ(z)/ ‘stay(s)’
CV:CC	/ʃa:dd/ ‘he argued’	VCC - VCCC	/ænt(s)/ ‘ant(s)’
		CVCC - CVCCC	/hʌnt(s)/ ‘hunt(s)’
		CCVC - CCVCC	/stɑp(s)/ ‘stop(s)’
		CCVCCC	/stændz/ ‘stands’
		CCCV	/skju:/ ‘skew’
		CCCVC - CCCVCC	/skɹi:n(z)/ ‘screen(z)’
		CCCVCCC	/spɹɪnts/ ‘sprints’
		CVCCCC	/tɛksts/ ‘texts’

Figure 1 shows the vowel charts of Arabic and English. The Arabic vowels are superimposed over the RP vowels, adjusted from Wells’ Dictionary (1991). The circled areas in

the monophthongs chart represent the Arabic vowels /ɪ- ɪ:/, /u-u:/, and /a-a:/; the dotted lines in the diphthongs chart represent the Arabic diphthongs /aɪ/ and /aʊ/.

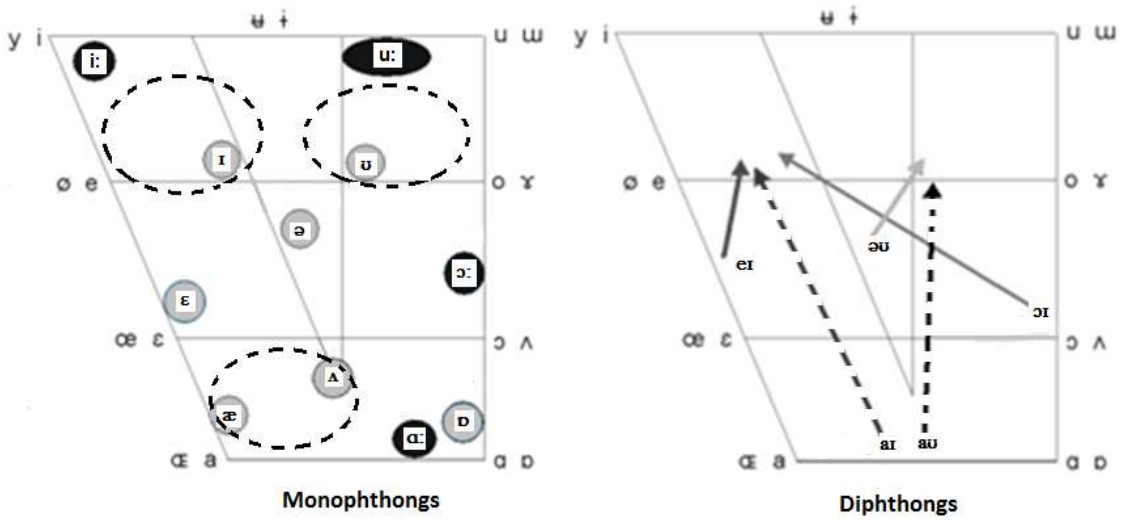

Figure 1 Arabic vowels superimposed over RP vowels, adjusted from Wells' Dictionary (1991), circled areas in the monophthongs chart represent the Arabic vowels /ɪ- ɪ:/, /u-u:/, and /a-a:/; dotted lines in the diphthongs chart represent the Arabic diphthongs /aɪ/ and /aʊ/

It is clear that the Arabic vowels are much less than the English ones, this normally results in difficulties of vowel realization, distinction and perception by the Arab learner of English. In particular, the back area of the vowel space where English back-rounded vowels are articulated is non-existent in Arabic. Similarly, the English DRESS vowel area is pressed between the two front Arabic vowels /ɪ- ɪ:/ and /a-a:/. Such vocalic differences along with the lack of the schwa pose serious challenges for Arab learners in articulating different English vowels.

Stress and rhythm errors are manifested in placing the English word stress on the wrong syllable, which in turn can result in the inability to properly produce a weak vowel (/ə/), an important aspect of English fluency. The stress rules of Arabic are highly predictable (Halpern 2009). Generally, in FA, the stress usually falls on the heavy syllable. In bisyllabic words, stress falls on the penultimate; /ˈwa.lad/ 'boy', in polysyllabic words stress falls on the penultimate if it is heavy; /ka.lɪ.ˈma:.tɪ/ 'my words', if not, then the antepenultimate is stressed; /ka.ˈlɪ.ma.tɪ/ 'my word'. English stress rules are not as straightforward; and differ depending on the word's part of speech (noun, verb, adjective, and adverb) and on the syllable number, not to mention compound words stress patterns and the influence of suffixes on word stress in English. There are also many exceptions to the English Germanic trochaic stress, particularly if the word is borrowed word from French, Latin or other languages (Carr, P. 2013).

Errors in stress placement in English can result in miscommunication especially in noun-verb distinctions as in *ˈpresent* (n.) vs. *preˈsent* (v.). However, in general, wrong stress placement contributes to the 'foreignness' of the non-native speaker of English which in turn distorts the proper English rhythm.

Prosodic errors are mainly manifested in producing a non-English intonation pattern. This type of errors is considered the most challenging for native speakers of Arabic, and indeed other learners of English. Inappropriate tonal patterns are not as clearly tangible and apparent as segmental or stress related pronunciation errors. More often than not, an Arabic speaker would be able to fluently produce all English consonants, vowels and stress patterns; however, there would still be 'something' non-native in their English speech. This 'something' is the melody of their utterance to which English native ears are susceptible. Such fine-grained differences in tonal patterns and details of pitch accents become discernable when analyzing the speech signal acoustically. Although Arabic and English are intonational languages that depend on tonal patterns and pitch accents to convey grammatical and attitudinal messages, they employ different tonal patterns for different purposes. Indeed, intonation errors play a major role in the staccato beat characteristic of English speech produced by Arabs and the common observation by English speakers that Arabic speakers sound abrupt and commanding.

Research Questions

In light of the various types and studies on English pronunciation errors by Arabic speakers, this study comes to complement some of the gaps in this field. Many researchers as mentioned above tackled the discussed errors from different aspects. However, the whole picture is often fragmented and incomplete for a single variety of spoken Arabic. Some researchers studied one type of error; consonants (Binturki 2008), vowels (Saadah, E. 2011), consonant clusters (Al Saidat, E. M. 2010), stress placement (Almbark, R., Bouchhioua, N., & Hellmuth, S. 2014). Studies of intonational aspects of English produced by Arabic speakers are scarce (Al Gethami 2008). Acoustical studies on the intonation of FA and Colloquial varieties of Arabic, using the auto-segmental metrical approach, came to light only in the past ten years.

This study aims to characterize the two types of English pronunciation errors; segmental and stress-related, by a single group of Arabic speakers; Jordanian university students. The segments under study were chosen based on the researcher's experience of teaching English pronunciation and speech courses to university level Jordanian students for the past three years. There are four research questions:

1. How are the consonants /p - v - ʧ - ʤ - ŋ - ɹ - ɬ/ realized by the Jordanian informants?
2. How are the tested English consonant clusters realized by the Jordanian informants?
3. How are the tested vowels /ɪ - ɛ - ɑ - ɔ: - oʊ - ə / realized by the Jordanian informants?
4. How are different English stress patterns realized by the Jordanian informants?

Informants

Six male students at the University of Jordan were chosen for the study. The average age range is 23 (20 – 26). The informants come from a fairly homogenous group. All informants are originally from the same city of Madaba (30 Kilometers south-west of the capital city of Amman). The variety of Colloquial Arabic under study thus, represents the Bedouin Jordanian Colloquial dialect, referred to here as JA (Jordanian Arabic). This dialect is considered a North Najdi variety of Arabic, an early version of the Najidi dialect used today in Saudi Arabia (Ingham, B. 1994, 9). None of the informants has hearing or speech problems. None has lived outside Jordan for over six months. All have both parents from the same city of Madaba. All have gone to similar schooling in Madaba. The Informants are students at the Faculty of Arts (only HS is from the Faculty of Tourism) where the language of instruction is Arabic. Informants

were chosen to have a 'fair' proficiency of spoken English (verified by the researcher) were the tested sounds would likely manifest in their English speech.

Methodology

Informants read 158 words twice (words for: consonants =54, vowel =50, consonant clusters = 36, stress = 18, see appendix). In total, the produced tokens were (158x2) x 6 informants = 1896 (70 tokens were discarded for mispronunciation); therefore, the total analyzed tokens were 1826.

The words chosen to represent the consonants and vowels were also checked for their frequency in English using the website http://www.wordfrequency.info/free.asp to make sure informants did not find the test words unfamiliar and to produce them at their ease.

Each word was placed in the carrier sentence 'say _ _ _ _ again.' and was presented on a Powerpoint slide. The list of words was randomized twice and read from a computer screen. Each informant clicked for the next sentence at their own pace. The recordings took place at the University of Jordan's Radio station (49.9FM) recording studio. The recording software was Sony Sound Forge (Pro. 11.0) 2013 - recording frequency: 44 KHz, computer: HP Elie7500: Windows 10 – core i 7 – 64bits. The informant's mouth was approximately 5 cm away from a RODE Procaster (Broadcast Quality Dynamic Microphone).

Acoustic analysis of the data was carried out using Praat (version 6.0.15).

Results

The present study investigates problems in English pronunciation by Jordanian speakers in four aspects: consonants, consonant clusters, vowels and word stress. The chosen consonants and vowels include the main challenging English speech sounds Arabic speakers have. The results of the data analysis are presented below in four sections, accordingly.

Consonants:

The tested consonants are /p - v - ʧ - ʤ - ŋ - ɹ - ɬ/. As can be seen in the Appendix, consonants were tested in various contexts, mainly: in the onset, in the coda, and between vowels. The affricate /ʧ/, usually spelt as 'ch', was also tested in its two other spelling 'ture'; *picture* and *nature* and 'tch'; *watch* and *catch*. These words were added to see if spelling had an influence on the way the sound is pronounced. The velar nasal /ŋ/ did not have a (V-V) context as it only occurs in the coda in English. The /ɹ/ had four extra words in onset consonant clusters; *try* and *great* as well as in the coda; *start* and *word*. Dark /l/; [ɬ] had extra words for its rendition in coda consonant clusters; *old* and *help*, after long vowels; *feel* and *school*, spelt as 'll', 'le', and 'al' in coda position; *will-all*, *table*, and *animal*, respectively.

Table 3 shows the correct pronunciation percentages of consonants in all contexts averaged for all informants. It can be seen that the two affricates /ʧ/ and /ʤ/ which are not present in the inventory of Formal Arabic were realized correctly most of the time. This suggests that Jordanian speakers do not have a problem producing the English affricates, as will be discussed later in the Discussion. However, only one speaker (HH) had [ʒ] renditions for /ʤ/ in the words *Jordan, just* and *major*. Similarly, the fricative /v/ was always realized correctly and voiced by all speakers and in all contexts; the word *visa* was read as [fi:zə] in one repetition by two speakers only.

Table 3 *Correct pronunciation percentages of consonants in all contexts averaged for all informants*

Consonant Realizations by All Informants		
Consonant	**Rendition % of correct sound**	**How it was realized**
p	36.1%	Almost always produced as [b] specially word initially and between vowels; *put* & *happy*
v	97.2%	[f] only twice in *visa*
ʧ	98.3%	Unanimously an affricate
ʤ	86.1%	Only one informant used [ʒ] in *Jordan, just* and *major*
ŋ	0%	Unanimously followed by a /g/:[ng]
ɹ	0%	Unanimously a tap [ɾ] in all contexts
ɬ	0%	Unanimously a light [lʲ] in all contexts

The speech sounds that were clearly problematic for the informants were /p - ŋ - ɹ - ɬ/. The voiced bilabial stop /p/ was correctly voiceless only 36.1% of the time, in all other renditions it was realized as a voiced [b]. Table (4) shows the individual renditions of /p/ by all informants. The correct [p] renditions are shaded for clarity. Sometimes, /p/ was realized correctly in coda position by four informants. This can suggest that it is easier for Arabic speakers to produce a voiceless bilabial stop word finally than word initially; as in *up* and *keep*. Interestingly, one informant (MA) did not have a problem realizing a [p] in most of his renditions. The correct pronunciation percentage would be 26.6% when the renditions of MA are excluded.

Table 4 *Individual renditions of /p/ by all informants; correct [p] renditions are shaded for clarity*

/p/		Speakers						%
contexts	**tokens**	**HH**	**HS**	**MA**	**MB**	**MS**	**MW**	
# -	*put*	b - b	b - p	p - b	b - b	b - p	b - b	[p] = 36.1% (26/72)
#C -	*place*	b - b	b - b	p - p	b - b	b - p	b - p	
V - V	*apple*	b - b	b - p	p - p	b - b	b - b	b - p	
V - V	*happy*	b - b	b - b	p - p	b - b	b - b	p - p	excluding MA [p] =26.6% (16/60)
- #	*up*	b - b	p - p	p - p	b - b	b - b	b - b	
- #	*keep*	p - p	p - p	p -b	b - b	b - b	p - p	

The three other consonants / ŋ - ɹ - ɬ/ were all realized as /ng - ɾ - lʲ/ respectively. The velar nasal /ŋ/ does not exist in Arabic as a phoneme, but as an allophone of /n/ and is always produced in the context /nk/ or /ng/. None of the informants produced /ŋ/ without a following voiced velar stop /g/. Figure (2) is a screenshot showing the waveform and wideband spectrogram of say 'king' again and says *'morning' again* by speaker MW. The pauses in the sound signal are very clear for the stops; /k/ in *king* and the /g/ at the end of *king* and *morning* and in the word *again*. The /g/ in *morning* has been highlighted for clarity.

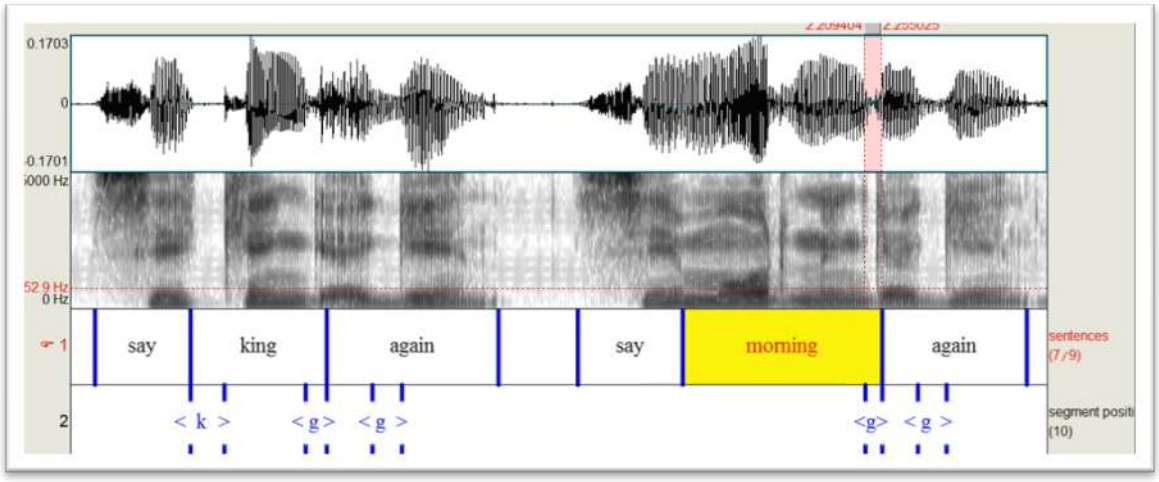

Figure 2 A screenshot showing the waveform and wideband spectrogram of *say 'king' again* and *say 'morning' again* by speaker MW; /g/ in *morning* has been highlighted for clarity.

The /ɹ/ is one of the most challenging English sounds for speakers of Arabic. The English approximant /ɹ/ was unanimously produced as a voiced tap [ɾ], the Arabic sound, in all contexts. An English /ɹ/ was produced once by speaker HS in *run*. Figure (3) shows the waveform and wideband spectrogram of [ɹ] and [ɾ] in the renditions of *run* by speakers HS and MB respectively. The abrupt [ɾ] highlighted in the signal is clear compared to the continuous [ɹ].

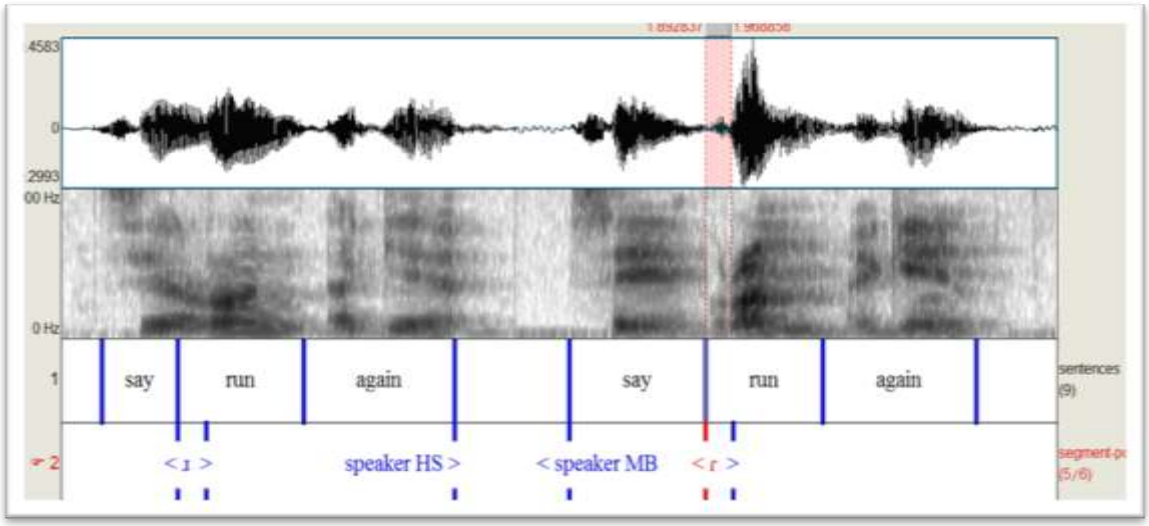

Figure 3 Waveform and wideband spectrogram of [ɹ] and [ɾ] in the renditions of run by speakers HS and MB respectively; [ɾ] is highlighted for clarity

Dark [ɬ] was not produced by any of the informants in its expected context in English; in coda position. All informants realized /l/ as a light [l̪] in all contexts. There was no difference in the /l/ realization whether in coda consonant clusters; *old* and *help* and after long vowels; *feel* and *school*. Similarly, spelling did not trigger any difference in pronunciation; all renditions of'll', 'le', and 'al' in *will-all, table,* and *animal* , respectively, were realized as a light [l̪].

Consonant Clusters

Consonant cluster production was tested in two contexts; within words and across words. The tested words 'within words' were three types; in onset position as in *screen-street*, in coda position as in *desks-clothes* and across syllables within the same word as in *include-explain*. Tested words for clusters 'across words' were also three types; four-consonant clusters as in *best friend – must try*, three-consonant clusters as in *best food* and three-same consonants clusters as in *bad dream*, and two-same consonant clusters as in *big girl*.

Table 5 shows the percentages of the correct pronunciation of the tested consonant clusters 'within words' as the total correct renditions out of all informants' renditions.

Table 5 *Percentages of correct pronunciation of the tested consonant clusters 'within words' counted as the total correct renditions out of all informants' renditions*

Consonant Clusters within Words					
Onset (CCC)		**Across syllables (C.CC / C.CCC / C.C)**		**Coda (CCC / CC)**	
screen-scream	skɹ = 40.9%	include-increase	ɪn.kl/ɪn.kɹ = 66.6%	desks	sks = 45.4%
square-squeeze	skw = 73.9%	instead-instance	ɪn.st = 29.1%	clothes	ðz = 0%
splash-spray	spl/spɹ = 60.8%	explain-express-exclude	ɛk.spl/ɹ = 38.8%	banks	nks = 83.3%
strong-street	stɹ = 78.7%	physically	k.li = 44.4%		
AVERAGE	**63.58%**	**AVERAGE**	**44.72%**	**AVERAGE**	**42.9%**

The highest correct percentages are the onset clusters renditions at 64% with the /skɹ/ cluster being the most challenging for informants (only 41% correct). The coda clusters proved to be very challenging specially for the word *clothes* which was unanimously produced as [klo:ðəz]. Coda clusters that include nasals were not as difficult for informants; only one speaker (HS) produced *banks* as [bænkəz]. In the clusters across-syllable of the same word, the most challenging was /ɪn.st/ in *instead* and *instance* at 29.1% correctness which was often produced with epenthetic /ə/ or /ɪ/ as [ɪnɪst]. Another challenging across-syllable cluster was /ɛk.spl/ɹ/ at 39% correctness; the epenthesis always included the vowel after the /s/ as [ɛk.sɪpl/ɹ].

In general, it seems that informants found coda clusters to be more challenging regardless of the number of consonants in the cluster. For example, the three-consonant cluster in onsets such as /stɹ/ had a 79% correctness rate compared to 45% for the three-consonant cluster in the coda of the word *desks*.

Table 6 shows the percentages of the correct pronunciation of the tested consonant clusters 'across words' counted as the total correct renditions out of all informants' renditions.

Table 6 *Percentages of the correct pronunciation of the tested consonant clusters 'across words' counted as the total correct renditions out of all informants' renditions*

Consonant Clusters across Words							
Four Consonants		**Three Consonants**				**Two Consonants**	
CC-CC		**CC-C / C-CC**		**Same CC-C / C-CC**		**C-C /Same C-C**	
best friend	st-tɾ = 33.3%	best food	st-f = 100%	must talk	st-t = 91.6%	was sitting	z-s =91.6%
don't stop	st-bj = 33.3%	don't sit	nt-s =100%	bad dream	d-dɾ = 60%	his side	z-s = 100%

just great	st-gɾ = 16.6%	just go	st-g = 91.6%	big group	g-gɾ =41.6%	bad dog	d-d = 90%
most beautiful	nt-st = 75%	most banks	st-b = 83.3%			big girl	g-g = 50%
must try	st-fɾ = 41.6%	was swimming	z-sw =58.3%				
		his snake	z-sn = 50%				
AVERAGE	**39.96%**	**AVERAGE**	**80.53%**	**AVERAGE**	**64.4%**	**AVERAGE**	**82.9%**

It can be seen that contrary to clusters 'within words', the realization of clusters 'across words' by the informants is influenced by the number of consonants in the cluster. Four-consonant clusters have the least rate of correctness at 40% compared to the 72.47% of three-consonant cluster (combined) and two-consonant clusters at 83%. Indeed some of the most challenging clusters are the four-consonant clusters in *just great* /st-gɾ/, *best friend* /st-tɾ/ and *don't stop* /st-bj/ at 17%, 33.3% and 33.3%, respectively. The epenthetic /ɪ/ or /ə/ in these clusters would always be placed between the two words boundary as in [bɛstɪfɹɛnd]. In some cases, there was no epenthesis; the informant would produce a short pause between the two words (approximately 10 ms) giving a staccato reading of English.

Three-consonant clusters of the same consonant were somehow challenging for most informants particularly in *big group* /g-gɾ/ which was often rendered as [bɪgɪgɹu:p]. Two-consonant clusters of the same consonant had the highest rate of correctness at 83%. The /z-s/ boundary in *his side* was unanimously produced correctly.

Vowels

The tested vowels were /ɪ - ɛ - ɑ - ɔ: - oʊ - ə /. Using the KIT and DRESS vowels interchangeably is common among Arab speakers since the DRESS vowel is considered as a variant of the 'kasra' in Arabic, particularly in Colloquial dialects of Arabic. Most speakers of Arabic confuse British English pronunciation (RP) with General American (GA), particularly when it comes to vowels. The realization of the LOT vowel is a common error and is usually rendered as the RP rounded [ɒ]. Many, if not most, Arab speakers adopt a GA accent (contrary to the assumption that RP is the most used variety of English in the Arab World cf. Kharma, N. & Hajjaj, A. (1997, 11)) and should therefore realize the LOT vowel as an unrounded [ɑ]. Another challenging vowel for Arabic speakers is the long monophthong THOUGHT vowel [ɔ:] as in *bought* and *caught* as opposed to the GOAT vowel in *boat* and *coat*, which is a diphthong [oʊ]. Finally, the realization of the schwa or *Comm*A vowel, according to JC Wells (1982), is investigated in different contexts; word initially and word finally, as well as in different spellings; 'en', 'ent', 'on', 'om', 'er', 'or', 'al', 'le', 'el' as in *open, student, lemon, freedom, computer, doctor, final, little*, and *camel*, respectively.

KIT & DRESS vowels /ɪ/ & /ɛ/

Figure (4) shows the acoustic chart of the KIT and DRESS vowel realizations averaged across all informants; F1 (y-axis) and F2 the (x-axis). It is clear that all renditions of the KIT and DRESS words occupy the same area in the chart, suggesting that the produced vowel is more or less the same. The F1 values in particular indicate that the vowels have relatively the same vowel height, which is a major indicator for the difference between /ɪ/ and /ɛ/.

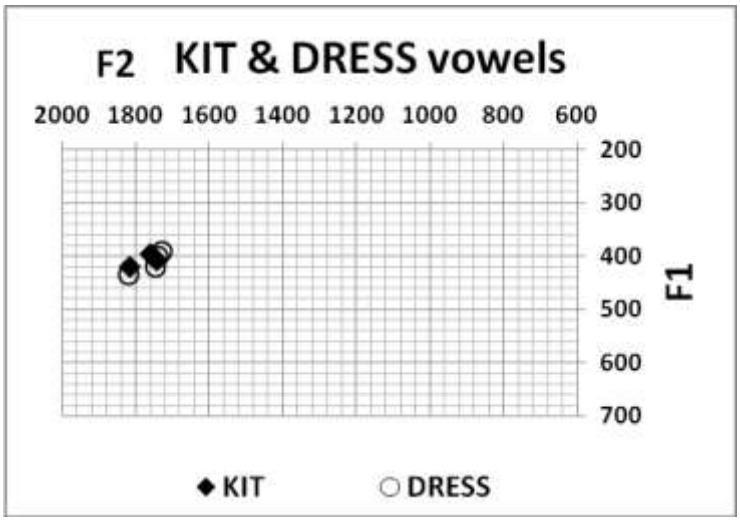

Figure 4 Acoustic chart of the KIT and DRESS vowel realizations averaged across all informants; F1 (y-axis) and F2 the (x-axis)

Figure (5) further shows the acoustic charts of the realizations of vowels in the pairs*; bit-bet, hid-head, miss-mess,* and *sit-set*, averaged across all informants. It is apparent that the realization of the vowels in these words is the same.

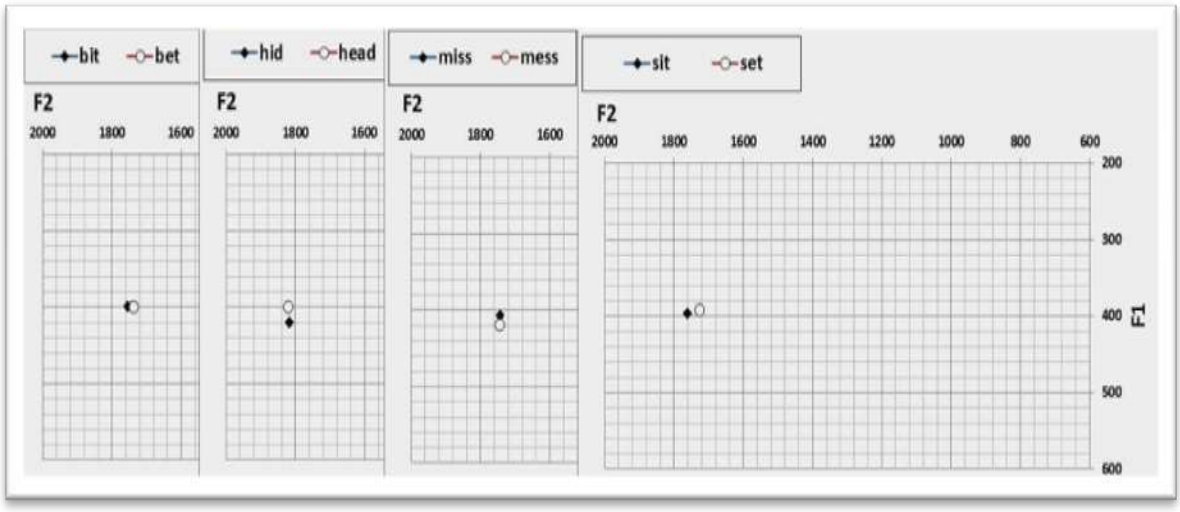

Figure 5 The acoustic charts of the realizations of the vowels in the pairs; bit-bet, hid-head, miss-mess, and sit-set, averaged across all informants

The LOT vowel /ɑ/ (in GA)

Figure 6 shows the acoustic chart of the realization of the LOT vowel averaged across all informants in the words; *Tom, hot* and *lot*. It can be seen that the vowel is realized as a relatively mid central-back vowel.

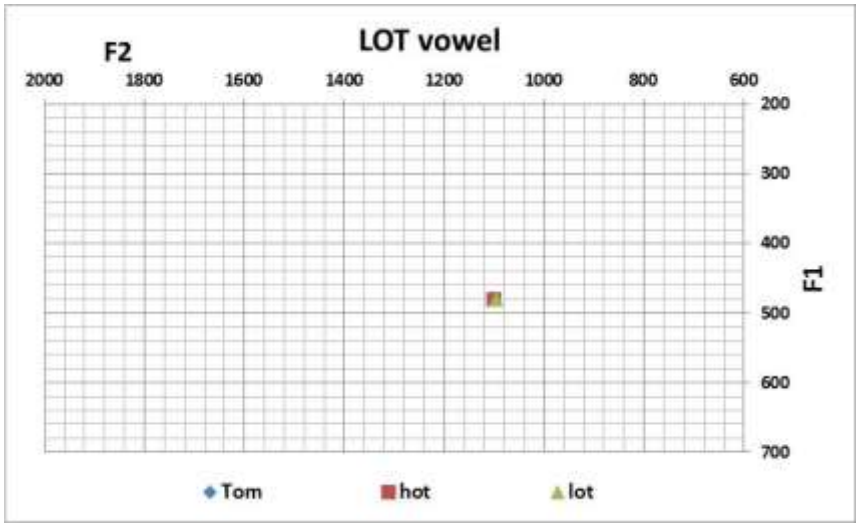

Figure 6 Acoustic chart of the realization of the LOT vowels averaged across all informants in the words; Tom, hot and lot

Table (7) compares the formant values of the LOT vowel averaged across all informants with those in RP (Deterding 1997) and GA (Hillenbrand et al 1995). The informants' F1 values for the LOT vowel are relatively lower than those in RP and GA, indicating that the vowel is relatively higher than that in RP and GA. The FA vowel is also produced with rounding of the lips unlike the GA unrounded [ɑ].Since the RP LOT vowel is realized as [ɒ], the closet IPA symbol for the realization of this vowel by the informants would be the mid-high rounded central-back short vowel [ɞ].

Table 7 *Formant values of the LOT vowel averaged across all informants compared with those in RP (Deterding 1997) and GA (Hillenbrand et al 1995).*

LOT vowel Formants	JA informants' English [ɞ] (Kalaldeh 2016)	RP [ɒ] (Deterding 1997)	GA [ɑ] (Hillenbrand et al. 1995)
F1	489	558	768
F2	1889	1047	1333
F3	2604	2481	2522

The THOUGHT vowel /ɔ:/

Figure 7 shows the acoustic chart of vowel renditions of the THOUGHT and GOAT vowels averaged across all informants. It can be discerned that the vowels occupy the same area in the chart, suggesting that they are realized with very similar qualities. Indeed the pairs: *bought-boat*, *caught-coat*, *hall-hole*, *mall-mole*, *law-low*, and *raw-row*, sound the same as produced by the informants.

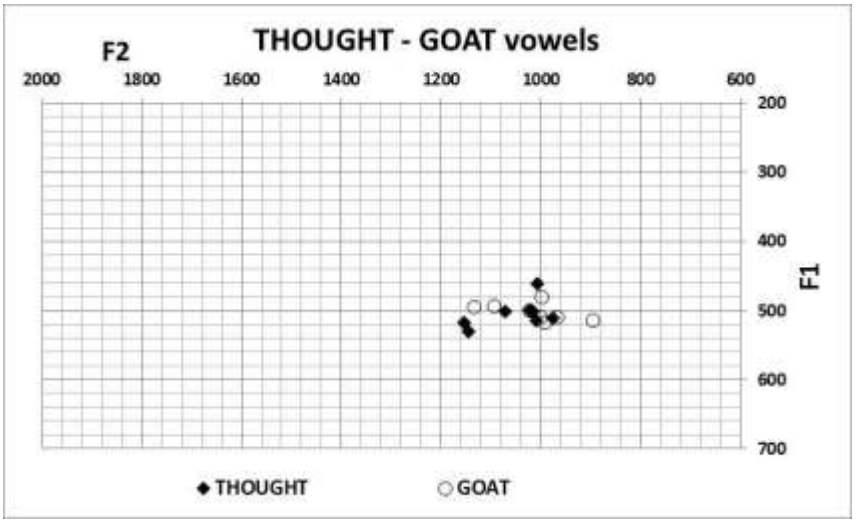

Figure 7 Acoustic chart of the renditions of the THOUGHT and GOAT vowels averaged across all informants

Figure 8 shows the acoustic charts of the individual realizations of vowels in the pairs: *bought-boat*, *caught-coat*, *hall-hole*, *mall-mole*, *law-low*, and *raw-row* averaged across all informants. The charts show that *bought-boat* and *caught-coat* are very close in their F1-F2 values. Similarly, *hall-hole* and *mall-mole* have very similar realizations. The vowel realizations in *law-low*, and *raw-row* are quiet indistinguishable.

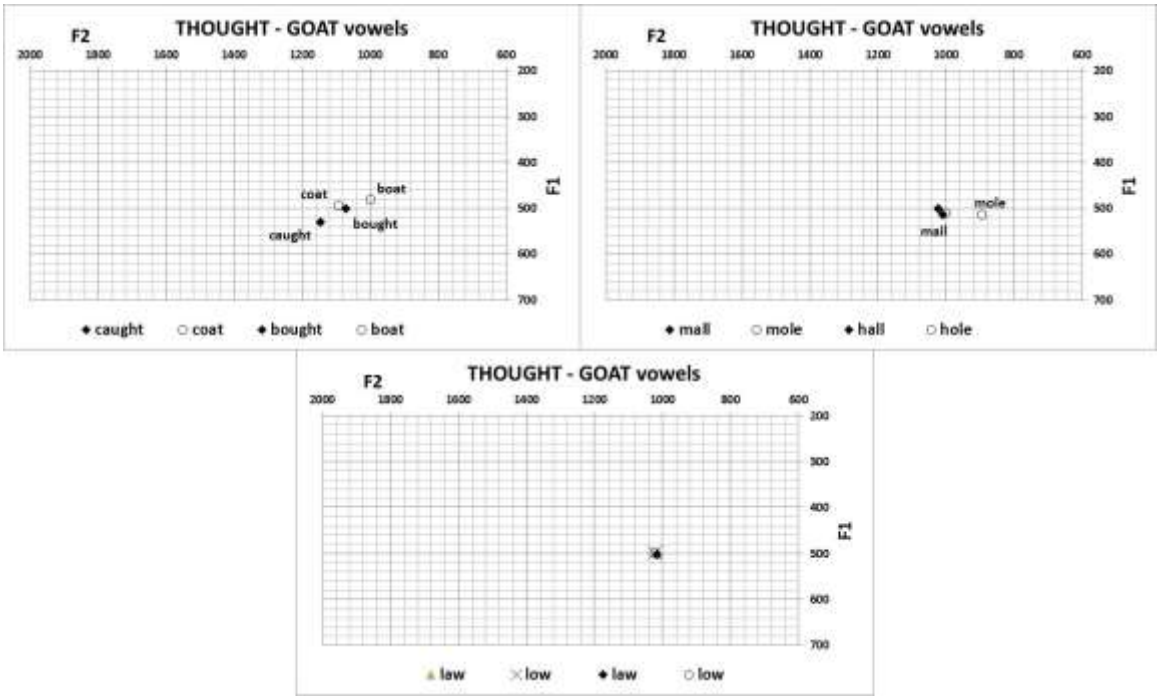

Figure 8 Acoustic charts of the individual realizations of the vowels in the pairs: bought-boat, caught-coat, hall-hole, mall-mole, law-low, and raw-row averaged across all informants

Figure 9 shows the vowels durations in the pairs; *bought-boat, caught-coat, hall-hole, mall-mole, law-low,* and *raw-row* averaged across all informants in (ms). Figure (9) indicates that the THOUGHT-GOAT pairs are not even different in vowel duration.

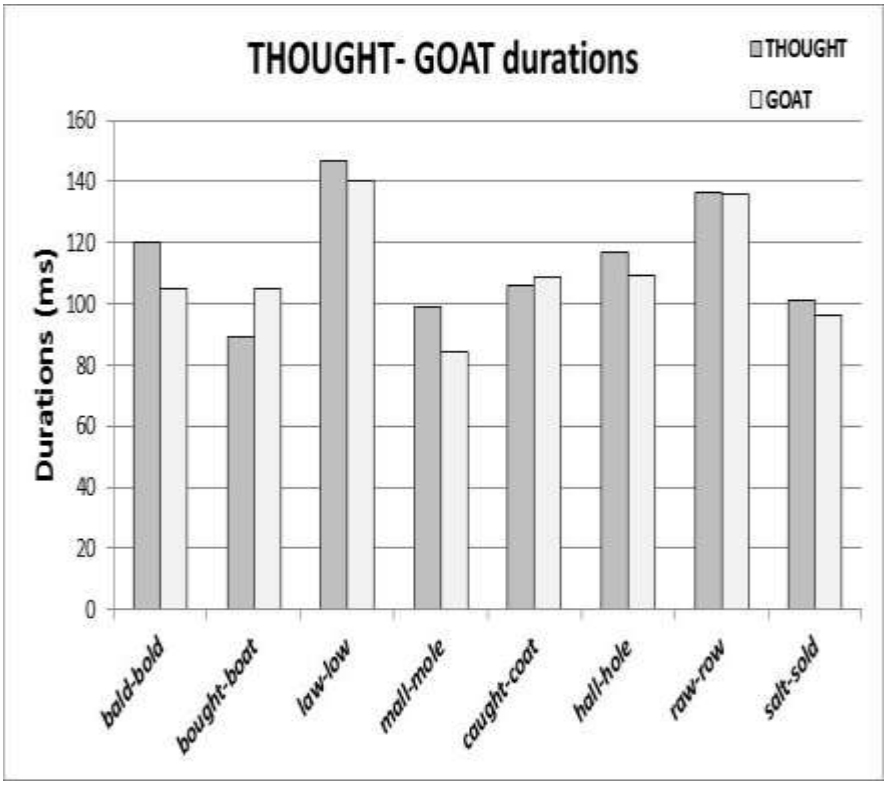

Figure 9 Vowels durations in the pairs; bought-boat, caught-coat, hall-hole, mall-mole, law-low, and raw-row averaged across all informants in (ms)

The *Comm*A vowel /ə/

The words chosen for investigating the realization of the schwa /ə/ include the initial position; *ago-about* the final position; *sofa-America* and in different spellings to see if the realization of the vowel is influenced by its spelling. Therefore, the vowel is tested in 'en'; *broken, open, happen, student, present*, in 'on'; *lemon-second,* in 'om'; *freedom-bottom,* in 'er'; *after-computer*, in 'or'; *doctor - factor*, in 'le'; *apple-little*, in 'el'; *came -level*, and in 'al'; *final-hospital*.

Figure (10) shows the acoustic chart of the *CommA* vowel in the test words; *ago, about, broken, open, happen, student, present, lemon, second, freedom, bottom, sofa, America, computer, after, doctor, factor, final, hospital, little, apple, camel* and *level* averaged across all informants.

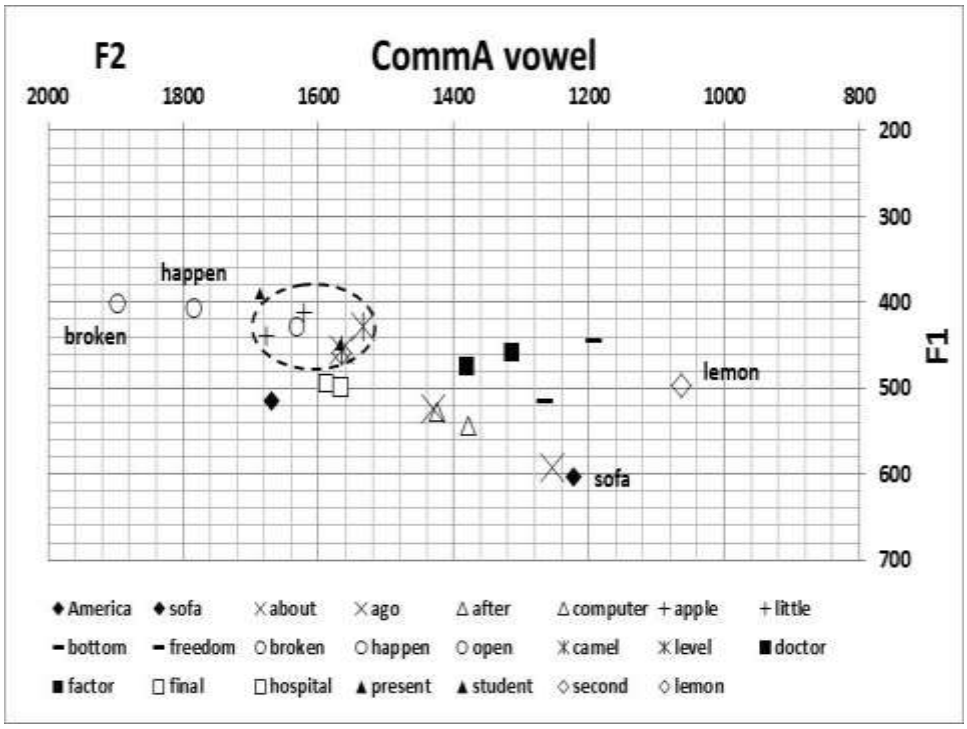

Figure 10 Acoustic chart of the CommA vowel in the test words; ago, about, broken, open, happen, student, present, lemon, second, freedom, bottom, sofa, America, computer, after, doctor, factor, final, hospital, little, apple, camel and level averaged for all informants

Two observations can be made from Figure (10). First, the vowels spread across the chart from the front area as in *broken* and *happen* to the back area as in *lemon* and *sofa*. This clearly shows that the vowels do not have the same realizations. Second, it can be noted that the vowels representing the different spelling are realized in relatively the same area, as can be seen for *apple-little* (+), *after-computer* (Δ) and *final-hospital* (□) with the exception of *lemon-second* and *America-sofa*. This suggests that the realization of /ə/ by the informants is indeed influenced by its spelling. In particular, the vowels in *freedom*, *bottom*, *lemon*, *factor*, and *doctor* were all realized in the area of the back LOT vowel.

The only vowels to sound like /ə/ for most informants, are those in the words *apple*, *little*, *camel*, *level* and *open*. The vowels in these words also closely fit the central-mid position of /ə/ in the vowel space and are enclosed in the dotted circle as shown in the Figure (10).
Figure (11) shows the durations of the vowels in the words representing the /ə/ averaged for all informants in (ms). Most vowels have similar durations except for the pairs *America-sofa*, *bottom-freedom*, and *second-lemon* which are longer than in the other words.

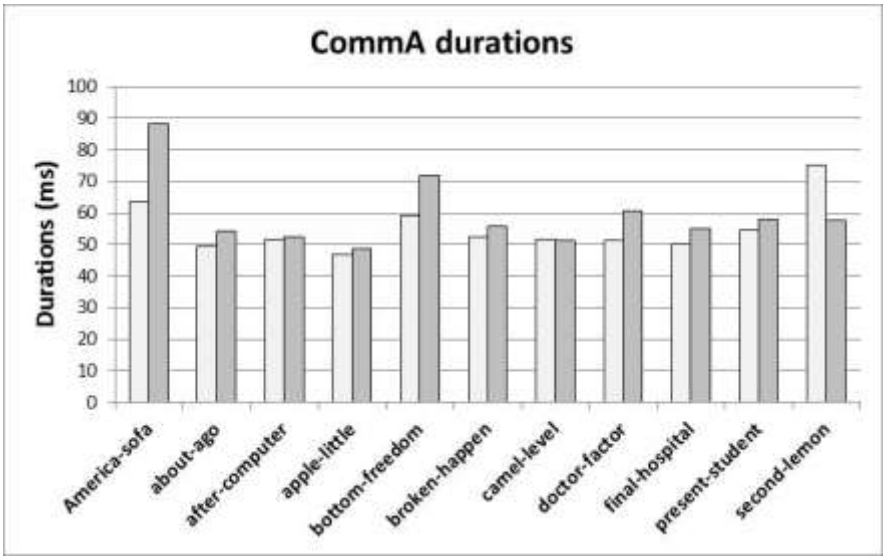

Figure 11 Durations of the vowels in the words representing the /ə/ averaged for all informants in (ms)

Figure (12,A) plots the averaged F1-F2 values for all test words per vowel averaged across all informants for the investigated vowels; KIT, DRESS, LOT, THOUGHT, GOAT, and *Comm*A . Figure (12, B) plots the averaged vowel durations for all test words per vowel averaged across all informants in (ms). Th eF1-F2 values and durations of the vowels in the pairs *America-sofa*, *bottom-freedom*, and *second-lemon* were excluded in representing the *Comm*A vowel.

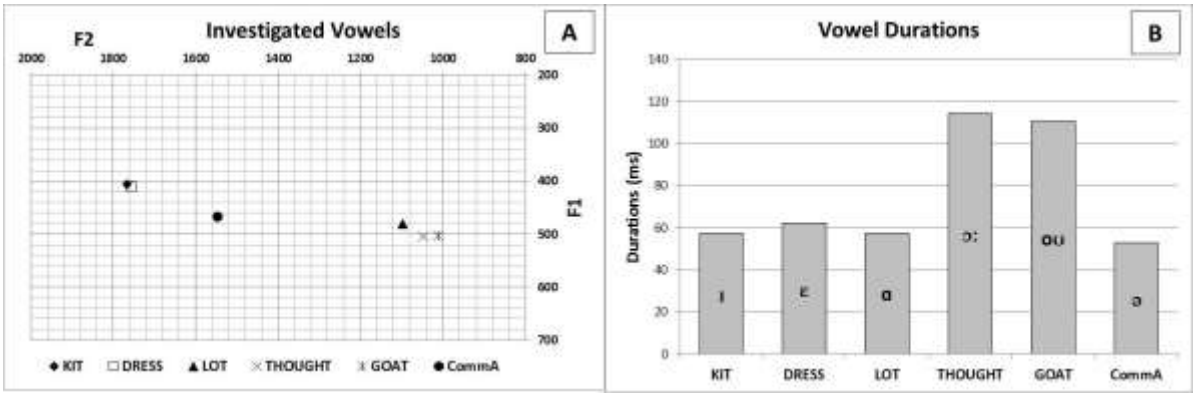

Figure 12 (A) averaged F1-F2 values for all test words per vowel averaged across all informants (B) averaged vowel durations for the investigated vowels; KIT, DRESS, LOT, THOUGHT, GOAT, and CommA

Word Stress

The words chosen to investigate word stress placement by the informants are based on the researcher's observation of the production of such words by Arab learners of English. Table (8) shows the correctness rate of stress placement for bisyllabic, three-syllable and more than three-syllable words averaged for all informants.

Table 8 *Correctness rate of stress placement for bisyllabic, three-syllable and more than three-syllable words averaged for all informants*

Stress Tokens % of Correct Renditions					
Bisyllabic Words		**Three-syllable Words**		**More than three syllable-Words**	
English	**Informants**	**English**	**Informants**	**English**	**Informants**
'isn't =33.3%	i'sn't	'Saturday=50%	Satur'day	un'fortunately=11.1%	unfortu'nately
'didn't =33.3%	di'dn't	o'fficial = 0%	'official	a'pparently = 30%	appa'rently
'mustn't =33.3%	mu'stn't	re'ligion =40%	'religion	i'mmediately =36.3%	imme'diately
'shouldn't=45.4%	shoul'dn't	de'velop = 0%	'develop (75%) deve'lop (25%)	o'ccasionally = 30%	occa'sionally
'couldn't =50%	coul'dn't			'certainly = 22.2%	cer'tainly
'wouldn't =44.4%	wou'ldn't			'suddenly = 25%	su'ddenly
'midnight =25%	mid'night				
37.81%		**22.5%**		**25.76%**	
AVERAGE = 28.69%					

Bisyllabic words include the short forms of auxiliary verbs *isn't* and *didn't* and the modal verbs *mustn't, shouldn't, couldn't* and *wouldn't*, as well as the compound word *midnight*. All such words are stressed on the penultimate syllable in English. The correctness rate of 38% indicates that the informants often wrongly place the stress on the final syllable. This tendency is probably a carryover from Arabic where stress is usually placed on heavy syllables.

Three-syllable words were also wrongly stressed in 22.5% of the time on the first or antepenultimate syllable as in *official, religion* and *develop*, but on *-day* in *Saturday*. In *official* and *develop*, the stress was unanimously placed on the first syllable; *develop* was also sometimes stressed on *-lop*. In *Saturday*, the stress was placed on the heaviest syllable [deɪ].

More than three-syllable words had also a low correctness rate of 26%. In such long words, informants seem to be influenced by the stress rules of Arabic where stress falls on the heavy penultimate syllable in polysyllabic words (Halpern 2009). The penultimate syllable is produced as [næt] in *unfortunately*, [rænt] in *apparently*, [djæt] in *immediately*, [ʤæn] in *occasionally*, [tɛn] in *certainly* and [dɛn] in *suddenly*.

In general, it can be deduced from Table (8) that informants wrongly stressed the words in over 70% of the time. This could be attributed to a carryover effect from the stress rules of Arabic where stress is usually placed on the heavy syllable of the word (Ibid.), a rule not always adhered to in English.

Discussion

In this section the, the results will be commented on in the order of the research questions:

1. How are the consonants /p - v - ʃ - ʤ - ŋ - ɹ - ɬ/ realized by the Jordanian informants?
2. How are the tested English consonant clusters realized by the Jordanian informants?
3. How are the tested vowels /ɪ - ɛ - ɑ - ɔ: - oʊ - ə / realized by the Jordanian informants?
4. How are different English stress patterns realized by the Jordanian informants?

To answer question 1, it was found that speakers of JA, have realization issues with /p-ŋ-ɹ-ɬ/. The voiceless bilabial stop /p/ is not a surprising result since almost all relevant studies have proven that this sound is indeed problematic to the wide majority of Arabic speakers of English (Mitchell, T, F. & Hassan, S. 1989, Kharma, N. & Hajjaj, A. 1997, El Zarka 2013, Binturki 2008, Hassan, E.M. 2014, Hago, O. & Khan, W. 2015).

The nasal velar in Arabic is an allophone of /n/ which occurs whenever /n/ is followed by /k/ or /g/ as in /baŋk/ 'bank'. Unlike English, Arabic has an almost one-to-one relation between orthography and pronunciation. Therefore, *king* would very likely be realized as [kɪŋg] by an Arab speaker since [ŋ] does not function contrastively in Arabic and its English spelling encourages such a realization.

The /ɹ/ is also an expected difficulty for Arab speakers. The Arabic phoneme /ɾ/ is a voiced tap that is often erroneously referred to as a trill by many (e.g. Kharma, N. & Hajjaj, A. 1997, Binturki 2008, Hago, O. & Khan, W. 2015). The trill /r/ is found in many languages sometimes in an allophonic relation with the alveolar voiced tap [ɾ]; however, in other languages such as Spanish they are distinct; *pero* [ɾ] 'but' and *perro* [r] 'dog'. The Arabic voiced alveolar tap /ɾ/ is a quick stop sound produced by a rapid single tap on the alveolar ridge. A repetition of the tap results in several consecutive taps or a trill [r] and is considered an 'error' realization of the Arabic /ɾ/. This error is often referred to by Arabic language phoneticians as *tar'eed.* When producing the English alveolar approximant /ɹ/, the airflow is not obstructed; a challenging aspect for the Arabic speaker in respect to their own native /ɾ/.

The lateral phoneme /l/ is not problematic for the informants in onset positions, since it is realized as a clear [lʲ] in that position in English. It is the dark [ɬ] that was not realized properly by all informants. In Arabic, /l/ is almost always clear except in the vicinity of emphatic and velarized phonemes; [nasˤɬ] 'tip of an arrow' (cf. [nasl] 'progeny') as well as in the word *Allaah* [ʔaɬɬa:h]. Clear and dark /l/ in Arabic are commonly referred to as *tarqeeq* and *tafkheem*, respectively.

Informants were not expected to produce the English affricates /ʧ/ and /ʤ/ properly, since these phonemes are absent in FA. However, JA has these affricates in most of its colloquial varieties. The impression of the researcher came from teaching English pronunciation and speech to a mixture of urban JA speakers who do not usually use affricates in their Arabic speech, a phenomenon previously reported (Mitchell, T, F. & Hassan, S. 1989, 98).

Question 2, is related to the production of consonant clusters. Clusters were investigated 'within words' and 'across words'. It was found that clusters in onset position had the highest rate of correctness at 64% compared to 42% for coda positions. This finding can be quite surprising since FA has only two-consonant clusters and only in coda positions. However, one can find an explanation in the familiarity and frequency of three-consonant onset clusters in English as in *street* and *square*. Moreover, in JA two-consonants coda clusters are often produced with epenthetic vowel between the last two consonants; [nɪsɾ] 'eagle' in FA, is often realized as [nɪsɛɾ] in JA. None the less, it should be noted that the coda cluster in *clothes* was unanimously incorrectly produced as [klo:ðəz]. Similar commentary on JA has been previously mentioned by Mitchell, T, F. & Hassan, S. (1989, 120).

In clusters 'across-words', the number of consonants in the cluster was influential in correctness rate; the larger the number of consonants the less the correctness rate. The most challenging clusters were in *just great* (17%) and *big group* (42%).

Question 3 investigates the realization of the two front vowel /ɪ - ɛ/, the back vowels /ɑ - ɔ: - oʊ / and the /ə/. The findings show that the KIT and DRESS vowels are realized as one vowel the closest IPA symbol of which is [e]. This aspect of Arabic pronunciation of English has been reported previously (e.g. Hago, O. & Khan, W. 2015, Kharma, N. & Hajjaj, A. 1997, Mitchell, T, F. & Hassan, S. 1989). The KIT-DRESS confusion can be related to the fact that in JA /ɪ - ɛ/ are variants of *kasra* /ɪ/.

The problem with the LOT vowel is that JA speakers, who wish to adopt an American accent by pronouncing the/ɹ/ word finally, often ignore important vocalic differences between GA and RP. Specifically, in GA the LOT vowel is a mid-low back unrounded vowel [ɑ], compared to the slightly higher and rounded RP [ɒ]. The findings indicate that informants produced the LOT vowel as a mid-high rounded back-central short [ɵ] which is closer to RP than GA.

Ali (2007) suggests that because /u:/, /o:/and /o/ are allophones in Arabic, Arab learners of English confuse words such as *boot, boat* and *bought* and this also results in the different spellings of words such as *Muslim* and *Moslem*. The THOUGHT-GOAT English vowel distinction is indeed problematic for the informants. The slight roundness of /ɔ:/ is not attained nor is the GOAT vowel realized as a diphthong /oʊ/. Instead, the two vowels are merged into a single long monophthong [o:], and all /ɔ: - oʊ/ pairs were produced as homophones; *bought-boat* [bo:t].

Finally, the realization of the most common vowel in English /ə/ was investigated word initially, word finally and in different spellings. The findings indicate that informants depend heavily on the orthography of the vowel to guess its pronunciation. The *Comm*A vowel was correctly produced as a weak central-mid vowel in renditions of the words spelt as 'el' and 'le'; *apple-little* and *camel-level*. The vowels in the ultimate syllable of words such as *bottom* and *lemon* were produced with a LOT vowel quality and vowels in the first syllables of words such as *about* and *ago* as [a / ɐ].

Question 4 investigates the word stress placement by the informants. Words with different numbers of syllables were wrongly stressed in 70% of the time. Word such as *isn't* and *didn't* were stressed on the ultimate syllable. Longer words such as *unfortunately* and *certainly* were stressed on the penultimate syllable. This trend of misplacing English word stress seem to originate from the Arabic stress rules which usually place the stress on heavy syllables and on the penultimate heavy syllable in polysyllabic words. In an interesting study, Almbark, R., Bouchhioua, N., & Hellmuth, S. (2014) found that Jordanian and Egyptian speakers of Arabic employ F0, duration and intensity to indicate word stress, whereas native speakers of English only employ F0 and duration. This implies that Arabic learners of English mark the stress of English words with 'too much' dependence on F0 and 'not enough' vowel reduction.

Conclusion

The present study investigates the realization of English consonants and vowels by native speakers of JA. The findings suggest that speakers of JA have problems with the following consonants /p - ŋ - ɹ - ɬ/ which are almost always produced as /b - g - ɾ - l/ in all contexts. Findings also suggest that the English affricates /ʧ/ and /ʤ/ are not problematic for JA speakers. However, words with the voiced palato-alveolar fricative /ʒ/ should be included in future work to verify its realization, since /ʤ/ was not found problematic. Informants were also prone to insert an epenthetic vowel between consonant clusters particularly in coda position as in *clothes* [klo:ðəz] and across words as in *just great*.

The present study also indicates that, as usually reported in the literature for other CA varieties, the KIT-DRESS and the THOUGHT-GOAT vowel distinctions are lost in the English speech of JA speakers, and a single vowel is merged to represent both distinctions as [e] and [o:], respectively. Such a merge necessarily creates confusion for the English speaker, who would probably misunderstand the intended word in the pairs *sit-set* or *caught-coat*, for example.

Finally, it has been shown that JA informants misplaced primary word stress in English words of different syllable numbers. This suggests that native speakers of JA, are somehow, influenced by the Arabic stress rules. English word stress can be very confusing for non-native speakers of English, since it can be very unpredictable not to mention the many exceptions to the default English stress rules. However, more detailed work has to be done in order to understand the underlying strategies JA speakers employ when placing English word stress.

All the findings in this study have important implications for teachers of English to Arabic speakers. Indeed, highlighting the problematic issues in English pronunciation and understanding the origins of such errors can be very conducive to learners and teachers of English alike. It is hoped that there would be more studies on English pronunciation errors by other CA speakers. Also, errors in the intonational aspects of English speech represent one of the most challenging problems for learners. Little has been done in that regard. The fine-grained acoustic cues in tonal patterns of English speech by Arabic speakers should be studied. Such cues would likely define the causes for the staccato beat and abruptness which Arabic speakers of English are commonly associated with.

About the Author:

Raya Kalaldeh is a lecturer of English Phonetics and Phonology at the University of Jordan. She has lived in Ireland for six years and has finished her Ph.D dissertation on the intonation of Irish English from the University of Trinity College Dublin in 2011. She publishes articles on various aspects of intonation in the field's leading journals.

References

Ali, N. (2007). Some Linguistic Problems Facing Arab Learners of English. *Adab Al-Rafidayn*, 48, 465-488. Available at http://www.iasj.net/iasj?func=fulltext&aId=33586

Al Gethami.(2008). The Production of English Speech Rhythm by L2 Saudi Arabic Speakers. PhD Dissertation. York: University of York.

Almbark, R., Bouchhioua, N., & Hellmuth, S. (2014). Acquiring the Phonetics and Phonology of English Word Stress: Comparing Learners from Different L1 Backgrounds. *Proceedings*

of the International Symposium on the Acquisition of Second Language Speech, Concordia Working Papers in Applied Linguistics,5 Available at http://doe.concordia.ca/copal/documents/3_Almbark_etal_Vol5.pdf

Binturki, T. A. (2008). Analysis of Pronunciation Errors Of Saudi ESL Learners. MA Thesis. Southern Illinois University Carbondale. US: Illinois. (Unpublished Work).

Boersma, P., & Weenink, D. (Producer). (2009) Praat: doing phonetics by computer [computer program].(Version 6.0.15) , retrieved 21 April 2016 from http://www.praat.org/

Deterding, D. (1997). The Formants of Monophthong Vowels in Standard Southern British English Pronunciation. *Journal of the International Phonetic Association*, 27, 47-55.

El Zarka, A., M. (2013). The Pronunciation Errors of L1 Arabic Learners of L2 English: The Role of Modern Standard Arabic And Vernacular Dialects Transfer. (Unpublished masters dissertation). The British University in Dubai. UAE: Dubai.

Emad, M. Al-Saidat. (2010). Phonological Analysis of English phonotactics: A Case Study of Arab Learners of English. *The Buckingham Journal of Language and Linguistics*, 3.

Hago, O. & Khan, W. (2015).The Pronunciation Problems Faced by Saudi EFL Learners at Secondary Schools. *Education and Linguistic Research*. 1, 2. Available at http://dx.doi.org/10.5296/elr.v1i2.7783

Halpern, Jack (2009). Word Stress and Vowel Neutralization In Modern Standard Arabic. 2nd International Conference on Arabic Language Resources and Tools. Cairo. 1-7.

Hassan, E.M. (2014). Pronunciation Problems: A Case Study of English Language Students at Sudan University of Science and Technology. *English Language and Literature Studies*, 4, 4. 31-44. Available at http://dx.doi.org/10.5539/ells.v4n4p31

Hillenbrand, J., Getty L. A., Clark M. J., & Wheeler K. (1995). Acoustic Characteristics of American English Vowels. *Journal of the Acoustical Society of America*. 97, 3099 - 3111.

Ingham, B. (1994). *Najdi Arabic: Central Arabian*. Amsterdam/Philadelphia: John Benjamins B.V.

Kharma, N. & Hajjaj, A. (1997). *Errors in English among Arabic Speakers: Analysis and Remedy*. Beirut, Lebanon: York Press.

Mitchell, T. F. & S. A. EL-Hassen (1989). *English Pronunciation for Arabic Speakers*. UK: Essex. Longman Group (FE) Limited.

Carr, P. 1999. *English Phonetics and Phonology: An Introduction*. (rev. ed 2013). UK: Oxford. Blackwell publishing Ltd.

Saadah, E. (2011). The Production of Arabic Vowels by English L2 Learners and Heritage Speakers of Arabic. (Unpublished doctoral dissertation). University of Illinois at Urbana-Champaign: Illinois.

Wells, J.C., 1962. A Study of the Formants of the Pure Vowels of British English**.** (Unpublished maters dissertation). University of London: UK, available at http://www.phon.ucl.ac.uk/home/wells/formants/index.

Wells, J. (1982). *Accents of English* (Rev. ed. 1998). Cambridge: Cambridge University Press.

Word Frequency Data: Corpus of Contemporary American English http://www.wordfrequency.info/free.asp

Appendix A

consonants	context	tokens
p	# -	put
	#C -	place
	V - V	apple
	V - V	happy
	- #	up
	- #	keep
v	# -	visa
	# -	villa
	V - V	even
	V - V	never
	- #	have
	- #	give
ʧ	# -	change
	# -	children
	C - V	picture
	V - V	nature
	- ing	reaching
	- ing	touching
	- #	which
	- #	each
	'tch'	watch
	'tch'	catch
ʤ	# -	Jordan
	# -	just
	V - V	major
	C - V	enjoy
	- #	knowledge
	- #	page
ŋ	- #	king
	- #	long
	'ing'	morning
	'ing'	looking
ɹ	# -	run
	# -	really
	C -	try
	C -	great
	V – V	very
	V – V	around
	- C	start
	- C	word
	- #	car
	- #	for
l	# -	like
	# -	look
	V – C	also
	C – V	only
	- C	old
	- C	help
	i: -	feel
	ɪ -	will
	ɔ: -	all
	u: -	school
	ə - # 'le'	table
	ə - # 'al'	animal

vowels	context	tokens
ɪ	C # C	hid
	C # C	sit
	C # C	miss
	C # C	bit
ɛ	C # C	head
	C # C	set
	C # C	mess
	C # C	bet
ɑ	C # C	Tom
	C # C	hot
	C # C	lot
ɔ:	'ought'	bought
	'aught'	caught
	'all'	hall
	'all'	mall
	- CC	salt
	- CC	bald
	'aw'	law
	'aw'	raw
oʊ	'oat'	boat
	'oat'	coat
	'ole'	hole
	'ole'	mole
	- CC	bold
	- CC	sold
	'ow'	row
	'ow'	low

ə	# -	ago
	# -	about
	'en'	broken
	'en'	open
	'en'	happen
	'ent'	student
	'ent'	present
	'on'	lemon
	'on'	second
	'om'	freedom
	'om'	bottom
	- #	sofa
	- #	America
	'er'	computer
	'er'	after
	'or'	doctor
	'or'	factor
	'al'	final
	'al'	hospital
	'le'	little
	'le'	apple
	'el'	camel
	'el'	level

Appendix B

clusters	tokens
# skɹ	screen
# skɹ	scream
# skw	square
# skw	squeeze
# spl	splash
# spɹ	spray
# stɹ	strong
# stɹ	street
'incl'	include
'incr'	increase
'inst'	instead
'inst'	instance
'expl'	explain
'expr'	express
'excl'	exclude
sks #	desks
ðz #	clothes
-kli-	physically
st # fɹ	best friend
st # f	best food
nt # st	don't stop
nt # s	don't sit
st # gɹ	just great
st # g	just go
st # bj	most beautiful
st # b	most banks
s # sw	was swimming
z # s	was sitting
z # sn	his snake
z # s	his side
st # tɹ	must try
st # t	must talk
d # dɹ	bad dream
d # d	bad dog
g # gɹ	big group
g # g	big girl

stress tokens
'isn't
'didn't
'mustn't
'shouldn't
'couldn't
'wouldn't
'Saturday
un'fortunately
a'pparently
i'mmediately
o'ccasionally
'certainly
'suddenly
o'fficial
'television
re'ligion
'midnight
develop