# Acoustic study of the production of stressed and unstressed-reduced syllables in word recognition

## Dr. Lana Kreishan, Dr. Belal Abu Rakiyyeh, Dr. Mohammad Abuoudeh

*Department of English Language and Literature, College of Arts*

*Al-Hussein Bin Talal University*

## ABSTRACT

This study compares the production of primary stressed (PS) and unstressed reduced (UR) syllables in English by a group of Jordanian English speakers and native English speakers along the dimensions of vowel quality (F1&F2), vowel duration, fundamental frequency, and intensity. The participants were six advanced undergraduate Jordanian learners of English at Al-Hussein Bin Talal University and two native American-born speakers. Data were collected and analyzed using Praat (2019) speech analysis software. The results show differences between the two groups in the acoustic features of vowel production and reveal that native language (L1) transfer was one of the main reasons for the deviation from native-like production.

**Keywords:** Stressed vowels; Unstressed reduced vowels; Suprasegmental features; and Arab learners of English.

## 1. Introduction

Society is rapidly changing, and continued globalization and modernization have made it essential to become bilingual or trilingual. In particular, as one of the widely spoken world languages, English is highly demanded, and using English has become mandatory to a great extent. To get membership in the big English-speaking community, members must master this

language or at least achieve sufficient skills, thus helping them improve their prospects and adapt to a globalized world.

Today, several native English speakers are confronted with numerous non-native English accents (Braun et al., 2011). These non-native varieties are initially more difficult to process than native versions (Braun et al., 2011), as accented or foreign speech may hinder comprehension for native speakers. This is a critical issue when considering the increasing number of non-native English-speaking communities. Another problem is that foreign-accented English may create a negative or unfavorable image (Flege, 1995).

L2 learning is no longer just about forming grammatical sentences and building new vocabulary, but also about developing communicative competence, which is a prerequisite for these skills. As a result, learning goals and priorities have changed significantly in recent decades, as reflected in new teaching approaches and methods. These changes have mainly been related to communicative competence as a prerequisite for successful L2 learning and linguistic skills. Like other linguistic aspects (e.g., grammar, structure, and meanings), L2 pronunciation has recently gained attention among the topics and issues related to improving the communication skills of L2 learners, thus being no longer neglected or considered as separate from the overall L2 learning process.

Language teaching now emphasizes the use of suprasegmental and segmental features to convey meaning during discourse (Morely, 1991). Consequently, the focus is now on the production and perception of segmental and suprasegmental L2 sound features, including stress, intonation, and rhythm; this also makes the issue of intelligibility increasingly important. Morely (1991, p.488) states that "intelligible pronunciation is an essential component of communicative competence" in English-speaking communities. Regardless of their native language (L1) background, non-native English speakers tend to transfer patterns and acoustic stress cues from their native languages (Zuraiq & Sereno, 2007).

As an auditory cue, stress is one of the most important features in English pronunciation and, accordingly, word stress has become an important aspect of L2 learning, especially for understanding spoken English and improving intelligibility (Checklin, 2012).

Current teaching trends prioritize improving intelligibility over copying native accents when teaching pronunciation (Checklin, 2012). Stress is a word property that should be placed and produced correctly; otherwise, words may not be recognized (Betti & Ulaiwi, 2018). In a review of studies on this concept, Checklin (2012) states that stress helps native English speakers cognitively interpret and localize words; instances in which stress is misplaced may affect their perception more than mispronunciation of phonemes. English language learners typically exhibit differences in their ability to produce stressed words; this can impede their intelligibility and affect their comprehension (Zuraiq & Sereno, 2007). In other words, stress plays a crucial role for native English speakers in processing and recognizing non-native speech. For both L1 and L2 learners, stress is a prominent feature associated with the degree of power in producing a given syllable (Betti & UIwaiwi, 2018).

Arab learners of English have difficulty with the phonetic realization of English stress and word production due to L1 transfer issues; for instance, stress is marked with "too much" f0 and "not enough" vowel reduction', where f0 denotes fundamental frequency (Almbark et al., 2014, p. 31). Arabic vowel quality is not weak in unstressed syllables compared to English. Transmitted L1 acoustic cues may influence native speakers' perception when listening to non-native speech. Unlike English, the stress of words in Arabic is also fixed; there is only one primary form of stress on each word, and all vowels are usually fully articulated and not reduced (Al-Jarrah, 2002). In this case, reduced vowels are shorter in duration, lower in quality, less intense, and lower in pitch when compared to non-reduced vowels (Gowhary et al., 2016). Stress patterns are not fixed in English but change depending on the context. Moreover, the English spelling system does not include symbols that indicate vowel reductions.

Phonetic systems are reorganized when they encounter new sounds during L2 learning or as a result of modification of old sounds; that is, the phonetic system used for sound production and perception is "adaptive over the life span" of language (Flege, 1995, p. 233). According to the Speech Learning Model proposed by Flege (1995), the mechanisms used in learning L1 sounds include the formation of categories that are also used in L2 acquisition. Bilingual speakers maintain this contrast for phonetic categories in both L1 and L2.

Flege's (1995) model assumes that the production of L2 vowels may determine whether these categories are formed; the phonetic categories used to process L2 vowels (rather than L1 vowels) reflect two different sources of input. In other words, L2 learners of any age may be able to retain all the capacities or categories that were used to successfully acquire the L1 language; thus, the L1 phonetic system remains influential for L2 speech production, because both the L1 and L2 phonetic systems coexist in the same space (Flege, 2016). Studies have shown that both segmental and suprasegmental elements develop in experienced and advanced L2 learners because they can develop fluent access to these systems as they process and comprehend L2 in different production modes (Saito, 2018). The acoustic features of stressed syllables, which have more vowel quality and lengthened higher pitches, differ from those of unstressed syllables, including those for weaker vowels such as the schwa (Checklin, 2012). In stress-timed languages, such as English, vowel-reduction leads to a centralization of connected vowels (Janson, 1979; Liu & Takeda, 2021).

Phonological acquisition precedes lexical acquisition, while suprasegmental features are acquired before other language features (Mehler et al., 1995). Rhythm is an important feature in any language; it is described as 'hierarchical in nature' (Nespor et al., 2011, p. 1147). That is, the stressed and unstressed positions establish a speech flow order by alternating in this hierarchy (Nespor et al., 2011). Most languages with different linguistic rhythms are classified into two main types according to their isochrony requirements: syllable-timed languages and stressed-timed languages (Nespor et al., 2011). English and Arabic are considered stressed-timed languages because their syllables have similar stress intervals, whereas languages such as Spanish and Italian are classified as syllable-timed languages based on the similarity of syllable quantities. The syllables used in time-stressed languages do not have equal stress patterns. Rather, some are more prominent than others, and some are not stressed at all (Checklin, 2012). However, all stressed syllables have distinctive characteristics determined by various factors (i.e., length, pitch, loudness, and vowel quality) (Al-Thamery and Ibrahim, 2005). Arabic and English are both stress-timed languages, but the stressed syllables in Arabic sentences deviate more by isochronous intervals than English stressed syllables (Tajima et al., 1999). Arabic word-stress is predictable. Rules can be used to identify where

the stress falls, and, unlike in English, stress is not used in Arabic to distinguish meaning (Al-Thamery & Ibrahim, 2005).

Vowel reduction, or the reduction of vowel quality, mostly depends on how the speakers interact (Bergam, 2013). Articulatory reduction happens when speakers reduce their articulatory efforts for some reason leading to a loss in vowel quality. In contrast, the practice of substituting full vowels with schwas is called linguistic reduction. The latter issue is a consequence of the former. Bergam (2013) indicates that speech more naturally requires both reductions and that word recognition contributes to speech recognition.

### 1.1 Literature Review

Previous research studies addressed phonological features of non-native speakers of English with different L1 backgrounds. In Flege and Bohn's (1989) study, stress was found to be less problematic than vowel reduction in Spanish learners of English. They examined stress placement and vowel reduction in isolated produced morphologically connected English words. In their study with two groups of participants (i.e., Spanish speakers of English and native speakers of English), morphophonological changes led to changes in vowel quality and stress. The results showed that stress was acquired before vowel reduction and unstressed vowels are an essential but not a sufficient condition for reduction in English.

The Russian learners of English in Banzina's (2012) study showed duration reduction in vowel production and considerable vowel quality. She compared the realization of secondary stressed syllables and unstressed unreduced syllables produced by six native English speakers and six Russian learners of English. The vowels produced by these learners were centralized and half (in duration) as short as those produced by native English speakers. The results of the psycholinguistic perceptual study were used to determine the degree of impairment due to inaccurate pronunciation in the secondary-stressed and unstressed-unreduced syllables for native speakers. The results showed that improving the quality of the vowels as well as the duration of the unstressed unreduced and secondary stressed syllables facilitated the recognition of the unstressed unreduced syllables. Native English speakers were then asked to assess their speech comprehension on lexical tasks that included modified Russian with secondary stressed and unstressed/unreduced syllables similar to native English, unmodified

Russian, and native English. Inhibition of lexical access was the result of syllables that were unmodified, unstressed, and unreduced.

In the Arabic context, the acoustic features of speech produced by Arabic learners of English shared some similarities with native speakers of English. In Zuraiq and Sereno (2007), Arabic participants resembled native English speakers in terms of duration and amplitude cues, although they used (F0) cues than native English speakers. The study examined lexical stress production in two groups: native English speakers and Arab learners of English. Four acoustic features were examined: duration, fundamental frequency, amplitude, and second formant frequency. Results showed that native English speakers used four features to signal stress: shorter duration, lower f0 and amplitude, and reduced vowels for unstressed syllables. Moreover, Arabic learners of English did not reduce unstressed vowels. In other words, Arab learners resembled native English speakers in terms of duration and amplitude, but they differed in their overuse of fundamental frequency features.

L1 transfer was evident in the study by Almbark et al. (2014) in the Arabic context. The Arabic speakers in their study marked stress in English by a lack of vowel reduction in unstressed syllables, and 'too much' f0 compared to native English speakers. The study examined the speech production among Arabic learners of British English in participants from two dialects, Jordanian Arabic and Cairene dialect, with the aim of determining the sources of non-native patterns in phonetic and phonological realization of stress. The results showed no significant difference between the two Arabic dialects in terms of the phonetic cues used to mark stress. However, there were significant differences in the correlates of stress between the Arabic dialects and British English. According to the study, Arabic stress was recognized using f0, duration, and intensity, whereas stress in English was marked by duration, F1 and F2.

With another Arabic sample of English speakers, Bouchhioua (2008) investigated how duration signals accent and lexical stress in British English and Tunisian Arabic. The study participants were Tunisian English speakers. The results showed that duration (rather than stress) indicates accent in Tunisian Arabic. In English, duration indicates stress and accent. Tunisian speakers of English thus produced English words of longer duration compared to

native English speech. The results also revealed considerable durational differences when producing stressed and unstressed English syllables.

De Jong and Zawaydeh (1999) investigated the language correlates of Arabic stress and word-final junctures in addition to their duration and fundamental frequency. The participants in the sample showed considerable lengthening at the word-final level. The results also showed that slight increases in vowel duration at the penultimate position were of similar quality, as in English. Lengthening of stress, indicating higher F1, was also found in Arabic. Here, the effect of lengthening on word-final prosody was greater than the effect of stress and lengthening of penultimate. The stress effect was also of lower duration and F1. The expression of word-level prosody in Arabic was similar to that in English. This result was remarkable for two unrelated languages. In other words, there were surprising similarities in the occurrence of prolongation before boundary and the relationship between pitch accents and stressed syllables.

The current literature shows that Arab learners of English have difficulty in acquiring English word stress patterns. According to the Optimality Theory, one of the main causes is that they cannot grasp the exact sequence of universal constraints that determine English word stress placement (Al-Jarrah, 2002). Although Arabic and English contain the same universal constraints, they use different orders (Al-Jarrah, 2002). Another difficulty is that pronunciation in general and suprasegmental features in particular are almost ignored during English instruction compared to structure and vocabulary, which are also given more importance in L2 learning. Strengthening phonological awareness of stress placement and vowel reduction in foreign speakers of English could improve word recognition and pronunciation. L2 learners have limited exposure to language and are mainly taught through formal instruction in classes in such as a context. Foreign accented speech normally impedes word recognition, leads to a lack of speech comprehension, and hinders effective communication. Addressing acoustic cues of foreign learners of English, compared with those of native English speakers, would help identify areas of differences between them to overcome any recognition and/or comprehension problems.

This acoustic study was begun based on observations of how Arab learners of English master English word stress. The aim was to investigate the suprasegmental features for both stressed and unstressed syllables pronounced and produced by two groups: native English speakers and Arabic English speakers. It is important to identify the acoustic differences, including vowel quality [F1 and F2], duration, f0, and intensity in the production of primary stressed and unstressed reduced syllables between native American speakers of English and advanced Jordanian speakers of English as a foreign language. Most previous research addressed the acoustic features of English as foreign language, whereas the current study focuses on the production of some vowels and their position in syllables besides acoustic cues of a group of native and non-native speakers of English.

## 2. Methods

### 2.1 Participants

The participants in this study were two male native speakers of American English (one aged 22 and one aged 50, both of whom were in Jordan for a short stay and only spoke English) and six male Jordanians who were advanced non-native speakers of English. They were recruited based on their status as advanced fourth-year students majoring in English at Al Hussein bin Talal University. The number of participants in this descriptive study was determined mainly based on the quality of the recorded utterances and the study design. Originally, there were 3 Americans and 8 Jordanians, but this number was reduced because some participants had problems with the intelligibility of the recorded utterances, which were difficult to analyze and read in the Pratt program; their utterances were excluded from the collected data. Normally, in such acoustic studies, the sample number depends on the study's design and the quality of the recorded utterances.

### 2.2 Instrument

Selected words were produced in isolation to avoid reduction due to the influence of neighboring words, taking into account that vowel reduction is strongly correlated with speech rate (Liu & Takeda, 2021). These words focused mainly on three front and central vowels in American English (e.g., /æ, /ɑː/, and /ə/) and vowels reduced to schwa /ə/. Thirty-

nine words were used for subsequent recording. They were divided into stressed and unstressed syllables according to three word positions: initial, medial, and final. Unknown words and words with foreign accents were excluded from the study. All transcriptions of target words were taken from the Merriam-Webster Dictionary.

### 2.3 Data collection procedures and data analysis

Prior to data collection, the study instrument was shown to experts in linguistics to verify its validity. The validity of the material was confirmed and it was determined that it met the objectives of the study. Both groups participated in a speech recording session. Data were collected after participants were asked to read the given word lists silently to ensure more natural speech production. First, they were presented with a transcription of each word according to the International Phonetic Alphabet. To ensure high recording quality, participants were instructed to speak at an appropriate distance from the microphone. The recorded words were saved and transferred to a computer for later analysis using Pratt software.

Data collected from the two male groups were analyzed using Pratt (2019) and R program for statistical analysis. T-test analysis was performed to detect possible differences between the two groups. Acoustic differences, including F1 and F2, vowel duration, f0, and intensity, were measured for the groups based on their speech production as a function of syllable type and position (initial, medial, and final) in the word.

## 3. Results

### 3.1 Fundamental Frequency F0 in Hz

The f0 for analyzed tokens produced by the Jordanian group was greater than the f0 for the native English speakers, identifying any significant differences between the two groups using a t-test analysis. The analysis revealed a statistically significant difference (p=0.05) in the primary stressed syllables in medial position for /æ/ and /ɑ/ and a significant difference (p=0.01) at f0 for /ə/ in the initially positioned unstressed syllables in favor of the Jordanian group. Although the Jordanian group produced some syllables in a native-like manner (e.g. the final schwa), there were still differences between the two groups in terms of syllable type

and its position. Figure 1 shows the f0 measurement for the two groups. In general, it was higher for the Jordanian group than for the native speakers for both stressed and unstressed syllables. In other words, advanced Jordanian speakers of English failed to accomplish native-like production in stressed and unstressed syllables in some positions and produced, instead of producing them at a higher pitch. In contrast, the f0 in both stressed and unstressed syllables were analogues for English native speakers.

**Figure 1. F0 values in Hz as produced by the two groups**
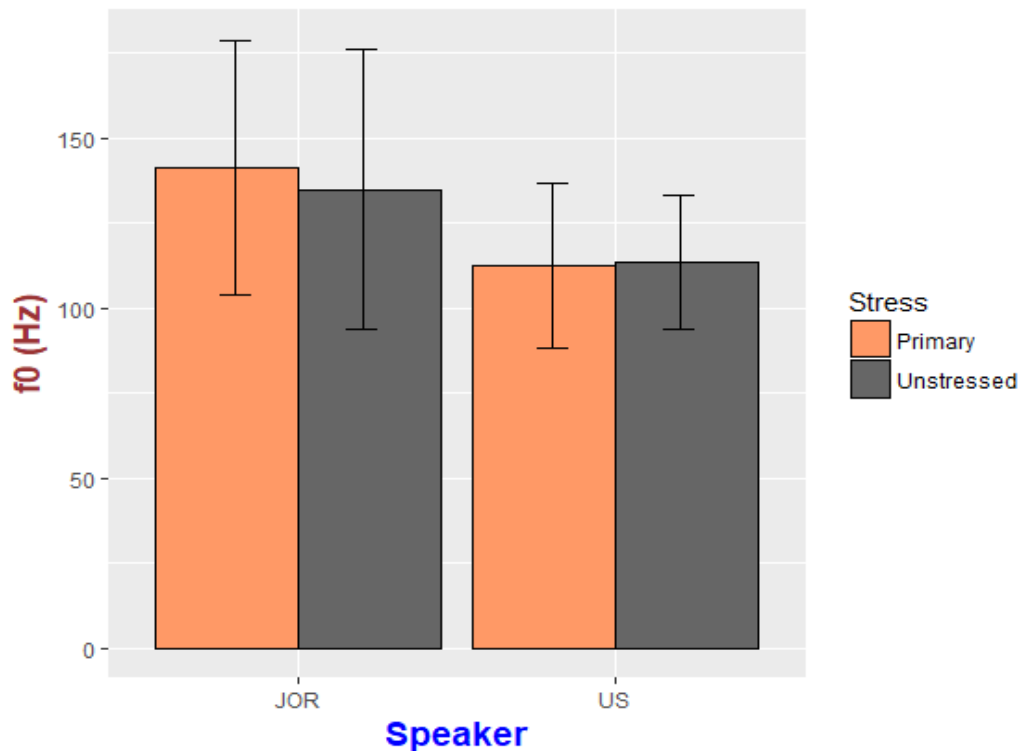


## 3.2 Vowel Quality (F1 and F2)

The first and second formants were measured for the two groups. The frequency of F1 is inversely related to the tongue height. High vowels have a low F1 frequency (Kent & Read, 2002). F2 is related to tongue advancement and its value increases as tongue position moves forward in the mouth (Kent & Read, 2002). The values of F1 and F2 usually indicate the occurrence of vowel reduction. A t-test analysis was performed to test whether there were statistical differences in F1 values between the two groups in the production of stressed and unstressed syllables. The results showed statistically significant differences in stressed syllables between the American and Jordanian groups in the initial and middle positions.

There was a significant difference in the production of /ɑ/ in stressed initial position and of /æ/ in unstressed in middle position. The mean scores were higher for the native English speakers (M=858, SD= .87; M=730, SD=.68 consecutively). In other words, the Jordanian non-native speakers lifted their tongues more during the production of these vowels than the American native speakers in the same positions. This means that the Jordanian group did not maintain the F1 quality of these vowels. There were also significant differences in the production of /ə/ in unstressed syllables in medial positions, and the mean scores were higher for the Jordanian group. An interesting finding is that the Jordanian group showed a significant difference in the production of /æ/ in stressed and unstressed syllables in medial position. The results showed higher mean scores in the case of stressed syllables. The results of the t-test analysis for the F2 values showed significant differences between native and non-native English speakers in the current study. In the production of /æ/ and /ɑ/ in stressed syllables in initial position, the mean scores were higher for native speakers. There were significant differences in the production of /æ/ in unstressed syllables with middle position. The results also showed differences in the production of /ə/ in final position syllables in favor of Jordanian speakers of English (M=144, SD=.15). Put simply, the Jordanian group of non-native speakers failed to match the native production of stressed and unstressed syllables in some positions, especially in the initial and middle positions. The F2 frequencies for the Jordanian sample showed a different tongue progress compared to the American sample.

Figure 2 shows the differences between the two groups in F1 and F2 values. This supports the results of the previous statistical analysis in the current study. There is an overlap between vowels in the Jordanian speakers. The production of /æ/ was similar to some extent in both groups, which has to do with L1 transfer and the effect of similarities between some sounds in both languages. Interestingly, the results for the F1 and F2 values also showed evidence of vowel reduction, as the Jordanian speakers produced more centralized back low vowels. In addition, the figure shows that Jordanian speakers of English have a different vowel quality compared to the native American speakers.

**Figure 2. F1 & F2 values as produced by the two groups**
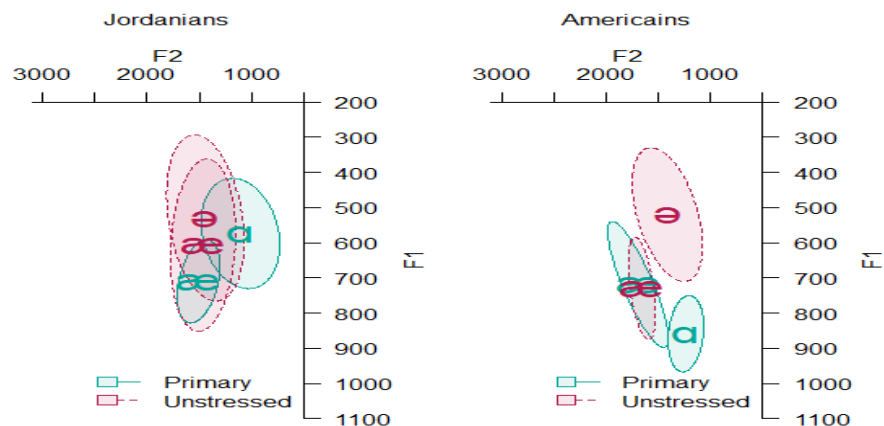


### 3.3 Duration

Vowel duration was measured for both stressed and unstressed syllables for the Jordanian and American groups. A t-test analysis was performed for each syllable type to determine statistically significant differences between the two groups. The results showed significant statistical differences in the production of /ɑ/ in stressed initial and medially positioned syllables and in the production of /æ/ in unstressed medial position. The average scores were higher in the American group in each case. This means that the Jordanian group shortened the vowels while producing them compared to the native speakers. In the case of the /ə/, there were significant differences (p=0.05) in the unstressed initial position syllables, and the mean scores for the Jordanians were higher (M=59 millisecond, SD=.25). This result also indicates that the Jordanian group does not distinguish the schwa in the initial position and tends to lengthen it. However, compared to the native speakers, they shortened it in final position. The lengthening of the schwa in native speakers in final position was normal because the tokens were produced in isolation. A t-test was also performed to find significant differences in the production of stressed and unstressed syllables for the Jordanian group. The results showed no significant differences in terms of syllable type. In other words, the Jordanians did not correctly distinguish between the duration of stressed and unstressed syllables, since stressed syllables are normally expected to be longer than unstressed syllables.

To show differences in the production of individual tokens, the spectrograms in Figures 3 and 4 below show the differences between a Jordanian speaker and an American speaker in the production of /ɑ/ in the stressed medial syllable of the word 'economy'.

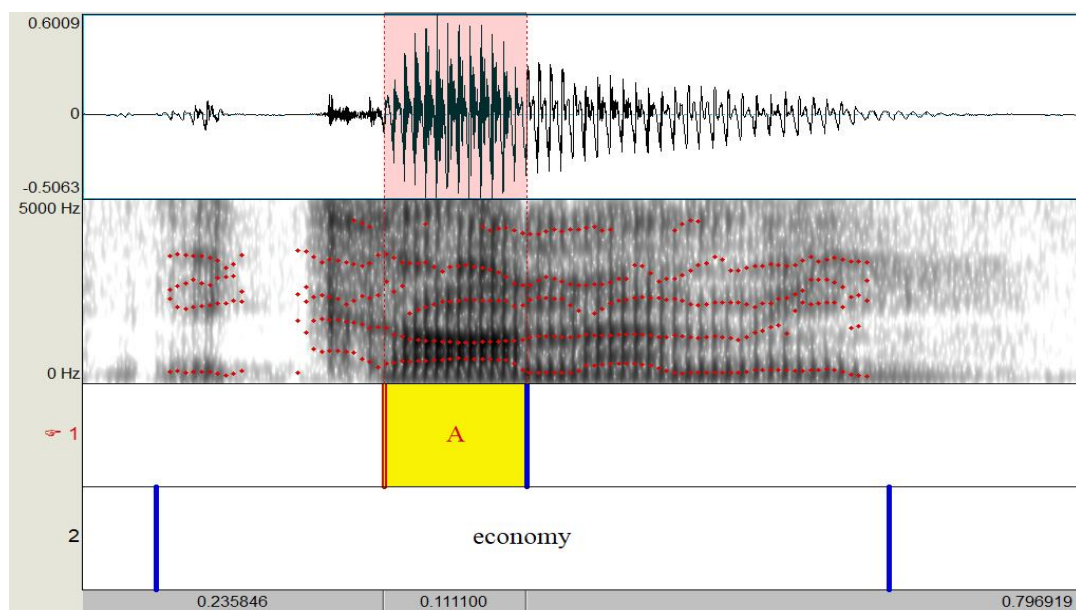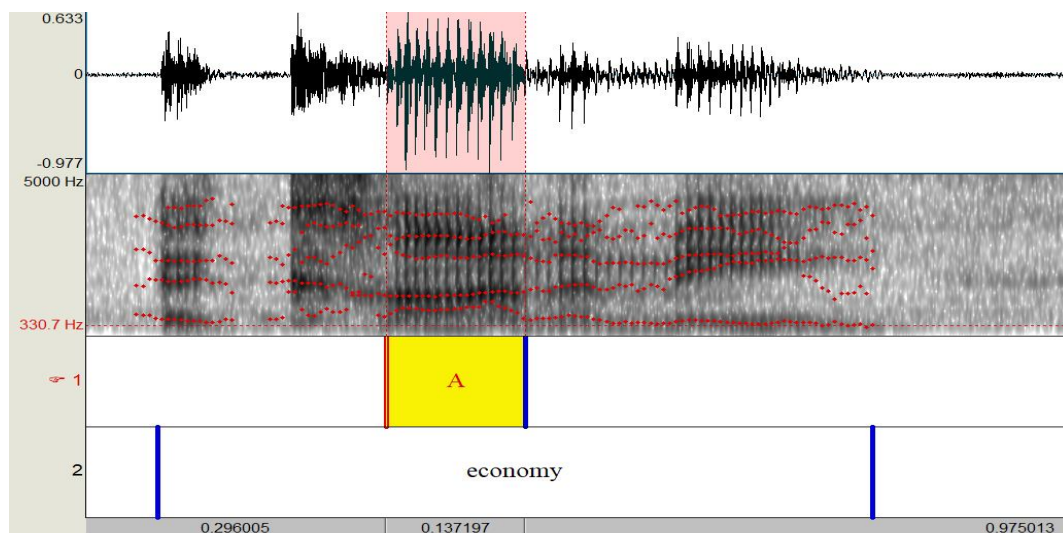**Figure 3. Vowel durations of the word 'economy' as produced by a Jordanian speaker**
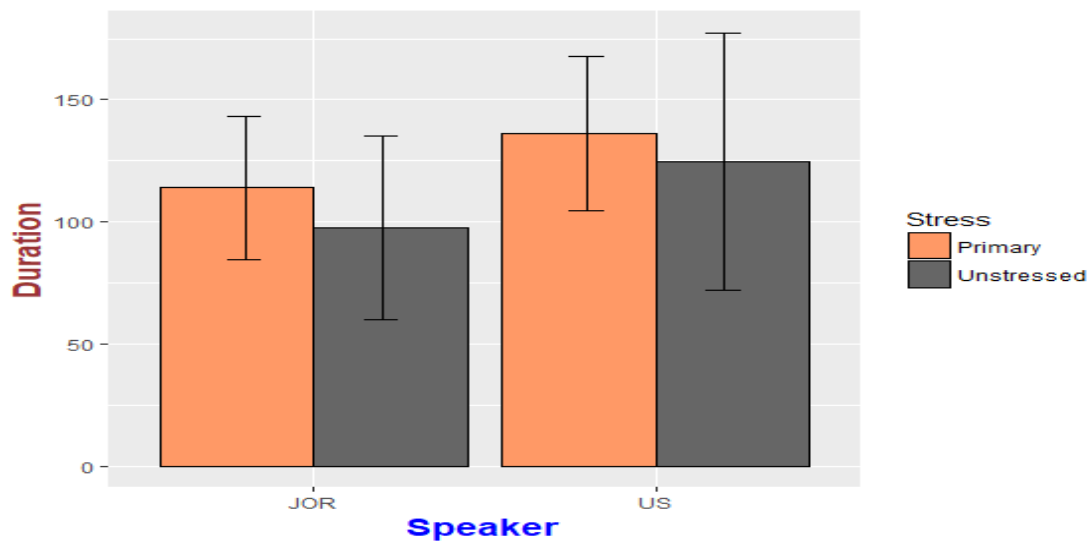


**Figure 4. Vowel duration of the word 'economy' as produced by an American speaker**



The findings presented in Figure (5) demonstrate obvious durational contrast for both groups according to the syllable type. The two groups displayed different durations to mark both types of syllables.

**Figure 5. Vowel durations values (in milliseconds) as produced by the two groups**



### 3.4 Intensity

Intensity is the fourth suprasegmental feature of stressed and unstressed syllables investigated in this study. It shows the strength in pronunciation needed to distinguish both types of syllables. A t-test analysis was performed to detect significant differences in intensity between the two groups. The results of the analysis showed no differences between the two groups in terms of syllable type in the initial and middle positions. However, there were significant differences in the intensity of schwa production in the unstressed initial and middle positions. The mean values of intensity for the Jordanian group were higher than the values for the American group in both cases (M=79, SD=.04; M=81, SD=.02), which were the same in both cases. In other words, the intensity of the schwa was the same in the initial and medial positions for the American group. Interestingly, the findings showed significant differences in intensity for the Jordanian group according to the syllable type in the production of the /æ/. It was higher in the case of stressed medial positioned syllables. There also was a difference in intensity of the schwa production in the final position. The native speakers tended to exhibit more power in their production. This result supports the previous result in the duration section that the American group lengthened the schwa in the final position compared to the Jordanian group. The results presented in Figure 6 below show the intensity for the American and Jordanian speakers of English. It appears that there are slight differences between the two groups.

**Figure 6. Intensity as produced by the two groups.**
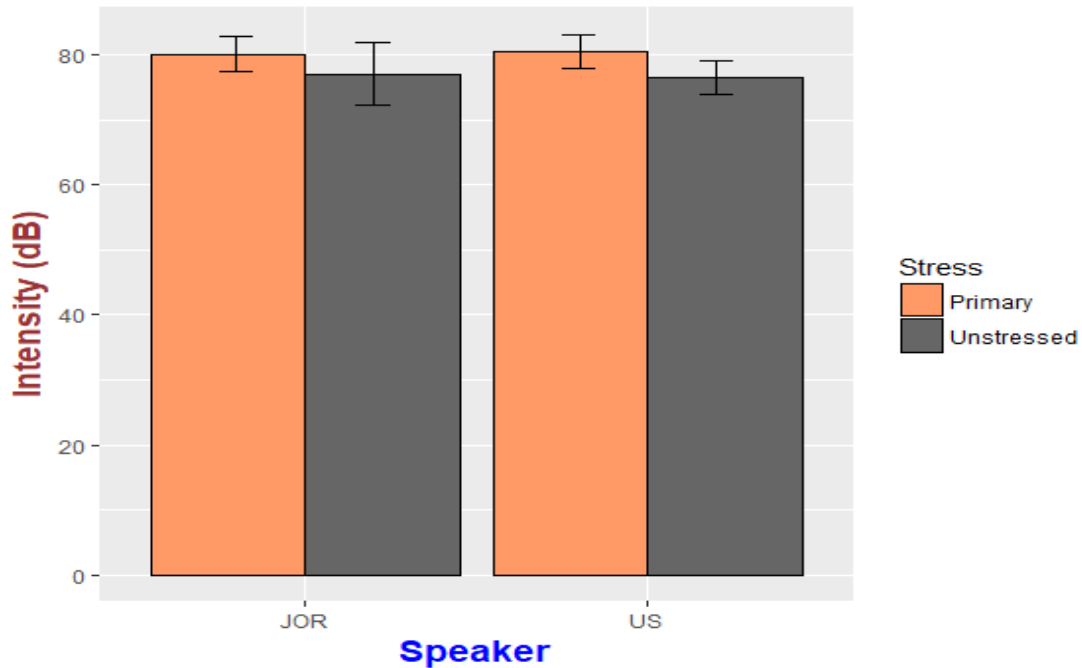


## 4.  Discussion

The purpose of this study was to investigate the acoustic correlates of English stress at the word level for American native speakers of English and Jordanian non-native speakers of English. Specifically, the study examined advanced Jordanian speakers of English treatment of stressed and unstressed syllables and measured the acoustic features of their vowel production. This could help identify accented speech or deviations from native speakers' productions. The f0 measurements for Jordanian speakers of English were higher than those of native speakers for stressed syllables, as opposed to unstressed vowels. Similar to Almbark et al. (2014), the Jordanian group in the current study marked stress with too much f0. However, this result is in contrast to the native f0 pattern produced by Russian learners of English in Banzina (2012). The effect of L1 negative transfer was evident because Arabic does not have vowels similar to the English vowels /ɑ / and /ə/, so they are produced differently from what native speakers would do. However, Arabic does have a vowel similar to the / æ/ vowel in English. For this reason, it was not an area of difficulty for Jordanian group. Another possible reason is that different individuals exhibit different acoustic systems in articulation, even though they come from the same region (Decker, 2012).

Formants analysis for stressed and unstressed syllables revealed differences in the quality of vowels produced by Jordanian speakers and native speakers. The F1 values of stressed syllables for Jordanians showed that they raised their tongues toward the mid to high frequency range while producing low vowels, especially for the /ɑ / vowels. In addition, the F1 value was higher for the Americans; the vowel was produced with a low tongue and an open jaw position. The production of low vowels in unstressed syllables also showed slight differences in vowel quality between the two groups, especially in the production of the low frontal vowel /æ/. Compared to the low vowels of the Americans, the lower F1 value in unstressed syllables in the Jordanian group suggests that this vowel was more centralized and maintained the quality of the mid-high vowels. This can be considered as a case of vowel reduction. This result is consistent with the results of Banzina's (2012) study in which Russian learners of English centralized and reduced the vowel /æ/. However, this result contradicts studies that claim that Arabic speakers of English tend not to reduce vowels in unstressed syllables (e.g., Zuraiq & Sereno, 2007; Almbark et al., 2014). In general, vowel reduction in unstressed syllables seems to be a problematic issue for L2 learners of English regardless of their L1, as shown in Flege and Bohn's (1989) study for Spanish learners of English.

The F2 frequency values for vowels in unstressed syllables showed that Jordanians did not have the same tongue prominence as native speakers because their F2 values were low. The low front vowel /æ/ was produced with a more centralized tongue position. In contrast, this vowel was reduced in unstressed syllables in native speakers who advanced the tongue to the anterior position. According to the F2 analysis, the Jordanian group partially reduced the vowel quality of /æ/ to a schwa. The stressed and unstressed syllables produced by the Jordanians were of higher intensity than the syllables produced by the American group. However, there were slight differences between the two groups, as the intensity in the American group were also high. This result is in consistent with the findings of Banzina (2012). Her study showed that Russian learners of English produced both stressed and unstressed syllables similarly in terms of intensity compared to native speakers, as they used the same stress cues in their L1. Similarly, the influence of the Arabic L1 was evident in the intensity of cues for stressed and unstressed syllables, although Jordanian English speakers showed native-like intensity.

In the syllable duration analysis, the Jordanian group clearly distinguished between the two syllables types, even though it did not reach the native duration. This result contrasts with the findings of Arabic studies, which claim that Arabic learners of English either match native speaker production in terms of duration (Zuraiq & Sereno, 2007) or are longer (Bouchhioua, 2008). One possible reason for this is that Arabic has a different phonological system than English. However, both languages are considered to be stressed-timed languages (Nespor et al., 2011) and have the same universal constraints on word stress (Al-Jarrah, 2002). Another possible explanation is that the Jordanian group failed to pronounce some words correctly. Another interesting finding is that Jordanian speakers of English shortened the vowel in the final position, unlike the American group; this finding shows that there was no effect of L1 transfer in terms of lengthening the word-final level as revealed in De Jong and Zawaydeh's (1999) study. L1 transfer was not the only reason for deviations in production or accented speech; learners' interlanguage could be another possible reason. Interlanguage is the linguistic system that learners develop from a second language in their heads, or, as it is called, proficiency.

## 5. Conclusion

The production of the three vowels was consistent among native speakers, while there was overlap among the three vowels among non-native speakers of English. The Jordanian sample did not differentiate between them in different positions. F1 frequencies were lower among Jordanian speakers of English. Native English speaker tend to lengthen the schwa in final position, while the Jordanian sample does not seem to be aware of its existence. The vowel quality of the schwa vowel in the final syllables is said to be consistent in the mid-central position; in contrast, syllable-internal schwa varies in lip position and backness and is high (Flemming & Johnson, 2007).

One of the limitations of this study is that it focuses on the performance of native and non-native speakers concerning isolated syllables. Another limitation is that a thorough comparison should be made between stressed and unstressed syllables for the same vowel in syllable position. In order to generalize the results of the study, it is recommended to include larger representative groups of native speakers and non-native speakers. This study was

mainly concerned with the realization of stressed and unstressed syllables produced by Jordanian non-native speakers of English. It would be useful to investigate the native speakers' perceptions of non-native speakers' production to address the problem of intelligibility, which, in turn, would reduce the risk of incomprehensibility of foreign speech.

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