

Arab learners' stress perception and production of English multisyllable items

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DOI: 10.1344/efe-2023-32-111-130

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Received: 26/05/2023 Accepted: 31/07/2023 Published: 12/09/2023

Alzi'abi, S. E. (2023). Arab learners' stress perception and production of English multisyllable items. *Estudios de Fonética Experimental*, 32, 111–130. <https://doi.org/10.1344/efe-2023-32-111-130>



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ABSTRACT

Mastering word stress is a crucial part of learning the English language because it is a vital part and parcel of word recognition and intelligibility. Arab EFL learners complain about the mystifying and elusive English stress patterns. This research examines their stress production and perception of di-, tri- and polysyllabic English words. Arab learners initially produced 90 infrequent English words with various syllable structures and word classes. They then identified the stressed syllables when hearing the words from native speakers. Analysis of the data showed that Arabs had a serious problem producing English word stress correctly owing to their tendency to mainly stress ultimate heavy syllables — a strategy usually employed in Arabic. Their performance on the stress identification task was much better than the production task but still gave problems, especially with tri- and tetrasyllabic utterances. Syllabi have to comprise stress drills in conjunction with their L1 stress patterns to help them overcome their difficulties in stressing English words.

KEYWORDS

stress production; stress perception; English word stress; Arabic word stress; Arab EFL learners

Percepció i producció de l'accent en mots polisíl·labs de l'anglès per part d'estudiants àrabs

RESUM

Dominar l'accentuació dels mots és essencial per a l'aprenentatge de la llengua anglesa; és fonamental per reconèixer i entendre els elements lèxics. Els estudiants àrabs sovint es queixen que els patrons accentuals de l'anglès són desconcertants i difícils d'entendre. Aquest estudi examina la producció i percepció de l'accent en 90 paraules angleses poc comunes, de dues i tres síl·labes, amb diversos patrons d'accentuació i de diferents categories gramaticals. Primer, un total de 88 estudiants àrabs va produir els mots. Seguidament, després d'anar-los escoltant pronunciats per un parlant nadiu, van identificar-ne les síl·labes accentuades. Els resultats revelen que els àrabs tenen problemes per reproduir correctament l'accentuació de l'anglès —sobretot per la tendència a accentuar les síl·labes finals pesants, una estratègia freqüent en àrab— i que la percepció de l'accent és millor, però no sense errors, especialment en paraules de tres i quatre síl·labes. Per millorar l'aprenentatge de l'accentuació de l'anglès, els plans d'estudis haurien d'incloure exercicis d'accentuació que tinguessin en compte els patrons d'accentuació de cada L1.

MOTS CLAU

producció de l'accent; percepció de l'accent; accent de mot en anglès; accent de mot en àrab; estudiants àrabs d'anglès com a llengua estrangera

1. Introduction

Many EFL learners have difficulty stressing English words correctly; studies by Celce-Murcia et al. (1996) suggest that they frequently cannot accurately understand and produce English stress. There has been no detailed investigation of how Arab EFL learners perceive and use stress and whether they rely on their L1 stress knowledge when processing English stress.

Present data is the product of small-scale studies. Researchers usually attribute the irregularity of English word stress and L1 stress patterns to being unlike L2. Incorrect stress placement hampers learners' intelligibility and perception skills (see Roach, 2009, p. 91) and "is highly likely to impede successful recognition of the word by native listeners" (Cutler, 2015, p. 115). Many Arab learners encounter problems placing the stress correctly through an inability to identify the prominent syllables in English. The root cause may be undue interference from L1 and their inadequate knowledge of essential English word stress.

This study examines whether L1 stress rules influence Arab EFL learners' production and perception cues. It attempts to gauge their competence in producing and perceiving English word stress and helps them master it and overcome shortcomings in teaching phonological features in Arab higher education. The specific aims are to investigate whether Arab EFL learners place English word stress accurately, discover whether learners can identify the stressed syllables in English, ascertain whether they perform best with di-, tri- or tetrasyllabic words, and establish any direct correlation between subjects' performance in stress perception and stress production. These findings will provide insight into devising more effective strategies for teaching English stress.

2. English stress vs. Arabic stress

In some languages, e.g., French, Polish and Turkish, stress position in words is reliably fixed. Cutler (2015) demonstrates that English is a lexical-stress

language, where stress is contrastive. Arabic is too a lexical-stress language, with the parts making disyllables or polysyllables not having a similar relative "perceptibility" (see Brazilai, 2021). In languages with variable stress positions like English, stress is not fixed but moves either leftward or rightward and may appear word-initially, word-internally or word-finally. Cutler (2015, p. 106) shows that stress in a lexical-stress language "can vary across syllable positions within words, and in principle can vary contrastively". English native speakers easily understand the major differences between stressed and unstressed syllables. In English, the vowel quality of unstressed syllables is reduced to make the stressed syllable more prominent, which may elude Arabic speakers. Ladefoged (2011) and MacKay (1987) state that prominence, the strong vocal effort with which a specific syllable is pronounced in one syllable, is often accompanied by vowel reduction in the adjacent syllables. A stressed syllable is invariably stronger, louder, longer-lasting and higher in pitch than neighbouring unstressed syllables (Roach, 2009).

English and Arabic differ sharply in their stress assignment rules. Some teachers may think English stress is unpredictable, for its numerous irregularities. It has to be clarified that English stress is variable but predictable (see Drescher & Kaye, 1990). Cutler and Carter (1987) claim that findings from earlier research confirm that English stress falls on the initial syllable. Vocabulary analysis showed that this was prevalent in speech utterances. Gimson (1980, p. 221) rightly maintains that stress is "fixed, in [...] that the main accent always falls on a particular syllable of any given word, but free, in [...] that the main accent is not tied to any particular situation in the chain of syllables". In generative phonology, Chomsky and Halle (1968) consider vowel length and number of consonants in a coda as two key indicators for stress placement. Other phoneticians maintain word class is a determining factor as disyllabic nouns frequently stress the first syllable and verbs the second (see Roach, 2009 for a detailed study of English stress patterns).

The differences in stress systems can be described as gradient; there is more variability in syllable weight in English (e.g., coda consonants can contain up to three consonants), and there is greater unstressed vowel reduction than in Arabic. Stress in Arabic is predictable and quantity-sensitive (Altmann, 2006; de Jong & Zawaydeh, 1999) but may differ slightly across modern Arabic dialects (Watson, 2002). Researchers argue that stress patterns in most Arabic dialects are broadly similar because their stress location is predictable. The factors usually determining the position of stress include number, weight, position and structure of syllables (Altmann, 2006; McCarthy, 1979; Watson, 2011; Abboud-Haggar, 2015; Mashaqba & Huneety, 2018).

Stress in Arabic usually falls on the heavy syllable comprising a long vowel, a diphthong or a short vowel nucleus followed by one or more consonants (syllables of the structure CVVC or CVCC, i.e., *superheavy* syllables which are longer than two moras). The rhyme in a light syllable has either a short-vowel nucleus or a short vowel followed by a consonant. In disyllabic words, stress falls on the penultimate syllable if the ultimate syllable is not heavy, as in < ذهب > /ðæ.'hæb/ 'gold'. In polysyllabic words, the stress falls on the penultimate syllable if it is heavy e.g., < ينادي > /jʊ.'nɑ:.di:/ 'call', < أنجيناكم > /ʔæn.dʒæj.'na:.kʊm/ 'we saved you', < حجارة > /hɪ.'dʒɑ:.ræh/ 'stones' and < سبحانك > /sʊb.'ħɑ:.næk/ 'Glory be to You (God)'; if not, then the antepenultimate syllable receives the stress as in < أنفسكم > /ʔæn.'fʊ.sæ.kʊm/ 'yourselves'. The stress falls on the first or last syllable when a word contains no heavy syllable, depending on the Arabic dialect. In some dialects, e.g., Jordanian, stress falls on either the penultimate or the antepenultimate syllable (see de Jong & Zawaydeh, 1999).

In English and Arabic, stress plays an important and complex role in derivational morphology (for details, see Cutler, 2015; Kiparsky, 2003; Bauer & Nation, 2020). When some affixes, particularly derivational suffixes, are added to an English word, they cause primary stress to change position to a different syllable, either leftward or rightward, as in Arabic. The following pairs illustrate this:

/əd,mɪnə'streɪʃən/ and /əd'mɪnəstrətɪv/ vs. < إدارة > /i.'dɑ:.ræh/ 'administration', < إدارية > /i.dɑ:.'rɪ.yæh/ 'administrative'.

Arabic, unlike English, does not have pairs of words that differ only in stress. Thus, stress cannot be the only source of inter-word contrast in these languages (cf. Cutler, 2015). Arabic rarely contrasts lexical items by accentual patterns, which may account for Arabic speakers' difficulties grasping this critical distinction. Arabs may be less capable of differentiating between English items of different parts of speech, which differ merely in stress patterns (e.g., *pervert* [n] vs. *pervert* [v]). Findings from earlier research (e.g., Ou & Guo, 2015) demonstrated that EFL learners had difficulty choosing between phonetic contrasts indistinct in their L1.

English word stress is further convoluted as almost all words in Arabic are not stressed in the same manner. Lexical stress in English is often correlated with a lack of vowel reduction; in function words, a short vowel or schwa often substitutes for a full vowel. Vowels in Arabic articles, conjunctions, prepositions, etc. are not usually shortened, so weak forms are non-existent (see Alzi'abi, 2011, 2017). Remarkably, Almbark et al. (2014) and Alzi'abi (2017) have found that Arab EFL learners rarely make any vowel reduction in English.

English stress closely relates to vowel quality. Arabic has fewer placement irregularities, and vowel length defines prominence and is an essential predictor of stress. These proposed rules for stress placement have notable exceptions, which create further problems for learners. Gimson (1980) and Roach (2009) argue that EFL learners should avoid exclusive reliance on such rules, recommending a holistic approach to learning correct stress placement derived from authoritative sources coupled with increased exposure to native speakers.

3. Importance of stress

Stress to comprehensible pronunciation is like the backbone of a human. Researchers have shown that effective communication may not be intelligible

without correct stress (Kang et al., 2010; Kenworthy, 1987). Incorrect stress sometimes hinders intelligibility and comprehensibility at word and sentence levels (Gallego, 1990; Ghosh & Levis, 2021; Jenkins, 2002). Grosjean & Gee (1987) aver that lack of intelligibility occurs because of listeners' overreliance on word stress to decode unfamiliar words.

Specialists maintain that stress is a distinctive feature of the word identity in English because it identifies word meanings and classes (see Kenworthy, 1987; Roach, 2009). Solé Sabater (1991) demonstrated that stress influences several aspects of language structure, including grammar, meaning and morphology. It has a precise function in establishing a distinction between words that contain the same phonemes yet differ in their stress patterns, e.g., *combat* (n) and *desert* (n) vs. *combat* (v) and *desert* (v). Likewise, incorrectly stressing *adolescent*, viz. stressing the second syllable rather than the third, alters the meaning and results in a *dollar cent* (see Baptista, 1981). Stress distinguishes compound nouns, e.g., *White House*, from similar modifier-noun structures, such as *white house*. The general rule is that the structure is a compound when stress falls on the first element; otherwise, it is a modifier noun.

Native English speakers rely on stress to recognise isolated words, process individual sounds, and listen to stress patterns (Brown, 1991; Cutler, 2015). Listeners face difficulties locating words within connected speech when stress has been inappropriately placed (Field, 2005). Incorrect stress is more apparent to a native speaker than mispronounced phonemes (Checklin, 2012). Learners who cannot perceive stress patterns correctly may encounter difficulties retrieving stored words from their lexicon, leading to communication breakdown (see Gallego, 1990).

4. Prior research into stress perception and production

Researchers have explored stress perception and production in various contexts with diverse L1

groups learning English. These included learners from Brazil (Rauber et al., 2010), China (Yu & Andruski, 2010), Japan (Yoshikawa & Leung, 2014), Korea (Guion, 2005), the Netherlands (Caspers & Kepinska, 2011), Poland (Porzuczek & Rojczyk, 2017), Spain (Guion et al., 2004), Taiwan (Ou & Guo, 2015), Thailand (Wayland et al., 2006) and Vietnam (Nguyen et al., 2008). The review below concerns the literature using Arab EFL learners first and then using other foreign learners of English. It was hard to get a narrower classification along conceptualized thematic grounds, as most studies combine a mixture of phonetics (acoustic analysis) and phonology (stress placement), production and perception, monomorphemic and multi-morphemic stimuli, etc.

Arab EFL learners share some phonological problems, such as syllable structure and erroneous stress placement, with other L2 learners whose L1 may influence transfer. According to Pallier et al. (1997), phonological interference occurs in the production and perception of L2 sounds. This could also be true for L2 stress, which will be established below, starting with studies on Arab EFL learners, followed by those on non-Arab EFL learners.

Youssef and Mazurkewich (1998) investigated Cairene Egyptian EFL learners' perception and production of word stress. The participants largely succeeded with words having a superheavy final syllable and excelled with the English items whose stress pattern resembled Arabic. Problems arose when the L2 stress patterns deviated from the Arabic ones.

Almbark et al. (2014) investigated learners' phonetic and phonological English stress acquisition and explored their L1 transfer of patterns. Acoustic analysis of two Egyptians' and two Jordanians' production of 12 English and 12 Arabic disyllabic near-minimal pairs showed no differences between Egyptian and Jordanian dialects. The L1 transfer was evident in their phonetic understanding of stress along with deliberate avoidance of any vowel reduction in unstressed items.

Helal (2014) explored 15 Egyptian English majors' difficulties deciding the place of stress in two- to five-syllable English, focusing on compounds. The tests showed that word length dictated participants' poor performance; the longer the word, the less likely it was correctly stressed. L1 and L2 different phonological structures of stressed syllables aggravated the problem.

Wayland et al. (2006) examined the impact of syllabic structure, lexical class and stress patterns of known words on ten Thai subjects' understanding of stress. They obtained similar results, particularly Youssef and Mazurkewich's (1998) results. The analysis of the production of 40 English nonce words revealed a tendency towards accentuating initial syllables with longer vowels in nouns, more often than verbs.

Yu & Andruski (2010) studied Chinese EFL learners' stressed-syllable identification and discrimination abilities using actual words, nonce words and hums. It involved 30 learners and 30 native English speakers. The participants encountered little difficulty identifying or discriminating stress patterns. However, the two groups used different acoustic cues to process words, supporting the assumption that L1 influences subjects' perception of English stress. Kang et al. (2008) came to a slightly different conclusion from the above, despite the different stress mechanisms. Forty-six EFL learners read 30 English and 25 actual Korean words. They performed better with Korean items regarding the number of syllables and stress placement. The more syllables in a word, the more problematic it proved, mainly when the two languages had distinctive stress patterns. These findings concur strongly with Youssef and Mazurkewich's (1998) and Karjo (2016) where the subjects had difficulty identifying stressed syllables owing to a lack of similar L1 stress patterns.

Rojczyk & Porzuczek (2019) assessed Polish EFL learners' acquisition of correct word stress in English using two groups of 41 Poles, lower proficiency and higher-proficiency English majors,

in two separate experiments. The researchers tasked the subjects with speeded identification and discrimination tests of some correctly and incorrectly stressed disyllabic and trisyllabic English words. The subjects' performance closely related to their proficiency and to the task type. Nevertheless, they fared better in the discrimination task. They encountered greater difficulty making accurate judgments without simultaneous access to correct and incorrect items.

Many word stress studies have thus far shown that EFL learners achieved variable success in stress identification. Altmann's (2006) test of multisyllabic nonce words revealed that Arab, Turkish and French subjects whose L1 had relatively fixed stress scored significantly lower than Japanese, Korean and Chinese subjects whose L1 were non-stress. The present Arab overall performance was better than Thais', who obtained a stress identification score of 41% (Chantaruchikapong, 2015). However, the Japanese subjects achieved successful primary stress of (94.5%) possibly due to their familiarity with the English words used (Andrade, 2005). These studies covered limited word stress patterns, and their underlying implication might be insignificant.

The above and many other studies have outlined the challenges learners face in acquiring foreign language word stress and emphasised that L1 interference and L1 prosodic features were the chief causes of most stress errors (Archibald, 1993, 1997). L2 stress errors directly reflected the influence of native language stress. Some studies revealed that subjects favoured stressing heavier syllables but had scant evidence of the cross-linguistic effects (Altmann & Kabak, 2011), making them insufficient evidence for L2 stress because of their small number of participants. Some research suggests a correlation between the similarity of L1 and L2 stress patterns and success in L2 stress. (Nguyen et al., 2008; Kijak, 2009). Other causes inducing errors included vowel height and length, the age of acquisition, mispronunciation and English proficiency (see also Checklin, 2012; Karjo, 2016; Khalifa, 2017).

Because of the dearth of research into Arab EFL learners' stress identification and production, it is still necessary to investigate this issue and contribute to the theoretical understanding of Arabs' stress perception and production, bearing in mind that most previous studies employed limited stimuli on a small sample of subjects.

5. The study. Methodology

5.1. Aim

The primary goal of this study is to gauge Arab EFL learners' competence in producing and perceiving English word stress. The specific aims are:

- a) To investigate whether Arab EFL learners can accurately stress di- and polysyllabic English words. This will help identify any factors adversely affecting their overall stress perception and phonological competence. Four specific questions will be addressed: (a) Are the subjects capable of accurately producing stress in di-, tri- and tetrasyllabic English words? (b) Is there a preponderance of successful production of stress within any of these categories? (c) Do they adopt any stress pattern behaviour, or exhibit any L1 influence in their performance? (d) Do their scores for the different word categories show any specific variance or do these establish any overall stress pattern for any category?
- b) To explore whether they can identify the stressed syllable in English and whether they perform better with di-, tri- or tetrasyllabic words. Therefore, it is better to address two secondary questions: (a) Do they perform competently in the perception task? (b) Do the subjects perform equally well regardless of the number of syllables in all stimuli, particularly tetrasyllabic words, as the extended number of syllables may mask the required stressed syllable?
- c) Is there any correlation between subjects' overall perception and production stress scores?

Arabs seemed to stress ultimate syllables in English items, particularly in disyllables and trisyllables, and penultimate syllables in tetrasyllables following the Arabic stress system. Kharma and Hajjaj (1989) contend that Arab EFL learners find difficulty in producing items in the stress-timed English language. They stress all words in an utterance irrespective of their context, nature and importance. Arabs may transfer their L1 stress strategies to L2 items and mostly stress syllables with long vowels. It is anticipated that the subjects would fare better in the identification test as the perception task is much easier. Earlier findings (e.g., Altmann, 2006) have shown that speakers of non-stress and unpredictable stress languages performed better in stress perception tasks. As to the last question, it could be true that a learner who is good at perceiving stress in English items is also so in producing it (see de Leeuw et al., 2021). However, some writers (e.g., Brawerman-Albini & Becker, 2014) argue that stress perception and stress production do not correlate. Maybe, this is because stress perception is more straightforward than stress production.

5.2. Subjects

The subjects were 88 third-year Jordanian English majors, 50 females and 38 males, 20 to 26, speaking the local Jordanian dialects. All were studying linguistics and translation courses at three different universities in Jordan. It was difficult to assess their proficiency level in English; nonetheless, they all attained a GPA score of 70+ within their first two years at college. To ensure a homogeneous subject pool, they undertook a Meara (1992) EFL Vocabulary Test, which measures the proficiency level of English among foreign learners. They completed test (309), i.e., No. 9 at Level 3. Other than the above, Eight subjects were removed from the study as their scores were well below 70. The mean score for the sample used was (82.7, Sd 5.3) (max.100). Typically, the subjects were at intermediate to upper-intermediate levels. It was not possible to include a control native comparison group.

None had received training in English stress. All started learning English at six, i.e., they had 14+

years of exposure to English. None had any hearing impairment. All subjects received the study's two tests, but six failed to take the second test.

5.3. Materials

The stimuli were 90 three-category items: 30 disyllables, 30 trisyllables and 30 quadrisyllables (tetrasyllabic structures). Each category contained ten adjectives, ten nouns and ten verbs. All were low-frequency items. Some scholars argue that familiarity with the stimuli may invalidate the objectives of empirical research (cf. Honbolygó et al., 2020). Infrequent words might not be equivalent to nonce terms but would fulfil an essential function of using nonce words – avoiding factors that might distract their attention, e.g., lexical or frequency effects. Frequency was estimated based on word frequency categories in the Cambridge Advanced Learner's Dictionary 4th edn. (CALD) and Longman's Dictionary of Contemporary English 5th edn. (LDOCE). None of the stimuli existed in the Academic World List (see Coxhead, 2000).

To help achieve the objectives set above and avoid any inconsistencies or data analysis complications, the stimuli were selected intentionally for their following distinctive characteristics. All were pronounced similarly in American English and British English. They also belonged to exclusive word classes; otherwise, they would have the same pronunciation for all word classes in both modes. Where possible, a final syllable with an obvious schwa sound /ə/ spelt *a*, *er*, *tion*, *y*, *ed*, *ous*, and *ure* was avoided. Most were closed-syllable.

The stimuli were randomly selected; 32 items had the primary stress on the first syllable, 42 on the second, 15 on the third, and only one on the fourth. Identical items were used in both tests.

5.4. Data collection

The subjects first completed a short questionnaire regarding their formal English instruction, age, knowledge of stress and any prior training in using stress.

For test 1 (stress production), participants were given visual stimuli, written words presented in an isolated context, and introduced individually in random order via a PowerPoint presentation on a computer monitor. Participants articulated each stimulus as it appeared on the screen and recorded their attempts. A WEISRE U-3315 microphone was positioned in front of the testee, some 20 cm from their lips, at approximately 45 degrees. The microphone was attached to a desktop computer and sound recordings were made using Audacity, a multi-track audio editor and recording software. In very few cases, and for technical reasons, an Olympus LS-100 recorder, or a smart cell phone with advanced voice recording quality, was deployed. Subjects were tested individually in a sound-attenuated room in the presence of two or three classmates, the latter unable to view the stimuli. The idea of between-speaker influences was dismissed as the subjects were far from the testee. The task was presented as an unremarkable reading task. The subjects produced all the stimuli in one sitting, time uncontrolled.

Participants were encouraged to produce the stimuli as naturally as possible and loud enough for accurate audio recording. They could mouth and repeat any word they found challenging to utter until they were satisfied it was the best of their abilities. To avoid any task effect, the researcher asked the subjects to give the meaning of each word in case they knew it. They could do this in either English or Arabic. Each subject's attempts, including the meanings of the stimuli, were saved as separate sound files for later analysis. For practical reasons, the recordings had no time constraints.

The second task was the auditory stress-identification test in which subjects had to identify the location of stress in each word; it took place two days after the stress production test. Before this, a brief session was held to instruct them on stress, without enlightening them as to the purpose of the session. A concerted attempt was made to offer a sufficiently simple explanation of stress to give them a proper understanding of the concept, using practice examples, including familiar and unfamiliar items.

They also practised using items similar to the test words, and each item appeared on a data projector screen synchronised with a native speaker's pronunciation. The pronunciations were those of LDOCE and CALD British speakers. Examples included words of all types used in the test.

The complete list of items was broken into syllables, which could facilitate the syllable identification task. Syllabification was performed as per the LDOCE and OALD (Oxford Advanced Learner's Dictionary 9th edn.) Scheme. CALD was consulted where items were missing in the former. A heavy dark dot demarcated syllable boundaries.

The subjects received test sheets with the stimuli ordered according to the native speaker's pronunciation, and they were tested in groups subject to language lab availability. They had to wear headphones and listen to words attentively, circling, on the test sheet, the syllables they felt had the most stress.

The audio recordings of the stimuli were the LDOCE online version, but some were CALD when the stimuli were missing in LDOCE, e.g., *amaretto*. The stimuli were generally pronounced at an average speech rate with falling intonation. VideoPad video editor removed any unwanted noise or external acoustic effects from the file containing the audio recording of the native speaker to ensure the words were clear to the listener. The response time for each token was approximately 5 seconds. After completing the two set tests, the participants were briefed on the purpose of the research.

As subjects were not always available, they did one task at a time, and as it was impossible to unify the order of tasks, some subjects did tasks in order A (test 1, test 2), and other subjects did them in order B (test 2, test 1).

5.5. Data analysis

The subjects' performance was analysed upon completion of the stress production test. Two expert native speakers, familiar with Arabic-accented

English and the author, listened to the pronunciations of slightly less than 8000 tokens and identified the correct stress placement. Based on the judges' evaluation of all the tokens, there was a 96% inter-rater agreement among the three judges. Praat software was used to judge a handful of complex tokens and the range of analysis displayed, such as spectrogram and waveform, provided solid evidence on intensity (loudness), pitch height and vowel duration. Vowels in stressed syllables were slightly longer and grew higher in intensity than vowels in unstressed syllables.

For accuracy, the researcher checked the participants' identification of the stressed syllables against the correct word stress in LDOCE and CALD. Each stressed syllable correctly identified was awarded one mark and zero if incorrect. The subjects' overall mean scores for both tests, and sub-scores for each item category, were computed, and the results were evaluated to find any predictable stress patterns adopted by the subjects.

6. Results

6.1. Stress production accuracy

The primary aim of this study was to explore how Arab EFL learners would apply stress correctly to polysyllabic words. There were 7920 tokens in all, with 5842 tokens incorrectly stressed. A chi-square test showed a significant difference between the correct and incorrect scores [$\chi(1) = 1788.85, p = 0.00$]. It was fully expected that a significant number of words would be incorrectly stressed, but it should be noted that all subjects displayed their unfamiliarity with most stimuli, as they were deliberately obscure. A one-sample t-test showed that their performance was above the chance level for each type of stimulus [$t = 3.810, p < .001$]. Despite their poor scores, the subjects seemed to perform best with disyllables [$\chi(2) = 347.60, p = 0.00$], correctly stressing 40%, i.e., 1019 out of 2640 (comparison here concerns disyllables and other categories, tri- and tetrasyllables, in the frequency of correct answers). This is attributable to many disyllables (60%) having end-stress, and many

subjects opted for end-stress in most of these items. Comparisons showed fewer correctly stressed trisyllables and tetrasyllables, 23% and 16% (figure 1 below); tetrasyllables came last [$\chi(2) = 347.60, p = 0.00$]. The subjects scored better with disyllables not because of random guessing; the raw percentage performance tended to be higher for the disyllables than trisyllables, and lower for tetrasyllables because more disyllables have end-stress.

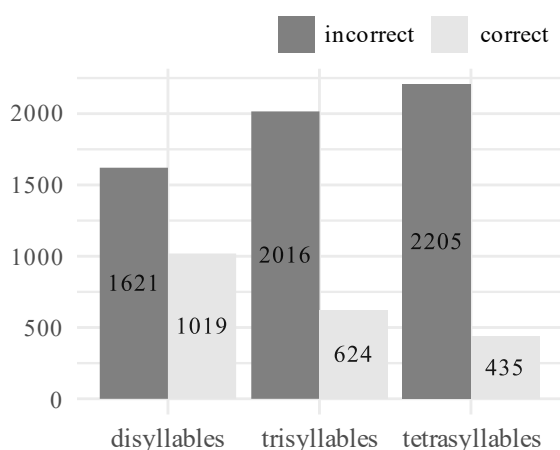


Figure 1. No. of incorrectly and correctly stressed tokens per syllable type.

Among the three word classes, nouns had the largest number of correct stresses (850), followed by verbs (686). Adjectives were the least correctly stressed (542). Table 1 displays a cross-tabulation of the correct answers to all item categories.

	M	SD
Disyllables	21.53	4.20
Trisyllables	18.90	5.22
Tetrasyllables	18.34	5.97

Table 1. Subjects' correct mean scores for the different types of stimuli (max. = 30).

Table 1 shows that the lowest correctly stressed items were tetrasyllabic verbs. For disyllables, verbs were the most correctly stressed and adjectives the least. A chi-square test revealed subjects did significantly better with disyllabic verbs than nouns and adjectives [$\chi(2) = 236.99, p = 0.00$]. This is probably because more disyllabic

adjectives (9) and nouns (6) stress the penultimate syllable. Remarkably, this score was the highest for verbs among all three-item categories. Subjects did best with trisyllabic nouns and scored the least with adjectives. Similarly, a chi-square test revealed that performance was significantly better with nouns [$\chi(2) = 179.21, p = 0.00$]. This score was the second-highest for nouns among all three-item categories. For tetrasyllabic items, the highest correct score was for adjectives and the lowest for verbs. A chi-square demonstrated a significant difference in favour of tetrasyllabic adjectives [$\chi(2) = 180.40, p = 0.00$]. This finding may be attributable to many tetrasyllabic adjectives having penultimate or ultimate stress, which was the participants' favoured choice. Overall, adjectives were the least correctly stressed and nouns the most; a chi-square test showed a significant difference among scores between the three-word classes [$\chi(2) = 92.96, p = 0.00$]. This is probably attributable to more disyllabic adjectives (9 out of 10) having initial syllable stress than trisyllabic and tetrasyllabic adjectives.

Seemingly, the more correct production in disyllables compared with other item categories reflects subjects' tendency to stress final syllables, which coincides with higher instances of word-final stress in disyllables. This accords with the predictions above.

6.2. Factors affecting performance

The most significant finding was that the participants tended to stress final syllables (reflected in the distribution of correct/incorrect production). This section provides further details on the distribution of stresses in each item class.

It was first necessary to establish whether the subjects followed any specific stress pattern attributable to L1 stress interference, demonstrated by their errors. This was to achieve the goal of identifying any factors affecting participants' stress perception and phonological competence. Table 2 shows the subjects' response analysis results across

item categories and word classes, suggesting more subjects favoured second and third-syllable stress.

	Disyll.	Trisyll.	Tetrasyll.	Total
Verbs	492	159	35	686
Nouns	349	344	157	850
Adject.	178	121	243	542
Total	1019	624	435	2078

Table 2. No. of correctly stressed items per item category across word classes.

The second and third syllables were stressed most frequently (65%). To illustrate, the second syllable is the ultimate in disyllables, the penultimate in trisyllables or the antepenultimate in tetrasyllables. A chi-square test showed a significant difference between the first and second syllable stress [$\chi(1) = 871.56, p = 0.00$], the first and fourth syllable stress [$\chi(1) = 406.15, p = 0.00$], the second and fourth syllable stress [$\chi(1) = 100.11, p = 0.00$] and the third and fourth syllable stress [$\chi(1) = 102.89, p = 0.00$].

This suggests the subjects stressed the second syllable more often than the first and fourth syllables. They also stressed the fourth syllable more often than the first and similarly they stressed the third syllable more often than the first and fourth syllables. Notably, the third syllable is the ultimate syllable in trisyllables or the penultimate in tetrasyllables. The difference between subjects' performance with items having the stress on the second and the third syllables was insignificant [$\chi(1) = .019, p = 0.88$]. Further investigation was needed to clarify whether ultimate syllable stresses were truly favoured in all stimuli.

Further analysis was undertaken to reveal the subjects' overall stress behaviour and detect any stress strategies (table 3).

	Stress on final syllable	Stress on other syllables
N. of items	6079	1841

Table 3. Subjects' stress placement irrespective of item category or word class.

Most subjects stressed final syllables; most probably, because of tendencies to stress final heavy syllables in their L1. Very few stressed penults or antepenults in the tri- and tetrasyllabic items. Chi-square tests highlighted that subjects significantly favoured ultimate syllable stress in comparison with non-ultimate syllable stress in all item categories: disyllables [$\chi(1) = 919.45, p = 0.00$], trisyllables [$\chi(1) = 859.10, p = 0.00$] and tetrasyllables [$\chi(1) = 522.07, p = 0.00$]. To reiterate, overall, 77% of items received ultimate stress. This confirms findings from earlier research on Arab EFL learners' use of stress and the assumption of this study that they have a strong tendency to place stress on the ultimate syllable.

However, the above scores might have masked the subjects' actual behaviour in articulating particular item types. Table 4 below shows subjects' actual stress behaviour per item type.

	N. of stresses
1 st syllable	849
2 nd syllable	2577
3 rd syllable	2587
4 th syllable	1907

Table 4. Subjects' actual stress behaviour (total: 7920)

Subjects favoured end-stress in most item types, i.e., 76.75% of cases. A chi-square test showed a highly significant difference between the above: [$\chi(1) = 2267.75, p = 0.00$]. Noticeably, subjects mostly opted for ultimate syllable stress.

6.3. Stress identification test

The study also investigated whether subjects performed better in identifying the stressed syllable than in the stress production test, as the former task is much easier. The subjects' overall mean score for correct responses was (58.78, out of max. 90, SD = 14.25). This result, albeit insignificant, exceeded the score achieved previously. Arab subjects performed significantly due to the close association with their competence level and little to no interference from L1. However, this still highlights their difficulty in

identifying the prominent syllables in English. To establish whether they excelled within any item category, the mean correct score for each item group was calculated. Table 5 shows the individual scores for stress identification of all item types.

	1 st syll.	2 nd syll.	3 rd syll.	4 th syll.
Disyll.	20.5% (541)	79.50% (2099)	—	—
Trisyll.	7.7% (204)	13.7% (363)	78.5% (2073)	—
Tetrasyll.	3.9% (104)	4.3% (115)	19.4% (514)	72.2% (1907)

Table 5. Proportion of subjects' actual stresses, item category vs. position of stressed syllables.

The highest score went to disyllables, viz. most disyllables received final stress. An ANOVA test showed a significant difference in final syllable stress among the three individual scores for the three-item categories [$F(2, 243) = 8.87, p = 0.00$]. Submitting these mean scores to post hoc multiple comparison tests in which the primary effect, predictor, was item type, a significant difference in correct answers appeared between disyllables and tri- and tetrasyllables [$F(2, 243) = 3.19, p = 0.00$]. Further scrutiny revealed that the effect was due to their relatively better performance with disyllables, where more correct answers were scored. There was no significant difference between trisyllabic and di- or tetrasyllabic items [$F(2, 243) = 0.561, p = 0.489$]. Similarly, no observable difference existed between tetrasyllabic and di- or trisyllabic items [$F(2, 243) = 0.561, p = 0.489$]. The subjects' task of correctly identifying stressed syllables was much easier with disyllables, leading to significantly higher scores. This result shows that subjects did not perform well with multisyllabic items, as the larger number of syllables masked the intended stressed syllable.

6.4. Stress perception-production correlation

A Pearson's correlation test was used to discover any correlation between stress perception and production. There was no relationship between both scores; a correlation rate of -0.058 was attained

between subjects' word stress perception and production, as stress perception might have been easier than stress production. The prediction made above then did not come true.

7. Discussion

7.1. Stress production accuracy

The subjects' overall performance suggested they encountered noticeable difficulty correctly assigning stress, particularly with polysyllabic utterances (cf. Youssef & Mazurkewich, 1998; Anani, 1989), making relative differences in their performance within the different word classes less significant. Their accuracy level remained low, highlighting their unfamiliarity with the items and their lack of training in suprasegmental phonology. They consistently placed primary stress on the ultimate syllable, especially heavy syllables – a strategy, mainly of their L1 stress system, which did not conform analogously to correct English stress (see the subsections below). Amer and Amer's (2011) findings were also consistent with the present ones, with most subjects experiencing difficulties stressing English words correctly, usually through L1 interference. Arab EFL learners again resembled other EFL learners, e.g., Chinese (Yu & Andruski, 2010) and Indonesians (Basri, 2010). All had difficulty stressing polysyllabic words and tended to opt for iambic stress patterns in disyllables and end-stress in others. A plausible hypothesis is that the greater the stress pattern variation readily observed between L1 and L2, the larger the L1 negative interference over the learners' stress placement.

Arabic stress which regularly falls on heavy syllables, typically occurring at the end of words, affected subjects' performance. Kenworthy (1987, pp. 124–125) contends that Arab EFL learners transfer their mother-tongue pronunciation habits to English, including stressing heavy final syllables. This tendency aided them in correctly stressing more disyllable English verbs, as many have ultimate stress. Interestingly, Dauer (1993) reports that 90% of disyllabic nouns have penultimate stress

and 60% of disyllabic verbs have end-stress. Not only were disyllables hard to stress, but the subjects also performed poorly with multisyllables containing antepenultimate and penultimate stress. Interestingly, other EFL learners, e.g., Indonesian and Polish speakers, misplaced stress in multisyllables, particularly disyllables, because of L1 transfer (Karjo, 2016; Porzuczek & Rojczyk, 2017).

7.2. Subjects' strategies

Close examination of the subjects' production revealed they adopted one obvious strategy — stressing the ultimate syllable, mainly when its nucleus was a long vowel, irrespective of it being a monophthong or a diphthong, e.g., *remonstrate* (100.0%), *delineate* (97.7%), *paralyse* (91.0%), *paramount* (88.6%), *quarantine* (81.7%), etc. Their responses revealed that the stimuli which contained vowels represented by the same letter in both syllables, in di- and trisyllables, were usually stressed on the ultimate syllable, e.g., *rampart* (95.5%), *pretext* (94.3%), *monotone* (93.2%), *canvass* (86.4%), *vacant* (84.1%), etc. This may suggest that the orthographic representation of L2 English words influences participants' production, a worthwhile follow-up point.

Two potential factors might have influenced the participants' performance. The first factor was the orthographic representation or end-stress. Some words have more graphemes in final syllables, e.g., “paramount”, or some of the five vowel letters. The participants might have interpreted these graphemes as an indication of greater prominence. Second, the subjects might have used their own pronunciation skills with other items and decided the peak in final syllables was long and stressed them. For instance, they typically produced the letter *a* sounds in most ultimate syllables as a long /a:/ or possibly /eɪ/ in constructions with *a* + consonant + *e*. In words having a long vowel, e.g., *podcast*, *supplant*; *trespass*, *remonstrate*, most stressed the ultimate syllable with the long vowel; they did similarly with *pinpoint*, *monotone*, *parasite*, and *expound*. The proportions for the ultimate syllable stress in the

above were 90.2%, 90.9%, 90.2%, 100%, 96.6%, 93.2%, 96.6% and 83.0%, respectively.

Occasionally, when the ultimate syllable did not have a long vowel, this vowel was prolonged and the syllable was stressed, being evident in *trenchant* (88.6%), *observant* (92.0%), *pollutant* (88.6%), *stubborn* (87.5%), *cockamamie* (85.2%). Sometimes, the ultimate syllable was stressed, although its peak should be shortened, e.g., *adolescence* (94.3%), *fluorescent* (89.8%), *opalescent* (86.4%), *circumspect* (83.0%), *belligerent* (83.0%), *acquiescence* (76.1%). No satisfactory explanation accounted for this behaviour, other than the strong tendency for end-stress, regardless of vowel quality. Generally, the subjects seemed less sensitive to the acoustic dimensions of stress, particularly at initial positions, than other EFL learners.

In the same vein, vowel quality is an essential cue to the instant recognition of English stressed syllables; these invariably have full vowels as their peaks. The findings indicate that Arab EFL learners are sensitive to vowel quality, as their L1 has a predictable weight-sensitive stress system (Altmann, 2006). Arabs are more capable of detecting stress when it falls upon a heavy syllable, i.e., syllables with a “tense” vowel. They more often assigned stress to syllables with full vowels regardless of their position in the utterances. This possibly confirms suspicions that one key factor in L2 word stress is learners' preference for placing stress on heavy syllables, i.e., CVV or CVC. Guion (2005) reported similar findings as Spanish and Korean learners placed stress on syllables having long English vowels. Curiously, Arabs in this study typically lengthened short vowels in unstressed syllables to be “stressable” (see below). This suggests they could not identify “unstressed” syllables with short vowels as stress carriers. Kijak (2009, p. 314) claims that a “universal bias” may exist “to perceive closed syllables as prominent” (for more on this, see Özcelik, 2021). Learners of L2 Polish assigned stress to closed syllables even though their L1 is quantity-insensitive.

Arab learners' strategies appeared to conform to other EFL learners because of L1 interference in production processing. L1 phonological stress patterns, such as end-stress, may have influenced transfer in L2 production as was the case with Thais (Chantaruchikapong, 2015; Wayland et al., 2006) who preferred final stress to initial stress and Brazilians (Rauber et al., 2010) who assigned stress to penultimates in English words even where the stress falls on initial or ultimate syllables, resulting in errors such as *operator* instead of *operator*. There remain, however, evident discrepancies between the present results and Altmann's (2006); her Arab subjects had a prevalence of incorrect *penultimate* stress, as they usually stressed non-penultimates.

The subjects were not consistently opting for end-stress in disyllables. So, it is likely that Arab learners were opting for for-stress in disyllables, particularly those orthographically with long vowel letters or graphemes (see Alzi'abi, forthcoming). Those items with more vowel graphemes or seemingly heavy vowels might have encouraged for-stress. This occurred wherever the assumed initial syllable had a long peak. For instance, some stressed the penultimate syllable in *nodule* (46.6%), *globule* (35.2%), *motel* (34.1%), *pontoon* (29.5%), etc.; possibly, they perceived the initial syllable as having a long vowel, which their pronunciation suggested. Their production of such instances was not statistically significant, confirming the initial stress effect and implying it was by chance. An issue that is again worth following up.

7.3. Stress identification

As expected, Arabs fared better in the stress identification test than the production test because identifying the most prominent syllable was much easier than producing it. Arab subjects are more adept at identifying the stressed syllables in words articulated by others, unlike French native speakers who struggled with phonological contrasts lacking in their L1 (Dupoux et al., 1997). It can be claimed that Arab EFL learners tend not to merely guess when identifying stressed syllables and are capable of perceiving the prominent part in the acoustic

speech signal. It could be true that unstressed heavy syllables in certain stimuli might have negatively influenced Arab learners' stress identification task.

Although it is acknowledged that learning in production generally does not depend on learning in perception (Baese-Berk, 2019), the relationship between word stress perception and production has not been addressed, and no psycholinguistic models of speech processing exist to explicate this point. Follow-up research is required further to explore the nature of stress perception and production relationship.

7.4. Causes of poor performance

The present result suggests the subjects experienced real difficulty correctly producing the stressed syllable in all word categories, particularly tri- and tetrasyllables. The longer an utterance, the more likely the subjects' failure to recognise the stressed syllable. Helal (2014) found that increased word length was closely associated with low performance. (cf. Kang et al., 2008; Karjo, 2016).

Arab subjects' stress production was affected by L1, and their L2 competency was also believed to be partly responsible for stress misplacement. A close analysis of their production showed L1 influence did not explain the incorrect production and perception of stress in some stimuli. Other purely acoustic or psycholinguistic factors might have caused their stress production difficulties.

As to stress identification, a thorough examination of the data indicated that the subjects fared better in utterances with ultimate syllable stress and penultimate or antepenultimate syllable stress in tri- and tetrasyllables, respectively. Maybe, they found it easier to detect the location of primary stress in such utterances. Many cases of stress misidentification occurred in items with initial syllable stress. It partially confirms Altmann's (2006) findings, where Arab subjects obtained highly accurate scores for penultimate stress identification in tetrasyllabics. The current subjects' performance differed from Thais' who correctly identified

initially-stressed items better and more accurately than ultimately-stressed ones (Jangjamras, 2011).

It is worth mentioning that Arab subjects achieved high scores with disyllables such as *pontoon*, *quartet*, *motel*, *courgette*, *expound*, *subdue*, and *obtrude*, trisyllables such as *nominee*, *flannelette* and *commandeer* and tetrasyllables such as *noncustodial*, *opalescent*, *cockamamie*, and *concessionaire*, where stress fell on the ultimate syllable in disyllables and trisyllables, and the penultimate in tetrasyllables. To reiterate, unintentionally, only one tetrasyllabic stimulus, *concessionaire*, had the stress on the ultimate syllable.

7.5. Limitations of the study

Although carefully planned, this study had limitations. First, the author should have evaluated the subjects' linguistic proficiency more thoroughly. Score differences in both tests could have been avoided had their level of phonological competency been carefully controlled. Second, the study should have explored whether Arabs actively used acoustic cues in processing English word stress, viz. modelling the effects of English stress acoustics, e.g., stressed syllable complexity, stressed vowel lengthening and unstressed vowel reduction, on the participants' perception of English stress. Third, the cues which signal prominence vary from one language to another, suggesting that intensity, duration and pitch are not invariant cues. Earlier research revealed contradictory findings regarding EFL learners' ability to use acoustic cues and their role in facilitating the correct perception of stress. Fourth, the unbalanced selection of the stimuli might also have influenced the findings.

8. Conclusion and pedagogical implications

The present study has shown that L1 phonological patterns affected the subjects' performance and encouraged them to opt for end-stress. The subjects performed better on stress perception than stress production, but their average accuracy was moderate. Both tests' results confirmed that L1 stress system largely influenced Arab EFL learners;

the subjects primarily opted for the heavy syllable, which frequently resulted in unsuccessful stress placement. This was more evident in polysyllables where heavy syllables did not readily fall where anticipated, i.e., within the rightmost region, and they were not always stressing the ultimate syllable. Overall, the results supported the predictions that L1 phonological stress patterns might affect stress production, viz. favouring end-stress, and Arab subjects would perform better in stress identification tests, as the task could be easier.

Moreover, the lack of correlation between stress perception and stress production would support Brawerman-Albini and Becker's (2014) claim that stress perception and production in English were independent of each other, i.e., word stress production issues are not reflected in perception.

8.1. Pedagogical implications

The findings from the two tests provided useful empirical data for teaching English stress, highlighting the importance of raising awareness of the suprasegmental features of articulation in their studies, as word stress would constitute a significant part of suprasegmental speech. These findings should encourage teachers to establish L1-L2 relationships in all English classes at different levels of analysis, including stress, thereby enabling learners to detect all problematic L2 stress elements. It can also assist them in overcoming difficulties to better their pronunciation and gain mutual intelligibility.

Arab teachers should exploit their students' strategy of placing stress on ultimate syllables when teaching stress-carrying suffixes. Teachers can also capitalise on Brawerman-Albini and Becker's (2014) finding (see above) through stress training and pronunciation classes, even though it is hard to generalise because it requires further verification. Morley (1991) argues that teachers must focus on developing functional intelligibility and communicability rather than attaining perfect articulation.

As stress is crucial in achieving adequate speech comprehension, EFL teachers would do well if they

foster learners' awareness of all aspects of word stress and provide proper intensive training to grasp this concept effectively for everyday use (Checklin, 2012). This is achieved by using specific textbooks for teaching pronunciation and comprehensive resource guides on the Internet (see also Jenkins, 2002). Detailed instruction on word stress patterns (Amer & Amer, 2011) and the use of Internet-based material (Hismanoglu, 2012) have proved effective as this may improve EFL learners' command of lexical stress (Porzuczek & Rojczyk, 2019; Waniek-Klimczak, 2015).

There has been a gradual increase in focus on suprasegmental features within Arab textbooks; introducing a growing wealth of phonetic and phonological information (see Alzi'abi, 2017). But still, important phonetic and phonological ideas are ignored by academia because some teachers are unqualified and ill-equipped to teach these topics or have time constraints within their teaching schedules (Alzi'abi, 2017).

Educationalists claim that learners' ability to localise stress correctly during conversations with native speakers is of prime importance for obtaining linguistic proficiency and facilitating effective communication. Having little exposure to native English language discourse, educationalists must ensure the average Arab EFL learners have opportunities for enough practice drills within courses to gain sufficient proficiency in English word stress. Many teachers deem learning and practising this essential skill paramount for EFL learners; its mandatory inclusion in any English syllabi for Arab learners is highly recommended.

8.2. Future research

The present study focused only on stress in isolated words. Any follow-up research should include further investigation of the role of adequate contextualisation of stimuli within sentences to reflect natural speech and examining what impact this may have on learners' ability to detect stress. Tarone (1987) argues that isolating the stimuli artificially may obscure the subjects' actual perception skills

because natural speech offers the listener contextual cues that facilitate comprehension.

Earlier research has shown that factors like age of the English language acquisition and frequency of exposure to English proved insignificant (Chantachukapong, 2015), influencing the levels of intelligibility and proficiency of some EFL learners' pronunciation. Therefore, exploring these issues with learners of different L1 is worthwhile. In-depth research is needed to confirm the relationship between word stress perception and production to account for the conflicting findings on stress identification and production tests, particularly with a longer list of controlled items and subjects.

One can conclude that Arabic stress has received little scrutiny. Mitchell (1960) argues that pre-modern phoneticians failed to explore stress systematically. This failure could be due to an unawareness of stress in Arabic or a pre-judgment of its importance. The rules suggested by recent researchers were *inconclusive* or contradictory. There is a demonstrable need for follow-up research. Hardly any institution includes word stress in their curriculum (see also Helal, 2014). It is still helpful to study Arabic stress more extensively and investigates ways of utilising rules to boost EFL learners' acquisition of English stress, particularly curbing their tendency to stress final syllables.

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