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## THE ACOUSTIC ANALYSIS OF SENTENCE STRESS BY IRAQI EFL LEARNERS BASED ON GENDER DIFFERENCES

**A B S T R A C T**

Sentence stress is a really complicated field of English pronunciation and it is intertwined carefully with rhythm and intonation. As a group they are named the prosody of speech. The present study aims at the following: 1) Investigating the difference in the mean values, of intensity, F0 and duration, in the production of stressed and unstressed words in a given sentence, among the Iraqi groups. 2) Identifying whether there is any statistical significance between F0, intensity and duration in the production of sentence stress. 3) Identifying gender differences between the British native speakers and the Iraqi Arabic learners regarding the three acoustic factors.

The results of the preceding aims are as follows: 1) In spite of the different levels of the Iraqi groups and their different levels of language proficiency, yet the difference among the four groups is deemed to be not significant. 2) There are no statistical differences in the three factors F0, intensity and duration. 3) There are observable differences in gender between the Iraqi groups and the English native speakers' group but it is not significant. In conclusion, the study experimented two essential aspects L1 interference and language proficiency and it is found that both hypotheses are not true acoustically but they can be seen as active on the level of production.

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التحليل الصوتي للنبر في نطق الجملة من قبل العراقيين المتعلمين للغة الإنكليزية كلغة أجنبية استناداً  
الى الفوارق بين الجنسين

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## الخلاصة:

النبر على مستوى الجملة هو مجال معقد للغاية في نطق اللغة الإنجليزية ويتم تقويته بعناية مع الإيقاع والتجويد. كمجموعة يتم تسميتهم العروض أو فن تحسين قافية الكلام. تهدف الدراسة الحالية إلى الآتي:  
(١) استقصاء الفرق في القيم المتوسطة للعوامل الصوتية الثلاثة في إنتاج الكلمات ذات النبر وغير ذات النبر في الجملة موضوع البحث ، بين المجموعات العراقية. ٢ ) معرفة ما إذا كانت هناك أية دلالة إحصائية لهذه العوامل في إنتاج النبر في الجملة ٣ ) معرفة ما إذا كانت هناك أية دلالة إحصائية لهذه العوامل في إنتاج النبر في الجملة.  
في الختام ، جربت الدراسة مدى إتقان اللغة ووجدت أن الفرضية ليست صحيحة من الناحية الصوتية ولكن يمكن اعتبارها فعالة على مستوى الإنتاج.  
الكلمات الأساسية: النبر على مستوى الجملة ، F0 ، الشدة ، المدة، الاهتزاز، الصوت

## 1. Introduction

Sentence stress is an extremely complicated domain of English pronunciation and it is involuted carefully with rhythm and intonation. As a group they are named the prosody of speech (Thornbury, 2006: 110). Intonation is to employ pitch distinction in discourse. Pitch is the auditory effect made by distinctions in the rate of vibration of the vocal folds. It is the employment of contours over speech stretches that sometimes contain more than a word (Carr, 2013: 235). There are two types of stress, lexical stress and sentence stress. Lexical stress which is the characteristic of a single word and its position is often fixed in a word; however, it generally depends on the type of language whether it is predictable or not. However, there are definite criteria for lexical stress placement that might affect learners' performance. So the problem that exists in a sentence stress placement may create problem to most EFL learners who encounter difficulty to assign it correctly. In this case, EFL learners need to depend on special

acoustic parameters to indicate the most prominent word in a given sentence and this is the gist of the current study.

## 1.2 The Adopted Model

The model of this study is Chen *et al.* (2001) "A study of sentence stress production in Mandarin speakers of American English." In this study, the researcher measures the three acoustic features F0, vowel duration, and intensity of Mandarin speakers and American English speakers to assess the difference in their production of English sentence stress.

## 2. Sentence Stress

Sentence stress is an extremely complicated domain of English pronunciation and it is involuted carefully with rhythm and intonation. As a group they are named the prosody of speech (Thornbury, 2006: 110). The difference between content and function word is so important in sentence stress. The content words receive emphasis in a sentence, i.e. they are said more loudly, with higher pitch; whilst function words might be decreased to their weak forms or they plainly turn to be gentler, shorter or out of any modification in pitch (Ebranova, 2014: 20).

## 3. Intonation

Intonation is the linguistic use of specific F0 contours in the speech production. The contours can best be characterized by using symbols which represent their format, they are: 'fall', 'rise', 'fall-rise', 'rise-fall', 'level'. A signal can also be used to show where in the speaker's total range, the contour is: 'a high fall', 'a fall to low', 'a low rise' (Ogden, 2009: 49). Intonation is an influential way

of human contact. It has a real importance in conveying thoughts and feelings and assists in shared knowledge among people (Gimson, 1970: 266).

#### **4. Rhythm**

"Every language has its own natural rhythm, some patterned way of modulating the pulse of the airstream that comes from the diaphragm. In English, the rhythm of speech derives from the marked contrast between strong and weak syllables" (Halliday, 2013: 13). The entity which handles the rhythm of spoken English is named the *foot* (Ebranova, 2014: 14).

### **5. The Acoustic Characteristics**

#### **5.1 Frequency**

It is a technical expression used to refer to an acoustic characteristic of a sound. It is the number of total cycles, i.e. repetitions, that the vibrator produces in one unit of time. (Ladefoged, 2001: 164-5). Ogden (2009: 44) assumes that the expression 'pitch' indicates is a percept not a concrete state. The rate of vibration of the vocal folds is usually named fundamental frequency, since it is the minimum constituent of speech. Fundamental frequency is usually shortened into F0.

#### **5.2 Intensity**

The loudness of a sound relies on the amount of difference in air pressure that takes place. The intensity is relative of the regular amount or amplitude of the differences in air pressure. Acoustic intensity is the measurement that is equivalent

to loudness. It is normally assessed in decibels, shortened as dB, related to the amplitude of several sounds (Ladefoged, 2001: 165).

### **5.3 Duration**

Sound duration is seen by Al-Ani (1970: 75) as the exact time it consumes to generate a sound. It is possible to measure and limit the amount of time, while the important temporal factor is not stable but proportional. The proportional duration of a specific phone relies on the surroundings, and the speed of one's speech, and other aspects.

## **6.Method**

### **6.1 Participants**

The subjects that participate in the current study are of two group, the British English group and the Iraqi Arabic group. The first group (the control group) includes 8 adults (4 males and 4 females) who speak British English as L1. All English subjects are English native speakers who are (typically from England). The English females' average age is 29 years (range=28-32 years). The English males' average age is 33 years (range= 28-41 years). The second language group is the Iraqi Arabic which consists of 24 subjects. This group is divided into 4 subgroups, the Iraqi Arabic advanced group (teachers), the MA research group, the MA courses group and the 4th year students' group. The advanced (teachers) group females' average age is 38 (range= 29-45), the males' average age is 42 (range= 29-51). The MA research group females' average age is 30 (average= 27-33), the males' average age is 28 (range= 24-51). The MA courses group females' average age is 26 (average= 24-27), the males' average age is 32 (range= 24-41). The 4<sup>th</sup>

year(college) group females' average age is 23 (average= 22-26), the males' average age is 23 (range= 23-24).

## 6.2 Speech Materials

The sentence “*I bought a cat there*” is given to all the participants emphasizing sentence stress. The production of the four cases of sentence stress should be with different stress assignment in each case. The four sentences with different stress positions, written in uppercase, bold and italics, are: “***I*** bought cat there”, “I ***BOUGHT*** cat there”, “I bought ***CAT*** there”, “I bought cat ***THERE***”. The same method was followed by (Chen et.al, 2001).

## 6.3 Audio Recording

Since the researcher was unable to record the voices in the universities (in a sound-attenuated booth) or sound laboratories, all participants are contacted through WhatsApp application. In audio recording, the following criteria are to be followed: (1) each participant is contacted by a voice call and is asked to read the sentences orally to make sure whether there are any speech or language disorders; (2) they are asked to sit in a very quiet room that is not affected by any outside noise; (3) they are also demanded to speak in a high and clear voice; (4) the words in uppercase, bold and italics are to be emphasized, i.e. stressed; (5) they should leave a space 3-5 seconds between sentences. The criteria are sent to the participants in a word document form.

## 6.4 Acoustic Analysis

The four sentences that have been converted are downloaded into a computer (DESKTOP-5TOHCL0). By using the same computer, the sound files are opened by “Praat software program (2020)” (Boersma and David, 2020). The

sentences that were produced by each participant are viewed as Praat waveform. Each sound file includes 4/5 sentences, by using the Praat cursor, a selection of one sentence is made and then the selection of the word generally and the vowel particularly is done to have only the vowel nucleus to be analyzed. The pitch range in this analysis is between 75-500 Hz, the drawing method chosen here is the speckles. The intensity range in this analysis is between 50-100 db. The duration here is measured in (m s).

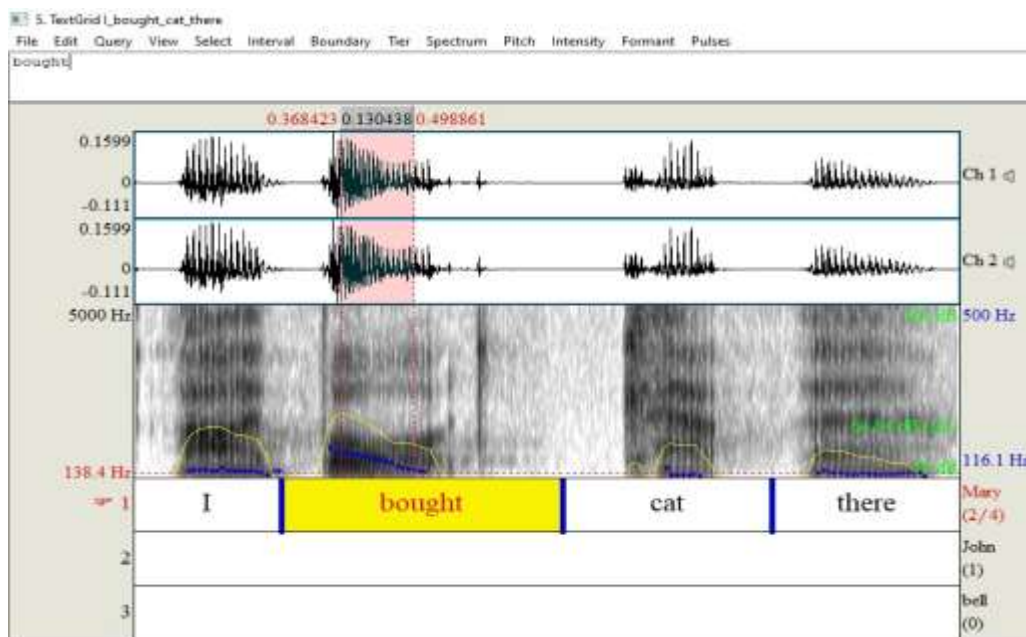


Figure (3.1) Praat analysis for the word '*bought*' within the sentence 'I bought a cat there'

## 4. Data Analysis and Results

4.1 What is the difference between the mean values of F0, intensity and duration in stressed and unstressed words among the Iraqi groups?

Table (4.1) below clarifies the different mean values of F0, intensity, and duration for the two cases of sentence, stressed and unstressed. In general, all the Iraqi groups show higher F0 and intensity as well as longer duration in the stressed sentence rather than the unstressed one. More strictly, the higher values of F0 and intensity are found in the Iraqi courses and the Iraqi research groups which are regarded exaggerated in comparison with the English native group. While the values are lower in the two other groups the Iraqi Arabic advanced and the Iraqi 4<sup>th</sup> year groups.

**Table (4.1) The mean values of stressed and unstressed sentences for all Iraqi groups**

Name	stressed Sentence				Unstressed Sentence		
	Sentence	F0	Intensity	Duration	F0	Intensity	Duration
Iraqi Advanced	I	197.79	74.14	0.22	213.24	74.58	0.13
	Bought	245.41	81.35	0.15	190.71	75.22	0.08
	Cat	232.67	78.56	0.16	165.24	74.46	0.11
	There	238.29	77.91	0.18	142.97	74.03	0.14
Iraqi Research	I	253.58	80.42	0.28	190.38	71.54	0.12
	Bought	254.98	80.93	0.05	217.86	73.56	0.10
	Cat	250.50	79.94	0.16	191.99	72.01	0.11
	There	220.26	81.26	0.19	169.80	71.74	0.15
Iraqi Courses	I	315.93	77.07	0.22	188.69	72.54	0.15
	Bought	254.98	80.93	0.20	191.34	76.76	0.17
	Cat	239.62	76.55	0.20	179.71	75.01	0.11
	There	209.44	76.07	0.19	172.35	74.62	0.14
Iraqi 4 <sup>th</sup> year	I	254.4	74.46	0.21	198.49	72.90	0.12
	Bought	247.63	76.55	0.15	193.74	70.06	0.08
	Cat	188.42	72.89	0.17	187.19	68.19	0.11
	There	209.88	76.90	0.15	156.56	67.30	0.12

#### 4.1.1 ANOVA Test Results for the Word 'I'

Taking the topic from a statistical perspective and after using the ANOVA, it was found that the F-values are less than the tabulated T-value of (3.1), which means that there is no significant difference between the four groups. There are two

figures for clarification, one for F0 and the other for intensity. See the following figures clarifying the ANOVA results for the word 'I':

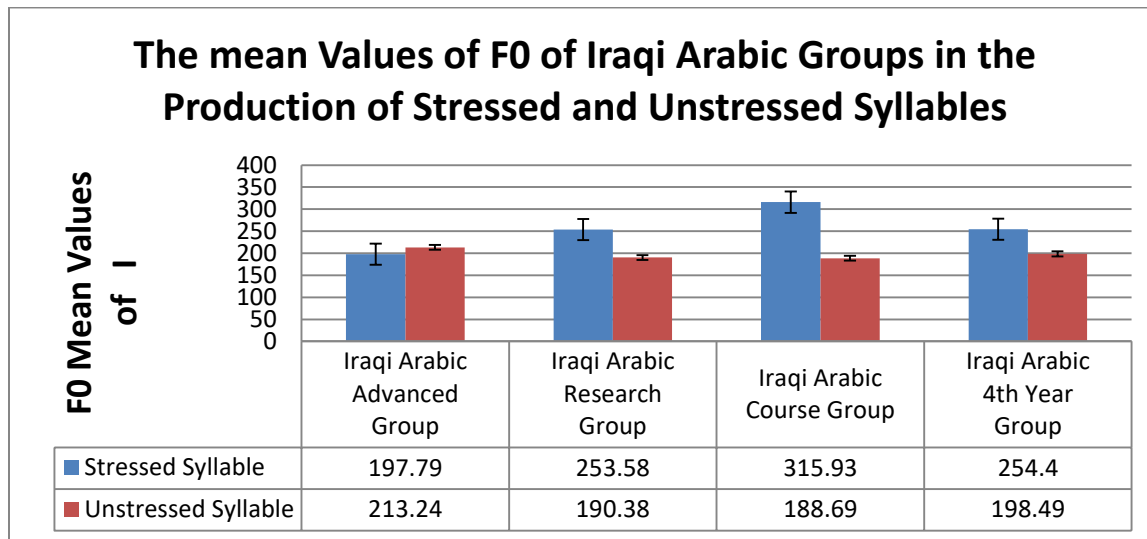


Figure (4.1) F0 mean values of "I" for Iraqi groups producing stressed and unstressed syllables

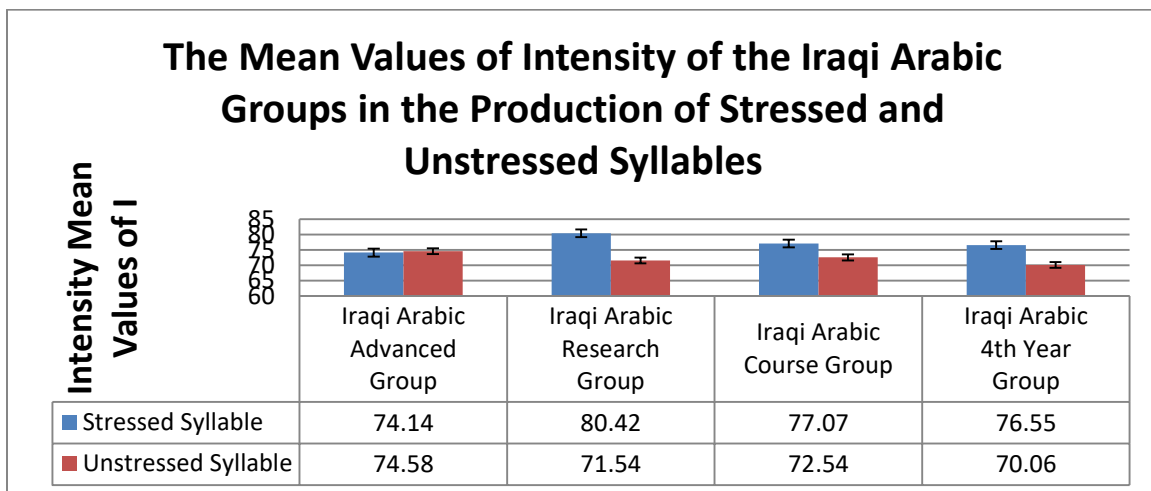
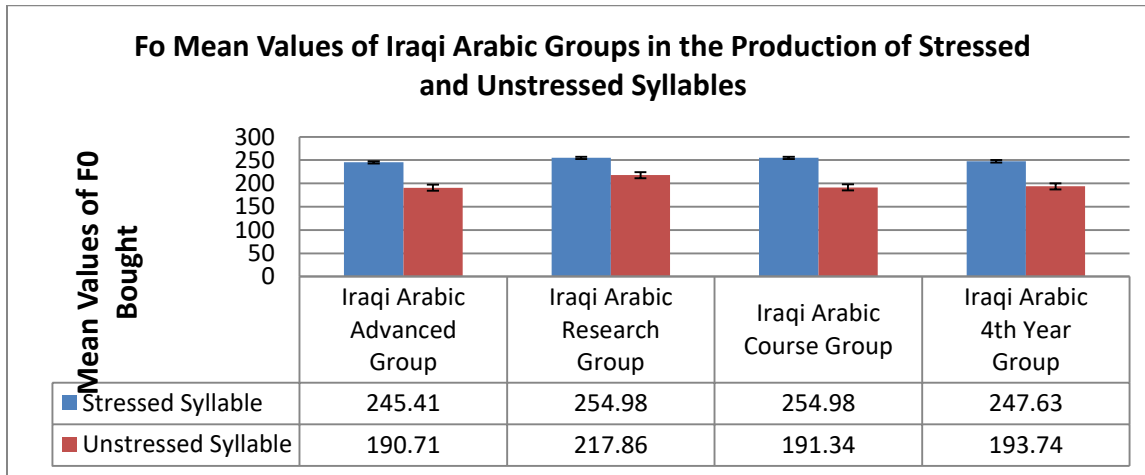


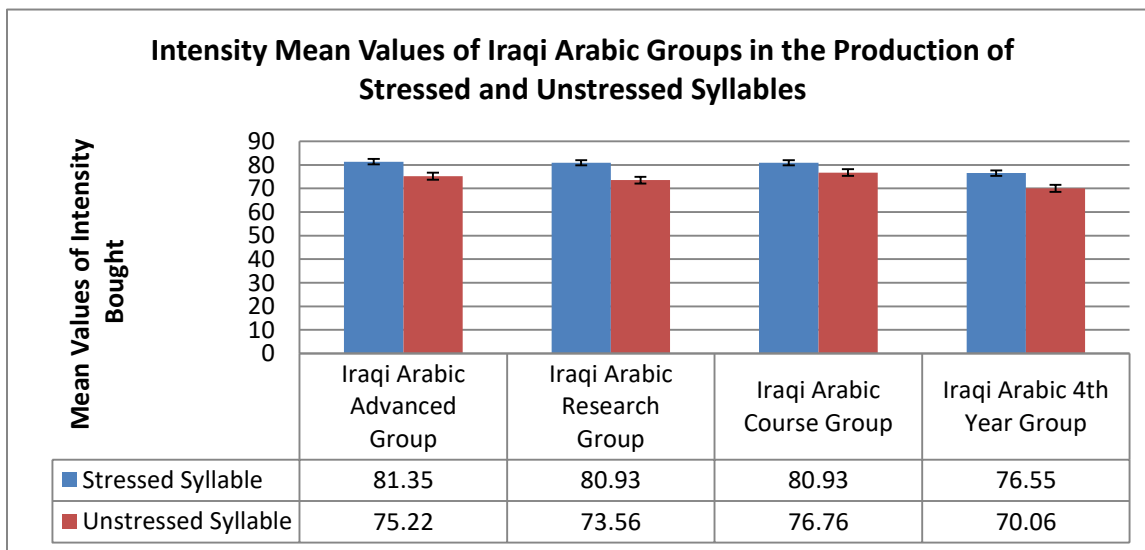
Figure (4.2) Intensity mean values of "I" for Iraqi groups producing stressed and unstressed syllables

#### 4.1.2 ANOVA Test Results for the Word 'bought'

Investigating the difference between the four groups by using the ANOVA test, it was found that the difference is not significant. The reason behind that is that some of the results in F-value are lower than the tabulated T-value of (3.1) and others are higher in percentage. Consider figures (4.3) and (4.4) for more details.



**Figure (4.3) F0 mean values of "bought" for Iraqi groups producing stressed and unstressed syllables**



**Figure (4.4) Intensity mean values of "bought" for Iraqi groups producing stressed and unstressed syllables**

### 4.1.3 ANOVA Test Results for the Word 'cat'

The ANOVA test of the word 'cat' shows that the results of F-value of the word 'cat' are lower than the tabulated T-value of (3.1). And this means that the difference is not significant. For illustration examine figures (4.5) and (4.6).

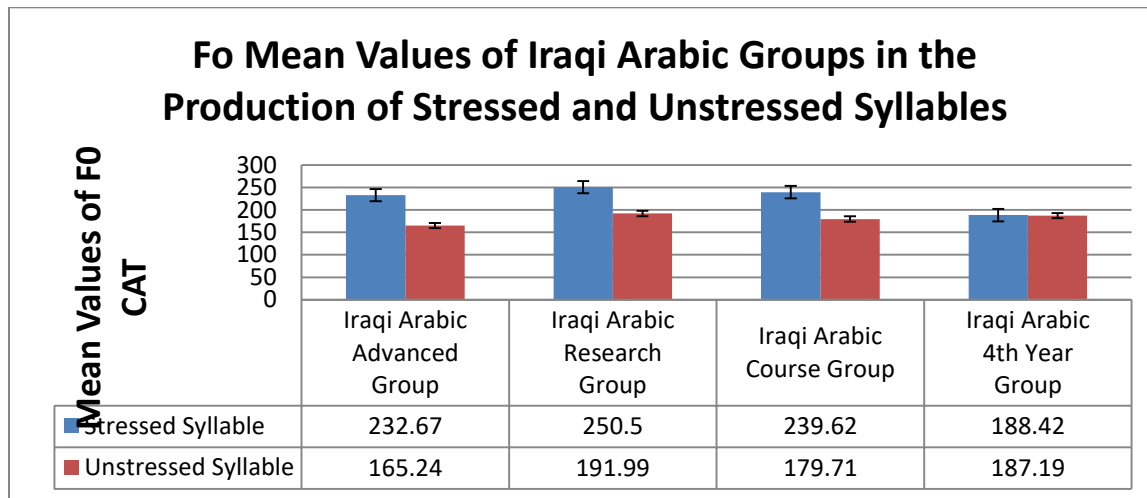


Figure (4.5) F0 mean values of "cat" for Iraqi groups producing stressed and unstressed syllables

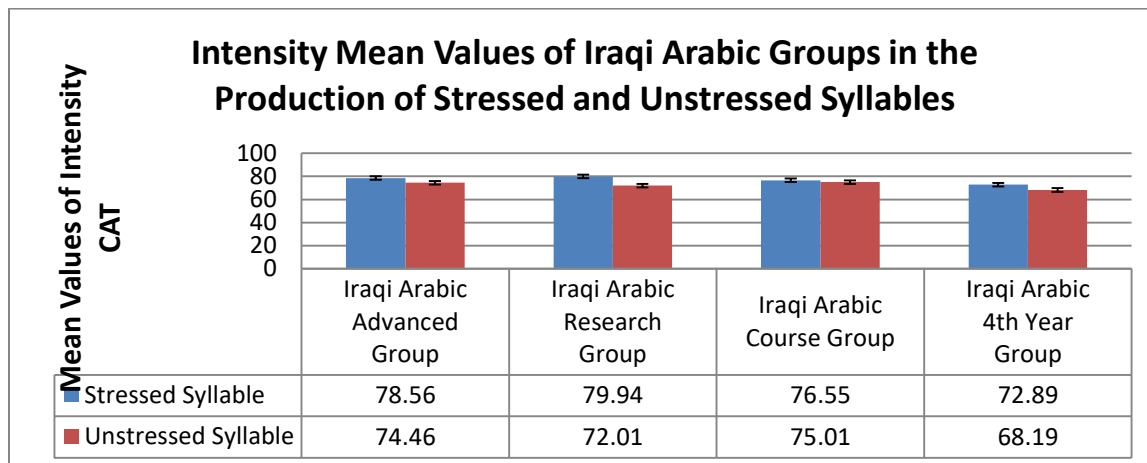


Figure (4.6) Intensity mean values of "bought" for Iraqi groups producing stressed and unstressed syllables

#### 4.1.4 ANOVA Test Results for the Word 'there'

It is found that the results of F-value are lower than the tabulated T-value (3.1) and this means that the difference is not significant. See figures (4.7) and (4.8).

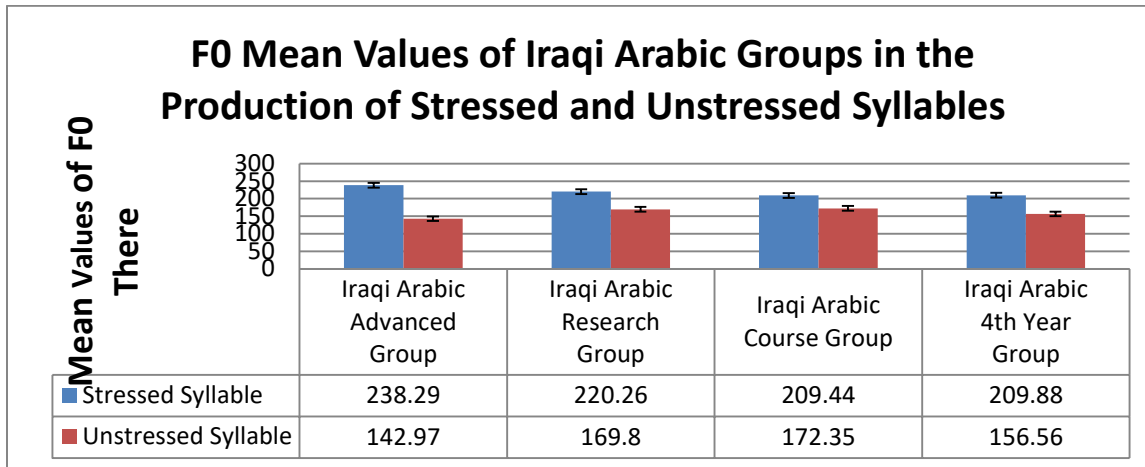


Figure (4.7) F0 mean values of "there" for Iraqi groups producing stressed and unstressed syllables

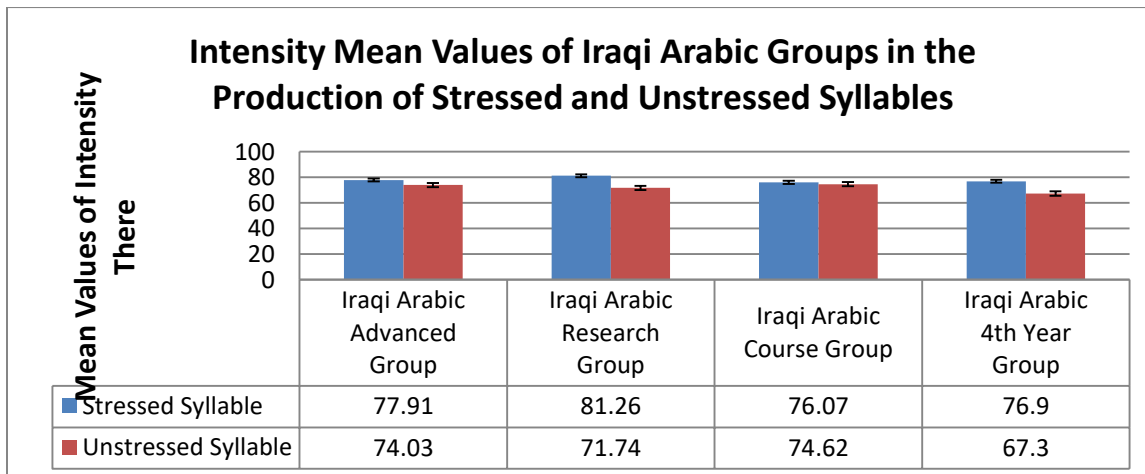


Figure (4.8) Intensity mean values of "there" for Iraqi groups producing stressed and unstressed syllables

#### **4.4 Are there any Gender Differences between the British native speakers and the Iraqi native speakers or among the Iraqi groups themselves in terms of the three acoustic factors, F0, intensity and duration?**

The last objective in this study concerns gender differences which is based on a comparison among the British native speakers and the Iraqi Arabic speakers as well as a comparison among the Iraqi Arabic groups themselves. That is based on statistical results put in the shape of tables and figures making results clearer. The results are put in two tables and five figures.

The two tables are a comparison one between the Iraqi female participants and the British English females and the other is for making a comparison between the Iraqi Arabic and the British English males. The two tables refer to the stressed sentence displaying for each acoustic factor in each word three things; mean, standard deviation, and the range.

##### **4.4.1 Iraqi Arabic Females vs. British English Females**

On the one hand, table (4.2) explores the two groups Iraqi female and British female participants' results. Each word of the sentence *I bought cat there* has three acoustic factors and for each acoustic factor there are three columns one for mean value, the second for standard deviation, and the third for the range of these values.

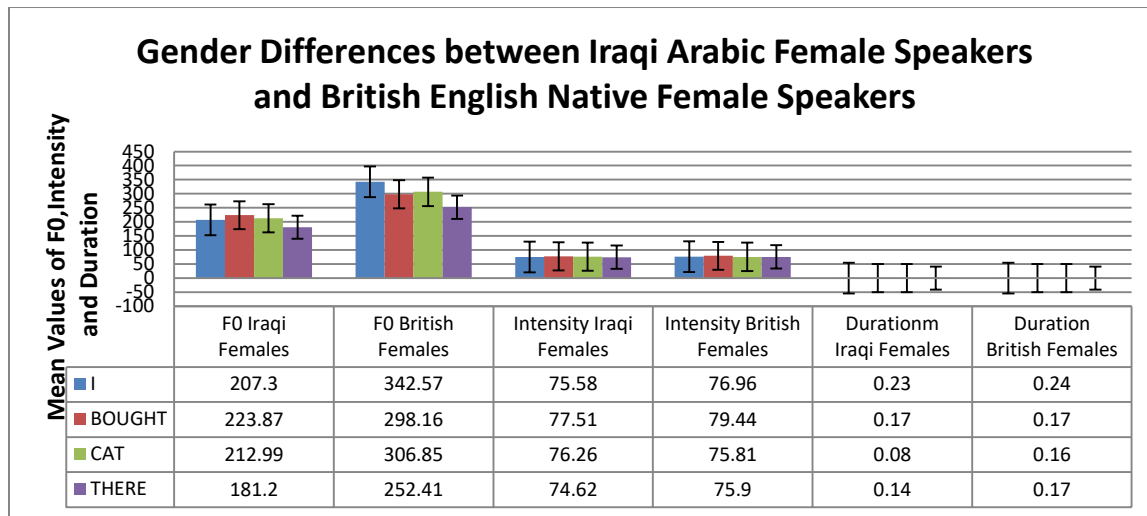
**Table (4.2) Mean (M), standard deviation (s.d.), and range values for F0 (Hz), intensity (dB), and duration (ms) for each stressed word produced by the group of British (B) female and Iraqi female speakers**

Group	Stressed Word	F0 (Hz)			Intensity (dB)			Duration (ms)		
		M	s.d.	Range	M	s.d.	Range	M	s.d.	Range
B-FEMALE	I	207.30	17.09	١٨٦-228	75.58	4.01	70-78	0.23	0.06	0.16-0.29
	BOUGHT	223.87	29.40	183-252	77.51	3.61	72-81	0.17	0.03	0.13-0.20
	CAT	212.99	28.12	177-245	76.26	4.61	72-81	0.08	0.02	0.07-0.10
	THERE	181.20	26.07	151-212	74.62	5.13	69-80	0.14	0.04	0.11-0.19
I-FEMALE	I	342.57	150.42	240-797	76.96	5.54	63-87	0.24	0.11	0.14-0.54
	BOUGHT	298.16	49.15	228-373	79.44	3.65	72-84	0.17	0.35	0.12-0.24
	CAT	306.85	58.47	217-409	75.81	7.03	60-84	0.16	0.04	0.11-0.23
	THERE	252.41	45.84	166-341	75.90	8.44	58-85	0.17	0.05	0.11-0.26

#### 4.4.1.1 Statistical Analysis

After finding the mean values and standard deviation for the acoustic characteristics of both the Iraqi females and British females, the T-value was calculated. Table (4.2) displays the results of the T-value showing the difference between the two groups, British females and the Iraqi advanced females. This results in a lack of significance since the T-value is lower than the tabulated T-value mentioned before. The difference between the British females and the Iraqi research females is distinct because of the existence of some of T-values that are higher than 3.1 and others that are lower than it.

As for the difference between Iraqi courses females and the native females, it seems to be not significant. The T-value in five results is higher than (3.1) so it is significant and in the rest is lower than it, so it is not significant. That is because the results of T-value are lower than the tabulated T-value (3.1). See figure (4.9) that makes the language of numbers clearer.



**Figure (4.9) mean values of F0, intensity and duration displaying gender differences between Iraqi females and British females**

#### 4.2.2 Iraqi Arabic Males vs. British English Males

Table (4.3), on the other hand, includes the Iraqi Arabic male and British male participants' results. The same procedure followed in table (4.2) is followed in this table. See figure (4.10) for illustration.

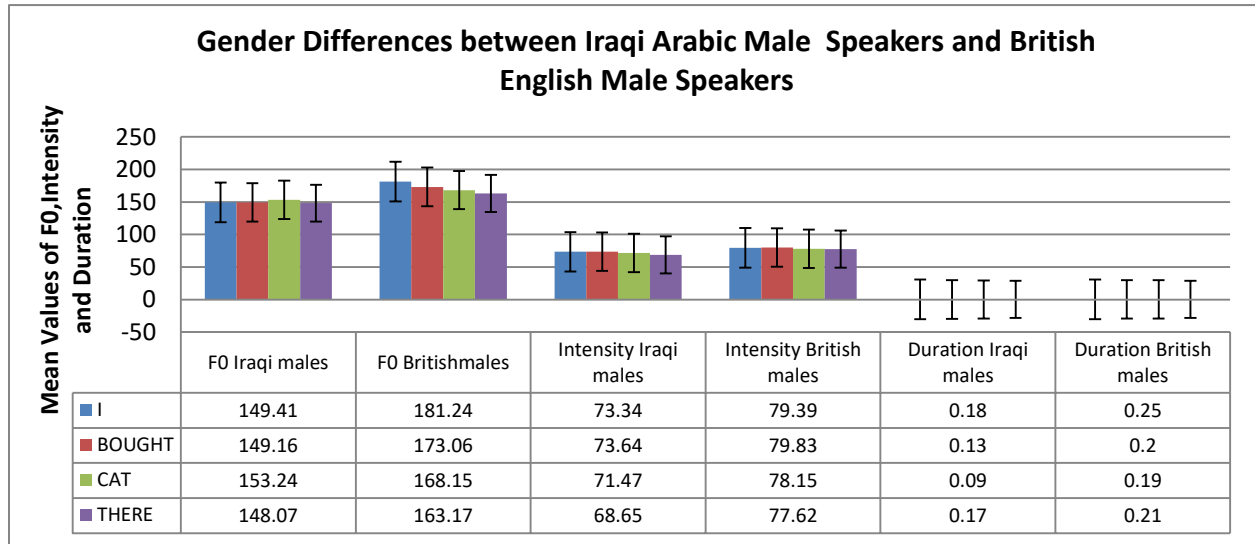
**Table (4.3): Mean (M), standard deviation (s.d.), and range values for F0 (Hz), intensity (dB), and duration (ms) for each stressed word produced by the group of British (B) male and Iraqi male speakers**

Group	Stressed Word	F0 (Hz)			Intensity (dB)			Duration (ms)		
		M	s.d.	Range	M	s.d.	Range	M	s.d.	Range
B – MALE	I	149.41	32.61	124-196	73.34	3.46	69-77	0.18	0.04	0.15-0.23
	BOUGHT	149.16	34.54	109-187	73.64	4.28	68-77	0.13	0.03	0.11-0.17
	CAT	153.24	44.60	127-219	71.47	5.53	63-76	0.09	0.04	0.05-0.14
	THERE	148.07	51.73	116-225	68.65	4.69	63-74	0.17	0.04	0.14-0.28
I – MALE	I	181.24	29.91	121-221	79.39	7.22	58-86	0.25	0.06	0.13-0.37
	BOUGHT	173.06	54.26	90-287	79.83	7.14	58-84	0.20	0.06	0.14-0.31
	CAT	168.15	46.75	90-243	78.15	7.15	56-82	0.19	0.06	0.14-0.32
	THERE	163.17	50.15	81-255	77.62	9.97	48-84	0.21	0.05	0.11-0.30

#### 4.2.2.1 Statistical Analysis

Table (4.3) states the difference between the Iraqi advanced male group and British male group. The difference is found to be not significant since most of the results are lower than 3.1 which is the tabulated T-value. The results of T-value between the research male group and the native speakers' group are lower than the tabulated T-value 3.1, so the difference is not significant.

the divergence between the British males and the Iraqi courses male group is caused by the fact that the T-value of both groups is lower than 3.1 so the difference is not significant. The same procedure is followed with the two groups, the British males and 4<sup>th</sup> year students' group. The difference here is not significant as well.



**Figure (4.10) mean values of F0, intensity and duration displaying gender differences between Iraqi males and British**

## 5. Discussion

The current study makes a comparison between Iraqi Arabic foreign learners and a group of British English native speakers. All four groups could pronounce the stressed vowel with effort and correctly. Generally, stressed vowels were spelled with higher F0, larger intensity and longer duration compared to unstressed vowels. There are salient differences in vowel production that were remarked between groups.

Language proficiency also grasps the researchers' interest. The results of the acoustic analysis gives some support for the hypothesis that English as an L2 can affect the bilinguals' stress production, the same procedure is followed by (Wang, 2013). The Iraqi Arabic advanced group includes teachers who have master diploma in English language, so they were expected to own higher level of proficiency. However, the advanced group was second to the 4<sup>th</sup> year students in language proficiency. One reason might cause this is that 4<sup>th</sup> year students began learning English at earlier age. And since all groups have the same L1, which is

Iraqi Arabic , the various scales of proficiency in English and the age of English learning (9-11 years old) might cause this difference. The same reason is supported by (Piske et al. , 2001; Wang, 2013, Flege, 1993).

## **6. Conclusions**

The difference among the Iraqi Arabic groups is found to be not significant even though they were of different levels of proficiency and have many observable discrepancy in production, that might be because the stages of learning are convergent as well as the variety of learning facilities that make language learning easier.

It might also be because the new generation is in acquaintance with new technology, social media good user, and can use the learning facilities found in the internet more actively what makes their language improvement easier.

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