The Correlation between Vowel Production and Vowel Perception as Elicited in the Performance of Adult Iraqi Learners of English: Acoustic Perspective

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Abstract:
   This paper reports the results of an acoustic study to the correlation between vowel production and vowel perception as performed by adult Iraqi learners (AILs) of English. The subjects representing the sample group of this work are 24 (12 males and 12 females) first- year Iraqi students who pursue their B.A. degree in English language and literature at the Department of English, College of Arts, University of Basra (Academic Year 2011-2012). They live in the city centre of Basra and the nearby districts. They are chosen randomly to represent the population of the study with no speaking and hearing defects. They perform a production and a perception tests where a list of 20English tokens is used. For the production experiment, a list of 5 dummy words (randomly chosen to decrease the subjects' tension and hesitation) as well as 20 monosyllabic and disyllabic words containing B.B.C. English pure vowels are randomly arranged to test the subjects' production performance . A perception-based test is designed to examine the participants' perceptibility of the vowels they have already produced. The perception stimuli are recorded on a computer model Toshiba NB505 with a CPU speed (1.7) GHZ, RAM (1.00) GB, and hard disk (222) GB.
   The recorded material is encoded into a computerized software input (PRAAT) (version 4.0). This software allows recording speech materials at a speech rate (16000 HZ) to create wide-band spectrograms accompanied by waveform graphs required for acoustic measurements. The acoustic data are subjected to t-test analysis where two levels of significance are deployed, p-value equals or less than 0.01(for considerable significance), and p-value equals or less than 0.05 (when the difference is only significant). Mean values and standard deviations for the responses of the vowels groups are also calculated.
   The main findings of this work are the following:
   1- Statistical results clearly reveal that there is irregular connection between short/long vowel
   production and perception.

2-   Learners' performance reflects a higher level of vowel production as compared to their perceptive ability.

3-   Generally, there is a negative correlation between vowel production and vowel perception. The

p-value scored is 0.2 which is more than 0.05 level of significance deployed in the statistical test.

4-   Statistically, gender variable proves insignificant in the production of short and long vowels.

However; it scores a significant value in the perception of short vowels only.

الترابط بين نطق صوائت اللغة الإنجليزية وتمييزها كما يؤديها متعلمو اللغة الإنجليزية من العراقيين الكبار: دراسة فيزيائية

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المستخلص :

يعرض هذا البحث نتائج الدراسة الفيزيائية للترابط بين نطق الصوائت الإنجليزية وتمييزها كما يؤديها متعلمو اللغة الإنجليزية من العراقيين الكبار. تتألف العينة التي استعملها الباحثان من 24 طالبا (12 ذكرا ، 12 أنثى) من طلبة المرحلة الأولى في قسم اللغة الإنجليزية - كلية الآداب – جامعة البصرة للعام الدراسي (2011- 2012) . يتحدث أفراد العينة اللهجة العراقية البصرية ويسكنون جميعا في مركز مدينة البصرة وضواحيها. تم اختيارهم بشكل عشوائي بعد التأكد من سلامتهم من أية عيوب نطقية أو سمعية . خضعت هذه العينة الى اختبار نطقي للصوائت الإنجليزية تضمن قائمة من 20 كلمة وخمس كلمات وهمية استعملها الباحثان لتقليل التوتر والتردد اللذين قد يحدثان اثناء التجربتين.

تم تصميم اختبار اخر لاختبار قدرة العينة على تمييز الصوائت الإنجليزية وجرى تسجيل الكلمات ذاتها التي وردت في الاختبار الأول. كيكا بايت.) بسرعة تبلغ (1.7) كيكا هيرتز وذاكرة تبلغ (NB505 1.00 تم تسجيل المثيرات السمعية على جهاز حاسوب نوع توشيبا.

من بين اهم النتائج التي توصل اليها البحث الآتي :

1- اثبتت النتائج الإحصائية بشكل واضح ان هناك ترابطا غير منتظم بين نطق الصوائت الإنجليزية وتمييزها.

2- اوضح اداء العينة مستوى عاليا في نطق الصوائت الإنجليزية مقارنة بتمييزها .

3- بشكل عام ، هناك ترابط سلبي بين نطق هذه الصوائت وتمييزها حيث سجلت القيمة الافتراضية 0.2 % التي هي اعلى من مستوى الأهمية المستخدم البالغ (0.05).

4- اوضح متغير التنوع الجنسي للعينة اختلافا ليس ذات اهمية احصائية في نطق الصوائت القصيرة والطويلة. في حين سجل هذا المتغير اهمية إحصائية في تمييز الصوائت القصيرة فقط.

1. Introduction

It is assumed that most if not all individuals who learn a second language will speak it with a detectable foreign accent (Flege, Muro and Mckay, 1995).This accent is partly cued by the incorrect production of vowels and consonants, and by the hypothesis that a critical age of learning exists (Scovel, 1969; Patkowski, 1989). A number of scholars (e.g. Flege,1981,1995; and Joup, 1995) admit that although L2 production accuracy is limited by perceptual factors, the capacity to learn new forms of speech intacts over the life span. Brain imaging works have provided evidence supporting the hypothesis of an intimate relationship between speech perception and speech production. Researchers have shown that motor areas are active during speech perception (cf. Rizzolatti, 1998), and auditory areas are active during speech production (cf. Hickok, 2000). In a similar vein, a number of experimenters have examined speakers who show variation in measures of perception and production and found a relation between them (e.g. Fox, 1982; Bradlow et.al, 1997; and Vic et.al, 2001). Specifically, those researchers have verified the hypothesis which states that speakers who have a relatively higher vowel discrimination score higher rates in vowel production than those who do not. Other scholars (e.g. Flege, 1995), attribute this type of correlation to the interaction between L1 and L2 sound systems, not from a neurologically triggered loss in the ability to learn speech. Flege (ibid.) clarifies that the nature of L1-L2 interaction varies according to the state of development of the L1 phonetic system when L2 learning begins.

Recent work on vowel production and perception proposes that the social background of the speaker (age, sex, etc.) affects how sounds are perceived and produced. Drager (2008), for example, believes that the incorporation of these social variables into the linguistic repertoire yields a better level of performance. It is the main objective of the current study to acoustically prove the correlation between vowel perception and vowel production as elicited in the performance of adult Iraqi learners (AILs) of English when they deal with B.B.C. English pure vowels. The subjects selected for this study are 24 (12 males and 12 females) undergraduate departmental students who pursue their BA programme in English. It is aimed that the findings of this study will contribute to adding some knowledge about the difficulty encountered by (AILs) in their attempt to master the English sound system in general, and the English vowels in particular.

2. Literature Review

To tackle the intimacy of vowel perception and vowel production as exhibited by non-native speakers of English, different studies have been conducted in this phonetic area. The subjects chosen for this end are native

speakers of different languages. These works will be reviewed chronologically, where the focus will be made on the methodology adopted and the major findings obtained.

Flege et.al. (1997) acoustically study the efficacy of English language experience on non- native speakers perception and production of English vowels. The subjects were (20) German, Spanish, Mandarin, and Korean as well as a control group of (10) native speakers of American English. The non-native speakers were intensively exposed to English language when they arrived to the USA. The accuracy of the subjects to produce the front vowels /ɪ , æ/ was assessed by native – English speaking listeners via acoustic measurements. The same subjects also identified the vowels in the synthetic " beat-bit", "bat-bet". They concluded that the experienced non-native subjects produced and perceived English vowels more accurately in comparison with the relatively experienced non-native speakers. Both production and perception accuracy varied due to the efficacy of native language background in a way that appeared to depend on the perceived relation between English vowels and vowels in the L1 inventory.

Flege et.al (1999) examined the interrelation between perception and production of English vowels by highly experienced native Italian speakers of English living in Canada. The study addresses three research questions: (i) whether the subjects' accuracy in perception and production minimizes as they learn English lately, (ii) if the subjects who began to learn English as young children (early bilinguals) would perform more like the subjects of native English comparison groups, and (iii) if the amount of L1 use affects the perception and production of English vowels. The accuracy of vowel production was assessed via an intelligibility test in which native- English speaking listeners identify vowels spoken by native Italian subjects. Vowel perception was assessed through a categorical discrimination test. The prominent findings of this work are: (i) the later the native Italian speakers arrive in Canada, the less accurately produce English vowels, (ii) the early bilinguals would perceive and produce English vowels in a native- like fashion, (iii) the age at which Italian/English bilinguals were first exposed to English influences the accuracy with which they produce and perceive English vowels. and (iv) there was no evidence that early Italian/ English bilinguals differed from monolingual native speakers in producing and perceiving English vowels.

Perkell et.al. (2003) carried out an acoustic study to show the relations between measures of vowel production and perception among speakers. The measures were collected from (19) young speakers of American English. In the production experiment, the subjects repeated the words "cod, cud, who'd, and hood" in a carrier phrase ranging at normal and fast rates. The researchers

recorded the articulatory movements and the associated acoustic signals, yielding measures of contrast distance between /ɔ/ and /ʌ/, and between /ʊ/ and /u:/. In the perception experiment, sets of seven stimuli ranging from " cod to cud" and " who'd to heed" were synthesized, based on the production of one male and one female speakers. The results revealed were: (i) measures of vowel contrast correlate with measures of vowel discrimination. This finding is compatible with a model in which articulatory movements for vowels are planned primarily in auditory space, and (ii) the findings verified the study hypothesis which states that the more accurately a speaker discriminates a vowel contrast, the more distinctly the speaker produces the contrast.

The perception and production of vowels in Australian English were investigated by Mannell (2008). He explores the progressive off glide reduction of /ɪ∂/ and /e∂/ and the on glide reduction of the long vowel / i:/. The method used was synthetic speech tokens where the patterns of vowel perception of female and male speakers of Australian English (1990-2007) were examined. The correlation between production and perception in (2007) was also studied. The prominent results of the study are: (i) there is a significant evidence of the monophthongization of /e∂/ which precedes that of /ɪ∂/, (ii) females show a stronger pattern, than males, of off glide production for / ɪ∂/ and /e∂/ (in hv context) and on glide production for /i:/ in (hvd context), (iii) females, but not males, show a significant negative correlation between/e∂/ perception and production patterns, (iv) females also show significantly stronger degrees of /ɪ∂/ monophthong perception in (hvd contexts) than males, and (v) there is an evidence for a significant change in this pattern between (1990- 2007).

Recently (2008), Drager investigated the interrelationship between vowel perception and production in terms of sociophonetic parameters and exemplar model. He has indexed social information to acoustic information where the weight of connection relevant to these parameters varies depending on the perceived salience of sociophonetic trends. The experiment designed in this work was intended to test the degree to which the age attributed to a speaker influences the perception of vowels undergoing a chain shift. He concludes that social characteristics of both speaker and perceiver influence vowel perception. The speaker's age of perception affects vowel categorization in the expected direction. The study also provides evidence of an interaction between the sex of the interlocutor and the sex of the stimulus.

Ho (2009) conducted an experimental work to identify the role of L1 and L2 proficiency levels on Taiwanese EFL learners' acquisition of American English front vowels. Three experiments were carried out: a perception task, a production task, and a first language assimilation task. In the perception task,

the participants identified the English front vowels /iː/, /ɪ/, /e/, and /æ/ produced by a native speaker in (bvt and bvd)contexts. The results showed that high proficiency EFL learners (HEFL) significantly outperformed the low proficiency EFL learners (LEFL) in all front vowels perception accuracy although neither group perceived any of the vowels in a near-native fashion. The HEFL group demonstrated a perceptual confusion in adjacent vowels, while LEFL group displayed an overlapping mental representation of all front vowels. Participants' productions of English front vowels in (bVt3 and bVd) contexts were acoustically measured and perceptually evaluated by native listeners. The HEFL group only articulated the vowel /e/ near-natively in all production measurements; F1,F2, vowel duration, and native listener intelligibility. The LEFL group produced the vowel /ɪ/ better than the other vowels, but none approached a near-native level. They also made no distinction between /ɪ/ and /iː/, and / ɪ/ and /æ/, and they produced /e/ with a very short glide. The researcher recommends for integrating systematic and explicit segmental pronunciation teaching and training into the EFL classroom to facilitate acquisition. It was also suggested that proficiency segmental difficulties should be identified before designing teaching and training techniques for a target group.

In (2009), Markovic studied the perception and production of the English front vowels /e/ and/æ/ by native speakers of Serbian. The research consisted of perception and production experiments. The subjects were first year students at Novi Sad University. The results of the perception tests indicate a poor discrimination level between the two L2 vowels. The production tests reveal that the /e/ and /æ/ occupy the same area in the vowel space in the interlanguage of the subjects. The author concludes that the subjects poorly discriminate between the two L2 vowels because of the transfer of L1 phonological categories.

Peperkamp (2011) studied the link between the perception and production of the front English vowels /iː/ and /ɪ/ contrast. The subjects were (17) French-English bilinguals who read aloud a set of English sentences and performed an ABX discrimination task that assesses their perception of this contrast. The pronunciation task was fulfilled by filling in a questionnaire. Via this questionnaire, the subjects can evaluate their English pronunciation (mean value 6.5).The results of the two tasks were analyzed in the light of the theories relevant to the link between perception and production in L2 phonological processing. It has been found that global native likeness in production correlated with pronunciation accuracy for the vowel contrast /iː/ and /ɪ/, and both production measures correlated with self- estimated pronunciation skill.

However, performance on the perception task did not correlate with either global native likeness or pronunciation accuracy of this vowel contrast.

Very recently (2012), Chladkova and Escudero acoustically investigate the efficacy of dialectal variation on the perception and production of vowels in Spanish and Portuguese. Spanish, Peruvian, Portuguese, and Brazilian listeners were tested in a vowel identification task with stimuli sampled from the whole vowel chart. The mean values of the perceived (F1) and second formant (F2) of every vowel category were compared across selected varieties of Spanish and Portuguese. The results have shown that there is a link between a dialectal-based perception of vowels and production for F1 but not F2. This suggests that there is a correspondence between the produced F1and the perceived vowel height but not between F2 and frontness.

3.Models of Perception and Production Correlation

The interaction between speech perception and production has been investigated by implementing different methods using different types of population. The main dispute revolved around that point whether there is a casual relationship between performance in one modality and that in the other. According to the Speech Learning Model (SLM), the accuracy with which non-native sounds are produced is determined by how accurately they are perceived. Hence, any enhancement in the production performance should be preceded by one in perception. However, experimental works with non-native speakers have given evidence for or against this hypothesis. The major problem in this model is that it is difficult to compare performance in a perception experiment with that in a production experiment, due to the differences in the experimental methods used for the two modalities.

The alternative model focuses on the question whether perception and production are correlated. Several studies have found a moderate correlation between the perception and production of L2 segmental contrasts (Peperkamp et.al., 2011). A number of Scholars (e.g. Johnson, 1997; Pierrehumbert ,2001) view this interaction from a sociophonetic point of view. They think that since social information patterns with linguistic variation in a predictable way, socially – conditioned variation can be accounted for in linguistic models. This model is known as Exemplar theory (ET) which states that utterances are stored in the mind as complete (acoustically-rich exemplars) which are incorporated to other types of information (such as information about the speaker) stored at the time of the utterance. Proponents of this model propose that the amount of attention paid to a particular component of the incoming signal (e.g. the formant values of a vowel) affects perception (cf. Nosofsky, 1986: 49). Hence, memory is stronger if more attention is paid when the signal is stored, and therefore, not all stored exemplars of a vowel (even within the same word) affect speech

perception in identically the same way (Johnson, 2006:493). During speech production, exemplars are activated based on their context-dependent similarity to the incoming utterance (Nosofsky, op.cit.). Followers of this model admit that during the production phase, speakers activate multiple exemplars that are incorporated to relevant social information. All of the activated exemplars contribute to the variant that is ultimately produced. Thus, ET predicts that social information which is indexed to acoustically rich exemplar (a vowel for example) influences speech perception during a lexical categorization task (Drager,2008).

   In the current study, the second model (the Correlation Model) is adopted since it is in agreement with the major objective behind this work. Following this model, some evidence may be found to either falsify or verify the existence of this type of link.

   4.Research Questions

   The current study explores the following research questions:

   1- Is there a positive correlation between vowel perception and vowel production?

   2- Is the correlation relative (moderate) since it is associated with the familiarity of vowels?

   3-Will learners who have a relatively higher vowel production score higher rating in vowel perception?

   4-Does the gender variable have its impact on the level of correlation?

   5.The Experimental Work

   Every speech sound has its own phonetic and phonological characteristics which distinguish it from the other sounds within the same phonological system. Supposedly, during their everyday vocal communication, humans produce and perceive speech sounds to some extent, in a similar way. On the contrary, what practically happens is that speech sounds are both produced and perceived differently. That is, each individual phonetically articulates and phonologically perceives consonant and vowel sounds in a distinctive manner (Morton, 1984). In the present study, the light is densely shed on how (AILs) of English pronounce and realise English pure vowels. For this purpose, a digital recordingmethodology is followed to carry out the experimental part of this study.

   5.1. Selection and Categorization of Data

   The empirical part comprises two experiments: the first is a production-based experiment; while the second one is a perception-based experiment. To investigate the learners' ability of producing English pure vowels, a list comprising (20)mono- -syllabic and disyllabic words was prepared. Each word displays a morphological structure revealing either short or long vowel

contrasts. It is worth noting that the English diphthongs have been also included in the list to give the participants the opportunity of producing and perceiving a versatile mixture of English vowels and to avoid focusing on a certain vowels type*. Most of the stimulus words have the syllabic structure CVC, except for the schwa which usually occurs in disyllabic words (CVCV), as in /betə/. Additionally, the different consonantal types occurring in word-initial and word-final positions have been carefully selected in order to avoid the difficulty of identifying the onset which precedes a given vowel sound when acoustic measurements were made. The stimulus words are displayed in appendix A. For the second experiment (perception test), the same reading stimuli of the B.B.C. English pure vowels and diphthongs are read to the subjects via a computer with sufficient clarity and loudness.

5.2. The Subjects

The recordings were performed by 24 (12 males and 12 females) native speakers of Iraqi Arabic spoken in Basra city (Basri Iraqi Arabic), the centre and several close districts to the centre. That is, they all speak Basri typical dialect. The subjects' ages range between 19 to 21 years. All the participants had no articulatory or hearing defects. They were born in the city of Basra where they are still living. In as far as their educational levels are concerned, they are all first-year students of English.

5.3. The Recording Technique

As it is mentioned above, the experimental work falls into two experiments. For the production-based experiment, the subjects were asked to pronounce a list of five isolated dummy words as well as 20monosyllabic and disyllabic words which are randomly arranged. That is, the list was randomized in accordance with the phonological structure of the stimulus words. Randomization helps keep tone variability during the recording sessions, i.e. it is intended to avoid uttering words monotonously (Ghalib, 1984 :153). As a result, each speaker accomplished a thirty-minute recording session. First, the participants were instructed to read the words on the list silently, then, to pronounce them in isolation (not embedded in a carrier sentence). In order to examine the participants' perceptibility of English pure vowels, the researchers re-read the same word list and asks each student to tick the number of the correct vowel he/she perceives. For the sake of accuracy, the participants were asked to repeat any word that might be pronounced not clearly (See appendix A and B for illustration).

The corpus of the data described above was recorded by using an external, highly sensitive (head-mounted) microphone attached to headphones (type: Sony MDR-667 MV) which were useful in listening, and consequently

identifying the onsets and offsets of certain speech sounds with a range of sensitivity at (110 db) and frequency at (20-20000 Hz). Besides, it was provided with volume meter to control sound loudness. Both the microphone and the headphones were directly connected to a computer which was a Toshiba NB505 with a CPU speed (1.7) GHz, RAM (1.00) GB, and hard disk (222) GB. The recordings were carried out in a quiet room. Every participant was seated before the computer. The headphone was placed on his/her head and the microphone was positioned in front of his/her mouth at a distance of 4 cm. Each recording session lasted for roughly (30) minutes with several interval breaks. After recordings had been made, they were immediately stored on the hard disk as a wave file type.

5.4. The Computer Software Package

The recorded data were converted into a computerized input by employing a computer software called PRAAT (version 4.0) (Leishout, 2002). It allows recording speech materials at a speech rate (16000) Hz in order to create wide-band spectrograms accompanied by waveform graphs required for extracting the acoustic measurements of the segmental duration.

5.5. Statistical Analysis

Throughout the present study, the researchers applied the statistical analysis that certain statistical parameters (e.g. percentile, arithmetic mean and standard deviation) were calculated in addition to the manipulation of the t-test analysis which supported results analysis in terms of the correct vowel productions and perceptions which are the core of the present research. The following null hypotheses have been assumed:

H01.All short English monophthongs are produced and perceived correctly.

 H02. All long English monophthongs are produced and perceived correctly.

H03. The gender variable does not affect vowel production and perception.

H04. Vowel production and vowel perception do not reciprocally affect each other.

To carry out this statistical analysis, two levels of significance have been determined: The first level where there is a considerably significant difference between the groups means, the p-value equals or less than 0.01 ($p \leq 0.01$); the second level where the difference is merely significant, the p-value equals or less than 0.05 ($p \leq 0.05$). Consequently, the differences are considered as non-significant where the p-value is more than 0.05 ($p > 0.05$).

5.6. The Results and Analysis

After sorting out the data collected, the outcomes were reported and the statistically analysed test results were tabulated to clarify the significance of the findings. The tables were designed in such a way that the average values and standard deviations in addition to t-values, which help obtain the p-values for

the purpose of determining the degree of significance of the differences between the groups means, were displayed. The findings are presented in detail as follows:

5.6.1. The Production and Perception of the Short and Long Vowels

Twenty four male and female (AILs) produced a list of 25 words containing the English pure vowels. This experiment displays the learners' short vowel production as compared to their short vowel perception. Generally, the results show that all the participants correctly produced 63% of the short vowels, while they properly perceived 46% of them. The probability value is 0.2, which is more than 0.05, indicates that the difference between short vowels production and perception is insignificant. However, this finding does not apply to all target vowel productions and perceptions equally. For example, The front vowels /ɪ/ and /æ/are correctly produced by 91% and 70% of the participants, but they are properly perceived by58% and 25% of them, respectively. On the contrary, the back vowel /ɒ/ is right produced by25% of the participants, but it is correctly perceived by 16% of them (See table 1 for more clarification).

Table1: Production VS. Perception of English Short Vowels

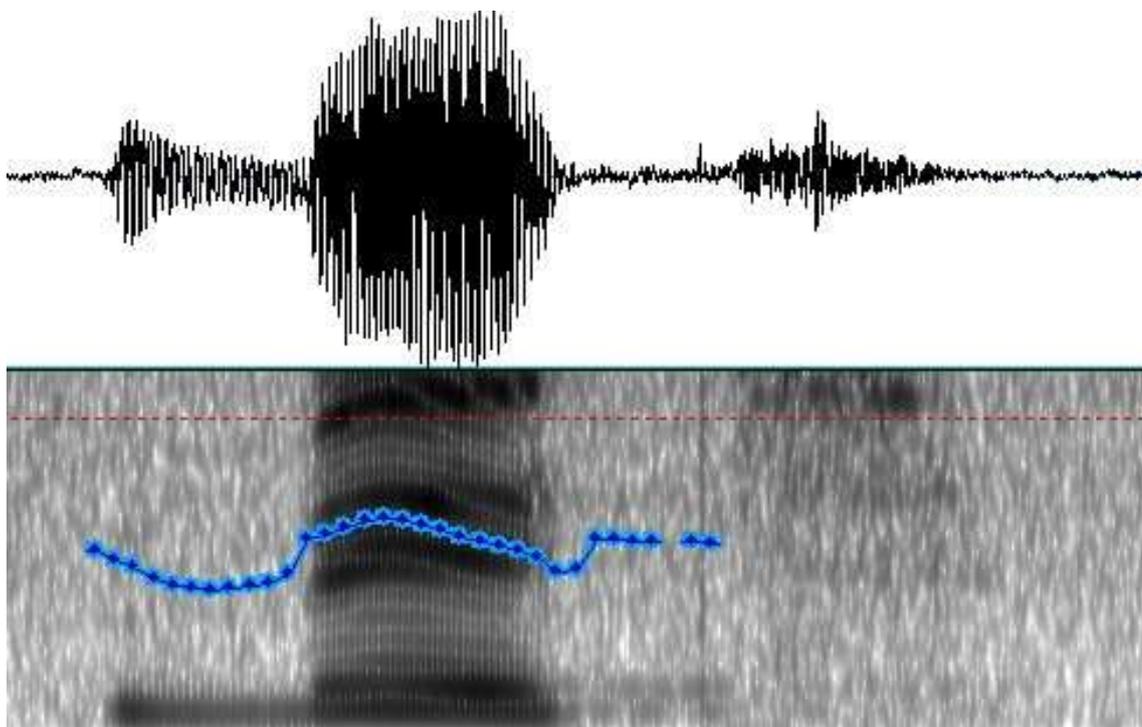| No.	Short Vowels	Vowel Productions	Percentage	Vowel Perceptions	Percentage
1	/ɪ/	22	91%	14	58%
2	/e/	8	33%	8	33%
3	/æ/	17	70%	6	25%
4	/ʌ/	12	50%	11	45%
5	/ə/	24	100%	18	75%
6	/ɒ/	6	25%	12	16%
7	/ʊ/	18	75%	17	70%
Percentage		63%		46%	
T-Value		1.16			
Probability		0.2			
Mean		15		12	
S.D.		6.85		4.28	

Figure (1): A waveform and a spectrogram of the short front vowel /ɪ / in the token " bit" as produced by a female talker

Regarding the long vowels, the production and perception experiments generally display a considerably significant difference between long vowels production and perception (p. value is 0.01which equals the first level of significance, i.e. 0.01). The results show that 71% of the participants correctly produced long vowels , while 42% of them properly perceived the target vowels. However, the front vowel /i:/ shows the opposite. That is, it is correctly produced by only 45% of the participants, while it is properly perceived by66% of the participants. Moreover, the central long vowel /ɜ:/ reveals a different tendency. That is, it scored relatively similar percentage of proper production 29% and perception 25%, respectively (Seetable 2 for more illustration).

Table 2: Production VS Perception of Long Vowels

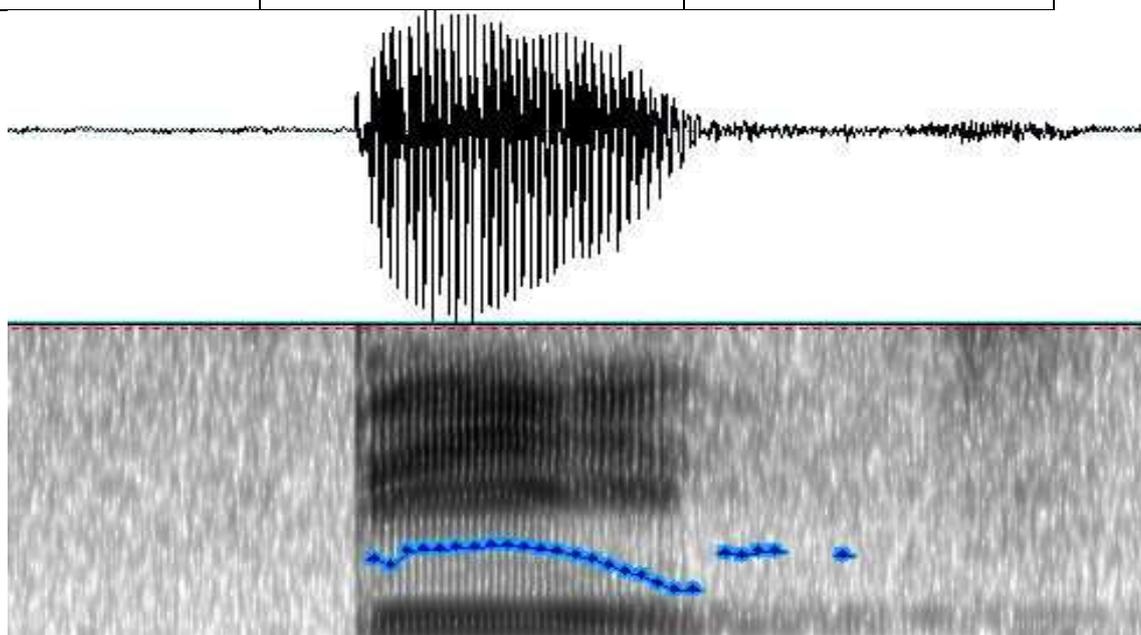| No.	Long Vowels	Vowel Productions	Percentage	Vowel Perceptions	Percentage
1	/i:/	11	45%	16	66%
2	/ɑ:/	23	95%	9	37%
3	/ɜ:/	7	29%	6	25%
4	/ɔ:/	22	91%	7	29%
5	/u:/	23	95%	13	54%
Percentage		71%		42%	
T-Value		1.78			
Probability		0.01			
Mean		17		10	
S.D.		7.63		4.51	

Figure (2): A waveform and a spectrogram of the long front vowel /i:/ in the token "beat" as produced by a male talker
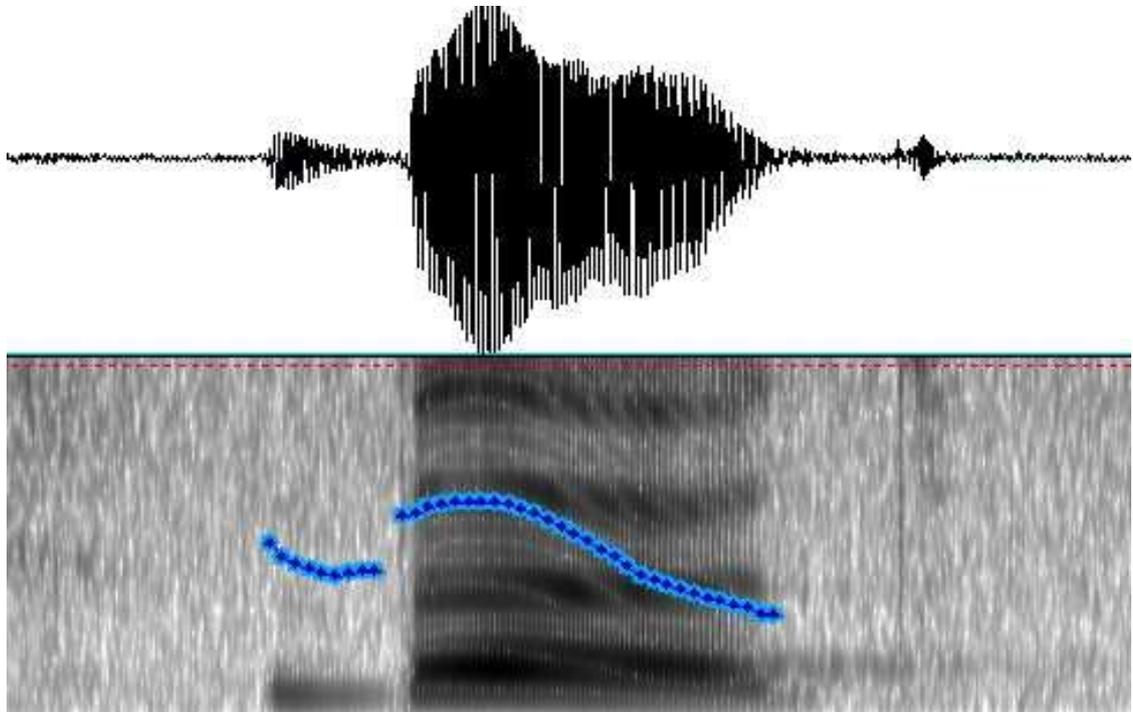
Figure (3): A waveform and a spectrogram of the long central vowel /ɜ:/ in the token "bird" as produced by a female talker

5.6.2. The Effect of the Gender Variable on Short and long Vowels Production and Perception

The variable of participants' gender is tested. The results show that the difference between female and male's scores is statistically insignificant (p. value is 0.5). This contradicts the findings of other researchers (cf. Mannell, 2008) who verified the hypothesis of the impact of the gender variable on this type of correlation. Regarding short vowels production, 66 % of the female participants score correct production as compared to the correct pronunciation of the male participants(60%).Yet, the productions of some short vowels indicated a different trend. For instance, 25% females correctly pronounced /e/, while 41% males produced the same vowel correctly. This obviously indicates a high-level male production of /e/. Differently, 91% and 83% females correctly pronounced /æ/ and/ʊ/,respectively, whereas 50% and 66% males uttered the target vowels rightly. The finding displays ahigh-level female production of /æ/ and /ʊ/ (See table 3) (for more details, see Appendix C).

Table 3: The Effect of Gender on Short Vowel Production

No.	Short Vowels	Female Production	Percentage	Male Production	Percentage
1	/ɪ/	11	91%	11	91%
2	/e/	3	25%	5	41%
3	/æ/	11	91%	6	50%
4	/ʌ/	6	50%	6	50%
5	/ə/	12	100%	12	100%
6	/ɒ/	3	25%	3	25%
7	/ʊ/	10	83%	8	66%
Percentage		66%		60%	
T-Value		0.40			
P.		0.5			
Mean		8		7	
S.D.		3.92		3.54	

The results of long vowels production also show statistically insignificant distinction between female and male's performance (p.value is 0.1). However, /i:/ and /ɜ:/ show a considerably significant difference. That is, 83% and 50% of the females correctly pronounced these vowels, respectively, while8% of the males rightly produced each of the target vowels. Generally speaking, gender has an insignificant influence on vowel production (See table 4 below).
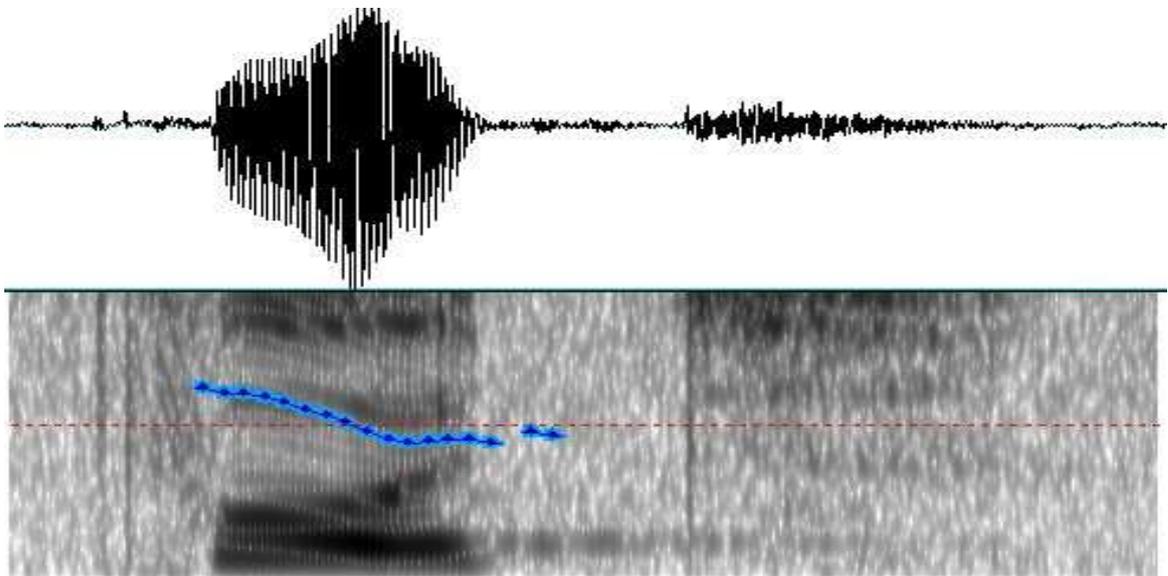
Figure (4): A waveform and a spectrogram of the short back vowel /ʊ/ in the token "put" as produced by a female talker
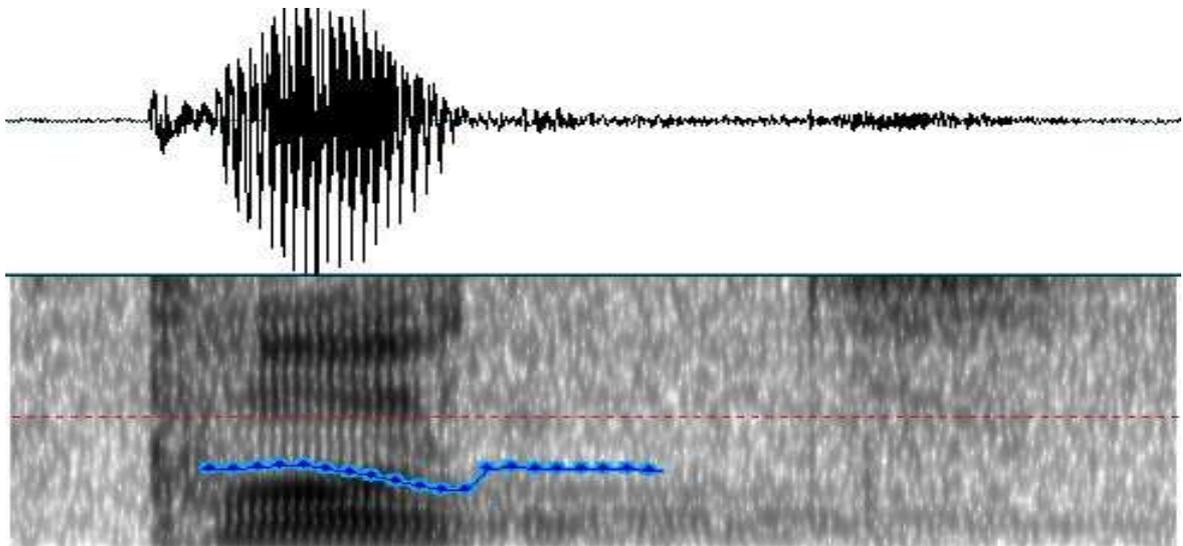

Figure (5): A waveform and a spectrogram of the short back vowel /ʊ/ in the token "put" as produced by a male talker

Table 4: The Effect of Gender on Long Vowels Production

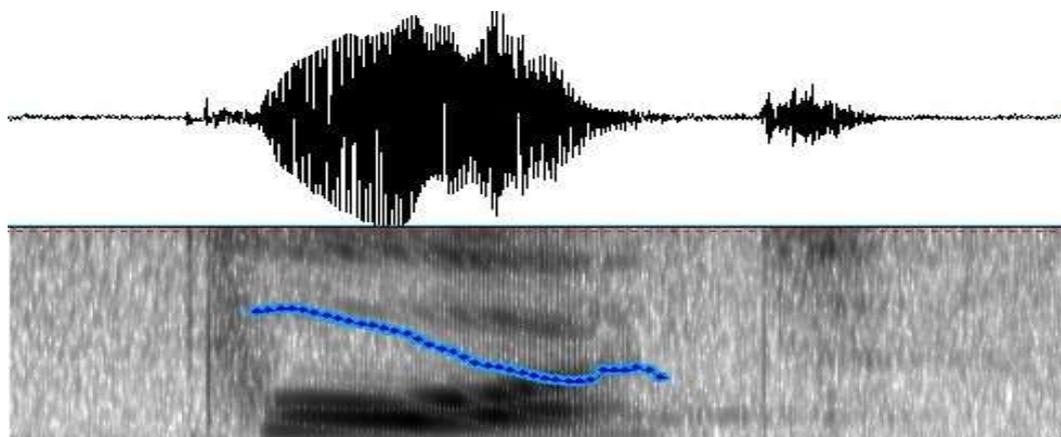| No.	Long Vowels	Female Production	Percentage	Male Production	Percentage
1	/i:/	10	83%	1	8%
2	/ɑ:/	12	100%	11	91%
3	/ɜ:/	6	50%	1	8%
4	/ɔ:/	11	91%	11	91%
5	/u:/	12	100%	11	91%
Percentage		85%		58%	
T-Value		1.32			
P.		0.1			
Mean		10		7	
S.D.		2.490		5.77	

Figure (6): A waveform and a spectrogram of the long back vowel /ɔ :/in the token " port" as produced by a female talker
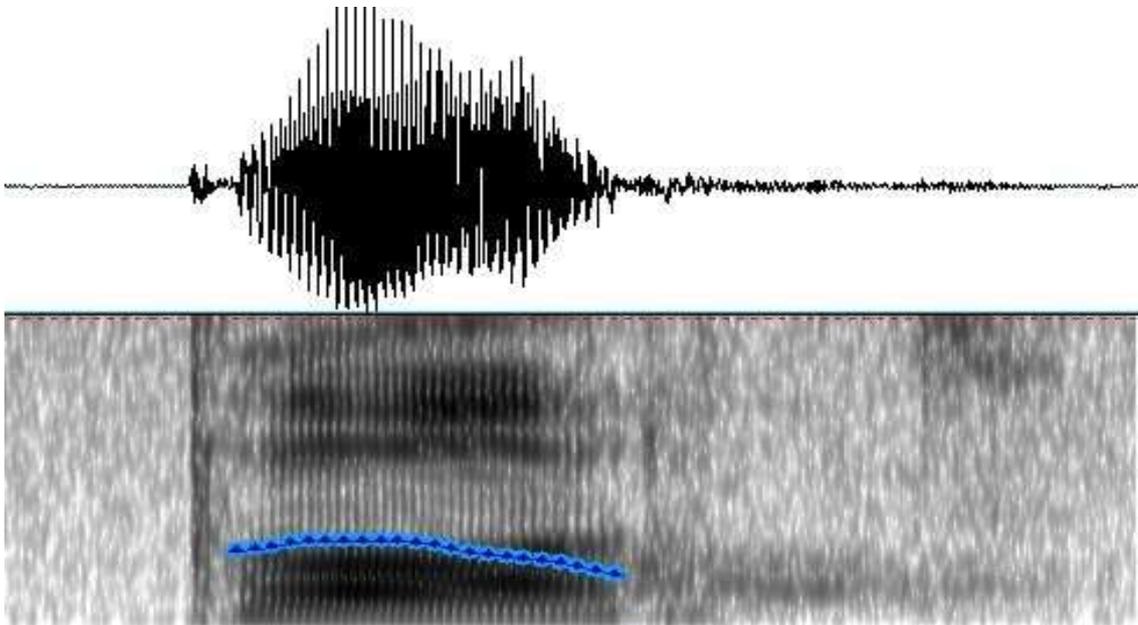
Figure (7): A waveform and a spectrogram of the long back vowel /ɔ:/ in the token "port" as produced by a male talker

In as far as the short vowels perception is concerned, the results statistically reflects a significant distinction between female and male's vowel perception (p.value is 0.03). It is found that 63% females properly perceived the short vowels pronounced in a native-like manner, while only 39% males have been able to take in the target vowels. This is considerably obvious in the perception of /ʌ/ and /ɒ/ which have been properly taken in by 66% and 83% females, whereas the same vowels have been recognized by 25% and 16% males, respectively (See table 5).

Table 5: The Effect of Gender on Short Vowels Perception

No.	Short Vowels	Female Perception	Percentage	Male Perception	Percentage
1	/ɪ/	8	66%	6	50%
2	/e/	5	41%	3	25%
3	/æ/	3	25%	3	25%
4	/ʌ/	8	66%	3	25%
5	/ə/	10	83%	8	66%
6	/ɒ/	10	83%	2	16%
7	/ʊ/	9	75%	8	66%
Percentage		63%		39%	
T-Value		2.45			
P.		0.03			
Mean		7		4	
S.D.		2.64		2.32	

On the other hand, long vowel perception variance was not important. he statistical analysis of the results shows that the probability value of the perception experiment scores is higher than 0.05 (0.1), which is considered to be insignificant difference indication. Accordingly, only 51% female easily recognized the target vowels, and 33% males perceived the same ones. However, 66%, 58% and 33%

females have indicated a perception levels of /uː, ɑː, ɜ ː/ higher than those of males scores, 41%, 16% and 16%, respectively (See table 6).

Table 6: The effect of Gender on Long Vowel Perception

No.	Long Vowels	Female Perception	Percentage	Male Perception	Percentage
1	/iː/	8	66%	8	66%
2	/ɑː/	7	58%	2	16%
3	/ɜː/	4	33%	2	16%
4	/ɔː/	4	33%	3	25%
5	/uː/	8	66%	5	41%
Percentage		51%		33%	
T-Value		1.49			
P.		0.1			
Mean		6		4	
S.D.		2.05		2.87	

5.6.3.The Correlation of Short and Long Vowels Production and Perception

Following the production and perception scores, most of the participants have displayed irregular connection between short/long vowels production versus perception. Accordingly, 63% of the participants correctly produced short vowels, and 46% of them have been able to recognize the same vowels. For long vowels, 71% of the participants rightly pronounced long vowels, and 42% of the participants could perceive the target vowels. Although the probability value indicated an insignificant distinction between short/long vowels production and perception, most of the learners have shown vowels production levels higher than those of vowels perception. This definitely explains how extraordinarily vowel production and perception are correlated. All in all, learners' performance reflected stronger vowel production ability than perception. This could be partly attributed to the overlap between L1 and L2 phonological systems, and partly to the impact of perceptibility of the native pronunciation of the target vowels (For a comprehensive view, see tables 1 and 2). The results obtained disfavour the findings of other researchers who confirm the positive link between vowel production and vowel perception (cf. Vic et.al, 2001; Perkell et.al, 2003). However, the results are in conformity with the findings of other scholars (e.g. Flege et.al, 1997; Markovic, 2009; Chladkova and Escudero, 2012).

6. Conclusions

Based on the statistical results, the following are the prominent findings of the present

research:

1- Statistical outcomes clearly reveal that there is an irregular connection between short/long vowel production and perception. Specifically, 63% of the subjects correctly produced short vowels while 46% of them were able to recognize the same vowels. With reference to long vowels, 71% of the participants rightly pronounced these vowels while 42% of them could perceive the target long vowels.

2- Learners' performance reflects a higher level of vowel production as compared to their perceptive ability. This points in the direction that (AILs) (especially the tested group) show a low level of vowel perception performance. In turn, it is an evidence that these learners face a crucial problem in vowel discrimination.

3- Generally, there is a negative correlation between short vowel production and perception. The p-value scored is 0.2 which is more than 0.05 level of significance deployed in the statistical test.

4- Short vowels production scores higher rating (level of significance) (63%) as compared to perception (46%). This is attributed to the learners' background regarding certain vowels, and to the vowel optimality in terms of similarity and difference with the source language vowel inventory.

5- The front short vowel /e/is the only one that registers relative (moderate) positive correlation, 33% for both production and perception tests. Such a finding is interpreted in terms of the familiarity with this vowel by the subjects.

6- As it is the case with English short monophthongs, long monophthongs reveal a negative correlation between their production and perception. The percentage of production is higher than the percentage of perception (71% vs. 42%). However, the subjects score higher production level with long vowels in comparison with the short ones (71% vs. 63%), while perception ratings read the opposite (42% vs. 46%). This gives a clear evidence that the production of English long vowels is less problematic as compared to the production of the short ones. The incidental finding shows that despite the higher level registered in the production of long vowels, the perception level is much less. The justification for this incidental outcome is that Iraqi learners do face a big vowel discrimination difficulty.

7- The only long vowel that reveals an opposite result is the front close vowel /i:/ where the rating of perception is higher than that of production (66% - 45%).

8-   The only long vowel that shows a relative correlation is the central vowel /ɜ:/ (29% for production vs. 25% for perception). This is beyond the expectation since the production and perception of this monophthong is problematic for Iraqi learners because it is a non-existent vowel in Iraqi Arabic.

9-   Statistically, the gender variable proves insignificant in the production of short and long vowels (66% for female production vs. 60% for male production) (T- Value is 0.40 as compared to p.value o.5), (85% for female production vs. 58% for male production) (T-value 1.32 against p.value 0.1), respectively.

10- The gender parameter only scores a significant value in the production of the long front vowel /i:/ and the long central vowel /ɜ:/(83% for female vs. 8% for male, and50% for female vs. 8% for male, respectively). This reflects a big gap between the two groups in the production of these vowels.

11- In short vowels perception, there is a significant statistical value for gender variation (T-value 2.45 vs. p.value 0.03) (63% for females vs. 39% for males). The finding provides an evidence for the accurate perception by females as compared to that of males, with reference to these vowels. This is interpreted in terms of the seriousness, high level of attention, and the good perception background of the female subjects.

12- The highest rating elicited in the perception of both sexes are those of the short vowels /ʌ/ and /ɒ/(66% for females against 25% for males, 83% for females against 16% for males, in the order mentioned.)

13- The perception of long vowels registers a non-significant value in terms of gender variance (T-value 1.49 vs. p. value 0.1) (51% for females vs. 33% for males).

14- The highest perception gender variance emerges in the performance of the long vowels /u:, ɑ:, /ɜ:/ which score (66% for females vs. 41% for males, 58% for females vs. 16% for males, 33% for females vs. 16% for males, respectively).

7- Recommendations

In the light of the feedback obtained, the following might be useful recommendations:

1-   Attention is to be given to the production and perception of B.B.C. English vowels where extensive drilling is urgently needed.

2-   Iraqi learners have to be exposed regularly to B.B.C. English where ear training and speaking activities are activated.

3-   Learners are to be given a sufficient opportunity for having audio materials via smart class, phonetic lab, and involvement in listening and speaking activities.

4- Gender variation is a matter of concern in teaching and drilling especially with the problematic vowels.

5- Teaching materials, supporting materials, textbooks, and teaching strategies relevant to the pronunciation activities are to be periodically revised and updated.

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* The statistical data relevant to the production and perception of English diphthongs are excluded from the final calculations and results due to the limitation of the present work to the pure vowels only.

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Appendix A
List of Stimuli for the Production-Based Experiment

No.	The Vowels	The Stimuli	The Stimuli Phonemic Transcription
1	/ɪ/	bit	/bɪt/
2	/e/	bet	/bet/
3	/æ/	bat	/bæt/
4	/ʌ/	but	/bʌt/
5	/ɒ/	pot	/pɒt/
6	/ʊ/	put	/pʊt/
7	/ə/	better	/betə/
8	/iː/	beat	/biːt/
9	/ɜː/	bird	/bɜːd/
10	/ɑː/	part	/pɑːt/
11	/ɔː/	port	/pɔːt/
12	/uː/	soon	/suːn/
13	/eɪ/	face	/feɪs/
14	/aɪ/	tide	/taɪd/
15	/ɔɪ/	voice	/vɔɪs/
16	/əʊ/	goat	/gəʊt/
17	/aʊ/	house	/haʊs/
18	/ɪə/	beard	/bɪəd/
19	/eə/	paired	/peəd/
20	/ʊə/	moored	/mʊəd/

(Adapted from Roach, 2009)

Appendix (B):The list of Vowels for the Perception-Based Experiment

No.	Symbol		No.	Symbol	
1	/ɪ/		11	/ə/	
2	/iː/		12	/ɜː/	
3	/e/		13	/eɪ/	
4	/æ/		14	/aɪ/	
5	/ɑː/		15	/ɔɪ/	
6	/ɒ/		16	/əʊ/	
7	/ɔː/		17	/aʊ/	
8	/ʊ/		18	/ɪə/	
9	/uː/		19	/eə/	
10	/ʌ/		20	/ʊə/	

Appendix C
Table 1: Female Production VS Perception of Short Vowels

No.	Short Vowels	Vowel Production	Percentage	Vowel Perception	Percentage
1	/ɪ/	11	91%	8	66%
2	/e/	3	25%	5	41%
3	/æ/	11	91%	3	25%
4	/ʌ/	6	50%	8	66%
5	/ə/	12	100%	10	83%
6	/ɒ/	3	25%	10	83%
7	/ʊ/	10	83%	9	75%
Percentage		66%		63%	
T-Value		0.34			
P.		0.6			
Mean		8		7	
S.D.		3.92		2.80	

Table 2: Female Production VS Perception of Long Vowels

No.	Long Vowels	Vowel Production	Percentage	Vowel Perception	Percentage
1	/iː/	10	83%	8	66%
2	/ɑː/	12	100%	7	58%
3	/ɜː/	6	50%	4	33%
4	/ɔː/	11	91%	4	33%
5	/uː/	12	100%	8	66%
Percentage		85%		51%	
T-Value		2.86			
P.		0.02			
Mean		10	6		
S.D.		2.49	2.06		

Table 3: Male Production VS Perception of Short Vowels

No.	Short Vowels	Vowel Production	Percentage	Vowel Perception	Percentage
1	/ɪ/	11	91%	6	50%
2	/e/	5	41%	3	25%
3	/æ/	6	50%	3	25%
4	/ʌ/	6	50%	3	25%
5	/ə/	12	100%	8	66%
6	/ɒ/	3	25%	2	16%
7	/ʊ/	8	66%	8	66%
Percentage		60%		39%	
T-Value		1.95			
P.		0.1			
Mean		7		4	
S.D.		3.25		2.32	

Table 4: Male Production VS Perception of Long Vowels

No.	Long Vowels	Vowel Production	Percentage	Vowel Perception	Percentage
1	**/iː/**	1	8%	8	66%
2	**/ɑː/**	11	91%	2	16%
3	**/ɜː/**	1	8%	2	16%
4	**/ɔː/**	11	91%	3	25%
5	**/uː/**	11	91%	5	41%
Percentage		58%		33%	
T-Value		1.06			
P.		0.3			
Mean		7		4	
S.D.		5.48		2.87	