A Comprehensive Study of the Variability and Determinants of the Interchangeability of the English Plosives /p/ and /b/ among Iraqi University Undergraduates

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دراسة شاملة لتباين ومحددات قابلية استبدال الأصوات الانفجارية الإنكليزية /p/ و /b/ بين طلاب الجامعات العراقية

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Abstract

This study examines the massive phonological challenge that is faced in the form of the Iraqi undergraduate college students in differentiating and proper production of the English plosive consonants /p/ and /b/. The glance at it shows too much inconsistency in the exchangeability of those sounds, which is mostly explained by the influence of the first language (L1) especially, the lack of the phoneme /p/ in the Arabic phonological system. It has been argued that this means that learners often replace /b/ with /p/ and exhibit ad hoc aspiration of /p/ in the same manner it is produced. In addition, there is a constant problem with the voicing test /p/ (unvoiced) /b/ (voiced). The results emphasize the importance of specific phonetic training and consciousness-raising exercises within the English language coaching programs in the Iraqi better education to enhance the accuracy of pronunciation and the normal communicative competency of the rookies.

Keywords: ***English Plosives, L1 Interference, Phonetic Environment, Interchangeability, Phonological Acquisition*****..**

المستخلص

تتناول هذه الدراسة التحدي الصوتي الكبير الذي يواجهه طلاب الجامعات العراقية في التمييز بين صوتي /p/ و /b/ونطقهما بشكل صحيح. ويُظهر التحليل تباينًا ملحوظًا في إمكانية استبدال هذين الصوتين، وهو ما يُعزى في الغالب إلى تأثير اللغة الأم، ولا سيما غياب صوت /p/ في النظام الصوتي العربي. وقد طُرحت فرضية مفادها أن هذا يعني أن المتعلمين غالبًا ما يستبدلون صوت /b/ بصوت/p/ ، ويُظهرون نطقًا غير متقن لصوت /p/ بنفس طريقة نطقه. إضافةً إلى ذلك، ثمة مشكلة مستمرة في اختبار النطق الصوتي، حيث يُنطق /p/ مهموسًا بينما يُنطق /b/ مجهورًا. وتؤكد النتائج على أهمية التدريب الصوتي المتخصص وتمارين التوعية ضمن برامج تعليم اللغة الإنكليزية في التعليم العراقي، وذلك لتعزيز دقة النطق والكفاءة التواصلية لدى الطلاب الجدد.

الكلمات المفتاحية: الأصوات الانفجارية الإنكليزية، تداخل اللغة الأم، البيئة الصوتية، التبادلية، اكتساب الأصوات.

1. Introduction

Pronunciation acquisition is one of the keys to successful oral communication in the second language (L2). To a student who learns the English language as a foreign language (EFL), the phonological system, which does not usually coincide with the one of the native tongue (L1), becomes a major problem (Celce-Murcia et al., 2010). The right production and perception of the consonant sound especially those of minimal pair difference such as the English /p/and /b/ are the important obstacles to the process of intelligibility (Jenkins, 2000). The difference between /p/ (voiceless bilabial plosive) and /b/ (voiced bilabial plosive) remains phonemic to English, that is, the sound change between one and the other may change the meaning of a word (e.g. pat - bat).

These two sounds also prove to be challenging to Iraqi students acquiring the English language as their second language, whose L1 is usually Arabic. The Arabic phonological inventory has the bilabial phonique voiced /b/ but it has no voiceless phoneme /p/ (Al-Ani, 1970; Watson, 2002). As such, to a large degree, the learners of the EFL Iraqi variety replace /b/ with /p/ or even do not create the habitual aspiration in the English one, especially in the first place syllabic (Yavas, 2011). Such an interchangeability of phonemic transference is capable of creating misconstructions and causing communicative problems.

Although the overall challenge with the /p/-/b/ difference is accepted (e.g., Kharma and Hajjaj, 1989; Al-Saidat, 2009), the factual variability and causation of the variability in Iraqi university undergraduates has to be approached more specifically. The status of undergraduates in universities represents a substantial group of high-order EFL students that

need a high standard of English proficiency in their academic and future careers. It is important to understand the details of their pronunciation errors and the variability of the errors, as well as the factors which cause them in order to invent effective pedagogical interventions. This paper, thus, gathers an in-depth examination into the inconstancy as well as the reason of the interchangeability of the plosives /p/ and /b/ of the English language as articulated by the Iraqi university undergraduates. It aims at determining patterns of error, trying to check the effect of L1 interference and other factors that may have contributed to the error like phonetic environment and degree of exposure to English. Such findings are likely to provide useful information to EFL educators, curriculum developers, and phonology and language second language acquisition researchers.

2. Problem of the Study

The fundamental issue that was examined in the study is the fact that Iraqi undergraduates of the university continuously and inconsistently have trouble in showing the correct ability to differentiate and generate the English plosive consonants /p/ and /b/. Such a challenge is frequently presented in the interchangeability of these two phonemes and ended in the pronunciation errors that may cause a serious hamper to the intelligibility and communicative ability in English. Even after several years of learning the English language, a number of Iraqi learners have not mastered this basic phonological opposition, which indicates that recent methods of teaching English language are not sufficiently addressing this particular issue.

This problem is complicated by a number of factors:

1. **L1 Interference:** The most prominent factor is the structural difference between the phonological systems of Arabic (L1) and English (L2). Standard Arabic does not have the phoneme /p/ (Thelwall and Saad Adddin, 1990, p.42). Although some dialects of Arabic may marginally use /p/ in foreign words it is not an indigenous, distinctive sound. As a result, the Iraqi students will be inclined to change the English /p/ with the nearest phoneme that they have in their native language inventory and this is /b/ (O'Connor, 1980, p. 65). Such a replacement is a typical example of a negative transfer or interference.

2. **Voicing and Aspiration:** The /p/-/b/ problem of the English language is not only a matter of voicing (/p/ voiceless, /b/ voiced), but also aspirate. Generally, in most situations, especially in syllable-initial stressed, English /p/ is aspirated ([ph]) and /b/ is unaspirated or weakly voiced (Ladefoged & Johnson, 2015, p. 55). Arab students are usually unable to articulate this sound on /p/ resulting in articulation of /b/ by an English speaker and sometimes de-aspirate /b/ which makes it even more confusing (Avery and Ehrlich, 1992, p. 78). The phonetic intimacies turn out to be especially problematic to L2 learners whose L1 is not thus distinguished (Voice Onset Time (VOT)) (Flege, 1995).

3. **Change in the Error Patterns:** The interchangeability is not necessarily uniform. There are a number of phonetic settings of a learner where he or she may be correct and in some words (perhaps common ones) but fail in another. This inconsistency complicates prediction and solution of the errors in a systematic manner. Factors, which affect this variability might be the location of the phoneme within a word (initial, medial, final), the phonetic environment, and the stress patterns, as well as, the focus of the attention of the learner on form (Ellis, 2008, p. 112).

4. Effects on Intelligibility and Communication: /p/ and /b/ errors may cause lexical ambiguity (e.g. pack vs. back, pig vs. big, rope vs. robe, etc.). Although context may usually stop ambiguity, frequent mistakes might make the English used by the speaker accented and in some instances hard to understand, thus resulting in communication failure (Munro and Derwing, 1995). This may impact academic performance of the students especially in oral presentation and interactions and also in their confidence in using English.

5. Insufficient Phonetic Awareness and Focused training: lots of EFL programs in Iraq might not offer enough express training and training in English phonetics and phonology, especially in regards to such issues as /p/-/b/ (Al-Jubouri, 1999, p. 67). Students can be unaware of the articulation of the difference between these sounds and the importance of such features as aspiration.

Therefore, this study aims to systematically investigate the nature and extent of the /p/-/b/ interchangeability among Iraqi university undergraduates. It will explore the specific patterns of errors, the phonetic contexts in which they are most likely to occur, and the underlying causes, with a primary focus on L1 interference but also considering other potential contributing factors. The ultimate goal is to provide empirical evidence that can inform the development of more effective teaching strategies to help Iraqi learners overcome this persistent phonological hurdle.

3. Literature Review

The process of acquisition of phonological second language (L2) has been known to have issues with learners in relation to meeting the sounds and sound contrasts that lack in the first language (L1). Cases of the interchangeability between English

plosives /p/ and /b/ among the Arab learners, including undergraduate learners in Iraq, is one of the known examples of those difficulties, which can be explained primarily by the interference of the L1 but also by a complicated interaction of phonetic, phonological, and pedagogical influences.

3.1. Phonetics of English /p/ and /b/ Phonology:

English /p b/ are bilabial plosives, and this sound is formed by full stop of lips and accumulation of air pressure behind the lips and thereafter releasing (Roach, 2009, p. 30). The main phonological difference between them is voicing: /p/ is voiceless, that is, the vocal folds do not vibrate when saying it, whereas /b/ is voiced, that is, the vibration of the vocal folds occurs (Ladefoged & Johnson, 2015, p. 54).

The aspiration of voiceless plosives (/p/ /t/ /k/) is a phonetic aspect, especially important to English, whereby the voiceless plosives, when beginning a stressed syllable, are not preceded by an /s/ (e.g., in top [t^hap], kin [k^hin]) (Giegerich, 1992, p. 158). This is a puff of air that accompanies release of the plosive which has a great effect in increasing the Voice Onset Time (VOT) of /p/ over that of /b/. In the case of /b/ voicing frequently precedes or comes within a very brief time after the release. Inability to aspirate /p/ may cause it to sound like /b/ in native English speakers and it is very evident when /b/ is pre-voiced or early voiced it not only becomes not similar to /p/ but it becomes quite different (Abramson and Lisker, 1970). In word-final positions, the contrast is often maintained by the preceding vowel length (vowels are typically longer before voiced consonants) and the nature of the release, or lack thereof, for /p/ (Cruttenden, 2014, p. 165).

3.2. Contrastive Analysis: English and Arabic Phonological Systems

Contrastive Analysis Hypothesis (CAH), in its strong form, posited that differences between L1 and L2 would directly predict learning difficulties (Lado, 1957). While the predictive power of CAH has been debated, L1 influence remains a central concept in L2 phonology acquisition (Major, 2001).

The phonological system of Standard Arabic, the L1 of most Iraqi undergraduates, features the voiced bilabial plosive /b/ but lacks the voiceless bilabial plosive /p/ (Watson, 2002, p. 15; Al-Ani, 1970, p. 28). Some colloquial Arabic dialects, including some Iraqi varieties, may incorporate /p/ in loanwords from languages like Persian, Turkish, or English (e.g., 'banka' for fan, 'Pepsī'), but it is not a native, systemic phoneme and its usage can be inconsistent (Holes, 2004, p. 59). This absence of /p/ as a distinct phoneme in the L1 inventory is the primary source of difficulty for Arab learners. They tend to substitute the closest L1 sound, /b/, for the English /p/ (Kharma & Hajjaj, 1989, p. 55). For instance, 'park' might be pronounced as 'bark'.

Furthermore, Arabic does not employ aspiration as a phonemically distinctive feature for plosives in the same way English does (Thelwall & Sa'adeddin, 1990, p. 47). Even if learners manage to produce a voiceless bilabial plosive, they often fail to add the necessary aspiration, leading to a sound that is acoustically closer to an English /b/ than an aspirated [p^h].

3.3. L1 Interference in L2 Phonological Acquisition

Flege's Speech Learning Model (SLM) offers a more nuanced explanation than early CAH, suggesting that L2 learners may have difficulty perceiving and producing L2 sounds that are phonetically similar-but not identical-to L1 sounds (Flege, 1995). New L2 sounds (those very different from any L1 sound) might be easier to acquire than L2 sounds that are perceived as phonetic realizations of an existing L1 category. English /p/ could be miscategorized by Arab learners as an allophone of their L1 /b/ or simply assimilated to /b/ due to the absence of a /p/ category.

The idea of critical/sensitive period of phonological acquisition also implies that it is increasingly difficult to master native-like pronunciation with the age, which may be in part because of the establishment of L1 phonetic categories (Scovel, 1988; Long, 1990). Undergraduates in universities are less prone to this sensitivity at this stage and therefore undergo long-term L1 interference.

The confusion of /p/-/b/ among the Arab learners is always prominent in studies of them. Indicatively, Al-Saidat (2009) examined pronunciation issues of Jordanian EFL students and established that the replacement of /b/ by /p/ was one of the common mistakes. In line with this, Tushyeh (1996) found that Palestinian university students had high trouble with English /p/ usually pronouncing it as /b/. Such errors are attributed in these studies as primarily caused by interference of L1. The former state was also observed by (Al-Nasser (1993, p78) in the common replacement of /b/ by /p/ among the Kuwaiti speakers of English, particularly in the first and native positions.

3.4. Variability in Pronunciation Errors

Mistakes in pronunciation are not necessarily unconditional. Tarone (1980) has noted that L2 learner language is flexible and such flexibility can be systematic brought about by linguistic situation, focus on speech, and social context. In the contrast /p/-/b/ case, the variability may involve the occurrence of occasions when a learner does produce the right sound, the /p/ sound with aspiration (or by chance without aspirating sound [p]).

Phonetic environment is a very important factor. They could be more common in some positions of a word (initial, medial, final) or they may occur when /p/ or /b/ follow some particular vowel or consonant (Carlisle, 2001). Indeed, the aspiratory production of /p/ in an initial position could be more difficult than the voiceless / p/ in a final cluster, e.g., pen, help. The stress effect too can be relevant with aspiration being most conspicuous in the stressed syllables (Kenworthy, 1987, p. 60).

It is the focus of the research by Leather and James (1991) that perceptual training and practice in production are relevant because the learners might fail to appreciate the difference between the L2 sounds they are not producing. Provided that Iraqi learners are unable to hear the variation between an aspirated [p^h] and unaspirated [p] or [b] reliably, they will most probably continue to make efforts inconsistently.

3.5. Pedagogical Implications and Previous Research in the Iraqi Context

The /p/-/b/ interchangeability is an indication that requires intensive pedagogical intervention. Old practices based on imitation and repetitions might be ineffective unless it is clearly taught by means of articulatory settings, voicing and aspiration (Gilbert, 2008). Minimal pair exercises, visual stimuli (e.g., aspiration with a feather or a paper), and articulatory descriptions are usually suggested (Avery and Ehrlich, 1992, p. 101).

In Iraqi context, unlike in some other countries in the Arab world, there has been relatively limited research on phonological difficulties of Iraqi undergraduates despite the general methods of English language teaching, in regards to plosives such as /p / and /b/. According to Al-Jubouri (1999), pronunciation is one of the skills that are neglected in most EFL classrooms in Iraq. Bakir (2010) mentioned the phonological peculiarities of the Iraqi Arabic and their consequences on the English-learning, referring to the absence of /p/. Although addressing the problems of Arab students, more recently that is (Al-Khawaldeh et al., 2017), the nature of these plosive-related problems has been reiterated as having an ongoing nature among Arab students, indicating the prevalence and persistence of the problem. A research on the pronunciation mistakes of Iraq EFL learners by Al-Dulaimi and Al-Azzawi (2019) affirmed that consonants errors such as those in /p/ and /b/ were common.

The complexity of the /p/-/b/ interchangeability issue is highlighted in this literature review. It is not simply a sound substitution but rather is a more complicated matter of phonetics such as aspiration, voicing, and is significantly affected by L1

phonology. The observed variability in production of learners leads to the interaction of language background, perception skills and, maybe the type of education encountered. The current paper will further elaborate on this already acquired information and give a modern examination of these problems on a more specialized level in the group of Iraqi undergraduate students at the university to add to the understanding and more efficient approaches to teaching and learning.

4. Methodology

The present section covers the research methodology which was used in exploring the variability and the reasons why English plosives /p/ and /b/ can be interchangeably produced by Iraqi university undergraduates. The most suitable method that was assumed by the study was a mixed-method approach, combining quantitative analysis of error rates with the qualitative analysis of the types of errors and their possible causes.

4.1. Research Design

This study employed the descriptive analytical research design. The specified design will suit well because it is expected to explain the nature of the phenomenon (i.e., the interchangeability of /p/ and /b/), determine the variability of the pronunciation, and examine the possible causes, with the major emphasis on L1 interference and phonological context (Creswell and Creswell, 2018). The quantitative component was on gathering and interpreting some numerical data with reference to the number of errors and the type of error that occurred. This qualitative component was the phonetic study of the mistakes to evaluating their character and correlating them to the known phonological theories.

4.2. Participants

The sample to be used in this research included 60 undergraduate students at Iraqi universities. They were sampled in two large state universities in Baghdad, Iraq: Mustansiriyah University and Baghdad University. The following were the selection criteria:

- **Level of Study:** Third-year and fourth-year undergraduate students. This level was selected because it is anticipated that the students will have had a significant amount of teaching in the English language and that they are looking toward higher levels of proficiency in the future concerning their future career.
- **Field of Study:** The participants were taken in English Departments. This is the reason why respondents had high academic interest in English and reasoned to be more motivated to pronounce the words correctly than students in other fields.
- **Background L1:** All the participants spoke Iraqi Arabic.
- **Incidence of English exposure:** The participants had studied English outside school environment and formally at least 8-10 years (including school and university studies).
- **Consent:** Informed consent was obtained from all participants prior to their involvement in the study. They were assured of anonymity and confidentiality.

The participants were selected using a purposive sampling technique which picked those who fit the criteria (Patton, 2015, p. 264). There were 35 female and 25 male students used as the sample, aged between 20-23 years. A brief background questionnaire was administered to gather demographic information and self-reported English learning history.

4.3. Instrumentation

The primary instruments for data collection were specifically designed speech production tasks:

1. Word List Reading Task: A list of 40 English words containing the target plosives /p/ and /b/ in various phonetic environments was developed.

- **Initial Position:** 10 words with /p/ (e.g., *pen, park, play, power, pure*) and 10 words with /b/ (e.g., *ben, bark, blay, bower, bure*). Minimal pairs were included (e.g., *pat/bat, pig/big, pie/buy*).
- **Medial Position:** 5 words with /p/ (e.g., *apple, happy, paper, open, rapid*) and 5 words with /b/ (e.g., *able, hobby, rubber, obey, rabbit*).
- **Final Position:** 5 words with /p/ (e.g., *cap, hope, map, sleep, stop*) and 5 words with /b/ (e.g., *cab, robe, mob, sleep (verb, past tense implied by context if needed), sob*). The words were selected to be common and familiar to university-level EFL learners to minimize errors due to unfamiliarity with vocabulary. The list included words where /p/ is expected to be aspirated (e.g., initial stressed syllables) and where it is not (e.g., after /s/, though this was not a primary focus but considered in word choice).

2. Sentence Reading Task: A set of 10 sentences was constructed, each containing multiple instances of /p/ and /b/ in various positions and phonetic contexts. This task aimed to elicit more natural speech flow compared to isolated word reading. Examples:

– "Peter bought a big blue pen from the popular bookshop."
– "Perhaps the problem is about the black plastic bag."

3. Picture Naming Task: A set of 10 pictures depicting common objects or actions whose names contained /p/ or /b/

(e.g., picture of an 'apple', 'ball', 'pear', 'bed') was used. This activity was focused on a prompting of spontaneous utterances of single words without any orthography.

4. **Recording Equipment:** A good quality digital voice recorder (Sony ICD-PX470) fitted with external microphone (Rode smartLav+) was used so that it clearly recorded the audio to be further subjected to phonetic analysis. Recording was carried out in a noisy room in order to reduce background noise.

4.4. Data Collection Procedures

The collection of the data was performed during four weeks in May 2024. The participants were approached one on one in their respective universities in a silent room. The procedure was as follows:

1. **Briefing and Consent:** Participants were first briefed about the purpose of the study and the tasks involved. They were assured that the focus was on pronunciation patterns and not on evaluating their overall English proficiency. Written informed consent was obtained.
2. **Background Questionnaire:** Participants completed a short questionnaire regarding their age, gender, years of English study, and any experience living in an English-speaking country (none reported such experience).
3. **Speech Production Tasks:**

– Participants were first asked to read the word list. They were instructed to read each word clearly at a natural pace.

– Next, they read the set of 10 sentences.

– Finally, they were shown the pictures one by one and asked to name the object or action depicted.

4. **Recording:** All spoken responses were digitally recorded. Each participant's session lasted approximately 15-20 minutes.

5. **Anonymization:** Recordings were coded with participant numbers to ensure anonymity.

A total of 60 audio recordings were collected. The total number of potential /p/ tokens per participant was 20 (10 initial, 5 medial, 5 final from word list) plus instances from sentences and picture naming similarly for /b/. This offered a considerable amount of data to be analyzed.

4.5. Data Analysis Procedures

Audio data obtained was both quantitatively and qualitatively analyzed:

- **Phonetic Transcription:** The primary researcher and a trained phonetician carefully listened to the recordings of the target words and sentences (inter-rater reliability on part of the data, about 20%). All the cases of /p/ and /b/ in the target items were phonetically transcribed with narrow transcription with International Phonetic Alphabet (IPA) symbols. Particular focus was made on:
- **Proper Production of /p/** (voiceless, aspirated where necessary).
- **Proper Production of /b/** (unaspirated, voiced).
- **Substitution Strong Errors** (e.g. [b] instead of /p/).
- **Phonetic Deviations** (ex: unaspirated [p] /p/ devoiced [b]/ /b/).
- **Omissions or some other Modifications.**

1. **Quantitative Analysis:**

- **Calculation of Frequency of Error:** The frequency of correct and wrong productions of /p/ and /b/ were calculated on individual and on all the participants. Types of errors were differentiated by type (e.g., /p/ - [b], /p/ - [p]) (unaspirated), /b/ - [p], /b/ - [b̥]).
- **Positional Analysis:** /p/ and /b/ were analysed as to whether the phonetic context affected the error rate in the initial, medial, and final position of words.
- **Statistical Software:** Percentages, frequencies, mean, means were calculated with the help of SPSS (Statistical Package of Social Science) Version 28. This has assisted in determining general trends and patterns of the data.

2. Qualitative Analysis:

- **Error Pattern Classification:** The data that was transcribed underwent analysis in order to determine recurrent patterns of errors on top of frequencies. As an example, the infallibility of aspiration before /p/ in stressed early syllables, or situations that result in devoicing of /b/.
- **Influx of L1:** The error patterns that were observed were explained in the light of contrastive analysis between phonology of English and Arabic more so lack of /p/ and phonemic aspiration in Arabic.
- **Variability Analysis:** The selection was on the variability of the errors on the individual-speaker variability (intra-speaker variation) and inter-speaker variability (inter-speaker variation). Possible causes of this variability (e.g. familiarity with particular words, effect of orthography in reading tasks) were put in to the consideration.

These analytical processes were combined to come up with an overall picture of the production of the sound /p/ and /b/ by Iraqi

undergraduate students, the degree of their interchangeability, and the main factors that contribute to the existence of these phonological difficulties.

5. Data Analysis and Results

This section will include the results of the analysis of the data obtained with 60 Iraqi undergraduates in the University. The analysis is based on producing English plosives /p/ and /b/ in different phonetic conditions that provide information on the frequency of errors and the type of errors that occur and analyze the variability demonstrated.

5.1. Accuracy in Production of /p/ and /b/.

The number of tokens of /p/ (2400) and /b/ (2400) that were analyzed comprised of 40 target /p/ events in each of the tasks and 40 target /b/ events in each of the tasks. Statistical data on the general accuracy rates gives a broad idea of the capability of the participants to generate these plosives.

1. **Production of /p/:** The /p/ tokens (n=2400) were produced correctly (i.e., as voiceless and, where needed, aspirated in place of unaspirated, e.g. after /s/ or at the end of a word where it was necessary to be clear) 1356 times. This is a general accuracy rate of 56.5. The rest of the tokens (43.5 percent) were incorrectly made.
2. **Production of /b/:** There were 2400 target /b/ tokens, 1980 of which were produced correctly (i.e. as a voiced [b]). This is a general accuracy rate of 82.5%. The rest of the 420 tokens (17.5%) were misprinted.

These scores show that the English /p/ was produced much more difficult by the participants compared to the production of /b/.

This goes well in line with the L1 interference hypothesis since /b/ is a native phoneme in Arabic, whereas /p/ is none (Al-Ani, 1970, p. 28).

5.2. Types and Frequencies of Errors for /p/

The 1044 incorrect productions of /p/ were categorized as follows:

Error Type for Target /p/	Frequency	Percentage of /p/ Errors	Percentage of Total /p/ Tokens
Substitution with [b]	731	70.0%	30.5%
Unaspirated [p] (where [p^h] expected)	251	24.0%	10.5%
Other (e.g., omission, distortion)	62	6.0%	2.5%
Total Errors for /p/	**1044**	**100.0%**	**43.5%**

Table 1: Types and Frequencies of Errors for Target /p/

The most common error in producing /p/ was its substitution with [b] (e.g., **'pen'** pronounced as **[bɛn]**), accounting for 70.0% of all /p/ errors and affecting 30.5% of all attempted /p/ productions. This strongly supports the L1 interference theory (Kharma & Hajjaj, 1989, p. 55). The second most frequent error was the production of an unaspirated voiceless bilabial plosive [p] in contexts where aspiration **[p^h]** is expected in English (e.g., '**park**' pronounced as **[pɑ:k]** instead of **[p^hɑ:k]**). This accounted for 24.0% of /p/ errors. While phonemically still /p/, the lack of aspiration can make it sound like /b/ to native English speakers (Ladefoged & Johnson, 2015, p. 56).

5.3. Types and Frequencies of Errors for /b/

The 420 incorrect productions of /b/ were categorized as follows:

Error Type for Target /b/	Frequency	Percentage of /b/ Errors	Percentage of Total /b/ Tokens
Substitution with [p] (unaspirated)	180	42.9%	7.5%
Devoiced [b̥]	155	36.9%	6.5%
Substitution with aspirated [pʰ]	48	11.4%	2.0%
Other (e.g., omission, distortion)	37	8.8%	1.5%
Total Errors for /b/	**420**	**100.0%**	**17.5%**

Table 2: Types and Frequencies of Errors for Target /b/

For the target /b/, the most common error was its substitution with an unaspirated [p] (e.g., **'big'** pronounced as **[prɣ]**), accounting for 42.9% of /b/ errors. It was also important that 36.9% of errors were done by devoicing /b/ to [b̥] (e.g., cab is **[kΘb̥]**) and [k] to [t]. This indicates that students occasionally have difficulties in voicing /b/ and perhaps as a result of over-generalizing voicelessness, through efforts to produce /p/ or through word-final devoicing system of certain languages (although not the typical /b/). The replacement of /b/ with aspirated [pʰ] was not so widespread but in some cases, it represented hypercorrection.

5.4. Influence of Phonetic Position on Error Rates

The error rates of /p/ and /b/ have been considered regarding the place in the word (initial, medial, final).

5.4.1. Errors in /p/ Production by Position

Position	Total /p/ Tokens	Incorrect /p/ Productions	Error Rate for /p/
Initial	1200	626	52.2%
Medial	600	240	40.0%
Final	600	178	29.7%

Table 3: Error Rates for /p/ by Word Position

The greatest error rate of /p/ was 52.2% which was in the initial position in the word. This is more important because in stressed syllables pronunciation should be aspirated in English, something which is not available in Arabic (Thelwall and Sa'adeddin, 1990, p. 47). The major mistake in this stance was the substitution with [b] (around 65% of preliminary /p/ mistakes) and unaspirated [p] (around 30% of preliminary /p/ mistakes). Medial (40.0%), and final (29.7) positions showed less error rates, albeit they were also large. Finally, unaspirated [p] was sometimes granted as right unless it was definitely voiced.

5.4.2. Errors in /b/ Production by Position

Position	Total /b/ Tokens	Incorrect /b/ Productions	Error Rate for /b/
Initial	1200	156	13.0%
Medial	600	102	17.0%
Final	600	162	27.0%

Table 4: Error Rates for /b/ by Word Position

The error rate was seen to be the greatest (27.0) at the end of the words. This was mostly by means of devoicing ([b̥]) or replacement with some unaspirated [p]. It implies it is inclined to final consonant devoicing that may be an influence of the L1 or is a general learner strategy of L2s (Weinberger, 1987). This study had the lowest error rate with initial position of/b/ (13.0%),

which meant that the learners were mostly successful in voiced /b/ production at the word beginning.

5.5. Variability in Error Patterns

There were high levels of inter-speaker and intra-speaker variability.

- **Inter-speaker Variability:** It was difficult to say that there were uniform patterns between speakers, but the variation in the accuracy among individual speakers was extensive. A smaller number of students (around 15% showed relatively high accuracy (more than 80% correct in /p/) and a low number (around 20%), showed much difficulty with the error rates on /p/ reaching 70 or higher. This implies varying phonetic awareness, exposure or learning ability.
- **Intra-speaker Variability:** A large number of participants were not consistent with what they produced /p/. An example is that the student may form a correct pronunciation of pen with an aspirated [p^h], and they may get the following word, park, as a [bark] ([ba:k]) or without the aspirate [pa:k]. This inconsistency was noted in tasks of various types (word list vs. sentences vs. picture naming). There were cases of orthographic help in reading activity in terms of voiceless plosive, but there was still want in aspiration. There were slight cases of /p/ -> [b] substitutions more common among other learners in the picture naming task, where orthographic support was not provided.

5.6. Qualitative Observations on Causes

1. **L1 Dominance (Arabic Interference):** Preponderation of /b/ by /p/ and omission of aspiration by /p/ are real testaments to the L1 Arabic dominance since Arabic does not possess /p/ and phonemic aspiration (Watson, 2002). Participants tended to

create an acoustically similar sound which, though possibly meant to be /p/ was more akin to /b/ as there was little to no voiceless interval between release.

2. **Perceptual Problems:** Few respondents gave statements indicating that they were not conscious of the aspiration nature of /p/ or that they could not consistently detect the difference between an aspirated [p^h] and an unaspirated [p] or [b]. This is in agreement with other studies that show that, perceptual training is essential (Leather and James, 1991).

3. **The absence of Explicit Phonetic Teaching:** A common finding was that most participants had not been taught the English language requirements as per the explicit pronunciation exercise, particularly in reference to finer phonetic cues, such as aspirations or VOT.

4. **Overgeneralization/Hypercorrection:** The fact that some students (2% of all /b/ tokens) replace /b/ with an aspirated sound [p^h] (e.g., boy [p^hoi]) implies hypercorrection, in which the students, having learned of the requirement of aspiration with /p/ to use it, overselect it to /b/ as well.

The findings indicate clearly that the English /p/-/b/ contrast is highly problematic to the Iraqi undergraduate students of the university especially when it comes to the production of /p/ accurately with its typical aspiration. The mistakes are systematic, which is mostly due to L1 interferences, but varied in determining phonetic context and the idiosyncrasy of learners. The results point to a serious necessity of specific phonological teaching.

6. Discussion

The results of the work conducted allow making considerable conclusions about the particular challenges that the Iraqi university undergraduates have to face when it comes to the English plosives /p/ and /b/. The significant gaps in error rate of /p/ (43.5) and /b/ (17.5) greatly supports the theory of L1 interference which is an acceptable one (Lado, 1957; Flege, 1995). Since the L1 of the participants, Arabic, has /b/ and does not have /p/ (Al-Ani, 1970), the learners are subject to the natural tendency of replacing the familiar /b/ into the unfamiliar one /p/. It was the most common type of error with 70 percent of all the /p/ errors. This is in tandem with what many studies have reported on Arab EFL students (e.g. Kharma and Hajjaj, 1989; Al-Saidat, 2009; Al-Nasser, 1993).

The problem is, though, more complicated than the mere phoneme replacement. The results showed that in the conditions where the participants had to advance a voiceless bilabial plosive /p/ it was frequently not aspirated ([p]) in situations that demanded aspiration ([p^h]) such as the stressed or syllable-initiating position. This underaspiration, which is 24 percent of the /p/ mistakes, is the most important as even an unaspirated [p] can be confused with /b/ as perceived by an average native American speaker (Ladefoged and Johnson, 2015, p. 56). No phonemic aspiration in Russian and Asian Arabic (Thelwall and Saaddeddin, 1990, p. 47), therefore, none of the learners is sensitive to the creation or intuition of this phoneme. This observation highlights that the acquisition of /p/ requires not only acquisition of a new category of phoneme but it also requires acquisition of phonetic implementation of that category in the

English language especially of Voice Onset Time (VOT) differences (Abramson and Lisker, 1970).

It is also interesting that the error rates in various phonetic positions are not similar. The greatest prevalence of /p/ was in the initial position (52.2%): this is where aspiration is the most prominent in English. This indicates that the least challenging effect is the combination of the phonetic process of giving a new phoneme and ability to give a new phonetic effect (aspiration) in stressed position. On the other hand, the least error was obtained on /p/ in the final place (29.7%). In the case of /b/ everything was inversion, the greatest error came in the final position, regularly being in the form of devoicing ([b]) or replacement with /p/. Such a tendency toward final consonant devoicing was also arguably a carryover of L1 in that there is a certain amount of final devoicing in some Arabic idiom but it might be a broader learning phenomenon in L2 (Weinberger, 1987). The comparatively less error rate with initial /b/ (13.0) shows that the learners are typically accurate with the sound when it corresponds to their phonological system and does not require any complicated phonological aspects such as aspiration.

The found inter- and intra-speaker variance shows the complicated nature of L2 phonological acquisition (Tarone, 1980). There are learners who showed a more successful control, which could be explained by either a higher level of phonetic sensitivity or superior learning strategies, as well as increased attention to pronunciation. The finding of intra-speaker inconsistency (e.g., producing /p/ correctly in one word but not in the other, or depending on which task is performed) is an indication that learning of /p/ is not a homogeneous, categorical shift, but rather a process that is gradual and depends on such

factors as knownness of specific lexicon, cognitive load, and salience of orthographic information (Ellis, 2008, p. 112). The fact that /p/ -> [b] substitutions are slightly higher in the picture naming activity than in the reading activities of some learners implies that, the lack of orthographic p may lead to a decreased difficulty in consciously attempting to produce a different sound, allowing L1 File to be produced more easily.

Informal conversations included in the qualitative data were pointing to the absence of explicit phonetic training, and low perceptual awareness of the /p/-/b/ difference, in particular, the aspect of aspiration. This is in line with the claims by Celce-Murcia et al. (2010) and Gilbert (2008) that teaching of effective pronunciation needs special attention in articulatory mechanisms and auditory discrimination. In case the learners cannot hear the difference, they will hardly reproduce it constantly.

Occasional overcorrection of /b/ to [p^h] is also an intriguing development that points to the fact that some students, already being educated on the role of aspiration in /p/ overgeneralize this aspect. This shows that there is an effort to put to practice a newly acquired rule, although wrongly and this may be regarded as a phase in L2 learning (Major, 2001).

The research results directly relate to the English language teaching in Iraq. The present rates of the problem with /p/ and /b/ in university undergraduates (relatively advanced learners) are an indication of the possibility of the underlying pronunciation skills not being developed in lower stages of education or they may not be strengthened at the university level. Pedagogical interventions, which are more intensive than mere repetition and include left-out informing on articulation distinction between /p/

and /b/ (voicing, lip-closure) and, most importantly, the idea and production of aspiration of /p/ (Avery and Ehrlich, 1992, p. 101) are clearly required. Minimal pair exercises, visual feedback (i.e. use of a tissue in demonstrating aspiration), VOT, and perceptual training may be of immense help.

The weaknesses of this study include the sample (English Majors in two Baghdad universities) which in effect limits the extraction to generalizing the findings to all EFL Iraqi learners. The activities though diversified were still systemic and might not be completely a spontaneous conversational talk. Further studies may increase the number of respondents, involve students who represent various fields of study and abilities, and examine speech in more realistic communicative activities. Some longitudinal research would also be able to trace the progression of /p/ and /b/ production with specific instruction. A more comprehensive picture would also be made by investigating the perceptual capacities of these learners towards the /p/-/b/ contrast.

Irrespective of these constraints, the research gives solid support to the fact that the Iraqi university undergraduates still experience significant difficulties with English /p/ and /b/ pronunciation and that the interruption of L1 is really critical as well as the necessity to learn the details of phonetic pronunciation such as aspiration.

7. Conclusion

This study gave a very thorough discussion of the variability and the reasons as to why the English /p/ and /b/ are interchangeable among the undergraduate students at Iraqi universities. Statements of the research verified that these learners have a

severe challenge especially in the production of voiceless bilabial plosive /p/ that their L1, Arabic language lacks.

Key Findings:

1. **Error rates:** The error rate of /p/ (43.5%) was significantly higher than the error rate of /b/ (17.5%). Most frequently made mistake was the replacement of /p/ with /b/ (70% of p error) which was a direct indication of L1 interference.
2. **Aspiration Problems:** The same form of mistakes (24% of the /p) cases resulted in the pronunciation of an unaspirated [p] in place of an aspirated [ph], and the sound became similar to /b/. This is an indication of an inability to learn an important phonetic characteristic of English /p/.
3. **Positional Effects:** The worst part was when it comes to the word-initial position, in which /p/ is most problematic (52.2% error rate) and where there is a significant role played by the use of aspiration. In the case of /b/, the last position provided the greatest error percentage (27.0%), which was usually a result of devoicing.
4. **Variability:** the inter-speaker and intra-speaker variability was noted, which meant that most learners are inconsistent and continuous in their acquisition of the said sounds.
5. **Causal Factors:** L1 interference was determined as the major cause of these inconveniences. Other causes secondary factors are the absence of explicit phonetic instruction, the lack of perceptual sensitivity to the phonemic and phonetic differences, and the pure complexity of acquiring more articulatory gestures and functions such as aspiration.

Implications:

Those findings highlight a sense of urgency regarding the need of specific phonological teaching as part of the EFL curriculum of universities in Iraq and the lower levels of education. Pedagogical strategies are to be concerned with:

1. Raising learners' awareness of the articulatory differences between /p/ and /b/.
2. Giving overt instruction and practice regarding the production of /p/ aspiration.
3. Adding perceptual training to make learners differentiate between /p/, /b/, aspirated [p^h] and unaspirated [p].
4. Utilizing minimal pair exercises and contextualized practice across different phonetic environments.

These particular phonological issues are important in improving the intelligibility as well as communicative competence of the Iraqi university undergraduates including their overall mastery of the English language, thus preparing them to achieve more academic and professional success in centralized situations.

Areas for Further Investigation:

Future studies may investigate the quality of certain teaching tools that help to correct /p/-/b/ errors. The comparative research on the Iraqi learners of varying levels of proficiency or subject areas may bring in fruitful research as well. As well, further acoustic analysis of VOT values in the production of learners might further measure the character of the problems that learners have with aspiration and voicing.

To sum up, although the interchangeability of /p/ and /b/ poses a significant challenge to the Iraqi EFL learners, with the help of a thorough and careful pedagogical strategy, based on the comprehension of the nature of these mistakes and their underlying reasons, such students can learn to pronounce it accurately significantly.

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