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# Saudi Speakers' Perception of the English Bilabial Stops /b/ and /p/

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Languages differ in their phoneme inventories. Some phonemes exist in more than one language but others exist in relatively few languages. More specifically, English Language has some sounds that Arabic does not have and vice versa. This paper focuses on the perception of the English bilabial stops /b/ and /p/ in contrast to the perception of the English alveolar stops /t/ and /d/ by some Saudi linguists who have been speaking English for more than six years and who are currently in an English speaking country, Australia. This phenomenon of perception of the English bilabial stops /b/ and /p/ will be tested mainly by virtue of minimal pairs and other words that may better help to investigate this perception. The paper uses some minimal pairs in which the bilabial and alveolar stops occur initially and finally. Also, it uses some verbs that end with the suffix /-ed/, but this /-ed/ suffix is pronounced [t] or [d] when preceded by /p/ or /b/ respectively. Notice that [t] and [d] are allophones of the English past tense morpheme /-ed/ (for example, Fromkin, Rodman, & Hyams, 2007). The pronunciation of the suffix as [t] and [d] works as a clue for the subjects to know the preceding bilabial sound.

*Keywords:* perception, Arabic, stops, English, phonology

## Introduction

Languages differ in their phoneme inventories. Some phonemes exist in more than one language but others exist in relatively few languages. More specifically, English Language has some sounds that Arabic does not have and vice a versa. For example, English has the phoneme /p/ that does not exist in Arabic. It is distinct from the phoneme /b/. Arabic has only one bilabial stop /b/ which gets devoiced under some conditions; however, the voicing contrast is not distinctive (see below).

In contrast, Arabic has the sound /x/ which English does not have. Both, Arabic and English, have the stops /t/ and /d/ where the voicing feature is distinctive.

In this essay, the focus will be on some Saudi Arabian students' perception of the English distinct phonemes /b/ and /p/. These students are currently doing their master's and Ph.D. theses in linguistics in Australia and have been there for years. When they finish their studies, they will be appointed as assistant professors at some Saudi universities. It will be more helpful to test the perception with the two sounds /t/ and /d/ that exist in both languages.

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## Methodology

This paper focuses on the perception of the English bilabial stops /b/ and /p/ in contrast to the perception of the English alveolar stops /t/ and /d/ by some Saudi speakers who have been speaking English for more than six years and who are currently in an English speaking country, Australia. These Saudi speakers are continuing their higher studies in linguistics. This phenomenon of perception of the English bilabial stops /b/ and /p/ will be tested mainly by virtue of minimal pairs and other words that may better help to investigate this perception. I have prepared some minimal pairs in which the bilabial and alveolar stops occur initially and finally. Also, I use some verbs that end with the suffix /-ed/, but this /-ed/ suffix is pronounced [t] or [d] when preceded by /p/ or /b/ respectively. Notice that [t] and [d] are allophones of the English past tense morpheme /-ed/ (for example, Fromkin, Rodman, & Hyams, 2007). The pronunciation of the suffix as [t] and [d] works as a clue for the subjects to know the preceding bilabial sound. These words are recorded by an Australian native speaker of English. Some of them are repeated to double-check if some answers have been chosen randomly and/or to see whether the subjects can distinguish the sound quite clearly whenever they hear it. The subjects' task is to listen to the words and then to determine whether the pronounced phoneme is /p/, /b/, /t/, or /d/ by circling the sound they hear or circling the letter "X", if they could not decide which sound it is. Then, the results show us whether those Saudi speakers could recognize the sounds of question. The next sections show briefly the Arabic and English stops, so the reader recalls some of their aspects before getting to the experiment.

## Arabic and English Stops

This section gives a brief idea about the plosives in both languages shedding more light on the sounds of question, namely the bilabial stops /b/ and /p/, and the alveolar stops /t/ and /d/. These subsections are not meant to detail the description of the Arabic and English stops and the reader is advised to see more descriptive work for more information. The paper starts with the Arabic sounds.

### Arabic Plosives (Stops)

Modern Standard Arabic (MSA) has eight stops "sounds that are produced by a complete closure of the air passage at some point through the vocal tract" (Nakshabandi, 1988, p. 35). These stops are pronounced in five different places of articulation. Four of them are voiced and have no voiceless counterparts. They are: the bilabial /b/, the velar /k/, the uvular /q/, and the glottal /ʔ/. The other four stops are voiced and they have their voiceless counterparts. They are the voiceless alveolar /t/, the voiced alveolar /d/, the voiceless emphatic alveolar /ṭ/, and its counterpart /ḍ/. Our focus will be on the bilabial /b/ and alveolar /t/ and /d/. Table 1 shows these Arabic stops.

Table 1

*MSA Stops and Voicing*

| | bilabial | Alveolar (emphatic) | Post-alveolar | velar | uvular | glottal |
|---|---|---|---|---|---|---|
| -voice | | t | ṭ | k | q | ʔ |
| **Stops** | | | | | | |
| +voice | b | d | ḍ | | | |

### English Plosives

English has six stops. They are pronounced in three different places of articulation. They are the bilabial voiced /b/ and its counterpart /p/, the voiced alveolar /d/ and its counterpart /t/, and the voiced velar /g/ and its

counterpart /t/. Table 2 shows the English voiced and voiceless stops.

Table 2

*English Stops and Voicing*

| | bilabial | Alveolar (emphatic) | velar |
|---|---|---|---|
| -voice | p | t | k |
| **Stops** | | | |
| +voice | b | d | g |

**Similarities and Differences Between Arabic and English /b/, /t/, and /d/**

**/b/ voiced bilabial stop.** The Arabic /b/ is relatively similar to the English /b/ as in "**b**oy". This sound is formed by completely closing the lips, stopping the air flow in the oral cavity then releasing it. It can occur initially, medially, and finally. For example, ***b****ait* "house", *ya****b****do* "seem", and *shaa****b*** "adult". This voiced bilabial stop is often devoiced next to voiceless sounds or if it occurs finally though the voicing contrast is not distinctive i.e., the meaning does not change if it is not devoiced. For example, the words [wΛΘb] "jumping" and [əs-sΛbt] "Saturday" show that the /b/ is devoiced because it is preceded and/or followed by a voiceless consonant. In [əs-sΛbt], the /b/ sound is followed by the voiceless stop /t/, therefore, it is devoiced, and in [wΛΘb], it follows the plain inter-dental voiceless sound **/Θ/** which causes the devoicing. This is the case in Standard Arabic and some other Arabic dialects as is argued by Watson (2002). Nevertheless, it does not get devoiced initially in MSA as Arabic allows CV (Consonanat-Vowel cluster) which means it must be followed by a vowel but not by a voiceless consonant as in [***b****aka*] "he cried". In [***b****aka*], the /k/ sound is voiceless but it does not affect the voiced /b/ to get devoiced because it occurs initially and it is followed by a vowel.

However, if these instances of devoicing are not devoiced and people produce the sounds as voiced, the meanings remain the same since the devoiced version of the Arabic /b/ is an allophone of the same phoneme. Changing allophones of the same phonemes does not change the meaning, whereas changing phones does change the meaning (for example, Yule, 2010).

In contrast, the English /b/ is voiced while, its counterpart, the /p/ phoneme is voiceless and both phonemes can occur initially "**b**ook", "**p**ay", medially "mo**b**ile", "a**pp**le", and finally "di**b**", and "mo**p**". Unlike Arabic, the English phoneme /b/ has its voiceless counterpart /p/ where the voicing is the phonetic property that distinguishes between minimal pairs such as "**p**in" and "**b**in", "si**p**" and "si**b**". However, most English speakers do not voice initial /b/ to the full extent, and it gets devoiced when it occurs finally as in "si**p**" and "si**b**". Native speakers have a clue by which they distinguish the /b/ and /p/ in such a case (Giegerich, 1992; Jensen, 1993; McMahon, 2002; Yavas, 2011). It is the preceding vowel that gets lengthened before the originally voiced one. This makes the job of non-native speakers of English even harder to perceive the intended sound.

So far, we have seen that both languages have the some cases of the voicing feature where it is distinctive. Also, we saw the voiced bilabial consonants in both languages. It is the main point of this paper where Arabic does not have a voiceless counterpart that changes the meaning. This leads to the misperception of the English /b/ and /p/. It is a good idea to test this perception along with other voiced-voiceless counterparts that exist in both languages, hence /t/ and /d/ will be the ones we need.

**/t/ voiceless alveolar stop.** The Arabic /t/ sound is relatively similar to the English /t/ sound as in **"t**op". It is produced with the tip of the tongue touching the alveolar ridge. In both languages, it occurs initially, medially,

and finally in Arabic in words such as ***t**umr* "dates", *ma**t**een* "fat", and "*bai**t***" "house" and in English words such as "**t**ie", "af**t**er", and "ma**t**". In Arabic and English, the voicing in /t/ and /d/ is the phonetic feature that distinguishes between word pairs such as "*aba**t***" "*aba**d***" where they mean in Arabic "she refused" and "forever" respectively, and in English as in "sa**d**" and "sa**t**" which mean completely different things.

**/d/ voiced alveolar stop.** The Arabic /d/ is the voiced counterpart of /t/. It is similar to the English /d/ sound as in "**d**oor". It is produced with the tip of the tongue touching the alveolar. In both languages, it occurs in all positions. For example, ***d**awman* "always", *ma**d**eenah* "city", and *baari**d*** "cold", and in English as in "**d**oor", "fe**d**eral", and "ma**d**".

**Aspiration**

In both languages, the voiced sounds are unaspirated as this phonetic feature is applied to voiceless sounds where there is a brief period of voicelessness immediately after the unvoiced sound is released because an extra puff of air is produced (Fromkin, Rodman, & Hyams, 2007). It is the case of all English voiceless stops when they occur initially [$p^h$ul], [$t^h$ul], and finally [set$^h$], [sep$^h$]. Like English, the Arabic alveolar stop /t/ is aspirated initially [$t^h$ubu] "you all repent", and finally as in [fæt$^h$] "gone".

## The Question and the Hypothesis

From the previous sections, we have noticed that the English and the Arabic stops are not completely the same. The crucial difference that we deal with is the fact that English has the voiceless stop phoneme /p/ but Arabic does not. This leads to the misperception of this sound by some Arabs because there is an overlap between the voiced stop /b/ that exists in both languages and the voiceless /p/ which Arabic language considers as an allophone of the voiced stop /b/ in some circumstances. Nevertheless, the voicing feature is not distinctive in Arabic /b/ and its allophone /p/. This paper, according to a well-established questionnaire, tries to answer the question "Do educated and post graduate Saudi speakers perceive the English stops /b/ and /p/ accurately or do they misperceive them?" Given that they are highly educated participants who have done their B.A. in English in Saudi Arabia and have been working on their M.A. and Ph.D. theses in English and have been in an English speaking country, I hypothesize that they can get some correct perception, but they cannot perceive them in a way that helps them distinguish whether the sound of question is /b/ or /p/, especially in some phonological environments where the voiced one gets devoiced, and in the medial and final positions.

## The Questionnaire and the Results

**The Questionnaire**

The questionnaire is divided into two main sections. The first section is divided into three parts. The first part experiments the perception of initial /p/ and /b/, the second tests the perception of the medial position where the phonemes /p/ and /b/ are followed by the suffix /-ed/ that indicates the past tense. In this environment this phoneme /-ed/ will be pronounced as [d] when preceded by the voiced phoneme and as [t] when preceded by [p]. The third part deals with the final position of the sounds /p/ and /b/ in which the voiced one is not fully voiced but it gets devoiced.

The second section deals with the perception of /t/ and /d/ phonemes that exist in both languages. Like the previous section, it has two parts that deal with the initial and finial positions of both sounds respectively. It does

not have a part dealing with medial position of /t/ and/or /d/ as the goal of this section is not to test the Arab's perception of these two phonemes. This is more explained later in section *initial position*.

For each part, there are twelve cells, each of which has the voiced phoneme, its counterpart and the letter "X" in between. The participants' job is to circle the intended sound they hear or to circle the letter "X" if they could not decide which sound it is.

Seven subjects did the test. To avoid mentioning their names, they were numbered from one to seven. They were given five minutes to read the questionnaire and to ask questions. Then, they had a two-minute test as an exercise in which they listened to some words chosen carefully from the real test to cover the four phonemes in different positions. In addition, each part was explained before playing the recordings. Each part has a written example showing the intended sound in bold and it was pronounced by the native speaker prior to saying the rest of the words. The following section will show the results in tables (see Table 3—7) to be clearly understood.

**The Results**

This section shows the results of each part by giving the number of each participant, the times they misperceived the sound of question, how many times they chose "X", and the phoneme that should be chosen instead of "X".

Table 3

*Initial /p/ and /b/*

| Subject's No. | **Initial /p/**, *Misperception* | **Initial /b/**, *Misperception* | **"X" instead of phoneme** |
|---|---|---|---|
| 1 | 1/6 | 1/6 | 1 instead of /b/ |
| 2 | 1/6 | 1/6 | - |
| 3 | 1/6 | All OK | - |
| 4 | 2/6 | 1/6 | - |
| 5 | 1/6 | All OK | - |
| 6 | 1/6 | All OK | - |
| 7 | 2/6 | 1/6 | - |

Table 4

*Final /p/ and /b/*

| Subject's No. | **Final /p/**, *Misperception* | **Final /b/**, *Misperception* | **"X" instead of phoneme** |
|---|---|---|---|
| 1 | 3/7 | 2/5 | 1 instead of /p/ |
| 2 | 4/7 | 3/5 | - |
| 3 | All OK | All OK | - |
| 4 | 2/7 | 1/5 | - |
| 5 | 4/7 | 2/5 | - |
| 6 | 4/7 | 4/5 | - |
| 7 | 2/7 | 1/5 | - |

Table 5

*Medial /p/ and /b/*

| Subject's No. | **Medial /p/**, *Misperception* | **Medial /b/**, *Misperception* | **"X" instead of phoneme** |
|---|---|---|---|
| 1 | 6/8 | 1/4 | - |
| 2 | 1/8 | 1/4 | - |
| 3 | All OK | All OK | - |

| | | | |
|---|---|---|---|
| 4 | 6/8 | 3/4 | 3 each instead of /p/ |
| 5 | 1/8 | 1/4 | - |
| 6 | 2/8 | 1/4 | - |
| 7 | 2/8 | 1/4 | 1 |

Table 6

*Initial /t/ and /d/*

| Subject's No. | **Initial /t/**, *Misperception* | **Initial /d**, / *Misperception* | **"X" instead of phoneme** |
|---|---|---|---|
| 1 | All OK | All OK | - |
| 2 | All OK | All OK | - |
| 3 | All OK | All OK | - |
| 4 | All OK | All OK | - |
| 5 | All OK | All OK | - |
| 6 | All OK | All OK | - |
| 7 | 1/6 | All OK | - |

Table 7

*Final /t/ and /d/*

| Subject's No. | **Final /t/**, Misperception | **Final /d/**, Misperception | **"X" instead of phoneme** |
|---|---|---|---|
| 1 | All OK | All OK | - |
| 2 | 1/6 | 1/6 | - |
| 3 | 1/6 | 1/6 | - |
| 4 | 1/6 | 1/6 | - |
| 5 | All OK | All OK | - |
| 6 | All OK | 1/6 | - |
| 7 | All OK | 1/6 | 1 instead of phoneme /d/ |

## The Analysis

The previous section shows the result of the misperceived sounds depending on the positions of the sounds i.e., initially, medially, and finally. This section analyzes the data, depending on the sound itself, showing the average of the subjects' results and some figures that help understand the results.

Generally, the results show an excellent perception of the sounds existing in both languages, namely /t/ and /d/. The perception of the bilabial stops varies from a position to another as well as from a subject to another.

As an over all trend, the subjects have no problems with the /t/ and /d/ sounds that occur in their native language although not all the subjects got all the cases correctly. In contrast, they have noticeable problems distinguishing the bilabial sounds. This is not only clear by virtue of the tables in the previous section, but also ,as mentioned early in this paper, by the words that have been repeated randomly in each part where most of the participants got the same word correctly at one time and incorrectly at another time. This interprets their choice as to be random or it might be that they could perceive the sound some times but not always even for the same words with the same positions. This happens with the voiceless /p/ many times but very rarely with its counterpart in the final and medial positions.

### The Phoneme /b/

**Initial position.** This voiced bilabial phoneme exists in both languages; therefore the Saudi subjects did not

have many problems with it, especially in the initial position where it was always fully voiced like the default Arabic one. Three of the subjects got it correctly in the initial position while others misperceived it at most only once. The average of perceiving it correctly was 5.428571 out of 6. Figure 1 shows the results of the subjects' test in initial /b/.

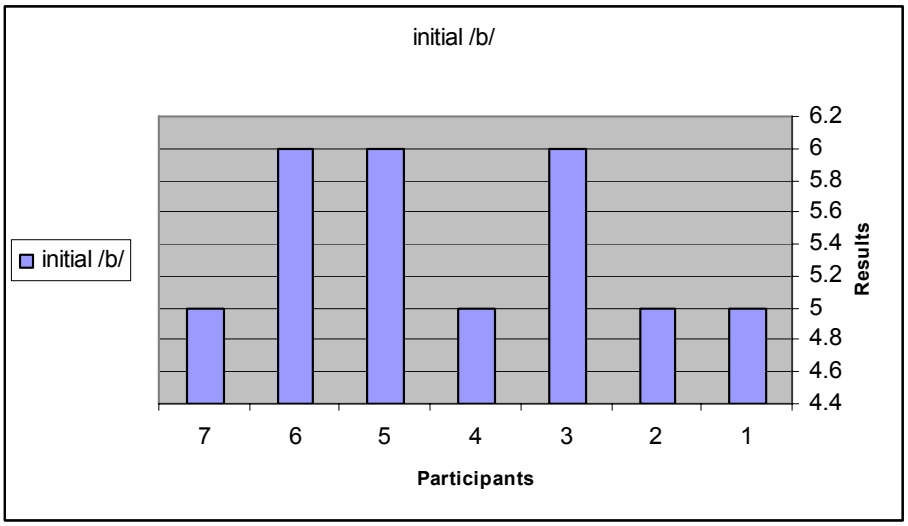


*Figure 1.* Initial /b/.

**Medial position of /b/.** The medial position in this essay means the environment in which the phoneme is followed by the past tense suffix /-ed/ where it is pronounced as [d]. This clue has helped the subjects to perceive it better than the final position. One subject got it correctly in all examples, five misperceived it only once and one of them misperceived it three times. Their average was 2.857143 out of 4. Figure 2 shows the results of this phoneme in the medial position.

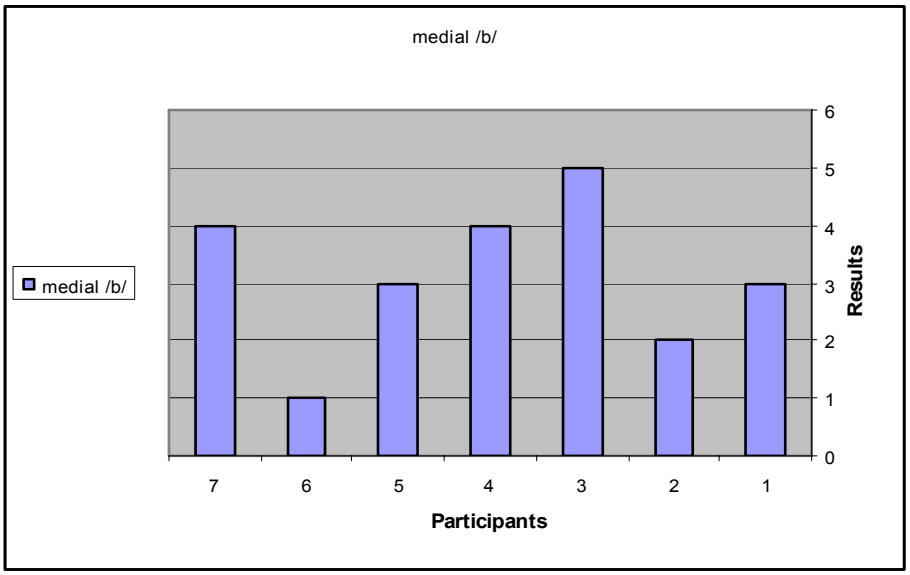


*Figure 2.* Medial position of /b/.

**Final position of /b/.** When it occurs finally, it becomes a little bit trickier. The participants varied in their perception in this case. Only one subject got it correctly in all examples and two subjects misperceived it twice while the others misperceived it more than two times but each got it at least once. Their perceptions' average was 3.142857 out of 4. Figure 3 shows that participants 1, 2, 5, 6, and 7 interestingly had the same perception's results.

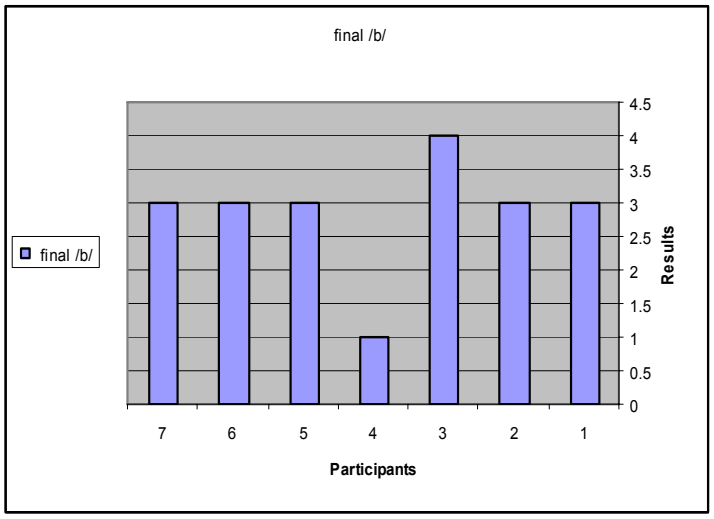


*Figure 3.* Final position of /b/.

**The Phoneme /p/**

**Initial position.** Arabic language lacks the /p/ phoneme, which is a fully unvoiced phoneme. Therefore, it is the source of the problem that Arabs face when trying to distinguish between the /p/ and /b/ sounds. However, the data shows unexpected results in this position. Five of the subjects (1, 2,3, 5, and 6) misperceived it only once and the other two did so twice. This might be because of the aspiration it had in all the words they listened to in contrast to its counterpart that was unaspirated. The chosen words were all minimal pairs where the /b/ or /p/ sounds occurred initially and followed by a vowel which allowed the aspiration feature to be captured. The subject's perception average was 4.714286 out of 5. Figure 4 explains this phoneme's results.

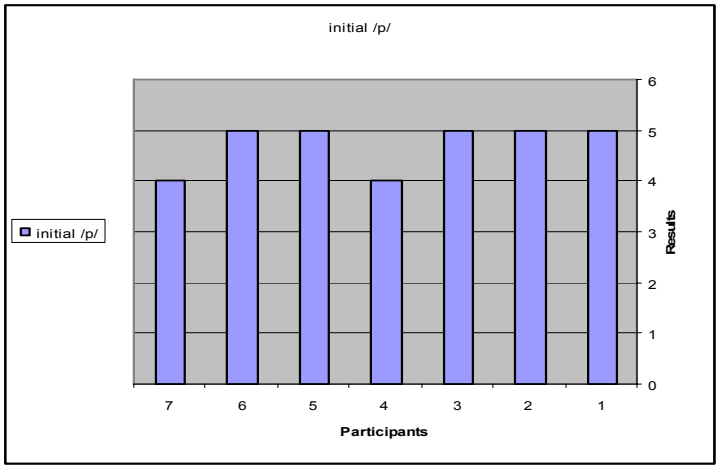


*Figure 4.* Initial /p/.

**Medial position of /p/.** The medial position in the questionnaire means that the phoneme /p/ is followed by the past tense suffix /-ed/ and regardingly pronounced [t]. This key allowed one subject to perceive it very well in all the eight words, two participants to get it correctly seven times, and two to perceive it correctly six times. The other two got it only twice. This variation shows how the medial position of the unvoiced phoneme /p/, which Arabic lacks, is so difficult to perceive. However, it is not the most difficult position as the next section shows. Figure 5 depicted these results where the perception average of the subjects was 5.428571 out of 8.

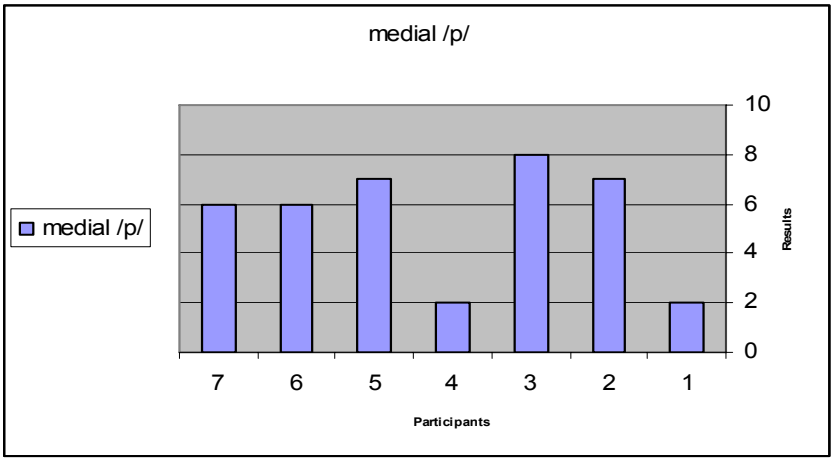


*Figure 5.* Medial position of /p/.

**Final position of /p/.** The voiceless /p/ in this position is very difficult for Arabs to perceive accurately. This resulted by the devoicing of its counterpart /b/, the voiced one, in this position where both become unvoiced. Native speakers can distinguish both sounds existing in the minimal pairs by the preceding vowel where it becomes a bit longer before the /b/ sound and remains as it is before the /p/ sound. This difficulty made the results vary from a subject to another.

One subject got all the seven words correctly and he was the one who got all the initial and medial words correctly, as well as the final ones. Two subjects got it five times; one subject got it four times; and the other three participants perceived it only three times. The average of the subjects' perception was 4.285714 out of 7. The following Figure 6 depicts the results and the average of the phoneme occurring in this position.

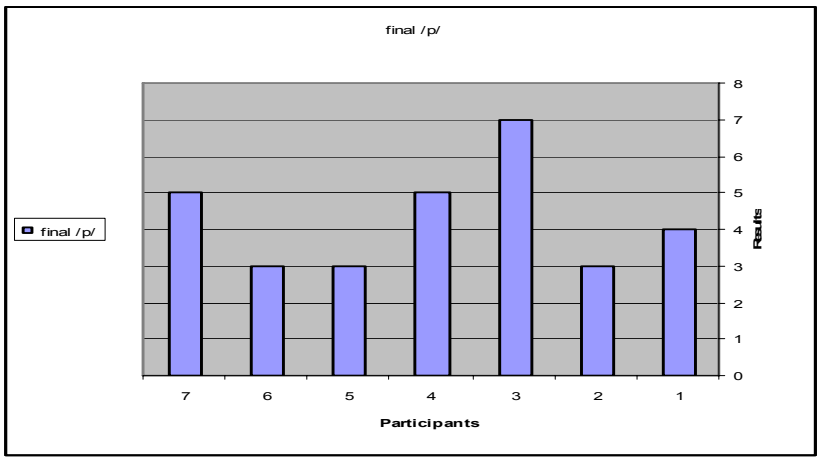


*Figure 6.* Final position of /p/.

**The Phoneme /t/**

**Initial position.** This voiceless phoneme /t/ occurs in the subjects' native language, Arabic, with its counterpart /d/. This essay's focus is not to examine the subjects' ability to perceive these two sounds, rather it uses the two phonemes to show the difference between the subjects' perception for the phonemes that exist in their language with the voicing as a distinctive feature, and the phonemes that do not exist as two different phonemes but as allophones, namely /b/ and /p/ in Arabic. Therefore, this section does not have medial position for the /t/ and /d/ sounds. Two positions were enough to compare them with the /p/ and /b/. Although the participants showed better perception of the phonemes /t/ and /d/, the results were unexpected as some of the subjects had misperception in these two phonemes. This was unexpected because the two sounds with the voicing feature exist in the subjects' first language, Arabic.

The results of the participants' perception of this phoneme were very high. Six subjects got it correctly while only one misperceived it once in the word "trip", although the /t/ was clearly aspirated. This misperception could be resulted by the fact that Modern Standard Arabic as well as that subject's dialect (Najdi Arabic) do not allow two consonants at the initial position, rather an intervening vowel must exist between the /t/ and the /r/ sounds. In this way, this initial /t/ differs in its environment from the Arabic one. The subjects' perception average was 5.857143 out of 6. Figure 7 shows this more clearly.

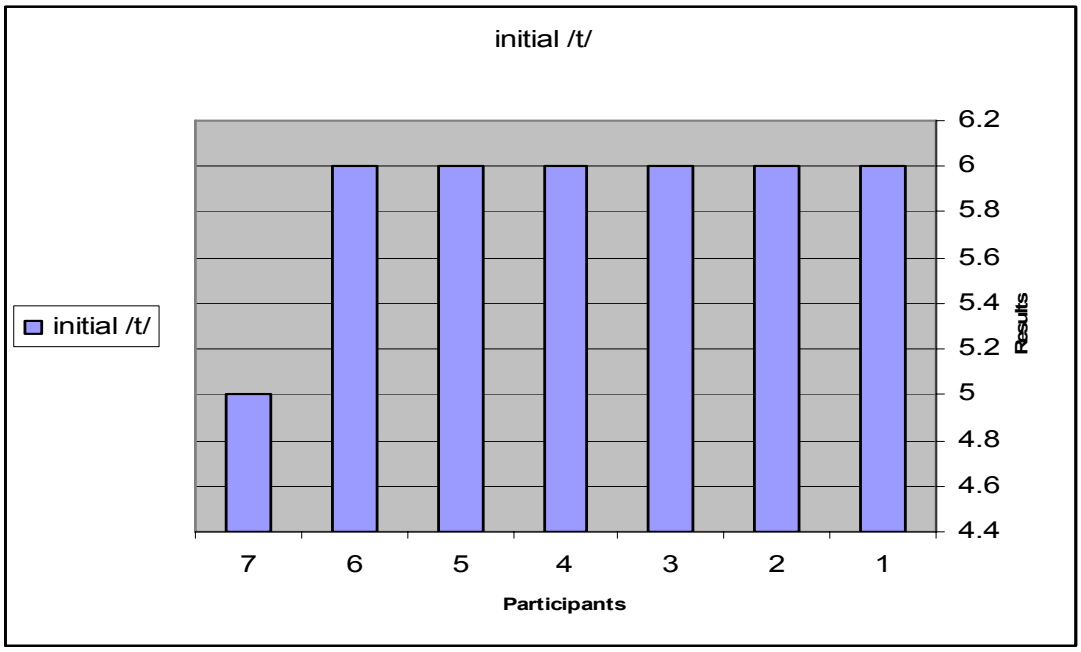


*Figure 7.* Initial position of /t/.

**Final position of /t/.** Only one subject has misperceived it once while others perceived it accurately. The misperceived word was "bat" which was clearly aspirated in the recording. It was misperceived by subject number four who did misperceive a lot of sounds and even the initial fully voiced /b/. The subjects' perception average was 5.857143 out of 6 and Figure 8 depicts this results.

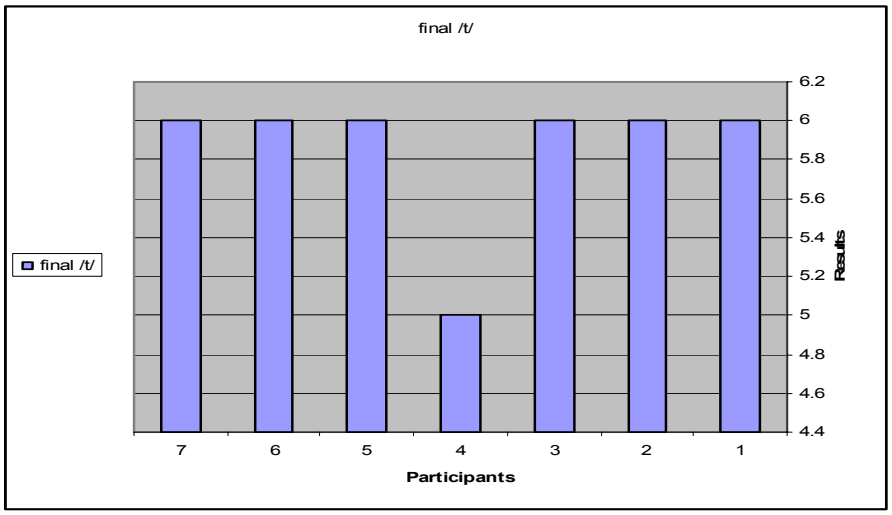


*Figure 8.* Final position of /t/.

**The Phoneme /d/**

**Initial position.** All subjects got it correctly. It was fully voiced and in the initial position followed by a vowel which was voiced, too. This made it easy for the subjects to perceive it very well. The average was 6 out of 6 and Figure 9 shows this clearly.

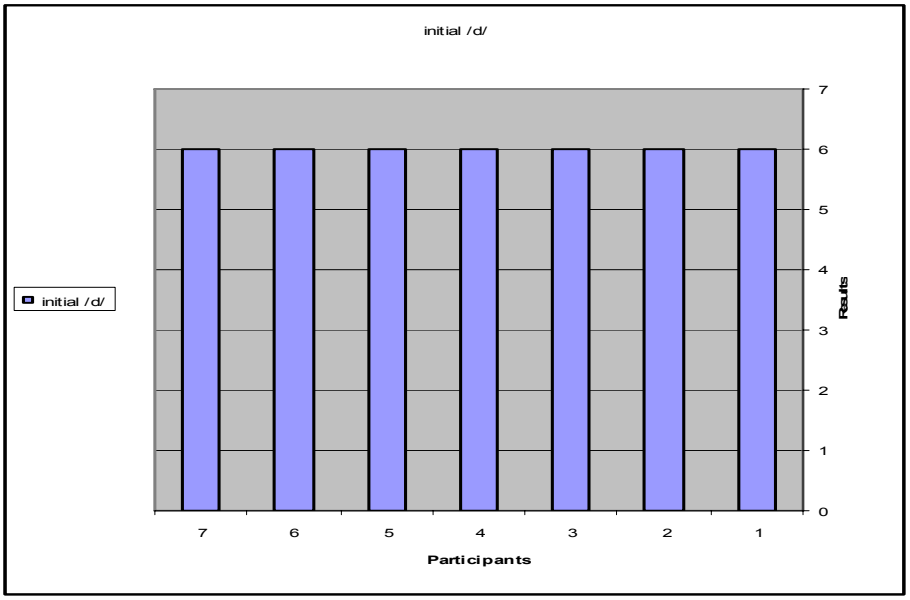


*Figure 9.* Initial position of /d/.

**Final position of /d/.** Two subjects perceived it accurately and five subjects misperceived it only once. Interestingly, the five subjects misperceived the same word "fi**d**" and it was repeated twice in that section. That meant the five subjects got it once and misperceived it once. Being in final position, its voicing was not clear as in initial position. The misperception was with the final /t/ which was fully unvoiced and aspirated. The subjects' perception average was 5.285714 out of 6 and this is clear in Figure 10.

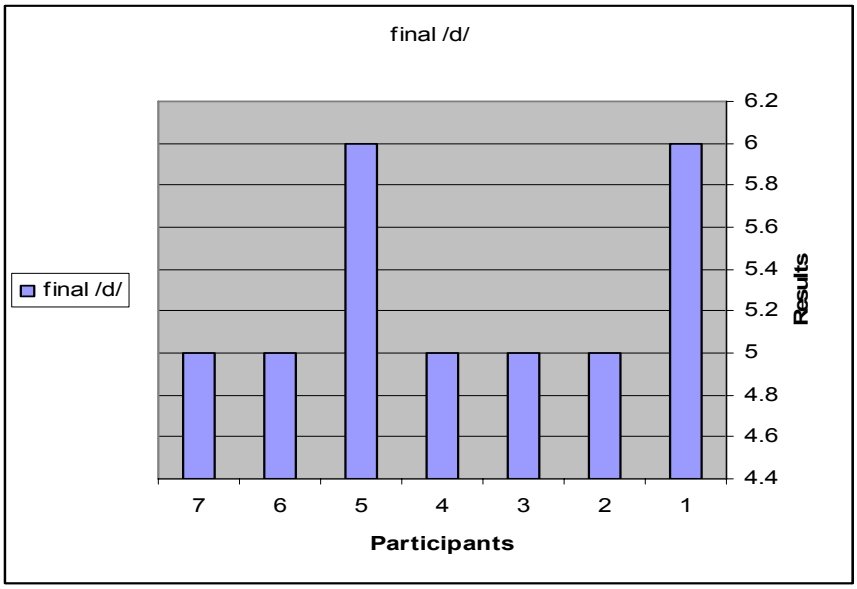


*Figure 10.* Final position of /d/.

## Conclusion

So far, we have seen that Arabic language has some sounds that English does not have and vice versa. Both languages have stops and have the voicing feature but the number of stops they have differs. Both languages have the alveolar stops /t/ and /d/ where the voicing is a distinctive feature. It is not the case in Arabic voiced bilabial stop /b/ which gets devoiced when occurs next to voiceless stops. This means Arabic language treats [p] and [b] as allophones of the phoneme /b/, and this makes the allophone feature indistinctive in Arabic. In contrast, it is distinctive in English where there are two completely different bilabial sounds /p/ and /b/. This makes the participants do better in the section of /t/ and /d/ compared by the section of /p/ and /b/.

The hypothesis in this essay is correct where the Saudi Arabian's perception of the English bilabial stops /b/ and /p/ was not accurate 100%. Because Arabic and English have the voiced one, the subjects found it easy to distinguish the English /b/ from its counterpart in initial position. When it occurred medially where it was followed by the [d], most of the subjects got this clue and perceived it very well. It was not the case when it occurred finally and got devoiced. This made the subjects' perception a bit difficult.

The other voiceless bilabial stop /p/, as a completely different phoneme from /b/, is the source that generates the problems for the subjects to distinguish it with its counterparts. However, given that the subjects are linguists, some of the subjects could perceive that well when they took into consideration that the /p/ was aspirated when it occurred initially and finally in the recorded material they listened to, and it was followed by the sound [t] when it occurred medially.

The phonemes /t/ and /d/ were perceived, to some extent, accurately and better than the bilabial sounds because they occurred in the subjects' native language where the voicing feature was distinctive.

This paper's results were not statistical because the number of the subjects was very limited and the number of the words in each part was not the same. However, it gives indication that Saudi learners of English who are more educated in the field of linguistics find it difficult to distinguish between the sounds of questions, English

/p/ and /b/. They were told about their results so they can convey this message to their future B.A., M.A., and Ph.D. students as those subjects are all teaching English and linguistics at some Saudi universities.

## References

Fromkin, V., Rodman, R., & Hyams, N. M. (2007). *An introduction to language* (International student ed.). Boston, Mass, London: Thomson Wadsworth; Thomson Learning.

Giegerich, H. J. (1992). *English phonology: An introduction.* Cambridge: Cambridge University Press.

Jensen, J. T. (1993). *English phonology*. Amsterdam; Philadelphia: J. Benjamins Pub. Co..

McMahon, A. M. S. (2002). *An introduction to English phonology.* Edinburgh: Edinburgh University Press.

Nakshabandi, A. (1988). *A descriptive study of the phonology and morphology of the Abha dialect.* Washington, D.C.: Georgetown University.

Newman, D. (2002). The phonetic status of Arabic within the world's languages. *Antwerp papers in linguistics, 100.*

Rasmussen, Z. (2007). The interlanguage speech intelligibility benefit: Arabic-accented English (thesis, University of Utah).

Roca, I., & Johnson, W. (2004). *A course in phonology* (6th ed.). Victoria: Blackwell.

Thesieres, H. (2002). An articulatory phonological analysis of vowel phonology in spoken MSA (Master thesis, Rice University).

Watson, J. C. E. (2002). *The phonology and morphology of Arabic.* Oxford: Oxford University Press.

Yavas, M. S. (2011). *Applied English phonology* (2nd ed.). Oxford: Wiley-Blackwell.

Yule, G. (2010). *The study of language* (4th ed.). Cambridge: Cambridge University Press.