The Differential Impact of Linguistic Experience on the Discrimination and Categorization of Non-Native Sounds in Foreign Language Learners

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Abstract. Speech perception has been extensively proven to be modulated by exposure to native language. As the perception of non-native sounds is predicted to be influenced by the phonological experiences of learners, it is worthwhile to study the perception of non-native speech sounds by learners who share the same language learning ecology but possess different linguistic repertoires. This study focuses on the perception of English dental fricatives, [θ] and [ð], by Persian and Arabic-Persian EFL learners, with the former lacking these sounds in their L1 and the latter having them in their L1 (Arabic) phonological system. To examine the perception of these sounds by both groups and their perceptual substitutes, 90 Iranian EFL learners – 32 Arabic-Persian bilinguals and 58 Persian monolinguals – completed a discrimination and an identification task. Although the results indicated a significant difference only in the identification of [θ], the trend showed that Arabic-Persian learners were more successful in the two tasks, presumably due to activating perceptual routines from their L1. The dominant substitution made in the two tasks by both groups reveals the prominence of acoustic features rather than articulatory similarity in the perception of the dental fricatives.

Keywords. English, Persian, Arabic, dental fricatives, non-native speech perception, discrimination, identification, perceptual substitution, monolinguals, bilinguals
1. Introduction

In spite of some general tendencies and predispositions that might be observed in the acquisition of a second or foreign language, the undeniable influence of learners’ first linguistic experiences can be traced in all of the studies targeting language development and acquisition whether in bi-, multi- or monolingual foreign language learners. Much of earlier research in the area of second language (L2) phonology acquisition has focused on examining and categorizing the deficiencies in non-native productions resulting from various language backgrounds. Many researchers have also investigated the effect of instruction on learners’ production of target segmentals and suprasegmentals to compensate for the interferences from their language background (Atli and Su Bergil 2012; Couper 2006; Daryagasht and Khodabandehlou 2014; Gordon 2012; to name but a few). Most researchers, however, do not regard L2 learners’ production errors to be due to their lack of knowledge about forming the relevant articulatory gestures for new L2 sounds, but to the misperception of non-native L2 sounds, implying that perception underlies accurate production (e.g. Altenberg 2005; García Lecumberri et al. 2008; Guion et al. 2000; Kabak and Idsardi 2007; Shih and Kong 2001; Zhang and Xiao 2014). Needless to say that models of second language perception have acknowledged the impact of linguistic experience and have attempted to explain the ways in which learners’ L1 guides their performance in most learning situations (Best and Strange 1992; Escudero 2005; Flege 1995; Major and Kim, 1996).

Compared to the large number of investigations on second and foreign language learners’ production, perception studies on these groups of learners are comparatively more recent (e.g. Best and Strange 1992; Escudero 2005; Flege 1995; Major and Kim 1996; for language-specific studies see Kissling 2015; Kusumoto 2012; Mi 2014; Wester et al. 2007). Not many studies have addressed the perception of non-native sounds by foreign language learners whose exposure to the language had been confined to the limited hours of formal classroom instructions (Holliday 2016; Mokari and Werner 2016, 2017). To further studies on the topic, this paper focuses on the perception of non-native sounds by learners who have had no functional communication in English as their foreign language. Moreover, they differ in their native language sounds but learn English in the same linguistic environment.
Second language perception studies have mostly focused on challenging and difficult sounds to account for how learners from different language background and with different degrees of L2 experience discriminate and identify them. Of these non-native challenging sounds, particularly for learners of English, one can single out the dental fricatives [θ] and [ð] which have been described as marked sounds and missing in the phonemic inventory of most language learners (Maddieson 1984). Although a wealth of studies has addressed the production of these two sounds by learners of English with various first language backgrounds, only few studies have focused on their perception (e.g. Brannen 2011; Lee 2011; Owolabi 2012; Syed 2013). To the best of our knowledge, no previous study has attempted to account for differences in the linguistic experiences of learners who come from the same ecology of language learning, but whose first languages provide two opposing scenarios regarding the existence of these phonemes in the inventory of the native language.

This study approaches the perception of these sounds by Persian monolingual and Arabic-Persian bilingual learners of English (henceforth referred to as P learners and AP learners). While Persian monolinguals do not have dental fricatives in their phonemic inventory, Arabic-Persian bilinguals have already been exposed to them in their first language. It should be pointed out that although in some Arabic dialects the dental fricatives have changed into some other sounds, namely [t] and [d] (Newman 2002; Paradis and LaCharité 2012; Watson 2002), the learners’ dialect in the current investigation (having residence in Abadan) is close to Iraqi Arabic which contains both [θ] and [ð]. These learners are learning English as a foreign language with the language of instruction being Persian, the unquestionably dominant language in most formal and informal situations in Iran. This linguistic situation is interesting, because Persian as the dominant language may override the phonological resources AP learners have at their disposal from their L1. This might be the case if they have lost the dental fricatives due to the extensive use of Persian in their interactions. The present study attempts to find out if there is any difference in the perception of the English dental fricatives by the two groups of P and AP learners. It further explores the perceptual substitutions made for English dental fricatives by these EFL learners.
To answer these research questions, two tasks of AX discrimination and transcription are employed to examine the ability of P and AP learners in (a) discriminating and (b) identifying English dental fricatives. In the remainder of the paper, studies on dental fricatives and second language perception studies will be briefly reviewed in sections 2 and 3, respectively. A detailed description of the study design will follow in section 4 and sections 5 and 6 will report the obtained results and their interpretation in relation to current perception models. The conclusion summarizes the findings of the study, highlighting further studies required to develop a model for foreign language perception.

2. Dental fricatives

English dental fricatives, [θ] and [ð] seem to be difficult even for native speakers (Tabain 1998), they are among the sounds that are learnt and mastered very late by native children (Bowen 2011). They are also known as notoriously difficult sounds to acquire for learners of English, which has spurred much research on their acquisition by learners with different language backgrounds (e.g. Hanulikova and Weber 2010; Hattem 2009; Hismanoglu 2009; Mousa 2014; Syed 2013; Wester et al. 2007; Wong 2005). Evidence on the realization of [θ] and [ð] by L2 learners shows that many of the participants tend to substitute them with sounds of their L1. Latin American Spanish (Hattem 2009 as cited in Mousa 2014), Québec French and Russian (Brannen 2011), and Jamaican (Mousa 2014) learners of English substitute [t] and [d] for the voiceless dental fricative [θ] and its voiced counterpart [ð], respectively. Brannen (2011), Hanulikova and Weber (2010), Rau et al. (2009) and Wester et al. (2007), among others, have reported [s] – [z] and [f] – [v] as substitutes for this contrast with varying degrees. Iranian learners of English had been reported to substitute [t], [s], and in much fewer cases [f] for [θ], and [d], [z], and more rarely [v] for [ð] (Mehrpour and Makki 2011). The question addressed here is how [θ] and [ð] sounds are perceived by P and AP learners and what pattern of speech perception their substitutions illustrate, i.e. if these substitutions occur as a result of the inability of P and AP learners to discriminate non-native sounds from their phonetically similar L1 sounds or whether the substitutes are pointers to learners’ categorization of sounds in terms of native phonemes.
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... originating from their failure in identifying non-native sounds and forming a new category for it.

Among the studies investigating the perception of L2 sounds by second language learners (Aoyama et al. 2004; Bradlow 2008; Bradlow et al. 1999; Darcy and Krüger 2012; Mayr and Escudero 2010; Miyawaki et al. 1975, to name but a few), few have exclusively investigated the perception of English dental fricatives and most of them have focused on the relation between their perception and production (e.g. Brannen 2011; Lee 2011; Owolabi 2012; Syed 2013). Empirical studies point to differences between perception and production patterns (De Wilde 2010; Syed 2013). Such a difference was also evidenced in Iranian learners (Kassaian 2011), but what is not yet known is how these two sounds are perceived by Iranian monolingual and bilingual learners with different L1.

The present study addresses the perception of non-native sounds by Iranian learners of English. Persian lacks [θ] and [ð] in its phonemic inventory, leaving Persian speakers with the task of establishing a new phonetic category for these sounds in the course of learning English. Although Persian is the only official language of Iran, many other languages are spoken, such as Azeri Turkish, Kurdish, and Arabic, among others, and as a result a majority of the population is bilingual. Of these bilinguals, Arabic-Persian bilinguals are focused on in the present study, because unlike Persian monolinguals, these bilinguals are familiar with the [θ] and [ð] sounds from their L1 phonemic inventory and are assumed to have no problem perceiving them. The situation provides a good base for comparing the perception of the dental fricatives by two groups of EFL learners in a globally similar linguistic environment with Persian as the dominant language of communication and instruction and Arabic as a minority language as well as investigating the impact of L1 phonological categories on non-native language speech perception.

To decide on the similarity of the sounds in Arabic and English, one criterion is the articulatory gestures (which resemble each other and have been described in a similar way with the same phonetic features) and the other is acoustic characteristics. To ensure the similarity of the acoustic properties of these two phones in Abadani Arabic and English, the spectrograms of [θ] and [ð] were checked in an intervocalic position produced by an Arabic dominant bilingual speaker who did not participate in the study. The analysis using
PRAAT showed that the Arabic dental fricatives are similar to those in English (Figure 1).

**Fig. 1:** Spectrograms for [oðɑ] and [oθɑ] in Abadani Arabic (upper panel) and English (below)\(^1\)

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3. **Speech perception in second language learning**

Models of cross-language speech perception emphasize the inevitable impact of first language (L1) on the perception of non-native sounds. Mentalist approaches to phonological acquisition regard sounds as mental representations, i.e. a bundle of abstract features forming the speakers’ linguistic knowledge which are drawn from a language-general pool of sounds and have become specific for a given language (Chomsky and Halle 1968; Clements 1985). Motor theory of speech perception (Liberman et al. 1967; Liberman and Mattingly 1985), on

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\(^1\) English productions were taken from IPA chart ([https://www.ipachart.com/](https://www.ipachart.com/)).
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The other hand, posits sounds as stored in the form of gestural scores, i.e. bundles of motor neurons that control articulatory movements and speech perception is tied to the activity of articulators and gesture perception. In the similar vein, models of second language speech perception attempt to account for speech perception by employing the notions of acoustic similarity (Flege 1995), gestural similarity (Best 1995; Best and Tyler 2007) or a combination of both (Strange 2006) by proposing a distinction between language-general and language-specific patterns of speech perception to account for the different performance of second language learners.

Perception has been generally defined as the cognitive process of recognizing speech sounds as instances of a mental category (Strange and Shafer 2008). However, to be measurable two different kinds of tasks, namely discrimination tasks and identification tasks (Liberman et al. 1957) have been extensively used to investigate perception at both levels with the former aiming at acoustic information that distinguishes sounds from each other and the latter being an indicator of the listeners' ability to categorize a sound in their phonological space.

The aim of this study, i.e. the investigation of English dental fricative perception by monolingual Persian and bilingual Arabic-Persian learners, can thus be approached from different perspectives and at different depths. Acoustic similarity has been claimed by Speech Learning Model (Flege 1995) to determine the level of difficulty with which learners perceive and establish a phonetic category for a non-native sound. Similar sounds are the most difficult and new sounds the easiest to discern their differences and learn; and equivalent sounds are matched to existing phonetic categories. AP and P learners are then hypothesized to be performing equally well since dental fricatives can be considered as equivalent for the former group who have interdentals in their native language and new for the latter group as they do not have dental fricatives in their native sound system. However, if AP learners perceived these sounds as similar rather than equivalent, P learners might outperform them. Speech sound perception can also be investigated from the perspective of gestural similarity (Best 1995) which is claimed to modulate speech perception with the different scenarios ensued: matching a non-native sound with a native sound category, accepting a non-native as good or bad exemplar of a native sound category or keeping it
uncategorized within the phonological space. According to the Perceptual Assimilation Model (Best 1995), AP learners are expected to have a better performance due to their L1 experience compared to P learners. A third perspective to the issue has been given by Automatic Selective Perception (Strange 2006) that posits language-general speech perception patterns and language-specific robust patterns set for L1 through experience. Both groups are predicted to show an equally high performance in the discrimination AX task that taps into the auditory capabilities of the learners. However, in the transcription task that taps into the learners’ phonological inventory, AP learners are predicted to perform better than P learners because of having the relevant routines in their L1 for dental fricatives.

4. Materials and methods

4.1. Participants

Participants of the study were 90 low-intermediate Iranian EFL learners among whom 58 were Persian monolinguals and the other 32 were Arabic-Persian bilinguals. The learners were between the age of 16 and 36 studying at Pouyandegan language institute in Abadan. They attended the classes held three times a week for 90 minutes each session and studied Top Notch 1A (Saslow and Ascher 2011).

4.2. Instrument and materials

Two tasks were used to measure learners’ perception of the dental fricatives; an AX discrimination and a transcription task. In the AX discrimination test, the participants were required to listen to the two sounds in each trial and decide whether they were the same or different. The stimuli (taken from Syed 2013) consisted of 50 items inclusive of the target sounds [θ] and [ð] and 16 distracter sounds from the reported substitutions and some other sounds such as nasals and affricates (Appendix A). Eighteen items tested the sounds under study, paired with their most reported substitutions; hence, [θ] was paired with [t], [s], and [f], and [ð] was paired with [d], [z], and [v]. Inter stimulus interval was 0.5 s which is enough to elicit information about the learners’ ability in acoustic discrimination of the sounds. The stimuli had been produced by a female native speaker of English in the context of /aXa/ which were resampled at the sampling rate of
44100 Hz using PRAAT (Boersma and Weenink 2018). The items were randomized and an answer sheet was used to collect the responses.

The transcription task, similar to the task employed by Altenberg (2005), required the participants to listen to the words and write them down. The task consisted of a list of 60 low frequent monosyllabic words of English (except for thee) extracted from the British Lexicon project (BLP) database (Keuleers et al. 2012; see Appendix B). They had the target sounds in their initial position and did not contain a consonant cluster in either the onset or coda position. Six items tested the sounds under study (thong, thug, thatch, thine, tho, thee). As most teachers orient themselves towards American English, the North American pronunciation of these words were extracted from the website of Oxford Learners’ Dictionary and concatenated with an inter-item interval of 3 s using PRAAT (Boersma und Weenink 2018). The participants provided their responses on an answer sheet by filling the blanks with the missing onset and following vowel (CV-) of each item they heard (e.g. ____sh). Given the level of the learners’ proficiency, their ability of sound-letter correspondences is taken for granted.

4.3. Procedure and Analysis

To ensure that all learners understood how to complete the task, a short instruction was provided in Persian. The audio files were then played once and the participants provided their responses on an answer sheet. The answers for each test item were categorized as either correct or incorrect and a total score for each task was calculated. The calculations were done using SPSS software, Windows 7 (64-bit) version 19.

5. Results

A series of independent samples t-test procedures were conducted to compare the perception of the English dental fricatives by the P and AP EFL learners. The overall standard score of the groups in the perception of dental fricatives summed up from both tasks showed a significant difference (t(88)= -2.061, p<.04) between P monolinguals (M=-.2413, SD=1.42) and AP bilinguals (M=.4374, SD=1.60). However,

http://oxfordlearnersdictionary.com/
looking separately at the results from each task revealed no significant difference between the two groups in the discrimination task ($t(88)=-0.92$, $p<.36$) and both groups did equally well in the task (P learners $M=14$, $SD=1.19$; AP learners: $M=14.44$, $SD=1.6$). The transcription task indicated a significant difference between the two groups ($t(88)=-2.11$, $p<.03$) with AP learners showing a slightly better performance, although both groups showed a poor performance on the task (P learners: $M=1.22$, $SD=1.17$; AP learners: $M=1.75$, $SD=1.04$), indicating that the transcription task was more challenging for them compared to the AX discrimination task. Investigating the target sounds separately in each task, we observed no significant difference for any of the sounds under investigation in AX discrimination task, but a significant difference was found between the two groups only in the transcription of the voiceless dental fricative ($t(88)=-2.77$, $p<.007$). Comparing the means of the two groups revealed that the AP learners outperformed P learners in identifying the [$\theta$] sound. The magnitude of the difference between the means calculated using Cohen’s $d$ was large (Table 1).

**Table 1:** Independent samples t-tests for [$\theta$]-[$\delta$] sounds in the AX discrimination and transcription tasks

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Sounds</th>
<th>$T$</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>Cohen’s $d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>AX</td>
<td>[$\delta$]</td>
<td>-0.675</td>
<td>88</td>
<td>.50</td>
<td>-133</td>
<td>.196</td>
<td>.142</td>
</tr>
<tr>
<td></td>
<td>[$\theta$]</td>
<td>-0.605</td>
<td>88</td>
<td>.54</td>
<td>-125</td>
<td>.207</td>
<td>.133</td>
</tr>
<tr>
<td>Transcription</td>
<td>[$\delta$]</td>
<td>-2.77*</td>
<td>88</td>
<td>.007</td>
<td>-459</td>
<td>.166</td>
<td>.61</td>
</tr>
<tr>
<td></td>
<td>[$\delta$]</td>
<td>-0.575</td>
<td>88</td>
<td>.567</td>
<td>-0.067</td>
<td>.116</td>
<td>.064</td>
</tr>
</tbody>
</table>

Regarding the substitutions that each group of the participants made for the dental fricatives in AX task, the results revealed that both P and AP learners confused [$\theta$] with [$f$] in 87% of the incorrect responses. The second most frequent substitution was [$s$] with 8% and 11%, followed by [$t$] with 5% and 2%, by P and AP learners, respectively. As for the voiced dental fricative [$\delta$], P learners misidentified it as [$v$] in 59%, as [$z$] in 40%, and as [$d$] in 1% of their inaccurate responses compared to the AP learners who confused it with [$v$] in 59%, with [$z$] in 37%, and with [$d$] in 4% of their incorrect responses (Figure 2).
Fig. 2: Misidentifications of the a) voiceless and b) voiced dental fricatives in the AX discrimination task

Regarding the transcription task, the results showed that \(<f>\) constituted the highest number of substitutions for the voiceless dental fricative represented by \(<\text{th}>\) among both P and AP learners (with 76% and 80%, respectively). P learners substituted \(<\text{s}>\) in 23%, and \(<\text{t}>\) in 1% of their inaccurate responses, while AP learners provided the same graphemes as substitutions in 18% and 2% of their incorrect responses, respectively. As for the voiced dental fricative represented also by \(<\text{th}>\), P learners identified it as \(<\text{w}>\) in 63%, as \(<\text{v}>\) in 21%, as \(<\text{z}>\) in 8%, and as \(<\text{d}>\) in 4% of their inaccurate responses; AP learners misidentified it as \(<\text{w}>\) in 65%, \(<\text{v}>\) in 23%, as \(<\text{z}>\) in 7%,
and as <d> in 2% of their incorrect responses. It was interesting to see <w> as a frequently substituted sound in the transcriptions by P and AP learners, a substitute which had not been previously reported in the literature (Figure 3).

**Fig. 3:** Substitutions for the a) voiceless and b) voiced dental fricative in the transcription task

6. **Discussion**

The goal of the present study was to find out if there is any difference between P and AP learners of English in the perception of English dental fricatives. A second aim of the study was to describe their perceptual substitutions, if any are made, shedding more light on the
acquisition of new L2 sounds by learners of various L1 backgrounds. It has been argued that in order for the L2 learners to produce the target sounds accurately, the target-like perception of the L2 phones is an important prerequisite (Flege 1995). Most of the research investigating the L2 phonology acquisition of Iranian learners, however, has focused on their production and the literature called for more research in this regard.

The results showed that the ability of the learners in the two groups to perceive [θ] and [ð] in a target-like manner was significantly different only in the transcription task in which both groups had an overall poor performance. The difference was limited to the identification of the voiceless dental fricative [θ] with AP listeners outperforming P listeners. The performance of the two groups in the AX discrimination task was not significantly different. The overall finding is counter to the acoustic similarity account (Flege 1995) that posits utmost difficulty for the perception of similar sounds and predicts equally good performance of both groups since the dental fricative sounds were “equivalent” for the AP learners and “new” for the P learners. However, a closer look at the results reveals equal performance of both groups in the AX discrimination that hinges on perceiving acoustic features, lending support for the Speech Learning Model (Flege, 1995) and emphasizing their auditory capabilities. The different performance in the transcription task points to a distinction between acoustic perception of sounds as a general strategy by language learners and establishing a phonological category facilitated by gestural similarity to L1 sounds (Best 1995) and through resorting to L1 Selective Perceptual Routines (Strange 2006, 2011). Specifically, the AP learners outperformed P learners in transcribing the [θ] sound, providing support that the former group might have been partially successful in equating one member of the [θ]/[ð] contrast with the native counterpart sound (Best 1995), underscoring the differential effect of their L1 in contrast to P learners.

The trend in the overall results evidence the beneficial impact of L1 phonological experience on L2 speech perception. Even in the AX task that measured the learners’ auditory performance and their ability for perceiving fine phonetic and acoustic distinctions exerted more influence, although no significant effect was observed, the results point into this direction. The transcription task was designed to tap into the phonemic knowledge of the learners and the time given
for task performance was enough to enable learners to extract categorical information from their phonological inventory. The lower performance of P listeners seemed to be influenced by the nonexistence of these sounds and their relevant phonetic categories in their phonological store. AP listeners, even peripherally, proved to be advantaged over P listeners due to the existence of these sound segments in their phonetic repertoire. In other words, the existence of equivalent L1 categories in their phonemic repertoire facilitated perceiving the non-native contrast for AP learners. Their better performance on [θ] can also be accounted in terms of it being a less marked sound in comparison to its voiced counterpart (Eckman 1977, 2008). To summarize, the results suggest that L1 phonetic categories do, in fact, play an important role in how the L2 learners perceive non-native target sounds modulated by markedness and will be surfaced in complex tasks requiring learners to extract information from their L1 phonological repertoire (Strange and Jenkins, 1978); otherwise, phonetic similarity takes the lead.

The second important finding, as related to the second research question, was that in both tasks, a large amount of substitutions in both discrimination task and transcription task is done on the basis of phonetic-acoustic similarity of the target sounds to L1 sounds and the most frequently reported substitute is [f] for [θ] in both tasks and both groups and [w] and [v] for [ð]. This finding is partially in line with De Wilde (2010) and Syed (2013) who have also reported that L2 learners of English confused [θ] and [ð] with acoustically similar [f] and [v], respectively. It is worthwhile to consider that AP learners have an equivalent contrast in their language, but when they make errors, they use acoustic cues and substitute an acoustically similar sound (Wester et al. 2007), rather than phonologically similar sounds ([s] and [z]) which make a very small portion of the substitutes. If perception relies on gestural similarity (Best and Tyler 2007), the expected perceptual substitutes are those that are articulatorily similar and very close in places of articulation – here alveolar [s] and [z] for the dental sounds that are both coronal, but both groups of learners have substituted sounds that have less similarity in articulation, i.e. the labiodental fricatives ([f] and [v]) based on phonetic cues, meaning that acoustic similarity overrides gestural similarity.

A rather surprising result was observed in the transcription task while addressing the second question: both groups of learners
reported <w> as a substitute for the voiced dental fricative in more than 60% of their substitutions. This substitution pattern can be explained for P learners in the light of the studies by Mehrpour and Makki (2011) reporting that Persian speakers pronounced English labiovelar approximant [w] as labiodental fricative [v] and Yarmohammadi (2005) who had described [v] and [w] as allophones of the same phoneme /v/ in Persian. P learners can be said to have extended the same pattern of substituting the voiced dental fricative with <v>, even if it surfaced as the <w> replacement. Regarding AP learners, the phoneme [v] does not exist in Arabic phonemic inventory (Watson 2002), and this replacement of the voiced dental fricative with <w> can be accounted for in two ways. AP learners are fluent Persian speakers and since they are learning English in an environment where Persian is the officially and functionally dominant language of interaction, even more so in formal contexts of instruction, they might have shown the same pattern as P learners through assimilation of [v] to native [w] category, to borrow Best’s terms (1995). However, further research is needed to investigate contact phonology of Persian and Arabic. Another explanation for this substitution might come from the lexical bias effect (Dell 1986) that they might have experienced when listening to the infrequent stimuli, here “thee” and “thine”, and accordingly they had perceived and transcribed them as the frequent words “we” & “wine”, receiving facilitating cues from both the partial orthographical form provided in the test and their familiarity with these English words. With some reservation, it can be concluded that both groups of learners had primarily misidentified the voiced dental fricative as [v], and they might have further undergone a process of making various decisions as to its orthographical representations as <w> or <v>.

Considering the findings related to both questions addressed in this study, it must be stated that in clear contrast to the studies that give knowledge of phonological category more prominence in second language speech perception (eg. Best 1995; Eckman 1977), the study showed that phonetic similarity plays a major role, not only in the discrimination of the sounds, but also in the identification and categorization of the sounds and their incorporation into their phonological space. Of course, given our data, we cannot be sure to claim how much of second language speech acquisition can be accounted for solely by recourse to acoustic similarity between non-
native and native sounds. The effect of L1 phonological repertoire, language ecology and markedness cannot be downplayed, as an interplay between these factors seem to have influenced the performance of AP learners, sometimes to their benefit as in the categorization of [θ] sound and sometimes to their disadvantage, mostly in the transcription task and in miscategorizing [ð] as [v].

This study focused on only two challenging English sounds in which Persian and Arabic are different. More studies on various similar and different non-native English sounds to the two languages such as liquids, labiodental fricative, velar approximants and vowels can be undertaken to give us a range of possible interactions between acoustic characteristics of sounds in and outside the relevant languages and their phonological systems. The tasks were also chosen from the two extremes of the perception continuum, one basically aimed at acoustic similarity and the other involved phonological categorization and grapheme-phoneme correspondence. To reduce the demands of the transcribing in a non-native script on the participants, orthography neutral tasks such as phoneme monitoring (Swinney and Prather 1980) and forced phonological identification task might be employed to provide us with a more reliable picture of their phonological knowledge and how they perceive non-native sounds. Also including tasks with different degrees of complexity that tap other aspects of their phonetics and phonological knowledge such as auditory phonological tasks of rhyming and pseudoword matching tasks might lead to a different pattern of performance and reveal the effect of L1 and language ecology better. Thus, given the ecology of language learners and considerations about the study design, some reservations must be made in the generalization of the data.

This study can, however, be repeated with Arabic monolingual and bilingual EFL learners from different language ecologies to study the differential impact of linguistic experience as well as the active responsible level (phonetic or phonology) in non-native speech perception; for instance, those residing in native English countries (England and United States) and those in countries with English as a non-native language (such as France and Germany whose dominant languages also lack the contrast). Investigating the same question in different levels of proficiency as suggested by Major and Kim (1996) would give us a picture of development from initial through uncertain transitory to final stages of category formation in non-native speech
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perception. The design of the study can also be further extended to have different arrays of interactions between languages with and without the interdental fricative sounds and other challenging sounds like liquid and labial approximant sounds. The instructors’ background and the language of instruction is an important factor that should be attended to in the investigation of language ecology impact.

7. Conclusion

This study tried to fill the gap that existed in the literature regarding English speech perception by Iranian learners with different linguistic experiences, namely Persian monolingual and Arabic-Persian bilingual EFL learners. Although the results did not yield a significant difference between the two groups in the discrimination and identification of the English sounds except in the identification of [θ], the trend supported the positive impact of linguistic experience, with AP listeners scoring constantly higher than P listeners for both sounds in the two tasks. An indisputable finding of this study was that phonetic similarity was more influential than gestural similarity in the substitutions in both tasks and by both groups of learners, although other study designs with different degrees of task complexity tapping different levels of phonetic and phonological knowledge of both groups is required before making a general statement.

8. References


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**Appendix A**

**AX discrimination test stimuli**

<table>
<thead>
<tr>
<th>f-θ</th>
<th>v-w</th>
<th>l-r</th>
<th>w-v</th>
<th>n-m</th>
</tr>
</thead>
<tbody>
<tr>
<td>dʒ-tʃ</td>
<td>m-n</td>
<td>w-w</td>
<td>θ-θ</td>
<td>v-v</td>
</tr>
<tr>
<td>d-d</td>
<td>t-t</td>
<td>ð-θ</td>
<td>θ-s</td>
<td>ð-ð</td>
</tr>
<tr>
<td>z-z</td>
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<td>n-n</td>
<td>f-f</td>
</tr>
<tr>
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<td>s-θ</td>
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<td>f-v</td>
<td>ð-z</td>
<td>ð-ʒ</td>
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<tr>
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<td>v-ð</td>
<td>m-m</td>
<td>d-t</td>
<td>l-l</td>
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**Appendix B**

**Transcription task stimuli**

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<th>1. Gawp</th>
<th>2. Lav</th>
<th>3. bawd</th>
<th>4. dike</th>
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<td>10. hod</td>
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<td>12. moap</td>
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<td>18. goof</td>
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