It has been well known that adult second language (L2) learners encounter difficulties learning L2 contrastive sound categories (Aoyama et al. 2004; Strange and Shafer 2008). Research on adult L2 learners has widely explored their acquisition of various English contrastive sounds such as English /l-r/ by Japanese learners (Bradlow et al. 1999; Hattori 2009; Sheldon and Strange 1982; Takagi 2002); however, less is known about Arabic learners’ perception and production of consonant contrastive sounds. In this follow-up investigation, the acquisition of Arabic consonant sounds by non-native adult speakers is examined. In particular, the study explores adult native English speakers’ ability to distinguish and accurately produce Arabic consonant contrasts and also examines the relationship between learners’ perception and production skills. To this end, 45 American English learners of Arabic from three separate levels of Arabic instructions participate in two chief tasks: perception and production. Three native Arabic speakers subsequently evaluate learners’ productions of the target stimuli as either correct or incorrect. The results show that novel Arabic contrastive consonant sounds are difficult for native English speakers to discriminate. However, the degree of difficulty varies, where the /t-ṭ/, /h-ħ/, and /s-ṣ/ pairs are found to be the most difficult and the /ħ-ʕ/ contrast is the easiest. Whereas advanced learners’ performance exceeds that of their counterparts in the other two groups, no difference in the performance on the two tasks is found between the beginner and intermediate learners of Arabic. Findings also provide some evidence for the perceptual assimilation model (PAM) predictions, where Best’s (1995) categories apply to certain learners’ perception patterns. Results suggest that even in the absence of study abroad experience and direct exposure to the Arabic language, English learners of Arabic are not only able to tackle the difficulties presented by the difficult Arabic consonant contrasts, but they show steady improvement as well.

3.1 Introduction

Learning a second language entails, among other things, acquiring its phonology. This seems to be a feasible task for young L2 language learners who start acquiring the second language by 6 years of age and subsequently achieve native-like proficiency (Long 1990). However, it is found to be a challenging task for late L2 learners, who encounter difficulties in perceiving...
and/or producing non-native segmental sound contrasts, and their speech is commonly characterized by a foreign accent (Goto 1971, Polka 1991; Bradlow et al. 1999; Aoyama et al. 2004; Broersma 2010). For instance, Japanese speakers have difficulty distinguishing and producing English /r/ and /l/ (Best 1995; Ingram and Park 1998; Bradlow and Pisoni 1999; Takagi 2002), and native Dutch speakers strive to differentiate words containing /æ/ from words containing /e/ (Broersma 2005; Cutler and Broersma 2005). In addition, Spanish learners of English find it difficult to discriminate and accurately produce the English /i/-/ɪ/ contrast and thus pronounce words like ‘ship’ as ‘sheep’, which results in comprehension misunderstandings (Flege and MacKay 2004).

In the realm of studying L2 learners’ acquisition of novel sounds, various research studies have investigated L2 learners’ perception and production skills (Borden et al. 1983; Flege 1999). In this regard, a good number of empirical studies have highlighted the influential role of several factors such as age of arrival (AOA) and length of residence (LOR) in the target country. For example, Bohn and Flege (1990) examined the perception and production of English vowels /e/ and /æ/ by two groups of native German speakers: experienced (i.e., lived in the United States (US) for more than five years) and inexperienced (i.e., lived in the US for less than six months). Findings showed that experienced learners were more accurate at perceiving and producing English vowel contrasts than their inexperienced counterparts. Bohn and Flege concluded that learners’ LOR could influence learners’ acquisition of novel L2 sounds. Moreover, Yamada (1995) found that native Japanese speakers with longer LOR and earlier AOA to the United States were more accurate at identifying synthetic English /l/ and /r/ contrasts than their counterparts with a short LOR and less L2 experience.

### 3.1.1 Background

By and large, the link between perception and production of unfamiliar L2 sounds in adult acquisition has been of growing interest to researchers in the past few decades. Findings of previous research studies have shown three main patterns explaining the nature of the perception-production relationship. The first pattern shows that learners’ perception ability is independent of their production ability (Borden et al. 1983; Flege 1988; Bohn and Flege 1990; Flege 1993). For example, Flege (1993) found Chinese and Taiwanese learners of English to be more accurate at perceiving the English /t/ and /d/ contrast than producing them. Furthermore, Flege et al. (1999) indicated that advanced native Italian leaners of English were less accurate at producing ten English vowels /i, ɪ, ɛ, æ, ə, ʌ, ɒ, ʊ, u/ than perceiving them. The second pattern stresses the link between perception and production that is confirmed by a number of studies. For instance, Akahane-Yamada et al. (1996) indicated that perceptual training for Japanese learners of English helped them to distinguish English /ɾ/-/l/ minimal pairs and consequently improving both learners’ perception and production. The same finding was confirmed by Okuno and Hardison (2016) who found that perceptual training could result in improving the production of Japanese vowel duration by English learners of Japanese. The third pattern, however, posits that perception is dependent on production. For example, some studies exhibited that the Japanese learners’ accurate production of the English /l-r/ consonant contrast may precede their accurate perception (Goto 1971; Sheldon and Strange 1982). Additionally, Zampini (1998) found evidence that production develops before perception for the Spanish /p/ by native English speakers. Similarly, Hattori (2009) found that intensive training improved Japanese learners’ production of the English /l/ and /ɾ/ but not their perception.
Taken together, the relationship between the perception and production of non-native contrastive sounds by adult L2 learners is still unclear where conflicting results were reported. Therefore, more research is still needed to better understand the nature of the link between the two abilities in adult L2 learners’ speech and consequently develop effective training that can help learners improve their perception and production skills. Thus, the first goal of this chapter is to explore the relationship between the perception and production of Arabic consonant phonemes by English learners of Arabic with different years of language instruction.

### 3.1.2 The Arabic language

Arabic is a Semitic language that is officially spoken by over 422 million in 22 countries in the Middle East and North Africa, where there are two main varieties used simultaneously: the high variety (i.e., Modern Standard Arabic (MSA)) and the low variety (i.e., the colloquial spoken dialects). While MSA is used in formal settings and is taught in schools and universities, the low variety includes a number of regional colloquial spoken variants that are commonly used in daily life communication and vary from one region to another. This paper focuses on MSA consonant phonemes (see the Introduction to this volume: Table 0.1). While MSA and English share a number of similar consonant phonemes (e.g., /b/, /t/, /d/, /k/, /ʔ/, /f/, /θ/, /ð/, /s/, /z/, /š/, /h/, /m/, /n/, /ʒ/, /l/, /r/, /w/, /j/), MSA has nine additional consonants sounds that are not part of the English consonant inventory (e.g., /ṭ/, /ḍ/, /ṣ/, /ð̩ /, /χ/, /γ/, /q/, /ħ/, /ʕ/) and represent a challenge for L2 Arabic learners (Alosh 1987; Shehata 2015a; Shehata 2017).

In the US context, Arabic is classified as a less commonly taught language that has recently witnessed a significant student enrollment increase at a number of US universities and colleges (Allen 2004; Welles 2004; Furman et al. 2010). Previous studies have mainly focused on literacy skills on Arabic as a first language (L1) (e.g., Asaad and Eviatar 2014; Saiegh-Haddad 2003; Abu-Rabia and Siegel 2002; Roman and Pavard 1987), a few on Arabic L2 reading and vocabulary (Khaldieh 2001, 2000; Redouane 2003), and most on Arabic L2 morphosyntax (Alhawary 2009). Nevertheless, few studies have investigated the acquisition of Arabic phonological features by adult L2 learners (Hong and Sarmah 2009; Zahid 1996), and among those, very little research has examined Modern Standard Arabic contrastive consonants experimentally exploring the difficulties that native American English speakers encounter in acquiring them (Alosh 1987; Shehata 2015b). For example, Alosh (1987) examined whether native Arabic speakers and American learners of Arabic utilized different strategies in perceiving Arabic pharyngealized consonants /sˤ, dˤ/. This was examined by using synthetic sounds consisting of three plain vowels /aa, ii, uu/ adjacent to each of the target consonants. The results provided evidence that the two groups used different strategies in distinguishing pharyngealization. Native Arabic speakers were better at discriminating pharyngealized consonants than their American counterparts, who seemed to be more sensitive to the pharyngealization feature in the pharyngealized vowel /aa/. Findings also showed a significant interaction between learners’ Arabic proficiency level and their abilities to identify pharyngealization, where learners with high proficiency level were more accurate at discriminating pharyngealization on the adjacent vowel.

Furthermore, Shehata (2015b) examined the influence of training in different talker variability presentation modes on the acquisition of Arabic pharyngeal-glottal consonant contrast /h-h/ by native speakers of English with no prior knowledge of Arabic using two discrimination AXB tasks: non-lexical and lexical. The results showed that learners who heard the target...
token produced by multiple speakers performed significantly more accurately than their counterparts in the single-talker training groups. This improvement was explained in terms of the richness of the input provided to learners in the multipletalker-training condition, which facilitated learners’ discrimination of the pharyngeal-glottal Arabic contrast.

More recently, Lancaster and Gor (2016) investigated English speakers’ perception of Arabic pharyngeal /ħ/, /ʕ/ and uvular /χ/, /γ/ fricatives using discrimination and identification tasks and a cloze test to investigate the predictions of two theoretical models: the perceptual assimilation model (PAM) and the automatic selective perception model (ASPM). The results provided evidence that learners were able to discriminate the pharyngeal sounds more accurately than the uvular ones on one hand and the voiced phonemes than their voiceless counterparts on the other hand. The authors concluded that their findings matched the predictions of the ASPM rather than PAM’s hypotheses.

The present study is a follow-up to Shehata (2015a) that explored the views of 107 adult native English speakers residing in the US regarding the difficulty of Arabic consonant phonemes in both perception and production. Learners’ beliefs about the essential factors in the acquisition of Arabic consonant sounds were also examined. Findings showed that the pharyngeal and the pharyngealized consonant phonemes were felt by learners to be too difficult to perceive, and produce. Moreover, all learners reported the fricative pharyngeal-glottal /h-ħ/ phoneme contrast to be the most challenging Arabic consonant contrast. This study attempts to build on earlier work by experimentally examining the perception and production of the same Arabic consonant contrasts used in Shehata’s study (2015a) by American English learners of Arabic. It aims at showing the effect of learners’ years of study on their discrimination and production abilities of the target contrastive consonants.

3.2 Statement of the research questions

Modern Standard Arabic includes a number of consonant sounds that represent a substantial challenge for English learners (Alosh 1987; Shehata 2015a, 2015b). Prior research has mainly focused on exploring adult L2 learners’ perception and production of novel Arabic segments independently (Alwabari 2013; Al Mahmoud 2013). However, the interrelation between L2 learners’ perception and production of Arabic consonant phonemes is still unclear. Thus, the present research aims to fill this research gap by exploring the relationship between native English speakers’ accuracy in perceiving and producing Arabic consonant contrasts, addressing the following two main questions:

1. Do learners’ years of Arabic instruction influence their perception and production of Arabic consonant contrasts?
2. Is there a relationship between learners’ perception and production of Arabic consonant contrasts?

3.3 Methods

3.3.1 Participants

There were two groups of subjects who participated in the current study. The first group included 45 native American English learners of Arabic between the ages of 18–30 years old (mean = 21) who were divided into three subgroups based on their length of study of the
Asmaa Shehata

Arabic language. In the beginner group, there were 15 native English speakers (ten females and five males) who spent at least one year studying Arabic (with a total of eight credit hours) and were in their third Arabic semester at the time of the study. In the intermediate group, there were 15 learners (nine females and six males) who studied Arabic for two years (with a total of 16 credit hours) and were in their fifth Arabic semester at the time of the study. The advanced group included 15 learners (eight females and seven males) who studied Arabic for three and a half years (with a total of 24 credit hours) and were in their seventh Arabic semester at the time of the study. All learners were recruited from a large Midwest university campus in the US, and they either received course credit or were paid for their participation. In the language background questionnaire that all learners completed before performing the study, they reported having no speech or hearing problems. None of them studied Arabic abroad nor spent extended periods of time in an Arabic-speaking country. The second group included three native Arabic speakers who listened to participants’ recordings in the production task grouped by target words and scored each token in turn as correct or incorrect. The three raters were graduate students at the same university where the data were collected; two of them were studying literature and the third one was studying education. Table 3.1 presents information about the three raters.

3.3.2 Stimuli and procedures

Twenty monosyllabic CVC Arabic nonwords were used as stimuli in the perception experiment and as target words in the production task. These tokens comprised ten minimal pairs contrasting the target Arabic phonemes (i.e., /t-ṭ/, /d-ḍ/, /δ-ɗ/, /ð-ð̣/, /s-ṣ/, /h-ħ/, /k-q/, /ʔ-ʕ/, /χ-ɣ/ and /ħ-ʕ/) in onset position (e.g., /da:k-ḍa:k/). These were the same nine consonant contrasts used in Shehata’s research (2015a), in addition to the pharyngeal contrast /ħ-ʕ/ that learners reported in their questionnaires to be a problematic contrast. The reason for choosing these sounds in particular was to be able to compare learners’ beliefs reported in the previous study with their actual performance in the current study. A native male Arabic speaker produced each of the nonwords four times in a carrier sentence, ʔuriidu ʔan ʔaquul kali- mata ______ “I want to say the word ________,” in a sound-attenuated booth, using a Marantz PMD 660 recorder and a Samson QV microphone. After recording, the second production of each stimulus was extracted and normalized to 65dB using Praat (Boersma and Weenink 2012). A list of the stimuli is provided in Table 3.2. Besides the language background questionnaire, all participants completed two main tasks: (1) a read-aloud production task; and (2) an AXB discrimination perception task; these were completed in the order explained here.

<table>
<thead>
<tr>
<th>Table 3.1 Three raters’ information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Rater 1</td>
</tr>
<tr>
<td>Rater 2</td>
</tr>
<tr>
<td>Rater 3</td>
</tr>
</tbody>
</table>
Table 3.2 Stimuli used in the perception and production tasks

<table>
<thead>
<tr>
<th>Consonant Contrast</th>
<th>Pseudowords (Auditory)</th>
<th>Arabic Script (Production)</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t-ṭ/</td>
<td>/ta:k-ṭa:k/</td>
<td>تاك – طاك</td>
</tr>
<tr>
<td>/θ-ð/</td>
<td>/θa:k-ða:k/</td>
<td>ذاك – ذاك</td>
</tr>
<tr>
<td>/s-ṣ/</td>
<td>/sa:k-ṣa:k/</td>
<td>صاك – صاك</td>
</tr>
<tr>
<td>/d-ḍ/</td>
<td>/da:k-ḍa:k/</td>
<td>داك – داك</td>
</tr>
<tr>
<td>/h-h/</td>
<td>/ha:k-ha:k/</td>
<td>هاك – هاك</td>
</tr>
<tr>
<td>/k-q/</td>
<td>/ka:k-qa:k/</td>
<td>قاك – قاك</td>
</tr>
<tr>
<td>/ʔ-ʕ/</td>
<td>/ʔa:k-ʕa:k/</td>
<td>عاك – عاك</td>
</tr>
<tr>
<td>/χ-ɣ/</td>
<td>/χa:k-ɣa:k/</td>
<td>خاك – خاك</td>
</tr>
<tr>
<td>/ħ-ʕ/</td>
<td>/ħa:k-ʕa:k/</td>
<td>عاك – عاك</td>
</tr>
</tbody>
</table>

3.3.2.1 Production task

The production task took place first in order not to expose the participants to auditory input involving the target stimuli. In a sound-attenuated booth, all learners were recorded using a Marantz PMD 660 recorder and a Samson QV microphone while producing the target minimal pairs that were presented in a word list using Arabic script (see Table 3.2). The recordings were later played to three native Arabic speakers who heard 45 recordings of each target word produced by different talkers, which they rated as either correct or incorrect. The inter-rater reliability score was 0.933, which referred to a very strong relationship between the three raters. The choice of the production task was guided by previous relevant research (Alosh 1987; Bradlow et al. 1997; Flege 1993; Hattori 2009; Munro 1992; Okuno and Hardison 2016) that indicated the appropriateness of this task that measures learners’ language production abilities of the target language. Moreover, the use of nonsense words makes this controlled task a suitable one, because the goal was to check if participants could produce the target sounds and blend them into words rather than recognizing the words by sight.

3.3.2.2 Perception task

After completing the production task, the same native English speakers participated in an AXB discrimination task in which they heard three nonwords (A, X, and B) and decided whether the second (X) was more similar to the first (A) or the third (B); e.g., /ta:k/, /ṭa:k/, /ṭa:k/. Participants registered their responses by pressing either the right or left shift keys (labeled First and Third) on a keyboard. Four test items (AAB, ABB, BAA, BBA) were generated for each of the 10 contrasts (listed in Table 3.2), as in the example here:

AAB /ta:k/, /ta:k/, /ṭa:k/
ABB /ta:k/, /ṭa:k/, /ṭa:k/
BAA /ta:k/, /ta:k/, /ta:k/
BBA /ṭa:k/, /ṭa:k/, /ta:k/

This resulted in a total of 40 that were presented in random order per block, and each block was presented four times (40 × 4 blocks = 160 total). The task took place in a sound-attenuated booth over one session that lasted for 30 minutes.
3.4 Results

3.4.1 Consonant production

Each participant’s correct production of each token, as rated by the three native speakers, was calculated and submitted to a two-way analysis of variance (ANOVA) to test the effect of contrast type (ten levels) and learner level (three levels: beginners, intermediate, and advanced) on learners’ production accuracy of the target consonant contrasts. The results indicated a significant effect of the contrast type, $F(9, 42) = 5.127, p < .001$ where /θ-ð/ and /χ-ɣ/ contrasts were the easiest and /h-ħ/ was the most difficult to produce, where learners’ accuracy rate was 100% and 66% respectively. There was also a significant effect of learner level, $F(2, 42) = 13.925, p < .001$ (see Figure 3.1). Crucially, there was no significant interaction between the effects of contrast type and learner level, $F(2, 42) = .580, p = .914$.

As seen in Figure 3.1, the accuracy of learners in the three groups reached the ceiling for two different contrasts: the familiar contrast /θ-ð/ and the novel one /χ-ɣ/. However, their production accuracy of the emphatic contrasts (i.e., /t-ṭ/, /s-ṣ/, /θ-ð̣/, /d-ḍ/) and the pharyngeal contrast /h-ʕ/ varied. Yet the pharyngeal-glottal contrast /ʔ-ʕ/ was found to be relatively less challenging, where learners’ accuracy rate was 73%. A Bonferroni post hoc test showed that the advanced learners were significantly more accurate at producing the target consonant contrasts than the beginner group ($p < .001$) and the intermediate group ($p = .003$). However, there was no significant difference between the beginner and intermediate groups ($p = .110$).

![Figure 3.1 Mean proportion correct for learners’ production by group and contrast](image-url)
3.4.2 Consonant perception

Each participant’s proportion of correct responses for the ten target contrasts was calculated, and the data were analyzed using a two-way ANOVA that examined the significance of the independent variable (contrast type). The results indicated a significant effect of contrast, $F(9, 42) = 4.798, p < .001$, and of learner level, $F(2, 42) = 8.660, p < .001$ (see Figure 3.2). However, there was no significant interaction between the effects of contrast type and learner level, $F(2, 42) = .248, p = .999$, indicating that the three groups did not differ from one another in their performance on the target contrasts.

A Bonferroni post hoc test showed that the advanced learners were significantly more accurate at discriminating the target Arabic consonant contrasts than the beginners ($p < .001$) and marginally more accurate than the intermediate learners ($p = .072$). However, the beginner group did not differ significantly from the intermediate one ($p = .179$). Taken together, the results suggested that both beginner and intermediate Arabic learners had more difficulty producing and discriminating the target consonant contrasts than the advanced learners.

3.4.3 Comparing perception and production

To examine the relationship between perception and production, participants’ perception and production scores were compared via a Spearman nonparametric correlation analysis, which showed a positive correlation between learners’ perception and production accuracy scores ($r = .740, p < .0001$), indicating the link between the two skills (see Figure 3.3).
Figure 3.3 Learners’ mean production and perception scores per contrast and group

3.5 Discussion

This study sheds light on American English speakers’ perception and production of 10 Arabic consonant contrasts and also explores the role of learners’ years of language instruction in their acquisition of these target L2 phonemes. In doing so, this study provides new data regarding the relationship between speech perception and production. In accordance with PAM predictions, learners’ discrimination success rate for the familiar /θ-ð/ contrast that PAM classifies as two-category assimilation (TC) is not only excellent (100%) but also the highest across other contrast types. This finding is consistent with native English speakers’ high accuracy for the Zulu TC pair /ɬ-ɮ/ and Malay speakers’ high accuracy rate for the English TC contrasts (/t-d/ and /f-v/) reported in Best et al. (2001) and Pilus (2005), respectively. In general, the results provide evidence that native English speakers experience difficulty distinguishing novel Arabic contrastive consonants such as /t-ṭ/, and /d-ḍ/. It is interesting to see learners stumbling over the /h-ħ/ contrast, which includes one familiar sound /h/ contrasting to an unfamiliar one /ħ/, but performing better on the voiceless-voiced phalangeal /ħ-ʕ/ contrast that includes two unfamiliar phonemes. This could be explained in light of PAM’s prediction of poor discrimination for the single category (SC) contrast, which includes one familiar sound [h] and an unfamiliar one [ħ]. Therefore, all learners regardless of their language level find the /h-ħ/ pair the hardest contrast. This can also explain learners’ poor success rate of the velar-uvular contrast /k-q/. Along the same line, learners’ discrimination accuracy for the other pharyngealized contrastive consonant sounds (i.e., /t-t̚/, /d-d̚/, /d-ð̣/, and /s-ṣ/) is slightly low, which is consistent with Alosh (1987), Alwabari (2013), and Shehata (2015a). With non-assimilable (NA) pairs that include distinct novel sounds that are not within the English phonetic space, however, learners find the /χ-ɣ/ and /ʕ-ħ/ contrasts to be easier, and their overall success rate is relatively good.

In relation to production results, it is worth noting that learners perform better in the word production task in general and reach ceiling in their accurate production of /θ-ð/ and /χ-ɣ/.
Native English speakers’ perception and production of Arabic consonants

(100%) contrasts in particular. In general, learners’ accuracy production scores are above chance for the other contrasts except for /h-ḫ/ and /d-ḍ/ contrasts, on which the intermediate learners performed above chance and the beginners performed at random chance. It is also found that the perception and production difficulties vary in light of the number of years of study. Advanced learners significantly display a different pattern across contrast types in comparison to the beginner and intermediate groups in both perception and production, and this answers the first research question. For instance, the production accuracy for the /ð-ð̣/ contrast improves from 57% for the beginner learners to 63% for the intermediate group and reaches ceiling (93%) for the advanced learners. By and large, after three years of study, the advanced group is at near ceiling level of accuracy in production and performs above chance in perception. In contrast, the beginner group displays more errors in distinguishing and producing the target tokens than the intermediate group; however, the results provide no evidence that the performance of the two groups significantly differs on both the AXB discrimination task and the read-aloud production task.

Comparing the findings of the present study to those of Shehata’s (2015a) shows similarities concerning learners’ difficulty of distinguishing the pharyngeal and pharyngealized consonant phonemes. The two studies also agree regarding the relative easiness of perceiving and producing both the /χ-ɣ/ and the /ʔ-ʕ/ pairs. However, there are some differences between the two studies regarding the level of difficulty of the Arabic contrasts at large. As shown in Figure 3.4, learners’ fears about difficulties reported in Shehata (2015a) were much higher than the actual performance of participants in the present study. For example, although learners in Shehata (2015a) reported a high level of difficulty for both /d-ḍ/ and /ð-ð̣/, which was over 70%, it is found to be less than 40% in this study. Even for the pharyngeal-glottal contrast that was found to be the most difficult phoneme to acquire in the two studies, its level of difficulty was higher (over 90%) in Shehata (2015a) than the current study (less than 48%). By and large, one of the positive findings of this study is the advanced learners’ improved overall accuracy in the identification and production of the target sounds, which gives a good message to beginner and intermediate learners that endurance pays off.

Figure 3.4a Percentage of difficulty of Arabic consonant phoneme contrasts in Shehata’s study (2015a)
Importantly, the results reveal that native English learners’ production ability, measured by a controlled production task, is positively correlated with perception ability, measured via an AXB discrimination task, and this answers the second research question. The results are consistent with previous research (Yamada et al. 1994; Bradlow et al. 1999) that found a significant link between L2 learners’ accurate production and perception of L2 phonemes. These similar findings can be explained in light of using the same controlled production task to examine learners’ production ability (i.e., of pronunciation). Although the results here suggest the link between the two language skills, the findings should be interpreted with some caution, as learners’ production is only tested by a reading aloud production task that may not accurately represent learners’ productive pronunciation accuracy. It is left to be seen whether using a less controlled (more spontaneous) production task such as a picture description task, which ensures subjects produce the target sounds in a communicative way, can lead to different results. There are two additional limitations in this study. First, the study’s stimuli focus on positing target sounds only in the initial position; second, they are presented in isolation. Testing target contrasts in different phonetic positions (i.e., initial, middle, and final) and in rich communicative contexts can give more robust results. For future investigation, other production tasks can be considered (e.g., a picture-naming task) and other phonological environmental positions (i.e., middle and final) can be investigated. Future research may also explore the possibility of extending the present study to new groups of learners with different L1 backgrounds and employing perceptual training to better understand the relation between Arabic consonant production and perception accuracies.

3.6 Conclusion and pedagogical implications

This chapter aims at exploring the learnability of Arabic consonant contrasts by examining the perception and production accuracies among native speakers of English from different Arabic instruction levels. Overall, the findings suggest that perception and production are dependent skills, where high production accuracy corresponds to high perception accuracy. Furthermore,
the number of years of study is found to be a significant variable at the advanced level that positively influences learners’ production and discrimination accuracy of all contrastive consonant sounds. In all cases, low proficiency learners (beginner and intermediate groups) find Arabic contrastive consonant sounds more challenging to discriminate and produce than advanced learners. Additionally, the data support a number of PAM hypotheses regarding certain assimilation patterns (e.g., /θ-ð/, /ʕ-ħ/, and /h-ħ/).

The study adds to the growing body of literature examining L2 learners’ acquisition of Arabic consonant sounds and has two crucial implications. First, the findings provide evidence that perception and production are connected, and thus teachers can help their students practice the two skills together. Second, results display that it is indeed the case that the pharyngeal-glottal contrast represents a challenge for L2 learners, who find it difficult to identify and produce even after years of language experience. Therefore, it is suggested that teachers need to develop instructional materials and practice drills that provide learners with various opportunities to practice these contrastive sounds and enable them to achieve perceptual and production improvements on all of them. This is the second study in the planned empirical research that is intended to provide data involving the Arabic language. Further studies are on the way that examine English learners’ perception and production of Arabic contrasts in different positions (initial, middle, and final) using different perception and production tasks at both controlled and spontaneous levels.

References
Native English speakers’ perception and production of Arabic consonants


