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Phonological Processes in The Production of English Consonants by Yemeni Efl Speakers of English

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Abstract

The Arabic consonant inventory lacks a few English consonants. This difference opens up a number of avenues for empirical research in L2 speech learning among EFL Arab learners of English. The present study, thus, aims to investigate the extent to which (1) phonological processes (i.e., voicing, devoicing, stopping, deaffrication, palatalisation, and velarisation) take place in Yemeni EFL learners' production of six target English consonants (i.e., /p/, /v/, /θ/, /ð/, /tʃ/, and /dʒ/); and (2) word position affects the frequency of these phonological processes in the production of the investigated sounds by Yemeni EFL speakers of English. Six Yemeni postgraduate students at Utara Universiti Malaysia (UUM) (three males and three females) were recruited for this acoustic phonetic study. They learn English as a foreign language (EFL) in Yemen. The productions of the target consonants across the three-word positions in isolation and a carrier sentence were recorded. The data were later acoustically analysed. The results showed that the most frequent phonological process in Yemeni EFL speakers' production was devoicing, followed by voicing, deaffrication, stopping, velarisation, and then palatalisation. Moreover, word position was shown to have a significant effect on voicing and devoicing, yet a near-significant influence on palatalisation. The influence of word position on stopping, deaffrication, and velarisation, on the other hand, was insignificant. The findings lend evidence to the importance of producing the target consonants correctly by L2 speakers of English to avoid misunderstanding due to such phonological processes. The results have important implications for L2 speech learning and pronunciation teaching and learning. More specifically, the results filled a knowledge gap in the phonetic literature regarding research on phonological processes by adult EFL Arab learners in general and Yemeni EFL learners in particular.

Keywords: Acoustic phonetic; EFL; phonological processes; production; word position

Introduction

Pronunciation is a primary hurdle in the language competence of a second-language (henceforth L2) user (Al-Ahdal, 2020). It is crucial for effective communication (Ridwan, 2020). However, one of the most challenging areas of acquiring a foreign language is to master its pronunciation. Some EFL/ESL learners make errors while producing some English sounds due to the effect of their first language (hereafter L1) to facilitate the pronunciation of the problematic sounds for them, leading to the existence of several phonological processes (Umale, 2015).

Phonological processes refer to the rules implemented by learners of a second language to simplify the pronunciation of L2 sounds (Leung & Brice, 2012). In general, phonological processes do not continue, particularly when a child reaches a particular developmental age. It was noted that the age at which the child stops using phonological processes varies by language (So & Dodd, 1995). Nevertheless, unlike children, adults may not overcome such developmental progression and continue to exhibit some deviations (Selinker & Lamendella, 1980).

The Speech Learning Model (henceforth SLM) of L2 speech learning by Flege (1995) argues that an adult's phonological system is malleable and that adult learners of a language can improve L2 pronunciation with an increase in experience and without direct pronunciation training. Hence, it was recommended by Franklin and McDaniel (2016) that future research should explore whether there is a predictable pattern in the disappearance of phonological processes over time in adult English learners' speech. Such an analysis can open the door to interesting clinical studies on pronunciation training approaches and adult accent modification (Franklin & McDaniel, 2016).

Problem Statement

Arab learners of English have trouble when producing certain sounds (Altamimi, 2015). In place of the real English sounds produced by instructors, sounds that are familiar in their L1 (Arabic) are heard. This causes learners to often repeat and produce errors in sounds. As a consequence, this affects the capacity of the learner to reproduce accurate sounds, causing misunderstanding when communicating orally in English. Such unintelligible sounds create obstacles and barriers to make successful communication among speakers (Ahmad, 2011).

Several experts suggested that Arab learners of English often have trouble with voicing contrasts for pairs, such as /p/–/b/ and /v/–/f/, and they are not aware of how certain sounds (e.g., /dʒ/, /ʒ/, /tʃ/ and /ʃ/) are produced (Rehman et al., 2020). Shabbir and Bughio (2009) also stated that some English sounds are unavailable in Arabic, including /p/, /v/, /g/, and /ʧ/, so Arab learners of English tend to substitute or borrow them from some other sounds of the English language.

Substitution of a sound can cause serious pronunciation troubles (Shabbir & Bughio, 2009) since it brings various meanings, particularly in words with identical spelling, yet different pronunciation (Tajeldeen, 2019) as in "Can I *bark* here?" instead of "Can I *park* here?" (El Zarka, 2013, p. 13). The English voiceless bilabial stop /p/ does not exist in the Arabic language, so some Arab learners of English unusually substitute /p/ with its voiced counterpart stop /b/, using the voicing as a repair strategy (El Zarka, 2013). Such usage of voicing in this context could result in miscommunication or incorrect-message delivery and so hindering mutual intelligibility (Mohammed, 2019).

The same pattern is applied to the English voiced labiodental fricative /v/ that triggers the majority of Arab learners to apply devoicing repair strategies because of its nonexistence in Arabic. Hence, Arab speakers of English incorrectly produce "vine" as "fine" and "veil" as "fail"(Barros, 2003).

In addition, the /dʒ/ sound is a cluster of /d/ and /ʒ/, which are produced together like

one diphthong sound of English (Chouchane, 2016). However, /dʒ/ is sometimes mispronounced as /g/ (velarised) by several Arab learners of English (Chouchane, 2016). For instance, the word "just" /dʒʌst/ is wrongly produced as /gʌst/, while "just", as well as "gust", are different words. Such a wrong production of /dʒ/ occurs due to fossilisation (Chouchane, 2016). Arab learners of English also wrongly produce "chair" /ʧeə/ as "share" (Shabbir & Bughio, 2009). Furthermore, Avery and Ehrlich (1992) confirmed that speakers of some dialects in Arabic might substitute /t/ for /θ/ and /ð/ with /d/, whereas speakers of other dialects may replace them with /s/ and /z/, respectively.

To date, little is known about the phonological processes that Yemeni EFL (adult) learners make when they produce English sounds in general. Moreover, very few past studies (e.g., Franklin & McDaniel, 2016; Iadkert & Hashim, 2020; Leung & Brice, 2012) investigated the phonological processes in adults' production of English sounds. As Franklin and McDaniel (2016) confirmed, fewer researchers have characterised the pronunciation of adult speakers of English as an L2 using phonological processes. In contrast, several studies were conducted on children's phonological processes when producing English sounds (e.g., Dinnsen et al., 2011; Ingram, 1986; Kirk & Vigeland, 2015; McIntosh & Dodd, 2008). Therefore, the current study aims to explore the phonological processes when producing six English consonants (i.e., /p/, /v/, /θ/, /ð/, /ʧ/, and /dʒ/) by Yemeni EFL postgraduate students at UUM. The target phonological processes to be investigated in the current study are (1) voicing, (2) devoicing, (3) stopping, (4) deaffrication, (5) velarisation, and (6) palatalisation.

Voicing as a phonological process refers to substituting a voiceless consonant with a voiced sound (Nicolosi et al., 2004). Voicing may involve either the wrong production of a voiceless consonant as a voiced sound, such as the wrong production of /p/ as /b/, or producing voiceless sounds with some voicing, as in the production of /ʧ/ and /θ/ with some voicing. On the other hand, devoicing indicates the replacement of a voiceless consonant for its voiced pair (Nicolosi et al., 2004), as in the substitution of /f/ for /v/, /θ/ instead of /ð/, or /dʒ/ as /ʧ/. EFL speakers may also incorrectly produce the consonant sounds /ð/ and /dʒ/ without voicing.

The other target phonological process is stopping, in which a fricative consonant is substituted with a stop (Nicolosi et al., 2004), as in the incorrect production of /θ/ as /t/ or either /d/ (or /t/) in place of /ð/. Moreover, deaffrication occurs when an affricate sound is substituted with a fricative sound (Campbell, 2013), as in the wrong production of /ʃ/ for /ʧ/ or /ʒ/ instead of /dʒ/. The affricate /dʒ/ may also be palatalised as /j/ (Hamzah, Bin Hadjah & Abdullah, 2020) or velarised as /g/.

Literature Review

Among the few prior studies that examined adults' phonological processes when producing English sounds is the one by Leung and Brice (2012). It analysed the phonological processes in the production of English sounds by 37 adult Cantonese-English speakers living in Hong Kong. Out of the total deviation (459), the most frequent phonological processes in Leung and Brice's (2012) study were gliding, lip rounding, vowel deviation, cluster reduction, fronting, and affrication. Nevertheless, the target phonological processes of the present study that were not frequent in the production of the Cantonese-English speakers were devoicing, voicing, stopping, and deaffrication.

Similarly, Franklin and McDaniel (2016) evaluated the production of some English

sentences by two female adult Japanese speakers staying in Washington. The deviations found in the speakers' production of English sounds were vocalisation, cluster reduction, final consonant devoicing, final consonant deletion, and stopping. Another study by Iadkert and Hashim (2020) examined Thai university students' production of English codas. The findings demonstrated three types of errors in the production of coda consonants by the participants: substitution, deletion, and insertion (see also Mohamad & Dako, 2021). Such phonological processes were found in non-English languages, including Buginese (L1), when speaking the Indonesian language (L2), as revealed by Jaya (2018). Other researchers investigated phonological processes displayed by children when acquiring non-English languages (e.g., Abou-Elsaad et al., 2019; Maphalala et al., 2014).

However, most studies did not directly examine the phonological processes. Instead, they listed substitution changes in the production of English sounds by non-Arab or Arab L2 learners of English. For instance, Farrah and Halahlah (2020) revealed that Palestinian English-major learners substituted /p/ with /b/ (voicing). Such a substitution of /p/ with /b/ was also displayed by other non-Arab (Inyang et al., 2017) or Arab learners of English (Al Abdey & Abdul-Rahman, 2021; Al Mafalees, 2020; Motair & Mhamed, 2022; Naser & Hamzah, 2018). Other speakers, including Akan L2 speakers of English, substituted /θ/ with /ð/ (Kpogo & Gathercole, 2020), which is another type of voicing.

Several researchers found that some English voiced consonants were substituted with their voiceless counterparts (devoicing). For example, the substitution of /v/ with /f/ was detected in the production of Arab (Kalaldeh, 2016; Motair & Mhamed, 2022) or non-Arab L2 speakers of English (Adnyani, 2021; Agustine et al., 2022; Chen & Han, 2019; Sridhanyarat, 2017; Untoro & Rustipa, 2020). Moreover, Demirezen (2021) found that /ʤ/ was produced as /ʧ/ (devoiced) by Turkish learners of English.

Substituting /ð/ with /d/ or /t/ and/or /θ/ with /t/ (stopping) was shown by a number of non-Arab L2 speakers of English. For instance, Kpogo and Gathercole (2020) revealed that Akan-English bilinguals wrongly produced /t/ in place of /θ/, while /d/ or /t/ for /ð/, which are all types of stopping (see also Agustine et al., 2022; Asante et al., 2022; Firdaus et al., 2020; Mariani, 2021; Maswani et al., 2021). Arab EFL learners were also found to substitute /θ/ with /t/ and wrongly produce /ð/ as /d/ (Jahara & Abdelrady, 2021; Motair & Mhamed, 2022).

Additionally, other types of English consonant substitutions may include the wrong production of /ʧ/ as /ʃ/, or /ʒ/ for /ʤ/ (deaffrication). The wrong production of /ʃ/ for /ʧ/ was demonstrated by non-Arab speakers of English (Paramal, 2019; Safotso, 2018) besides Arab EFL learners (Bin Hadjah & Jupri, 2018; Farrah & Halahlah, 2020; Hamzah, Bin Hadjah & Abdullah, 2020). Likewise, the substitution of /ʤ/ with /ʒ/ was shown by non-Arab learners (Safotso, 2018) and some Arab learners when speaking English (Emran & Anggani, 2017; Hamzah, Bin Hadjah & Abdullah, 2020; Motair & Mhamed, 2022).

Moreover, the incorrect production of /ʤ/ as /g/ (velarisation) was found in a few previous studies (e.g., Chouchane, 2016; Maswani et al., 2021). Other speakers of English were shown to substitute /ʤ/ with /j/ (palatalisation) (Hamzah, Bin Hadjah & Abdullah, 2020; Senowarsito & Ardini, 2019).

Furthermore, little has been known about the effect of word position on the occurrence of phonological processes in adult speakers' production of English sounds. For instance, Hamzah, Bin Hadjah and Abdullah (2020) showed that /ʧ/ was deaffricated as /ʃ/

more frequently in word-final position compared to the other word positions, while /ʤ/ was palatalised as /j/ when occurring word-medially or word-finally (see also Bin Hadjah & Jupri, 2018). However, many previous studies that indicated such an effect of word position on the production of English sounds used the general term "substitution" rather than the exact phonological process (e.g., Adhani et al., 2021; Alzinaidi & Abdel Latif, 2019; Farrah & Halahlah, 2020; Kpogo & Gathercole, 2020; Sridhanyarat, 2017; Thakur, 2020). In a few studies (e.g., Hamzah & El-Weshahi's, 2018), however, word position was found to slightly affect the production of English sounds.

The experimental results of the current study will assess the prediction of the SLM and the Contrastive Analysis Hypothesis (henceforth CAH) by Lado (1957) regarding whether the occurrence of phonological processes will be more frequent in the shared (i.e., /θ/, /ð/, and /ʤ/) or non-shared consonants (i.e., /ʧ/, /p/, and /v/) between English (L2) and Arabic (L1). This study aims to answer the following research questions:

RQ1. To what extent do phonological processes (i.e., voicing, devoicing, stopping, deaffrication, palatalisation, and velarisation) take place in Yemeni EFL learners' production of six target English consonants (i.e., /p/, /v/, /θ/, /ð/, /ʧ/, and /ʤ/)?

RQ2. To what extent does word position influence the occurrence of these phonological processes in Yemeni EFL learners' production of the six target sounds?

The findings of this study will show which phonological process exists more frequently in the production of the six target consonants by Yemeni L2 speakers of English and whether or not their occurrence will be affected by word position. The study hypothesis, thus, puts forward that word position affects the frequency of the investigated phonological processes. Yemeni EFL speakers' production of English consonants was shown in a few prior studies to be affected by word position (e.g., Al Mafalees, 2020; Bin Hadjah & Jupri, 2018; Hamzah, Bin Hadjah & Abdullah, 2020).

Method

Research design

The present study employed a quantitative case-study research design. In quantitative research, numerical data is collected from a large number of people via instruments with predetermined questions and answers (Creswell, 2012). In this study, the researchers recorded and then acoustically analysed 2592 tokens: 72 words × 6 times reading (3 times in isolation, 3 times in a carrier sentence) = 432; 432 × 6 speakers = **2592**. Thus, the number of speakers was appropriate and considered as a large number.

Participants

The sample of the current study was collected using a purposive sampling technique. According to Mills et al. (2010), by means of all the distinct rationales for selecting cases, purposive or strategic sampling is accomplished when researchers intentionally take into account the characteristics of the case. The participants were Yemeni non-English major EFL postgraduates (three males: MS1, MS2, MS3; and three females: FS4, FS5, and FS6) at UUM. Their L1 was Arabic. They received their primary, secondary, and first-degree education in Yemeni schools. They studied English as a foreign language in Yemen. They lacked any exposure to a native English-speaking environment. All the participants received

more than Band 6 at the UUM final examination of the English intensive course.

Instruments

The target consonants of the current study were included in 72 isolated words. We implemented words with specific features: the number of words for each target sound was four in both word-initial and word-final positions: two monosyllabic words and two disyllabic words. However, in word-medial position, all words were disyllabic. The investigated sounds in word-medial position were included in words with two syllables for better measurements of their acoustic properties. Each of the 72 isolated words was then inserted in the following carrier sentence: *"I say (the target word) three times."* which was adapted from Hamzah (2013).

Data collection

First, the speakers were asked to produce the isolated words three times (i.e., the same 72 isolated words were included in three lists yet in random order to be read one after another). After completing the first experiment, the second production task was given to the speakers, in which the seventy-two isolated words were ordered differently in three lists within the previously mentioned carrier sentence.

Prior to collecting data, the instrument was piloted to ensure both its validity and reliability. The content validity of the two instruments was assured by a jury of five experts in teaching English and linguistics (three Malaysians and two Yemenis). Furthermore, Cronbach's Alpha, as found, was .868, hence ensuring the reliability of the instrument (Nunnally, 1978).

Data analysis

The procedure for data analysis was as follows: Firstly, the data of the production experiments were recorded using a smartphone and then analysed using Praat (Boersma & Weenink, 2022). Concerning the analysis of /p/ and /v/ in Praat, the voicing or devoicing of /p/ and /v/ were identified by visually inspecting the existence of the pulses, pitch, and voice bar in waveforms and spectrograms in Praat. The appearance of one of them in waveforms and spectrograms suggests the occurrence of voicing, while there is no voicing if all are not present (Hagiwara, 2009).

Regarding /θ/ and /ð/, distinguishing /θ/ from /ð/ was easily accomplished with the help of the existence of the pulses, pitch, as well as voice bar in waveforms and spectrograms of /ð/ and the absence of all of them in those of /θ/. However, to identify the stopping of /θ/ as /t/ or /ð/ as /d/ (or perhaps like /t/), this was performed with the presence of friction in the spectrogram when producing the fricatives /θ/ and /ð/ and the absence of it in the production of the stops /t/ and /d/ (Firdaus et al., 2020). With regard to /tʃ/ and /dʒ/, on the spectrogram, the two affricates were identified by a closure of the plosive portion followed by a sharp release of the fricative aperiodic noise portion (Alqarni, 2013).

Furthermore, within and between-subjects ANOVAs were carried out to examine the effect of word position on the occurrence of the investigated phonological processes, using

the Social Sciences Statistical Package (SPSS) program, version 23.

Findings And Discussion

Findings

The results are provided below in the sequence of the two research questions.

Results for Question 1

Phonological processes (i.e., voicing, devoicing, stopping, deaffrication, palatalisation, and velarisation) as occurred in Yemeni EFL learners' production of the six target English consonants (i.e., /p/, /v/, /θ/, /ð/, /tʃ/, and /dʒ/).

The first question examines the extent to which the six investigated phonological processes take place in Yemeni EFL speakers' production of the target consonants. It was found that devoicing was the most frequent phonological process that took place in the production of the six target consonants by the six speakers (518 times), followed by voicing (262 times), deaffrication (159 times), and then stopping (61 times). Velarisation occurred in their production only 25 times, whereas the least frequent phonological process was palatalisation (only 14 times). Other substitutions occurred 40 times in the production of the target consonants (see Figures 1-2).

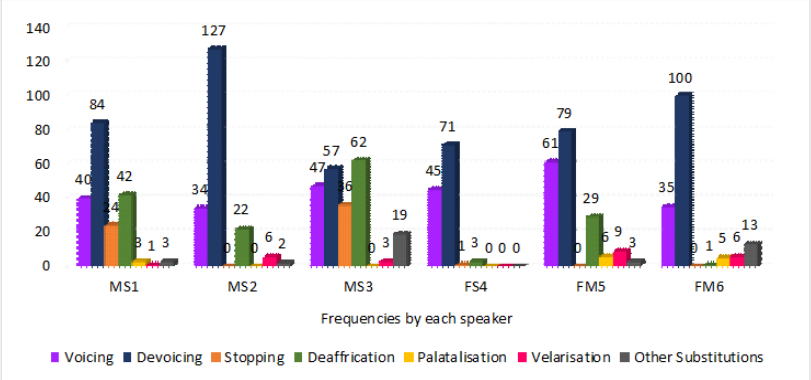

Figure 1. Frequencies of each phonological process by each speaker

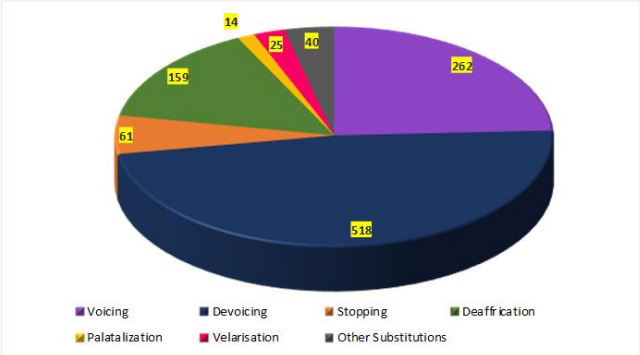

Figure 2. Total frequencies of each phonological process

The following sections present the results of phonological processes as produced by

each speaker.

Phonological Processes in the Production of MS1

Regarding the occurrence of the six target phonological processes in the production of the first male speaker (MS1), devoicing was found to be the most frequent phonological process in his production, followed by deaffrication, voicing, stopping, palatalisation, and then velarisation.

The sound /v/ was devoiced as /f/ (9%, 40 times) (see Figure 3), implying that /v/ was a problematic consonant for MS1.

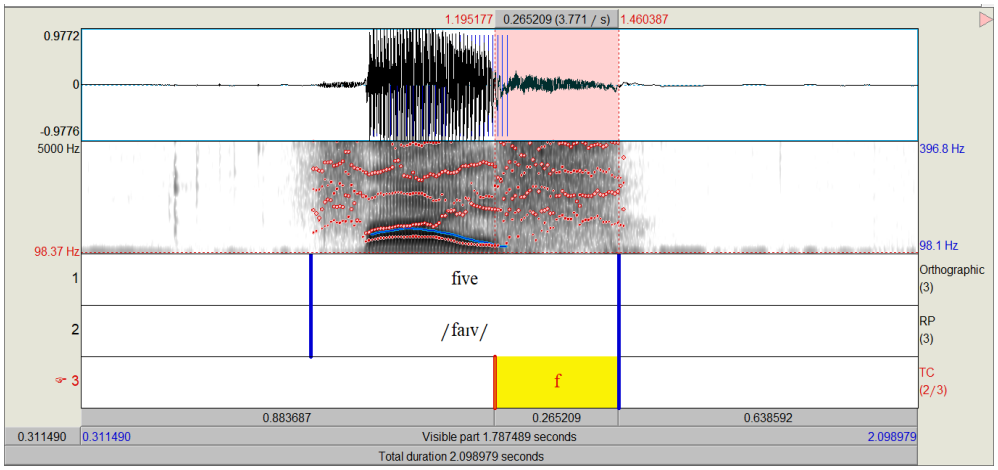

Figure 3. Devoicing word-final /v/ as /f/ in “five” by MS1

MS1 also produced the affricate /ʤ/ without voicing (8%, 34 times), while he produced /ð/ either without voicing (2%, 8 times) or devoicing it as /θ/ twice. He deaffricated /ʧ/ as /ʃ/ (7%, 31 times), while his deaffrication of /ʤ/ as /ʒ/ took place only 3% (11 times). Voicing was also observed in MS1’s production of /p/, which was voiced as /b/ (7%, 30 times). He also voiced /θ/ (2%, 9 times), while his partial voicing of /ʧ/ was found only once. MS1 stopped /θ/ as /t/ (2%, 7 times), while he stopped /ð/ either as /t/ (1%, 4 times) or /d/ (3%, 13 times) (see Figure 4).

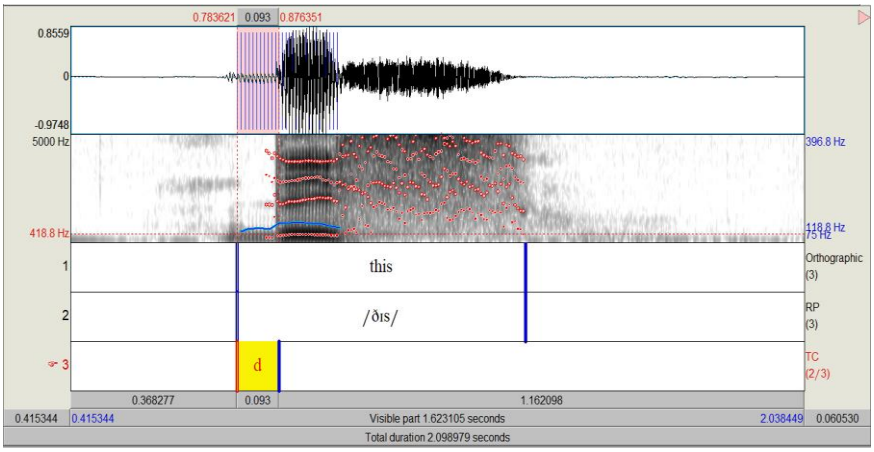

Figure 4. Stopping word-initial /ð/ as /d/ in “this” by MS1 Palatalising /ʤ/ as /j/ took place in MS1’s production only 1% (3 times). The voiced affricate /ʤ/ was also velarised as /g/ by this speaker only once only.

Phonological Processes in the Production of MS2

Regarding the second male speaker (MS2), devoicing mostly took place in producing the target sounds, followed by voicing, deaffrication, and then velarisation. However, stopping and palatalisation were not displayed in the production of MS2.

Devoicing was shown by MS2 most often in the production of /v/ and /ʤ/. For /v/, this sound was devoiced as /f/ (11%, 47 times). In contrast, he produced /ʤ/ either without voicing (10%, 43 times) or as /ʧ/ (1%, 3 times). The sound /ð/ was devoiced as /θ/ (5%, 21 times) or produced without voicing (3%, 13 times). Moreover, /p/ was voiced as /b/ (7%, 32 times), yet his partial voicing of /ʧ/ was displayed only twice. The affricates /ʤ/ and /ʧ/ were deaffricated by this male speaker as /ʒ/ (3%, 13 times) and /ʃ/ (2%, 9 times), respectively. He also velarised /ʤ/ as /g/ (1%, 4 times) or /k/ twice (see Figure 5). MS2 also substituted the affricate sound /ʧ/ with /ts/ in two tokens. No phonological process was found in the production of /θ/ by MS2.

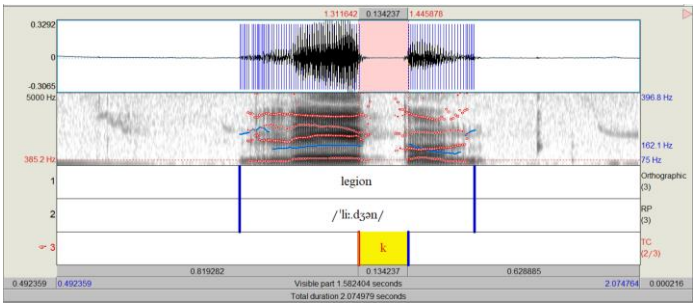

Figure 5. Velarisation of word-medial /ʤ/ as /k/ in “legion” by MS2

Phonological Processes in the Production of MS3

The third speaker (MS3) had some difficulties with the production of the six target consonants. The descending order of the phonological processes was as follows: deaffrication, devoicing, voicing, stopping, and velarisation. No sound was palatalised by MS3.

Concerning the consonants that were devoiced by MS3, interestingly, both /v/ and /ʤ/ were devoiced (6%, 25 times). He also devoiced /ð/ as /θ/ (2%, 7 times). Additionally, MS3 deaffricated /ʧ/ as /ʃ/ (9%, 37 times), but his deaffrication of /ʤ/ as /ʒ/ took place 6% (25 times). MS3 had some difficulties with the production of /p/ since he voiced it as /b/ (10%, 43 times) (see Figure 6).

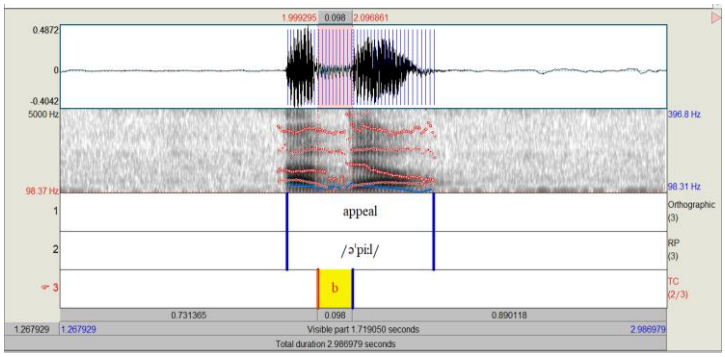

Figure 6. Voicing word-medial /p/ as /b/ in “appeal” by MS3 MS3’s voicing of /θ/ was also revealed in this study, although with very low occurrence (1%, 4 times). Stopping by MS3

was shown to be more frequent in the production of /θ/ than in /ð/. MS3 stopped /θ/ as /t/ (6%, 26 times) (see Figure 7), whereas he stopped /ð/ as either /d/ (1%, 4 times) or /t/ (1%, 6 times).

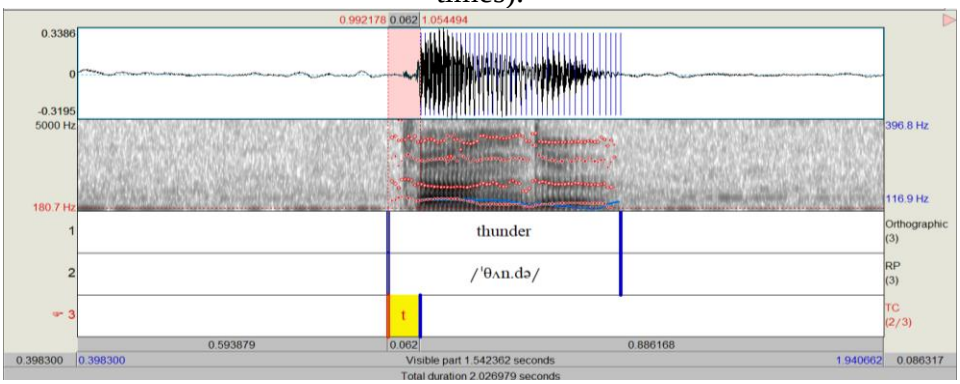

Figure 7. Stopping word-initial /θ/ as /t/ in "thunder" by MS3 Velarising /ʤ/ as /g/ was detected in MS3's production only 1% (3 times). Another substitution found in the third speaker's production was the deletion of word-final /θ/, /ð/, and /ʧ/, which took place 15 times, 3 times, and only once, respectively, with a total percentage of 4%.

Phonological Processes in the Production of FS4

Concerning the fourth speaker (FS4), only four phonological processes were shown in her production, which were devoicing (with the highest occurrence), voicing, deaffrication, and stopping (with the least occurrence).

The most devoiced consonant sound by FS4 was /ʤ/. She produced it with no voicing (9%, 40 times) (see Figure 8).

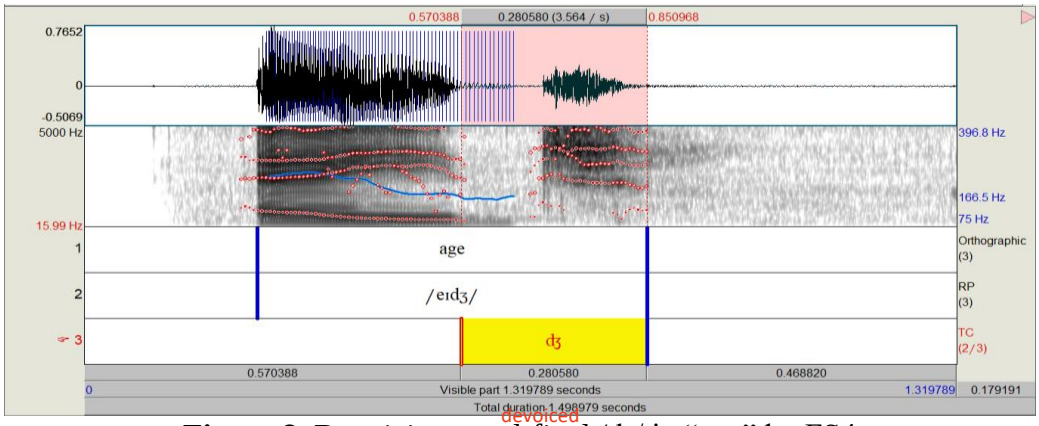

Figure 8. Devoicing word-final /ʤ/ in "age" by FS4

FS4 also devoiced /v/ as /f/ (4%, 17 times). The dental voiced /ð/ was also devoiced as /θ/ (3%, 14 times). FS4's voicing occurred the most in her production of /p/, which she voiced as /b/ (6%, 28 times). She also voiced /θ/ (3%, 12 times) and partially voiced /ʧ/ (1%, 5 times). Deaffrication took place only in her production of /ʤ/, which was produced as /ʒ/ (1%, 3 times). FS4 also stopped /ð/ as /d/ only once.

Phonological Processes in the Production of FS5

The order of the phonological processes as occurred descendingly in the production of FS5 were devoicing, voicing, deaffrication, velarisation, and palatalisation. Stopping did not occur in the production of FS5.

Most of FS5's devoicing was shown in the voiced affricate /ʤ/, which was produced with no voicing (8%, 35 times). She also devoiced /v/ as /f/ (7%, 29 times) and /ð/ as /θ/ (2%, 9 times) or without voicing (1%, 6 times). Furthermore, FS5 voiced /θ/ as /ð/ (1%, 6 times) (see Figure 9) or produced it with voicing (1%, 4 times).

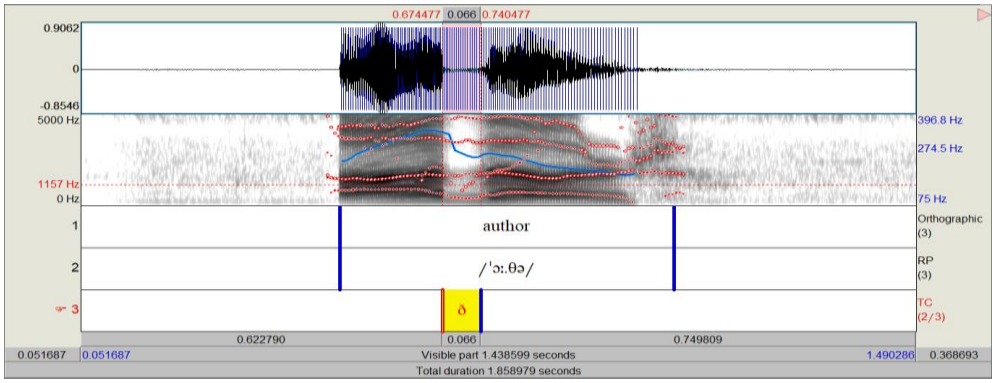

Figure 9. Voicing word-medial /θ/ as /ð/ in "author" by FS5 Unlike the other speakers, the most problematic target consonant for FS5 was /p/, which was voiced by her as /b/ (12%, 51 times), while the second challenging sound for her was /ʤ/. She faced fewer problems with the production of /θ/. Another phonological process made by FS5 was deaffrication which was found only in her production of /ʧ/ as /ʃ/ (7%, 29 times) (see Figure 10).

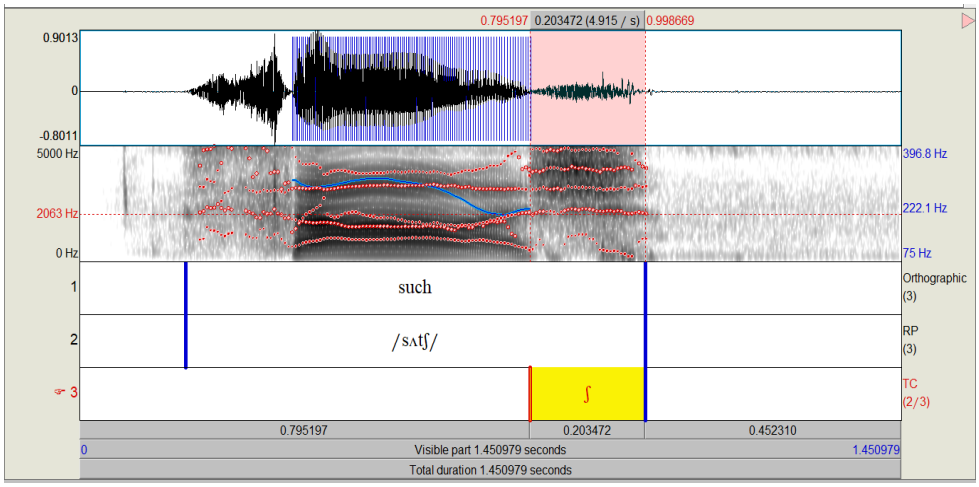

Figure 10. Deaffrication of word-final /ʧ/ as /ʃ/ in "such" by FS5

The voiced affricate /ʤ/ was not deaffricated by this female speaker, yet it was palatalised as /j/ (1%, 6 times) and velarised as /g/ (2%, 9 times) (see Figure 11). Another substitution shown by the fifth speaker was the deletion of the word-initial /ð/ (1%, 3 times).

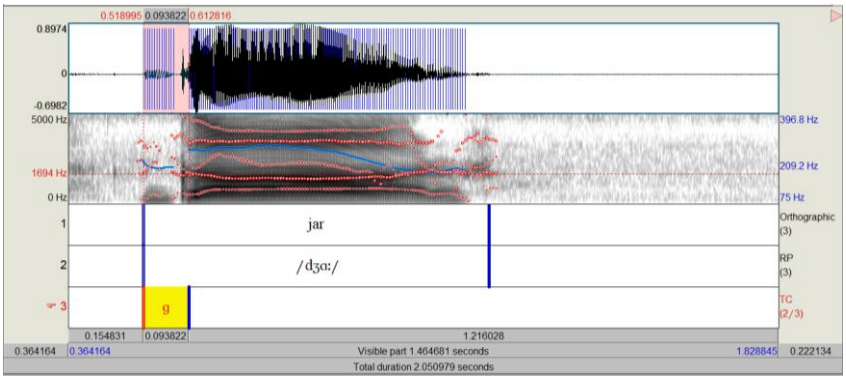

Figure 11. Velarisation of word-initial /ʤ/ as /g/ in "jar" by FS5

Phonological Processes in the Production of FS6

The order of the phonological processes as occurred descendingly in the production of FS6 were devoicing, voicing, velarisation, palatalisation, and then deaffrication. Stopping did not take place in FS6's production.

Most of FS6's devoicing was detected in her production of /ʤ/ and /v/, which took place 9% (39 times) and 8% (33 times), respectively. The sound /ð/ was devoiced as /θ/ (3%, 15 times) or with no voicing (3%, 13 times) (see Figure 12).

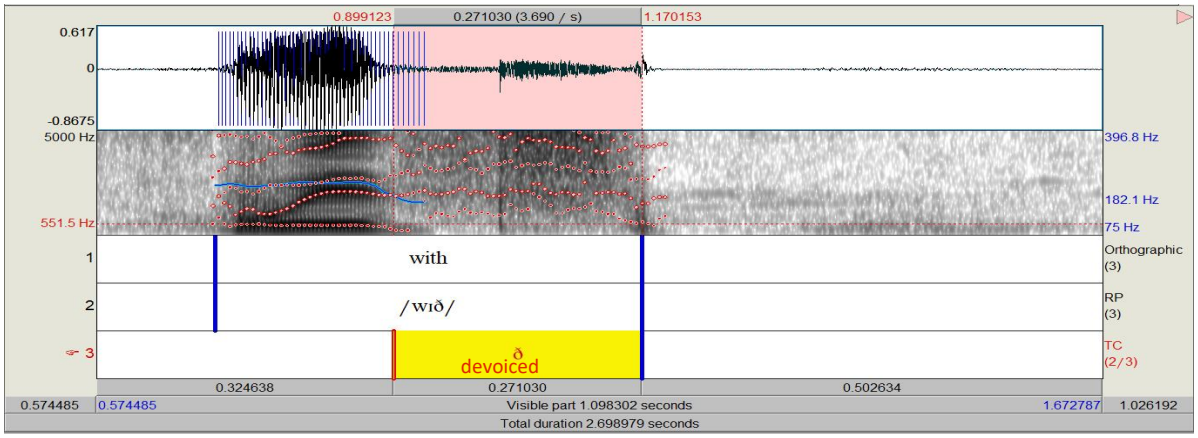

Figure 12. Devoicing word-final /ð/ in "with" by FS6

The second frequent deviation in FS6's production was voicing. Only two consonants were voiced by her. The sound /p/ was voiced as /b/ (7%, 29 times), while /θ/ was produced with voicing (1%, 6 times). The only deaffricated consonant by FS6 was /ʤ/. Her deaffrication of /ʤ/ as /ʒ/ took place only once. However, she palatalised /ʤ/ as /j/ (1%, 5 times) and velarised /ʤ/ as /g/ (1%, 6 times). Other substitutions occurred in FS6's production (13 times, 3%).

Results for Question 2

The effect of word position on the occurrence of the investigated phonological processes in Yemeni EFL learners' production of the six target sounds

Concerning the effect of word position on the occurrence of the six target phonological processes, first, ANOVA results indicated that there was a significant effect of word position on the frequency of voicing at the $p<.05$ level across all word positions [$F(2, 15) = 4.893$, $p = .023$] (see Table 1).

Table 1. Effect of word position on voicing

ANOVA
Voicing

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	423.444	2	211.722	4.893	.023*
Within Groups	649.000	15	43.267		
Total	1072.444	17			

Post hoc comparisons using the Bonferroni post hoc test indicated that the mean score

for the sounds that were voiced in word-medial position (M = 8.33, SD = 5.428) was significantly (*p* = .021) different from the mean score of the sounds that were voiced in word-final position (M = 20.17, SD = 6.080). However, voicing in word-initial position (M = 15.17, SD = 7.960) did not significantly differ from voicing in word-medial (*p* =.276) or word-final positions (*p* = .623) (see Table 2).

Table 2. Effect of word position on voicing (multiple comparisons)

Bonferroni						
(I) Word-position	**(J) Word-position**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Initial	Medial	6.833	3.798	.276	-3.40	17.06
	Final	-5.000	3.798	.623	-15.23	5.23
Medial	Initial	-6.833	3.798	.276	-17.06	3.40
	Final	-11.833*	3.798	.021*	-22.06	-1.60
Final	Initial	5.000	3.798	.623	-5.23	15.23
	Medial	11.833*	3.798	.021*	1.60	22.06

*. The mean difference is significant at the 0.05 level.

Moreover, there was a significant effect of word position on the frequency of the devoicing phonological process at the p<.05 level for all word positions [F(2, 15) = 27.362, *p* = .000] (see Table 3).

Table 3. Effect of word position on devoicing

ANOVA Devoicing					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	5502.778	2	2751.389	27.362	.000*
Within Groups	1508.333	15	100.556		
Total	7011.111	17			

The Bonferroni post hoc test indicated that the mean score for the sounds that were devoiced in word-final position (M = 53.50, SD = 10.858) was significantly (*p* = .000) different from the mean score for the sounds that were devoiced in word-initial position (M = 16.83, SD = 10.088). Similarly, the mean score for the sounds that were devoiced when occurring word-finally significantly (*p* = .000) differed from the mean score for the sounds that were devoiced in word-medial position (M = 16.00, SD = 9.055). However, no significant difference (*p* = 1.000) was detected between devoicing in word-initial and word-medial positions (see Table 4).

Table 4. Effect of word position on devoicing (multiple comparisons)

Bonferroni						
(I) Word-position	**(J) Word-position**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
					Lower Bound	**Upper Bound**
Initial	Medial	.833	5.790	1.000	-14.76	16.43
	Final	-36.667*	5.790	.000*	-52.26	-21.07
Medial	Initial	-.833	5.790	1.000	-16.43	14.76
	Final	-37.500*	5.790	.000*	-53.10	-21.90
Final	Initial	36.667*	5.790	.000*	21.07	52.26
	Medial	37.500*	5.790	.000*	21.90	53.10

*. The mean difference is significant at the 0.05 level.

Similarly, word position was shown to significantly affect the occurrence of palatalisation at the p<.05 level for the three-word positions [F (2, 15) = 4.375, *p* = .032] (see Table 5).

Table 5. Effect of word position on palatalisation (multiple comparisons)

ANOVA Palatalisation					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	21.778	2	10.889	4.375	.032*
Within Groups	37.333	15	2.489		
Total	59.111	17			

However, the Post hoc comparisons using the Bonferroni post hoc test demonstrated that the difference between the mean score for palatalisation in word-medial position (M = 2.33, SD = 2.733) and word-initial position (M = .00, SD = .000) was near significant (p = .065). Such a near significant difference (p = .065) was also detected between the sounds that were palatalised in word-medial position and word-final position (M = .00, SD = .000). However, no significant difference (p = 1.000) was detected between palatalisation in word-initial and word-final positions (see Table 6).

Table 6. Effect of word position on palatalisation (multiple comparisons)

Bonferroni						
					95% Confidence Interval	
(I) Word-position	**(J) Word-position**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
Initial	Medial	-2.333	.911	.065	-4.79	.12
	Final	.000	.911	1.000	-2.45	2.45
Medial	Initial	2.333	.911	.065	-.12	4.79
	Final	2.333	.911	.065	-.12	4.79
Final	Initial	.000	.911	1.000	-2.45	2.45
	Medial	-2.333	.911	.065	-4.79	.12

On the other hand, no significant effect for word position was found on the occurrence of stopping *(p* = .809), deaffrication *(p* = .321), or velarisation *(p* =.395).

Such results provided partial support to the hypothesis of the current study. The effect of word position was found to be significant on voicing as well as devoicing and near significant on palatalisation. However, the occurrence of stopping, deaffrication, and velarisation was not significantly affected by word position.

Discussion

The present study investigated the phonological processes in the production of six English consonants by Yemeni EFL postgraduates at UUM. The order of the overall phonological processes as occurred descendingly were devoicing, voicing, deaffrication, stopping, velarisation, and palatalisation.

In a similar study, Leung and Brice (2012) revealed that devoicing occurred 4% (17 times), voicing 3% (15 times), stopping 2% (8 times), while deaffrication only once. However, it can still be noticed that in the current investigation as well as the one by Leung and Brice (2012), devoicing occurred more frequently in the speakers' production than voicing. Moreover, devoicing was found by Reynaldi (2019) among the most frequent

deviations.

One of the main factors that led to the occurrence of devoicing, as confirmed by Arikan and Yilmaz (2019), was the principle of the least effort. In other words, EFL learners usually switch from voiced to voiceless sounds rather than voiced ones because voiceless consonants are easier to articulate than voiced sounds (Arikan & Yilmaz, 2019; Nazarloo & Navidinia, 2016).

The current study did not explore the reasons beyond the presence of the investigated phonological processes. However, some past researchers proposed several factors contributing to the occurrence of such deviations, including L1 interference, inadequate knowledge of phonological limitations in English, and background of logographic writing (Jaya, 2018; Leung & Brice, 2012).

L2 learning of English is affected by the learners' L1 (Rajini & Krishnamoorthy, 2020). Thus, for Arab learners of English, the discrepancy between spelling and pronunciation in the English language is typically confusing since there is a strong correspondence in Arabic between orthography and pronunciation (Ammar & Thai, 2016). Naturally, the way Arab learners are taught in standard Arabic influences their English pronunciation learning (El-Halees, 1986). That is why L2 (English) sounds were substituted with L1 (Arabic) in this study, leading to the existence of numerous phonological processes.

In the present study, several phonological processes were revealed in the production of these six English consonants by Yemeni EFL speakers, mainly as a result of L1 transfer as suggested by the Language Transfer Theory (LTT) (i.e., L2 (English) sounds are substituted with L1 (Arabic) sounds). For example, some speakers substituted /p/ with /b/ (voicing) because /p/ is an English sound that is not available in Arabic (Al Abdey & Abdul-Rahman, 2021; Alwazna, 2020; Jahara & Abdelrady, 2021; Zoghbor, 2018). Therefore, Arab EFL learners sometimes substitute it with /b/ (Al-Jarf, 2022; Farrah & Halahlah, 2020; Hamzah et al., 2020). Moreover, some speakers devoiced /v/ as /f/ since /v/ exists in English but not in Arabic (Alwazna, 2020; Zoghbor, 2018), so it is usually devoiced as /f/ by Arab speakers of English (Al-Jarf, 2022; Farrah & Halahlah, 2020).

Concerning /θ/, this consonant was stopped in some tokens as /t/. However, in others, it was produced with some voicing. Such a substitution of /t/ for /θ/ (stopping) by Arab learners of English was also found by some past researchers (e.g., Jahara & Abdelrady, 2021; Khayra, 2017; Motair & Mhamed, 2022; Soni, 2018). Moreover, /ð/ was stopped as /d/ or devoiced as /θ/ by some speakers. Similarly, some Arab EFL learners were revealed to replace /ð/ with /d/ (Shalabi, 2017) or devoice it as /θ/ (Farrah & Halahlah, 2020).

In addition, in this study, the English affricate /ʧ/, which is not available in the Arabic language, was deaffricated as /ʃ/. Such a replacement of /ʃ/ for /ʧ/ was also found in other studies (e.g., Al-Jarf, 2022; Farrah & Halahlah, 2020; Hamzah & El-Weshahi, 2018). The sound /ʧ/ was produced with some voicing by very few speakers. This could be as a result of producing the sound /t/ of /ʧ/ as the Arabic sound (ط). In classical Arabic, the emphatic voiceless dental plosive (ط) may have been voiced, although in most dialects today, it is produced as a voiceless pharyngealised dental stop (Watson, 2002).

The last target consonant tested in this study was /ʤ/. This English consonant does

not exist in Arabic (Alwazna, 2020; Zoghbor, 2018). As found in the current study, /ʤ/ was generally the most challenging consonant produced by the speakers. Several phonological processes occurred in the production of /ʤ/ by the Yemeni speakers, including deaffrication, palatalisation, velarisation, devoicing it as /ʃ/, and producing it without voicing. This could be attributed to the fact that the Arabic (ج) /ʤ/ also has several realisations in Yemeni dialects, such as the reflex /ʤ/, the voiced velar stop /g/, the voiced palatal stop /ɟ/, and palatal glide /j/ (Watson, 2002). Similarly, deaffrication or palatalisation of /ʤ/ by Yemeni speakers was revealed by Hamzah, Bin Hadjah and Abdullah (2020), while velarising /ʤ/ as /g/ among Arab learners of English was found in some studies (e.g., Al-Kinany et al., 2022; Tajeldeen, 2019; Thakur, 2020).

Overall, the findings provided partial support for both the CAH and the SLM. In other words, the English sound /θ/ has a counterpart in Arabic which is (ث) (Shariq, 2015). Thus, /θ/ was found to be the easiest consonant produced by the Yemeni speakers in this study. This result supported the CAH. Nevertheless, although the English affricate /ʤ/ is similar to the Arabic sound (ج) (Ashour, 2017; Mohammed, 2019), most errors occurred in the production of /ʤ/. This result provided support to the SLM. Moreover, the English sounds /p/ and /v/, which are absent in Arabic (Shariq, 2015), were also problematic for the speakers. This result supported the CAH. Nevertheless, despite the fact that the English affricate /ʧ/ is not available in Arabic (Mohammed, 2019), Yemeni speakers had fewer difficulties to produce it. This result supported the SLM. Such a partial support/rejection for the CAH or the SLM was found in very few past studies (e.g., Kitikanan, 2016).

In addition, in this study, word position significantly affected voicing and devoicing, while its effect on palatalisation was nearly significant.

Conclusion

The basic goal of the present study was to examine the existence of six phonological processes (i.e., voicing, devoicing, stopping, deaffrication, palatalisation, and velarisation) in Yemeni EFL speakers' production of six English consonants (i.e., /p/, /v/, /θ/, /ð/, /ʧ/, and /ʤ/) and to examine the extent to which word position affect their occurrence. The findings of the present study show that the most frequent phonological process in the production of Yemeni EFL speakers was devoicing, followed by voicing, deaffrication, stopping, velarisation, and lastly, palatalisation. Furthermore, word position was found to affect only the occurrence of voicing, devoicing (significantly), and palatalisation (near significant).

Additionally, the findings provided partial support to the SLM and CAH. On the one hand, /θ/ has a similar Arabic sound, and it was easier to produce by the speakers, while /p/ and /v/ are absent in Arabic, which causes difficulties in the production of the speakers. This finding supports the CAH. On the other hand, /ʤ/ is available in Arabic, but it was hard to produce, while /ʧ/ does not exist in Arabic, yet it was easy to produce, and this result lends support to the SLM.

Implications Of the Study

The usefulness of the current research lies in recognising the importance of producing the target consonants correctly by L2 speakers of English to avoid misunderstanding due to such phonological processes. This may enable learners of English as an L2 to be more

conscious of such issues when producing English sounds. In this study, six phonological deviations when producing the target consonants were investigated experimentally. Such an analysis may also attract EFL teachers' awareness of the importance of using Praat when teaching pronunciation since Praat can acoustically measure the properties of segments (Boersma and Weenink, 2014).

This is the first study of its kind focusing on EFL Yemeni postgraduates at UUM. The results have important implications for L2 speech learning and pronunciation teaching and learning. More notably, the findings filled a knowledge gap in the phonetic literature concerning studies on phonological processes by adult Arab EFL learners, generally, and Yemeni EFL learners, particularly, when producing English consonants.

Limitation

This study experimentally investigated only six phonological deviations (i.e., voicing, devoicing, stopping, deaffrication, palatalisation, and velarisation) when producing six target English consonants (i.e., /p/, /v/, /θ/, /ð/, /ʃ/, and /ʤ/). Researchers may conduct additional research in the future on other phonological processes that may occur in Yemeni/Arab learners' production of English vowels and the other English consonants that were not examined in this study. They may also look into whether the frequency of phonological processes would be affected by other linguistic factors, excluding word position (such as the number of syllables: monosyllabic vs. disyllabic or trisyllabic words; context type; sentences vs. story or dialogues, etc.) or even social factors (including age, ethnic identity, social class, etc.).

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