Raising Phonological Awareness to Rectify the Misarticulation of Plosive Consonants Among Adult EFL Learners

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Abstract

English as a Foreign Language (EFL) speakers often face difficulties producing certain English phonemes correctly when they live in a non-English-speaking country. The sounds /p/, /t/, and /k/ are among the most common articulation problems Saudi EFL learners have to encounter. In adult learners, the speech habits formed during the early years become "fossilized" and affect the acquisition of correct pronunciation. Therefore, recent research investigates the effectiveness of targeted phonological awareness training on improving these hard-to-articulate phonemes among adult Saudi EFL learners at the tertiary level. To address this issue, this study conducted a four-week experimental teaching session that involved improving phonological awareness with explicit teaching of the Voice Onset Time (VOT), and the precise place and manner of articulation of the sounds in question to twenty pre-medical Saudi EFL learners. This was enhanced through repetitive practice of the targeted phonemes, use of minimal pairs, and extended, reading aloud of passages. The results showed that participants were able to identify their pronunciation errors and articulate the target sounds in isolated words and in continuous speech. There was also an overall improved oral fluency of the test participants in their English production, possibly indicating that the phonological awareness approach could have wider benefits beyond the simple articulation of phonemes.

Keywords: phonological awareness, misarticulation, plosives, second language acquisition, fluency

1. Introduction

For EFL/ESL (English as a Foreign/Second Language) learners achieving complete orthographic transparency is a significant challenge, especially for those learning English in a non-native environment. Orthographic transparency involves the relationship between written symbols (i.e., graphemes representing speech sounds) and phonemes (Milankov, Golubovic, Krstic, & Golubovic, 2021). Ideally, learners may often recognize the correlation between certain English graphemes and their phonemic sounds by relating them to familiar phonemes from their native language. However, graphemes that represent unfamiliar English sounds are often incorrectly associated with similar sounds from the learners' first language. This tendency to equate near-similar sounds with exact matches often results in pronunciation errors, which are well documented in literature (Best & Tyler, 2007; Celce-Murcia, Brinton, & Goodwin, 1996; Flege, 1980; Fromkin, Rodman, & Hyams, 2011; Gimson, 2001; Jones, 1972; Khattab, 2002; Knight, 2012; Roach, 1998; Skandera & Burleigh, 2011).

Saudi EFL learners rarely receive enough correction from either native or proficient English speakers, so, these errors often remain unaddressed in their speech. As a result, such pronunciation mistakes later become habitual mispronunciations. In this regard, it is quite common for adult Saudi EFL learners to experience difficulties with certain English phonemes. Specifically, the phoneme /p/ often poses a serious problem and tends to be replaced by the bilabial voiced plosive /b/. Aspiration, when present, introduces an additional layer of difficulty. For example, the phonemes /p/, /t/, and /k/ are aspirated in English—that is, pronounced with a subsequent puff of air—when they occur at the beginning of a word or stressed syllable, thus, resulting in a longer Voice Onset Time (VOT). However, Arabic plosives are common to have a far more reduced VOT than their English counterparts, causing Saudi speakers to articulate the English consonants /p/, /t/, and /k/ with a shorter VOT. This adjustment often makes their pronunciation resemble the unaspirated variants of English sounds. As a result, many learners fail to distinguish accurately between aspirated and unaspirated sounds, leading to persistent pronunciation errors over time.

In addition, Saudi speakers are also widely documented to misarticulate the phonemes /v/, /ʒ/, /ɪ/, /ŋ/, and a few qualities and quantities of vowels. Without corrective feedback, over time, such pronunciation problems become fossilized. As a result, this makes it highly difficult for learners to alter their pronunciation even after several attempts. This phenomenon highlights the critical need for early and effective intervention strategies to address phonetic misarticulations among EFL learners.

1.1 Research Problem

Extensive research has been conducted to address the issues previously mentioned among Saudi and Arab English speakers in general, as evidenced by the existing literature. This is particularly true regarding the tendency of Saudi EFL learners to misarticulate the phoneme /p/ as /b/ (Abdelaal, 2017; Alanazi, 2018; Al-Jarf, 2022; Binturki, 2008; Elmahdi & Khan, 2015; Jathmi, 2021). Various researchers have

so far proffered some strategies to address this persistent issue, and a number of studies have reported some degree of success, too. The majority of these interventions have focused on raising phonemic awareness of the learners, especially related to phonemes /p/, /t/, /d/, /k/, and /g/.

However, a preliminary review of the existing literature indicates that, although researchers generally aim to address the misarticulation of English plosive consonants among Saudi and other Arab speakers, there is a notable absence of solutions specifically targeting the misarticulation of /p/ and the short VOT associated with the phonemes /t/ and /k/. Therefore, the current research has been designed to address these neglected areas by investigating the mispronunciation of English plosives among Saudi learners of English. Moreover, the researchers feel that a more holistic approach is necessary—one that not only identifies the root causes of the problem but also examines potential interventions to effectively improve the English pronunciation of adult Saudi EFL learners.

Thus, the current research has been conducted to establish the place and manner of articulation errors committed by Saudi EFL learners in producing the selected phonemes, advance the learners' general phonological awareness, and specifically focus on these problematic sounds. In addition, the study involved the participants in experimental teaching sessions that introduced repeated self-practice of target sound production, aiming to facilitate accurate pronunciation.

2. Literature Review

2.1 Phonological Awareness

Phonological awareness (PA) reflects itself in all the four language skills, with particular emphasis on reading and speaking (Anthony & Francis, 2005; Elhassan, Crewther, & Bavin, 2017; Gillon, 2018; Leafstedt, Richards, & Gerber, 2004; Milankov et al., 2021; Skubic, Gaberc, & Jerman, 2021). For example, in reading, PA involves the ability to recognize the correspondence between written symbols and their corresponding sound units (i.e., phonemes and morphemes). Besides, it is an awareness of semantic and phonic connotations of diacritical and punctuation marks used in writing. In speech, PA includes awareness of various phonetic features such as the place and manner of articulation of phonemes, morphemes, and their clusters, as well as suprasegmental features such as stress, intonation, and pitch.

PA starts to develop in the early stages of language acquisition, which, occurs during early childhood. Parents, peer groups, schooling, and the social environment are some of the factors that contribute to the development of PA. However, in the case of EFL/ESL learners, formal education often serves as the main source of phonological awareness in the foreign language. When learners of English, or any foreign language, are either not fully trained or knowledge of certain elements of it is not imparted to them, the development of PA in English does not occur. Therefore, it is essential to address and enhance PA at any stage when deficiencies are identified.

2.2 Research in PA

Research has shown that the modification in linguistic skills, especially in the early stages of foreign language learning, leads to improvement in learners' phonological awareness. However, most of these studies are focused only on reading skills (Alshaboul, Almahasneh, Hassanein, & Ibrahim, 2019; Anthony & Francis, 2005; Elhassan et al., 2017; Gilakjani, 2011; Gillon, 2000; Leafstedt et al., 2004; Milankov et al., 2021; Skubic et al., 2021). Improved phonological awareness has received little attention as a factor influencing EFL learners' speaking ability, and no research literature is available on this subject, especially regarding adult EFL learners. Although there are a few studies investigating the positive influence of phonological awareness on learners' reading skills (Adam & Mohammed, 2017; Alhumsi, 2021; Almekhlafy, 2021; Al-Qahtani, 2020; Al-Rubaat & Alshammari, 2020; Alzahrani & Algethami, 2023; Firman, Haerazi, & Dehghani, 2021; Ghoneim & Elghotmy, 2015; Ibrahim, 2018), there is a lack of research studies particularly exploring its role in speaking performance.

As a result, there is a clear gap in research on how phonological awareness enhancement influences improvements in the speaking skills of adult EFL learners. The present study addresses this gap — though partially — by focusing on three English phonemes: /p/, /t/, and /k/. These phonemes have VOT values different from their Arabic cognates. For instance, the average VOT values for American English voiceless stops /p/, /t/, and /k/ are about 60 ms, 70 ms, and 80 ms respectively. On average, Arabic voiceless stops have smaller VOT values than their American English counterparts; however, they do tend to vary from one dialect to another. In some Arabic dialects, for example, the mean VOT for /t/ is reported to be approximately 25-30 ms, while for /k/ that is approximately 50-60 ms. Such VOT values show different norms with respect to voicing and aspiration between the two languages. This hierarchical pattern (VOT increases with more posterior articulations) has been found to be quite consistent across studies. Therefore, /k/ is found to be the sound with the longest VOT among the voiceless stops. Chodroff and Wilson (2017) found that in connected speech, the mean VOT values for American English voiceless stops are slightly shorter than those in isolated speech contexts. The approximate mean values are about 51 ms, 61 ms, and 56 ms for [pʰ], [tʰ], and [kʰ], respectively. These values tend to be lower due to the speeding up of articulation and coarticulation reduction typically associated with connected speech. According to Chodroff and Wilson (2017), the mean values of VOTs for voiceless stops /pʰ/, /tʰ/, and /kʰ/ in isolated words in American English are about 89 ms, 98 ms, and 99 ms, respectively.

In Arabic, the normal voiced plosives /b/, /d/, and /g/ have negative VOT values, indicating pre-voicing. In contrast, the voiceless stops /t/ and /k/ normally have positive VOT values (the further back in the mouth, the longer the duration). Aljutaily and Alharbi (2022) reported in their study on Najdi Arabic that the voiced and voiceless plosives show different VOT patterns. The VOT value was negative as the voiced stops /b/, /d/, and /g/ shared the articulation of pre-voicing, while in the case of voiceless stops /t/ and /k/, the VOT values were

positive. Specifically, the VOT for /t/ and /k/ ranged from 45 to 65 ms and from 48 to 77 ms, respectively, based on the vowel length and context. In contrast, the VOT durations of voiced plosives were shorter: /b/, /d/, and /g/ ranged between 15-29 ms with short vowels and 19-35 ms with long vowels.

Furthermore, the investigation by Flege (1980) showed that Arabic native speakers had significantly reduced VOT values of certain sounds compared to those of English native speakers. Therefore, VOT values obtained are closer to the Arabic phonetic norm than to English norms. Correspondingly, VOT values are on average equal to about 37 ms for the /t/ sound and 52 ms for the /k/ sound, which are shorter than the typical VOT values in English. Many Saudi Arabic learners of English have difficulties in producing the phoneme /p/, as Arabic does not possess this sound. They may articulate /p/ either with glottal pulsations or with a short-lag VOT, following Arabic voicing patterns. Their produced VOT has turned out to be less native-like when compared with those produced by native American English speakers and became the major phonetic variation for /p/ (Flege & Port, 1981).

Overall, Arabic speakers develop different VOT patterns for /b/, /t/, and /k/ compared to the American English norm. In addition, Arabic speakers face additional challenges that occur with the pronunciation of the non-native English phoneme /p/. These three sounds were selected based on the common misarticulations observed in the preliminary analyses of speech samples of participants. Due to time, resources, and the scope of data analysis, the study was further limited to these three phonemes.

3. Objectives of the Present Research

Based on the identification of these problematic phonemes, the main objective of this research was established: to bring an improvement in the pronunciation of English spoken by adult Saudi EFL learners, specifically in relation to the misarticulation of /p/, /t/, and /k/. In course of the study, yet another objective became relevant: to improve the oral fluency of learners of English. The decision to limit the study to these three phonemes was influenced by practical constraints, including time, resources, and the manageable scope of data analysis.

This research is based on the assumption that a focused phonological awareness and phonetic approach would enhance the perception and unlearning of fossilized articulatory habits in a targeted manner, especially by prolonging the VOTs of the English plosives among adult EFL learners. Besides, this will not only correct the misarticulation of the target sounds but will also bring a long-lasting positive effect in the general improvement of learners' pronunciation.

3.1 Research Questions

The following research questions were formulated to guide the investigation:

RQ 1: Can enhancement in phonological awareness in adult EFL learners facilitate the unlearning of fossilized articulatory patterns, and assist in improving their articulation?

RQ 2: To what extent does the enhanced phonological awareness contribute to the improvement in oral fluency in adult EFL learners?

4. Research Design

This research was conducted as an empirical study that comprised three interrelated steps: identification, intervention, and measurement. First, the speech samples collected from the participants were analyzed to identify problematic phonemes.

Then, the strategies of intervention were elaborately designed and implemented to provide the participants with increased articulation accuracy. Lastly, the effects of the intervention were measured in order to determine whether or not it was effective. There were two major approaches employed during the intervention:

• Raising Phonological Awareness: In this approach, the participants were imparted the theoretical knowledge, with practical demonstration, of pronunciation of the target sounds.

• Experimental Teaching: This method focused on helping participants through methods of repetition and reinforcement.

5. Theoretical Framework

The present research is guided by the idea that phonological awareness is closely linked to better articulation of unknown / alien sounds among foreign language learners (Kim, Petscher, Foorman, & Zhou, 2010; Roberts, 2005; Saad, 2017). The idea was to be tested by systematic phonics instruction, demonstration, and practice. The holistic approach was identified as the most appropriate experimentation technique to be followed to carry out the tasks.

The following strategies were employed to enhance phonological awareness intervention:

• Minimal Pair Training: Participants engaged in identifying phoneme contrasts by practicing with minimal pairs, specifically focusing on distinctions, such as /p/ versus /b/ and /f/ versus /v/.

• Voice Onset Time (VOT) Modification: Participants were encouraged to adjust voiceless plosive sounds by increasing aspiration and altering their duration to effectively modify the VOT.

• Articulatory Adjustments: Participants received guidance to modify both the place and manner of articulation for target sounds when appropriate, ensuring conscious and deliberate sound production. The following illustrations (Figure 1) proved to be of much help in the task:
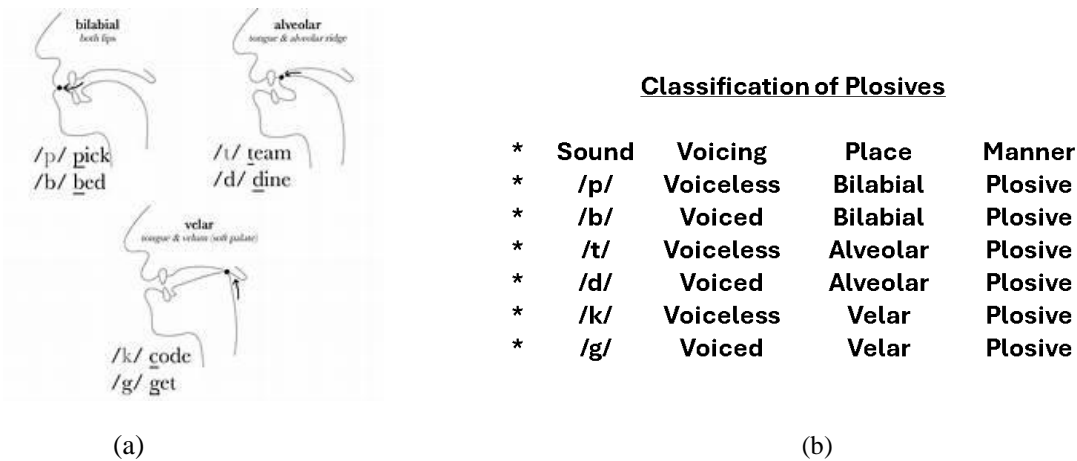
(a)   (b)

Figure 1. (a) Pictorial representation of place and manner of articulation of plosive sounds. (Credit: www.thesoundofenglish.org) and (b) Classification of Plosives (Credit: www.easysitebug597.weebly.com)

A month later, participants repeated the experiment by reading the Stella passage again. This repetition was conducted without their prior knowledge, ensuring control over variables that could influence the results. Sound recordings from both the pre-test and post-test were analyzed using PRAAT (Boersma & Weenink, 2016). The VOT of the voiceless plosives was extracted for each of the following sounds:

- /p/: plastic, peas, please
- /t/: toy, train
- /k/: kids, can, call

6. Method

The study employed a mixed-methods research approach using both quantitative and qualitative techniques. Numerical data were interpreted and presented narratively for ease of understanding. Experimental teaching sessions were introduced as an intervention, with pre-tests and post-tests conducted to analyze any progress made by the participants.

6.1 Participants

The participants in this study were Preparatory Year students enrolled in the English Language Institute Health (ELIH) track, aspiring to pursue higher education in fields, such as medicine, dentistry, pharmaceuticals, or nursing, depending on their performance during the preparatory year. All participants were male undergraduate students who had completed one year of English studies within the ELIH program. Their mean age was 18.35 years (SD = 0.59). English served as both the medium of instruction and a foreign language they had studied prior to university, achieving moderate fluency.

A control group of 20 native American English-speaking persons was included in the study. Recordings for this group were obtained from the Speech Accent Archive (Weinberger, 2024), which is a broad database that has provided standardized samples of speech for accent and pronunciation analysis. Therefore, both groups read the same scripted passage, the "Stella passage," for consistency in comparing analysis (Weinberger, 2024).

6.2 Participant's Phonological Awareness

The participants demonstrated significant weaknesses in phonological awareness, especially in the manner and place of articulation of English sounds. Their grasp of English phonics was minimal, stemming from a lack of systematic instruction in the Saudi Arabian public school EFL/ESL curriculum. Although the curriculum declares the development of vocabulary and grammar, as well as the four skills of listening, speaking, reading, and writing, it does not stress upon the teaching of foundational phonics (Ministry of Education, 2024). Teachers often overlook phonics since it is not clearly emphasized in the curriculum, especially in government schools.

As a result, students enrolling in universities exhibit fossilized articulatory patterns. While their pronunciation may meet general standards, specific sounds such as $[p^h]$, $[t^h]$, and $[k^h]$ are misarticulated, and vowel sounds are often distorted to an unacceptable degree. These misarticulations notably affected participants' fluency development.

6.3 Procedure

The experiment was conducted at King Abdulaziz University, Rabigh branch. The participants were recorded using a computer. They were seated in front of a table where a microphone was connected to the computer. The participants were then introduced to a few passages. At the beginning of each passage, the students were asked if they had encountered the passage before. One of these passages was the Stella passage (provided below), and the students confirmed that they had not encountered it before. Most importantly, the Stella

passage was adopted without the participants' knowledge that it would be set both as a pre-test and post-test.

The participants were given these instructions: "Please silently look at the following paragraph for a minute." Then, they were asked to read the passage out loud:

"*Please call Stella. Ask her to bring these things with her from the store: six spoons of fresh snow peas, five thick slabs of blue cheese, and maybe a snack for her brother Bob. We also need a small plastic snake and a big toy frog for the kids. She can scoop these things into three red bags, and we will go meet her Wednesday at the train station.*"

Following the recording, the participants completed a background questionnaire that included questions about their Arabic variety, other languages they speak, age of onset, and demographic information (See, Appendix A).

7. Data Analysis

The results from the post-test were compared with those from the pre-test in order to assess any difference that might have taken place in participants' pronunciation of the target sounds. This also called for a statistical analysis of the differences to assess whether there has been any meaningful improvement in participants' articulation after the intervention.

The data collected consisted of sound files that were analyzed for VOT values using PRAAT (Boersma & Weenink, 2016). The VOT values of the plosive sounds in question, i.e. /p, t, k/, were measured from the words: plastic, peas, please, toy, train, kids, can, and call. The following intervals were labelled: the word, and the sound (p, t, k). The mean values of the pre-test, post-test, and native speakers' VOT of sounds (calculated from VOT values measured for each participant in each group) are presented in Table 1. These VOT measures enabled a quantitative comparison to be made in the changes within the articulation of the plosive sounds, namely the $[p^h]$, $[t^h]$, and $[k^h]$ sounds, in pre- and post-test conditions. Quantitative VOT data were then complemented through qualitative perceptual judgments in order to achieve a complete understanding of the participants' advancement in the articulation of both the plosive and the other sounds. As a result, this allowed for a more valid interpretation of the efficiency of the intervention.

8. Results

A total of 480 (20 participants x 8 words x 3 sounds) tokens were produced by all speakers, including native speakers. No words were discarded from the sample since it was a reading task, and the participants were allowed to repeat any mispronounced words, if they so desired. Table 1 and Figure 2, given below, illustrate the mean VOT values for each of the three voiceless plosives across the three conditions: pre-test, post-test, and native speakers. The mean VOT for /p/ before treatment is 24 ms, which increased to 40 ms after treatment. For native speakers, the mean VOT for the same sound is 60 ms. The mean VOT for /t/ before treatment is 48 ms, which rose to 53 ms after treatment. For native speakers, the mean VOT for this sound is 82 ms. The mean VOT for /k/ before treatment is 61 ms, which increased to 67 ms after treatment. For native speakers, the mean VOT for this sound is 76 ms.

As shown in Table 1, there are noticeable differences in VOT patterns, with Saudi Arabic speakers of English exhibiting the shortest VOT values before treatment, compared to what they produced after treatment (post-test) and native speakers, who demonstrated the longest mean VOT values.

Table 1. Mean Voice Onset Time (VOT) for /p/, /t/, and /k/ sounds in different speaker groups

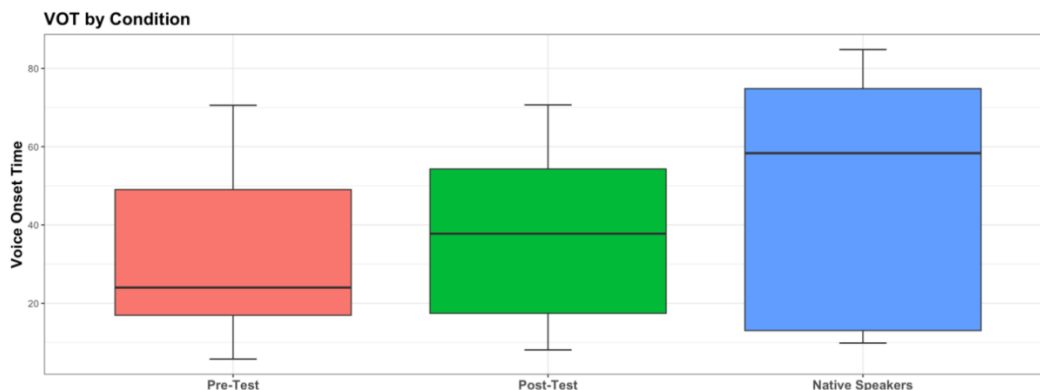| Group (Condition)	/p/ Mean VOT (ms)	/t/ Mean VOT (ms)	/k/ Mean VOT (ms)
Saudi Speakers (Pre-test)	24	48	61
Saudi Speakers (Post-test)	40	53	67
Native speakers	60	82	76

Figure 2. Mean of Voice Onset Time (VOT) by Group

X-axis = Groups: Saudi Speakers pre-test, Saudi Speakers post-test, native speakers)

Y-axis = Voice Onset Time (ms)

Figure 3, given below, presents three box plots comparing VOT values across three conditions — pre-test, post-test, and native speakers — for the sounds /p/, /t/, and /k/. The plots show the distribution of VOT values for each sound, with the conditions displayed along the x-axis.

For /p/, VOT values are the shortest for the pre-test condition, followed by the post-test condition, and the longest for native speakers. For both /t/ and /k/, the VOT values for the pre-test group are the shortest, the post-test group has an average or middle value, and the group of native speakers shows the longest value.
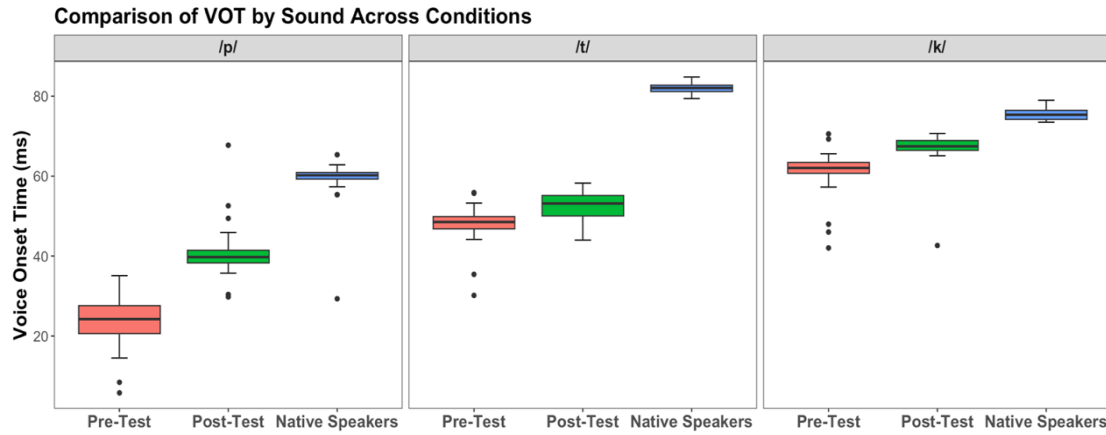

Figure 3. Mean Voice Onset Time (ms) by Sound Across Groups

X-axis = Groups: Saudi Speakers pre-test, Saudi Speakers post-test, native speakers)

Y-axis = Voice Onset Time (ms)

While it appears from Table 1 and Figures 2 and 3 that there are apparent improvements in VOT values of the sounds produced by Saudi speakers between the pre-test and post-test conditions, it remains to be established whether differences between conditions are statistically significant. To that end, two levels of analysis were conducted. A linear mixed-effects model to assess group differences and paired statistical tests to examine phonemes improvements.

A linear mixed-effects model was fitted using the lmer function from the lme4 package in R (Bates et al, 2015). Condition (the native speakers, post-test group, and pre-test group) was included as a fixed effect, and Participant and Consonant Label were included as random effects. The random effects' structure allowed intercepts to vary by Participant and Consonant Label with variances of 0.5234 and 536.7789, respectively. Residual variance was 77.0509, indicating that there was some unexplained variability. Meanwhile, the estimate of the intercept —the baseline VOT for native speakers— was 48.51 ms (SE = 10.38, t = 4.675).

Within the fixed effects, the results indicated that there was a difference between the post-test group and native speakers: the post-test group displayed a significantly lower VOT compared to that of native speakers, with an estimated difference of −8.41 ms (SE = 0.752, t = −11.176). In addition, there was a difference between the pre-test and native speakers—the latter had an even smaller VOT, with an estimated −12.54 ms (SE = 0.752, t = −16.668).

To further investigate improvement patterns, paired-sample tests were conducted for each consonant. A Wilcoxon signed-rank test revealed no significant improvement in VOT for /b/ (V = 76, p = .294, d = −0.30), which is consistent with expectations for voiced stops.

Voiceless stops showed statistically significant gains. For /p/, a Wilcoxon signed-rank test showed a strong improvement post-training (V = 210, p < .001, d = 6.08). /t/ also improved significantly based on a paired t-test (t(19) = 9.22, p < .001, d = 2.06). Similarly, /k/ showed significant improvement (t(19) = 25.27, p < .001, d = 5.65). These effects were all large.

These results are consistent with the pairwise mean comparisons presented in Table 2 below, which show that /p/ had the largest gain from pre-test to post-test (+16 ms), followed by /k/ (+6 ms) and /t/ (+5 ms). The largest total gap with native speakers was seen for /p/ (+36 ms), suggesting it is the most difficult to acquire—likely due to its absence in Arabic. Smaller differences were observed for /k/, indicating it may be easier for L2 learners to acquire.

Table 2. Pairwise Mean Differences (in ms)

Comparison	/p/ Diff	/t/ Diff	/k/ Diff
Saudi Pre vs. Post	+16	+5	+6
Saudi Post vs. Native	+20	+29	+9
Saudi Pre vs. Native	+36	+34	+15

In summary, the mixed-effects model confirmed group-level improvement, while the phoneme-level analysis highlighted substantial training-related gains for voiceless stops, especially /p/ and /k/. These findings align with well-known challenges in L2 acquisition of aspiration and support the effectiveness of explicit pronunciation training.

9. Discussion

A few key points emerge from a cursory examination of the pre-test mean VOT values for the sounds, as shown in Table 1. In particular, the articulation of the phoneme /p/ among participants displayed an interesting pattern. The mean VOT value for /p/, calculated from the utterances of all participants before treatment, was 24 ms. This value is neither close to the typical VOT for the phoneme /p/ nor to the VOT for the phoneme /b/, as reported in previous studies. As reported in previous research studies, the standard VOT for /p/ uttered by native English speakers ranges between 47 ms and 87 ms. For example, it is found that the VOT for /p/ among American, Canadian, and British English speakers is about 58 ms, 87.9 ms, and 85 ms, respectively (Kessinger & Blumstein, 1997; Lisker & Abramson, 1964; Macleod & Stoel-Gammon, 2005). However, the VOT for /b/ typically ranges from 0 ms to 19 ms (Abdelaal, 2017; Klatt, 1975). Based on the calculation of the utterances of all native speakers in this study, the mean VOT value for /p/ is 60 ms.

Among bilingual speakers, the VOT for /p/ tends to fall between 30 ms and 38 ms, while VOT for /b/ can sometimes be negative, ranging from -87 ms to -99 ms (Kessinger & Blumstein, 1997; Macleod & Stoel-Gammon, 2005). In light of this, an important question arises: What is happening with Saudi EFL learners? The simplest explanation for this phenomenon is that the sound produced by these learners falls somewhere between /p/ and /b/. It can be inferred that while learners attempt to articulate /p/, habitual articulatory patterns cause their production to shift toward /b/. This indicates that they require only minimal intervention to address and correct this issue.

The impact of intervention is clear in the post-test results, as evidenced from Table 1. The post-test mean value of VOT of /p/ was 40 ms. Based on the post-test values, it is clear that the participants demonstrated higher improvement in the articulation of /p/ than in pronouncing other sounds. It was argued earlier that /p/ is a non-existent phoneme in Arabic. According to previous studies, a sound that is different from L1 can be acquired more easily (Alharbi, Foltz, Kornder, & Mennen, 2023; Flege, 1995). Therefore, among all three sounds, /p/ might have demonstrated the highest rate of improvement.

Regarding the /t/, the pre-test mean VOT value for this phoneme was 48 ms. The mean for /t/ produced by the native speakers in this study was 82 ms. For Saudi EFL learners, a mean pre-test value of 48 ms indicates incomplete acquisition of the target VOT of the phoneme (likely due to the influence from their L1), which does not have voiceless aspirated plosives like /t/. In the post-test, participants showed an improvement in the articulation of /t/. Meanwhile, the mean for the post-test VOT value was 53 ms, showing an advancement toward native-like VOT. These results show the significant role of focused training in helping learners approximate the aspiration patterns of native speakers for /t/ through targeted intervention.

An examination of the pre-test mean VOT values for /k/, as shown in Table 1, reveals a significant difference. The average pre-test VOT value for /k/ was 61 ms, which is considerably lower than the typical range observed in native English speakers. For native speakers, the mean VOT for /k/ was 76 ms based on the recent study. This pre-test value of 61 ms for Saudi EFL learners highlights the influence of L1 transfer. Although participants did not achieve native-like VOTs for /k/, the post-test results demonstrated improvement, with the mean VOT value increasing to 67 ms. This progress suggests that participants are moving toward producing native-like VOT values for /k/, despite the need for additional training beyond the current intervention.

The improvement in participants' oral fluency, despite fluency being both a subsidiary and non-targeted objective, emerged as one of the most unexpected yet significant findings of the intervention. Three clearly identifiable behavioral changes were observed, which are all characteristic of more fluent English users: Firstly, nearly all participants eliminated false starts in their speech — a behavior that had been prevalent prior to the intervention. False starts—beginning an utterance and then aborting it — are often linked to hesitations, mispronunciations, or thought interruptions. The researchers observed that for adult Saudi EFL learners, false starts were frequently related to difficulties with articulating certain sounds, which in turn affected their fluency.

Secondly, those participants, who previously used filler phrases many times in their speech, reduced the frequency. Repeated usage of such fillers shows hesitation and displays a lack of fluency in speech. Thirdly, those participants who previously constructed short sentences in English started to employ longer and more complex sentences while conversing and conducting presentations after the intervention. This shift toward more elaborate utterances further demonstrates enhanced fluency.

A direct comparison with the findings of other investigations cannot be provided here due to the limited quantity of scientific research concerning the issue. Nevertheless, the results from the present study regarding the articulation of /p/ before the treatment contradict those reported by Abdelaal (2017). In his study, Arabic-English speakers produced /p/ with a mean VOT of 51.5 ms and did not appear to face significant difficulties in pronouncing this phoneme.

Specifically, the present study introduces new contributions to the understanding of phonological awareness and oral fluency development, as there is no previous research that directly examined the relationship between these areas. Although a few more relevant research works (Aljumah, 2011; Al-Shehri, 2022) were conducted regarding the phonological awareness-based fluency development, they employed different intervention strategies. Moreover, studies by Suggate (2014), Nation and Snowling (2004), and Vetsch-Larson (2021) focused on reading fluency rather than oral fluency, especially among EFL learners.

10. Conclusion

Based on the results obtained from the data analysis, it can be confidently concluded that the present research findings establish the efficacy of phonological awareness and associated intervention strategies in helping adult EFL learners improve their pronunciation of English. The intervention strategies, particularly those that encourage learners to consciously correct their errors and that provide practical

demonstrations of the correct production of target sounds, have proven to be especially beneficial. These strategies help learners unlearn fossilized articulatory habits and make notable improvements in their pronunciation.

The intervention techniques showed particularly positive results with Saudi learners, suggesting that these methods could be equally effective for other Arab speakers of English as well. The success of these strategies underscores their potential for broader application in EFL instruction, especially in regions where learners share similar phonological challenges. Furthermore, raising adult EFL learners' phonological awareness not only impacts their pronunciation but also significantly contributes to their oral fluency. The data suggest that there may be a correlation between improved pronunciation and enhanced fluency. One potential explanation for this connection is that achieving better pronunciation instils greater confidence in the speaker. This confidence reduces hesitation, false starts, and other psychological barriers that often inhibit fluent speech. When learners no longer have to worry about mispronouncing words, they are more able to focus on producing longer, more coherent utterances, thereby speaking more fluently.

The results obtained from this study point to the importance of integrating phonological awareness into the teaching of adult EFL learners, as this not only helps them achieve better pronunciation but also supports their overall fluency development. These findings could have significant implications for language teaching methodologies and curricula development, particularly in contexts where learners struggle with both pronunciation and fluency.

In conclusion, the present study has highlighted important aspects of phonological awareness and pronunciation improvement. Notably, strategies that encourage learners to consciously correct their errors and offer practical demonstration of the correct articulation of target sounds have proven to be highly effective. Such methods succeed in helping learners unlearn fossilized articulatory habits with consequent remarkable improvements in pronunciation. It has also opened new areas of inquiry that deserve further exploration. Future research could expand on these findings, explore additional variables such as gender differences, and more deeply investigate the correlation between phonological awareness and fluency.

11. Limitations of the Study

Due to time and resource constraints, the scope of the current study had to be somewhat limited. One notable limitation of this paper is that it was based only on the data collected from male subjects. Inclusion of female participants could have altered the results.

Moreover, an unexpected finding reported in the present study is related to the generalization of phonological awareness into oral fluency development. Oral fluency development could also have been studied in the current research paper to examine the [positive] relationship between the two variables.

12. Further Recommendations

To address the gaps that still exist in literature, further research is needed. It is recommended that future researchers build on the foundations of the present study and address those areas that are not yet properly researched. For example, a similar paper might include female subjects either solely, or in mixed participation, to obtain a wider perception about the intervention strategies employed and to examine whether gender has any impact on phonological awareness and pronunciation improvement. Gender-related differences in language acquisition and pronunciation have been explored in other studies, but further investigation into how these differences manifest in EFL learners' phonological development would be beneficial.

Second, the discovery of a potential relationship between phonological awareness and oral fluency development presents a compelling avenue for future research as it indicates that raising phonological awareness could indirectly lead to improvements in fluency. Further research incorporating phonological awareness and oral fluency as additional variables would shed more light on the relationship between fluency and phonological awareness. Understanding this relationship more thoroughly could contribute to the development of more effective teaching methods that not only target pronunciation accuracy but also promote overall oral fluency.

Authors' contributions

Dr. Abdullah Alfaifi was responsible for conceptualizing the study, designing the methodology, theoretical framework, data analysis, and drafting the manuscript. Dr. Mohammed Saleem was responsible for data collection, editing and revising the manuscripts, and referencing. Both authors revised the manuscript critically for important intellectual content and approved the final version.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

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The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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Appendix A

Questionnaire

Dear participant, thank you for continuing your participation in the research study on the articulation of English plosives. Kindly complete the brief questionnaire below. Your cooperation is greatly appreciated.

1. What is the variety/dialect of Arabic you speak at home?

    (a) Southern   (b) Hijazi   (c) Bedouin Hijazi   (d) Hadrami   (e) Urban Hijazi

2. What language(s) do you speak, other than Arabic and English?

    (a)   (b)

3. Please indicate your age range:

    (a) 16-18 years

    (b) 18-20 years

    (c) 20-22 years

4. Please indicate your intended field of education:

    (a) medicine   (b) dentistry   (c) pharmacy   (d) nursing

5. Do you speak English out of class as well?

    (a) Yes   (b) No

6. If you are learning English using any other medium, apart from the classroom, please spcify:

    (a)   (b)

7. Have you ever studied English phonics, (i.e. the manner and place of articulation of English sounds)?

    (a) Yes   (b) No

8. What was the medium of instruction for your secondary education?

    (a) Arabic   (b) English

9. Were you taught English phonics in school when English was taught as a subject of study?

    (a) Yes   (b) No

10. Were you ever taught to articulate certain English sounds correctly?

    (a) Yes   (b) No

Thank you for your time and patience!