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Instrumental Study of Speech Variability of English Back-Rounded Vowels Between the English & Karachiites Pinglish

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Abstract

The paper aims to examine the physical properties of English back vowels produced by English natives through computerized corpus data of English secondary data and non-native Karachiites ESL speakers as primary data. The purpose of this experimental study is to obtain the data from Karachiites' Urdu-speaking native speakers' acoustic values of back-rounded vowels and to investigate the differences in voice quality, duration, and pitch-fundamental frequency of English sound production between native Americans' back-rounded vowels and Urdu speaking native community from Karachi. Based on modifications of F1, F2, F3, F0, and the duration of rounded back vowels, Karachiites L1 speakers were compared to L2 native speakers of English. The English back-rounded vowels examined in this study were four: /uː/, /ɒ/, /oː/, and /ʊ/. The participating students (*N=10*) took part in this study from different Universities in Karachi. Five participants

(*n=5*) were male and (*n=5*) were female students. A total of 120 voice samples (4×3×10=120) were calculated. Praat Speech Processing Tool was utilized to record and evaluate four back-rounded vowels. The difference in fundamental and voice quality frequencies and the length of the vowels were the defining characteristics evaluated for the conclusion. The study measured that out of back-rounded vowels, three vowels /u:/, /o:/ and, / ʊ / were higher in American English than in Pakistani English whereas, the vowel / ɒ / is produced higher in Pakistani English than in American English. This study hypothesized that Pakistani English Karachiites speakers differ in voice quality, fundamental frequency, and durational values of the vowels in the production of English back-rounded vowels if compared to American English speech production. The findings of the study revealed that the hypothesis was accepted as true in view of the variability of English speech by Karachiites and English native speakers.

Keywords: Back-rounded vowels, ESL Karachiites, Formants, Duration, Voice quality

1. Introduction

Languages differ in accent, structure, vocabulary, tenseness, stress patterns, and a variety of other elements that make it difficult for non-native speakers to speak the language with fluency and precision. In view of differences in their native languages' phonetics and phonology, ESL learners may not be able to develop ideal accents while learning English. It is usual to find that non-native speakers make more errors in word production than native speakers. To experiment with this study, ESL learners were given a list of words with CVC context in back-rounded vowels. The back vowels need a backward movement of the tongue. Back vowels are frequently referred to as dark vowels because they are supposed to sound darker. The degree of rounding in lips during the articulation of a vowel is referred to as vowel roundedness. Therefore, back-rounded vowels are produced from the tongue's rear part when the lips are rounded. There are a total of four back-rounded vowels in the International Phonetic Alphabet: /u/, /ɒ/, /o:/, and /ʊ/ (International Phonetic Association (1999) & Handbook of the International Phonetic Association., 1999). Studies have been conducted to investigate the patterns and variations in the production of English vowels by English native speakers and non-native speakers. The study (Abbasi A., Channa, John, Memon, & Ahmed, 2018) was significant for the subsequent analysis. The durations and formants F1, F2, F3, and F0 of twelve American and Pakistani English monophthongs were examined in the study. The research findings reveal that American and Pakistani English have acoustic speech variations in vowel sounds. (Ladefoged, 1990) did remarkable research on the vowels of the world's languages. This study briefly investigated back vowels and how they are formed by lip rounding. It also included a comparison of rounded and unrounded back vowels, which provided a better understanding of back-rounded vowels.

This study aims to examine how back-rounded vowels are produced by American and Pakistani English since acoustic variations in accent and vowel articulation need to be analyzed. Generally, in such studies, it is possible to assess a wide range of variations among the speakers of Pakistani English.

1.2 Objectives

To analyze fundamental frequency F0

To analyze the voice quality & durational values of Karachiites ESL.

To compare Pakistani English vowel production with American English

2. Literature Review

Smith (Smith, Johnson, & Hayes, 2019) conducted a study on the intraspeaker variability of ESL learners in producing American English tense and lax vowels. It assisted in recognizing the possibilities of variety among native and non-native English speakers. When compared to native speakers, they are predicted to generate a higher variety in vowel tenseness and laxness. and similar research, (Holt, 2016) compared speakers of AAE and WAE and analyzed how consonant voicing influenced the temporal difference between tense and lax vowels. (Muneeb-u-Rehman, 2017) conducted a comparison between Pakistani English and Singaporean English discussing the within-speaker variability observed in Pakistani speakers and Singaporean English. The study discovered that there was no significant difference between Singaporean and Pakistani English, however, there was a significant proportion differential among Pakistani speakers (male and female). When tokens are generated by different individuals (male and female), the formant values are measured for the same vowel change (Wang, 2006). (Goldrick, 2014) conducted a study on how non-native utterances may be accented when they are not prompted to switch from their original language. Accents, according to the study, show the difficulties a speaker may have in pronouncing the sounds of a second language, and the influence of partially created representations during online language processing. Variations in idiolects, dialects and factors like speaking rate and level of stress affect the spectral and temporal characteristics that identify any L1 vowel category (Flege, Yeni-Komshian, & Liu, Age constraints on second-language acquisition, 1999).

(Baumgardener, 1993) proposed the study on the "Urduization of English in Pakistan," which looked at the distinctive elements of the Urdu language that are incorporated into the English language when spoken by ESL learners. The phrase and clause levels of Pakistani English are affected by code-switching. The focus of this research was to

explore if non-native speech is more varied than native speech (Vaughn, Baese-Berk, & Idemaru, 2019). The purpose of the group-based experiment was to investigate and analyze how speech changes from speaker to speaker on an acoustic and phonetic basis. The research found that there is a probability of non-native speech differing from native speakers. Moreover, non-native ESL learners need to learn all forms of variation in native speech, as each speaker differs from the standard.

Mahboob (Mahboob & Ahmar, Pakistani English: Phonology, 2008) concluded that due to spelling errors produced by ESL learners, Pakistani English pronunciation considerably differs from other Englishes of the world. They struggle to form the right words because they omit some vowel and consonant sounds, which influences pronunciations. Vowel-inherent spectral shifts and consonantal transitions make dynamic features crucial for distinguishing vowels (Nearey, 2013). (Best & Tyler, 2007) presented research on the perception of non-native and second-language speech. The study provided a better understanding of how a speaker is influenced by their surroundings, as well as how they perceive language and its use. According to neurophysiological studies, exposure to native phonology influences early pre-attentive speech sound processing. In that regard, both the sound's phonemic status within one's native language or dialect and its distinctive phonological structure (the contrastive function of its multiple acoustic dimensions) are important (Scharinger, Idsardi, & Poe, A comprehensive three-dimensional cortical map of vowel space, 2011). It has also been observed that non-native speakers are confused by sound perception and lack understanding. (Flege & Liu, 2001); (Flege & MacKay, Perceiving vowels in a second language, 2004). As a result of the findings, many L2 learners admit that their phonological systems are not significantly different from those of L1. Some studies reveal a poor or nonexistent relationship between L2 segmental perception and production (Kartushina & Frauenfelder, 1014).

The foundational work of (Abbasi M. A., Channa, John, Memon, & Ahmed, 2018) served as the basis for this investigation of back-rounded vowels. The research examined the disparities in vowel production between Pakistani and American English due to the articulatory shift towards the front position. It also looked at the frequency variations between male and female speakers of Pakistani English, findings of the study revealed that several vowels were produced higher and greater in durational values in females than in males (Abbasi, Pathan, & Channa, Experimental phonetics, and phonology in Indo-Aryan and European languages, 2018); (Abbasi & Channa, Phonetics and cognitive linguistics in Pakistani English (Pinglish), 2020). Cross-gender disparities are reportedly common in most languages. Similarly, Pépiot (Pépiot, 2014) concluded that females have higher fundamental frequencies in both Persian, French and American English than males.

Wade (Wade, Jongman, & Sereno, 2007) conducted a study focused on acoustic variation and category overlap, both of which can make it difficult to produce sounds. The benefits of training people and their effects when they have category overlap and confusability have also been discussed in this study. This study thoroughly examined the vowel space and variability between various non-native speakers by conducting three tests that were effective in concluding the high diversity among speakers and the influence of training. According to the NASA TLX measure, non-native listeners experience more listening effort than native listeners while attempting to comprehend English speech. (Peng & Wang, 2019); (Jin & Liu, 2014)) discussed that vowel space between native (L1) and non-native (L2) languages, partially contributed to vowel intelligibility for Chinese-native and Korean-native groups proving that the vowel space can have a larger impact on SL Learners. According to (Liu & Jin, 2011), vowel audibility was like or even better for non-native speakers than for native speakers, showing that vowel audibility did not explain non-native speakers' lower-than-native intelligibility in noise.

(Mahboob, The English language in Pakistan: A brief overview of its history and linguistics, 2003) gave a brief overview of Pakistani English's phonology, syntax, morphology, and lexis. However, there hasn't been much background research done on Pakistani English, thus it couldn't be looked at from every viewpoint. The distinction between Pakistani English and British/American English was further emphasized. The effects of Pakistani languages on Pakistani Speakers are the factor that gives English its unique pronunciation (Sheikh, 2012). This study was carried out to look for variances in Pakistani English (PE) by gathering samples from people in Lahore and phonetically evaluating vowels and diphthongs sounds. The vowels are categorized by referencing three phonetic factors i.e., the height of the vowel, back-ness, and lip rounding (Abbasi, Pathan, & Channa, Experimental phonetics, and phonology in Indo-Aryan and European languages, 2018). According to (Ladefoged & Maddieson, 1990), rounding and height are also connected since higher vowels are often rounder than lower vowels. This connection does have some exceptions. According to the study conducted by (Abbasi A. M., Channa, Kakepoto, Ali, & Mehmood, 2018), Urdu speakers have a comparable pronunciation to RP rather than any other accent close to American. The study also suggested that non-natives (Urdu speakers) make some changes that must be acknowledged as Pakistani English's key characteristics.

The back vowels of Standard British English were compared by (Bilal, Azher, Ishfaq, & Mumtaz, 2021) to those of English. According to the findings, Pakistani English has fewer back vowels than British English. Additionally, it was discovered that two low-back vowels had been combined like in other Asian languages. It was also revealed that Pakistani English is distinctive among Asian languages. (Shaista & Samia , 2015) came to the same conclusion that Pakistani English is distinct from other World Englishes

because it has a specific trait that is present in both male and female sound production. (Munro & Derwing, 1995) examined learning intelligibility, accent, phonetic, phonemic, and other grammatical errors. Ten Mandarin native speakers and two native speakers contributed to the production of the words. Many listeners revealed a correlation between accented-ness and mistakes, but this does not imply that the intensity of learning a foreign language can be measured by it. (Bauer, Introduction to International Varieties of English, 2016) clearly describes how the English Language has a notable variety when spoken in different parts of the world and by different speakers, particularly ESL learners who have an already developed Language, making it difficult for them to speak English the way it is. It examined the diverse dialects and methods of pronouncing American English that were originally vastly different from what we hear now. However, the study gave an inside look into the evolution and usage of American English in its entirety. Flege (Flege, Schirru, & MacKay, Interaction between the native and second language phonetic subsystems., 2003) states that the major goal of this study was to see how the two phonetics subsystems of a bilingual communicate. Based on phonetic category assimilation and phonetic category dissimilation, the researchers investigated the differences in the production of sounds by bilinguals and native speakers. Early bilinguals generated sounds that were more comparable to late bilinguals, according to the findings. Furthermore, (Abbasi A.M., Channa, Kakepoto, Ali, & Mehmood, 2018) also discovered that Native speakers of different languages, including English, have a strong intuition regarding syllables of English words as compared to other Indo-Aryan Languages.

Strange et al. (Strange, Bohn, Nishi, & Trent, 2005) revealed a distinguishing trait of American English vowels when compared to North German English. American English vowels are relatively similar to North German English vowels; however, they differ when generated in context due to substantial allophonic diversity in the production of American Vowels. The study contributed to developing diverse phonemic and phonological perspectives on American English vowels. This study (Hillenbrand, Getty, Clark, & Wheeler, 1995) was carried out as an extension of previously published research, with 45 men, 48 women, and 46 children assisting in data collection. LPC spectra were used to evaluate the formants F1-F4. Eye inspection was used to achieve the most stable formant patterns for comparison with PB data. The study indicated that there are some disparities between the data gathered via the study and those previously investigated in terms of the frequency of F1 and F2, as well as the degree of overlap among surrounding vowels.

This book comprises (Strange, Speech Perception and Linguistic Experience: Issues in Cross-Language Research, 1999) numerous chapters that provide a thorough knowledge of how our native language is rooted in our thoughts and how this makes it harder for us to perceive new sounds that are not present in our original language. (Levey, 2004) also

discovered that English vowels that were not present in Spanish offered the most difficulty, while vowels that were comparable to those in Spanish presented the least difficulty. Additionally, ESL learners should receive training to produce words more accurately and fluently. If the recognizer is taught and evaluated using vowels produced by the same speaker group, the English vowels will be more accurately recognized as the speaker intended (Yenkimaleki & Heuven, 2016).

2.1 Research Queries

When compared to native English speakers, why do Karachiites ESL learners produce acoustic speech variations in F1, F2, F3, F0 and durational values of the targeted vowels?

2.2 Hypotheses

H1: When ESL learners produce English back-rounded vowels, they produce acoustic speech variations in terms of F1, F2, F3, F0, and durational values.

H2: When ESL learners produce English back-rounded vowels, they differ from American English in terms of F1, F2, F3, and duration.

3. Methods & Procedures

3.1 Sampling

The voice samples were obtained from 10 ESL learners who were undergraduate students ranging between the age of 18 and 21. This study included 5 male and 5 female undergraduates from different Karachi Universities. Participating students recorded their voice samples for the study as follows: 5 females, whose initials have been mentioned AK, SB, and SK, FA from the Medical Department, and YB from the Media Department recorded the voice samples. Whereas for males, AM, GA, MZ, PK & SM from the Department of English recorded voice samples. The students were encouraged the participation in research activities.

3.2 Data Collection & Speech Material

For this experiment, participants recorded 120 voice samples through highly configurated mobile phones then the data was transferred into Praat Speech Processing Tool installed on DELL Core-i3 7th Generation laptop. A total of twelve English words were taken for the analysis, which included three words from each vowel. For the vowel /u:/, the words were food, fool, and mood. For the vowel /o:/ the words were corn, dog,

and faun. For the vowel /ɒ/, the words were hot, cot, and holiday. For the vowel /ʊ/, the words were i.e., pull, bull, and put. The words were written in CVC (Consonant-Vowel-Consonant) format on indexing cards/the list of targeted words written on the paper. The chosen words for the recordings were monosyllabic tokens except for a single three-syllabled word holiday. The participants were given a list of these English words and explained to them the recording procedure. They were told to follow the instructions as written on the paper. For improved voice quality, the participants were also advised to record voice samples without background noise, and later the data were put on Praat Speech Processing Tool for data analysis (Boersma, 2016). Table 1 illustrates the stimuli as follows:

Table 1: Speech Material

Vowel	Stimuli		
/u:/	Food	Mood	Fool
/ɒ/	Hot	Cot	Holiday
/o:/	Corn	Dog	Faun
/ʊ/	Pull	Bull	Put

3.3 Recordings

Ten native Urdu speakers (5 male and female) captured 120 voice samples using their mobile phone recorders without any background disruption. The parameters for each vowel were analyzed according to their F1, F2, F3, F0, and duration values. To further analyze using the Praat Speech Processing Tool (Boersma, 2016), 120 voice samples overall were received as data and converted into Mp3 audio files. The recordings were opened on Praat Software, and the 'View and Edit' option was selected to get a spectrograph of the sample that were recorded. The token was then chosen to be examined. Cursors were placed on the chosen vowel to measure the duration of the chosen token; however, this generated a duration measurement in seconds, which was then converted into milliseconds for analysis. The F1, F2, and F3 keys on the keyboard were used to measure the F1 formant, F2 formant, and F3 formant, and the F0 option from the format option.

4. Data Analysis

The data were examined with Praat Software. The option "View and edit" was selected from the object window. The recorded data was taken from files and then entered into

the Praat software. The sound samples appear as a triangular waveform (Abbasi A. , et al., 2018). The tab key on the keyboard was used to thoroughly evaluate data to capture the specific vowel sound. The vowel sound was then chosen to record the Formants F1, F2, F3, F0, and duration.

4.1 Duration Measurement

The durations were manually examined ranging from short vowels to long vowels by selecting the target vowel sounds and then using visual inspection of a wideband spectrographic display to ensure the accuracy of the durations. Praat Software recorded durations in seconds, thus converted them to milliseconds.

4.2 Formants Measurements

The formants F1, F2, F3, and F0 were measured by selecting the target vowel sound and then pressing the keys Frequency 1 for First Formant (F1), Frequency 2 for Second Formant (F2), and Frequency 3 for Third Formant (F3). Whenever a mismatch between the track and the visually apparent formant band in the spectrogram was detected, the formants were checked by visual inspection of a wideband spectrographic display on a computer screen (Abbasi A. M., et al, 2018).

4.3 Vowel /o:/

This is a back-rounded tense vowel which was, using the word corn, produced by a non-native speaker. The spectrogram is used to provide a more detailed perspective of the experiment. The frequencies F0, F1, F2, F3, and duration differed between males and females. Table 2 illustrates the average frequency and duration of the tokens as listed below.

Table 2: Vowel /o:/

Data	F0 (Hz)	F1 (Hz)	F2 (Hz)	F3 (Hz)	Duration (ms)
Female	235	617	1203	2530	89
Male	127	619	928	2804	94

4.4 Vowel /u:/

This is a back-rounded tense vowel which was, using the word food, produced by a non-native speaker. The spectrogram is used to provide a more detailed perspective of the experiment. The frequencies F0, F1, F2, F3, and duration differed between males and

females. Table 3 illustrates the average frequency and duration of the tokens as listed below.

Table 3: Vowel /u:/

Data	F0 (Hz)	F1 (Hz)	F2 (Hz)	F3 (Hz)	Duration (ms)
Female	254	439	909	2677	196
Male	130	359	928	2525	121

4.5 Vowel /ɒ/

This is a back-rounded lax vowel which was, using the word cot, produced by a non-native speaker. The spectrogram is used to provide a more detailed perspective of the experiment. The frequencies F0, F1, F2, F3, and duration differed between males and females. Table 4 illustrates the average frequency and duration of the tokens as listed below.

Table 4: Vowel /ɒ/

Data	F0 (Hz)	F1 (Hz)	F2 (Hz)	F3(Hz)	Duration (ms)
Female	202	703	1254	2994	104
Male	125	612	1016	2631	119

4.6 Vowel /ʊ/

This is a back-rounded lax vowel that was, using the word pull, produced by a non-native speaker. The spectrogram is used to provide a more detailed perspective of the experiment. The frequencies F0, F1, F2, F3, and duration differed between males and females. Table 5 illustrates the average frequency and duration of the tokens as listed below.

Table 5: Vowel /ʊ/

Data	F0 (Hz)	F1 (Hz)	F2 (Hz)	F3 (Hz)	Duration (ms)
Female	198	430	1322	2874	84
Male	142	434	1185	2603	70

For Pakistani speakers, the fundamental frequency (F0) is determined simply to detect the diversity among Pakistani speakers (male and female). The female subjects have the highest value (254) Hz of F0 of vowel /u:/ and the lowest value (198) Hz of F0 of vowel /ʊ/. The male subjects have the highest value (142) Hz of F0 of vowel /ʊ/ and have the lowest value (125) Hz of F0 of vowel /ɒ/. The fundamental frequency (F0) for all back-rounded vowels, including /u/, /ɒ/, /o:/, and /ʊ/ is said to be higher in females when compared to male speakers.

5. Discussion

The investigation of vowels has been discussed in further detail in this section. Back-rounded vowels and their comparability to American English were the subjects of this investigation. However, by comparing voice samples of male and female vowel production, the study analyzed it into great depth on each vowel's production. Male and female Pakistani speakers generated vowel sounds that differed from one another, as revealed by spectrograms and tables previously. The topic of discussion is how they differed from the creation of American vowel sounds, which will be discussed further with the use of data supplied by previous studies on American vowel production and frequencies. First, the study will examine the differences in vowel frequencies. It should be noted that these values were obtained by averaging data from both males and females and comparing it to American English Vowel production. The research (Scharinger, Idsardi, & Poe, A comprehensive three-dimensional cortical map of vowel space, 2011) was used for frequency data for American English. Table 6 illustrates the average frequency and duration of American English as listed below.

Table 6: Vowel /u:/

Data	F1 (Hz)	F2 (Hz)	F3(Hz)
Female	446	981	2745
Male	357	879	2556
Average	402	930	1500
Native American	310	870	2250

As the data indicates, there is a clear distinction between Native American vowel production and non-natives (ESL learners). This supports the earlier hypothesis that natives and non-natives generate different English vowels. As seen in Table 6. there are several disparities in the data of both males and females, indicating that these differences are frequent. The disparity in average frequencies between natives and non-natives

cannot be ignored. F1 has a difference of 91.49 Hz, F2 has a difference of 59.707 Hz, and F3 has a difference of -1049.71 Hz, which is obtained by subtracting native data from non-native data. Table 7 illustrates the average frequency and duration of the American English as listed below.

Table 7: Vowel /o:/

Data	F1 (Hz)	F2 (Hz)	F3 (Hz)
Female	632	1158	2746
Male	609	965	2713
Average	620	1062	2729
Native American	590	880	2540

This is a mid-back tense long rounded vowel that was examined using the words corn, dog, and faun. The table demonstrates that the diversity in vowel production is significant, with a difference in F1 of 30 Hz, F2 of 182 Hz, and F3 of 189 Hz. Table 8 illustrates the average frequency and duration of the American English as listed below.

Table 8: Vowel /ɒ/

Data	F1 (Hz)	F2 (Hz)	F3 (Hz)
Female	678	1374	2872
Male	617	1091	2610
Average	648	1232	2741
Native American	710	1100	2540

This vowel, which is a low back lax rounded vowel, has a difference of F1 of -62 Hz, F2 of 132 Hz, and F3 of 200 Hz. Table 9 illustrates the average frequency and duration of the American English as listed below.

Table 9: Vowel /ʊ/

Data	F1 (Hz)	F2 (Hz)	F3 (Hz)
Female	493	1314	2792
Male	431	1156	2497
Average	462	1235	2645

Native American	450	1030	2380

The sound of the vowel is quite distinctive, and it is commonly heard as /u:/ yet it is a short vowel. F1 has a frequency difference of 12 Hz, F2 has a frequency difference of 205 Hz, and F3 has a frequency difference of 265 Hz. The Pakistani speakers have F1 of long vowel /u:/ as 401 Hz and short vowel /ʊ/ as 462 Hz which is quite close given, that they are short and long vowels that should be produced differently. Similarly, the F1 of the long vowel /o:/ is 620 Hz and the short vowel /ɒ/ is 648 Hz, indicating that they have identical production. We'll also use a graph to discuss the lengths of back-rounded vowels and the variations between non-natives and natives. The figure graph represents the durations of all vowels in American English calculated in ms; however, in this study, we will only focus on the back-rounded vowels. Figure 1 illustrates the average duration of American English as follows.

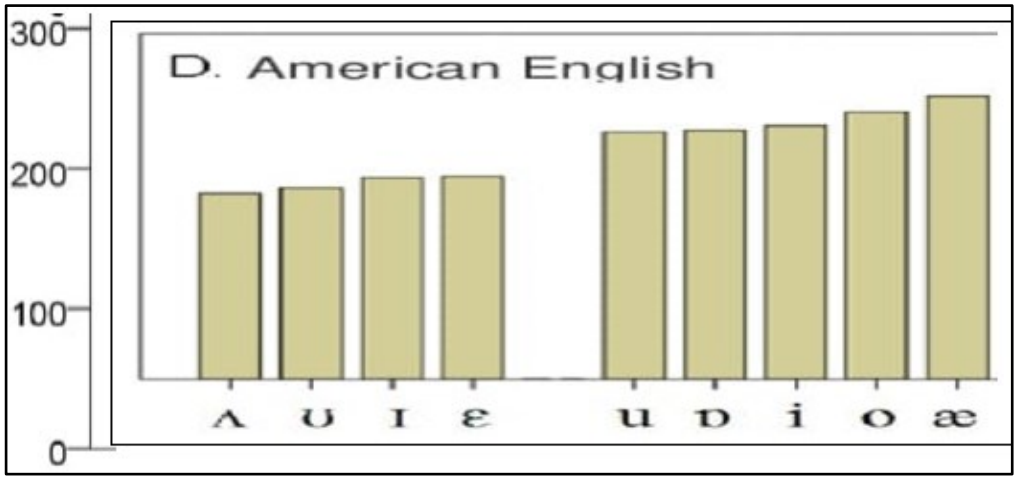

Figure 1: represents the durations of all vowels in American English taken from the research conducted by (Van Heuven, 2016).

The data demonstrates that there is a significant variation in vowel production, particularly in terms of duration. The vowel /ʊ/ is a short vowel that is determined to be less than 200ms and greater than 150ms in American English but is less than 100 towards 70ms in Pakistani English (non-native). The vowel /u:/ is a long vowel with a length like the short vowel /ɒ/ approximately 200 above in American English, but 100 above in non-natives production. The vowel /ɒ/ is a short vowel with a duration of more than 200ms in American English but less than 100ms in Pakistani English. The vowel /o:/ is a long vowel with a duration of over 250ms in American English but less than

100 ms in Pakistani English. Figures 2 and 3 illustrate the average formant frequency of male female Karachiites (Pinglish) vowels.

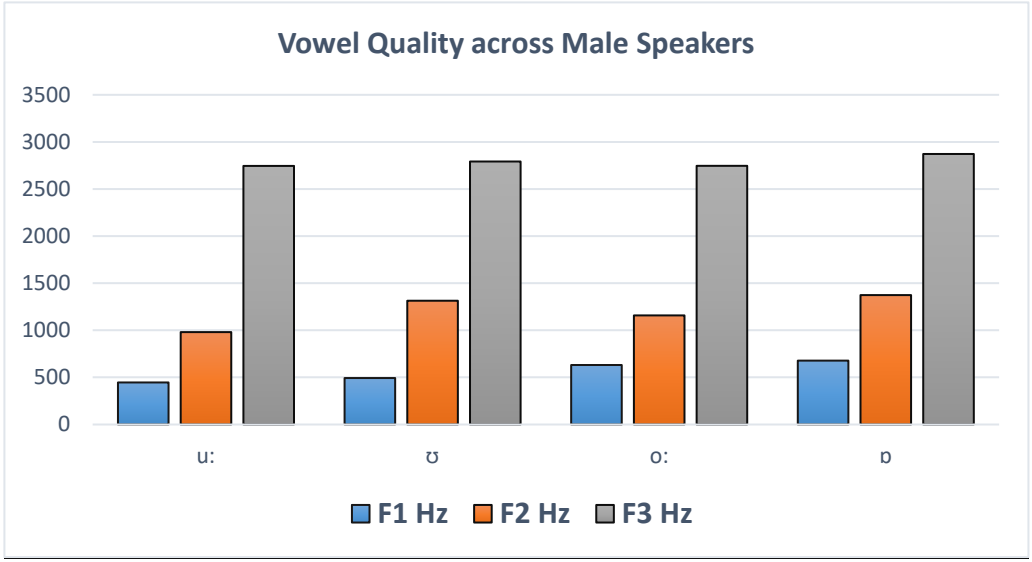

Figure 2: Vowel quality across male speakers

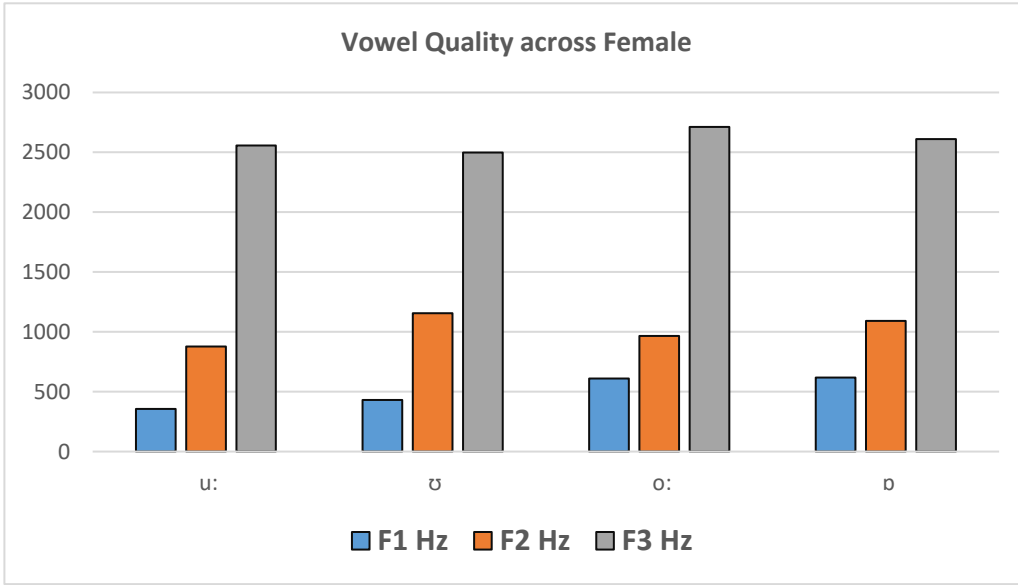

Figure 3: Vowel Quality Across Female Speakers

Figures 4 and 5 illustrate the average durational values of Karachiites (Pinglish) vowels.

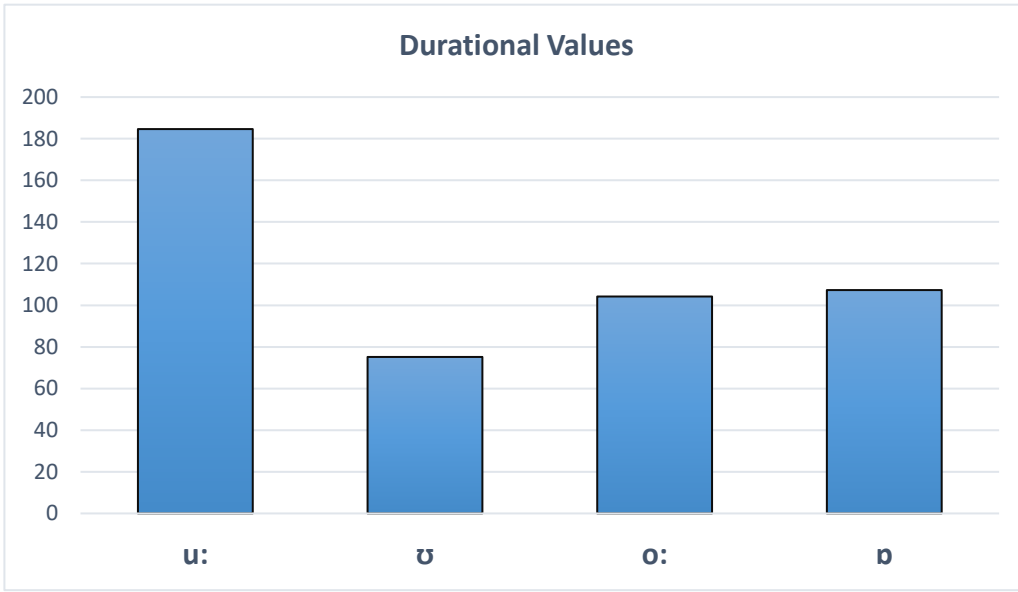

Figure 4: Duration (ms) across male speakers

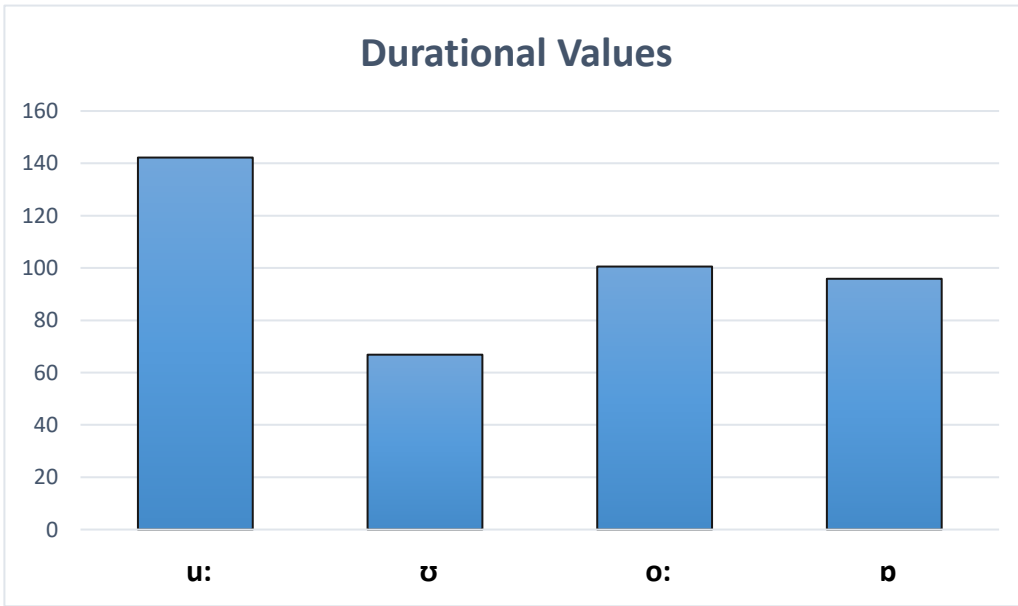

Figure 5: Duration across female speakers

Figures 6 and 7 illustrate the average F0 values of Karachiites (Pinglish) vowels.

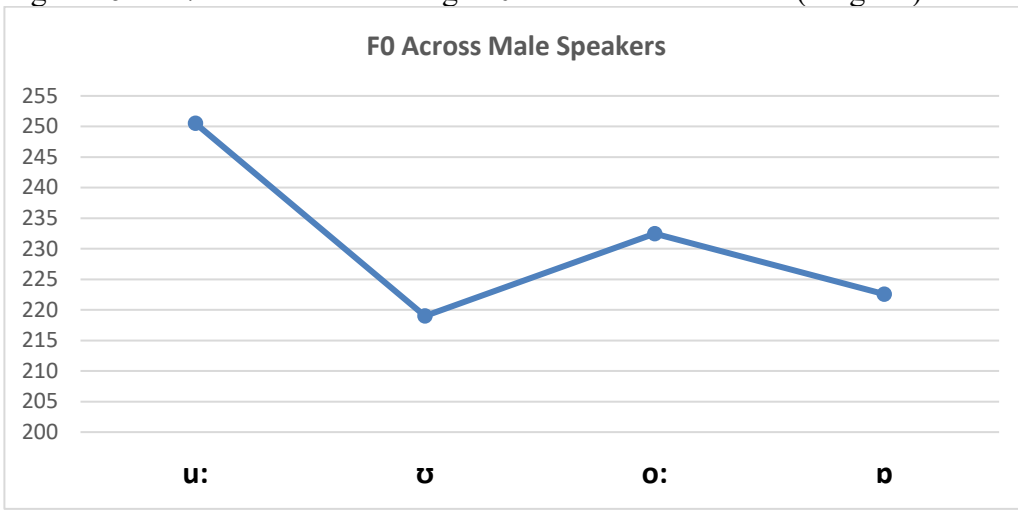

Figure 6: F0 across male speakers

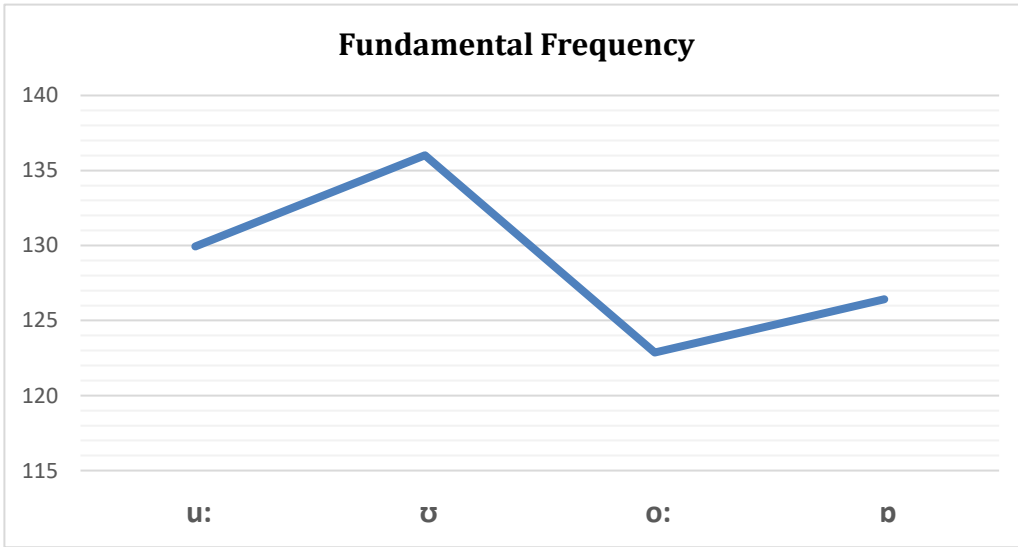

Figure 7: F0 across female speakers

Within-speaker variability is a distinguishing characteristic of Pakistani English from other global languages (Shaista & Samia, 2015). Since female formant frequencies are 10 to 15% higher than male formant frequencies, there is a constant variation in Formant F1 and F2 of most males and females (Wang & Van, 2006). This strong acoustic

evidence has been found in this study of Karachiites Pinglish, it has further been illustrated through the tables and graphs.

6. Conclusion

The study examined if American English differed from Pakistani English in terms of F1, F2, F3, and duration of vowel production. The within-speaker variability among non-natives can be noticed, which is frequent among speakers and was determined by taking the average of the data from females and males. American English, on the other hand, is considerably distinct from Pakistani English. The vowels /u:/, /o:/, and /ʊ/ are produced higher in American English than in Pakistani English (Pinglish) whereas, the vowel /ɒ/ is produced higher in Pakistani English than American English based on Formant Frequency-F1 values. The length of /ɒ/ and /u:/ was measured above 200ms in American English and the length of /o:/ and /ɒ/ was less than 100ms as shown by the data, which revealed that the durational values varied substantially in both short vowels /ʊ/ and /ɒ/ and in both long vowels /u:/ and /o:/. The difference in duration shows that short vowels in American English are more clearly defined and easier to hear when spoken in word contexts than short vowels in Pakistani English, which are delivered more quickly and are more challenging to hear when spoken in word contexts. These differences might be due to differences in sound perception and the absence of sounds in the native language. The data of the study is not as many as should be undertaken for a broader understanding of the acoustic similarities between other languages, particularly features of Pakistani English (Pinglish) by Karachiites ESL learners.

References

Abbasi, A., & Channa, M. (2020). *Phonetics and cognitive linguistics in Pakistani English (Pinglish)*. Berlin (Germany): LINCOM Academic Publisher Germany.

Abbasi, A. M., Channa, M. A., & John, S. (2018). Awareness of L2 American English word stress. International Journal of English Linguistics, 101-107.

Abbasi, A., Channa, M., John, S., Memon, M., & Ahmed, R. (2018). An Acoustic Investigation of Pakistani and American English. International Journal of English Linguistics, 115-121.

Abbasi, A., Channa, M., Kakepoto, I., Ali, R., & Mehmood, M. (2018). A perceptual study of phonological variations in Pakistani English. International Journal of English Linguistics, 91-100.

Abbasi, A., Channa, M., Memon, M., John, S., Ahmed, I., & Kumar, K. (2018). Acoustic Characteristics of Pakistani English Vowel Sounds. International Journal of English Linguistics, 27-34.

Abbasi, A., Pathan, H., & Channa, M. (2018). Experimental phonetics and phonology in Indo-Aryan and European languages. Journal of Language and Cultural Education, 21-52.

Abbasi, A. M, (2018). An acoustic investigation of Pakistani and American English vowels. International Journal of English Linguistics, 115-121.

Bauer, L. (2016). Introduction to International Varieties of English. Edinburgh: Edinburgh University Press.

Bauer, L., & Bauer, L. (2016). Introduction to International Varieties of English. Edinburgh: Edinburgh University Press.

Baumgardener, J. K. (1993). The Urduization of English in Pakistan. In J. Baumgardener, The English language in Pakistan, 83-203. (pp. 83-203).

Best, C., & Tyler, M. (2007). Nonnative and second-language speech. Language experience in second language speech learning: In honor of James Emil Flege.

Bilal, H., Azher, M., Ishfaq, M., & Mumtaz, A. (2021). Acoustic Investigation of Back Vowels of Pakistani English. Review of Education, Administration & Law, 37-52.

Boersma, P. (2016). Praat: doing phonetics by computer. Retrieved from http://www. praat. org/.: http://www. praat. org/.

Flege, J., & Liu, S. (2001). THE EFFECT OF EXPERIENCE ON ADULTS' ACQUISITION OF A SECOND LANGUAGE. Studies in second language acquisition, 527-552.

Flege, J., & MacKay, I. (2004). Perceiving vowels in a second language. Studies in second language acquisition, 1-34.

Flege, J., Schirru, C., & MacKay, I. (2003). Interaction between the native and second language phonetic subsystems. Speech communication, 467-491.

Flege, J., Yeni-Komshian, G., & Liu, S. (1999). Age constraints on second-language acquisition. Journal of memory and language,

Goldrick, M., Runnqvist, E., & Costa, A. (2014). Language switching makes pronunciation less nativelike. Psychological science, 1031-1036.

Hillenbrand, J., Getty, L., Clark, M., & Wheeler, K. (1995). Acoustic characteristics of American English vowels. Journal of the Acoustical Society of America, 3099-3111.

Holt, Y., Jacewicz, E., & Fox, R. (2016). Temporal variation in African American English: The distinctive use of vowel duration. Journal of Phonetics and Audiology, 1-8.

International Phonetic Association. (1999). Handbook of the International Phonetic Association. (1999). Cambridge: Cambridge University Press.

Jin, S., & Liu, C. (2014). Intelligibility of American English vowels and consonants spoken by international students in the United States. Journal of Speech, Language, and Hearing Research, 583-596.

Kartushina, N., & Frauenfelder, U. (1014). On the effects of L2 perception and individual differences in L1 production on L2 pronunciation. Frontiers in psychology2-46.

Ladefoged, P., & Maddieson, I. (1990). Vowels of the world's languages. Journal of Phonetics, 93-122.

Levey, S. (2004). Discrimination and production of English vowels by bilingual speakers of Spanish and English. Perceptual and motor skills, 445-462.

Liu, C., & Jin, S. (2011). Audibility of American English vowels produced by English-, Chinese-, and Korean-native speakers in long-term speech-shaped noise. Hearing Research, 49-55.

Mahboob, A. (2003). The English language in Pakistan: A brief overview of its history and linguistics. Pakistan journal of language, 1-28.

Mahboob, A., & Ahmar, N. (2008). Pakistani English: Phonology. Varieties of English, 244-258.

Munro, M., & Derwing, T. (1995). Foreign accent, comprehensibility, and intelligibility in the speech of second language learners. Language learning, 73-97.

Nearey, T. (2013). Vowel inherent spectral change in the vowels of North American English. Vowel inherent spectral change, 49-85.

Peng, Z., & Wang, L. (2019). Listening effort by native and non-native listeners due to noise, reverberation, and talker foreign accent during English speech perception. Journal of Speech, Language, and Hearing Research, 1068-1081.

Pépiot, E. (2014). Male and female speech: a study of mean f0, f0 range, phonation type and speech rate in Parisian French and American English speakers. Speech Prosody, 305-309.

Rehman, Q. M., Abbasi, A. M., & Lashari, A. A. (2017). Speech variation in Pakistan vs. Singaporean English. Journal of Social Sciences and Media Studies, 36-49.

Scharinger, M., Idsardi, W., & Poe, S. (2011). A comprehensive three-dimensional cortical map of vowel space. Journal of cognitive neuroscience, 3972-3982.

Scharinger, M., Idsardi, W., & Poe, S. (2011). A comprehensive three-dimensional cortical map of vowel space. Journal of cognitive neuroscience, 3972-3982.

Shaista, H., & Samia, I. (2015). Acoustic Analysis of Back Vowels (/ɒ/ and /ɔ:/) in Pakistani English. Global Journal of HUMAN-SOCIAL SCIENCE: G Linguistics & Education, 1-7.

Sheikh, Q. (2012). An analysis of the vowel sounds of Pakistani English. Bulletin of Education and Research, 1-18.

Smith, B., Johnson, E., & Hayes, H. (2019). ESL learners' intra-speaker variability in producing American English tense and lax vowels. Journal of Second Language Pronunciation, 139-164.

Strange, W. (1999). Speech Perception and Linguistic Experience: Issues in Cross-Language Research. In Cross-Language Perception (pp. 105-107). Phonetica.

Strange, W., Bohn, O. S., Nishi, K., & Trent, S. A. (2005). Contextual variation in the acoustic and perceptual similarity of North German and American English vowels. The Journal of the Acoustical Society of America, 1751-1762.

Van Heuven, V. J. (2016). Acoustic characterization of English vowels produced by American, Dutch, Chinese,d Hungarian speakers. Hungarian Journal of Applied Linguistics, 1-20.

Vaughn, C., Baese-Berk, M., & Idemaru, K. (2019). Re-examining phonetic variability in native and non-native speech. Phonetica, 327-358.

Wade, T., Jongman, A., & Sereno, J. (2007). Effects of acoustic variability in the perceptual learning of non-native-accented speech sounds. Phonetica, 122-144.

Wang, H., & Van, H. (2006). Acoustical analysis of English vowels produced by Chinese, Dutch, and American speakers. Linguistics in the Netherlands, 237-248.

Yenkimaleki, M., & Heuven, J. (2016). Effect of explicit teaching of prosodic features on the development of listening comprehension by Farsi-English interpreter trainees: An experimental study. . International Journal of English Language Teaching, 32-41.