Acoustic Variations in Native and Non-native English Vowel Contrasts

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Abstract

This study examines eleven English monophthongs /iː, ɪ, e, æ, ʌ, ɑː, ɒ, ɔː, ʊ, uː, ɜː/ produced by Pakistani non-native English speakers. The aim is to compare the acoustic properties of Pakistani English vowels with those of British English vowels, focusing on F1 and F2 measurements. Data was collected from voice recordings of twenty students (10 males, 10 females) studying at BS level in different departments of Quaid-e-Azam University Islamabad. For native data, the formants (F1 and F2) of eleven pure vowels from RP (Standard Southern British SSB) were extracted, and selected from Deterding (1997). The measurements were made using Praat spectrograms for each vowel which were repeated five times by all L2 speakers, and their average is taken for this study for more accurate results. These measurements were taken from a frame sentence, allowing comparison with previous formant values measured from citation-connected speech. The study postulated that there are two distinct English varieties of Pakistani non-native English speakers' vowels and Received Pronunciation (RP), which are expected to exhibit dissimilarities. The study also examined the acoustic variations of male and female speakers within the group of second language (L2) speakers. The study revealed that the vowels produced by male participants were significantly different in the measurements in connected speech than female speakers. This initial investigation confirmed disparities in the attributes of English vowels among Pakistani individuals and native English speakers.

Keywords: Native English Variety, Non-nativ English, Vowels, Acoustics

1. Introduction

The growing use of English for industry, travel, or education communication has become important to people with different language

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backgrounds around the world. The constantly growing extent of English as major international language has expedited the emergence of distinctive English varieties. House (2003) claimed that in many contexts, people who speak English as non-native speakers now outnumber those who speak the language as native speakers. Using English as a language for international and intercultural communication has given the stimulation for further novel varieties of accented Englishes to be used for communication and one of the significance of such capriciousness is the likely deficiency of joint intelligibility among differently accented Englishes speakers. Non-native English speakers can be easily stigmatized due to their differing ability to speak English (Lindemann, 2005). This lack of fluency can result from interference with the sound system of their mother tongue (L1), resulting in non-native pronunciation of their second language (L2), English (Best, 1994; Flege, 1995, 2003).

In Pakistan there is a disagreement among the various linguists over the total agreed number of language. The difference within the list of the talked languages is due to the perplexity of language as lingo or as an isolated dialect, as Rehman (2002) said that there are 59 talked languages in Pakistan whereas there are 72 talked languages agreeing to Ethnologists, and numerous of these languages have a place to Indo-Iranian, Indo-Aryan, Indo-European, and Turkic language families (Gordon, 2005). Urdu is the mother tongue of around 8% of the population in the country (Rahman, 2011). However, it serves as a shared language for individuals from diverse linguistic backgrounds (Kothari, 2015). In addition to serving as a lingua franca in the country, it is also employed as the medium of instruction in educational institutions (Javed, 2017). In addition to the five prominent regional languages, namely Balochi, Pashto, Sindhi, Punjabi, and Saraiki, there are other lesser-known languages spoken in the nation. It is worth mentioning that when individuals who speak various ethnic languages around the world speak English, their speech carries a subtle influence from their native language, which in many ways sets them apart from speakers of other languages.

English is Pakistan's official language (Mahmood, 2009), which is also the primary teaching medium in several academic institutions. Naturally, it is spoken and understood by a big segment of the population of the country. Baumgardner (1992) notes the utilization of English in Pakistan by accurately contending that tying down English in Pakistan is so vital that it codifies the Constitution and enactment in English. When

explaining the usage of English in Pakistan, the use by saying that English is primarily used in four particular fields in Pakistan. These four fields are: regular official communications, in several educational establishments as a means of instruction, in technical education and as a tool of communication in foreign commerce and exchange. English is a vital learning medium in Pakistan's educational system. According to Pakistan's education policy, it is a mandatory subject for all students from both the private and public sectors. As a result, it manifests for Pakistanis that English is a big key to victory in every life context. This would not be unreasonable to say that English language learning has been promoted to combat the worldwide communications market (Romaine, 2006). When the speakers of various regional languages of the country speak English, we frequently note that in many respects it is in a distinctly different type from that of others that their language has an undertone of their first language (mother tongue). One may say that it is not English that is spoken in our country, but Englishes. Therefore, Pakistani English speakers doesn't seem to have a single standardized variety, but rather a set of multiple sub-varieties. The acquired language tends to have its own syntax, vocabulary, and distinct phonology and phonetics. English spoken by Pakistanis appears to be influenced by their respective mother tongues in various areas. In this way we obtain multiple varieties of regional English.

This study is conducted to address the problem that non-native speaking communities are encountering. It too includes standardizing models and norms between different "Englishes" to address internal variations. Hence, the researchers try to objectively analyze the non-native production of English monophthongs by Pakistani L2 speakers of two major languages of Pakistan. To make the work oriented and achievable, only the RP monophthongs are selected for exploration. Hence, this study focuses on contrastive speech analysis by observing acoustic differences in the behavior of the Pakistani Non-native English speakers when studying English monophthongs. These acoustic differences are due to the nativity influence of the first language for example, Pashto and Sindhi languages, which is the hypothesis of this research. From the typological perspective, it is aimed to examine the English pure vowels acoustically to measure F1 and F2 by L2 speakers from two major languages of Pakistan and native English speakers. Specifically, the goal is to find out whether the first language L1 (Sindhi and Pashto) vowel systems affect the vowel output of non-native speakers. Prior studies (Ahad, et.al, 2020; Baidar et.al, 2020; Abbasi, 2021; joyo, et.al, 2023; Hussain. et.al, 2022) have focused on

acoustic analysis of English vowels production by Pakistani speakers from one linguistic background i.e., Pashto or Sindhi speakers. It is anticipated that this typological research will contribute significantly to the country's existing body of knowledge, as it will concentrate on the phonological problems of Pakistani learners from a new and different vantage point. This would be the first study from the typological perspective on Pakistani L2 English speakers that will focus on the acoustic analysis of English RP monophthong production by native and Non-native speakers of English, as well as the similarities and differences between these two varieties.

Pakistani speakers have variant forms of English pronunciation, even though studying English as a foreign language (EFL) for many years. Pakistani EFL learners face difficulties in perceiving and generating segments of L2 (i.e. vowels and consonants) that are either unique (do not exist in their L1) or are very similar (phonetically) to L1 phonemes. It is to be noted that they learn English in Pakistan and as a result, the feedback (especially speaking and listening) they receive has very little to do with Received Pronunciation (RP), except for some audiovisual materials used in schools/universities, TV, movies as well as other media platforms in daily life. Consequently, there are variations in acoustic properties of native and non-native (Pakistani English speakers) vowels contrast. The comparative acoustic study of English monophthongs production by Pakistani and British English speakers can provide useful information on how prior LI (two regional languages) knowledge affects the L2 (RP English) production. Therefore, it will be decided which English vowels are not easy to differentiate by Pakistani speakers and to find whether there are first languages crossover effect on their English. Baseline knowledge about the acoustic characteristics of British English Pakistani speakers will also be useful in recognizing and collaborating with international accent reduction for native Pakistani speakers in the creation of clinical intervention programs by speech-language pathologists.

This study examines the acoustic characteristics of vowels in English, specifically focusing on the relationship between the frequency of the first formant (F1) and the height of the tongue, as well as the frequency of the second formant (F2) and the backness of the vowels. The analysis is conducted using the Praat Speech Processing Tool and compared the differences between male and female speakers in terms of vowel height (F1) and quality (F2).

1.1 Research Objectives
- Investigate the acoustic disparities in the pronunciation of RP native English and Pakistani non-native English speakers (Pashto and Sindhi).
- Examine the differences in the way male and female speakers produce English vowels in terms of their (F1) and (F2) frequencies.

1.2 Statement Problem
Pakistani English is a variant of English that is spoken with a distinct accent, differing from Received Pronunciation (RP) English. The statement of the problem is to ascertain the potential dissimilarities between female and male spoken English, specifically in terms of the quality of English vowels (F1 and F2). Additionally, this research aims to explore the disparities between these two language types as spoken in Pakistan and Standard Southern British dialect.

1.3 Research Queries
i. What are the acoustic differences in vowel quality between Pakistani and RP accents, specifically in terms of F1 and F2 frequencies?
ii. What are the differences in vowel quality, specifically in terms of F1 and F2, between native and non-native English-speaking males and females?

1.4 Hypothesis
If Pakistani individuals who are not native speakers of English articulate English vowels, there will be changes in the height and quality of the speech's F1 and F2 frequencies compared to Received Pronunciation (RP) English.

2. Literature Review
Pakistan is a democracy with a pluralistic society. People live here have diverse racial, economic, social, theological and linguistic histories. Including the main languages of Urdu, Pashto, Sindhi, Brahvi, Punjabi Saraiki, Kashmiri and Hindko; in total there are 72 languages in Pakistan which are spoken (Rahman, 1990). Almost all of these are intermixed. If one would analyze these languages, he would find excessive use of similar words among these languages. All this is due to the reason that they all have tremendous curiosity, sensitivity and similarity to foreign terms.

A wealth of research exists on phonological difficulties evaluated using acoustic analysis. Several academics have undertaken acoustic analysis to compare and contrast native English vowel and diphthong sounds with those of other languages. The aim is to identify variations between native English speakers and non-native speakers who speak English with their own accent. Hussain (2010) and Abbasi (2015) indicate that there is a lack of research on second-language English learners in South Asian locations, but there has been adequate research conducted on spoken languages in Pakistan. Nevertheless, a scientific methodology is essential for examining the fundamental auditory cues used in speech evaluation.

According to acoustic theory (Fant, 1985), formants are considered to be resonances of the vocal tract, where the energy of voice waves is concentrated. The main objective of the study is to analyse and contrast the formant-1 and formant-2 patterns among male and female individuals who are both native and non-native speakers of the English language. This study examines the vocalic inventory of two widely spoken indigenous languages in Pakistan, namely Pashto and Sindhi. The present text provides a concise overview of the literature study pertaining to their vowel sounds.

2.1 Pashto

Pashto is classified as an East Indo-Iranian language and is spoken by a population of approximately twenty million individuals (Robert, 2000). According to Elfenbein (1997), Pakistan had 12 million speakers and Afghanistan had 8 million speakers in 1979. While it is considered a provincial language in Khyber-Pakhtunkhwa, it holds the status of an official language in Afghanistan (Din & Rahman, 2011). It possesses a distinctive characteristic among Iranian languages by having several retroflex consonants, similar to Urdu and Punjabi. Urdu and Punjabi are neighbouring languages, however they are distantly linked to Pashto (Robert, 2000). Din and Rehman (2011) identified five varieties of Pashto: Yusuzia, Kandahari, Middle Tribal, Central, and the Quetta dialect. Elfenbein (1997) states that the intricate branching dialects of Pashto have a challenging phonology. The phonetic inventory of the language is a subject of controversy. Din and Rehman (2011) argue that it consists of nine vowels, while Robert (2000) claims there are only seven, and Ijaz (2002-2003) suggests there are ten. According to her, Pashto people employ short vowels in a haphazard manner, while long vowels are exclusively utilised for Persian and Arabic foreign words.

Table 1: Pashto vowels

	Din & Rehman, 2011	Robert T., 2000	Ijaz M.
1	I	i	i
2	ɪ	-	ɪ
3	e	ee	e
4	ə	e	ə
5	u	u	u:
6	ʊ	-	u
7	æ	-	-
8	a	aa	a:
9	o	o	o
10	-	a	a

In their study, Baidar et.al (2020) determined that Pashto speakers pronounced certain English short vowels, such as /ɪ/, /e/, and /ʌ/, with comparable height but varying backness compared to native speakers. Conversely, vowels like /ə/ and /ɒ/ were produced by Pashto speakers in a manner similar to native speakers, with no discernible differences in height or backness.

2.2 Sindhi

Sindhi is a native language in Pakistan (Omniglot). In 1996, the language was classified as the 50th most widely spoken in the world. The 1981 census reported 19 million speakers, while the 1998 census reported 30.4 million speakers in Pakistan. In Sindh, the first language is considered to be Sindhi, whereas Urdu and English are regarded as second languages. Urdu and Hindi, being equipped with two writing scripts, are regarded as a single language with dual scripts. The language consists of six distinct dialects: Thareli, Lasi, Lari, Vicholi, Utradi, and Kachhi. However, Vicholi is a commonly used dialect that is specifically linked to the Sanghar district. According to Keerio (2010), there are 10 vowels that may be distinguished using minimal pairings.

Table 2: Sindhi Vowels

Sr. no.	IPA Symbol	Sindhi
1	I	اِي
	ɪ	اِ
2	e	اي
	ɛ	اَي
3	ə	اَ
	ɑ	اَ
4	ɔ	او
	o	او
5	ʊ	اُ
	u	او

Joyo and Memon (2023) discovered a little disparity in the F1 and F2 values of the vowels /ʌ/, /ɑ:/, /ae/, /e/, /ə/, /3:/, / I /, while a significant difference was observed for the vowels and diphthongs /i: /, /ɒ/, /ɔ:/, /ʊ/, /aʊ/, /əʊ/, /u:/, /aɪ/, /eɪ/, /ɔɪ/, /eə/, /ɪə/ and /ʊə/.The researchers additionally determined that female Sindhi speakers exhibit greater F1 and F2 values compared to male speakers. Moreover, they found that these results were very significant for certain phonemes.

The vowels in second language acquisition are influenced by the age at which the language is learned, as the reciprocal relationship between the native language (L1) and the second language (L2) mutually impact each other (Grace, et al., 2011). The vowels in the target language (English) are pronounced similarly to the vowels in the first language (Li & Jia, 2018). The articulatory postures of native and non-native English speakers change significantly while creating vowel sounds. While some English vowels are pronounced similarly to native speakers, others are produced with distinct tongue locations (Wang, Jia, Li & Xu, 2016). Second language learners often find English vowel sounds more challenging than consonant sounds since variations in languages are mostly observed in vowel sounds (Al-Badawi, & Salim, 2014). The faults identified were primarily observed in the pronunciation of English by those who acquired the language later in life. These errors mainly included the vowels and resulted in acoustic overlap, notably in the production of front vowel sounds (Rogers, et al., 2013).

Vowels have a significant part to play in expressing the full sense of a word. Pure vowels have simple and recognizable features for which monophthongal vowels are the focus of linguists' work. Best's (1993, 1995) Perceptual Assimilation Model and Flege's (1995) Speech Learning Model are the most prominent in bringing into consideration the dynamic effect of L1(first language) into consideration. Many of the earlier studied have applied Contrastive Analysis Hypothesis for checking English learning, but they do not justify the effective development of any of the expected troublesome sound segments due to their nonappearance in the L1. Noticed that significant variations were detected while producing English vowels by second language speakers.

Flege (1995) analysis shows a great number of variations in the effect of L1 on L2 while producing non-native speech. To quantitatively distinguish various native and non-native speech sounds, the analysis of phonetic variations between the L1 and L2 parts is used. In his SLM, Flege (1995) claimed that during the process of speech processing, if there are similar vowels in L1 and L2 vowel system; the more complicated it is to obtain the L2 vowel, though those that differ from the L1 vowels are relatively easier to grasp. In the current study, it is aimed to define the acoustic features of the English monophthongs produced by Pakistani EFL speakers and further investigating whether identical vowels in English and L1 (two regional languages) are more difficult to produce for Pakistani students. This research tried to figure out if the L2 systems have different F1 and F2 vowel production than L1 vowels.

3. Research Methodology
The essence of the research is epistemological, and is strongly related to positivism, since the conclusions have been collected by using analytically empirical methodologies. The research is exploratory in nature and has been planned to explore the typological differences of the Pakistani English speakers. The field of acoustic phonetics has therefore been chosen for a comparison study of Pakistani non-native English speakers in reference to RP monophthongs. The data for the current study was taken from two different samples; native and non-native English speakers. For native speakers, the study of Deterding (1997) on 'The formants of monophthong vowels in Standard Southern British English pronunciation' is adopted as a model study for native speaker speech for comparison. For Non-native speakers of English, 20 speakers (10 from each; 5 male & 5 female) from Pashto and Sindhi were selected as a sample from Quaid-e-

Azam University Islamabad. Thus, twenty Pakistani EFL speakers were selected using the convenience sampling method from different departments of the BS degree program (male and female), age ranging from 19-25. They had all received their education in Pakistan, having English as a medium of instruction from school to university. The goal behind the selection of this category is to have a clear understanding of the English language. The other key explanation is that a person with a university degree will be affected and attached as much to his / her mother tongue as to English, the second language. Furthermore, participants of the study have same L2 experience in their formal education. No speaker was selected with hearing or speech disorder.

3.1 Data Collection and Experimental Procedure

A total of 1100 (20 speakers x 11 vowels x 5 repetitions = 3300) tokens were segmented in Praat (Boersma & Weenink, 2014). By using Praat, their F1, F2, and vowel scatter plots were extracted during articulation of English vowels. The selected vowels for this study are only 11 monophthongs, while schwa /ə/ is missing here, the reason behind leaving it is the model study of Deterding (1997) for native English speakers format which didn't include schwa in his study. Furthermore, only monophthongs are selected to study the similarities and differences of English vowels produced by native and non-native speakers of English. The speech content involved is a list of 11/hVd/vowels in a carrier sentence; "I can say……again", which the subjects were asked to produce five times: 'heed, herd, hard, horde, who'd, hid, head, had, hudd, hood and hod.'

Table.3.1 Vowel category, test words and (assumed) corresponding lexical sets

Vowels	/hvd/ List Items	Lexical Set
/i:/	Heed	Fleece
/ɪ/	Hid	Kit
/e/	Head	Dress
/æ/	Had	Trap
/ʌ/	Hudd	Hut
/ɑ:/	Hard	Start
/ɒ/	Hod	Lot
/ɔ:/	Horde	North
/ʊ/	Hood	Foot
/u:/	Who'd	Shoes
/3:/	Herd	Heard

The words given in Table 3.1 were shown to the participants on the computer screen in order to produce them in a carrier sentence. After every sentence, they were guided to pause. It was advised to produce the test sentences in a natural speech style and at a pace that they believed was relatively normal. Recordings were made in a sound proof room at Quaid-e-Azam University using the experimental procedure compact Zoom H6 optical voice recorder with an external microphone to make audio recordings. All speech was captured in stereo mode at 44.1 kHz and encoded in 16-bit, uncompressed WAV format. Stereo recordings then transformed to mono by averaging the two channels using the usual Praat mono conversion algorithm (Boersma & Weenink, 2014). Recordings were digitized on the server using PRAAT, and the digitized information was analyzed. The acoustic onset and offset of each word in each speech data file was identified from the wide-band spectrograms and the acoustic waveform and labelled on the 'word' rank. Vowels in each tier considered as the onset and offset of normal vocal energy-associated formation activity that is visible from the spectrographic display. A limit of 1100 tokens were segmented at Praat (Boersma & Weenink, 2014), version 6.0.30. Every English monophthong was generated five times. The length of the vowel, F1, F2, and the scattered plot of the vowel was plotted for the analysis.
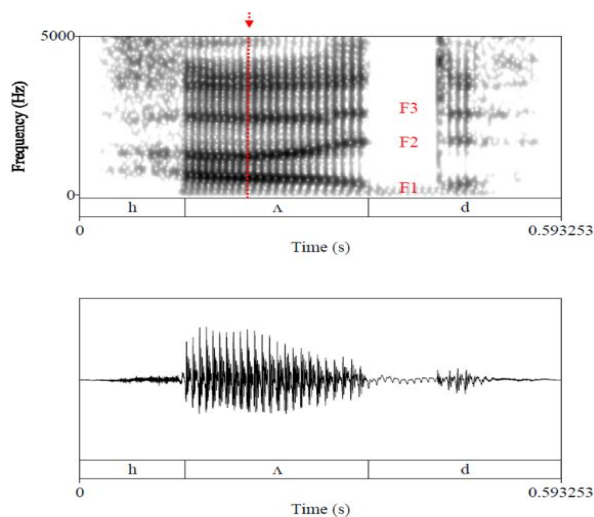
Fig .1 Spectrogram and waveform of an English word, "Hudd". The red line specifies how to generate F1 and F2 values for / ʌ /

The same segmentation method was used across languages. In the case of any background noise, mispronunciations and missing repetitions, those tokens were excluded from the study. In the current study, the data was reported based on male and female gender as a vital feature of phonetic variation; thus, including data from two genders made the study more comprehensive. For the elimination of the physiological variances caused by age and gender, the vowels were normalized by altering them to the auditory Bark scale, using the formula suggested by Zwicker and Terhardt (1980), where F is the frequency in Hertz and Z the frequency in Bark:

$Z = 13 \arctan(0.00076F) + 3.5 \arctan(F/7500)2$

4. Data Analysis

In the research, the recording of the word list (Table.3) was done by Sindhi and Pashto L1 speakers (male and female). For the speakers of two genders of both languages, the middling values of the foremost two formants in Hz and Bark are compared with Deterding (1997) values of both gender of speakers. The data of both languages are described here as follows:

4.1 Sindhi EFL Speakers

The comparison of native (from citation Deterding, 1997) English speakers and non-native Pakistani EFL speakers (L1 Sindhi) is as follows:

Table 4.1: Comparison of average frequency values (Hz) of male and female Sindhi speaker with citation (Deterding, 1997)

Comparison of Average Frequency values (Hz) of Male Sindhi speaker with citation (Deterding, 1997)					Comparison of Average Frequency values (Hz) of Female Sindhi speaker with citation (Deterding, 1997)				
Vowels	F1	F2	F1 (RP)	F2 (RP)	Vowels	F1	F2	F1 (RP)	F2 (RP)
iː	318	2479	303	2654	iː	316	2165	280	2249
ɪ	496	2412	384	2174	ɪ	461	1963	367	1757
e	735	2120	719	2063	e	539	1869	494	1650
æ	836	1512	1018	1799	æ	553	1849	690	1550
ʌ	541	1284	914	1459	ʌ	521	1370	644	1259
ɑː	825	1446	910	1316	ɑː	690	1027	646	1155
ɒ	556	1157	751	1215	ɒ	534	873	558	1047
ɔː	577	1018	389	888	ɔː	553	955	415	828
ʊ	465	1104	410	1340	ʊ	465	1347	379	1173
uː	445	915	328	1437	uː	416	1610	316	1191
ɜː	767	1553	606	1695	ɜː	572	1357	478	1436

To dispense with the physiological contrasts caused by age and gender, the information of vowels was normalized by changing over them to the auditory Bark scale.

$$Z = 13 \arctan (0.00076F) + 3.5 \arctan(F/7500)2$$

The formula used was given by Zwicker and Terhardt (1980), where F represents frequency (Hz) and Z represents frequency in Bark.

For the better observation of the variances between native and Pakistani (Sindhi) speakers, all the values converted to Bark scale as follows:

Table 4.2: Comparison of average frequency values (in Bark) of male and female Sindhi speaker with citation (Deterding, 1997)
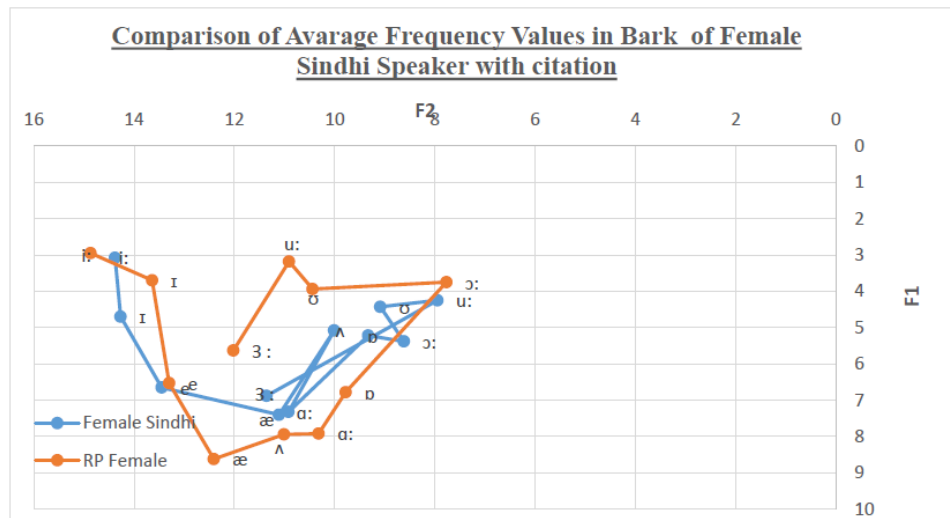
Comparison of Average Frequency Values in Bark of Male Sindhi Speaker with citation (Deterding, 1997)				Comparison of Average Frequency Values in Bark of Female Sindhi Speaker with citation (Deterding, 1997)			
Vowels	**Sindhi**		**RP**		**Sindhi**		**RP**
	F1	**F2**	**F1(RP)**	**F2(RP)**	**F1**	**F2**	**F1(RP)**	**F2(RP)**

Vowels	Sindhi F1	Sindhi F2	RP F1(RP)	RP F2(RP)	vowels	Sindhi F1	Sindhi F2	RP F1(RP)	RP F2(RP)
iː	3.07	13.59	2.73	13.85	**iː**	3.08	14.38	2.95	14.87
ɪ	4.39	12.97	3.54	12.26	**ɪ**	4.7	14.27	3.7	13.64
e	5.07	12.65	4.68	11.84	**e**	6.65	13.45	6.53	13.3
æ	5.19	12.56	6.31	11.42	**æ**	7.4	11.11	8.62	12.41
ʌ	4.91	10.57	5.94	10.02	**ʌ**	5.08	10.01	7.94	11.01
ɑː	6.3	8.68	5.96	9.45	**ɑː**	7.32	10.92	7.92	10.32
ɒ	5.01	7.55	5.23	8.81	**ɒ**	5.22	9.33	6.78	9.78
ɔː	5.19	8.19	3.98	7.34	**ɔː**	5.38	8.62	3.75	7.77
ʊ	4.42	10.38	3.65	9.55	**ʊ**	4.43	9.09	3.94	10.44
uː	3.97	11.07	3.07	9.65	**uː**	4.25	7.95	3.18	10.91
ɜː	5.34	10.52	4.54	10.91	**ɜː**	6.88	11.36	5.63	12.02

For visual representation of the comparison amid English speakers from RP and L2 speakers (Sindhi), it can be better understood through charts as follows:
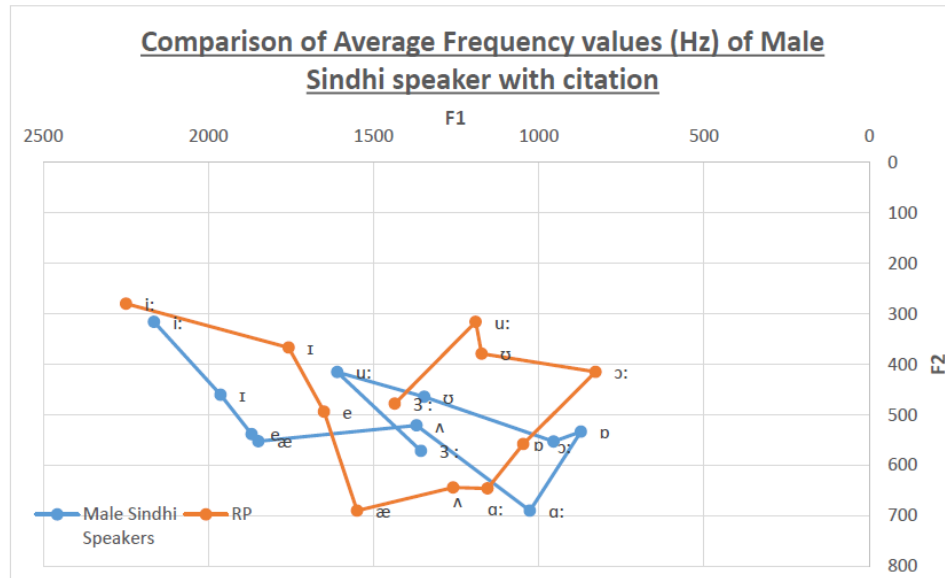
Fig. 4.1 Comparison of Average Frequency values (Hz) of Male Sindhi speaker with citation

The comparison (Fig. 4.1 and tables 4.1 & 4.2) shows the variation of F1 and F2 during English vowels production by native and non-native speakers of English. There are significant differences between the average values of both speakers. There are some very significant variations; like Sindhi speakers have pronounced /e/ and / æ/ quite similar, it shows that they can't differentiate between these two different vowels. There is also minor difference between production of /ɒ/ and /ɔ:/ by Sindhi speakers and they produced English /ɔ:/ like native /ɒ/ which can be shown closer to it in vowel chart. This shows that Sindhi speakers are unable to make differentiation between /e/ and / æ/ due to their first language and they consider it same. One important point is that there is no difference in frontness/backness of vowels except /u:/ by Sindhi male speakers which they have pronounced more like front vowels than as back vowel.

Fig. 4.2 Comparison of Average Frequency values in Bark of Female Sindhi speaker with citation

Like male Sindhi speakers, female Sindhi speakers also make significant variation in vowel production as compared to native speakers. Here Sindhi female speakers have confused /æ/ and /a:/ and produced them alike. Same is case with /ɒ/ and /ɔ:/ for Sindhi females, they have produced them much in same fashion. Central vowel /ʌ/ have very significant difference in their F1 and F2. Several independent t-tests were applied in order to find the difference between native and non-native vowels production. All the vowels showed p<0.05 which shows there is significance difference between Sindhi female and RP female speakers. Only /e/ and /i:/ has P>0.05 (0.22) which shows that there is no significant difference in the production of /e/ by native and Sindhi female speakers. It further clarifies that female Sindhi speakers can easily produce /e/ and /i:/ vowels, while other RP vowels are problematic for them to produce them in RP native-like manner. So, it justifies significance difference in the production of English vowels by male Sindhi and RP speakers.

4.2 Pashto EFL Speakers

The comparison between second language speakers under study (Pashto) and citation (Deterding, 1997) is also done on the same trend i.e., by making comparative tables and graphs. Table 4.3 shows the comparison of male and female Pashto speakers' average value comparing to the citation (Deterding, 1997) and same contrast in Bark values shown in Table 4.4.

Table 4.3: Comparison of average frequency values (Hz) of male and female Pashto speaker with citation (Deterding, 1997)

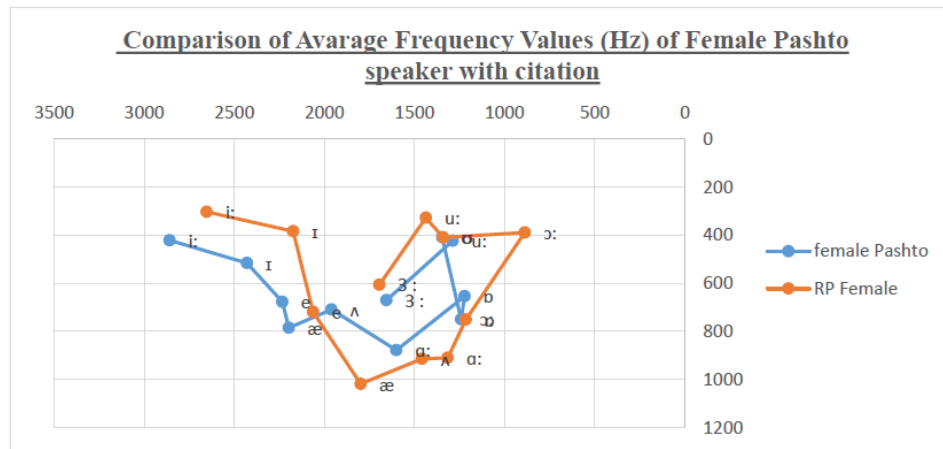| Comparison of Avarage Frequency Values (Hz) of Male Pashto speaker with citation (Deterding, 1997)					Comparison of Avarage Frequency Values (Hz) of Female Pashto speaker with citation (Deterding, 1997)				
Vowels	F1	F2	F1(RP)	F2(RP)	vowels	F1	F2	F1(RP)	F2(RP)
iː	293.5	2026.5	280	2249	iː	421.5	2859.5	303	2654
ɪ	425	1724	367	1757	ɪ	516	2430	384	2174
E	519.5	1596.5	494	1650	e	677.5	2233.5	719	2063
Æ	501	1676	690	1550	æ	785	2198	1018	1799
ʌ	594	1255.5	644	1259	ʌ	709	1960.5	914	1459
ɑː	660	1200	646	1155	ɑː	878	1601	910	1316
ɒ	613	1072.5	558	1047	ɒ	654	1222	751	1215
ɔː	548.5	1038	415	828	ɔː	749.5	1241.5	389	888
ʊ	410	1040	379	1173	ʊ	409	1346.5	410	1340
uː	381.5	895.5	316	1191	uː	423	1287.5	328	1437
ɜː	532	1318.5	478	1436	ɜː	670.5	1656	606	1695

The average frequency values of all Pashto speakers were converted to Bark scale to eliminate the physical difference caused by gender or age.

Table 4.4: Comparison of average frequency values (in Bark) of male and female Pashto speaker with citation (Deterding, 1997)
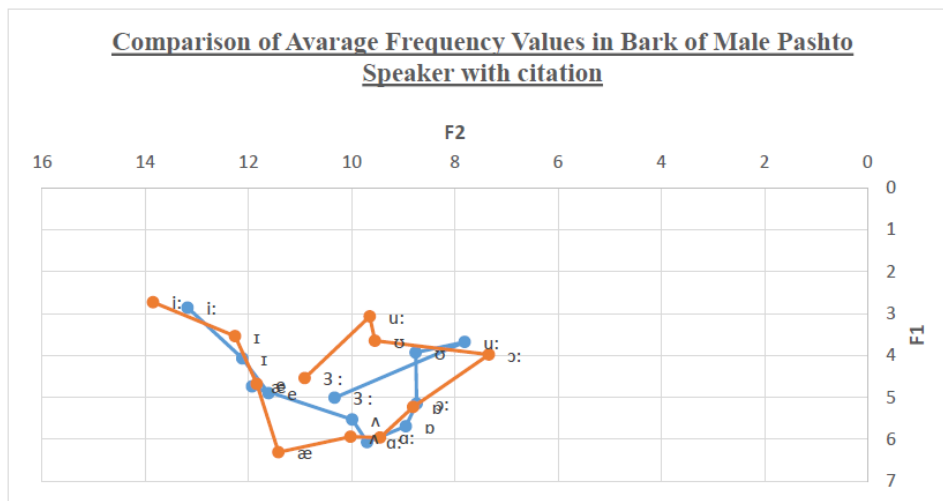
Comparison of Average Frequency Values in Bark of Male Pashto Speaker with citation (Deterding, 1997)					Comparison of Average Frequency Values in Bark of Female Pashto Speaker with citation (Deterding, 1997)				
vowels	Sindhi		RP		vowels	Sindhi		RP	
	F1	F2	F1(RP)	F2(RP)		F1	F2	F1(RP)	F2(RP)
iː	2.86	13.18	2.73	**13.85**	iː	4.04	15.24	2.95	14.87
ɪ	4.07	12.12	3.54	**12.26**	ɪ	4.87	14.31	3.7	13.64
e	4.9	11.61	4.68	**11.84**	e	6.21	13.79	6.53	13.3
æ	4.74	11.93	6.31	**11.42**	æ	7.01	13.69	8.62	12.41
ʌ	5.53	9.99	5.94	**10.02**	ʌ	6.45	12.96	7.94	11.01
ɑː	6.07	9.7	5.96	**9.45**	ɑː	7.7	11.63	7.92	10.32
ɒ	5.69	8.95	5.23	**8.81**	ɒ	6	9.82	6.78	9.78
ɔː	5.15	8.74	3.98	**7.34**	ɔː	6.77	9.93	3.75	7.77
ʊ	3.93	8.76	3.65	**9.55**	ʊ	3.93	10.28	3.94	10.44
uː	3.68	7.81	3.07	**9.65**	uː	4.05	10.09	3.18	10.91
ɜː	5.01	10.33	4.54	**10.91**	ɜː	6.07	11.86	5.63	12.02

These tables can be visualized more efficiently by vowel charts of F1 and F2 as follows:

Fig. 4.3 Comparison of Average Frequency values (Hz) of Female Pashto speaker with citation

Fig. 4.4 Comparison of Average Frequency values in Bark of Male Pashto speaker with citation

The statistical results showed that $P< 0.05$ for all F1 and F2 values of the vowels of L2 (male and female) Pashto speakers and RP speakers, which shows there is significant difference in the production of these vowels by native and non-native speakers.

In comparing the data of Pakistani EFL speakers (Sindhi and Pashto) against citation words from RP, it shows a noteworthy variance in values of F1 and F2 (as shown in tables and figures above) by native English and Pakistani EFL speakers.

5. Conclusion

In this research, it is concluded that there is a disparity not just in comparison of English speakers from Pakistan and RP, but also between English speakers in Pakistan locality from different first language backgrounds i.e., Sindhi and Pashto. The researchers concluded that non-native English speakers from Pakistan produced English monophthongs in a different manner as compared to British speakers. Furthermore, the same trend was observed between Sindhi and Pashto and also between males and females. It has also been noted that Pakistani speakers of a language have taken different F1 and F2 frequency to pronounce all eleven monophthongs in almost all chosen 1100 instances of tokens. Nevertheless, the degree of change in each monophthong was different due to its modified time period, duration, and number of pulses. Moreover, whenever a speaker replaced the English monophthong, he brought a new monophthong or a new vowel that may be unique to their L1 because of their mother tongue.

The findings of this study have significant significance for educators and curriculum creators in Pakistan, particularly for individuals who speak Pashto and Sindhi. It is crucial to acknowledge and tackle the distinct difficulties faced by English learners who speak Pashto and Sindhi in developing their ability to produce and pronounce English sounds. To improve their speaking abilities and promote their language development, it is beneficial to provide direct teaching and interventions that focus on the specific phonological processes revealed in this study.

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