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Descriptive Analysis of Monophthongs in Pakistani English: Articulatory and Acoustic Evidence

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ABSTRACT

This study presented an acoustic description of monophthongs in Pakistani English (PakE), an indigenized variety of non-native Englishes. The study addressed the following research questions: what are the acoustic characteristics of monophthongs in PakE as spoken by Punjabi speakers, in what ways do these monophthongs differ from or resemble those of Standard British English (SBE), how many monophthongs can be identified in PakE, and what patterns of vowel merger, if any, are observable. Monosyllabic words with /hVd/ context were recorded in a carrier phrase and analysed using Praat. The first two formants (F1 and F2) and vowel duration were extracted. Statistical analyses were conducted using SPSS. The values were compared with those of SBE to observe the similarities and differences. The results showed PakE having 10 monophthongs (four front, two central, and four back) classified into five long and five short vowels, unlike SBE, which has five long and seven short vowels. Depending upon these results, it was concluded that vowels in PakE behave differently. These differences lead to the variation in pronunciation patterns. The findings provide empirically grounded phonetic evidence that contributes to the descriptive documentation of PakE, offers a reference framework for future phonological and comparative World Englishes research, and supports applied linguistic domains such as pronunciation teaching, speech technology development, and accent-sensitive language assessment. The study contributes to the codification of PakE as an indigenized variety of English.

Keywords: acoustic measurement; monophthongs; formant frequencies; Pakistani English; PRAAT

INTRODUCTION

As a natural phenomenon, languages keep changing. English is no exception in this regard (Aitchison, 2001). English is used as a lingua franca around the world, bridging ethnic and linguistic differences among nations (El-Dakhs et al., 2024; Gobbo & Marácz, 2021). The global spread of English has resulted in the emergence of nativised varieties of English in various regions of the world that have traces of local cultures and languages (Graddol, 1997; Schneider, 2010), with PakE being a member of the family.

PakE is a less-researched variety, though a few significant studies (see Ahmad et al., 2019, 2025; Buriro et al., 2023; Fatima et al., 2023; Pervez et al., 2024) have been conducted to explore and document the linguistic features. Many researchers opine that a new nativised variety of English is in the making, i.e. PakE (Baumgardner, 1993; Kennedy, 1993; Tallat, 2003).

The current study focuses on the analysis of the speech of Punjabi speakers of English. Punjabi is widely spoken in Pakistan in the province of Punjab. Approximately 70 million individuals use Punjabi as either their primary or secondary language (Shackle, 2023). Punjabi is the primary language for about 60% of the population (Bhatia, 2008). According to the Bureau of Statistics of Pakistan (2023), more than 44% of the population of the country speaks Punjabi as their mother tongue, with its spread all across Pakistan.

While PakE is widely spoken, its vowel system, particularly the monophthongs, remains under-described. Existing studies largely focus on lexical features of PakE (Baumgardner, 1993; Tallat, 2003) or pronunciation patterns using observational methods (Rahman, 1991; Raza, 2008), providing limited empirical data on how PakE vowels differ in articulation and acoustic properties. This lack of systematic description makes it difficult to understand the unique phonetic patterns of PakE, complicates pronunciation teaching, and limits the codification of PakE as a recognised indigenized variety of English. Therefore, an in-depth acoustic and articulatory analysis of PakE monophthongs is needed to fill this knowledge gap and provide a reference for both theoretical and applied linguistic research.

To be specific, the study focuses on segmental phonetic features, namely the articulation and acoustic properties of monophthongs, to provide a detailed description of PakE pronunciation patterns. By examining these precise linguistic features, the study situates itself within the broader literature on vowel variation in World Englishes and second-language phonetics.

The current study endeavours to acoustically analyse the vowels of PakE as spoken by Punjabi speakers. The objective of the study is to provide empirical evidence regarding the differences and similarities of vowels as compared to SBE. The study also investigates how many vowels are in PakE. Based on these observations, it is concluded whether PakE is a nativised variety of English with its idiosyncratic features of vowels.

Therefore, this study investigates the acoustic characteristics of monophthongs in PakE and examines the ways in which these vowels differ from or resemble those of Standard British English (SBE). In doing so, it also explores several subsidiary concerns, including the number of monophthongs that can be identified in PakE based on acoustic evidence and the extent to which patterns of vowel merger may be observed among specific monophthong pairs.

LITERATURE REVIEW

English is taking new forms around the world. It is adopting and adapting itself into new forms through distribution and spread. PakE has been identified as a sub-variety of non-native Englishes (Baumgardner, 1993; Tallat, 2003). A few researchers have tried to explore and identify its phonological (Bilal & Asghar, 2023; Bilal et al., 2021, 2025) and morphological features (Kennedy, 1993), and have tried to establish that PakE is a different variety (Hickey, 2005). Considering its position and location regarding World Englishes, it is evident that it belongs to ESL varieties. This classification is a result of the interaction between English and local languages during the period of colonisation. Kachru's well-known model places PakE in the outer circle, where varieties of English set their peculiar standards. This categorisation acknowledges that PakE is in the process of being recognised as an indigenised variety due to its unique linguistic characteristics. Schneider's framework (Schneider, 2010) suggests that PakE is simultaneously going through the phases of 'Nativisation' and 'Endonormative Stabilisation'. This indicates that people in Pakistan are beginning to recognise that they speak a distinct variety of English.

In Pakistan, English serves as a lingua franca and a major mode of communication, especially among the educated and urban elite (Ahmad & Ali, 2023; Rahman, 1991). English enjoys the status of "the most important elite language and the language of power in contemporary Pakistan" (Rahman, 2020, p. 279). Rahman (2020) adds that speaking English in Pakistan is a symbol of "high status, modernisation, power, and modernity" (p. 282), and labels it a "well-guarded elite reserve" (p. 290).

Though little research is available on PakE phonology, certain similarities can be seen between PakE and other South Asian Englishes. Mahboob and Ahmar (2004), Mesthrie and Bhatt (2008) and Hickey (2005) have listed a few phonological characteristics of PakE, despite the fact that the scope of their studies is quite small. Syed and Atta (2020) conclude that Pakistani speakers of English do not distinguish between /w/ and /v/. Collecting data from 10 Saraiki speakers living in Pakistan and thirty Saraiki speakers living in England, they argue that both groups of speakers confused /w/ with /v/, the results correspond with Abbas et al. (2020), Kamran (2022) and Bilal et al. (2025).

Rahman (1991) reports that Pakistani speakers tend to articulate a few diphthongs as monophthongs, e.g., /ei/ is changed into /e:/, /əu/ is changed into /o:/ or /ɔ:/. However, the study does not provide instrumental acoustic evidence to substantiate these observations. Khattak and Shah (2022) conclude that the pronunciation of Pakistani speakers of English is influenced by Urdu. Pakistani speakers easily articulate English sounds that have their equivalents in Urdu, while for those sounds which do not have an equivalent, the speakers tend to find a sound in Urdu that appears closer to the English sound. The same is reported by Umer and Riaz (2021). While this claim is widely accepted, the extent of such influence is not quantitatively specified.

Khalfan and Anjum (2024) reported the nasalisation of vowels in PakE, a feature that distinguishes PakE from SBE. Nevertheless, their focus on nasalisation alone leaves other vowel parameters underexplored. According to Jadoon and Ahmad (2022), the phoneme /ɔ:/ in PakE is realised as /a:/, /ə/ as /a:/, /i/ as /ə/ in certain contexts, /e/ as /æ/, etc. Certain diphthongs /ei/, /əu/ and /ou/ tend to become monophthongs. Such findings indicate variability, yet the contextual conditioning of these realisations remains insufficiently detailed.

Malik et al. (2022) reported that, though Pakistani speakers differentiated between long and short high-front vowels, the duration was different compared to SBE. Ijaz et al. (2021) have reported a similar phenomenon that Pakistani speakers of English do not merge high-front and

high-back vowels. Taken together, these studies suggest relative stability of front vowel contrasts, though methodological differences may account for minor discrepancies across findings.

Kousar et al. (2023) reported that Pakistani speakers articulate all three central vowels (i.e., /ɜ:/, /ə/ and /ʌ/), a finding which does not correspond to the results reported by Bilal and Asghar (2023) and Warraich et al. (2011), where the merger of the central vowels is reported. This inconsistency points to the need for further systematic acoustic verification. Mahboob and Ahmar (2004) stated that /ə/ is absent in PakE and is articulated as /ʌ/. These conflicting accounts highlight the lack of consensus regarding the status of central vowels in PakE.

Asghar et al. (2021) and Ahad et al. (2020) in their study on the high vowels of PakE concluded that the long and short high vowels are realised as distinct phonemes, and the pattern of their articulation follows that of SBE. Bilal et al. (2021) reported that there is a merger of low-back vowels in PakE. Kousar et al. (2023) reported that low-back vowels /ɑ:/ and /ɒ/ tend to be centralised in PakE. Overall, prior studies reveal important patterns, yet the diversity of findings suggests that a comprehensive, systematically controlled acoustic description is still required.

The present study is grounded in an acoustic phonetic framework, analysing vowels through the first two formants (F1 and F2) and duration, which reflect tongue height, advancement, and phonemic distinctions. Previous research has highlighted vowel variation in PakE, but findings remain inconsistent due to methodological differences, and systematic acoustic analyses in controlled environments are limited. Most studies are largely observational, with few instrumentally grounded investigations. To address these gaps, the current study provides a comprehensive acoustic analysis of PakE monophthongs using a substantial dataset, forming the empirical basis for the subsequent methodology.

METHODOLOGY

The research is framed in the context of World Englishes. It is quantitative and empirical as it collects and analyses numerical data and ascertains the validity of results through statistical analysis.

PARTICIPANTS

To keep the data homogeneous, certain parameters were strictly followed. For the study, twenty participants were selected from undergraduate students of English at a public sector university in Punjab, Pakistan. The participants were students of bachelor's and master's degree programmes in English, aged between 20 and 25 years, with Punjabi as their mother tongue, having at least 10 years of exposure to English as a language of their academics. They had completed their primary and secondary education in English medium schools and were able to communicate in English.

WORD-LIST

The study was restricted to pure vowels only (i.e., /i:/, /i/, /e/, /æ/, /ɜ:/, /ʌ/, /ɑ:/, /ɒ/, /ɔ:/, /u/ and /u:/). Words for each of the 11 monophthongs of English with /hVd/ context were selected. The words selected for the analysis were: heed /hi:d/, hid /hid/, head /hed/, had /hæd/, heard /hɜ:rd/, hudd /hʌd/, hard /hɑ:rd/, hawed /hɒd/, hod /hɔ:rd/, hood /hud/ and who'd /hu:d/. The schwa /ə/ was not included in the study, as it is reported that the schwa sound is absent in non-native varieties of

English, and there is no word with an /hVd/ template that can accommodate the reduced vowel, as it occurs only in a multisyllabic word (Indrayani & Nugraha, 2020; Kachru, 2005).

PRAAT

Praat 6.3.09 (Boersma & Weenink, 2023) was used for acoustic measurement and analysis. It is a computer programme for analysing, synthesising and manipulating speech and other sounds, and for creating publication-quality graphics. Praat has been the choice of most researchers in recent years working on acoustic analysis of vowels and consonants. The main advantage of Praat is its functional flexibility, as it is script-based.

PROCEDURE

DATA COLLECTION

The participants were given the word list and were asked to speak each word using a carrier sentence, i.e. "please say _____ loudly'. The words selected for analysis were monosyllabic, containing the CVC structure. The vowel tokens were elicited using Praat, and the formant frequencies (F1-F2) were recorded as the first two formants are used to describe the quality of the vowel (Ladefoged & Johnson, 2011; Thomas, 2011). The two acoustic dimensions, the first and the second formant frequency (F1 and F2), have been generally accepted as representing the basic high/low and front/back articulatory dimensions, corresponding generally to the tongue and the vocal tract configurations during vowel production (Stevens & House, 1955).

DATA ANALYSIS

Using descriptive statistics (SPSS), the mean values of the two formants were calculated, along with the minimum and maximum range of the spread of the formants, and the standard error. Mean values of the duration of articulation of each vowel were also recorded. One-sample t-tests were performed along with data normality tests using SPSS to see if the results were significant and if the data were normally distributed. Finally, these values were compared with those of the SBE, as described by Ladefoged (2001) and Cruttenden (2014), to observe any similarities and differences.

DELIMITATIONS

The study is limited to the investigation of the vowel quality of the English speakers with Punjabi as their L1, as they form the largest section of the population of the country. The current study investigates the vowel features of Punjabi English as articulated by the male speakers only. Scientific studies prove that male and female speakers have significant differences in their acoustic parameters (Morris et al., 2008), and both groups need to be studied separately. The study is also limited to the measurement of the first two formants (i.e., F1 and F2) along with the durational properties of the vowels.

ANALYSIS

FRONT VOWELS

This section gives a detailed analysis of the four front vowels (i.e., /i:/, /i/, /e/ and /æ/) of SBE as articulated by Punjabi speakers of PakE. The /hVd/ monosyllabic words used for the analysis were heed /hi:d/, hid /hid/, head /hed/ and had /hæd/.

HIGH-FRONT VOWEL /i:/

This vowel was articulated as a long high-front vowel, with the front part of the tongue raised towards the hard palate. Unlike other native varieties of English, where it is spoken with spread lips, the speakers of Punjabi English did not spread their lips during articulation.

TABLE 1. Descriptive Statistics of F1 and F2 for /i:/

	Descriptive Statistics				
/i:/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	330	375	360.05	13.15
F2	20	2830	3025	2940.00	54.43

The descriptive statistics (Table 1) showed that the data were closely clustered around the mean. Figure 1 shows the spread of the data.

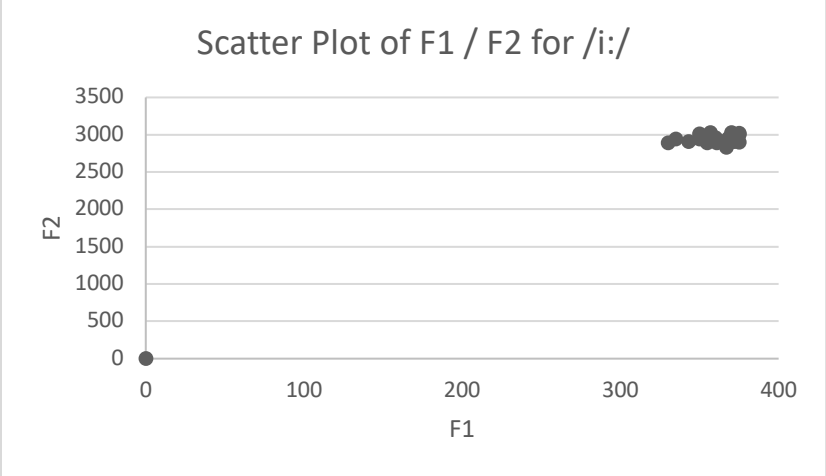

FIGURE 1. Scatter Plot of F1 and F2 for /i:/

The one-sample t-test (Table 2) performed for the high-front vowel /i:/ shows that the t-statistics for both the formants F1 and F2 are greater than the test value. The p-value for both the formants was .00 which is lower than 0.05. The higher t-values ($t>0$) and the lower p-values ($p<.05$) indicate that the data are strongly significant and reliable.

TABLE 2. One-Sample T-Test Results for F1 and F2 for /i:/

One-Sample T-Test						
/i:/	t	df	Sig. (2-tailed)	Test value = 0 Mean Difference	95% Confidence Interval of the Difference Lower	 Upper
F1	122.50	19	<.001	360.05	353.90	366.20
F2	241.54	19	<.001	2940.00	2914.52	2965.48

Figure 2 shows the data distribution for both the formants (i.e., F1 and F2). The bell curves ascertain that the data are normally distributed.

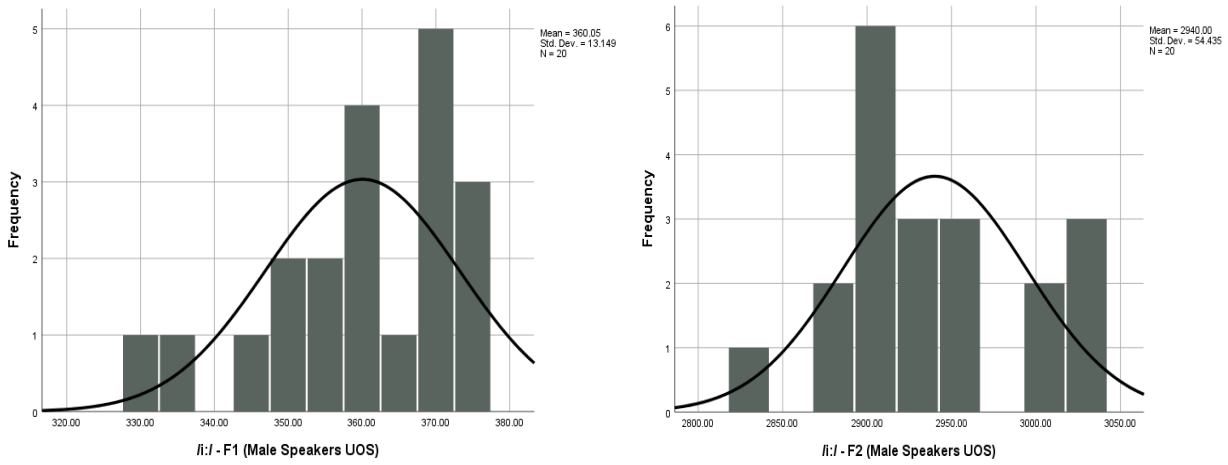

FIGURE 2. The Bell Curve for F1 and F2 for /i:/

HIGH-FRONT VOWEL /i/

The speakers articulated the vowel as a short high-front vowel. The lips were neutral during the articulation, while the front part of the tongue was raised towards the hard palate. The formant frequencies of the long high-front vowel /i:/ and the short high-front vowel /i/ did not show any significant difference. The major difference between the two vowels was the duration of articulation, which was 0.15s for /i/ and 0.30s for /i:/.

TABLE 3. Descriptive Statistics of F1 and F2 for /i/

Descriptive Statistics					
/i/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	375	435	404.95	19.877
F2	20	2750	2890	2834.35	39.877

The descriptive statistics (Table 3) showed that the data were clustered tightly around the mean, showing that the data are statistically robust and significant. Figure 3 shows the range of the spread of the data.

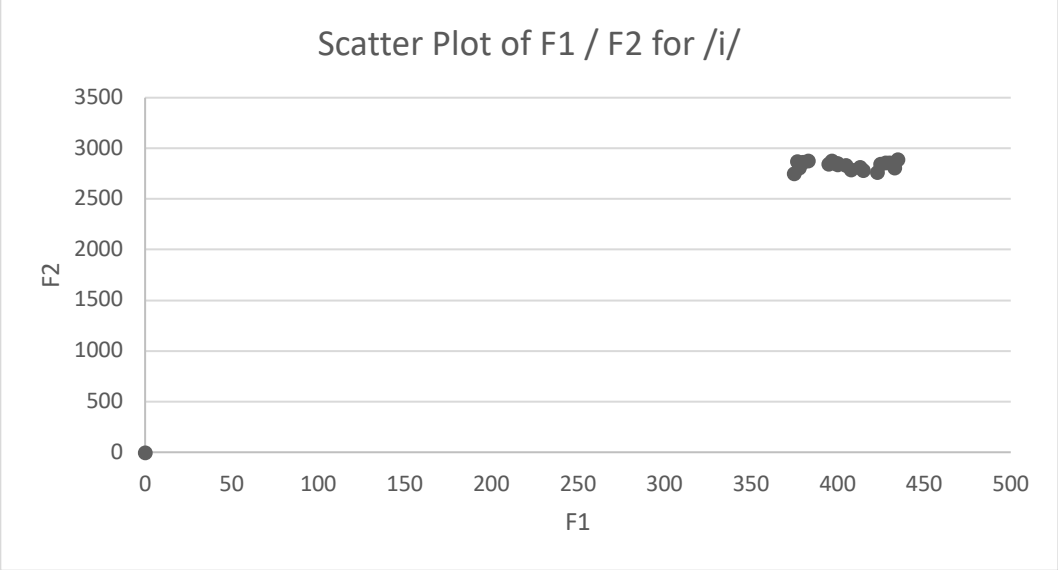

FIGURE 3. Scatter Plot of F1 and F2 for /i/

The analysis also showed that the pattern of articulation remained similar, that is, all the speakers realised it as a short high-front vowel.

TABLE 4. One-Sample T-Test Results for F1 and F2 for /i/

One-Sample T-Test						
/i/	t	Df	Sig. (2-tailed)	Test value = 0 Mean Difference	95% Confidence Interval of the Difference Lower	 Upper
F1	91.102	19	<.001	404.95	395.65	414.25
F2	317.86	19	<.001	2834.35	2815.69	2853.01

The statistical test, that is, one-sample t-test (Table 4), performed for the high-front vowel /i/ exhibited that the t-statistics for both the formants F1 and F2 were greater than the test value. The upper and lower limits of CI are narrow, and the difference between these two limits is small. The p-value for both formant frequencies (F1 and F2) was calculated to be .00, which is significantly lower than the commonly accepted threshold of .05. This low p-value indicates a high level of statistical significance, confirming that the observed differences are unlikely to have occurred by chance. Figure 4 illustrates the data distribution for both formant frequencies, F1 and F2. The distribution curve confirms that the data are normally distributed.

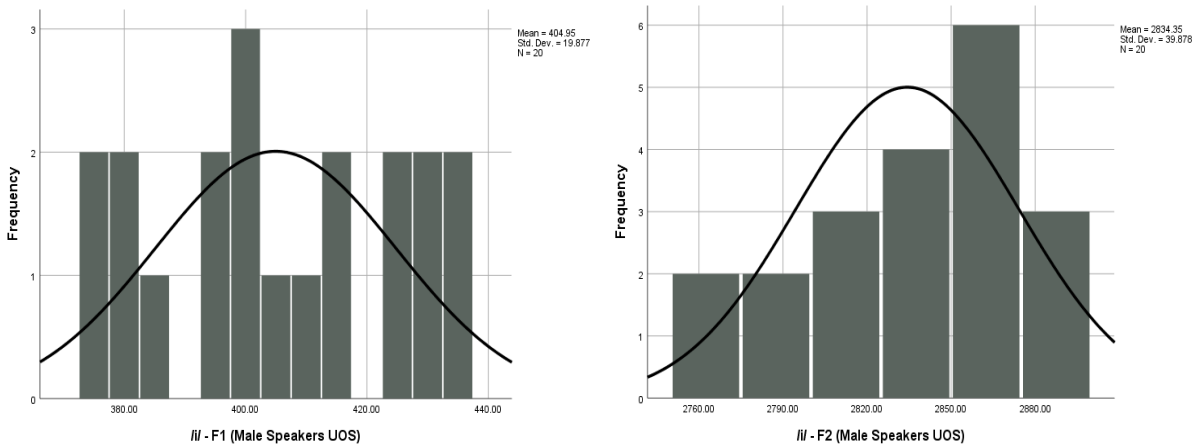

FIGURE 4. The Bell Curve for F1 and F2 for /i/

The two high-front vowels were articulated following the British articulation pattern (i.e., long high-front vowel /i:/ and short high-front vowel /i/). Unlike some Asian varieties, where the distinction between these two vowels is absent, Pakistani Punjabi English speakers maintained this distinction between long and short vowels. The major difference observed between the two varieties was the position of the lips. The front vowels were pronounced with neutral lips, unlike SBE speakers who articulate the vowel with spread lips (Westerman & Ward, 2015).

MID-FRONT VOWEL /e/

This vowel is articulated as a short mid-front vowel by SBE speakers (Ladefoged & Johnson, 2011; Roach, 2009). The Punjabi speakers pronounced it similarly. The descriptive statistics (Table 5) showed that all the speakers articulated the vowel /e/ in a manner consistent with its articulation with SBE. The consistency in articulation across all speakers points to a standardisation in the pronunciation of this vowel.

TABLE 5. Descriptive Statistics of F1 and F2 for /e/

Descriptive Statistics					
/e/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	455	505	480.60	16.05
F2	20	2805	2855	2829.75	14.69

Figure 5 visually confirms this narrow data spread, further emphasising the minimal variation in pronunciation.

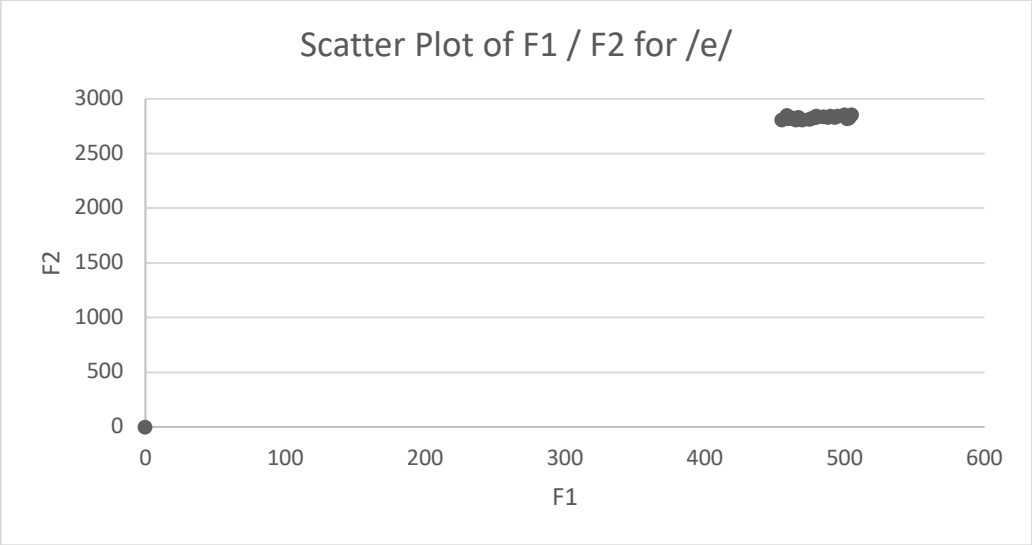

FIGURE 5. Scatter Plot of F1 and F2 for /e/

The statistical test (Table 6) performed for the mid-front vowel /e/ affirmed that the t-statistics for both formants F1 and F2 were higher than the assigned test value. The higher t-values (t>) and the lower p-values (p<.05) indicate that the data are strongly significant and reliable.

TABLE 6. One-Sample T-Test Results for F1 and F2 for /e/

One-Sample T-Test						
			Test value = 0			
/e/	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	133.88	19	<.001	480.60	473.0866	488.11
F2	861.51	19	<.001	2829.75	2822.8752	2836.62

Figure 6 shows the normal data distribution for both formants for the vowel /e/.

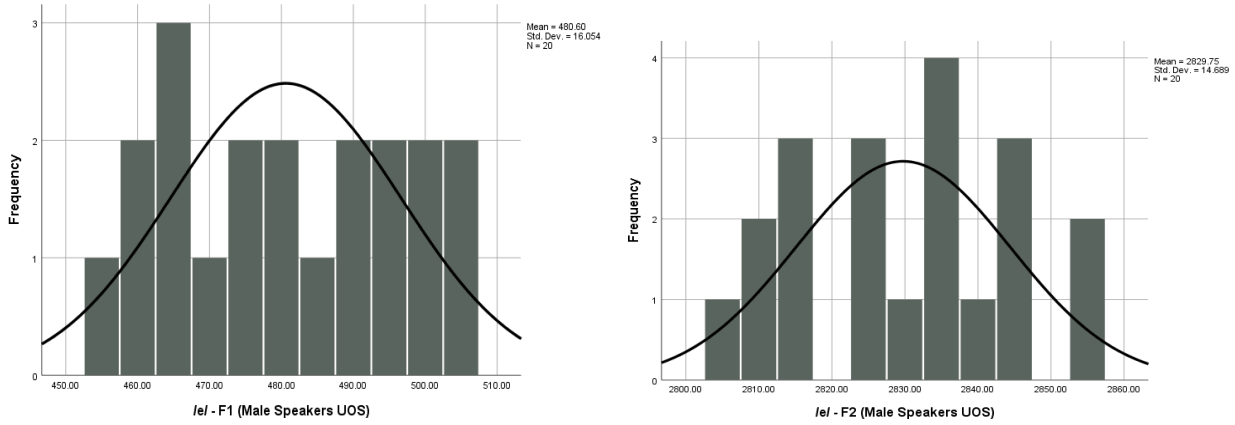

FIGURE 6. The Bell Curve for F1 and F2 for /e/

LOW-FRONT VOWEL /æ/

The vowel /æ/ was realised as a low-front vowel by the speakers. It was noted that the articulation of this vowel did not conform to the typical classifications of long or short vowels. Specifically, when compared with the duration of the long vowel /i:/ and the short vowel /i/, the duration of the vowel did not fit neatly into either category. To elaborate, the duration of this vowel was found to be longer than that of the two short front vowels /i/ and /e/, but shorter than the long front vowel /i:/. The average duration of the vowel was measured at 0.21 seconds. This intermediate duration suggests that the vowel occupies a unique temporal space between the established short and long vowel categories, highlighting a unique aspect of vowel articulation among these speakers. It was articulated as a low vowel, like that of SBE (Ladefoged & Johnson, 2011; Roach, 2009). The two varieties shared the characteristics of the vowel, except for the duration, the SBE vowel being shorter. The descriptive statistics (Table 7) display the formant frequencies and the standard deviation.

TABLE 7. Descriptive Statistics of F1 and F2 for /æ/

Descriptive Statistics					
/æ/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	490	565	534.85	21.86
F2	20	2310	2435	2380.80	38.14

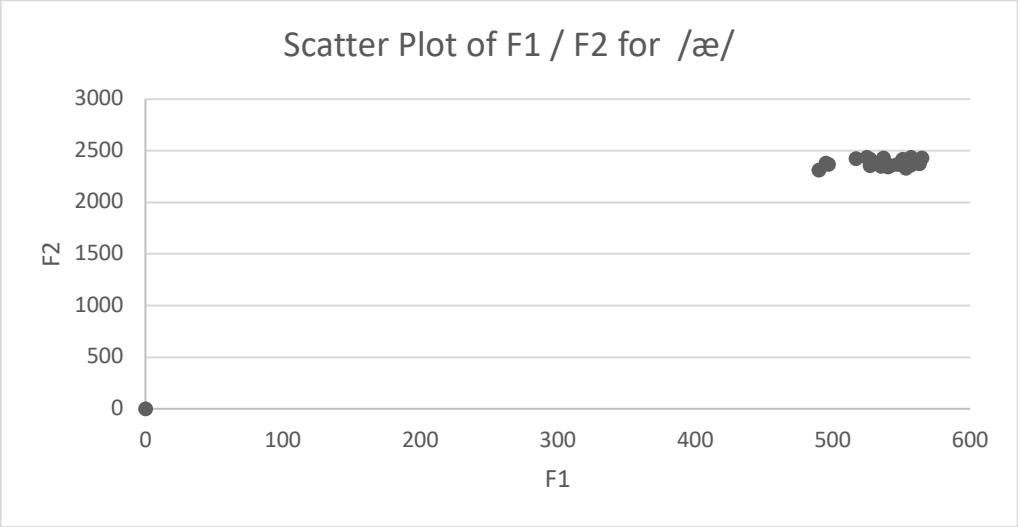

FIGURE 7. Scatter Plot of F1 and F2 for /æ/

The standard deviation for the formant frequencies indicates that the data points were closely grouped around the mean. The scatter plot in Figure 7 visually demonstrates this tight clustering. The statistical test (Table 8) performed for the low-front vowel /æ/ affirmed that the data are strongly significant and reliable.

TABLE 8. One-Sample T-Test Results for F1 and F2 for /æ/

One-Sample T-Test						
	Test value = 0					
/æ/	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	109.43	19	<.001	534.85	524.62	545.08
F2	279.18	19	<.001	2380.80	2362.95	2398.65

In Figure 8, the bell curve ascertains that the data are normally distributed.

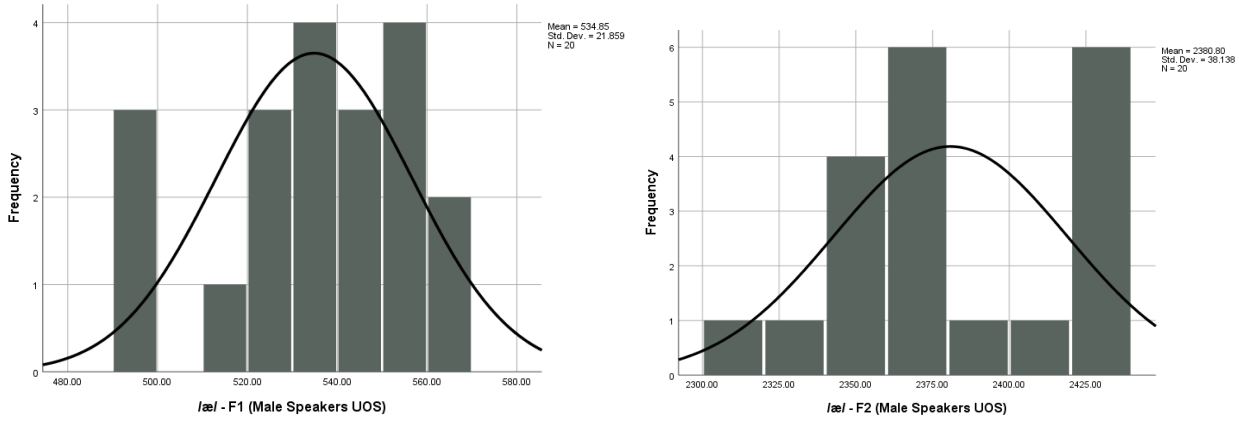

FIGURE 8. The Bell Curve for F1 and F2 for /æ/

The PakE speakers distinguished among all four front vowels, namely /i:/, /i/, /e/, and /æ/. This distinction is particularly significant as it demonstrates that there was no merger of the long and short vowels. The clear separation between these vowels indicates that Pakistani speakers maintained the phonemic distinction between long and short vowels.

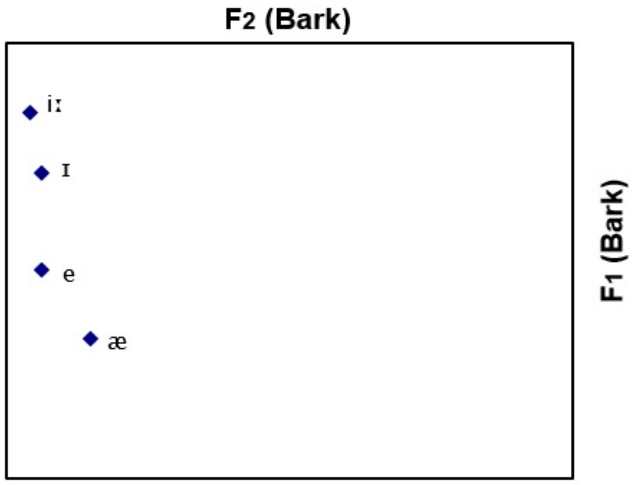

FIGURE 9. Articulation of Front Vowels (i.e., /i:/, /i/, /e/, and /æ/)

This differentiation aligns with the pronunciation patterns observed in other varieties of English, but with a small difference. Figure 9 provides a visual presentation of the articulation of these four front vowels. The duration of the long vowel /i:/ as in 'heed' was twice the duration of the short vowel /i/ as in 'hid' (Table 9).

TABLE 9. Formants and Duration of Front Vowels

UOS Speakers			
Vowel	F1	F2	Duration in seconds
/i:/	360	2940	0.30
/i/	405	2835	0.15
/e/	480	2830	0.14
/æ/	535	2380	0.21

Figure 10 gives the graphic display of the duration of four front vowels, i.e. /i:/, /i/, /e/ and /æ/.

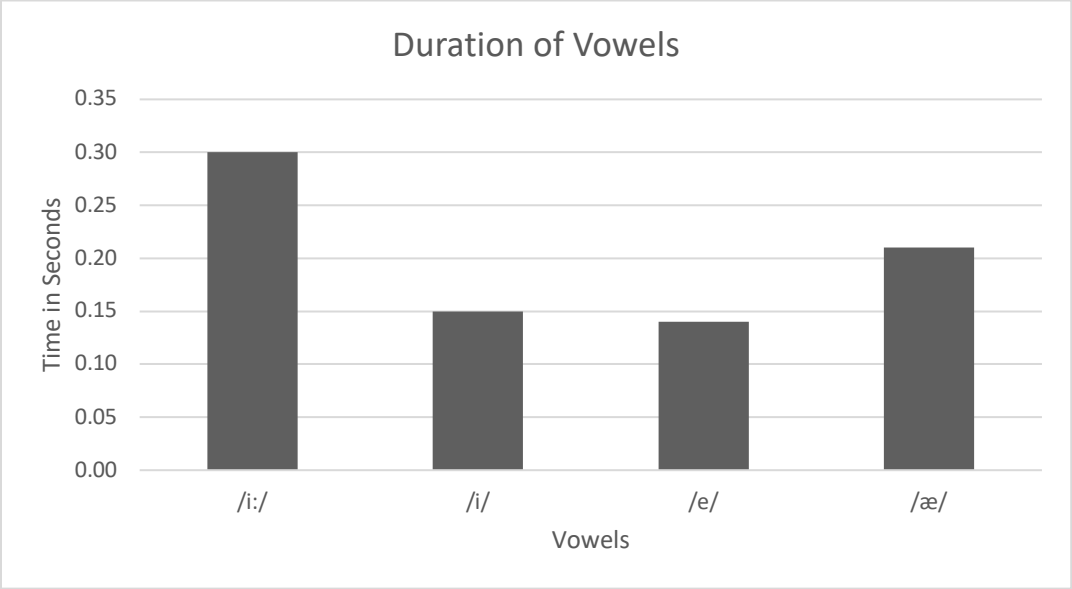

FIGURE 10. Duration of Front Vowels

CENTRAL VOWELS

This section highlights the features of central vowels as spoken by Punjabi speakers of PakE. The words for the analysis were heard /hɜ:(r)d/ and hudd /hʌd/.

LONG CENTRAL VOWEL /ɜ:/

The vowel was articulated as a central vowel, but unlike SBE, it was articulated as a close mid-central vowel. The position of the lips remained unrounded. This is the only vowel in the study which has /r/ at its coda, and /r/ is pronounced as PakE is a rhotic variety (Hickey, 2005; Mesthrie & Bhatt, 2008). The vowel /ɜ:/ took a bit longer than the low-central vowel /ʌ/, i.e. the average duration of /ɜ:/ and /ʌ/ remained at 0.19 seconds and 0.12 seconds, respectively.

TABLE 10. Descriptive Statistics of F1 and F2 for /ɜ:/

Descriptive Statistics					
/ɜ:/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	405	475	429.95	21.43
F2	20	1430	1505	1466.95	22.40

The standard deviation (Table 10) shows that the data were clustered around the mean. Figure 11 displays the spread of F1 and F2 for the central vowel /ɜ:/.

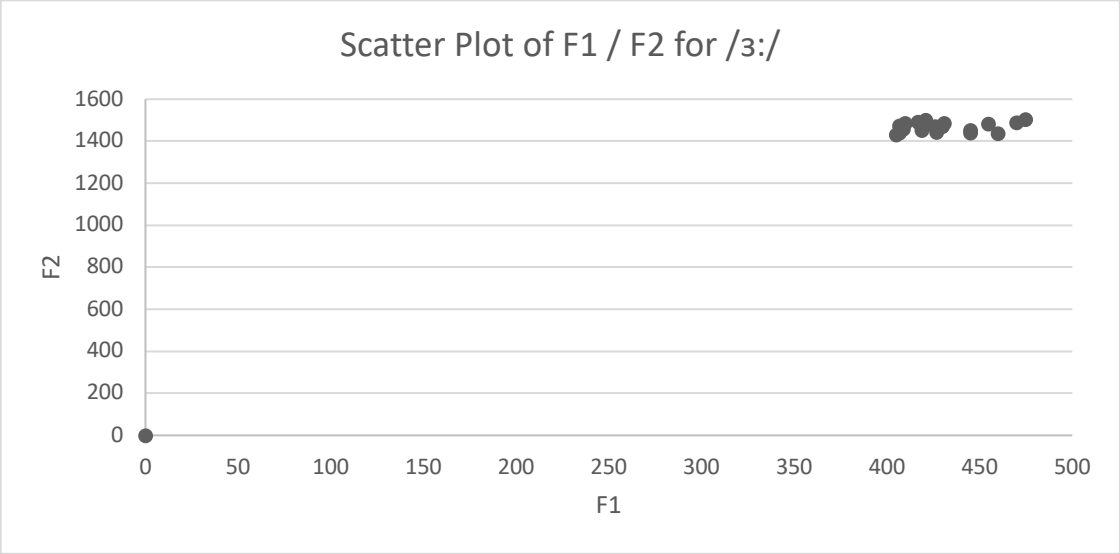

FIGURE 11. Scatter Plot of F1 and F2 for /ɜ:/

The statistical test (Table 11) performed for the central vowel /ɜ:/ exhibited that the t-statistics for both the formants F1 and F2 were larger than the test value, indicating that the data were reliable and significant.

TABLE 11. One-Sample T-Test Results for F1 and F2 for /ɜ:/

One-Sample T-Test						
/ɜ:/	Test value = 0					
	t	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	89.74	19	<.001	429.95	419.92	439.98
F2	292.91	19	<.001	1466.95	1456.47	1477.43

The upper and lower values of the 95% CI are narrow, and the difference between these two limits is small. The higher t-values ($t>0$) and the lower p-values ($p<.05$) indicate that the data are strongly significant. Figure 12 shows the normal data distribution for both formants.

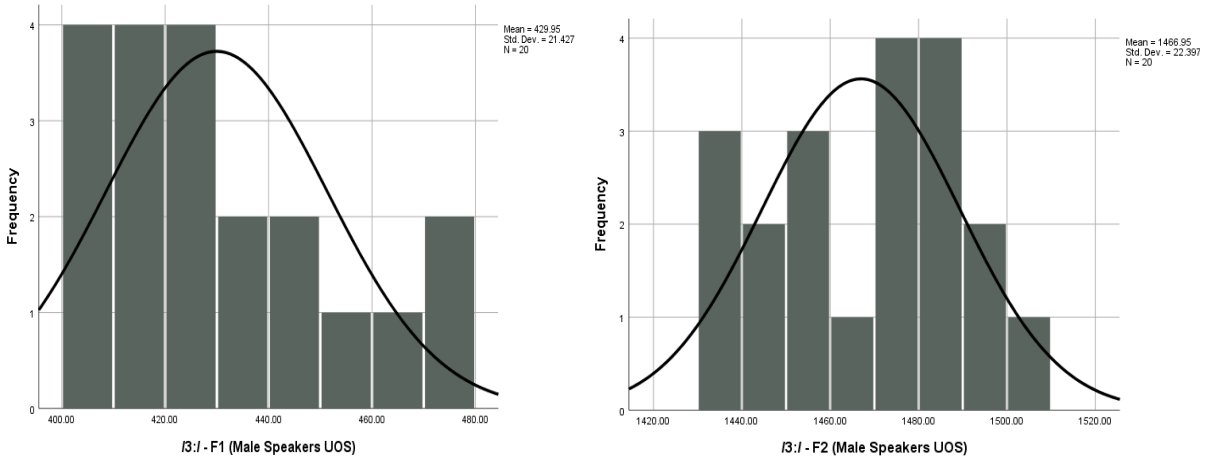

FIGURE 12. The Bell Curve for F1 and F2 for /ɜ:/

LOW CENTRAL VOWEL /ʌ/

The vowel was realised as a short low-central vowel. Comparing it with /ɜ:/, it was observed that /ʌ/ was articulated a bit lower and shorter. The vowel was pronounced with unrounded lips. The average time of articulation of the vowel /ʌ/ was 0.12 seconds.

TABLE 12. Descriptive Statistics of F1 and F2 for /ʌ/

Descriptive Statistics					
/ʌ/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	415	485	451.25	23.07
F2	20	1415	1505	1449.65	27.75

The descriptive statistics (Table 12) showed maximum and minimum formant frequencies and the standard deviation for F1 and F2. Figure 13 displays the spread of F1 and F2 for /ʌ/.

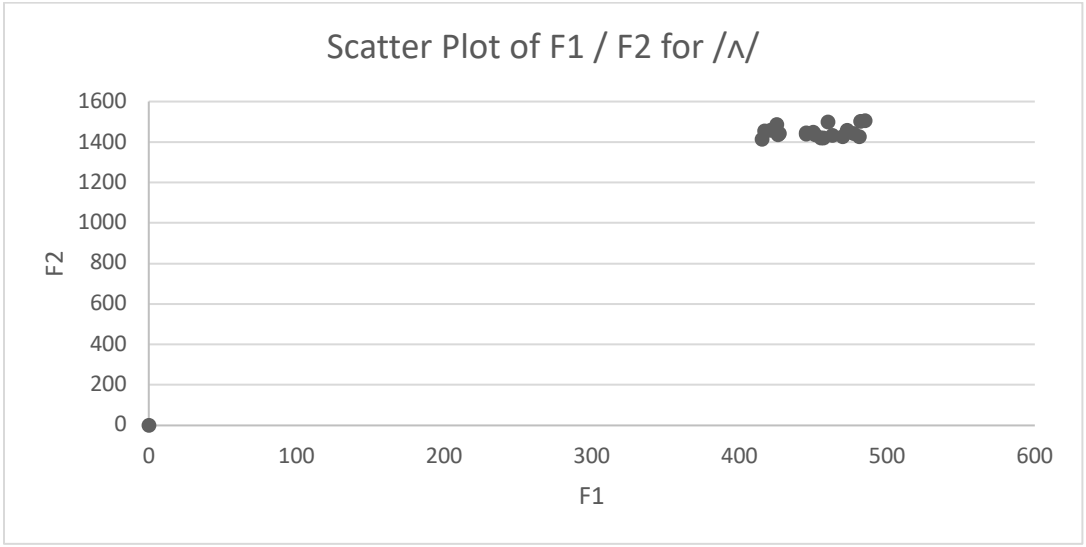

FIGURE 13. Scatter Plot of F1 and F2 for /ʌ/

The one-sample t-test (Table 13) showed that the upper and lower values of the 95% CI are narrow and the difference between these two limits is small. The p-value for both the formants was .00, which is lower than .05. The higher t-values (t>0) and the lower p-values (p<.05) demonstrate that the data are highly significant.

TABLE 13. One-Sample T-Test Results for F1 and F2 for /ʌ/

One-Sample T-Test						
	Test value = 0					
/ʌ/	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	87.46	19	<.001	451.25	440.45	462.05
F2	233.66	19	<.001	1449.65	1436.66	1462.64

Figure 14 shows data distribution for both the formants, with the bell curves affirming normal data distribution, adding to the reliability and significance of the data.

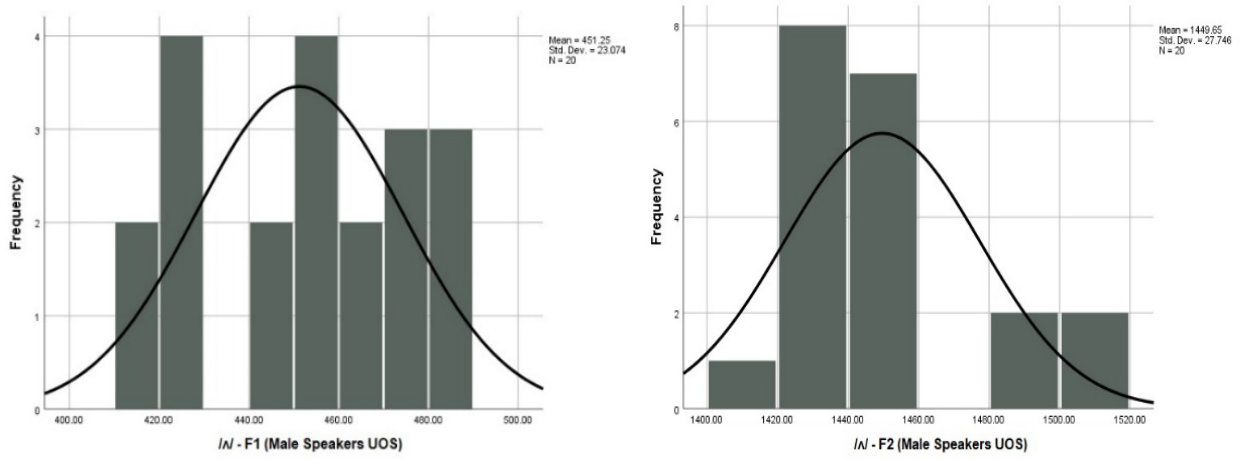

FIGURE 14. The Bell Curve for F1 and F2 for /ʌ/

Figure 15 displays the central vowels.

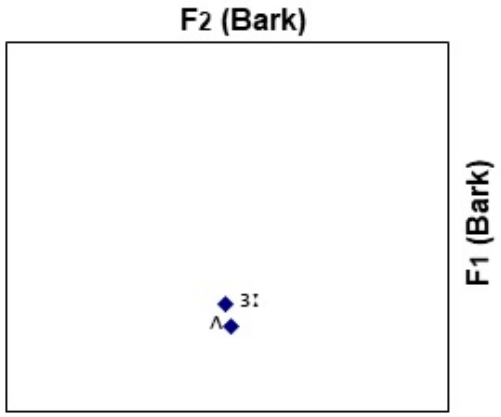

FIGURE 15. Central Vowels

The articulation pattern of the two central vowels shows that they were pronounced as low vowels. SBE mid-centre long vowel /ɜ:/ showed some variation, as it was articulated as a low vowel by Pakistani speakers. Figure 15 shows how the two central vowels were produced. The duration of the two vowels appeared to be the difference, though the vowel /ɜ:/ was pronounced with less duration than the other long vowels. Yet the only difference between the two central vowels was the duration (Table 14).

TABLE 14. Formants and Duration of Central Vowels

UOS Speakers			
Vowel	F1	F2	Duration in seconds
/ɜ:/	430	1465	0.19
/ʌ/	450	1450	0.12

Figure 16 shows the comparison of the duration of the two vowels (i.e. /ɜ:/ and /ʌ/).

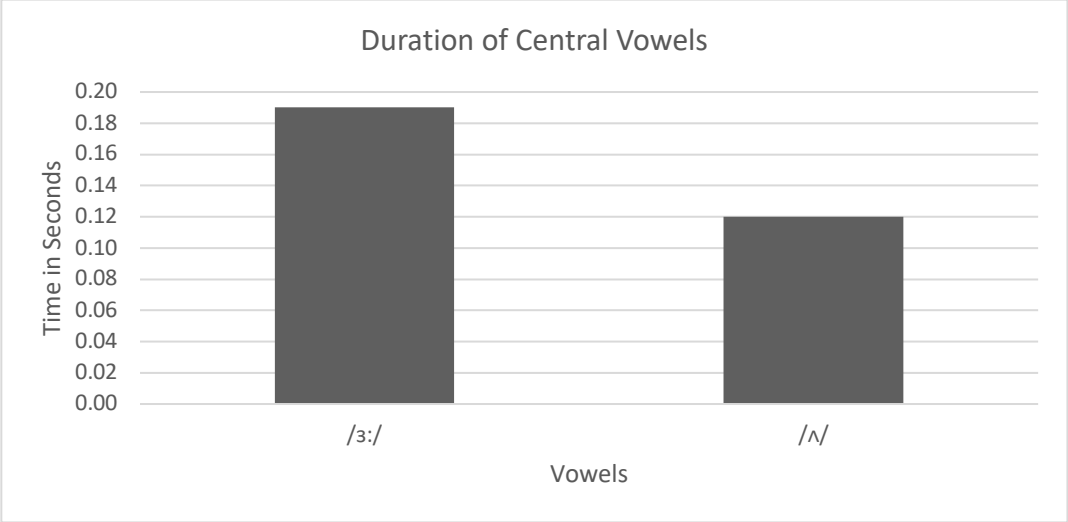

FIGURE 16. Duration of Central Vowels

BACK VOWELS

This section presents the analysis of the five back vowels of SBE, i.e. /ɑ:/, /ɒ/, /ɔ:/, /u/ and /u:/, as articulated by Punjabi speakers of PakE.

LOW BACK VOWEL /A:/

The vowel /ɑ:/ was articulated as a long low-back vowel.

TABLE 15. Descriptive Statistics of F1 and F2 for /ɑ:/

Descriptive Statistics					
/ɑ:/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	520	575	546.75	17.88
F2	20	1090	1155	1122.30	20.08

The values of the standard deviation (Table 15) affirm that the data were closely scattered around the mean. Figure 17 provides a scatter plot depicting the formant values of the vowel /ɑ:/. The distribution of these formant values indicates that they are closely clustered around the mean, suggesting a pattern of homogeneity among the dataset.

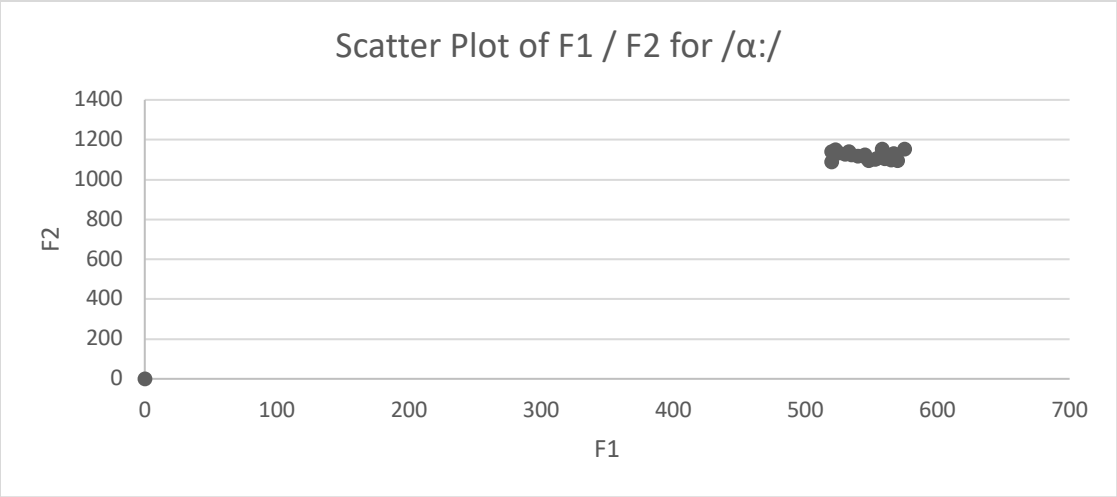

FIGURE 17. Scatter Plot of F1 and F2 for /ɑ:/

The statistical analysis (Table 16) exhibited that the t-statistics for both the formants F1 and F2 were larger than the assigned test value.

TABLE 16. One-Sample T-Test Results for F1 and F2 for /ɑ:/

One-Sample T-Test						
/ɑ:/	t	df	Test value = 0			
			Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	136.78	19	<.001	546.75	538.38	555.12
F2	250.00	19	<.001	1122.30	1112.90	1131.70

The upper and lower values of the 95% CI are narrow, and the difference between these two limits is small. The p-value for both formants was .00, which is lower than .05, indicating that the data are strongly significant. Figure 18 displays data distribution for both formants, i.e. F1 and F2.

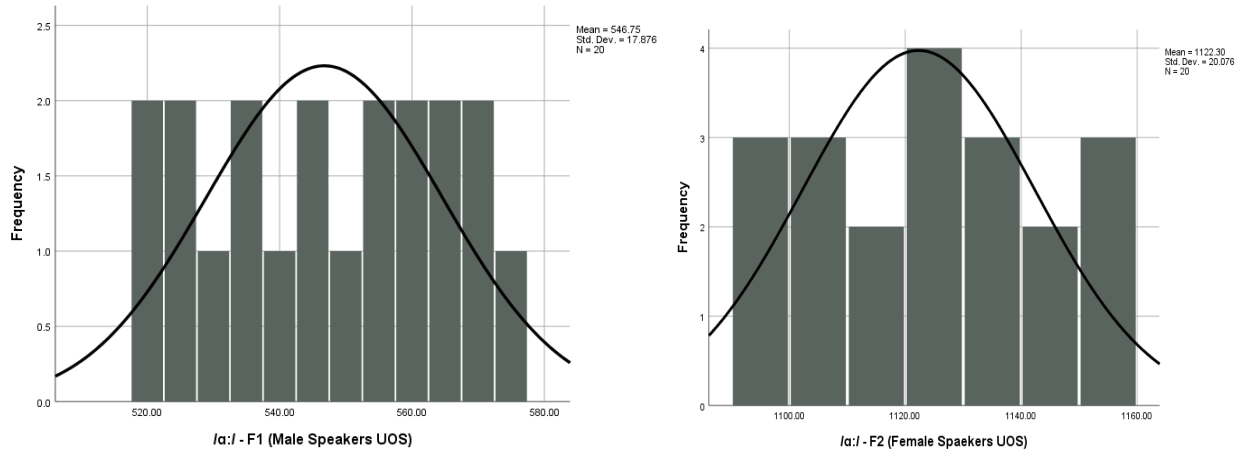

FIGURE 18. The Bell Curve for F1 and F2 for /ɑ:/

LOW BACK VOWEL /ɒ/

The vowel was realised as a short low-mid back vowel. The lips were semi-rounded during the articulation. The average time of articulation of the vowel /ɒ/ was 0.16 seconds. Comparing it with /ɑ:/, it was observed that /ɒ/ was articulated slightly high and back.

TABLE 17. Descriptive Statistics of F1 and F2 for /ɒ/

Descriptive Statistics					
/ɒ/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	450	530	487.40	22.72
F2	20	1005	1095	1050.30	27.33

The standard deviation for the first formant was 22.71, and for the second formant, it was F2 (Table 17). The values indicate that the data clustered tightly around the mean. Figure 19 shows the scatter of the data.

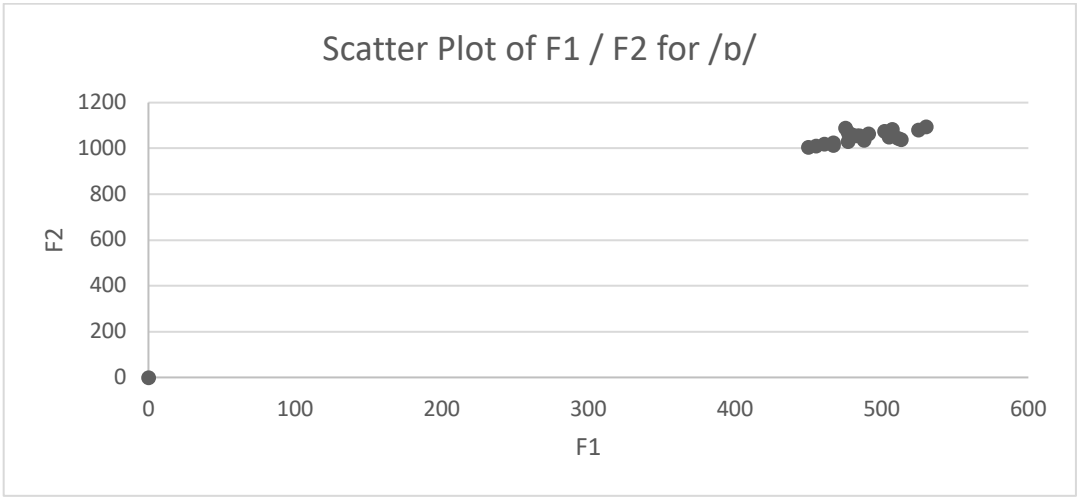

FIGURE 19. Scatter Plot of F1 and F2 for /ɒ/

Both t-value and p-value suggest that the data are strongly significant and reliable (Table 18).

TABLE 18. One-Sample T-Test Results for F1 and F2 for /ɒ/

One-Sample T-Test						
/ɒ/	Test value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	95.95	19	<.001	487.40	476.77	498.03
F2	171.85	19	<.001	1050.30	1037.51	1063.09

Figure 20 shows the data distribution for both the formants, while the bell curves indicate that the data are normally distributed.

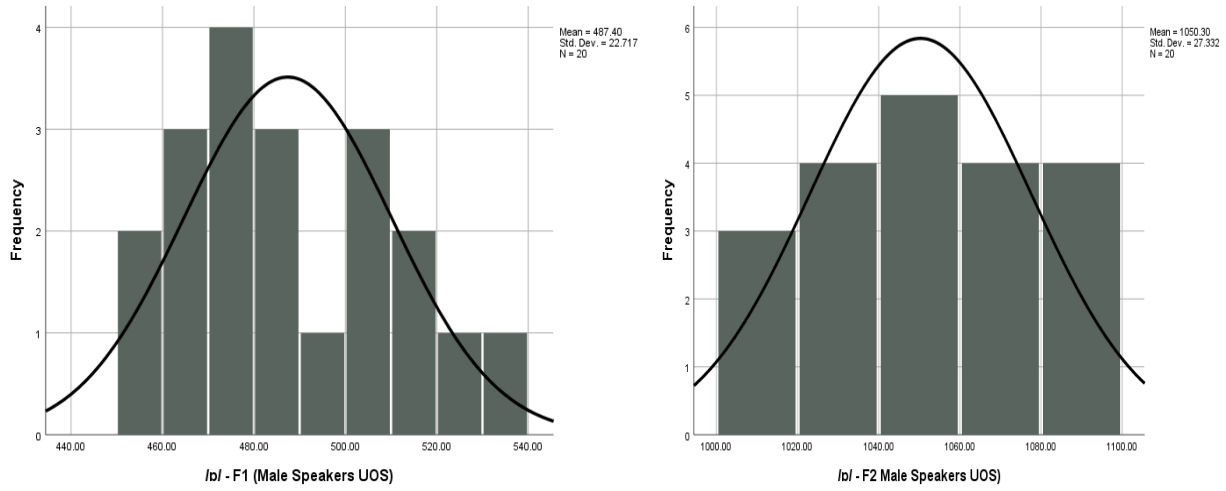

FIGURE 20. The Bell Curve for F1 and F2 for /ɒ/

MID-BACK VOWEL /ɔ:/

Unlike the previous two vowels that behaved similarly to their SBE counterparts, this vowel showed a tendency to be articulated as a low mid-back vowel, though the length showed that it was articulated as a short vowel. Unlike SBE, which is a mid-back vowel (Ladefoged & Johnson, 2011; Roach, 2009). Comparing it with /ɒ/, the vowel /ɔ:/ got almost a similar place in the trapezium. The average time of articulation of the vowel /ɔ:/ was 0.17 seconds. The descriptive statistics (Table 19) showed that the data are closely grouped around the mean.

TABLE 19. Descriptive Statistics of F1 and F2 for /ɔ:/

Descriptive Statistics					
/ɔ:/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	405	495	461.20	26.65
F2	20	995	1085	1040.60	24.82

Figure 21 shows the spread of the formants for the said vowel.

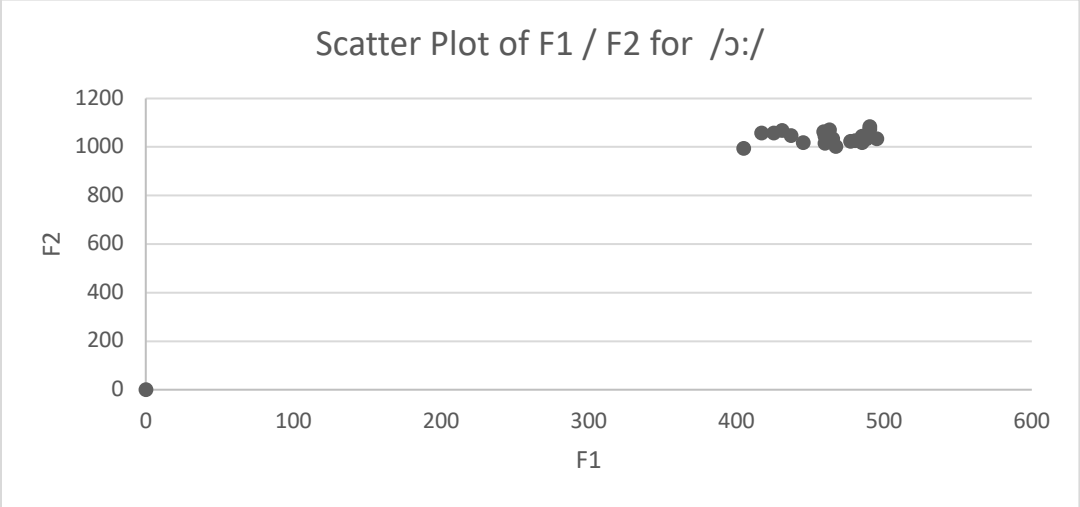

FIGURE 21. Scatter Plot of F1 and F2 for /ɔ:/

The statistical values (Table 20) suggest that the data are significant and precise, i.e. the spread of the data is normal and reliable.

TABLE 20. One-Sample T-Test Results for F1 and F2 for /ɔ:/

One-Sample T-Test						
/ɔ:/	Test value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	77.38	19	<.001	461.20	448.73	473.67
F2	187.48	19	<.001	1040.60	1028.98	1052.22

Figure 22 shows data distribution for both the formants, while the bell curve indicates that the data are normally distributed.

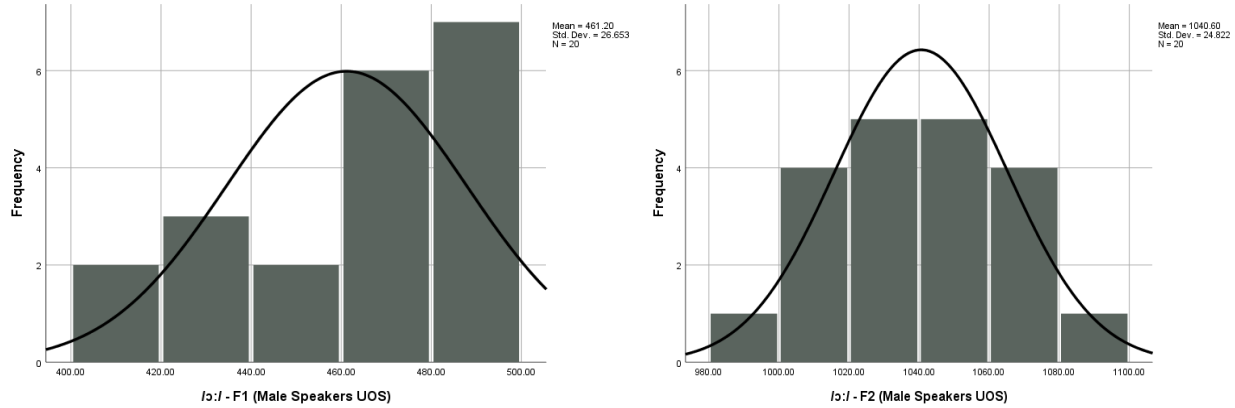

FIGURE 22. The Bell Curve for F1 and F2 for /ɔ:/

An interesting observation was recorded that the speakers did not show any difference in the realisation of the two back vowels, i.e. /ɒ/ and /ɔ:/. The formant frequencies and the time duration showed no significant difference. Based on the analysis, it can be said that the two vowels, i.e. /ɒ/ and /ɔ:/, are merged.

HIGH BACK VOWEL /u/

The vowel /u/ was realised as a short high-back vowel. The position of the lips was fully rounded, and the back of the tongue was raised towards the soft palate.

TABLE 21. Descriptive Statistics of F1 and F2 for /u/

Descriptive Statistics					
/u/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	330	405	374.90	24.35
F2	20	1070	1139	1112.85	19.57

Table 21 is descriptive statistics indicating that the data are spread around the mean. Figure 23 is the graphic presentation of the spread of the data.

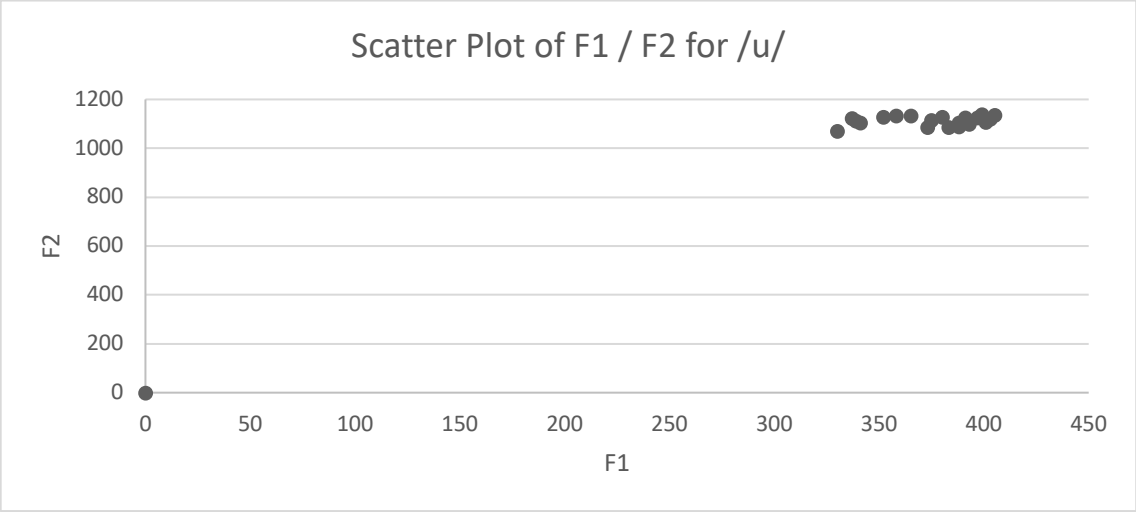

FIGURE 23. Scatter Plot of F1 and F2 for /u/

Statistical analysis (Table 22) indicated that the variance in the values of both formants, F1 and F2, remained statistically insignificant among speakers. This implies that despite individual differences, all the speakers exhibited a consistent articulation pattern for the vowel.

TABLE 22. One-Sample T-Test Results for F1 and F2 for /u/

One-Sample T-Test						
/u/	Test value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
F1	68.84	19	<.001	374.90	363.50	386.30
F2	254.35	19	<.001	1112.85	1103.69	1122.01

Figure 24 displays the data normality test, which states that the data were normally distributed, a quality of robust, reliable and significant data. Figure 24 shows the graphic display of data distribution for both the formants, i.e. F1 and F2.

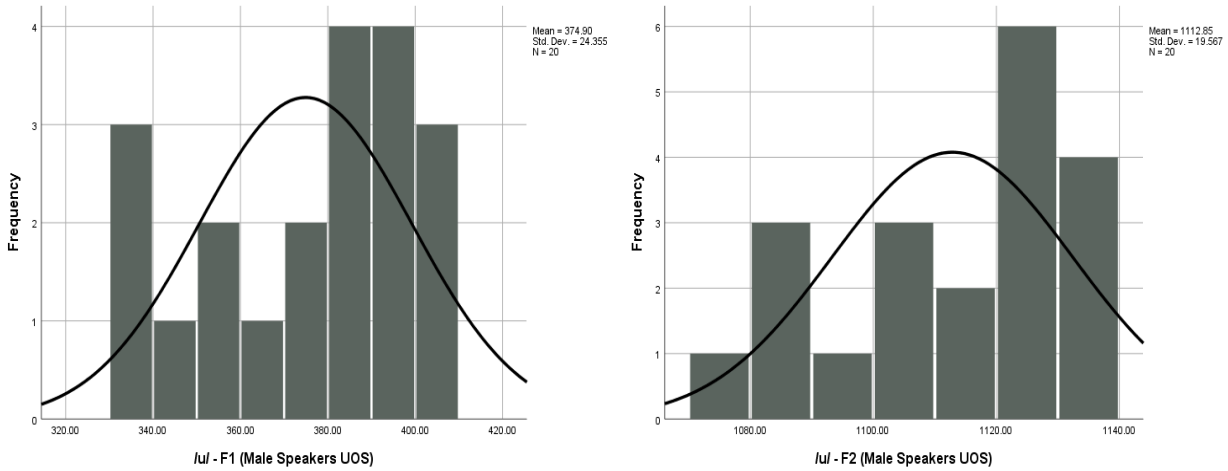

FIGURE 24. The Bell Curve for F1 and F2 for /u/

HIGH BACK VOWEL /u:/

This vowel was articulated as a long high-back vowel. The duration of articulation was 0.31 seconds. The vowel was articulated with rounded lips.

TABLE 23. Descriptive Statistics of F1 and F2 for /u:/

Descriptive Statistics					
/u:/	N	Minimum	Maximum	Mean	Std. Deviation
F1	20	320	375	349.30	17.52
F2	20	980	1105	1047.85	41.87

The descriptive statistics showed that the data were tightly distributed around the mean (Table 23). Figure 25 shows the spread of the data. The data exhibited a clustering tendency around the mean, signifying that the values were closely grouped near the average.

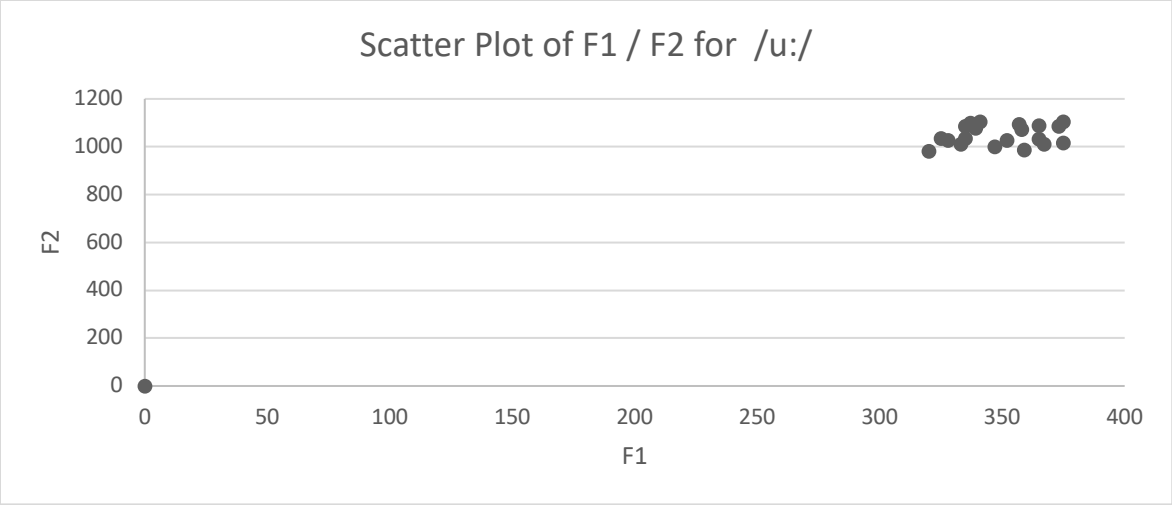

FIGURE 25. Scatter Plot of F1 and F2 for /u:/

The statistical values (Table 24) suggest that the estimation of the mean values is accurate and meaningful. The p-value for both the formants was .00, which is lower than .05. The higher t-values (t>0) and the lower p-values (p<.05) indicate that the data are strongly significant.

TABLE 24. One-Sample T-Test Results for F1 and F2 for /u:/

One-Sample T-Test						
/u:/	t	df	Test value = 0		95% Confidence Interval of the Difference	
			Sig. (2-tailed)	Mean Difference	Lower	Upper
F1	89.15	19	<.001	349.30	341.10	357.50
F2	111.91	19	<.001	1047.85	1028.25	1067.45

Figure 26 shows the graphic display of data distribution for both the formants, i.e. F1 and F2. The bell curves ascertain that the data are normally distributed.

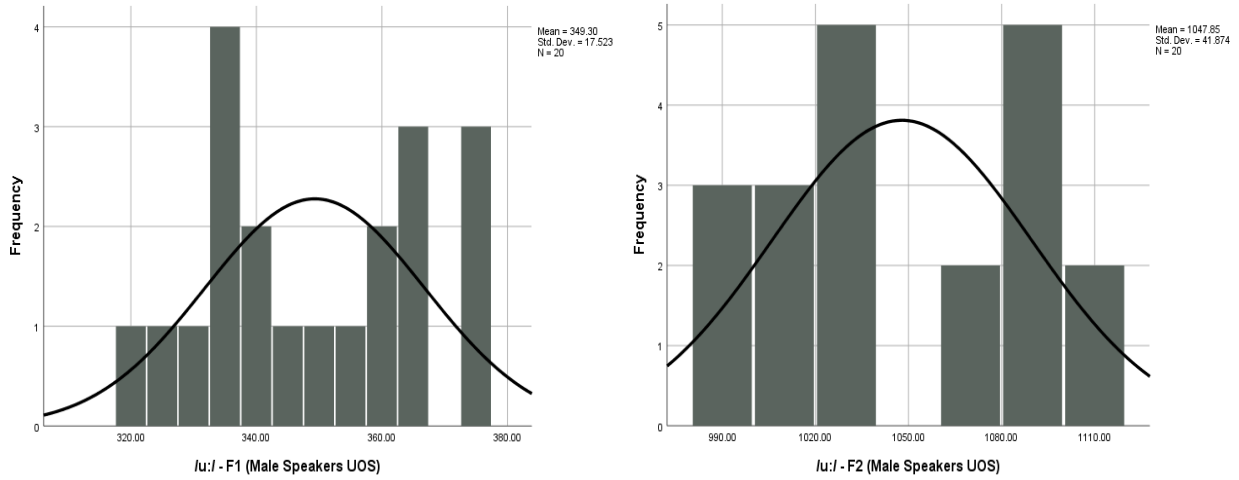

FIGURE 26. The Bell Curve for F1 and F2 for /u:/

The analysis showed that Punjabi speakers of PakE realised four back vowels instead of five, like some other Asian varieties of English, where the speakers were unable to realise the difference between long and short vowels (Gargesh, 2006). The mid-back long vowel /ɔ:/ and the low-back short vowel /ɒ/ were merged (Figure 27). It was concluded that PakE has four back vowels, i.e. two long and two short, unlike SBE, which has five, i.e. three long and two short (Ladefoged & Johnson, 2011; Roach, 2009).

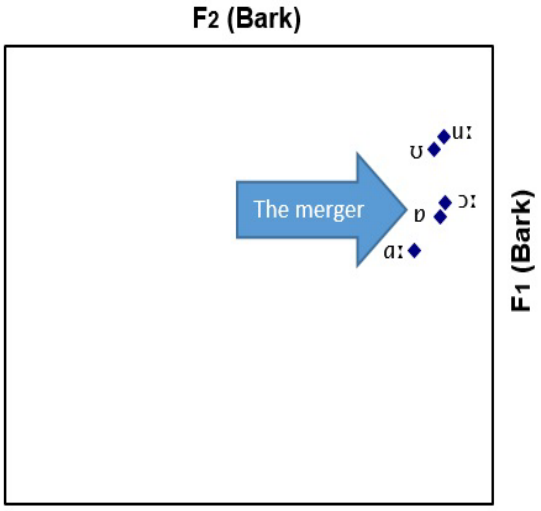

FIGURE 27. Back Vowels

The PakE speakers showed variation in the realisation of these two phonemes (i.e. /ɒ/ and /ɔ:/) as compared to the same phonemes of SBE. The other three back vowels /ɑ:/, /u/ and /u:/ showed a similar pattern of articulation as that of SBE. Table 25 presents the summary of the formants and duration.

TABLE 25. Formants and Duration of Back Vowels

	Speakers		
Vowel	F1	F2	Duration in seconds
/ɑ:/	545	1120	0.28
/ɒ/	485	1050	0.16
/ɔ:/	460	1040	0.17
/u/	375	1110	0.15
/u:/	350	1045	0.31

The chart below (Figure 28) indicates the difference in the duration of articulation of the five back vowels.

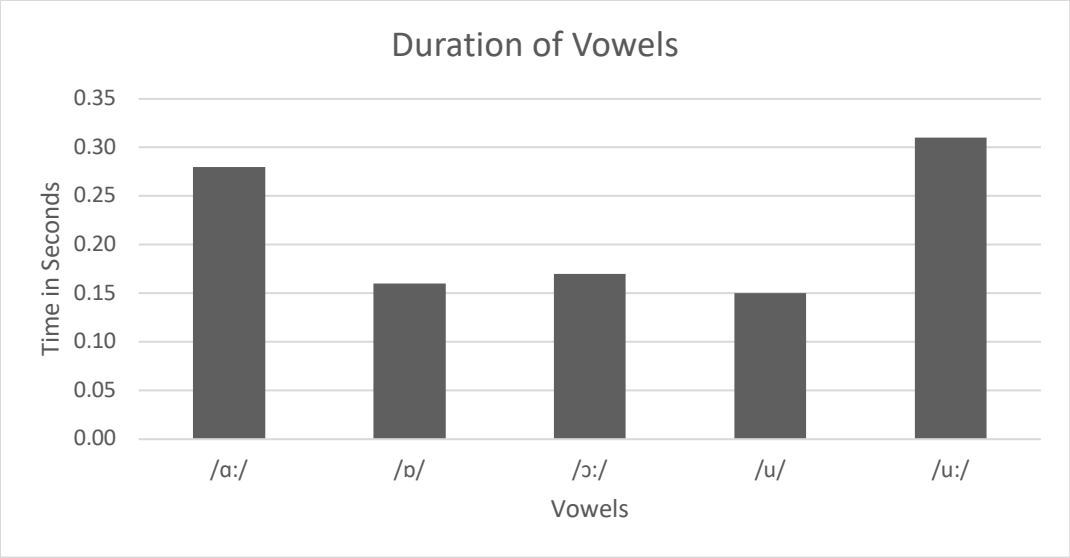

FIGURE 28. Duration of Articulation of the Five Back Vowels

CONCLUSION

The study addresses the following research questions: (1) What are the acoustic characteristics of monophthongs in PakE as spoken by Punjabi speakers, and (2) how do these monophthongs resemble or differ from those of SBE? The analysis provides answers by demonstrating that PakE is a systematically patterned variety of non-native Englishes. Pakistani Speakers articulated the front vowels in a similar pattern as that of SBE, i.e. all four front vowels with further classification as two high-front vowels (i.e. /i:/ and /i/), one mid-front vowel /e/, and one low-front vowel (i.e. /æ/). They tend to articulate the low-front vowel /æ/ as a long vowel with an average duration of 0.22 seconds. The same phenomenon is reported by Raza (2008), that /æ/ is articulated significantly longer than the other short vowels by Pakistani speakers.

Regarding the central vowels, Pakistani speakers realised/ʌ/ and /ɜ:/ as two different phonemes. The pair was realised as long /ɜ:/ and short /ʌ/ vowels. Both vowels were articulated as low central vowels. Though /ɜ:/ was realised as a long vowel, its duration was shorter than the other long vowels of PakE. Mesthrie and Bhatt (2008) and Mahboob and Ahmar (2004) reported the merger of /ɜ:/ into /ʌ/ in PakE, ascribing this merger to the rhoticity of PakE. However, the current research shows some differences in duration between the two vowels.

The analysis of the back vowels revealed that Pakistani speakers realised four back vowels, with further division of two long and two short vowels. The three vowel phonemes, i.e. /ɑ:/, /u/ and /u:/, followed SBE, while the short low-back vowel /ɒ/ and long mid-back vowel /ɔ:/ showed a merger, and both were realised as a short low-mid back vowel. The findings of the study are in agreement with the observation reported by Asghar et al. (2021) and Rafique (2020), who described that there are four back vowels of PakE and there is a merger of the short low-back vowel and the long mid-back vowel. Asghar et al. (2021) stated that there are three back vowels in PakE. The vowels /ɒ/ and /ɔ:/ merge into /ɑ:/. The merger of low-back vowels in PakE is also reported by Bilal et al. (2021).

To present a summary of the results, it can be concluded that PakE, as spoken by Punjabi speakers, has 10 monophthongs, including four front vowels, two central vowels, and four back vowels. There are two long and two short front vowels, one long and one short central vowel, and two long and two short back vowels in PakE. These findings answer the subsidiary questions by showing both the number of identifiable monophthongs and the presence or absence of mergers among specific vowel pairs. So it can be concluded that PakE has a different set of vowel phonemes as compared to SBE.

Focusing on the objectives and research questions of the study, i.e. to find out if PakE can be declared as a unique variety of English based on its vowel phonemes, it is evident that PakE has shown systematic phonetic variation within the domain of monophthongs. However, these results should be interpreted cautiously, as they are limited to vowel evidence and do not represent the entire phonological system. Addressing the research questions of the study, it can be concluded that PakE has a different set of vowel phonemes, not only in number but also in their realisation. These phonemic differences provide empirical support for describing PakE as a distinct variety at the phonetic level**,** with its own characteristic features.

The findings of this study have several theoretical, pedagogical, and sociolinguistic implications. Recognising PakE as a distinct variety may reduce the stigma associated with non-native accents, increase speakers' confidence in communication, and guide educators and policymakers in developing contextually appropriate teaching strategies. Researchers, scholars and policymakers will shift their attention to codifying the language, giving it an independent, legitimate identity like Indian English, Nigerian English, etc. The recognition and codification of PakE as a legitimate variety would help in resolving the accuracy vs fluency debate.

Finally, this study suggests directions for future research, including investigations of consonantal systems, suprasegmental features, and larger speaker samples to provide a more comprehensive description of Pakistani English and its phonological patterns.

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