



The Acoustics of Gender and Regional Variation in Pakistani English: A Sociophonetic Analysis of Long Close Front Monophthong [i:]

Mumtaz Yaqub¹, Dr. Muhammad Kamal Khan², Dr. Rashida Imran³

¹PhD Scholar, Department of English and Applied Linguistics, AIOU, Islamabad,

Email: Yaqub.mumtaz@yahoo.com

²Associate Professor, Department of English and Applied Linguistics, AIOU, Islamabad

³Assistant Professor, Department of English and Applied Linguistics, AIOU, Islamabad

ARTICLE INFO

Article History:

Received: March 08, 2026

Revised: April 04, 2026

Accepted: April 11, 2026

Available Online: April 15, 2026

Keywords:

Pakistani English, Sociophonetics, Vowel Acoustics, /i:/, Montreal Forced Aligner, PRAAT, Gender Variation, Regional Dialects

Corresponding Author:

Mumtaz Yaqub

Email:

Yaqub.mumtaz@yahoo.com

ABSTRACT

This study provides an extensive sociophonetic investigation of the high front tense monophthongal vowel /i:/ properties in Pakistani English (PakE), by considering their spectral (F1, F2) and temporal (duration) characteristics across two genders and thirteen (13) regional variants. Speech data were achieved from 208 undergraduate students (104 males, 104 females) from major geographic areas of Pakistan. Vowel segments were automatically timed to the Montreal Forced Aligned Transcription of the data. Subsequently, the aligner (MFA) was followed by acoustic derivation on the basis of custom PRAAT scripts. To adjust for cross-speaker physiological disparity, formant and duration values were z-score normalized separately by gender. Statistical investigation used descriptive measures, two-way ANOVA (Region × Gender), and Tukey HSD post-hoc tests. The findings indicate that /i:/ is a highly acoustically stable sound in Pakistani English, with strong gender effects in spectral and rather weak gender effects in duration. Regional variation, even though statistically significant, is phonetically modest, evidencing the categorization of /i:/ as a stable and socially prominent vowel in Pakistani English influenced by prestige alignment and limited substrate impact.

DOI: <https://doi.org/10.59075/tamsaal.v4i4.94>



© 2026 The Authors, Published by ULLR. This is an Open Access Article under the Creative Common Attribution (CC-BY 4.0)

Introduction

Pakistani English (PakE) is an institutionalized postcolonial and has evolved as a result of long-term interaction between English and a variety of local languages, such as Punjabi, Sindhi, Pashto, Saraiki, Balochi and some languages spoken in the north (Baumgardner, 1993; Rahman, 1991). Under the World Englishes scale, PakE has stabilized in the Outer Circle where it has both a developing endonormative and continued orientation towards exonormative norms and specially, British English (Kachru, 1985; Schneider, 2007).

Descriptive studies of PakE phonology have a long history (Mahboob and Ahmar, 2004; Rahman, 2020), whereas more detailed studies of acoustic variation have been rare, usually limited to a few metropolitan areas, or have been driven by impressionism. Specifically, there is no regionally comprehensive sociophonetic research to investigate both spectral and temporal domains of vowel production in normalized acoustic measures and via inferential statistics.

The high front tense vowel /i:/ is of specific theoretical attention due to its extreme articulatory position and its function as a reference point in vowel systems. Cross-linguistic and cross-dialectal studies consistently displays that /i:/ is categorized by low F1 and high F2 values, indicating a high and front tongue position, and that it has a tendency to resist significant phonetic change (Hillenbrand et al., 1995; Ladefoged & Johnson, 2015). Sociophonetic studies also reflect that /i:/ inclines to be sociolinguistically salient, indexing prestige and standardness mainly in second language English and postcolonial (Harrington et al., 2011).

Against this background, the current research provides an inclusive acoustic description of /i:/ in thirteen (13) regional varieties of Pakistani English. By incorporating regional and gender-based examination on a single statistical platform, the study aims at explaining the degree to which /i:/ is a consistent phonological unit in PakE despite the fact that Pakistan is a vastly diverse language area.

The study attempts to find the answer of the following research questions:

1. How is the vowel /i:/ structured acoustically within the regional phonetic space of PakE?
2. What role does gender play in shaping the spectral and temporal realization of /i:/?
3. How do regional and gender-based constraints jointly impact the production of /i:/ in PakE?
4. To what extent does /i:/ function as a stable phonological category within PakE despite regional discrepancy?

Historical Background

In acoustic and sociophonetic studies, the high front vowel /i:/ has always been described as the high front unrounded vowel with the extreme values of F1 and F2, representing its extreme articulatory formation and perceptual prominence (Peterson & Barney, 1952; Hillenbrand et al., 1995). As a result of this articulatory extremity, the vowel /i:/ tends to have condensed dispersal and it is a powerful reference point in the vowel system, often serving as the point of reference in a phonetic explanation or normalization procedure (Ladefoged & Johnson, 2015). These characteristics have directed /i:/ to be broadly considered as among the most acoustically stable English vowels.

Dynamic and sociophonetic researches also advocate that even though /i:/ is normally resilient to extensive diachronic and synchronic change, slight change can occur through dialect contact, social judgment, and individual speaker-dependent variables such as gender (Fox & Jacewicz, 2009; Harrington et al., 2011). The difference by gender is quite strong: in most varieties of the English language and other languages, female speakers are more likely to produce higher and fronter realizations of /i:/ caused both by physiological and sociolinguistic preferences to prestige and standard forms (Labov, 1990; Simpson, 2009). Consequently, /i:/ tends to have social connotation despite being phonemically stable.

Within the framework of the World Englishes, a postcolonial Englishes vowel system also normally exhibits the combination of stability of peripheral vowels and variation of mid and lax ones (Kachru, 1985; Schneider, 2007). Empirical researches of Asian Englishes (Indian, Singaporean, and Hong Kong English) validate that /i:/ inclines to retain a native-like production even though in intense multilingual context, whereas other vowels experience restructuring or centralization (Wiltshire & Harnsberger, 2006; Deterding, 2007). This tendency supports the view that periphery vowels, such as /i:/, are less likely to be affected by the substrate than are non-periphery vowels, but also may reflect local phonological patterns and rhythm preference, to a degree, the frontness and length of /i:/ may be influenced by the substrate.

The studies on Pakistani English are broadly consistent with these findings but provide only limited in terms of fine-grained acoustic variation. Early descriptive literature defines Pakistani English as intensively oriented toward British English phonology, with systematic variation influenced by local languages, sociolinguistic environment, and educational background (Rahman, 1991; Baumgardner, 1993). One of the most extensive phonological accounts of Pakistani English is offered by Mahboob and Ahmar (2004), who state that tense - lax opposition like /i:/-/i/ is usually maintained, but there can be a gradual phonetic variation among speakers and between speakers in regions.

More current acoustic studies document gender-based vowel variances in Pakistani English that reflect cross-linguistic patterns, with female speakers articulating fronter and higher vowels (Rahman, 2020). Nonetheless, there are still a few region-level acoustic comparisons, which are methodologically inconsistent and mostly limited to only a few cities. Subsequently, there has been an eminent lack of any large-scale sociophonetic observations that simultaneously test regional and gender-based fluctuation by means of normalized acoustic criteria and inference statistics.

The current research fills this gap by giving the first large-scale, regionally stratified acoustic study of the vowel /i:/ in thirteen varieties of Pakistani English. The work combines normalized spectral and time measures, and an impressive statistical display to give the complete depiction of the linguistic stability and sociolinguistic regularity of /i:/ in PakE.

Research Design

The dataset includes of recorded speech from 208 undergraduate students (104 males and 104 females) of PakE. Participants were selected from thirteen (13) cities selected to reflect all major geographic regions of Pakistan: Abbottabad (ABT), Gilgit (GLT), Islamabad (ISB), Khuzdar (KHD), Karachi (KHI), Lahore (LHR), Mirpur (MRP), Multan (MUL), Muzaffarabad (MZB), Peshawar (PSH), Quetta (QUE), Skardu (SKD), and Sukkur (SKR). All the participants were local people who had received formal education and English was used as a medium of instruction during their education, thus establishing functional competence in Pakistani English. By restricting the sample to undergraduate students, there was reduced variation according to age and level of education, allowing for a more direct investigation of gender and regional phonetic effects.

Controlled word list reading tasks were used to obtain the target vowel /i:/ in stressed syllable (e.g. eat, seat). The recordings were made in quiet locations with the highest quality digital

recorders and head mounted microphones. All the recorded speech files were digitalized with a normal sampling rate and stored in the WAV file format for acoustic analysis.

The MFA was employed to complete segmental annotation which provided automatic phone-level time alignment of the orthographic transcription to speech signals. The generated Text Grids were then manually inspected to make certain alignment of the boundaries of the vowels.

Acoustic data was obtained via custom written PRAAT scripts, which enabled automatic calculation of F1 and F2 values at the middle of each /i:/ in the token, and of vowel duration. Midpoint measurement was chosen to minimize the influence of neighboring consonants on the measurement.

Physiological variation amongst speakers was controlled by z-scoring all acoustic measures in both male and female speakers. This normalization made sure that variation seen is caused by linguistic and sociophonetic influences and not by anatomical variation.

The statistical procedures used were descriptive statistics, two-way ANOVA with Region and Gender as fixed variables and Tukey HSD post-hoc tests to describe significant inter-regional variances. Standard statistical software was employed to do all analyses.

The vowel /i:/ was analyzed for:

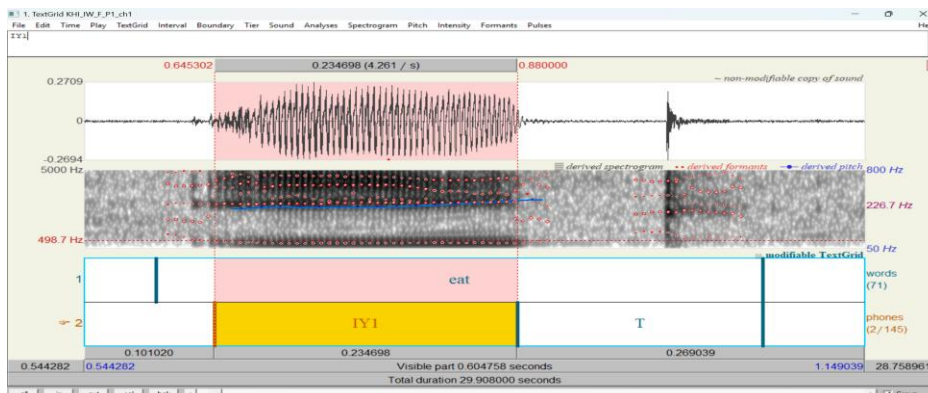
- F1 exhibiting vowel height and openness
- F2 exhibiting vowel backness and frontness
- Duration (given in ms)

To stabilize the physiological variation or to neutralize their influence on the acoustic values, all values were z-score normalized discretely for male and female participants. This normalization confirmed that detected variances indicated linguistic and sociophonetic disparity instead of anatomical factors.

Interpretation of Findings

The aim of this section is to describe F1, F2 and duration (temporal) characteristics of the vowel /i:/ in thirteen regional varieties of Pakistani English with a clear emphasis on tendencies and statistics related to the gender of the speaker.

Figure 1 Image Showing a PRAAT Spectrogram and Waveform of /i:/ for the Word “eat”

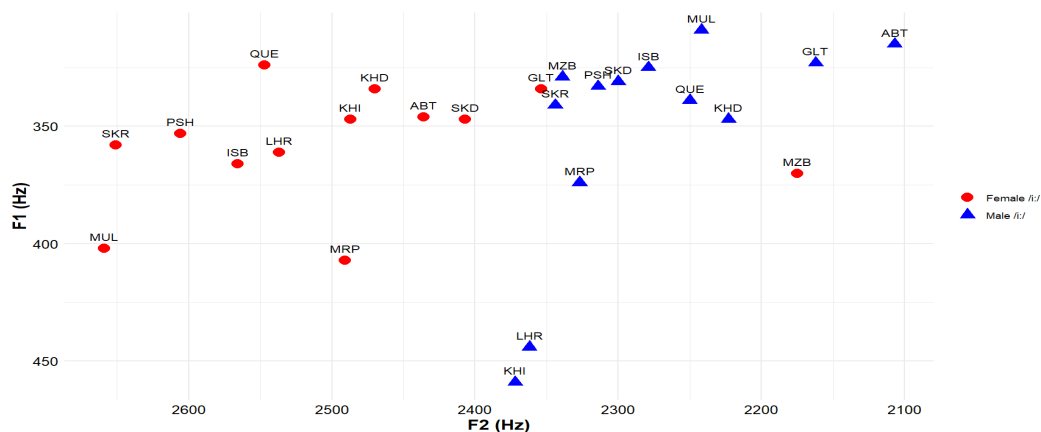


Spectral Characteristics:

In all regions, /i:/ is described by systematically low F1; a justification for its production as a high vowel. F1 is lower for female speakers (higher tongue position) throughout the raw Hertz values when compared with male speakers. F1 values for females ranged around 330 to 400 Hz in some areas such as Khuzdar (KHD) and Abbottabad (ABT) while F1 values of males tended to go in higher range; ranging above 450 Hz in some areas like Karachi (KHI). This systematic gender disparity is in line with the z-score normalized data with both genders showing significantly negative F1 scores, but females are grouped closer to the extreme high-vowel region.

The differences between regions in terms of F1 are statistically significant but not phonetically significant. Vowel realization (low F1) is slightly higher in the northern dialects (e.g. Gilgit, Skardu, Abbottabad) and a slightly higher value of F1 (vowel lowering) is observed in some of the central and southern dialects (e.g. Multan, Mirpur, Karachi). As seen in the ANOVA table, the Region x Gender interaction is significant, suggesting that these regional trends were not uniform in genders.

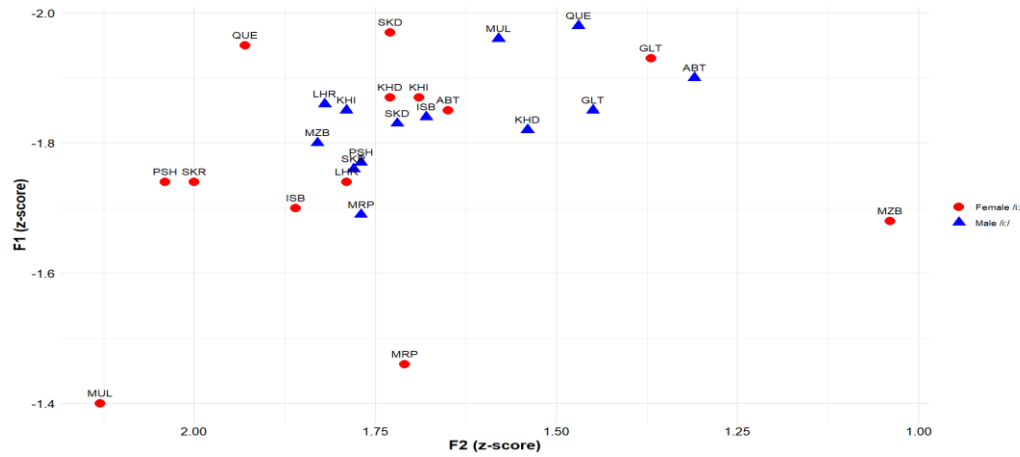
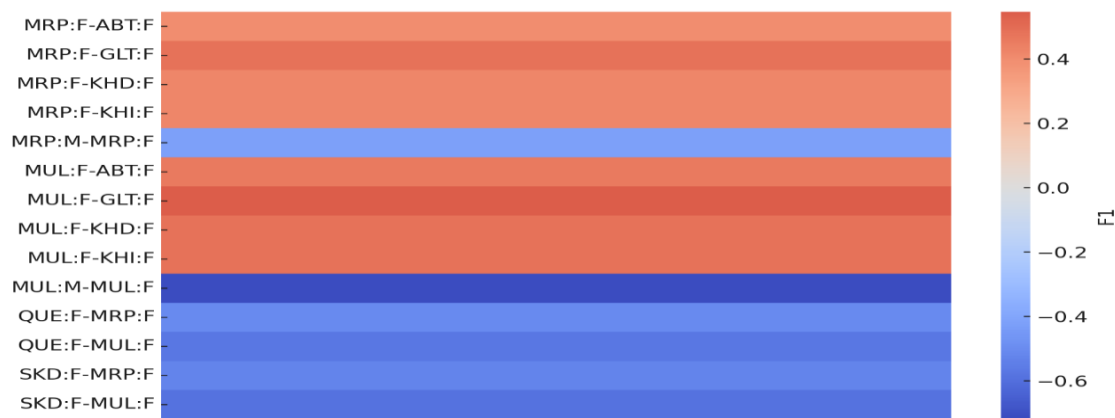
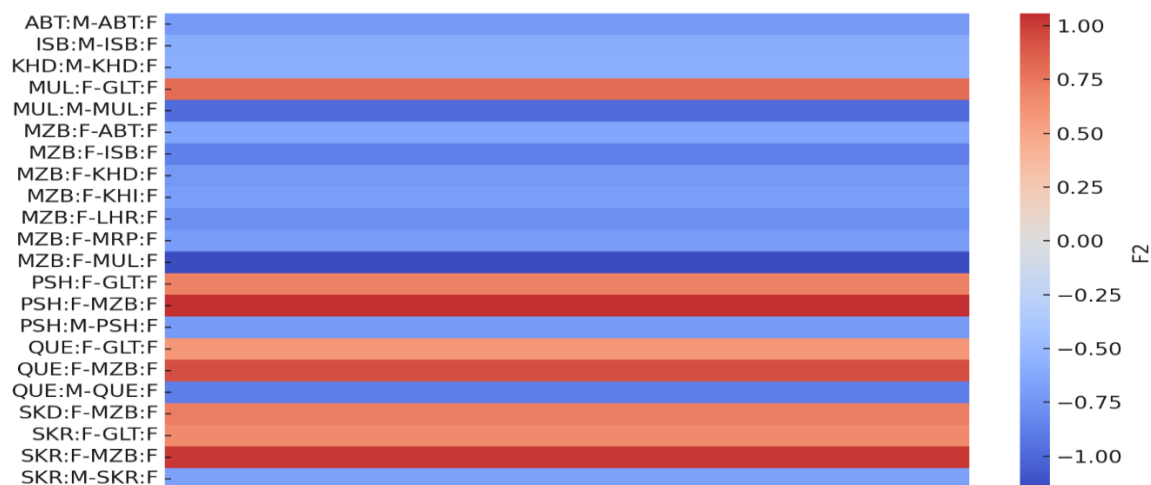
Figure 2 Showing Mean Values in Hz for /i:/ across All 13 Regions (Male vs Female)



The vowel [i:] has consistently high F2 formant tones in all regions, confirming that it is a front vowel. The F2 value of the female speakers is higher than that of the male speakers in all regions, which shows a systematic vowel fronting. F2 in Females are often higher than 2500 Hz in many areas (Raw Values) whereas F2 in males are comparatively lower, normally around the 2200-2350 Hz range.

Z-score Normalization Values:

Z-score normalized F2 values also reveal that female speakers are located in a more peripheral front-vowel area, with positive z-scores often exceeding +2 in certain areas. It is also noted that the values of F2 are also lower in Muzaffarabad (MZB) than the other two cities showing somewhat backed production while the cities of Multan (MUL), Quetta (QUE) and Sukkur (SKR) exhibit relatively higher values of F2 indicating somewhat fronted productions. The results of post-hoc comparison using Tukey HSD is in line with this concept, which indicates that some of these inter-regional differences are statistically significant, particularly between speakers of female and male varieties.

Figure 3 Mean F1 and F2 (z-scores) for /i:/ Across Pakistani English Varieties by Gender**Figure 4 Significant Tukey HSD contrasts in F1 (vowel height) for /i:/ (IY1) across dialects and genders in Pakistani English****Figure Error! No text of specified style in document. Significant Tukey HSD contrasts in F2 (vowel frontness/backness) for /i:/ (IY1) across dialects and genders in Pakistani English**

Temporal Characteristics: Duration

The vowel /i:/ retains a constantly long duration across all 13 varieties of Pakistani English. Mean raw durations usually range between 0.18 and 0.22 seconds which verify its tense and long vowel status. Female speakers exhibit a tendency to articulate slightly longer tokens in numerous regions, however this trend is not consistent within the dataset.

Figure 3 Showing Mean Values in Hz for All /i:/ across 13 Regions (Male vs Female)

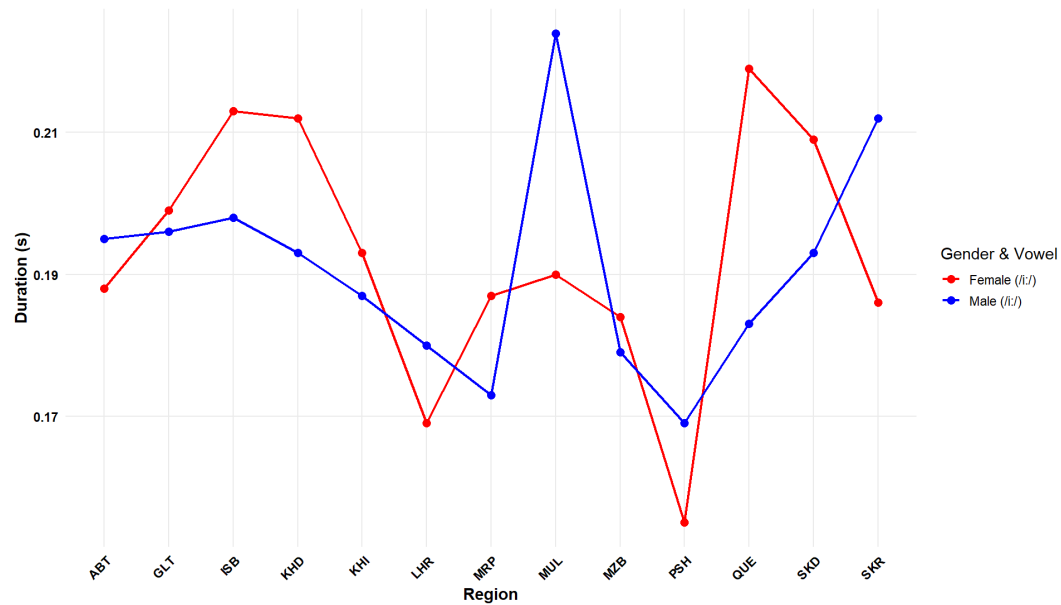
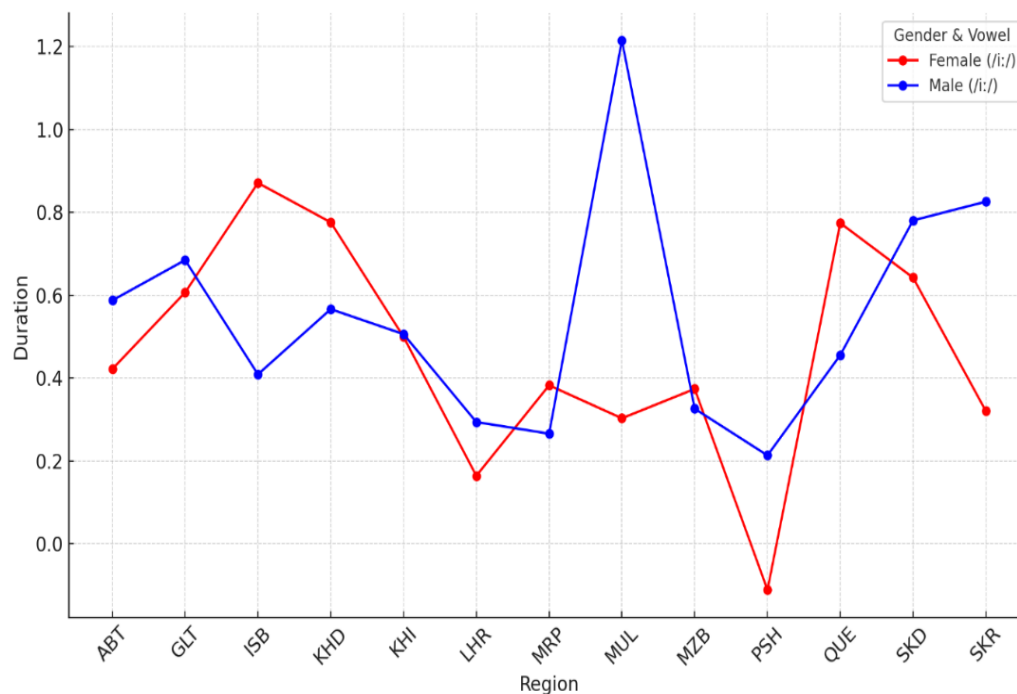


Figure 4 Z-score Mean duration of /i:/ across regions of Pakistani English by Gender



According to the results of ANOVA, there is a significant main effect of Region on duration, however, there is no significant main effect of Gender. This means that the extent of the temporal change of /i:/ is also more strongly affected by speech rhythm in the region than by the effect of gender. However, in some areas such as Multan, Skardu and Islamabad, there are strong interactions between Region and Gender which suggest that gender affects durations in those areas. Positive durations, or Z-scores, for these results show that durations in most regions are longer than the speaker-normalized mean, and reinforce these results.

Figure 8 *Boxplots Showing the duration patterns of /i:/ (IY1) across 13 Pakistani English dialects*

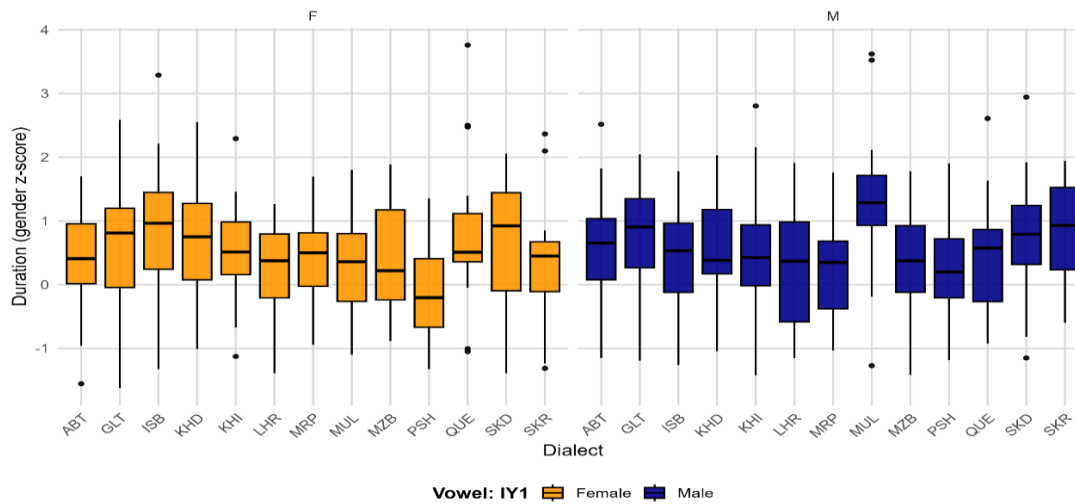


Figure 9 *Significant Tukey HSD contrasts in Duration for /i:/ (IY1) across dialects and genders in Pakistani English*



Variability and Dispersion

The values of standard deviation (SD) for both the first (F1) and second formant (F2) show a low range of variability across regions, highlighting the phonetic stability of the schwa vowel in /i:/. In the barometer of duration and frequency there are slight differences between the male and female speakers, with the female speaker being slightly more variable in areas such as Quetta (QUE) and Skardu (SKD). Elliptical plots of z-score normalized F1–F2 space validate considerable overlap among regional varieties of Pakistani English, further indicating that /i:/ lies in a narrow acoustic space in Pakistani English.

Figure 10 Mean and Standard Deviation (z-scores) of /i:/ Across Pakistani English Varieties

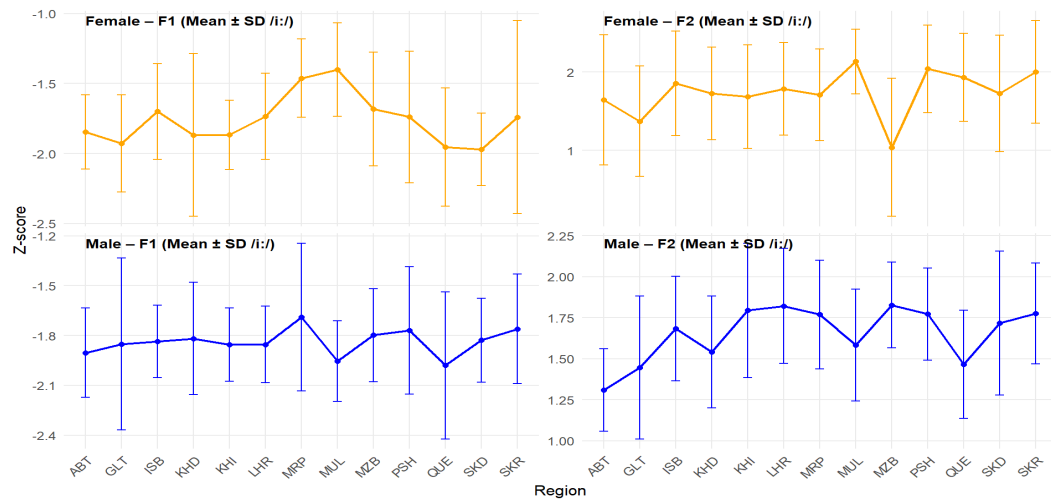
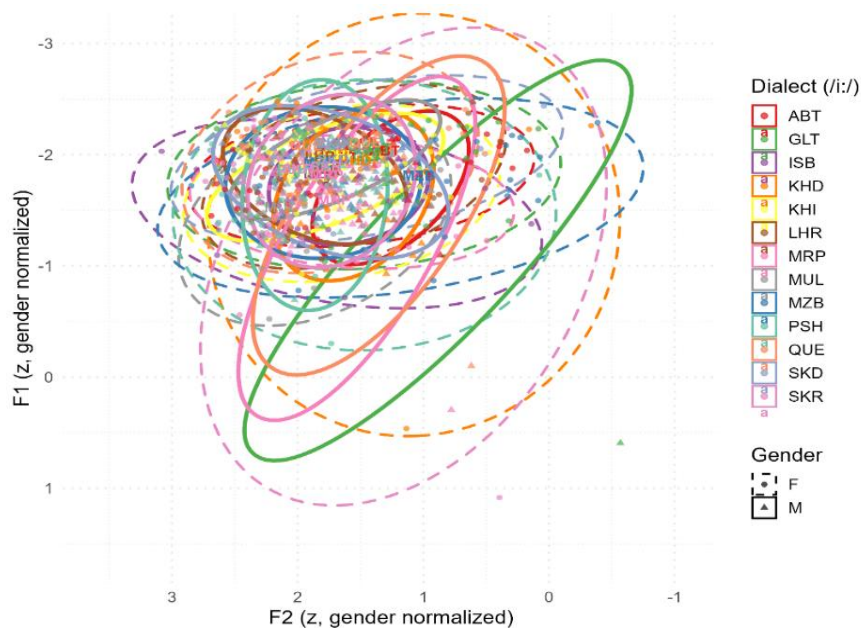


Figure 11 Elliptical Plot Showing the Distribution of the Vowel /i:/ across Pakistani English Varieties



Summary of Statistical Outcomes

Overall, the two-way ANOVA results indicate that:

- Both Region and Gender have significant and strong effects on the spectral properties (F1 and F2).
- Only region, but not gender significantly influences the duration.
- Interactions between Significant Region and Gender on all measures indicate that regional trends are partially gender mediated.

Together these findings identify that although there is a small degree of variation in the pronunciation of /i:/ across regional and gender variants, the basic acoustic properties remain very stable in varieties of Pakistani English.

Linguistic and Sociolinguistic Interpretation of /i:/

The vowel /i:/, in Pakistani English, is a high front unrounded tense vowel categorized by low F1 and high F2, indicating a constantly high and front tongue placement. It has a strong acoustic instability/dispersal across 13 regional varieties, and has a high tense–lax contrast. In gender cross-linguistic patterns, female speakers tend to have lower F1, and higher and fronter articulations, while higher F2 is characteristic of higher and fronter articulations.

Sociolinguistically, /i:/ is a stable and prestigious vowel in more contact areas such as urban and educational centres like Islamabad (ISB), Lahore (LHR) and Karachi (KHI). There may be slight regional differences (such as minor centralisation or retraction in Multan, Skardu and Khuzdar) in local languages that do not have a tense/lax distinction. Durational pattern verify /i:/ long vowel (usually > 0.20 s).

In general, /i:/ displays stable phonetic production in Pakistani English, with slight gender and regional disparity due to the language contact and exposure to education.

Discussion

The results validate that /i:/ is one of the most acoustically stable vowels of Pakistani English, which is consistent with the cross-varietal studies of English phonetics (Hillenbrand et al., 1995; Ladefoged & Johnson, 2015). Another credible detail is the constant low F1 and high F2 means across all areas, which signify a constant high-front articulation, thus substantiating the assertions that tense peripheral vowels are expected to inhibit widespread regional differentiation and act as footholds in vowel systems (Harrington et al., 2011). The difference between the genders is systematic and strong, as female speakers have higher and more fronter realizations of /i:/ which is sufficiently supported by other cross-linguistic sociophonetics (Labov, 1990; Simpson, 2009). Such a gendered trend coincides with previous results indicating that female speakers are more orientated towards supra-local or prestige standards (Rahman, 1991; Mahboob, 2015).

Regional effects are statistically significant, although with a relatively small phonetic size, which not only supports the idea (Schneider's 2007) of convergence in core phonological features in stabilized postcolonial varieties but also results in the limited under-differentiation of regions. In the Pakistani English, only a limited number of deviations that are seen in areas like Multan, Skardu, and Khuzdar are feasibly explained by substrate language influence, especially by those

languages with weaker tense-lax vowel contrast, as opposed to systemic phonological restructuring (Rahman, 2020).

Lastly, the duration has appeared as a more area-sensitive parameter than the vowel quality, implying that temporal organization is a major area of regional differentiation in the Pakistani English.

The result supports previous research studies of South Asian Englishes that identified rhythm and speech timing as the major areas of regional variation while the segmental vowel categories have fairly consistent values (Wiltshire & Harnsberger, 2006; Hassan, 2016).

Conclusion

This paper demonstrates that high front vowel /i:/ in the Pakistani English vowel space is acoustically stable, has consistent gender differences, and has minimal regional differences. The findings are incorporated in the already growing body of evidence for the sociophonetics of Pakistani English and provide statistical evidence for the categorisation of /i:/ as a stable and socially salient vowel in the variety.

Future research can be conducted by extending this study to other tense/lax vowel pairs in other Pakistani English varieties to compare the study with other tense/lax vowel pairs and to include dynamic formant trends.

Note: The data were gathered by the PhD scholar, Ms Mumtaz Yaqub, on her own and who did not receive any external funding for this purpose. Subsequently, the scholar received an IRSIP scholarship to come to the University of Arizona in USA to analyze the data. The analysis was conducted at the Douglas Phonetics Laboratory under the supervision of Dr. Natasha Warner.

References

1. Baumgardner, R. J. (1993). *The English language in Pakistan*. Oxford University Press.
2. Deterding, D. (2007). *Singapore English* (Dialects of English). Edinburgh University Press.
3. Fox, R. A., & Jacewicz, E. (2009). Cross-dialectal variation in formant dynamics of American English vowels. *Journal of the Acoustical Society of America*, 126(5), 2603–2618.
4. Harrington, J., Kleber, F., & Reubold, U. (2011). The contributions of the lips and the tongue to the diachronic fronting of high back vowels in Standard Southern British English. *Journal of the International Phonetic Association*, 41(2), 137–156.
5. Hassan, S. (2016). Rhythm and timing in Pakistani English. *Journal of South Asian Linguistics*, 4(2), 45–68.
6. Hillenbrand, J., Getty, L. A., Clark, M. J., & Wheeler, K. (1995). Acoustic characteristics of American English vowels. *Journal of the Acoustical Society of America*, 97(5), 3099–3111.
7. Kachru, B. B. (1985). Standards, codification and sociolinguistic realism: The English language in the outer circle. In R. Quirk & H. Widdowson (Eds.), *English in the world* (pp. 11–30). Cambridge University Press.

8. Labov, W. (1990). The intersection of sex and social class in the course of linguistic change. *Language Variation and Change*, 2(2), 205–254.
9. Ladefoged, P., & Johnson, K. (2015). *A course in phonetics* (7th ed.). Cengage Learning.
10. Mahboob, A. (2015). Pakistani English. In R. Hickey (Ed.), *Researching Northern English* (pp. 369–388). John Benjamins.
11. Mahboob, A., & Ahmar, N. (2004). Pakistani English: Phonology. In E. W. Schneider et al. (Eds.), *A handbook of varieties of English* (Vol. 1, pp. 1003–1018). Mouton de Gruyter.
12. Rahman, T. (1991). *Pakistani English: The linguistic description of a non-native variety of English*. National Institute of Pakistan Studies.
13. Rahman, T. (2020). *Language and politics in Pakistan*. Oxford University Press.
14. Schneider, E. W. (2007). *Postcolonial English: Varieties around the world*. Cambridge University Press.
15. Simpson, A. P. (2009). Phonetic differences between male and female speech. *Language and Linguistics Compass*, 3(2), 621–640.
16. Wiltshire, C., & Harnsberger, J. (2006). The influence of Gujarati and Tamil L1s on Indian English: A preliminary study. *World Englishes*, 25(1), 91–104.