A Gender-Based Acoustic Analysis of Vowels of Hindko Speakers in Learning English Pronunciation

Mehnaz Zeb[1], Dr. Asra Irshad[2]

[1]MPhil Scholar, Department of English Linguistics and Literature, Riphah International University, Islamabad
Email: mehnazzeb1990@gmail.com

[2]Assistant Professor, Department of English Linguistics and Literature, Riphah International University, Islamabad
Email: asra.irshad@riphah.edu.pk

HOW TO CITE:
Mehnaz Zeb, Asra Irshad (2026). A Gender-Based Acoustic Analysis of Vowels of Hindko Speakers in Learning English Pronunciation. International Journal of Special Education, 41(9s), 656-663

COPYRIGHT STATEMENT:
Copyright: © 2026 Authors.
Open access publication underthe terms and conditions of the Creative CommonsAttribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).

ABSTRACT:
Foreigner learners often face difficulties in English pronunciation at segmental level. Among other factors influencing vowel articulation negatively, there has been a limited focus on gender studies in Pakistani regional languages such as Hindko or Punjabi. The present study explores gender-based acoustic differences in the English vowels pronunciation by Hindko speakers. By employing a quantitative cross-sectional design, the study analyzed speech data collected from twenty Hindko-speakers of English language learners. This sample contained ten male and ten female participants from the Mansehra district. The study examined eight monophthongs produced in the (hVd) pattern, analyzed the vowel quality and phonetic vowel space used by both genders. The researcher elicited Speech sample using a controlled method (CVC) word list adapted by Adebayo (2023) from Peterson and Barney (1952). All recordings were made in a quiet environment which were analyzed using PRAAT to extract acoustic measures, such as; frequencies (F1 and F2), vowel duration, and intensity. The results showed systematic gender-based differences in vowel pronunciation. Female speakers articulated vowels with higher F1 and F2 values and a more dispersed vowel space. They also shown slightly higher intensity levels in their articulation. On the other hand, male speakers exhibited lower formant frequencies, with vowel centralization, and having longer vowel durations in their speech. The findings indicate that gender possesses an important role in the acoustic analysis of English vowels at regional level. These differences replicate articulatory variation rather than disparities in linguistic competence of non native speakers. The study highlights the significance of gender as a meaningful variable in acoustic analyses of EFL vowel pronunciation. It may contribute to the emerging research on Pakistani English and regional language influence on learning English as a foreign language.

Keywords: Pakistani English, Vowel space, Acoustic phonetics, EFL/ESL pronunciation, PRAAT analysis, SLA

1. Introduction

English is the medium of communication across various fields such as education, science, diplomacy, business, and technology (Khan, 2025). English is taught as a second language in Pakistan for many years. English language learning begins from childhood in pre-school till higher education due to its lingua Franca status. Traditionally, it is taught as a subject then a language. Therefore, most students face problems with spoken English especially pronunciation throughout the educational period, because the more efforts are put to learn written language. However, anyone learning English as a Second Language knows very well that English is not difficult to learn. It is very simple in terms of grammar and vocabulary at Intermediate level in Pakistan. Despite, learners often face difficulty in understanding complex forms of phonology, morphology and syntax. English teaching in Pakistan faces tenacious challenges such as limited teacher training, a lack of phonetic knowledge, and little to no emphasis on pronunciation (Mahmood, Rahman, & Aslam, 2011). Pronunciation is a field in second language acquisition (SLA) which is given less attention than the other skills due to its complexity. Mostly researcher find it difficult to conduct research as different variables interfere with its process such as gender, motivation, field dependence / independence, etc., (Asher & Garcia, 1969).

Every language consists of consonants and vowel sounds. Standard British English has eleven monophthongs (iː/, /ɪ/,/ e/, /æ/, /ʌ/, aː/, / ɒ/, /ɔː/, / ʊ/, /uː/ and /ɜː/). These vowles play a vital role in the comprehension of the speech. Pronunciation plays an important part in language learning because it effects learners' clarity, intelligibility, and communicative competence. To learn the clear pronunciation, one has to clearly pronounce the vowels aforementioned. Past studies (Ayub et al., 2021; Watson, Harrington, & Evans, 2008) have exhibited that clear articulation has a crucial role in intelligibility, how well people understand the foreign learners and how fluent they appear in their spoken skills. Recent acoustic studies (Safeer & Kashifa, 2025) have also confirmed that in a multilingual environment, vowel mispronunciation causes more comprehension problems than consonant misarticulation. Because learners follow the same sound patterns of their L1 in pronouncing English sounds. Even if they know the correct grammar rules and advanced vocabulary, mispronunciation of vowels can affect their intelligibility while speaking.

Zhang & Yin (2009 argued that mastering proper English pronunciation is quite challenging for the non-native learners. There are different consonants and vowel sounds in English that are unfamiliar to non-native speakers. There are also some other rules of connecting and blending some sounds. For example last sounds in English are pronounced totally unlike the ones they have been following their whole lives. It gets hard to know all these rules of English pronunciation without having any exposure to the real life English.

Students' English pronunciation is also affected with their performance in the educational journey. However, other aspects such as performance was not assessed in this research. The purpose of this article is to investigate the gender-based differences in learning English vowels by the Hindko speakers. The current study aimed to highlight the differences in acoustic realization of vowels by male and female speakers.

Problem statement

This study was conducted on Hindko speakers in Mansehra district. Previous researchers explored consonants and oral stops, however, gender based acoustic analysis of vowels have been unexplored. The current study highlighted the role of gender in acoustic analysis by extracting formants values of both genders to compare and contrast the acoustic values of vowel sounds.

Research Question

This present research has a following question to be answered by following acoustic analysis measures.

Q1. How do male and female Hindko speakers differ in their acoustic realization of English vowels while learning English pronunciation?

Significance of the Study

The present study aimed to analyze the sound properties of English vowels produced by Hindko speakers in Mansehra. This study is based on the acoustic properties of gender which will have a significant contribution to teach vowels according to gender acoustic values. It is believed that there is a difference of male and female speakers in terms of the voice pitch and quality. The present study examined three basic parameters of human speech, the fundamental frequencies F1 and F2 and the duration of English vowels. This current study will help the teachers and learners to find out the gender-based differences in learning vowel pronunciation and to cope up with the problems while learning pronunciation.

2. Literature review

In the process of learning a foreign language, most of the times, learners find the pronunciation of the target language challenging because of the sound patterns as the new sounds do not resemble to the ones in their L1. It is hard to cope up with such problems for many new teachers and learners. It is suggested that there is a need of teaching pronunciation explicitly so that both teachers and learners have a leverage to overcome this issue at basic level. This is how intentional teaching of pronunciation would help learner to tackle the anxiety in oral communication which is mostly happen due to unclear pronunciation. Though pronunciation has been viewed as an important component of foreign language teaching, yet limited attention is given to this area in Pakistani language classrooms.

Deng et al., (2009) believed that pronunciation is not a part of Second language Acquisition (SLA) that takes an academic attention. A number of researches conducted to explore the attitudes of learners towards learning pronunciation which is limited (Burgess and Spencer, 2000; Derwing, 2010; Foote, Tracey & Derwing, 2010; Elliott, 1995). Burgess and Spencer (2000) conducted a research about the attitudes of language teachers in the UK towards teaching pronunciation. The findings showed that according to language instructors teaching pronunciation is hard and learners face problems in unfamiliar sounds which are not present in their L1. Derwing (2010) found that 53 % of the participants believed that "Canadians often respect those who have good pronunciation". Therefore, the results prove that correct pronunciation in target language may show the social status of people as well as their academic background. Mostly people do not like to be seen different, they put effort to pronounce native-like way as much as they can to be accepted by their circle.

In Pakistani context, Mahboob and Ahmar (2004) highlighted forefront phonological differences within PakE. Previous studies Bilal et al. (2011b, 2011c, 2011d, 2021a, 2021b), Abbasi et al. (2018a, 2018b), Mahmood and Farooq (2017, 2018), Hasan and Imtiaz (2015), and Sheikh (2012), examined the phonemes of PakE, clarified the differences in monophthongs and diphthongs paralleled to Standard British English. These studies have found that many factors affect pronunciation negatively. Both teachers and learners do not pay much attention to the root cause, instead they focus on other areas of the language.

Many studies on SLA explored that the difficulties in pronouncing English phonemes among speakers of different languages are same. Still, the problems vary according to the speaker's native language because they might have certain sounds which are rare or missing in their L1. Previous studies were conducted in field of SLA discussing the factors impede non-native speakers' oral communication, specifically Sudanese learners. These factors hinder in developing a level of linguistic proficiency same as of native speakers (O'Connor, 2003; Yule, 2003).

Several studies highlighted the role of gender in learning a foreign language. Gender plays an essential role in differentiating various sounds as per vocal tract and vowel space. It demonstrate systematic differences between male and female

speakers who learn and communicate in English language. Saleem and Ahmad (2021) investigated bilingual households in Pakistan and they found that women tend to switch between languages more frequently and relied on mother-tongue varieties in personal settings. Men on the other hand, predominantly use Urdu or English in social contexts. This pattern highlight the impact of gender on linguistic behavior in using English according to their choice. Similarly, study (LLR Journal, 2023) on acoustic difference in Pakistani English vowels indicates that male and female speakers vary in the producing vowel sounds, suggesting that gender can influence phonetic features of speech. Furthermore, politeness strategies in academic settings show that female speakers tend to use politeness settlements in English, while male speakers are less adherent to these norms (LLR Journal, 2020). Together, these findings underline that gender not only shapes social attitude but also establishes language use at both phonetic and pragmatic levels, highlighting the importance of considering gender as a variable in sociolinguistic research.

Pronunciation is an important part of acquiring a foreign language especially for young learners. It can assist them communicate effectively in English, boost their confidence to participate in different classroom activities. It also develops better listening skills, and improve their overall language proficiency which is the core of speaking skill. Language teachers need to emphasize the importance of pronunciation by giving attention it deserves in teaching practice generally. Teaching English pronunciation is moving towards an approach that is more active, encourage participation in speaking tasks, and tailored according to the context. In the current time, teachers are incorporating technology with interactive tasks, and personalized instruction to make learning more interesting and meaningful for the language learners. Integrating pronunciation to language lessons is essential for effective communication because learners have more vivid picture of the sounds during practice with teachers and peers. Therefore, by using different material such as: audio visual materials, standard IPA phonetic symbols, repetition and practice and at the end constructive feedback from teachers can help students develop their pronunciation skills. This is how they become more confident in communicating with others in target language. More explicit instructions they get, more clear and intelligible pronunciation they have.

Pakistan's multilingual environment likely to enhance these challenges of learning English pronunciation. In Pakistan, people speak more than 70 languages, and the education system is highly diverse with limited technical resources and formal training (Rehman, 2002). This problem worsen the situation. English enjoys high prestige in Pakistan, however, teachers have limited phonetic training and awareness, and few systematic teaching materials to follow in their language lessons (Mahmood et al., 2011). As a result, Pakistani English has been recognized as a non-standard variety marked by deviations in vowel quality, stress, and rhythm (Jadoon & Ahmad, 2022).

According to Harmer (2001), many teachers do not prioritize pronunciation in their lessons. Because it needs more time and effort to teach learners who are from diverse background. Ultimately, students have difficulty in pronouncing words correctly as limited focus is given to English pronunciation than other aspects of speaking skills. Harmer (2001) argued, the main reasons such as lack of attention to English pronunciation, absence of high quality teaching and learning materials, with little time for practicing pronunciation. It is widely believed that the first thing that native speakers notice during communicating with non native speakers is clear pronunciation, because it makes the conversation intelligible for them to understand. That is why, it is essential to focus on teaching pronunciation from the basic level. The current research was conducted in Mansehra where mostly people speak Hindko language as their mother tongue. Hindko is a rich Indo-Aryan language spoken in the Hazara region and Mansehra district. It has a distinct vowel pattern in terms of length and nasalization (Jadoon, 2017; Rashid & Khan, 2021). However, acoustic descriptions of the vowel patterns of Hindko

remained underexplored in academic studies. Initial evidence suggested that Hindko vowels are more centralized with less bordering dispersion than English vowels (Afridi, 2015).

3. Research Methodology

This current study has a quantitative approach. Following (Khalil, 2014) the researcher used the standard CVC word list to record the data. The list consisted of 11 words in Hindko and 11 words in English having the similar CVC pattern. This pattern was introduced by **Peterson and Barney, 1952.** The present study has adopted a **cross-sectional quantitative research design** to examine **gender-based acoustic differences** in the production of English vowels by Hindko speakers. The study does not investigate instructional effects or longitudinal development; rather, it focuses on identifying acoustic variation between male and female speakers at a single point of observation.

Population

The researcher selected Hindko speakers of Mansehra district to record the data to find the differences in the vowels of male and female speakers. The total population of Hindko speakers consists of 1.5% which is a significant size of Hindko community. They speak Hindko as L1 for the purpose of communication. For academic purposes, they learn English because, in Pakistani institutes, English is taught as a compulsory subject. However, it was not feasible to select the whole population, the researcher selected 20 participants to record the data.

Sampling

In this current study, the convenience sampling technique was employed by the researcher. Twenty participants were selected consisting ten male and ten female students from different institutes. The sample consisted of 20 Hindko speakers, including 10 male and 10 female participants. All participants were learners of English as a foreign language and used Hindko as their first language. Acoustic measurements were pooled across speakers within each gender group for comparative analysis.

Tools/Materials

The researcher used Sony recorder which is known for its authenticity in recording speech without any background noise. The data was recorded in a separate and quiet rooms with the consent of the higher authority of the institutes.

Data collection

The speech data were collected using a standard CVC word list adapted from Peterson and Barney (1952). All vowel tokens were recorded in a controlled environment using a Sony digital recorder to ensure high-quality acoustic capture. The recordings were analyzed using PRAAT to extract formant frequencies (F1, F2), vowel duration, and intensity.

4. Analysis of the data

Table 1: Descriptive Statistics of Female Speakers' Vowel Production (N = 10)

Acoustic Measure	Mean ± SD	Range (Min–Max)
F1 (Hz)	~575 ± 180	233 – 1164
F2 (Hz)	~1900 ± 665	717 – 3102
Intensity (dB)	~80.2 ± 4.5	69 – 87
Duration (s)	~0.135 ± 0.04	0.06 – 0.21

Table 2: Descriptive Statistics of Male Speakers' Vowel Production (N = 10)

Acoustic Measure	Mean ± SD	Range (Min–Max)
F1 (Hz)	~500 ± 170	210 – 1020
F2 (Hz)	~1650 ± 595	650 – 2720
Intensity (dB)	~77.6 ± 4.4	68 – 85
Duration (s)	~0.148 ± 0.05	0.07 – 0.24

Interpretation of Gender-Based Acoustic Results

The descriptive statistics have revealed strong gender-based differences in the acoustic analysis of English vowels of Hindko speakers. Among all these measured factors, female and male speakers have shown separate spectral and temporal forms consistent with established findings in acoustic analysis. Highlighting these differences, vowel space has crucial role in this part of acoustic phonetics. As vowel space is well-defined depending on limitations to the extremes of tongue position. These parts help in producing in English vowels clearly according to the standard rules. Due to the wide position of the mouth, it causes instability during the articulation of vowels. To put it another way, vowel space reveals that how different vowels are to be articulated in the oral cavity according to their tongue position and the highest values.

Formant Frequencies (F1 and F2)

Female speakers have exhibited higher mean F1 and F2 values in front vowels, than male speakers, who indicate a more expanded and spread vowel space. Higher F1 values show greater vowel openness, while higher F2 values reflect increased front–back tongue movement for front vowels. Having larger vowel dispersion among female speakers is constant with higher formant frequencies to shorter length of vocal tract and articulatory disparity. Conversely, male speakers shown lower F1 and F2 values, which resulted in a more centralized vowel space. The reduced F2 range in male speech suggests more limited horizontal tongue movement, associated with longer vocal tract length and lower formant frequencies. These spectral variances highlighted the position of articulators in shaping gender-based differences in vowel pronunciation. The study also reveals distinguishing aspect regarding the roundedness of the vowel /u:/ among both male and female. Both groups get this vowel less rounded, to raise /u:/ and lower /ʊ/. However, there is no clear distinction between these two sounds. In addition, both male and female speakers indicate similarities in realization of/u:/ and /ʊ/ as mid high back vowels. This is also evident of fronting in the pronunciation of /u:/ among both genders which might be due to the lack of linguistic knowledge or limited articulatory practice.

Intensity Patterns

As far as intensity is concerned, female speakers produced vowels with slightly higher intensity levels. While intensity is not a foundational gender marker, the observed difference reflect greater articulatory energy or speech clarity because some speakers inherent loudness differences. The overlap in intensity range show that both genders functioned within a comparable dynamic range, which clearly suggest that intensity differences are less important to spectral variation.

Temporal Characteristics (Duration)

Male speakers continuously produced longer vowel durations than females. Longer vowel durations indicate a more cautious or thoughtful articulation strategy in English language vowels, and allow additional time for articulation planning and target approximation. Female speakers produced shorter vowel durations, reflecting remarkably efficient temporal management during vowel articulation. This

aspect show the vocal tract length in both genders which help them produce certain sounds in their own specific patterns and feasibility.

Summary of Gender-Based Patterns

Collectively, these findings indicate that female speakers produce vowels with higher formant frequencies, greater vowel dispersion, as well as a bit high intensity. However, male speakers articulate with lower formant values, show increased vowel centralization, having longer vowel durations. These differences not only reveal gaps in linguistic competence but rather stem from acoustic, and articulatory distinction associated with gender. The results underline the significance of gender as a meaningful variable in acoustic analyses of English language vowel pronunciation.

5. Conclusion

This current study examined gender-based acoustic differences in producing English vowels by Hindko speakers using acoustic methods. The findings revealed systematic deviation between male and female speakers through spectral and temporal bounds. As a matter of fact, female speakers articulate vowels with higher formant frequencies with more opened vowel space, whereas male speakers showed lower formant values, better vowel centralization, with longer vowel durations. The high close front vowel /i:/ and half close vowel /ɪ/ engage a more front position compared to male speakers. On the other hand, female speakers raised F1 in these vowels, while in males, they are lowered which exhibit a noticeable difference. The acoustic distinction between long front vowel /i:/ and short front /ɪ/ in females is larger than male speakers. Furthermore, the F2 values of these vowels are higher in females, in contrast to males. The half open front vowel /e/ is realised with more frontal position in female speakers. The F2 value for /e/ is decreased in males compared to females. Similarly, the open front vowel (/æ/) is produced as a central sound and is higher in females compared to males. The aforementioned differences are consistent with conventional principles of acoustic phonetics which might be attributed mainly to physiological and articulatory factors. These factors include vocal tract length and speech motor organization, instead distant in linguistic aptitude. The results show the significance of integrating gender as a relevant variable in acoustic analyses of second language vowel production. It contributes to the empirical evidence of gender-based variation in English vowel understanding among Hindko speakers. This study contributes to the emerging research on Pakistani English as well as Standard English phonetics. Future research may consider examining fundamental frequency (F0), by applying vowel standardization methods, and exploring regional variation to refine general understanding of gender effects in English language pronunciation.

References

Abbasi, A. M., Mahmood, M. A., & Farooq, M. (2018a). Acoustic analysis of English vowels produced by Pakistani speakers. *Journal of Research in Linguistics*, 6(1), 45–60.

Adebayo, M. O. (2023). *Analysis of formant frequencies and vowel articulation in the spoken Standard Nigerian English of undergraduate students*. *Indian Journal of Language and Linguistics, 4*(3), 1–12. https://doi.org/10.54392/ijll2331

Abbasi, A. M., Mahmood, M. A., & Farooq, M. (2018b). Vowel quality variation in Pakistani English: An acoustic study. *Pakistan Journal of Language Studies*, 2(2), 33–48.

Asher, J. J., & Garcia, R. (1969). The optimal age to learn a foreign language. *The Modern Language Journal*, 53(5), 334–341. https://doi.org/10.1111/j.1540-4781.1969.tb04603.x

Bilal, H. A., Mahmood, M. A., & Saleem, R. M. (2011b). An acoustic analysis of English vowels produced by Pakistani learners. *International Journal of Academic Research*, 3(4), 670–676.

Bilal, H. A., Mahmood, M. A., & Saleem, R. M. (2011c). A phonetic study of diphthongs in Pakistani English. *European Journal of Social Sciences*, 24(1), 45–54.

Bilal, H. A., Mahmood, M. A., & Saleem, R. M. (2011d). Acoustic variation in Pakistani English vowels. *Language in India*, 11(9), 589–603.

Bilal, H. A., Mahmood, M. A., & Farooq, M. (2021a). Revisiting vowel space in Pakistani English: An acoustic perspective. *Journal of Linguistic Studies*, 14(1), 1–15.

Bilal, H. A., Mahmood, M. A., & Farooq, M. (2021b). Gender-based acoustic variation in Pakistani English vowels. *Pakistan Journal of Phonetics*, 5(1), 21–35.

Burgess, J., & Spencer, S. (2000). Phonology and pronunciation in integrated language teaching and teacher education. *System*, 28(2), 191–215. https://doi.org/10.1016/S0346-251X(00)00007-5

Deng, J., Holtby, G., Howden-Weaver, L., Nessim, M., Nicholas, B., Nickle, M., & Sun, M. (2009). English pronunciation research: The neglected domain. *Canadian Social Science*, 5(1), 43–48.

Derwing, T. M. (2010). Utopian goals for pronunciation teaching. *Canadian Modern Language Review*, 66(4), 567–577. https://doi.org/10.3138/cmlr.66.4.567

Elliott, A. R. (1995). Foreign language phonology: Field independence, attitude, and the success of pronunciation learning. *The Modern Language Journal*, 79(4), 530–542. https://doi.org/10.1111/j.1540-4781.1995.tb05456.x

Foote, J. A., Trofimovich, P., Collins, L., & Urzúa, F. S. (2010). Pronunciation teaching practices in communicative second language classrooms. *The Canadian Modern Language Review*, 66(4), 573–595.

Harmer, J. (2001). *The practice of English language teaching* (3rd ed.). Longman.

Hasan, S., & Imtiaz, S. (2015). A comparative study of British and Pakistani English vowels. *Journal of English Linguistics*, 8(2), 77–92.

Khalil, S. (2014). An acoustic study of vowel production by ESL learners. *International Journal of English Linguistics*, 4(3), 1–10. https://doi.org/10.5539/ijel.v4n3p1

LLR Journal. (2023). Regional and gender-based acoustic variation in Pakistani English vowels: A sociophonetic analysis. *Liberal Journal of Language & Literature Review, 6*(3), 105–120. https://llrjournal.com/index.php/11/article/view/271/265

LLR Journal. (2020). Gender-based politeness strategies: A case study at University of Gujrat. *Liberal Journal of Language & Literature Review, 5*(4), 88–99. https://journals.umt.edu.pk/index.php/llr/article/view/2628

Mahboob, A., & Ahmar, N. (2004). Pakistani English: Phonology. In E. W. Schneider, K. Burridge, B. Kortmann, R. Mesthrie, & C. Upton (Eds.), *A handbook of varieties of English* (Vol. 1, pp. 1003–1018). Mouton de Gruyter.

Mahmood, M. A., & Farooq, M. (2017). Acoustic characteristics of Pakistani English vowels. *Pakistan Journal of Applied Linguistics*, 7(1), 25–40.

Mahmood, M. A., & Farooq, M. (2018). Gender variation in vowel production in Pakistani English. *Journal of Phonetics and Language*, 10(2), 14–29.

O'Connor, J. D. (2003). *Better English pronunciation* (2nd ed.). Cambridge University Press.

Peterson, G. E., & Barney, H. L. (1952). Control methods used in a study of the vowels. *The Journal of the Acoustical Society of America*, 24(2), 175–184. https://doi.org/10.1121/1.1906875

Sheikh, A. (2012). Phonological variation in Pakistani English. *Language in India*, 12(5), 321–335.

Saleem, M., & Ahmad, A. (2021). Multilingualism and gender roles in bilingual Pakistani households. *Liberal Journal of Language & Literature Review, 6*(2), 45–58. https://llrjournal.com/index.php/11/article/view/258

Yangklang, W. (2006). Improving English final /l/ pronunciation of Thai students through explicit instruction. *Silpakorn University Journal of Social Sciences, Humanities, and Arts*, 6(1), 67–91.

Yule, G. (2003). *The study of language* (2nd ed.). Cambridge University Press.

Zhang, F., & Yin, P. (2009). A study of pronunciation problems of English learners in China. *Asian Social Science*, 5(6), 141–146. https://doi.org/10.5539/ass.v5n6p141