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An Acoustic Analysis of consonants of Khattak Dialect of Pashto

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Abstract

A R T I C L E I N F O

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Pashto, an ancient language written in Perso-Arabic script, is predominantly spoken in Pakistan's Khyber Pakhtunkhwa Province and Afghanistan. Despite its wide usage, more research is needed on the consonantal sounds of the Khattak dialect. This study aims to fill this gap by providing a detailed acoustic analysis of the Khattak dialect's consonants. An inventory of 28 consonant phonemes was developed using the standard Pashto IPA chart and the Yusufzai dialect chart. Minimal pairs were created and recorded using an Android phone and an iPhone, involving two native speakers, one male and one female, both BS students. The recordings were converted into .wav files, and acoustic analysis was performed using PRAAT software, focusing on formants and waveforms. The findings offer comprehensive insights into the phonetic characteristics of the Khattak dialect, contributing to a broader understanding of Pashto phonology and addressing a significant gap in the literature on Pashto dialectology. This research not only provides a foundational inventory for future studies but also enhances the comparative linguistic analysis of Pashto dialects. It underscores the unique phonetic features of the Khattak dialect, facilitating its preservation and further linguistic exploration. The study's methodology, involving high-quality recordings and native speakers, ensures the reliability and authenticity of the data, providing a valuable reference for linguistic research and applications in speech technology.

INTRODUCTION

Pashto in Pakistan is spoken in Khyber Pakhtunkhwa Province, including Swat and Kaghan valley. Pashto is also spoken in the eastern and southern regions of Afghanistan, where it is the national language. Pashto is spoken by 9,585,000 speakers in Pakistan which is 8.47% of the total population according to the 1993 census estimation; 100,000 people speak Pashto in the United Arab Emirates as recorded in the 1986 census; and 14,161 Pashto native speakers reside in India, noted in 1994 census. All Pashto speakers in Pakistan were estimated at 13.2% of the total population, according to the 1981 Census. Pashto has many regional dialects in Pakistan, such as Kohati, and

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Khattak dialects. Yusufzai dialect is also known as Peshawari; Afridi; Mohmandi; Shinwari; and Shilmani. The major dialect of Khattaks, also known as Kohati and Kandahari, is considered a soft dialect. The Yusufzai one is known as a hard dialect or the literary dialect, mostly practiced in schools and media in Khyber Pakhtunkhwa and its adjacent tribal regions in Pakistan (Baart, 2001).

Pashto is an ancient language, and its script is written in Perso-Arabic. Pashto vocabulary contains words mostly borrowed from Ossete, Sanskrit, Hindi, Persian, Urdu, and some other regional and local languages of Pakistan. It has also absorbed words from Indo-Aryan languages. Pashto Language is regarded to be in close similarity with Persian language but there exists certain contradictory features in Pashto Language that do not exist in Persian. For example, in Pashto, there are some consonants and vowels which are not present in Persian such as retroflex oral stops, retroflex flap, retroflex nasal and retroflex fricatives. Moreover, in the Persian language, gender and noun cases are not found. Nouns are there only for categories of definiteness and number but in Pashto language it does exist. Stress and intonation patterns are also different between Persian and Pashto. In Pashto, the strong stress is placed not on the last syllable like in Persian but can vary in different syllables. This liberty plays a significant grammatical function in Pashto and is practiced in giving different meanings to similar words.

Despite the diversity of Pashto dialects, there has been limited research on the consonantal sounds, especially concerning the Khattak dialect. Notably, no major work has been done on the consonants of the Khattak dialect, and even the consonant inventory is not readily available. In this study, I have created an inventory of 26 consonant phonemes using the standard Pashto IPA chart and the Yusufzai dialect chart. This study primarily focuses on the Khattak dialect, aiming to fill this research gap by providing a detailed analysis of its consonantal sounds.

To achieve this, I developed minimal pairs and recorded the sounds using two devices: an Android phone and an iPhone. The recordings were made with two participants, a male and a female, both BS students and native speakers of the Khattak dialect. The recorded words were converted into .wav files, and acoustic analysis was conducted using the software PRAAT. This analysis focused on examining the formants and waveforms of each sound, providing a comprehensive understanding of the phonetic characteristics of the Khattak dialect's consonants.

By undertaking this study, we aim to contribute to the broader understanding of Pashto phonology and provide valuable insights into the specific features of the Khattak dialect, thus addressing a significant gap in the existing literature on Pashto dialectology.

LITERATURE REVIEW

Phonetics is the study of the origin of speech sounds, while phonology deals with how speech sounds in a language differentiate meaningful parts like words and how they are shaped. Phonology considers meaning, while phonetics does not (Delahunty, 2010). Phonetics studies the sounds in different languages, often using the International Phonetic Alphabet (IPA) to represent them. Phonology is the study of sounds used by speakers of a specific language. A phoneme is a sound that makes a difference in a language regarding meaning. Languages use different sets of phonemes for communication (Freeman, 2004).

English has 44 phonemes, including 24 consonants and 20 vowel sounds. Consonants are produced with a certain obstruction or hindrance, with airflow released after such obstruction by articulators (Syed et al., 2017).

Pashto is the mother language of the Pashtun people in Afghanistan and northwestern Pakistan. It is a split-ergative language, allowing the expression of all types of ideas and opinions. Pashto is the official and national language of Afghanistan, used in communication and education. There are about fifty million Pashto speakers globally. Pashto has a phonological system, with 27 consonants and 9 vowel sounds in the Yousafzai dialect (Shahabullah et al., 2022).

In the Pashtun-based province of Pakistan, Pashto is taught in educational institutions from first grade to grade 12, mostly in government-based institutions (Farooq, 2004). A study on Sindhi speakers revealed a lack of clear contrast between English vowel pairs in terms of vowel quality (Hussain et al., 2022).

The phonetic analysis involves drawing frequencies of phonemes using tools like PRAAT, which mathematically analyzes sounds in different frequencies, recording and analyzing their pitch, intensity, formants, and duration. Every vowel sound has a pattern of 2 or 3 prominent frequencies called formants (Fasold, 2013).

In a research study, Sharma (2019) defined and classified 20 vowel sounds in English into monophthongs and diphthongs. Monophthongs are single vowels with no noticeable change in vowel quality. Diphthongs are sounds made by gliding from one vowel sound to another. Mother language influences learning a target language. Pashto being the mother language (L1) of the target students influences their pronunciation of English vowel sounds (Rannah, 2021).

Psychological factors like age, personality, attitude, culture, learning goals, and motivation influence language learning to a great extent (Masgoret & Gardner, 2003). Behavioral analysis of individuals on their learning performance, analyzing cognitive styles among Pakistani ESL learners, suggests focused activities and drills should be used to enhance knowledge of the English language (Tariq et al., 2023).

Sayed Kazem Shahedkhel's work provides insights into the phonetics of Pashto, examining its connections to the broader Indo-European language family. This study underscores the foundational role of phonetics in linguistics, linking it to grammar, morphology, and phonology (Shahedkhel, 2019).

Hussain (2018) examined the voicing contrast of initial stops in Pashto, with Voice Onset Time (VOT) as the primary acoustic cue for voicing contrast across all places of articulation. Syed (2013) provides additional information on the VOT of initial voiceless stops in Pashto, with voiceless stops exhibiting short lag VOT.

Voicing cues of final stops in other languages vary, with some studies highlighting the vowel length of the preceding vowel as the main voicing cue, while others emphasize closure duration, voicing during closure, and burst release. Berkovits (1993) showed that final stops in Hebrew had longer closure durations than their non-final counterparts, suggesting that closure duration might be significant in the word-final position.

Habib and Asd (2016) investigated the acoustic properties (VOT, closing duration, word duration) of Pashto plosives in the Yousaf Zai dialect spoken by L1 speakers. The study recorded plosives (bilabial, dental, retroflex, velar, uvular) from five Pashto speakers in an academic context. Results indicated that the velar plosive /k/ had the longest VOT, while the bilabial plosive had the shortest. In terms of closure duration, the bilabial /p/ had the longest duration, while the dental voiced /ḍ/ had the shortest. Interestingly, unlike English stops, the VOT did not increase with further back articulation; the VOT of the bilabial stop was longer than that of the retroflex. These findings contribute to our understanding of Pashto phonetics and the differences from English stops.

The phonetic inventory of Pashto varies across dialects, with the Khattak dialect exhibiting a diverse range of consonantal sounds. Phonetic analysis techniques, including spectrographic analysis, can be applied to examine the detailed phonetic properties of consonants in the Khattak dialect (Saeed, Saleem, Khan, & Kakar, n.d.).

The study of Bux et.al (2024) explores the challenges faced by Pashto ESL learners in articulating nine specific English consonants, focusing on the Khilji, Khattak, and Afridi dialects of Pashto. The study aims to identify the most problematic sounds for these speakers and to provide learnable solutions. Unlike previous studies that typically examined around six troublesome consonants, this study targets nine consonantal sounds to offer a more comprehensive analysis.

The primary objective is to understand why speakers of these Pashto dialects struggle with certain English consonants by examining the phonetic and phonological differences between Pashto and English. The study is designed based on the Contrastive Analysis Theory formulated by Lado (1967). The selected consonants for this study include the voiceless labio-dental fricative /f/, the voiced labio-dental fricative /v/, the voiceless dental fricative /θ/, the voiced dental fricative /ð/, the voiced postalveolar fricative /ʒ/, the voiceless velar stop /k/, the voiceless alveolar ridge stop /t/, the voiced labio-velar approximant /w/, and the voiced alveolar stop /d/. Utilizing purposive sampling, six participants from colleges and universities in Karachi, representing three different Pashto dialects, were selected to record speech stimuli following study protocols. The results reveal that Pashto ESL learners find the voiceless labio-dental fricative /f/, voiceless velar stop /k/, voiceless alveolar ridge stop /t/, and voiced alveolar stop /d/ less challenging to articulate. Conversely, the most problematic sounds were the voiced and voiceless interdental fricatives /θ/ and /ð/, voiced labio-dental fricative /v/, voiced alveor-palatal fricative /ʒ/, and voiced labio-velar approximant /w/. The findings indicate that the differences in sound systems between Pashto and English, as well as the absence of certain sounds in Pashto, contribute to the articulation difficulties faced by Pashto native speakers. Interestingly, these results diverge from previous studies, suggesting that articulation variations are influenced by dialectal features. This highlights the need for a dialect-specific approach when addressing pronunciation issues in ESL learners from diverse linguistic backgrounds.

The Pashto language, spoken in Afghanistan and Pakistan, comprises numerous dialects. Previous studies suggest there are a maximum of five dialectal groups (Dvgryankov, 2017). Geographical and political factors, coupled with the absence of a comprehensive study, have resulted in divided orthography and a lack of a unified literary and standard dialect (Dinakhel, 2017). This paper focuses on the classification, differences, and literary and social status of the Kandahari and Yusufzai dialects, analyzed primarily on phonological bases (Boberg, Nerbonne, & Watt, 2018).

Existing studies, such as those by N.A. Dvgryankov and George A. Grierson, have classified Pashto dialects based on phonological features. The main phonological differences include: The preservation of the phonemes š and ž in southern and western dialects, and their development into x and g in north-eastern dialects (Dvgryankov, 2017). Vowel shifts in east-central dialects (Grierson, 1921). Assimilation of dental affricates c and j into s and z in northeastern dialects (Boberg, Nerbonne, & Watt, 2018). Phenomena like assimilation, dissimilation, metathesis, and palatalization (Boberg, Nerbonne, & Watt, 2018). There are two main groups of Pashto dialects: Eastern (Peshawar or Yusufzai) and Western (Kandahar). The classification is primarily based on the pronunciation of certain letters (Dvgryankov, 2017). For example, the north-east dialect pronounces ښ as ḵẖ and ږ as g, while the south-west dialect pronounces them as šh and žh (Grierson, 1921).

Dialectal differences are influenced by social, economic, and cultural divisions, which also affect mutual intelligibility. Some linguists have categorized Pashto dialects into two main groups (Eastern and Western) based on hard and soft dialect distinctions (Boberg, Nerbonne, & Watt, 2018). The Eastern dialect, centred in Peshawar, and the Western dialect, centred in Kandahar, have notable pronunciation differences, particularly in the letters ښ and ږ (Grierson, 1921).

Shahabullah (2022) conducted a descriptive study on the voice onset time (VOT) duration for Pashto stops in the Yousafzai dialect and their impact on subsequent vowel length. The study involved recordings of stops, including bilabials, dental, retroflex, velar, and uvular, from five Pashto speakers aged 18-30, selected through convenient sampling. The results indicated that retroflex /ʈ/ had the shortest VOT duration of 0.015 ms, while dental /d̪/ had the longest VOT duration of -0.127 ms. Additionally, the study found that vowel sounds were shorter after voiceless stops but longer after voiced stops. These findings contribute to our understanding of Pashto phonetics and may be valuable for language learners and researchers interested in Pashto phonology.

This study pioneers the acoustic analysis of Khattak consonant phonemes using PRAAT software, addressing gaps in linguistic research by developing a comprehensive Khattak consonant inventory aligned with the IPA chart. It enriches Pashto linguistics by providing foundational insights for phonetics, language preservation, and speech technology, while enabling comparative analyses with other dialects and languages.

This study focused on a select set of sounds within the Khattak dialect of Pashto, leaving out sounds in loanwords and not providing a comprehensive analysis of all possible phonetic variations. The analysis was limited to sounds in the onset position and one in the coda position, restricting our understanding of how these sounds behave in different phonetic contexts. Additionally, while frequency and intensity were key focuses, other acoustic features like formant transitions, duration, and spectral tilt were not extensively examined, potentially omitting significant details that could differentiate Khattak sounds from those in standard Pashto or other dialects

METHODOLOGY

This study employed a structured methodology to conduct a comprehensive acoustic analysis of Khattak consonant phonemes. Minimal pairs of consonants were created to clearly distinguish between different phonetic sounds, ensuring a diverse representation of consonant phonemes in the Khattak dialect. These minimal pairs were carefully selected to accurately reflect the dialect's phonetic features.

For the acoustic analysis, PRAAT software was utilized due to its recognition and capabilities in phonetic research. The software enabled detailed examination of the consonant phonemes' acoustic properties, providing in-depth insights into their frequency, duration, and formant structure. This ensured that the study was based on high-quality, authentic data.

1. Data Collection Technique

Data was collected through recordings of words containing minimal pairs, made using two devices: an iPhone 11 Pro and a Mi 10T Android phone. This dual-device approach ensured audio quality and reliability. Recordings were conducted in a controlled, quiet environment to minimize background noise, enhancing clarity. Two native Khattak speakers, one male and one female, both pursuing bachelor's degrees in the English department, participated in the recording process. Their native proficiency in the dialect was vital for the authenticity and accuracy of the data.

2. Data Analysis Technique

The acoustic data collected from the recordings were analyzed using PRAAT's advanced phonetic analysis tools. The primary analysis technique involved the extraction of key acoustic parameters such as formant frequencies, pitch, duration, and intensity. These parameters were measured for each consonant phoneme in the minimal pairs. The data was then compared across phonemes to identify distinguishing acoustic features. Statistical techniques were applied to determine the significance of variations in these features, allowing for a detailed understanding of the Khattak consonant phonemes. The analysis also included a comparison with standard IPA symbols to assess the alignment of Khattak sounds with the broader phonetic inventory.

FINDINGS AND DISCUSSIONS

FINDINGS

The Khattak dialect phoneme inventory includes various consonant sounds, as shown in the table 1. below. These consonants are represented in words, along with their corresponding gloss for clarity. Each consonant is illustrated through a specific word example, such as /p/ in "pora" (leaf) and /b/ in "bel" (next). This inventory offers a foundation for understanding the phonetic and phonological characteristics of the Khattak dialect, which can be useful for comparative linguistic studies and further acoustic analysis. By exploring these consonants, this study contributes to the broader understanding of the Khattak dialect within Pashto linguistics, highlighting its unique features.

Table 1. Khattak inventory phonemes

Consonants	words	Gloss
/p/	pora	leaf
/b/	bel	Next
/m/	mor	Mom
/w/	waar	Door
/t/	Taral	Tie
/d/	daam	Breathe
/n/	na	No
/ɣ/	ghaer	Greasy
/ʈ/	taak	Bite
/ɖ/	daak	Full
/k/	koor	House
/g/	garal	Count
/ʃ/	shal	Twenty
/ʒ/	ghaez	Ear
/s/	saar	Head
/z/	zoor	Strength
/x/	xaar	stupid
/tʃ /	Chaar	Work
/ʤ/	Jaam	Glass
/ɬ/	loor	Tool
/ʎ/	yel	speak
/h/	haer	Forget
/l/	loor	Daughter

Table 1 presents the phoneme inventory of the Khattak dialect, listing a range of consonants found in the language, along with corresponding words and their gloss (English translations). Below is an explanation of these data:

1. **Consonant Sounds**: The table includes 24 distinct consonant sounds, represented by symbols from the International Phonetic Alphabet (IPA), such as /p/, /b/, /m/, and so on. These sounds are essential components of the Khattak dialect's phonological system.
2. **Words**: Each consonant sound is exemplified by a word from the Khattak dialect. For instance, the sound /p/ is represented by the word "pora" (leaf), and the sound /b/ by the word "bel" (next). These word examples provide context for the use of each consonant in the dialect.
3. **Gloss**: The glosses (translations) offer the meaning of each Khattak word in English. This helps in understanding the specific words in which these consonants appear, such as /m/ in "mor" (mom) and /s/ in "saar" (head).
4. **Diversity of Consonants**: The table includes a variety of consonant types, from stops like /p/ and /t/ to fricatives like /ʃ/ and /ʒ/. There are also examples of affricates, such as /tʃ/ (ch), and liquids

like /l/ and /ʎ/. This diversity highlights the range of consonantal sounds that make up the phonemic inventory of the Khattak dialect.

5. **Phonetic Features**: The inventory includes sounds that are characteristic of Pashto and its regional dialects, such as the retroflex /ɽ/ (as in "ghaer," greasy), which is a distinctive feature of many South Asian languages.

In summary, this table provides a detailed inventory of consonants used in the Khattak dialect, offering valuable insight into its phonetic and phonological structure, which can aid in comparative studies and further linguistic research.

DISCUSSIONS

Data Analysis

Here is the analysis of the consonant phonemes which were analyzed through PRAAT software.

/bəl/ vs /ʃəl/ vs /ʎəl/

/b/ is voiced bilabial stop/ plosive in Pashto Khattak dialect. The waveform on the spectrogram shows the sudden release of air to produce sound. However, the amplitude wavelength of the same word i-e /bəl/ is different when produced by females and males. Obvious differences could be seen in its spectrographs. Formants for the consonant's sounds are not kind of visible. The darkness at the bottom of the graph shows the voicing of the consonant phoneme. But we could tell from the graph that the intensity (green line) also varies in the same word due to gender difference, which also includes the variation in the pitch.

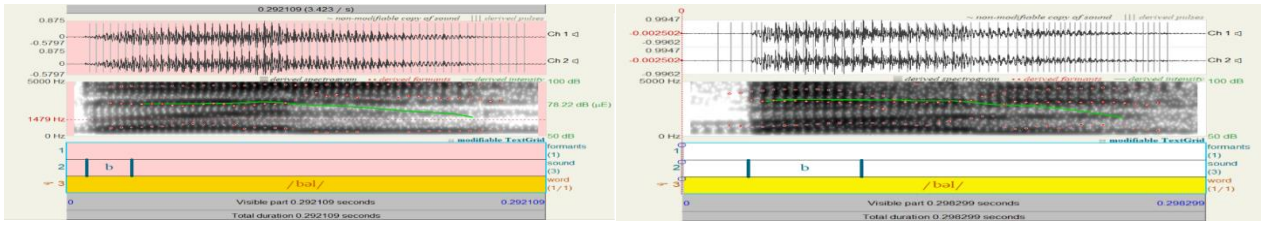


Figure 1.1

/ʃ/ is voiceless palatal fricatives of Pashto. During their production, the tongue touches the hard palate on either side while the tip of the tongue is flattened to let the air escape through the centre of the tongue. The amplitude of waveforms of female-produced sound i-e /ʃəl/ in spectrograph shows high wavelengths as compared to the male one. The empty spaces at the bottom of the spectrogram represent the absence of voicing in the consonant /ʃ/. /ʃ/has higher frequency than /b/.

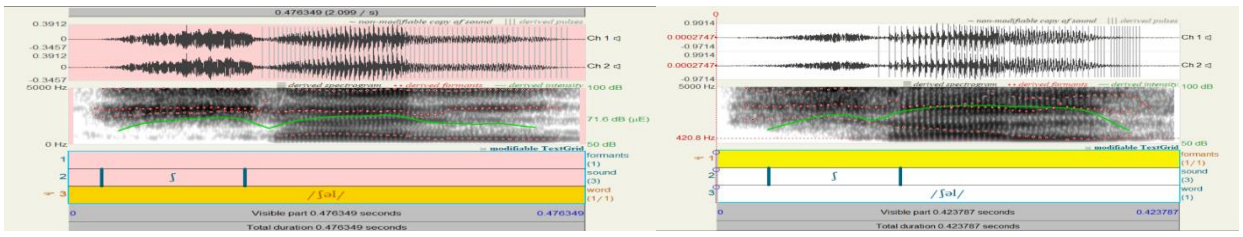


Figure 1.2

/ʎ/ Many phoneticians who have worked on Pashto language phonetics and phonology consider this phoneme to be alveolar or postalveolar approximant and prescribe the phonetic symbol /j/ to it as they consider it equivalent to the /j/ sound in English words like ‘yellow’ and ‘you’ etc. I consider it a palatal lateral approximant due to a reason. In IPA this is a type of consonantal sound used in some spoken languages and gives this sound the phonetic symbol of /ʎ/, a rotated lowercase letter /y/. There is no dedicated symbol in the International Phonetic Alphabet that represents the alveolo-palatal lateral approximant. Pashto phoneticians would prefer to use the symbol /ʎ/ for this phoneme of Pashto, that is why I have also used the same symbol. Sound in the word /ʎəl/ was recorded by both female and male participants. Waveforms of sound are quite similar in both graphs showing almost equal frequency. Formants are also not quite visible for the consonant /ʎ/ in both graphs. The darkness at the bottom of the sound in the spectrogram is lighter which shows no formants are being formed there. Hence the sound is voiceless.

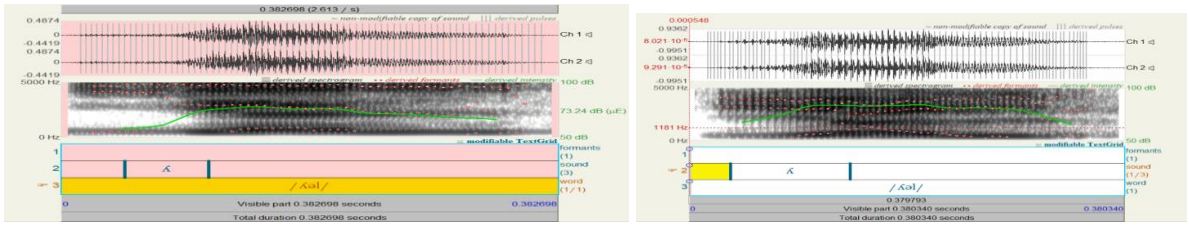


Figure 1.3

/bəl/, /ʃəl/, /ʎəl/ are minimal pairs. Onset sounds varied in all three words, making them different words with different meanings. The structure is CVC. The spectrogram also proves them to be different from each other with distinct sounds. The amplitude of the wavelength is different showing the different frequencies among the sounds of the words.

/pɔɽə/ vs /kɔɽə/

The /p/ sound is voiceless i.e. there is no vibration in the vocal cords when we pronounce it in isolation. A sudden burst of air produces it. However, in continuous speech, it might be voiced or voiceless depending upon the succeeding and preceding phonemes whether they are vowels or consonants and whether they are voiced or voiceless. For instance, in this case, the word /pɔɽə/ is a voiceless bilabial stop, since it is preceded by a vowel /ə/. However, the spectrogram shows the opposite nature of /p/. The area at the bottom is dark, also forming a formant. This is due to the air that might have been recorded while recording the sound. But if we analyze it as the spectrogram is showing it, /p/ is voiced in the word /pɔɽə/.

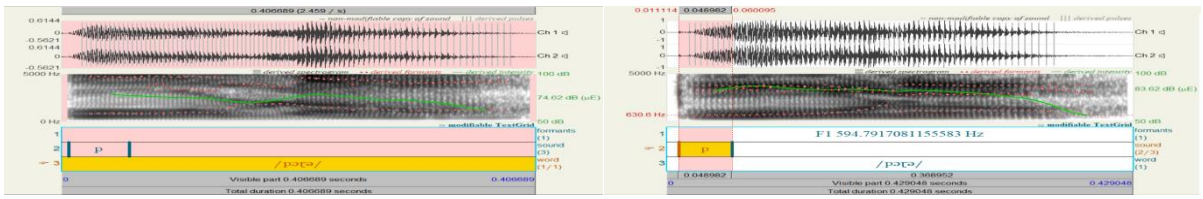


Figure 2.1

/k/ is a voiceless velar stop in the Pashto Khattak dialect. The spectrograph shows a waveform that is not formed with a sudden burst. It is produced with aspiration. However, the spectrogram shows its voice which might be due to the air interface while recording the word by participant. The spectrogram is darker at the bottom which shows the voicing of the consonant phoneme. The intensity of the word in the spectrograms also varies in both recordings because it was recorded by a female and a male. Both have the same articulators but still vary in function.

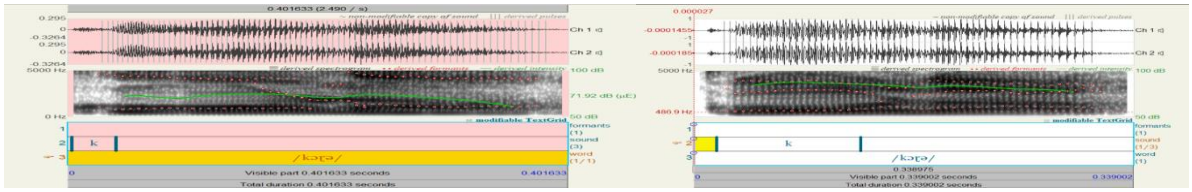


Figure 2.2

/p/ and /k/ make the words i-e /pɔʈə/ and /kɔʈə/ as minimal pairs. Their physical properties are distinguished through the spectrograms as in Fig 2.1 and 2.2 respectively.

/ʇəʈəl/ vs /gəʈəl/

/ʇ/ is voiceless, dental stop. It is a short and high-frequency sound as it can be seen in the spectrograph. There is no F1 but F2 and F3 could be observed from the spectrogram. The spectrogram is almost the same for the word articulated by female and male respectively as shown in Fig 3.3.

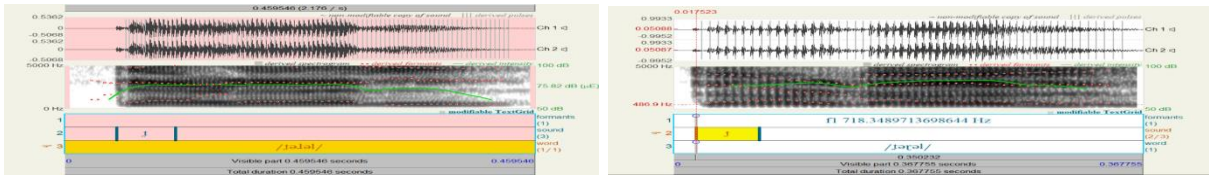


Figure 3.3

/g/ is voiced velar stop in Khattak dialect. The spectrogram of both female and male at the bottom shows darkness which proves the voicing of the sound. F1 is quite visible in both the spectrograms of females and males as shown in Fig. 3.4.

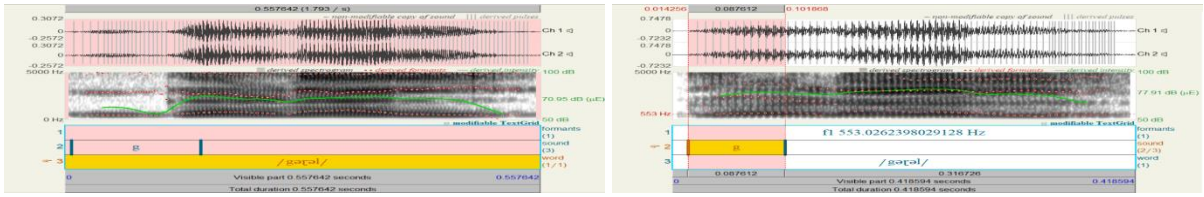


Figure 3.4

/ɖɑ:m/ vs /ʤɑ:m/

/ɖ/ is voiced dental plosive. Through the spectrogram of both females and male, we can observe that it is voiced, and waves have very low amplitude. The vertical spike represents the release burst. F1m, F2 and even F3 are also visible through formants in the spectrogram.

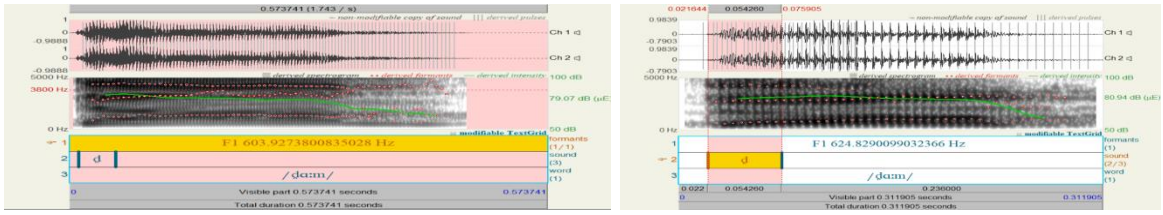


Figure 4.1

/ʤ/ is voiced alveolar affricate. The spectrogram of both female and male participants shows a vertical spike of the waveform indicating the release and a period of high frequency immediately after the burst. The voicing continues since it is followed by a vowel sound. Formants could also be observed from the spectrogram as in Fig 4.2.

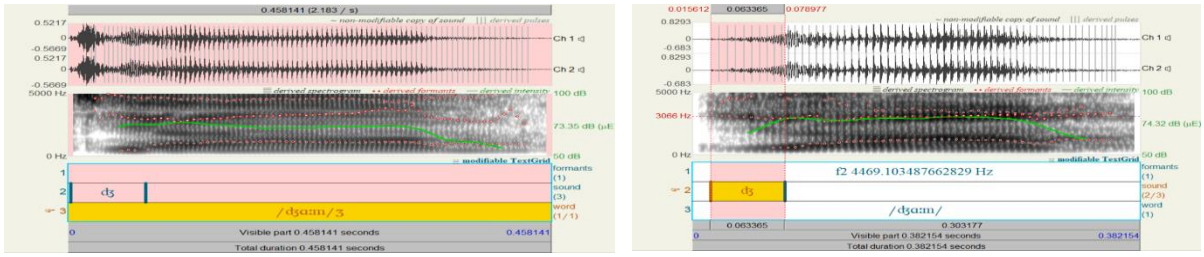


Figure 4.2

/tʃɑ:r/ vs /Xɑ:r/ vs /sɑ:r/ vs /wɑ:r/

/tʃ/ is voiceless alveolar affricate. This consonant sound has high-frequency noise following the burst. The bottom of the voicing bar is lighter in colour proving it is voiceless in both female and male spectrograms as in Fig 5.1. formants and not visible in both cases. The waveforms vary in female and male graphs.

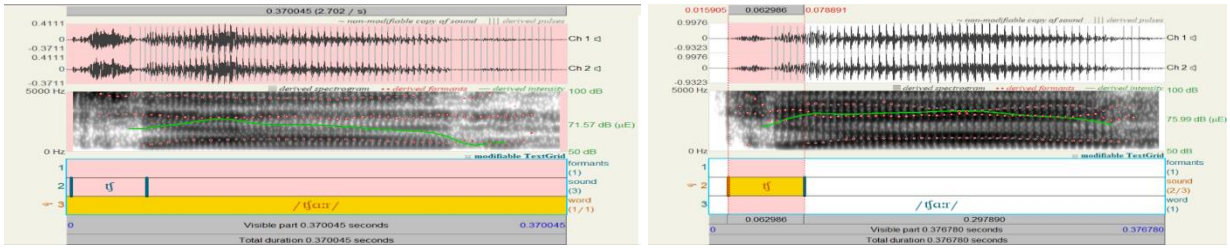


Figure 5.1

/X/ sound is a voiceless uvular fricative. The spectrogram shows a lower frequency as compared to /s/. the female spectrogram of sound shows fluctuated amplitude of the waveform as compared to the male spectrogram. As a native speaker of the dialect, I can assure you that the male has pronounced the sound correctly. The female recording might have air distortion which is making it voiced in the spectrogram.

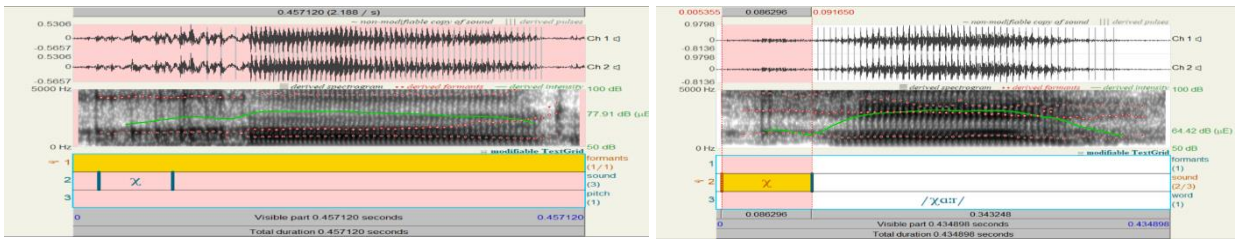


Figure 5.2

/s/ is a voiceless alveolar fricative. The pressure after the burst shows the fricative nature of the consonant. The voice is intense and sharp. The spectrogram at the bottom has space showing the absence of voicing and no visible formats.

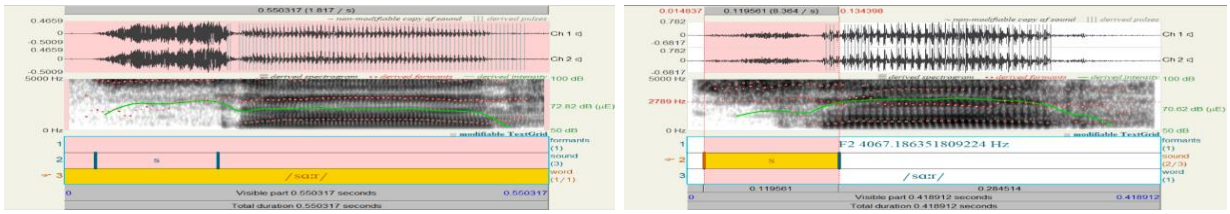


Figure 5.3

/w/ voiced labiovelar approximant. The voicing of the consonant is obvious from the spectrogram of both female and male spectrogram. The frequency of /w/ and /s/ varies by almost 100 Hz.

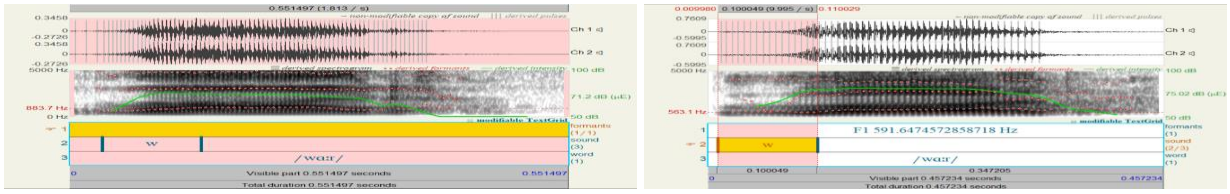


Figure 5.4

/hær/ vs /ţær/

Being a native speaker of the language, I know that this /h/ voiceless glottal fricative exists in the Khattak dialect. However female participants have pronounced it, unlike male participants who have pronounced the succeeding vowel of the word. The spectrogram of the female participants does not show any formant, hence confirming the absence of voicing in the word while the male participants' spectrogram shows the formation of f1 due to the influence of vowel phoneme. See fig 6.1

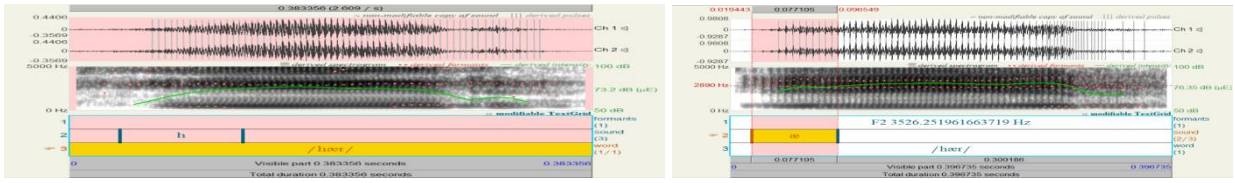
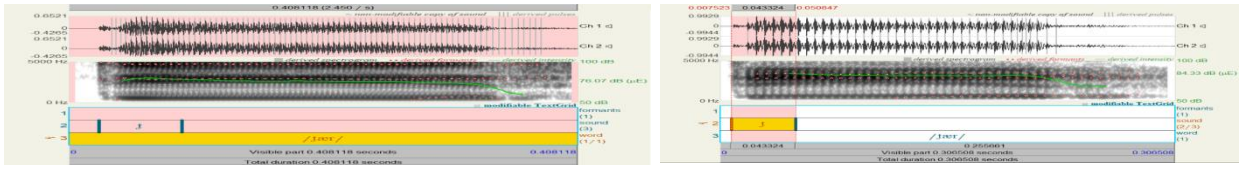


Figure 6.1

/ʈ/ is voiceless, dental stop. It is a short and high-frequency sound as it could be seen in the spectrograph. There is no F1 but F2 and F3 could be observed from the spectrogram. The spectrogram is almost the same for the words articulated by females and males respectively as shown in Fig. 6.2.



Both sounds /h/ and /ʈ/ exist in the Khattak dialect of Pashto.

Figure 6.2

/Xəɽ/ vs /ɭəɽ/

/X/ sound is a voiceless uvular fricative. The spectrogram shows a lower frequency as compared to /s/. the female spectrogram of sound shows fluctuated amplitude of the waveform as compared to the male spectrogram. As a native speaker of the dialect, I can assure you that the male has pronounced the sound correctly. The female recording might have air distortion which is making it voiced in the spectrogram. See fig 7.1

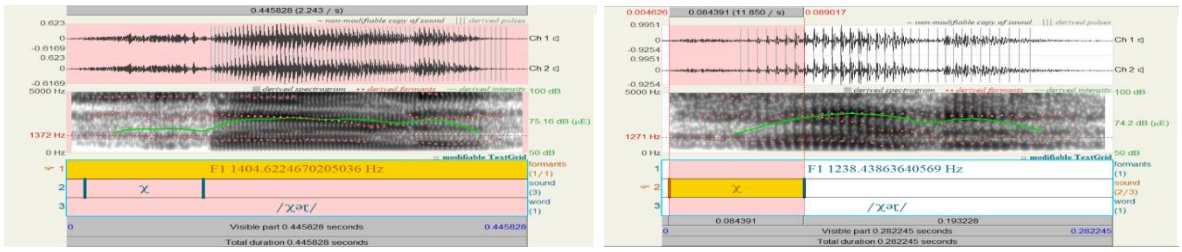


Figure 7.1

/ɭ/ voiced retroflex lateral approximant. The pressure in the waveform develops as the noise gets stronger. This could be observed through the waveforms of the swords in Fig 7.2. formants could also be observed through the spectrogram of the words.

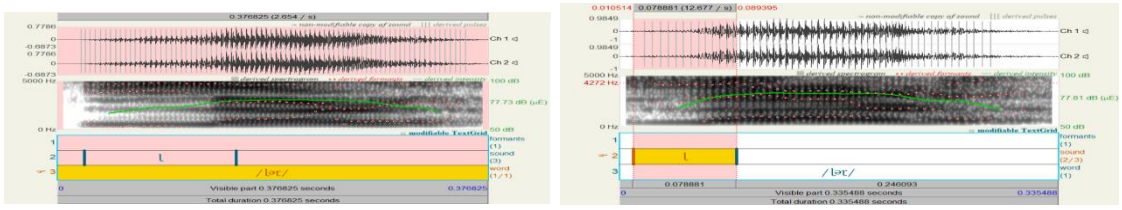


Figure 7.2

/mu:r/ vs /ku:r/ vs /zu:r/ vs /lu:r/

/m/ is voiced bilabial nasal. The bottom of the spectrogram is darker and shows formant formation clearly thus showing the presence

of voiceness in the consonant phoneme. The vibration is also quite obvious from the graphs. See Fig 8.1

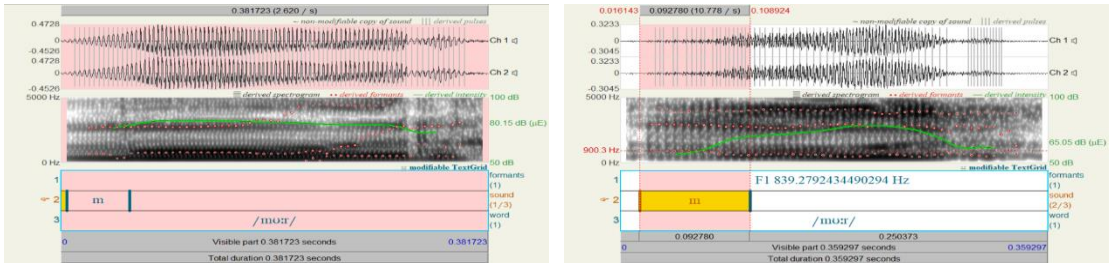


Figure 8.1

/k/ is a voiceless velar stop in Pashto Khattak dialect. The spectrograph shows a waveform that is not formed with a sudden burst. It is produced with aspiration. However, the spectrogram shows its voice which might be due to the air interface while recording the word by participant. The spectrogram is darker in the bottom which shows the voicing of the consonant phoneme. The intensity of the word in the spectrograms also varies in both the recording because it was recorded by a female and a male. Both have the same articulators but still vary in function. Observe Fig 8.2.

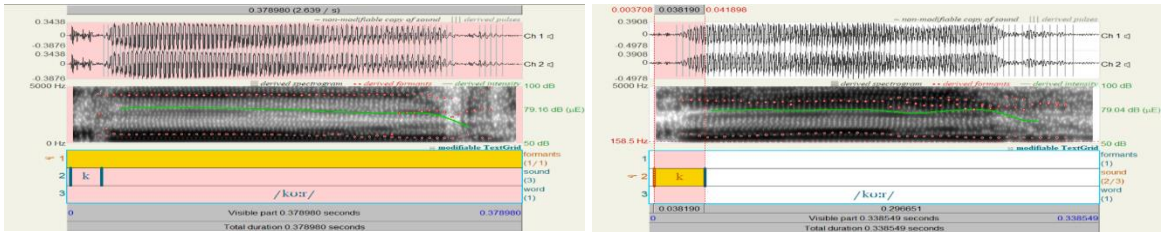


Figure 8.2

/l/ is voiced alveolar lateral approximant. The dark band in the spectrogram shows its voiced nature. F1, F2, and F3 are being formed. See fig 8.3

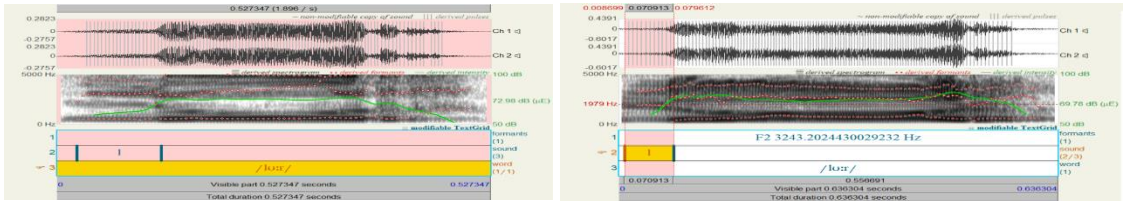


Figure 8.3

/z/ is voiced alveolar fricative. There are visible formants in the spectrogram of both female and male participants. It has a higher frequency as compared to nasal /m/. see fig 8.4

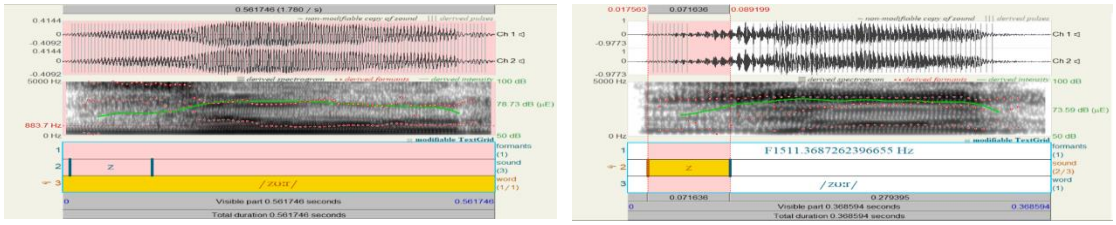


Figure 8.4

/ɣæʒ/ vs /ɣæɽ/

/ʒ/ is voiced post alveolar fricative. Due to the fricative nature of consonant /ʒ/ there is continuous noise signal indication friction in the waveform. The vocal cord vibration is visible in the voicing band of the spectrogram which is darker in the shade in the spectrogram.

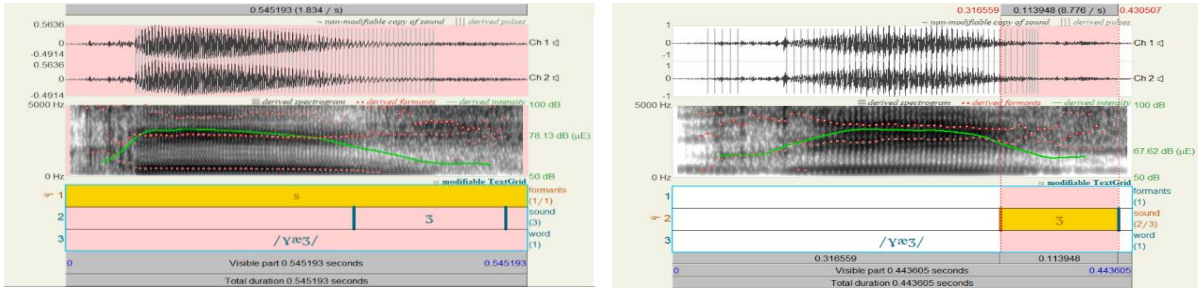


Figure 9.1

/ɽ/ retroflex flap is a voiced consonant, obvious from the dark voicing band in the spectrogram of both the female and male participants. It is also because it has a strong influence on voiced long vowel phonemes. See fig 9.2

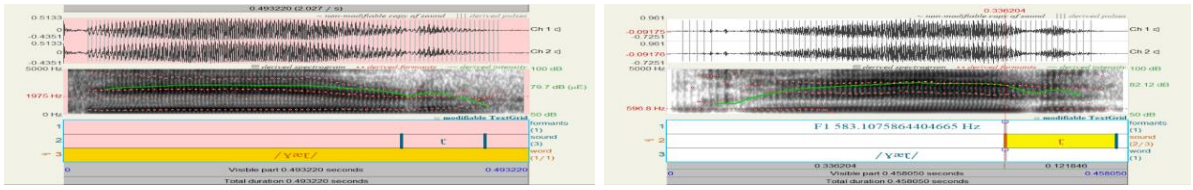


Figure 9.2

/mə/ vs /nə/

/m/ is voiced bilabial nasal. The bottom of the spectrogram is darker and shows formant formation clearly thus showing the presence of voiceless in the consonant phoneme. The vibration is also obvious from the graphs. See fig 10.1

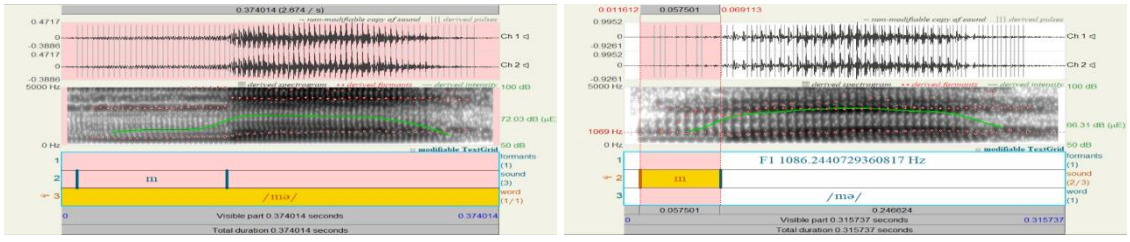


Figure 10.1

/n/ is voiced alveolar nasal. There is a visible voicing bar indication of vocal cord vibration. Both participants have pronounced it as shown in the spectrogram. See fig 10.2

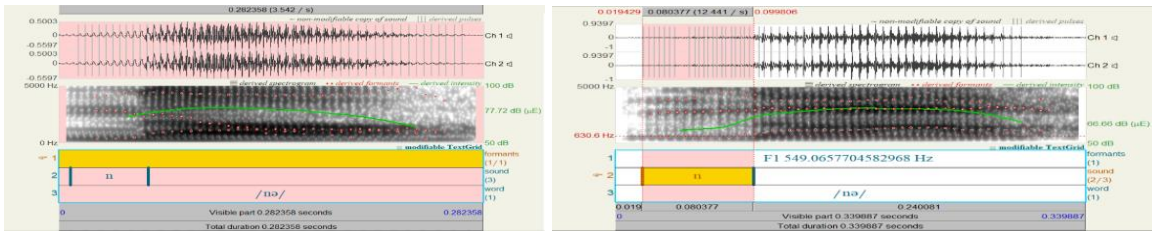


Figure 10.2

/ʈɑ:k/ vs /ɖɑ:k/

/ʈ/ is voiced retroflex stop. A sudden burst of releasing of sound due to aspiration could be analyzed in the waveform of the spectrogram. Frequencies coming up clearly on both participant's spectrograms.

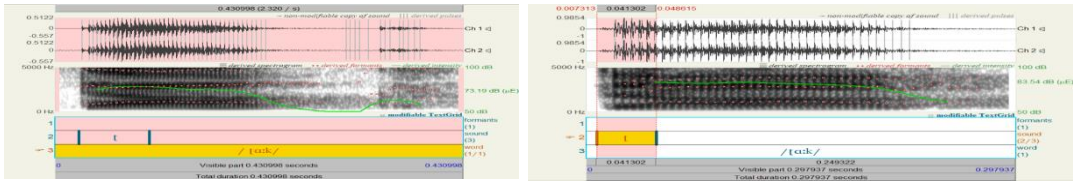


Figure 11.1

/ɖ/ is voiced retroflex stop. The voice bar is darker in shade hence showing the voicing of the consonant of the word on onset position. The vertical spike of the waveform represents the burst of phonemes. Formants are clear in the spectrogram. The consonant is followed by the long vowels increasingthe vibration and frequency of the sound.

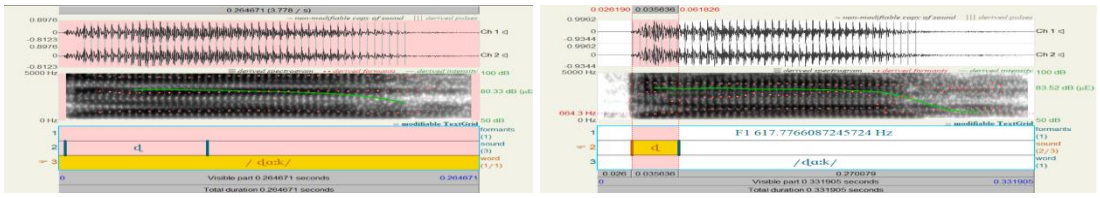


Figure 11.2

CONCLUSION

This study provides a detailed acoustic analysis of the consonantal sounds in the Khattak dialect of Pashto, addressing a significant gap in the existing literature. By developing an inventory of 28 consonant phonemes and utilizing minimal pairs recorded by native speakers, the research offers valuable insights into the phonetic characteristics of this dialect. The use of PRAAT software for acoustic analysis has highlighted unique features of the Khattak consonants, contributing to a deeper understanding of Pashto phonology. The findings underscore the importance of preserving and studying regional dialects to enrich linguistic knowledge and support language preservation efforts.

Additionally, this research sets a foundation for future studies and applications in linguistic research and speech technology, enhancing the comparative analysis of Pashto dialects and fostering further exploration into the phonetic intricacies of regional languages.

SUGGESTION

Future studies should expand the range of sounds analyzed to include additional phonemes from standard Pashto, particularly those used in loan words. This would provide a more thorough understanding of the phonetic inventory of the Khattak dialect and its relation to standard Pashto. It is essential to analyze sounds in various phonetic contexts beyond just the onset and coda positions. Examining sounds in medial positions and within different phonological environments will offer a more complete picture of their phonetic properties and how they might vary depending on their position in a word. Future research should incorporate a broader range of acoustic features. Including formant analysis, and duration, among other features, will deepen the understanding of the phonetic characteristics of the Khattak dialect. This comprehensive acoustic analysis could uncover subtle but significant differences that were not captured in this study. By addressing these limitations and following the suggested directions for future research, we can achieve a more nuanced and complete understanding of the phonetic characteristics of the Khattak dialect of Pashto and its relationship to standard Pashto and other dialects.

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