ACOUSTIC ANALYSIS OF LEXICAL TONE IN TWO NAGA LANGUAGES

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CERTIFICATE

This is to certify that this dissertation titled "**Acoustic analysis of lexical tone in two Naga languages**" is a bonafide work submitted as part of the fulfillment for the degree of Master of Science in Speech Language Pathology of the student bearing Registration Number 19SLP016. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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DECLARATION

This is to certify that this dissertation entitled "**Acoustic analysis of lexical tone in two Naga languages**" is the result of my own study under the guidance of Dr. Santosh M Associate Professor, Department of Speech-Language Sciences, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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Dedicated to

My Family SK Generation

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

“Of over 6000 languages in the world, it is estimated that as many as 60-70% are tonal.” (Lewis, 2009; Yip, 2002)

CHAPTER 1

INTRODUCTION

1.1 Tonal language

Pike (1948) defined tonal language as “a language having lexically significant, contrastive, but relative pitch on each syllable”. In tonal languages, the change in pitch of a word changes the meaning of the word. The main phonetic elements of tone can be found in the domain of a syllable's specific pitch level. Hence, Gandour (1978) defined tone language as “a language in which pitch is used to contrast individual lexical items or words”.

In a tonal language significant pitch differentiates the meanings of utterances, and when the pitch is lexical that is it differentiates the meaning of words it is referred as Lexical tone. Thus, “a tone language must have pitch that is significant and lexical” (Pike, 1948). In non-tonal languages significant pitch can also be found e.g. English, although unlike tone languages, its semantic difference refers to the sentence or phrase as a whole rather than the meaning. In other words, each syllable in a tone language contains at least one significant pitch unit, and there is usually a one-to-one correspondence between the number of syllables and the number of tones in any given utterance; in contrast, there is no such correspondence in a non-tone language.

When it comes to forming contrastive words, the tone or pitch component in tone languages works in similar ways as consonants and vowel do in a word. In tone languages, a syllable is defined as one that has at least tone and a vowel, or the idea of the tone being absent. Tones are relative rather than absolute, which means they

change depending on the situation. The effect of nearby consonants or tone is the most typical cause of such occurrences.

1.2 Tone System:

Due to the general nature of tone, tone languages have been divided into contour and register tone systems over time (Pike, 1948). The register tone system is most closely connected to the tone systems of African languages and only tangentially related to contour tones, whereas Asian languages, such as Chinese, employ the contour tone system.

While register tones also called as level tone are judged as steady since the pitch of a syllable do not fall or rise throughout production, contour tones also called as gliding tone are evaluated as gliding from one pitch level to another with a noticeable fall or rise, or a combination of rising and falling tones. While Chinese contour tones are viewed as unitary units, African languages' contour tones are usually considered composite (comprising of two consecutive level tones).

Most of the lexical tones and characteristic of the major tonal languages of the world have been described. For example in Mandarin four contrastive tones: high level, high rising, low falling rising and high falling tones are present (Chao, 1948; Howie, 1976; Moore & Jongman, 1997). Cantonese has six lexical tones: high level, mid level, high rising, low rising, low falling, and low level (Chao, 1947; Kao, 1970). Mizo has four tones: low, high, rising and falling (Sarmah, & Wiltshire, 2010).

1.3 Dimensions of Tonal Contrasts:

What is the maximum number of pitch levels that a tonal language can have? Linguists determined that, while people can produce a wide range of phonetically different pitch levels in speech, no language possesses more than five pitch levels

(Chao, 1948; Maddieson, 1978). For known tonal language, five-level phonetic transcriptions of tones, such as Chao's numbers and the IPA tone markers, have been proved to be sufficient. In actuality, the number of contrastive levels is typologically is far more limited. Maddieson's (1978) cross-linguistic survey indicated that five- and four-level tonal languages are exceedingly rare in comparison to languages with fewer contrastive levels, and that the most prevalent type of contrast is a two-level contrast.

Different pitch levels (from 1 to 5) or pitch movements of various direction, slope, and form can be used to create tone contrasts. Most phonologists now agree that High and Low autosegments connected with tone carrying unit (TBU) such as the mora or syllable are the best representation for cross-linguistic patterns of tonal contrast and alternation syllable (Goldsmith, 1976; Gandour, 1974; Anderson, 1978; Yip, 1989, 1995, 2002; Duanmu 1994, Zhang 2002, Gussenhoven 2004). In languages with register tone levels contrast is in the presence of H vs. L (or H vs. L vs. Ø), whereas "contour tone languages" allow several associations for each TBU, such as LH for a rising pitch pattern. Additional intermediary class nodes may be required in more sophisticated systems: For example, Yip (1995) proposes the addition of a register node [+/- higher] to account for systems with more than three pitch levels.

1.4 Acoustic features of Tone languages

According to Rose (1989), the tone is the result of an interaction between the F0 and other speech acoustic characteristics. The fundamental frequency or pitch, such as mean pitch and pitch contour, is the key acoustic cue for identifying tone. Duration, volume, voice range, and a speaker's register are all secondary cues for identifying tones. These additional signals assist native listeners in distinguishing

tones when pitch the cues are lacking or concealed (Liu & Samuel, 2004; Whalen & Xu, 1992).

Studies in Mandarin indicate that pitch height, pitch contour, turning point and duration are all acoustic correlates of tone (Lin, 1965; Dreher & Lee, 1966; Howie, 1976). In the North-eastern languages of India studies on tone indicates that fundamental frequency and duration may play a part in tone identification depending on the language family and the tones system: contour or level tone. Sarmah and Wiltshire (2010) reported no difference in the average F0 for the rising vs. low tones and the falling vs. high tones in identifying the tone types in Mizo. In contrast, Veikho, Lemaina, and Sarmah (2018) reported differences in the average F0 of all four tones: high-falling, mid-falling, rising-falling and low-falling in Poula and that the average F0 is highly linked to the tone type. Teo (2014) reported that the three level tones: low, mid and high of Sumi differed significantly in pitch.

Blankenship et al. (1993) found a gap of 20 to 30 Hz in the four level tones of Khonoma dialect of Angami/ Tenyidie. Similarly, Coupe (2003) found 10 to 20 Hz gap in Mongsen Ao. Teo (2014) reported a gap between the three tones was 30 Hz. According to the findings of Rietveld and Gussenhoven (1985), pitch changes of 1.5 semitones (approximately 10 Hz) or more are reliably regarded as noticeable distinctions, i.e. a 10 Hz separation is sufficient to distinguish two tonal groups.

Gandour (1997) reported that in Thai dialects the vowels with high tones had shorter duration than vowels with low tones. Similarly, Joseph and Burling (2001) also found duration differences in the two Tiwa tones whereas, Sarmah, Wiltshire, and Hong (2013) found no duration differences for the two contour tones of Tiwa. Teo (2014) also found no duration differences for the three level tones of Sumi. The duration of the tone-bearing unit does get affected by contextual factors like the

syllable structure, type of consonants and vowels, tone system and the type of language family (Kong, 1987; Svantesson, 1988; Xu, 1997; Joseph & Burling, 2001; Samrah & Wiltshire, 2010; Samrah, Wiltshire, & Hong 2013). While there are a few factors to consider, research has shown that duration is important in distinguishing acoustic cues for tones throughout time (Gandour, 1977; Joseph & Burling, 2001, Liu & Samuel 2004; Sarmah & Wiltshire, 2010; Kwon 2011).

1.5 Language Background

Nagaland is one of India's Northeastern states, home to around 16 major tribes and a few lesser tribes. Each of these tribes has its own language, with varying dialects depending on the location. These languages are classified as part of the Sino-Tibetan family. The Nagaland Assembly declared Indian English to be the state's official language in 1967, and it is the medium of instruction in the state. Aside from English, Nagamese, an Assamese-based creole language, is commonly used for communication among various tribes.

1.5.1 Tenyidie Language

Tenyidie is a language spoken by the Angami tribe of Nagaland, residing in the region of Kohima on the state's southern border. Tenyidie has been referred to as Angami in previous work and these two terms are sometimes used interchangeably when referring to the language, Tenyidie is the official name of the language, whereas Angami is the name of the tribe and people.

Tenyidie is a tone language. For example, the word 'da' in Tenyidie has at least 4 meanings: 'to cut,' 'to arrange,' to blame,' and 'to paste,' each of which has its own pitch production. A change in pitch has distinct meaning, just as change in vowel height or progress can change the entire meaning of a word. Four level tones were found by Blankenship et al (1993; 1994). They are:

Extra High (h)	dȃ̋ ‘to cut’
High (H)	dá ‘to arrange’
Mid (M)	dā ‘to blame’
Low (L)	dà ‘to paste’

Ravindran (1974), Burling (1960), and Kuolie (2006) conducted separate investigations on Tenyidie tones and identified five tones: high, mid, high-low, low-high, and low. Meyase (2014) identified five tones in Tenyidie. The fifth tone being a bi-tonal, that is a combination of the mid and the high tone, but it was more of a phonological tone than a phonetic tone. On the other hand, Dutta et al. (2012) conducted a statistical study of pitches on the five tones reported in the literature to see if they were phonetically distinct. The findings revealed that just four tones were phonetically unique, which was consistent with Blankenship et al (1993; 1994) finding’s. In the present study the four tones: Extra High, High, Mid and Low are considered.

1.5.2 Khezha Language

The Chakhesang community in Nagaland's Phek District speaks Khezha Naga as their native language. It is one of the Chakhesang Naga tribe's three main languages, and Khezha people speak it the most. Khezha or Khuzhale is mostly spoken in the Pfutsero and Chizami regions of Phek District and in a few villages in Manipur's Ukhrul District's western part. According to the 2011 census Khezha language is spoken by about 41625 people in India and is considered as one of the major languages spoken in Nagaland. The UNESCO Atlas of the World's Languages in Danger classifies it as a "vulnerable" language.

In Khezha's grammatical system, relative tone levels are very important because they are needed to contrast each lexical unit independently. That is, in

Khezha, every syllable has a tone, and every utterance has a one-to-one relationship between the number of syllables and tones. For example, the word /so/ in Khezha can denote ‘repeat’, ‘drink’, 'count, or bribe’ and the sole distinction is the pitch of each of the syllable (Kapfo, 2005). Khezha has three primary tones (Kapfo, 2005). They are:

High tone (H)	só 'repeat'
Mid tone (M) (unmarked)	so 'drink'
Low tone (L)	sò 'count’, ‘to bribe'

Researchers have sought to investigate the majority of Naga languages in recent years. However, no one has done extensive research on Khezha, and hence little is known about its tonal system.

1.6 Need of the study

Scholars have classified Naga languages into three groups, viz. Western, Central and Eastern. According to this classification, Khezha, Angami/Tenyidie, Chokri, Mao, Regma, Sema and Pochuri, constitute the Eastern (or Southern) group. There have been a number of research on the many characteristics of languages in several regional Indian languages (Telugu, Kannada, Malayalam, Tamil, Hindi), but not in Naga languages. Currently, the concentration in Naga languages is on linguistic features of the languages and anthropology for the people's culture. However, there is a scarcity of information on Naga languages.

There are currently just a few reports on the acoustic characteristics of tonal languages in Naga languages. These languages, although mostly belong to the Sino-Tibetan language family, and are phonetically and morphologically distinct from other Indian languages. There is a need to study the acoustic features of tone in Naga languages, as this information will help us to better understand the languages, its

structures, acoustic cues, how it differs across the languages and various groups of population. Similarly studies on Bilingual speakers are not investigated for any of the Naga languages. Hence, the present study is a preliminary attempt to look into the acoustic features of tones in the Khezha and Tenyidie languages and to compare the acoustic characteristics between a monolingual and bilingual speakers of the languages.

1.7 Aim of the study

1. The primary aim of the present study was to compare the acoustic features of tones in two Naga (Tenyidie and Khezha) languages.
2. The secondary aim was to compare the acoustic characteristics between monolingual and bilingual speakers of Khezha.

1.8 Objective:

1. To prepare monosyllabic word list for Khezha and Tenyidie
2. To calculate the normalised F0, duration, and mean F0 for monosyllabic words in both languages.
3. Using the normalised Z-score value, identify the tones of each word in both languages.
4. Using the words, establish an average normalised F0 for each tone.
5. Determine whether the tones and their durations differ from one another in a language
6. Determine whether participants who speak Khezha alone and participants who speak both Khezha and Tenyidie have different tones and tone duration

CHAPTER 2

REVIEW OF LITERATURE

2.1 Lexical Tone:

Lexical tone refers to changes in the fundamental frequency contour at the syllable level that differentiate the meanings of a word. They are acoustically displayed by changes in fundamental frequency (F0) and physiologically related to the rate of vocal fold vibration. Different lexical tones such as high, low, mid, rising, and falling tones are represented by different pitch contours or F0 heights (Howie, 1976; Li & Thompson, 1977).

Lexical Tone is mostly identified by fundamental frequency or pitch, such as mean pitch and pitch contour. Duration, vocal range, amplitude, and a speaker's register are all secondary cues. When pitch cues are missing or hidden, these secondary signals assist native listeners in identifying tones (Liu & Samuel, 2004; Whalen & Xu, 1992).

The tone is typically represented on the vowels, and it also interacts with the surrounding consonants (Hombert, Ohala, & Ewan, 1979; Lee, 2000). But, the lexical tone differs from the consonants and vowels in two ways. To begin, lexical tone necessitates syllable level shifts, whereas vowels and consonants require segmental shifts. As a result, tones are sometimes classed as suprasegmental signals, while vowels and consonants constitute segmental cues. Second, the distribution of acoustic energy between vowels, consonants, and tones differs. Vowels and consonants are associated with formant qualities and are not usually described in basic frequency F0 (Ladefoged & Disner, 2012). Lexical tone, on the other hand, is usually determined by F0 variation rather than formant structure (Gandour, 1978).

2.2 Acoustic Features of tones:

Liu's (1925) dissertation on the acoustic analysis of tones in numerous Chinese languages, laid the foundation on the experimental studies of the phonetics of lexical tones.

2.2.1 Average F0:

In the context of linguistic tone, F0 denotes to the number of vibrations of the vocal folds per second. Sarmah and Wiltshire (2010) studied the average F0 for Mizo tones and reported the value as 236.80 Hz for falling tone, 251.71 Hz for high tone, 210.81 Hz for Low tone and 214.54 Hz for rising tones. Statistically, they found that the average F0 of rising and low tones, as well as falling and high tones, are identical, and that the F0 contour alone is insufficient for differentiating tone kinds in Mizo.

Sarmah, Wiltshire, and Hong, (2013) did a study on average F0 of Tiwa tones. The participants were nine native speakers of Tiwa language between the age range of 20 and 40 years. They calculated the average F0 using a 100ms time step, where the first 20% from the onset and the final 20 % of the pitch contour was excluded due to consonantal effects. The results indicated that the Tiwa tones interacts with the contour tones of the language and that the rising tone had a higher F0 (239.51 Hz) value than the falling tone (227.97 Hz).

Teo (2014) conducted a study on Sumi tone. One female and one male at the age of 38 and 39 years respectively were considered. In a carrier phrase, the participants were requested to produce the three level tones. The mean F0 for female low tone was 169 Hz, mid tone was 198 Hz, and high tone was 228 Hz, while the mean F0 for male low tone was 119 Hz, mid tone was 151 Hz, and high tone was 185 Hz. A one-way ANOVA on tone category revealed significant pitch differences

for the female and male speakers: F (2, 1649) = 1949.9, p< 0.001 for the female speaker and F (2,396) = 1134.6, p <0.001 for the male speaker. Tukey post-hoc tests revealed that each of the three tones differed significantly in pitch for both speakers. For both speakers, the gap between the low and mid tones, as well as the mid and high tones, was typically around 30 Hz. Tones in Sumi contrast in pitch height rather than pitch movement, as evidenced by the fact that all three tones were mostly level.

Veikho, Lemaina, and Sarmah (2018) studied Poula tones. For the study, six speakers were considered. The stimuli were composed of 120 words organised into 30 minimal sets and were produced isolation to avoid any kind of Tone Sandhi effects. Three speakers were asked to produce in a variety of sentence structures and natural phrases. For both isolation and sentence frames, visual study of pitch tack revealed four tones: high-falling, mid-falling, rising-falling, and low-falling, although pitch track is different for both. Acoustic examination revealed the same four tones. They discovered that the average F0 of all four tones differed significantly from one another, and that the average F0 is highly linked to the tone type.

2.2.2 Duration:

In global languages, vowel duration is usually found to be adversely associated to the estimated average F0, whereas in some languages they are associated with the average F0. This type of interplay between tonal contrasts and duration can be found in many languages around the globe. Gandour (1977) reported that “the vowels on rising tones are longer than those on falling tones, while the vowels on low tones are longer than those on high tones”.

Joseph and Burling (2001) studied Tiwa tones and reported that the falling tones are longer in duration than the high tones. The CV and CVC type of syllable duration were statistically significant.

Sarmah, Wiltshire and Hong (2013) considered CV, CVC and CVV type of syllables. They reported that rising tones in CV syllables had considerably shorter vowel lengths than falling tones [p=0.02, p=<0.05]. Similarly, the rising tones in CVV syllables were shorter than the falling tones. They were, however, statistically indistinguishable [0=0.282, p>0.05]. CVC syllables, on the other hand, had rising tones that were considerably longer than falling tones [p=0.04, p0.05]. They also stated that, while CVC and CV syllables had statistically significant duration variations, they did not follow the pattern proposed by Joseph and Burling (2001), and therefore the vowel length does not appear to be influenced by tone types. The duration for CV syllable was 173.73ms for the rising tone and 187.75ms for the falling tone.

Sarmah and Wiltshire (2010) investigated Mizo tone duration. The stimuli were recorded using sentence frames and one female native Mizo speaker was considered for the study. They compared the duration of the rimes (CVVN) in Mizo across all four tone categories in a bimoraic setting. The average duration for tone types effect demonstrated overall significance, demonstrating a significant interaction between tone types and average rime duration [F (3, 172) = 17.74, p=0.001]. However, they discovered that only the falling tone differs from the other three tones, with no significant differences in rime length across the high, rising, and low tones.

According to numerous research Mandarin Tones 1 [55- high tone] and 4 [51- high falling tone] are shorter than Tone 2 [35- mid rising tone], which is shorter

than Tone 3 [214- Low dipping tone] (Brotzman 1964; Howie 1974; Ho 1976; Howie 1976; Nordenhake & Svantesson 1983). Kong (1987) discovered similar results in Cantonese, except he notes that the mid-tone [33- Mid level tone] is the longest, the mid-low level tone is intermediate, and the high-level tone and low-level tone are the shortest.

On the other hand, the perception of duration may be influenced by the *F0* pattern. Alan (2010) investigated at the perceptual relationship between perceived duration and tone. Sixteen native speakers of English were considered. The stimuli were 300ms [pa] syllable which were synthesized and a 3 step duration continuum was created with 100ms decreasing increment. The F0 of it was manipulated to get 5 varying F0 contours that are 3 level tones: high [55], low [11], mid [33] and 2 dynamic tone syllables: rising [15] and falling [51] tones. The participants were given a 7-point scale to rate the duration, with 1 being the shortest and 7 being the longest. The results showed that when comparing level tone syllables, the T55 syllable was perceived to be longer than the T33 and T11 syllables. The perceived duration was influenced by both the F0 slope and the height. Syllables with a dynamic F0 were perceived as being longer than those with a flat F0, and syllables with a higher F0 were heard for longer than those with a lower F0.

Although there are a few considerations, research has indicated that duration do play a role in identifying acoustic cue for tones throughout time. To begin, the tone differs from one language to the next, and the tonal system of the language must be taken into account: A level or a contour system (Kong, 1987 for Cantonese; Xu, 1997 for Mandarin; Liu & Samuel 2004 for Mandarin). Second, consonants and the type of syllable pattern must be considered (Joseph & Burling, 2001 for Tiwa; Samrah & Wiltshire, 2010 for Dimasa; Samrah, Wiltshire, & Hong 2013 for Tiwa).

Third the type of vowels: long vowels and short vowels. Long vowels have low tones and short vowels have high tones (Svantesson 1988 for Hu) or long vowels might once have had dynamic tones (Gandour, 1977 for Thai; Kwon 2011 for Korean).

2.3 Normalization of F0

The variation in the length and mass of the vocal cords is one significant physiological source of between speaker's acoustic output disparities. As a result of these changes, the fundamental frequency (F0) has a distinct or default values and ranges (Nolan, 1983). The most fundamental acoustic correlate of perceived pitch is F0 and it serves as a dimension for suprasegmental linguistic systems of intonation, tone and stress (Lehiste, 1970). As a result, male speakers with longer, huge vocal cords tend to have lower F0 values than female speakers; while a female's phonologically low tone can have a greater F0 value than a male's phonologically high tone.

Compared to the vast amount of research done on vowel normalisation, the normalisation of the acoustic correlates of intonation has gotten very little attention, and the same for tone has received even less attention. Apart from (the uncommon) access to bilingual speakers, normalisation is the only way to evaluate transcriptionally based ideas on the nature of linguistic-phonetic tonal variance in them.

The normalization procedure of F0 is considered when comparing different repetitions of the same linguistic condition (e.g. repetition of a high tone by the same speaker) or different linguistic conditions (e.g. high tone vs. mid-tone by all speakers). This procedure takes a fixed number of uniformly spaced measurements in each interval, such as a segment or syllable and aligns the utterances whose

duration is otherwise different. As a result, the actual temporal location of a particular measured value is lost.

Z-score normalization is one such F0 normalizing procedure (Disner 1980; Ishihara 2000; Rose 1987, 1991). It is used to avoid the between speaker differences. Rose (1991) reports this method to be superior in normalizing the F0. The z-score normalization procedure uses the mean F0 and the standard deviation of the population to normalize the data.

$$NP_n = (F0i - x)/SD.$$

Where NP_n = normalized z-score of a sampling point

x = average F0 of all sampling points

F0i = sampling point,

SD = standard deviation of the average of all the sampling points.

2.4 Second language (L2) lexical tone learning:

Speech variety aids lexical tone learning in non-tonal language speakers. But, it is not known if tonal language speakers can gain advantage from speech variability when acquiring lexical tone in a second language (L2) and if the L1 background has any impact on L2 acquisition. Speech variability may have a different influence on tonal language speakers' L2 lexical tone learning than it does on non-tonal language speakers' L2 lexical tone learning. These tones can be treated as new tone categories by the learners, and mental representations can be developed. However, some L2 lexical tones may present in their L1 or share substantial parallels with their L1. According to approaches such as the perceptual assimilation model (PAM; Best, 1995) and the speech learning model (SLM; Flege, 1995, 2007), learners tend to integrate these L2 tones into their L1 tone groups and attain these L2 tones based on their L1 tone categories' mental representations.

The efficiency of speech variety was also discovered to be limited to learning new items, according to studies. Non-tonal language speakers must create new mental representations for every tone groups since L2 lexical tones are unique. However, the situation for tonal language speakers is complicated, and some tone groups in L2 differ significantly from lexical tones in L1.

Harrison (2000) conducted research on the responses of tone-language exposed (Yoruba) and non-tone language exposed (English) infants to tonal contrasts. He employed the visual reinforcement paradigm to elicit responses from infants aged 6 to 8 months. The findings demonstrated that whereas Yoruba-exposed children could discern some Yoruba tones, English-exposed infants couldn't distinguish any of the tone differences. This study offered the first ever experimental evidence that tone language experience affects early tone discrimination.

Hao (2012) investigated whether second language (L2) learners from non-tonal and tonal first language (L1) backgrounds perceive and produce L2 tones differently. The results showed that the perception and production of L2 tone (Mandarin) by speakers of tonal language (Cantonese) and non-tonal language (English) were not significantly different, and the most difficult task for both groups was identifying pitch contours with tonal categories, rather than precisely hearing or articulating pitch contours. The apparent similarity of the L1 and L2 tone categories accounted for only a portion of the difficulty in learning Mandarin tones.

Zhang et al. (2018) investigated whether speech variability only aids tonal language speakers' acquisition of L2 tones that differ from their L1 tones. They divided 35 native Mandarin speakers into two groups at random: 17 in the high variable group and 18 in the low variable group. The control group comprised of 17 native Cantonese speakers from Hong Kong. Speech with HV in both pitch height

and pitch slope and speech with LV in both pitch height and pitch slope were used as stimuli. The participants were required to attend two training sessions, one following the pre-test and the other following the mid-test. Each training session consisted of six training sets, with Mandarin subjects being required to complete one set every two days. There were two tasks in the test session: production and identification. Only one test session was given to the control group. The results revealed that speech variability had a minor impact on Mandarin speakers' ability to learn Cantonese tones. The High Variable training aided Mandarin individuals in producing CT33 and CT22 tones, which are unrelated to any Mandarin tones, but not CT55, CT25, CT23, or CT21 tones, which have identical Mandarin counterparts. This finding confirmed the hypothesis that Mandarin individuals were more sensitive to pitch height following HV training and that speech variability only helped the acquisition of tonal categories that were different from the tones in their L1. The research also discovered a gap between L2 perception and production. i.e., an increase in production was not linked to an increase in perception.

CHAPTER 3

METHOD

The primary aim of the present study was to compare the acoustic features of tones in two Naga (Tenyidie and Khezha) languages. The secondary aim was to compare the acoustic characteristics between monolingual and bilingual speakers of above mentioned languages.

3.1 Selection of Participants:

Forty-two adults in the age range of 20-78 years old were recruited as participants for the study and were divided into three groups; Group T, Group K and Group TK.

Group T consisted of 15 participants from Kohima village area, Nagaland who spoke Tenyidie as their first language (L1) and the mean age of the participants was 42 years (SD=17.90). Group K consisted of 15 participants from Kohima, Nagaland who spoke Khezha as their first language (L1) and the mean age of the participants was 34 years (SD=11.04). Group TK comprised of 12 participants from Kohima and Dimapur, Nagaland who spoke Khezha as their first language (L1) and Tenyidie as their second language (L2) and the mean age of the participants in the group was 41 years (SD=13.39). The details of the participants are presented in Table 3.1. Because dialectical variants exist in these languages, the individuals chosen for the study spoke the Tenyidie language which originated in the Kohima Village area, and the Khezha language, which originated in the Khezhakeno Village area. LEAP-Q questionnaire was used to profile the language proficiency of each participant and the amount of exposure of each language.

Note: Throughout the study the Group T will be considered as monolingual Tenyidie and Group K as monolingual Khezha speaker and Group TK as Bilingual speakers.

Table 3.1

Participants Information

Group K			Group T			Group TK		
P	**Age**	**Gender**	**P**	**Age**	**Gender**	**P**	**Age**	**Gender**
K1	22	Female	T1	30	Male	TK1	44	Female
K2	29	Female	T2	78	Male	TK2	50	Female
K3	55	Male	T3	45	Female	TK3	46	Female
K4	30	Male	T4	47	Female	TK4	45	Male
K5	51	Male	T5	40	Female	TK5	63	Male
K6	29	Female	T6	45	Male	TK6	24	Female
K7	27	Male	T7	29	Male	TK7	26	Female
K8	24	Male	T8	74	Female	TK8	23	Female
K9	34	Female	T9	26	Male	TK9	51	Male
K10	35	Female	T10	25	Male	TK10	26	Female
K11	25	Male	T11	20	Female	TK11	50	Male
K12	41	Male	T12	21	Male	TK12	52	Female
K13	48	Female	T13	53	Female			
K14	49	Male	T14	47	Male			
K15	25	Female	T15	56	Male			

Note. **P = Participants**

3.1.1 Participants proficiency:

The participants' language proficiency in L1 and L2 languages were assessed using the Language Experience and Proficiency Questionnaire (LEAP-Q). LEAP-Q is a self-rating scale initially developed by Marian et al. (2007). It assesses language proficiency by considering the language history, proficiency, accent, function, and affect in each language. The measure takes into account the participants' ratings for four language skills (understanding, speaking, reading, and writing).

For each language skill, the proficiency grade ranges from one to four, with one indicating ‘zero proficiency,’ two indicating ‘poor proficiency,’ three indicating ‘good proficiency,’ and four indicating ‘native-like/perfect proficiency.’ Ramya (2009) adapted and validated this questionnaire to the Indian context and this is used in the present study (Appendix).

It should be noted that English is the official language and the medium of instruction in schools in the state of Nagaland. For internal communication in Nagaland, another language called Nagamese, a creole language based on Assamese, is widely used. As a result, practically all of the participants in the study have a second or third language, such as Nagamese or English apart from their native language (L1).

3.1.1.1 Group T LEAP-Q:

Language Experience and Proficiency Questionnaire (LEAP-Q) suggested that all the participants had native-like/perfect subjective ratings on the domain of understanding and speaking for L1 (Tenyidie). For reading in L1, 2 participants rated ‘perfect’, 6 participants rated ‘good’ and 7 participants rated ‘Low’. For the domain of writing 2 participants rated ‘perfect’ whereas the remaining 13 participants rated it as ‘low”. It is to be mentioned that because Tenyidie is an

option taken up as a second language in schools and is not compulsory, hence the majority of the participants' reading and writing scores are lower than in English. The details of the Individual participant profile of other language characteristic for Group T is presented in Table 3.2 and the results of LEAP-Q four domains in table 3.3.

3.1.1.2 Group K LEAP-Q:

According to the Language Experience and Proficiency Questionnaire (LEAP-Q), all individuals had native-like/perfect subjective scores for L1 (Khezha) understanding and speaking. It is worth noting that Tenyidie and Khezha both employ Latin script. However, unlike Tenyidie, Khezha is not taught as a second language in schools, and hence reading and writing domain were not applicable for the language. The details of the Individual participant profile of other language characteristic for Group K is presented in Table 3.4 and the results of LEAP-Q four domains in table 3.5.

3.1.1.3 Group TK LEAP-Q:

Based on the Language Experience and Proficiency Questionnaire (LEAP-Q) the participants self-reported higher proficiency for understanding and speaking in both L1 (Khezha) and L2 (Tenyidie) for understanding and speaking. Subjective ratings were rated as ‘good’ proficiency by 4 participants and ‘perfect’ proficiency for the remaining 8 in L1 for the understanding domain. For the same domain in L2, It was rated by 4 participants as ‘good’ proficiency and as ‘perfect’ by 8 of the participants. Considering the speaking domain, ‘good’ proficiency was rated by 8 of the 13 participants in L1 and 4 of them in L2 as opposed to 7 of them rating it as ‘perfect’ proficiency in L1 and 5 of them rating the same in L2.

Table 3.2

Individual participant profile of other language characteristic: Group T

Participant	Languages			AOE (Years)		Years of exposure			Extent of exposure L1		Extent of exposure L2		Extent of exposure L3	
	L1	L2	L3	L2	L3	L1	L2	L3	DPW	HPD	DPW	HPD	DPW	HPD
T1	Tenyidie	Nagamese	English	5	6	45	40	39	7	10	7	6	7	8
T2	Tenyidie	Nagamese	NA	8	NA	74	66	NA	7	18	7	3	NA	NA
T3	Tenyidie	English	Nagamese	4	5	40	36	35	7	6	7	6	7	6
T4	Tenyidie	Nagamese	English	5	5	26	21	21	7	8	7	8	7	2
T5	Tenyidie	Nagamese	English	2	5	25	23	20	7	13	7	10	7	2
T6	Tenyidie	Nagamese	English	3	3	45	42	42	7	15	7	3	7	5
T7	Tenyidie	Nagamese	English	3	3	47	44	44	7	14	7	5	7	8
T8	Tenyidie	Nagamese	English	3	3	20	17	17	7	15	7	5	7	8
T9	Tenyidie	Nagamese	English	3	6	47	44	41	7	14	7	5	7	5
T10	Tenyidie	Nagamese	English	2	4	21	19	17	7	13	7	7	7	2
T11	Tenyidie	Nagamese	English	4	5	53	49	48	7	11	7	4	7	1
T12	Tenyidie	English	Nagamese	4	8	30	26	22	7	12	7	6	7	6
T13	Tenyidie	Nagamese	English	4	5	56	52	51	7	12	7	3	7	1
T14	Tenyidie	Nagamese	English	8	5	29	21	24	7	10	7	8	7	5
T15	Tenyidie	English	Nagamese	8	10	78	70	68	7	18	7	4	7	6

Note. L1 = **First Language, L2 = Second Language, L3 = Third Language, AOE =Age of exposure, DPW = Days Per Week, HPD = Hours Per Day, NA = Not applicable**

Table 3.3

Results of LEAP- Q across the four language domains: Group T

L P P	**Understanding**			**Speaking**			**Reading**			**Writing**		
Languages	**T**	**E**	**N**	**T**	**E**	**N**	**T**	**E**	**N**	**T**	**E**	**N**
K1	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect	Good	Good	NA	Low	Good	NA
K2	Perfect	NA	Low	Perfect	NA	Low	Good	NA	NA	Low	NA	NA
K3	Perfect	Perfect	Perfect	Perfect	Good	Good	Good	Perfect	NA	Low	Perfect	NA
K4	Perfect	Low	Good	Perfect	Low	Good	Low	Low	NA	Low	Low	NA
K5	Perfect	Low	Perfect	Perfect	Low	Good	Low	Low	NA	Low	Low	NA
K6	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect	Low	Perfect	NA	Low	Perfect	NA
K7	Perfect	Perfect	Good	Perfect	Perfect	Good	Perfect	Good	NA	Perfect	Good	NA
K8	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect	Good	Good	NA	Low	Good	NA
K9	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect	Good	Perfect	NA	Low	Perfect	NA
K10	Perfect	Good	Perfect	Perfect	Low	Perfect	Low	Good	NA	Low	Low	NA
K11	Perfect	Low	Good	Perfect	Low	Good	Low	Low	NA	Low	Low	NA
K12	Perfect	Perfect	Good	Perfect	Perfect	Good	Good	Good	NA	Low	Good	NA
K13	Perfect	Low	Good	Perfect	Low	Good	Low	Low	NA	Low	Low	NA
K14	Perfect	Good	Good	Perfect	Good	Good	Low	Good	NA	Low	Good	NA
K15	Perfect	Good	Good	Perfect	Good	Good	Perfect	Good	NA	Perfect	Good	NA

Note. **LPP = Language Proficiency Parameters T = Tenyidie, E = English, N = Nagamese, NA = Not Applicable**

Table 3.4

Individual participant profile of other language characteristic: Group K

Participant	Languages			AOE (Years)		Years of exposure			Extent of exposure L1		Extent of exposure L2		Extent of exposure L3	
	L1	L2	L3	L2	L3	L1	L2	L3	DPW	HPD	DPW	HPD	DPW	HPD
K1	Khezha	Nagamese	English	4	5	22	18	17	7	12	7	10	5	7
K2	Khezha	Nagamese	English	3	5	29	26	24	7	13	7	13	1	0.5
K3	Khezha	Nagamese	NA	9	NA	55	46	NA	7	15	7	8	NA	NA
K4	Khezha	English	Nagamese	5	12	30	25	18	7	12	7	0.5	7	8
K5	Khezha	Nagamese	English	8	9	51	43	42	7	15	7	10	7	10
K6	Khezha	Nagamese	English	5	6	29	24	23	7	12	7	12	1	0.5
K7	Khezha	Nagamese	English	7	7	27	20	20	7	17	7	10	5	7
K8	Khezha	Nagamese	English	2	2	24	22	22	5	6	7	14	7	8
K9	Khezha	English	Nagamese	8	12	34	26	22	7	12	7	0.5	7	12
K10	Khezha	English	Nagamese	5	5	35	30	30	7	15	5	2	7	10
K11	Khezha	Nagamese	English	3	5	25	22	20	7	12	7	12	5	4
K12	Khezha	Nagamese	English	4	5	41	37	36	7	14	7	8	7	3
K13	Khezha	Nagamese	NA	10	NA	48	38	NA	7	16	7	10	NA	NA
K14	Khezha	Nagamese	English	5	5	49	44	44	7	15	7	6	7	5
K15	Khezha	Nagamese	English	4	5	25	21	20	7	8	7	8	5	7

Note. **L1 = First Language, L2 = Second Language, L3 = Third Language, AOE = Age of Exposure, DPW = Days per Week, HPD = Hours per Day, NA = Not applicable**

Table 3.5

Results of LEAP- Q across the four language domains: Group K

L P P	Understanding			Speaking			Reading			Writing		
Languages	**K**	**E**	**N**	**K**	**E**	**N**	**K**	**E**	**N**	**K**	**E**	**N**
K1	Perfect	Perfect	Perfect	Perfect	Perfect	Perfect	NA	Perfect	NA	NA	Perfect	NA
K2	Perfect	Good	Good	Perfect	Low	Good	NA	Good	NA	NA	Low	NA
K3	Perfect	NA	Good	Perfect	NA	Good	NA	NA	NA	NA	NA	NA
K4	Perfect	Good	Perfect	Perfect	Good	Perfect	NA	Good	NA	NA	Good	NA
K5	Perfect	Good	Good	Perfect	Good	Good	NA	Good	NA	NA	Good	NA
K6	Perfect	Good	Perfect	Perfect	Good	Perfect	NA	Good	NA	NA	Good	NA
K7	Perfect	Perfect	Perfect	Perfect	Perfect	Good	NA	Perfect	NA	NA	Perfect	NA
K8	Perfect	Good	Perfect	Perfect	Good	Perfect	NA	Perfect	NA	NA	Perfect	NA
K9	Perfect	Good	Good	Perfect	Good	Good	NA	Good	NA	NA	Good	NA
K10	Perfect	Good	Good	Perfect	Good	Good	NA	Good	NA	NA	Good	NA
K11	Perfect	Good	Good	Perfect	Good	Good	NA	Good	NA	NA	Good	NA
K12	Perfect	Good	Good	Perfect	Low	Good	NA	Low	NA	NA	Low	NA
K13	Perfect	NA	Good	Perfect	NA	Good	NA	NA	NA	NA	NA	NA
K14	Perfect	Good	Good	Perfect	Good	Good	NA	Good	NA	NA	Good	NA
K15	Perfect	Perfect	Good	Perfect	Good	Good	NA	Good	NA	NA	Good	NA

Note. **LPP = Language Proficiency Parameters K= Khezha, E = English, N = Nagamese, NA= Not Applicable**

The reading domain received ratings by 6 participants as 'perfect' proficiency, 6 participants rated 'good' proficiency and 2 participants rated 'low' proficiency for L2. Finally, the domain of writing was rated by the participants who revealed rating of 'good' proficiency by 6 participants, 1 participant rated 'perfect' proficiency and 5 participants rated 'low' proficiency. The details of the Individual participant profile of other language characteristic for Group TK is presented in Table 3.6 and the results of LEAP-Q four domains in table 3.7.

3.1.2 Speech Language assessment:

To see if any of the participants had speech, language, hearing impairments, or neurological disorders an informal evaluation of speech, language, and hearing was conducted. A visual examination of the oral structures was performed to identify if any structural or functional deficits were present.

3.1.3 Participant inclusion criteria:

Group T

1. Individuals speaking the Tenyidie language and have been residing in Kohima village and exposed to the dialect for at least 15 years.
2. Individuals who use the dialect at home and on a regular basis.
3. Individuals with no history of any speech, language, hearing or any neurological disorders.
4. No structural or functional deficit on oro-motor examination.

Group K

1. Individuals speaking Khezha language (Khezhakeno village dialect) and have been residing in Dimapur / Kohima and exposed to the dialect for at least 15 years.
2. Individuals who uses the dialect at home and on regular basis.

Table 3.6

Individual participant profile of other language characteristic: Group TK

Participant	Languages		Age of Exposure L2 (years)	Years of exposure		Extent of exposure Khezha		Extent of exposure Tenyidie	
	L1	L2		Khezha	Tenyidie	DPW	HPD	DPW	HPD
TK1	K	T	10	44	34	7	13	7	4
TK2	K	T	3	50	47	7	13	7	10
TK3	K	T	6	46	40	7	15	7	10
TK4	K	T	4	45	41	7	16	7	16
TK5	K	T	18	63	45	7	10	7	2
TK6	K	T	7	24	17	7	10	3	2
TK7	K	T	2	26	24	7	6	7	5
TK8	K	T	6	23	17	7	15	7	12
TK9	K	T	3	51	48	7	12	7	10
TK10	K	T	7	26	19	7	15	7	12
TK11	K	T	5	50	45	7	12	7	5
TK12	K	T	3	52	49	7	10	7	5

Table 3.7

Results of LEAP- Q across the four language domains: Group TK

Language Proficiency Parameters	Understanding		Speaking		Reading		Writing	
Languages	**Khezha**	**Tenyidie**	**Khezha**	**Tenyidie**	**Khezha**	**Tenyidie**	**Khezha**	**Tenyidie**
TK1	Perfect	Good	Perfect	Good	NA	Good	NA	Low
TK2	Perfect	Perfect	Perfect	Perfect	NA	Good	NA	Good
TK3	Perfect	Perfect	Perfect	Perfect	NA	Good	NA	Good
TK4	Perfect	Perfect	Perfect	Perfect	NA	Good	NA	Low
TK5	Perfect	Good	Perfect	Good	NA	Perfect	NA	Good
TK6	Good	Good	Good	Good	NA	Low	NA	Low
TK7	Good	Good	Good	Good	NA	Good	NA	Low
TK8	Good	Perfect	Good	Good	NA	Low	NA	Low
TK9	Perfect	Good	Perfect	Good	NA	Good	NA	Good
TK10	Good	Perfect	Good	Good	NA	Good	NA	Low
TK11	Perfect	Perfect	Perfect	Perfect	NA	Perfect	NA	Good
TK12	Perfect	Perfect	Perfect	Perfect	NA	Perfect	NA	Good

Note. **NA = Not Applicable**

3. Individuals with no history of any speech, language, hearing or any neurological disorders.
4. No structural or functional deficit on oro-motor examination.

Group TK

1. Individuals speaking Khezha and Tenyidie language and have been residing in Dimapur / Kohima and exposed to the dialect for at least 15 years.
2. Individuals who uses the dialect at home and on a regular basis.
3. Individuals with no history of any speech, language, hearing or any neurological disorders.
4. No structural or functional deficit on oro-motor examination.

3.1.4 Participant exclusion criteria:

1. Participants who speak Khezha and Tenyidie language for < 15 years
2. Do not use the dialect at home and on a regular basis.
3. History of any speech, language, hearing or any neurological disorders.
4. History of structural or functional deficit on oro-motor examination.

3.2 Stimuli

The stimuli were made up of ten monosyllabic words with two to three minimum pairs. As a result, Khezha consisted of 30 words while Tenyidie consisted of 29 words. The word lists are presented in table 3.8 for Khezha and table 3.9 for Tenyidie.

3.2.1 Preparation of the word list

The word list was compiled by interviewing native language speakers about words that sounded similar but had different meanings. For both languages, a total of high frequency 20 words were discovered, along with their minimum pairs. The total

Table 3.8

Khezha Word list

Sl.no	Word	Meaning	Tone	Meaning	Tone	Meaning	Tone
1.	/ba/	Hand	Mid	Han/Support	Low	To add on	Low
2.	/dzə/	Water	low	Short	Low	Testis	High
3.	/fə/	Tooth	Mid	Search	Low	Chicken	High
4.	/ka/	Post/Pillar	Low	Meaning	Low	Traditional way of closing door/gate	Low
5.	/kha/	To hold Firm	Mid	To ask	Low	To cook	Low
6.	/khu/	Cough	Mid	To tie	Mid	Pattern	High
7.	/li/	To plant	Low	Sharpness	Mid	Buffalo	High
8.	/pu/	Tell	Low	Grandfather	Mid	Loan	Mid
9.	/so/	Often	High	Drink	Mid	Count	Low
10.	/je/	Star	Mid	Count	Mid	Pluck	Low

Table 3.9

Tenyidie Word list

Sl.no	Word	Meaning	Tone	Meaning	Tone	Meaning	Tone
1.	/cha/	Ask	Mid	Long	Mid	Road	Extra High
2.	/chə/	Flesh	Low	Do	High	Pain	Mid
3.	/da/	Cut	Extra High	Blame	Mid	Paste	Low
4.	/dzə/	Water	Extra High	Short	High	Lost	Low
5.	/lɛ/	Hot	Mid	Think	Mid	Enter	Low
6.	/pɛ/	Shoot	Low	Incline	Extra High	Bridge	Mid
7.	/pu/	Tell	Extra High	Loan	Mid	-	-
8.	/sɛ/	To use	Extra High	Three	Mid	To please	Low
9.	/si/	Cold	Low	Know	Mid	Wood	Extra High
10.	/ti/	Time	Extra High	Sky	Extra High	Black	Low

Note. **(-) in the table indicates no word in that column.**

words were 60 for each language. At this point, 10 monosyllabic words along with its minimal pairs were randomly considered to be utilised in the study.

3.3 Ethical standards

The participants were informed about the nature of the study, and written consent was taken from each of the participants before the study.

3.4 Procedure

3.4.1 Recording:

The participants were presented with ten printed monosyllabic word list together with the minimal pairs and the meanings in English. Each participant was asked to read the word list before the recording to get comfortable and familiar with each monosyllable word. After that, the participants were asked to read each monosyllable word together with their minimal pairs in a moderately loud and clear voice, with two to three-second pauses between each word. A total of 30 words were recorded for each participant in Khezha and 29 words in Tenyidie. The Mi dual Driver in-ear earphones recorded each speech as a .wav sound file via Praat. The sound files were recorded in a completely silent environment to avoid any noise interference.

A total of 1593 words were recorded from both the languages. 810 sounds were Khezha, of which 450 words were produced by Group K and 360 words by Group TK. Similarly, a total of 783 sounds were recorded in Tenyide, with 435 belonging to Group T and 348 to Group TK.

3.4.2 Segmentation of Consonants and vowels:

By carefully listening to the sound sample and examining the spectrogram, consonants and vowels were segmented. The pitch was segmented into three parts, the curve part (on-glide), the main part (tone), and the dropping part (off-glide). The

initial consonant is represented by the on-glide, whereas the vowel is represented by the tone and off-glide (Lin, 1995). As a result, the beginning of the pitch was ignored and vowel measurement began where the wave form of the F0 became periodic and concluded where the wave form became irregular or stopped vibrating. After that, the sound samples were annotated by converting them to a Praat text grid file (version 6.1.49). Some sounds were distorted and accompanied by noise, so a total of 23 sounds were eliminated from the main data. Out of the 1593 sounds, 1570 were segmented.

3.5 Data Analysis:

A Praat script was run on the annotated text grid file, which extracted the Average F0, duration and the F0 at every 2 %, 4%, 6%.....100 % of the segmented vowel in an excel sheet. Due to Praat auto correlation feature 49 sounds were not represented from Group TK Tenyidie words, 20 from Group TK Khezha words, 61 from Group T and 44 from Group K. A total of 174 sounds had at one point or the other an undefined value or missing value in the extracted F0 at every 2 %, 4%, 6%.....100 %. The missing values words were removed and a total of 1396 sounds were further run on R programming.

The R program normalizes the F0 of every 2 %, 4% ….100% to normalized Z-score scale in order to facilitate cross-subject comparison. Z score normalization was used to remove between speaker differences. Rose (1991) reported that the z-score normalization procedure to be superior in normalizing the F0.

The z-score normalization procedure is:

$$NP_n = (F0_i - x)/SD.$$

NP_n = normalized z-score of a sampling point

x = average F0 of all sampling points

F0i = sampling point,

SD = standard deviation of the average of all the sampling points.

3.5.1 Tone identification

The normalized z-score for each group were separated into different excel sheet and was averaged for a single normalised F0 value for all the words of the language. The minimum and maximum z-score was estimated for each language. To make it more objective the range was divided into three equal part for Khezha to identify the words into tones: Low, Mid, and High and four equal ranges for Tenyidie, to identify as Low, Mid, High and Extra High tone. The range for Khezha tone is displayed in table 3.8 and table 3.9 for Tenyidie tones.

The graph of each word was produced using the R programming package ggplot2, and the words were recognised based on which range the z-score for that word falls on. Example of one of the words for Khezha is displayed in figure 3.1 and Figure 3.2 for tenyidie. Overall graph for all the words in a language for each group is displayed in Figure 3.3 for Group K, Figure 3.4 for Group T, Figure 3.5 for Group TK- Khezha and Figure 3.6 for Group TK- Tenyidie. It is based on the averaged normalized z-score value of each group.

Table 3.10

z-score range for different tones of Khezha

Tone Range for Khezha	
Range	**z- score**
Min Range	-1.21
Max Range	1.85
Low Range	-1.21 to -0.19
Mid Range	-0.19 to 0.83
High Range	0.83 to 1.85

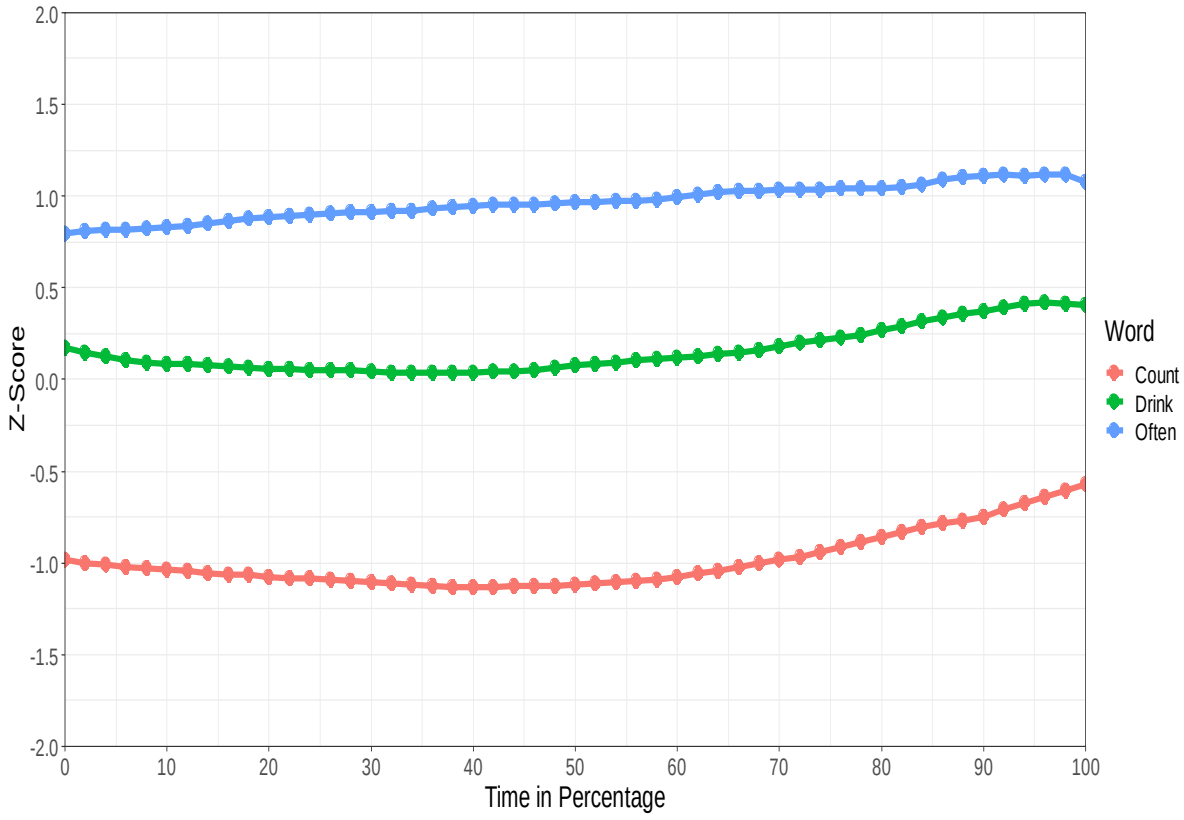
Table 3.11

z-score range for different tones of Tenyidie

Tone Range for Tenyidie	
Range	**z- score**
Min Range	-1.50
Max Range	1.69
Low Range	-1.50 to -0.70
Mid Range	-0.70 to 0.09
High Range	0.09 to 0.89
Extra High Range	0.89 to 1.69

Figure 3.1

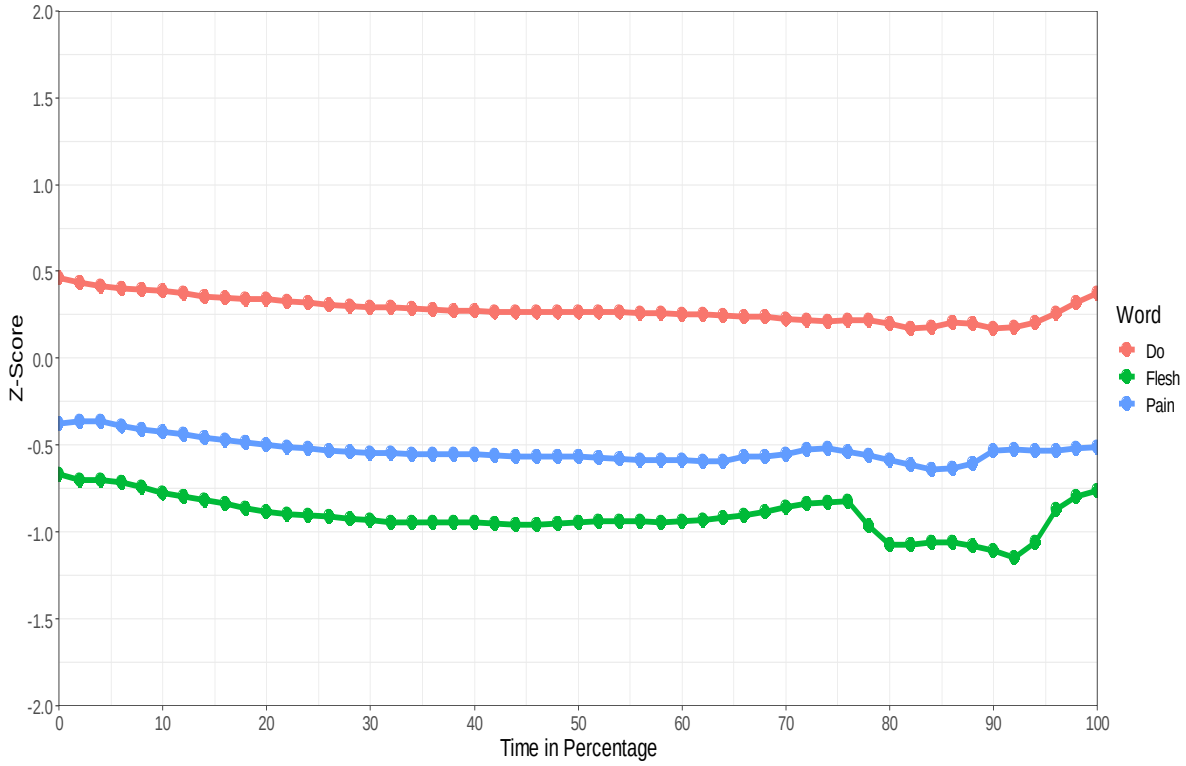
Group K Normalized F0 z-score for the word /so/ with three meaning



Note. **Blue = High tone, Green= Mid Tone and Red= Low tone**

Figure 3.2

Group T Normalized F0 z-score for the word /chə/ with four meaning



Note. **Blue = Mid tone, Green= Low Tone and Red= High tone**

Figure 3.3

Group K Normalized z-score Pitch contour for all words

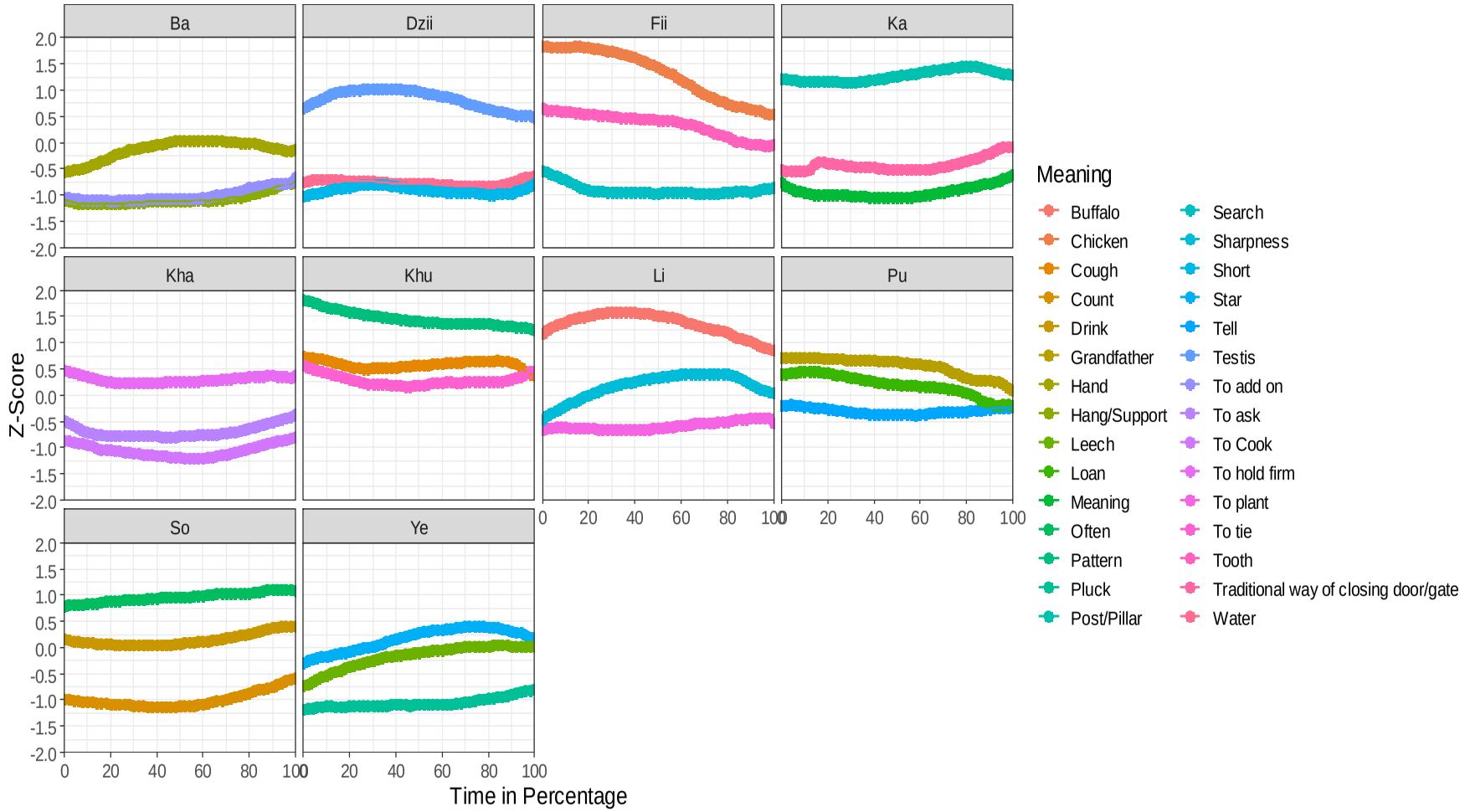


Figure 3.4

Group T Normalized z-score Pitch contour for all words

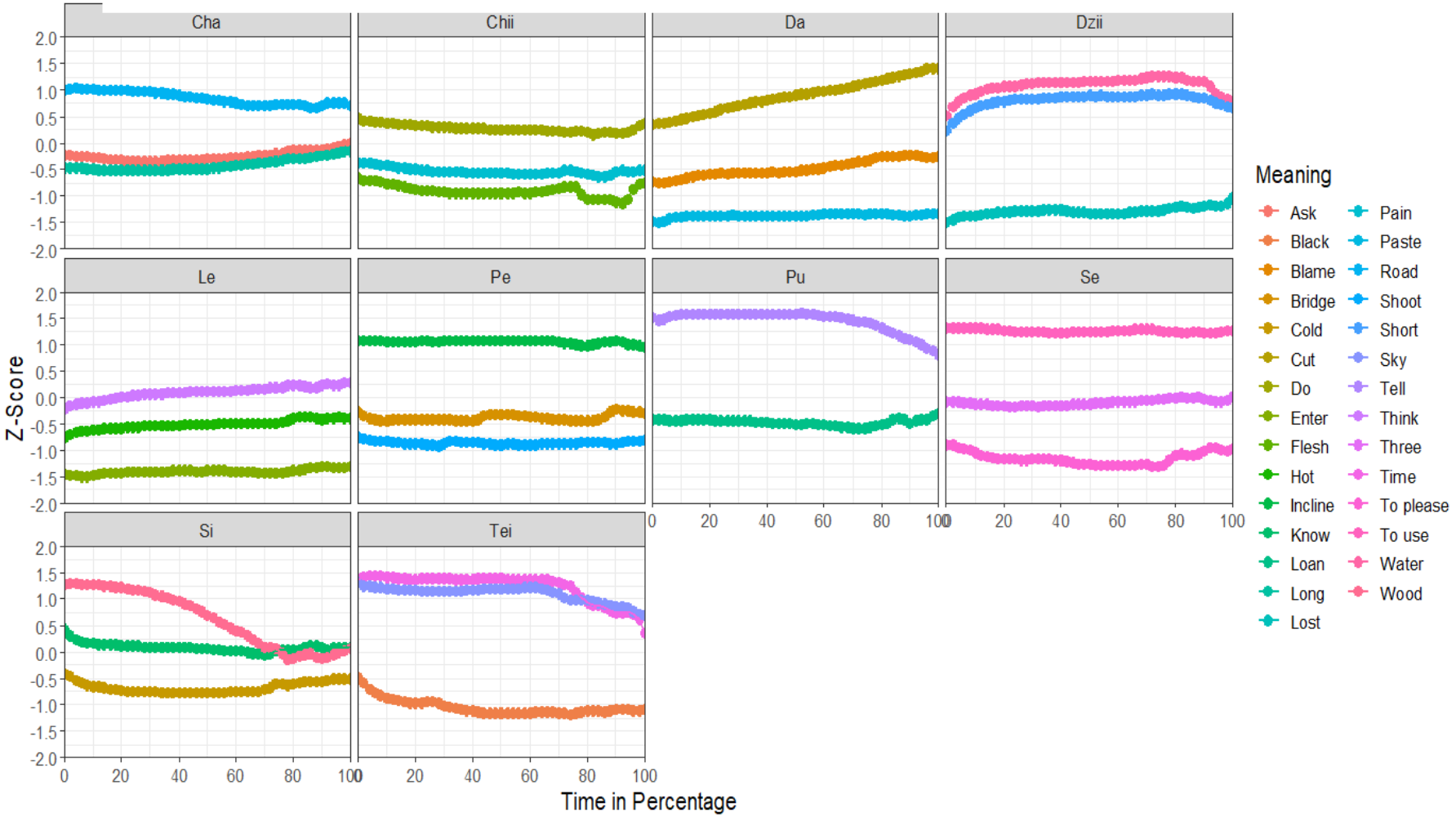


Figure 3.5

Group TK- Khezha Normalized z-score Pitch contour for all words

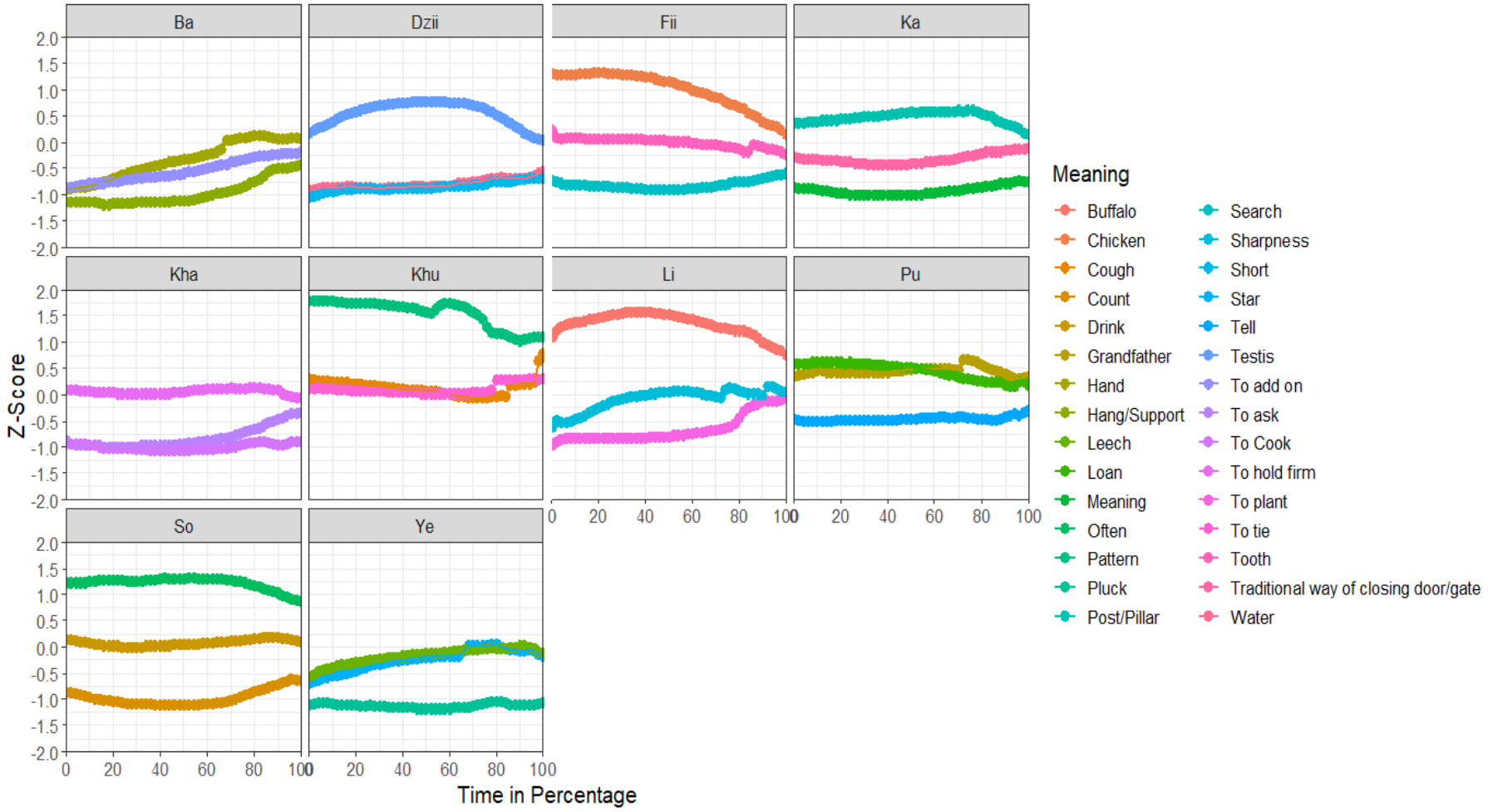
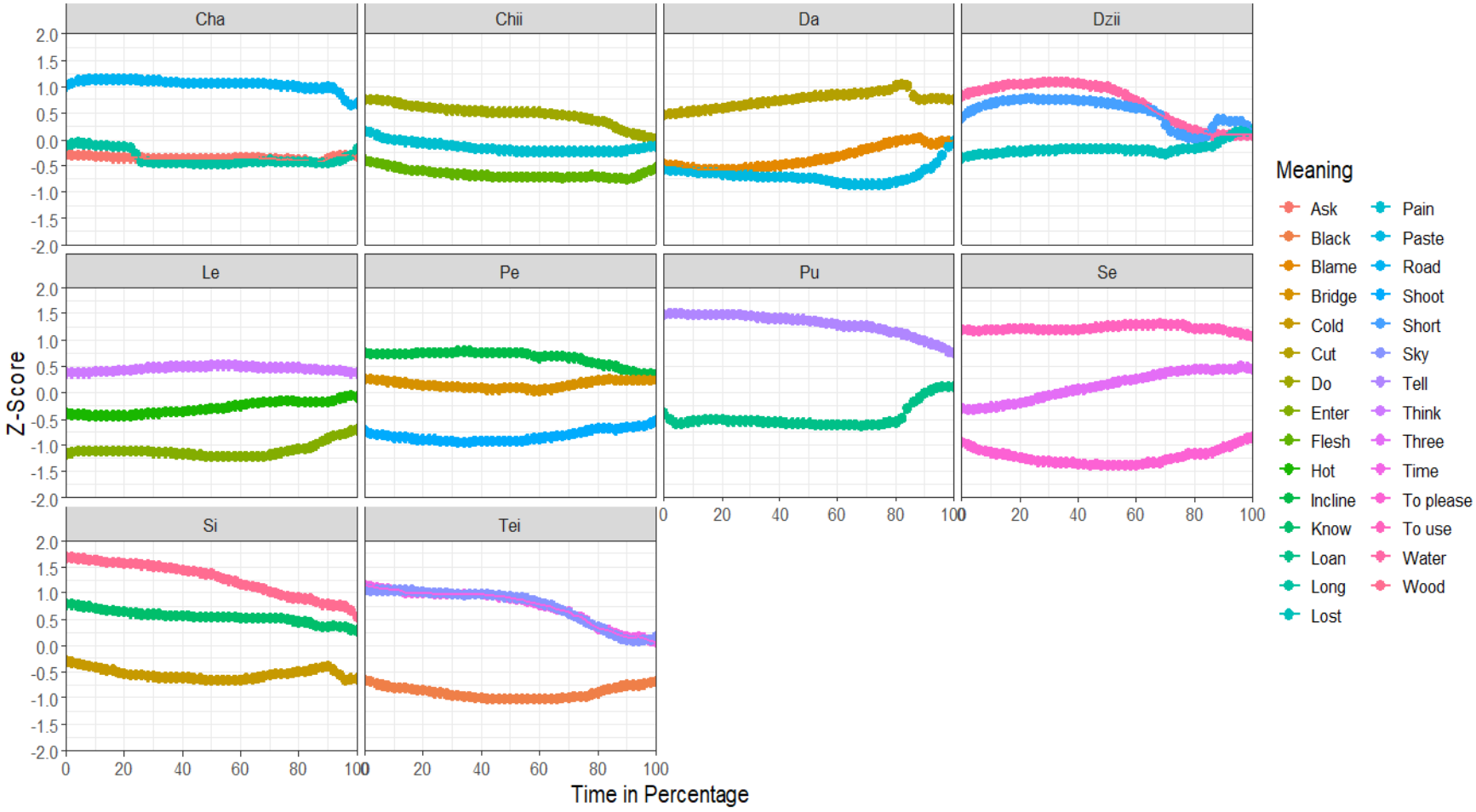


Figure 3.6

Group TK- Tenyidie Normalized z-score Pitch contour for all words



3.5.1 Acoustic analysis

1. Average Fundamental Frequency

The Praat script was used to extract the mean fundamental frequency of the segmented vowel in each word, and then the words were averaged for male and female tones individually.

2. **Duration**

The Praat script was used to extract the duration of the segmented vowel in the monosyllabic word, which was then averaged to represent the duration of each tone.

3. Pitch contour

Each word was separated by tone, and the normalised Z-scores for each tone were averaged to provide a final normalised Z-score. Using the R programming software package ggplot2, the pitch contours of each tone were shown in one combine graph.

3.6 Statistic

The normalized z-score for each participant was averaged based on the tone and this data was subjected to statistical analysis using the "SPSS 20" software. Statistical test such as repeated measure ANOVA, Huynh-Feldt and Bonferroni test was carried out to answer the research question.

CHAPTER 4

RESULTS

The primary aim of the present study was to compare the acoustic features of tones in two Naga (Tenyidie and Khezha) languages. The secondary aim was to compare the acoustic characteristics between monolingual and bilingual speakers of Khezha. The results of the study are discussed in the following heading for each group:

- Comparison of Fundamental frequency (F0) of lexical tones in Khezha
- Comparison of duration of lexical tone in Khezha
- Comparison of Fundamental frequency (F0) lexical tone in Tenyidie
- Comparison of duration of lexical tone in Tenyidie
- Comparison of Fundamental frequency (F0) lexical tone between monolingual and bilingual Khezha
- Comparison of duration of lexical tones between monolingual and bilingual Khezha
- Comparison of Fundamental frequency (F0) lexical tones between monolingual and bilingual Tenyidie
- Comparison of duration of lexical tones between monolingual and bilingual Tenyidie

4.1 Comparison of Fundamental frequency (F0) lexical tone in Khezha

A total of 450 words were produced by Group K (monolingual), which had 15 participants. Six words were removed during segmentation due to poor sample quality, and forty-four samples were removed after running the Praat script due to missing data. There were 400 samples in total that were examined.

4.1.1 Comparison of mean Fundamental frequency (F0) of the three lexical tones

The Praat Script was used to extract the mean F0 for every word and it was further segregated based on the tones and a final mean F0 was taken for both Male and Female participants. Figure 4.1 represent the Mean F0 value of male and female participants for Khezha tones. Figure 4.2 Represents the three Khezha tone.

Figure 4.1

Mean F0 of the three Khezha tones for both the Male and Female participants

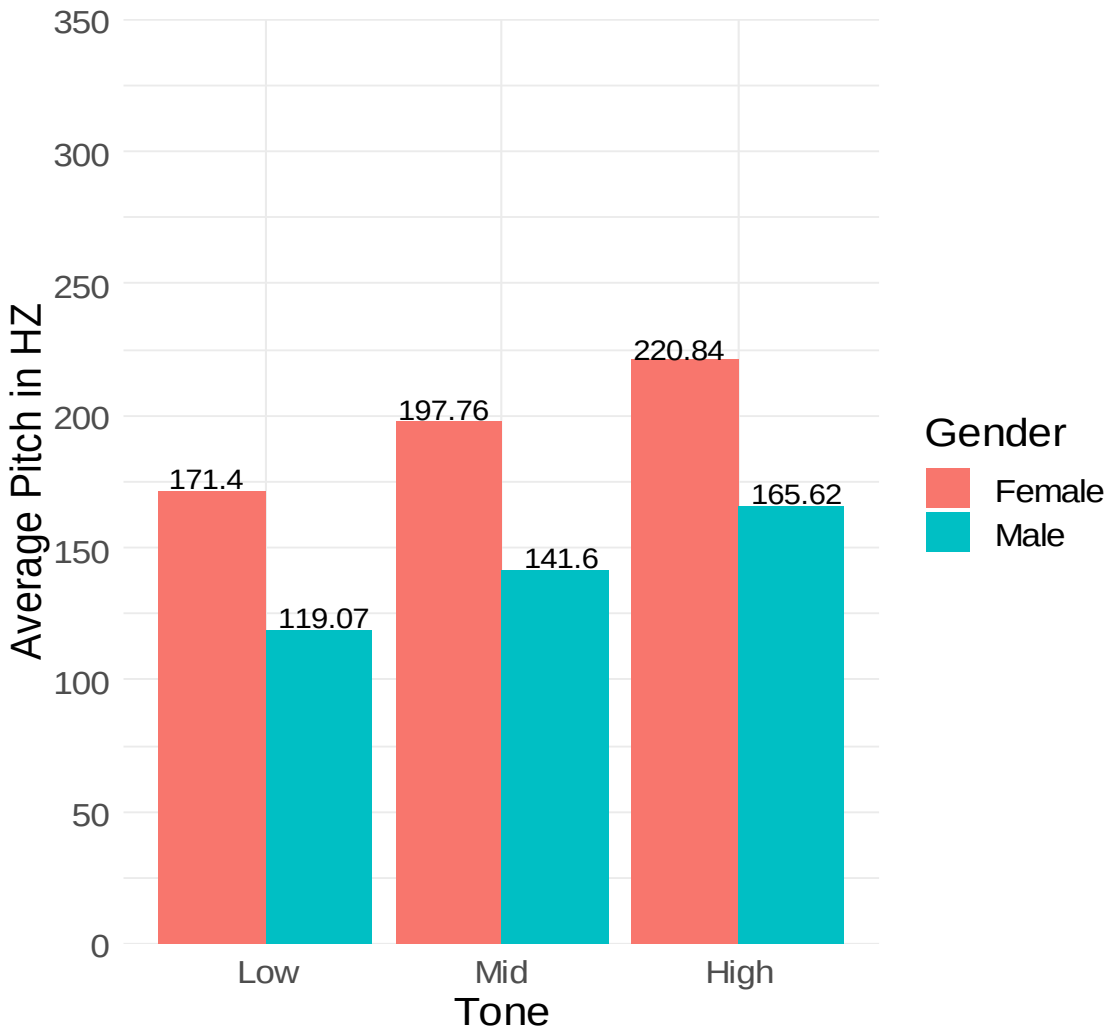
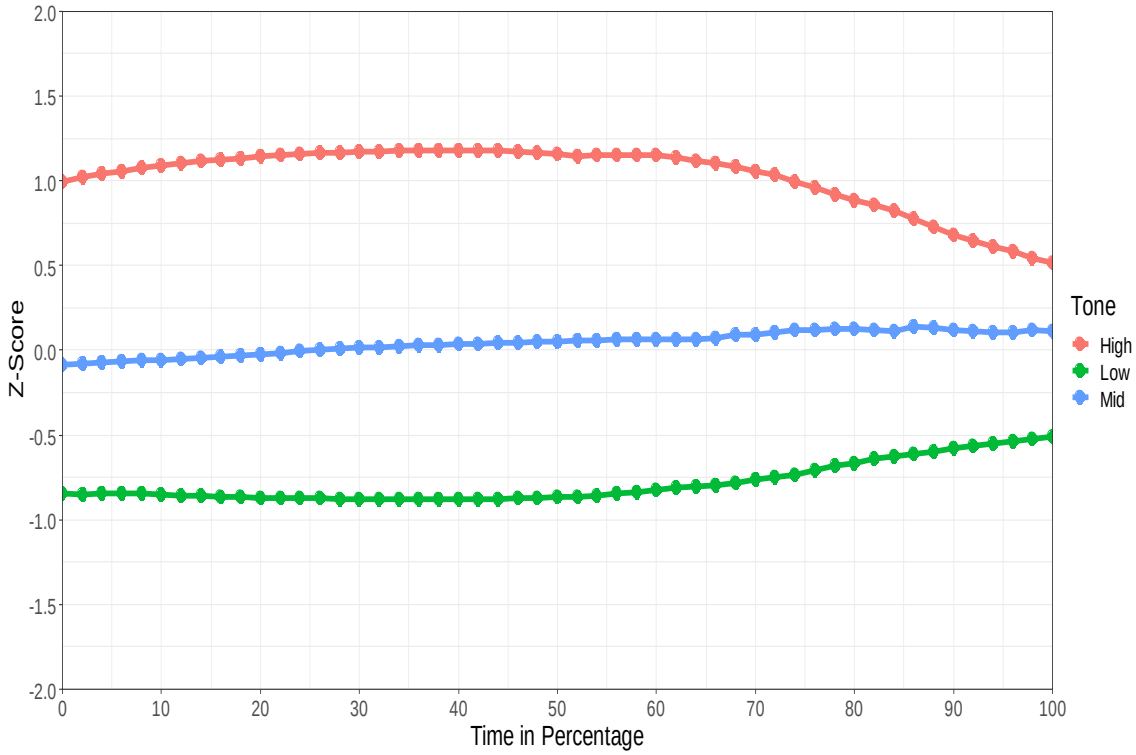


Figure 4.2

Pitch Contour of the three Khezha Tones



4.1.2 Normalized F0 of the tones

The normalised F0 value at every 2%, 4%... 100% was averaged for all the tones for each participant and was used to determine the main tone effect. A repeated measures ANOVA was conducted. Results indicated significant main effect of tone ($F(1.40, 19.60) = 465$, $p<0.001$) indicating that there was a statistically significant difference between the normalized F0 of the three tones. A post hoc analysis was further done. Bonferroni test indicated significant difference between the normalised F0 of low tones, mid tone and high tone ($p<0.001$). The high tone had the highest normalised F0 1.20 (SD: 0.23) followed by mid tone 0.23 (SD: 0.09) and low tone F0 -0.81 (SD: 0.12).

4.2 Comparison of duration of three lexical tones in Khezha

The segmented vowel duration was extracted by the Praat script and the mean duration of the tones were obtained from each participants of Group K (monolingual). To determine the main duration effect, a repeated measures ANOVA was conducted. Results indicated significant main effect of duration ($F(1.46, 20.55) = 57.66$, $p<0.001$) indicating that there was difference between the duration of the three tone of Khezha.

A post hoc analysis was further done. Bonferroni test indicated significant difference between the duration of the low tones, mid tone and high tone ($p<0.001$). The mid tone 276.65ms (SD: 49.08) had the longest duration followed by low tone duration 232.38ms (SD: 36.92) and high tone 208.4ms (SD: 35.02).

4.3 Comparison of Fundamental frequency (F0) of lexical tones in Tenyidie

A total of 435 words were produced by Group T (Monolingual), which had 15 participants. Six words were removed during segmentation due to poor sample quality, and sixty one samples were removed after running the Praat script due to missing data. There were 368 samples in total that were examined.

4.3.1 Mean Fundamental frequency (F0) of the tones

The Praat Script was used to extract the mean F0 for every word and it was further segregated based on the tones and a final mean F0 was taken for both Male and Female participants. Figure 4.3 represent the Mean F0 value of male and female participants of Tenyidie tones. Figure 4.4 Represents the four Tenyidie tone.

Figure 4.3

Mean F0 of the four Tenyidie tones for both the Male and Female participants

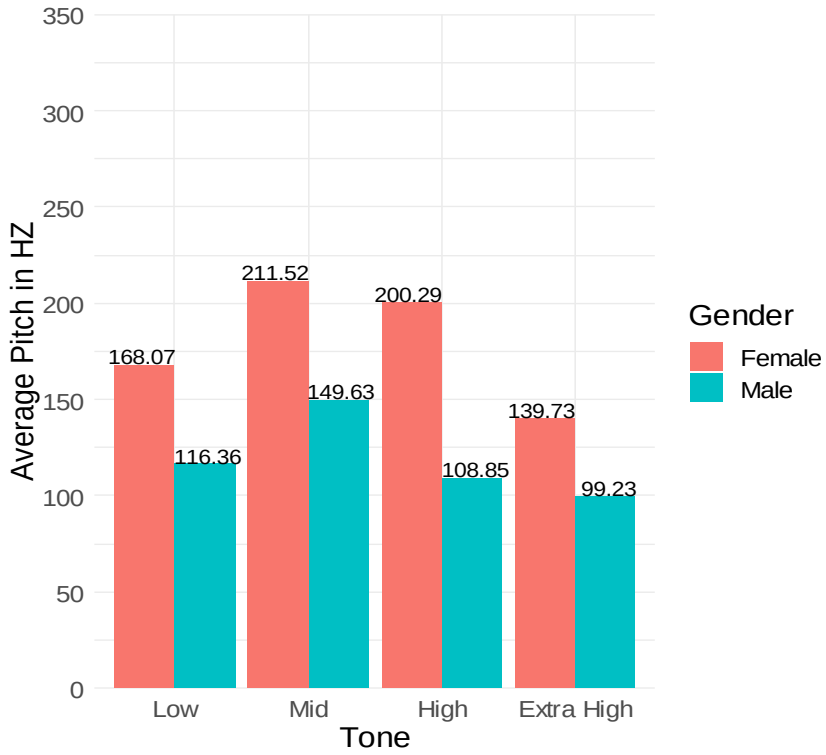
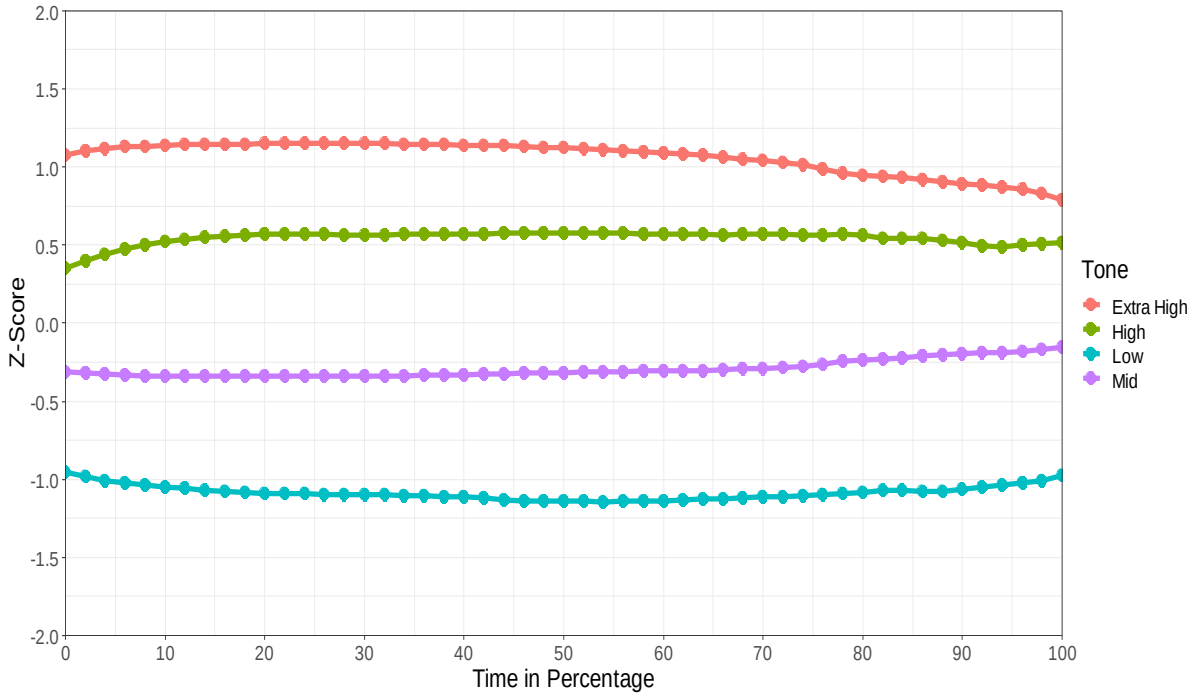


Figure 4.4

Pitch Contour of the four Tenyidie Tones



4.3.2 Normalized Fundamental frequency (F0) of the tones

The normalised F0 value at every 2%, 4%... 100% was averaged for all the tones for each participant and was used to determine the main tone effect, a repeated measures ANOVA was conducted. Results indicated significant main effect of tone ($F (2.62, 36.68) = 272.12$, $p<0.001$) indicating that there was a statistically significant difference between the normalized F0 of the four tones of Tenyidie. A post hoc analysis was further done. Bonferroni test indicated significant difference between the normalised F0 of low tones, mid tone, high tone and extra high tone ($p<0.001$). The extra high tone had the highest normalised F0 1.10 (SD: 0.17) followed by high tone 0.54 (SD: 0.22), mid tone -0.31 (SD: 0.20) and low tone F0 -1.04 (SD: 0.21).

4.4 Comparison of duration of lexical tones in Tenyidie

The segmented vowel duration was extracted by the Praat script and the mean duration of the tones were obtained from each participants. To determine the main duration effect, a repeated measures ANOVA was conducted. Results indicated no statistically significant main effect of duration ($F (1.88, 26.39) = 3.27$, $p>0.05$) indicating that there was no difference between the duration of the four tones of Tenyidie. A post hoc analysis was not carried out as there was no significant main effect of duration. The mean duration for low tone 254.75ms (SD: 48.29), mid tone 287.49ms (SD: 53.22), high tone 292.12ms (SD: 78.80) and extra high tone 283.65ms (SD: 56.37).

4.5 Comparison of lexical tone between monolingual and bilingual Khezha

The normalised F0 value at every 2%, 4%... 100% was averaged for all the Khezha tones for each participant in both the group and a repeated measure ANOVA

was conducted to determine if there is any difference in the mean F0 and normalized F0 in between the two groups: Monolingual (Group K) and bilingual (Group TK).

4.5.1 Mean F0 of the tones

The Praat Script was used to extract the mean F0 for every word and it was further segregated based on the tones and a final mean F0 was taken for both Male and Female participants. Figure 4.6 represent the Mean F0 value of the three tone of Khezha for male monolingual and bilingual group and Figure 4.7 represent the Mean F0 value of the three tone of Khezha of female monolingual and bilingual group.

Figure 4.5

Mean F0 of the three Khezha tones for Male monolingual and bilingual group

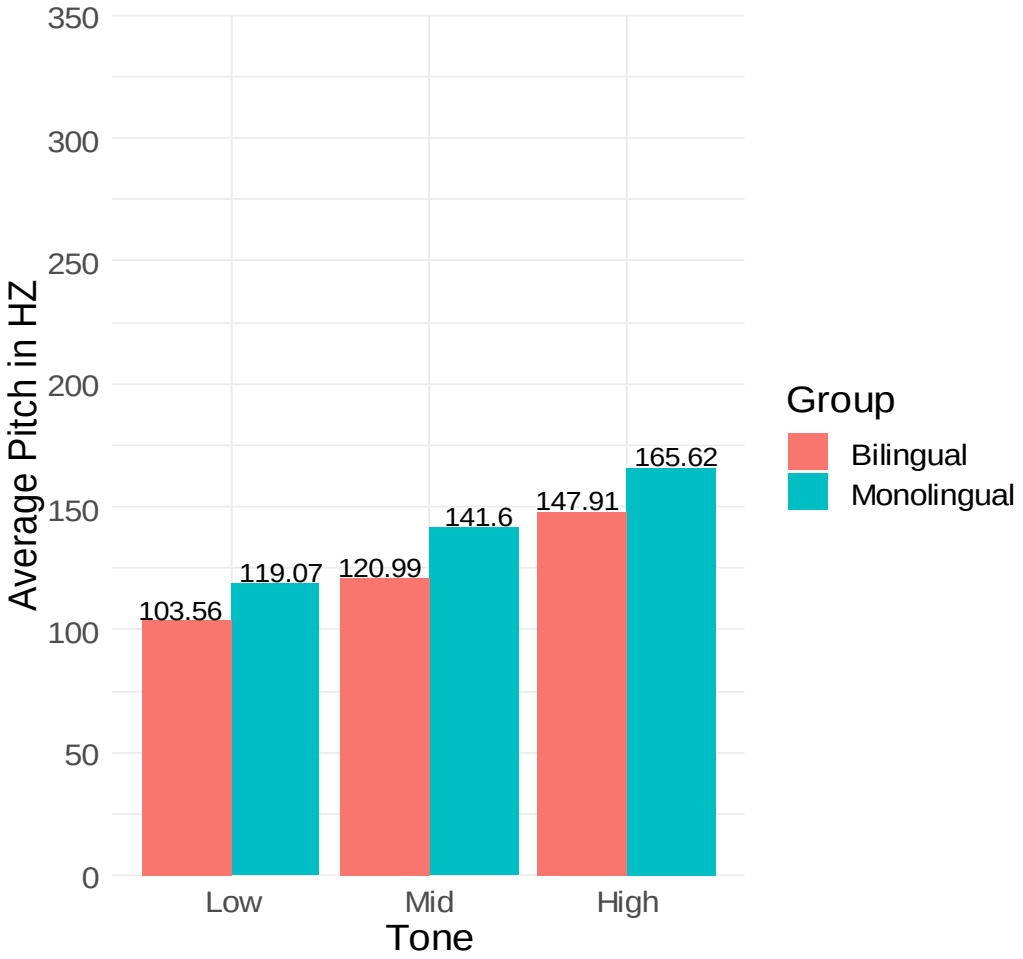
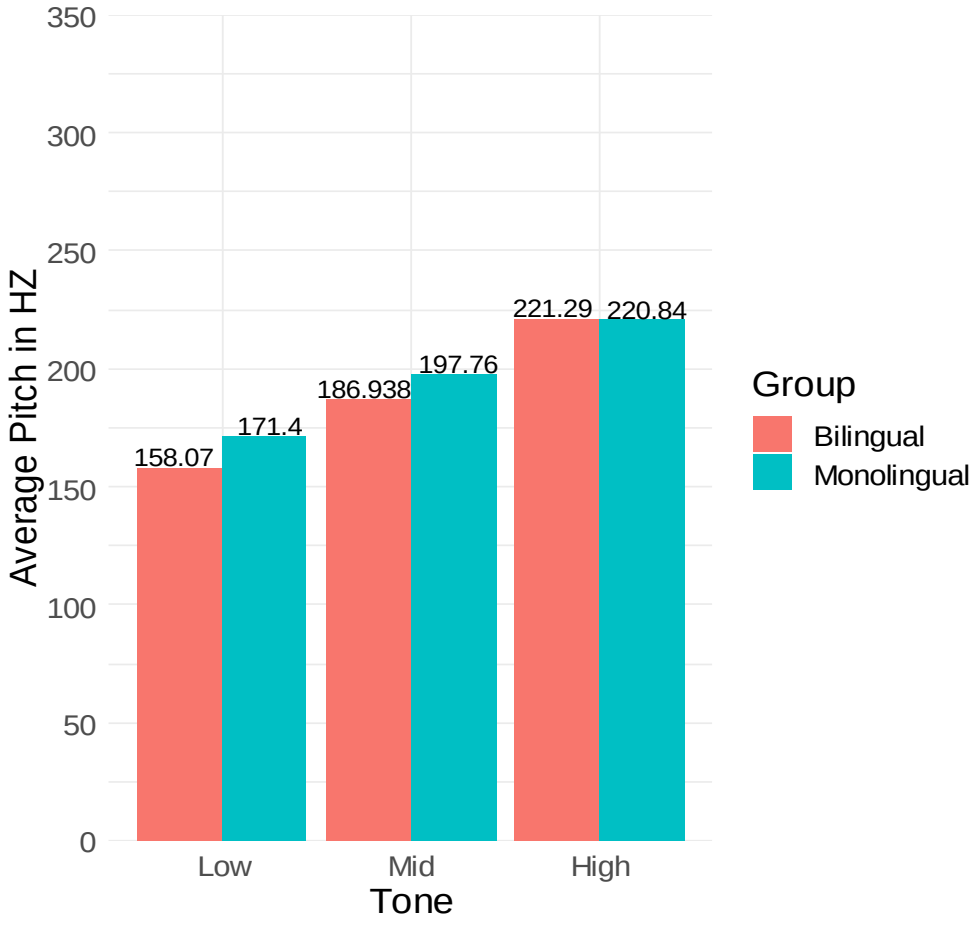


Figure 4.6

Mean F0 of the three Khezha tones for female monolingual and bilingual group



4.5.2 Normalized F0 of the tones

Results test indicated that the main tone effect was significant (F (2, 50) = 412.68, P<0.001). There was a significant difference between the different tone: low, high and mid. The main group effect was significant (F (1, 25) = 6.62, P<0.05) indicating that there is statistically significant difference between the two groups. The interaction effect between the tones and group was not significant (F (2, 50) = 2.11, P> 0.05). Hence Post hoc analysis was not carried out.

4.6 Comparison of duration of lexical tone between monolingual and bilingual Khezha

RANOVA was conducted to examine the main duration effect. It indicated statistically significant ($F(1.65, 41.32) = 48.67$, $P<0.001$) difference between the duration of the three tones. The main group effect was not significant with $F(1, 25) = 1.990$, $P>0.05$. It indicated that there was no difference between the two groups. The interaction effect of duration with group indicated no significant difference between the duration of the tones and the groups ($F(1.65, 41.326) = 0.429$, $P>0.05$). Post Hoc analysis was done as there was a significant ($P<0.05$) main duration effect. Bonferroni test revealed significant difference between low vs. mid, high vs. low, and mid vs. high tones. The duration pattern was mid tone 289.91ms (SD: 12.83), low tone 241.93ms (SD: 8.81), high tone 224.29ms (SD: 7.47).

4.7 Comparison of lexical tones between monolingual and bilingual Tenyidie

The normalised F0 value at every 2%, 4%... 100% was averaged for all the Tenyidie tones for each participant for both groups and a repeated measure ANOVA was conducted to determine if there is any difference in mean F0 and normalized F0 in between the two groups: Monolingual (Group T) and bilingual (Group TK).

4.7.1 Mean F0 of the tones

The Praat Script was used to extract the mean F0 for every word and it was further segregated based on the tones and a final mean F0 was taken for both Male and Female participants. Figure 4.8 represent the Mean F0 value of the four tones of Tenyidie for male monolingual and bilingual group and Figure 4.9 represent the Mean F0 value of the four tones of Tenyidie female monolingual and bilingual group.

Figure 4.7

Mean F0 of the four Tenyidie tones for Male monolingual and bilingual group

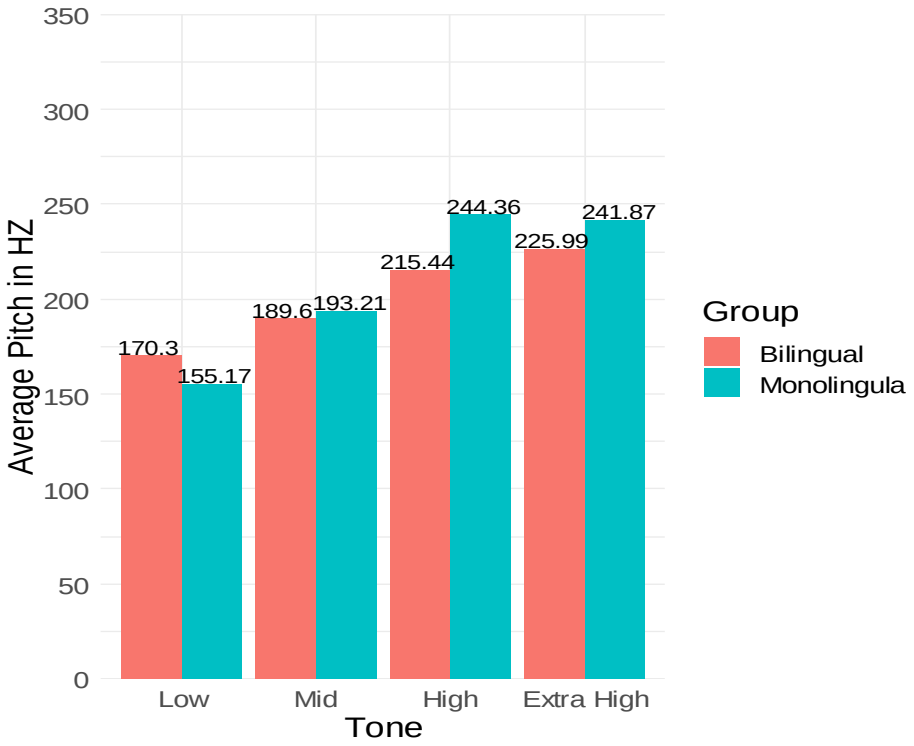
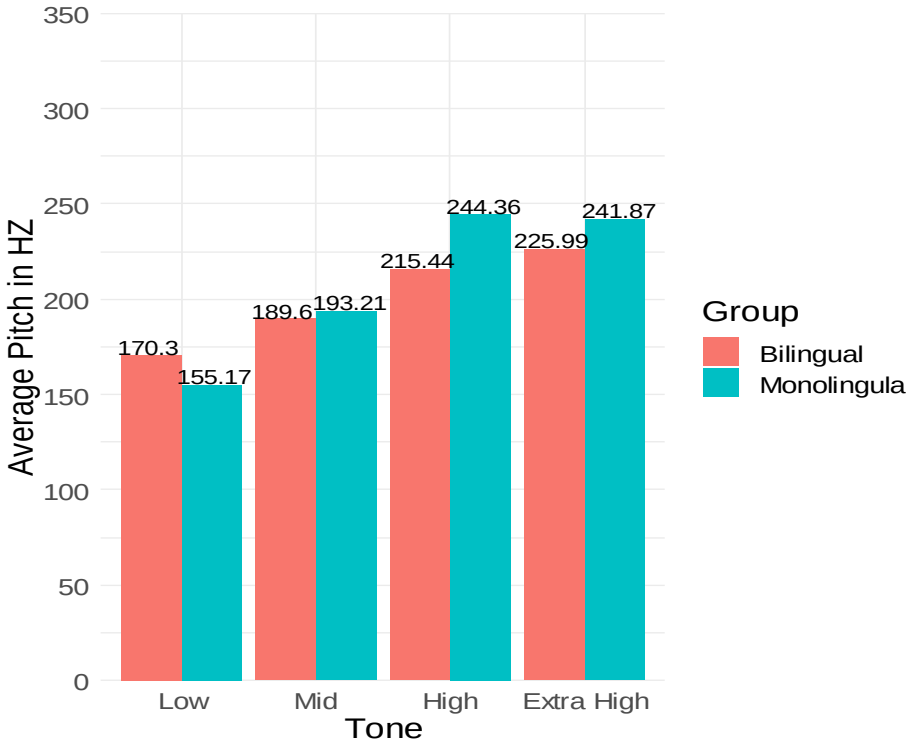


Figure 4.8

Mean F0 of the four Tenyidie tones for female monolingual and bilingual group



4.7.2 Normalized F0 of tones

RANOVA was conducted. The main tone effect indicated statistically significant (F (3, 75) = 259.32, p<0.001) difference between the type of tones: low mid, high, and extra high. The main group effect was not significant with F (1, 25) = 2.28, p>0.05. It indicated that there was no difference in between the two groups. The interaction effect of tone with group indicated significant (F (3, 75) = 5.35, p<0.05) difference between the tones and groups interaction. A post hoc analysis was done. Bonferroni test indicated significant (< 0.05) main tone effect between low vs. mid , low vs. high, low vs. extra high tone, high vs. mid tone, high vs. extra high tone. The extra high tone normalized mean F0 1.03 (SD: 0.05), high tone F0 0.50 (SD: 0.06), mid tone F0 -0.18 (SD: 0.45), and low tone -0.87 (SD: 0.05).

4.8 Comparison of duration of lexical tones between monolingual and bilingual Tenyidie

RANOVA was conducted. The main tone effect indicated significant (F (2.07, 51.78) = 11.618, p<0.00) difference in the four tone duration. The main group effect was not significant with F (1, 25) = 0.484, P>0.05. It indicated that there was no difference between the two groups. The interaction effect of duration with group indicated no significant difference between the duration of the tones and the groups with F (2.07, 51.785) = 0.66, P>0.05. Post Hoc analysis was done as there was a significant main duration effect. Bonferroni test revealed significant difference (p<0.05) between low vs. mid, low vs. high, low vs. extra high tone but not with high vs. mid tone, high vs. extra high tone. Low tone had the shortest duration among all the tones 241.69ms (SD: 8.68).

CHAPTER 5

DISCUSSION

The current study was undertaken since there were few acoustic studies on lexical tones in Naga languages, and it is one of the first studies in India's North-Eastern languages to compare the acoustic characteristics of monolingual and bilingual speakers. Though there are studies in other tonal languages around the world, the majority of them are concerned with non-tonal (L1) and tonal language (L1) speakers acquiring, identifying, and producing a tonal language L2 (Harrison, 2000; Hao, 2012, Yang, 2019; Yao et al. 2020), rather than the acoustic aspects of the tone. As a result, the purpose of the study was to see if there were any changes in the F0 and duration of tones in Khezha and Tenyidie and to examine if there were any differences in the F0 and duration of the tones in a monolingual and bilingual speaker. The results of the study were discussed under the following heading:

5.1 Comparison of Fundamental frequency (F0) of lexical tones in Khezha

The current study found a difference in the mean F0 of Khezha's three tones. The high tone had the highest mean F0, followed by the mid tone, while the low tone had the lowest mean F0. The interval between the low and mid tones, as well as the mid and high tones, was around 20 Hz which were similar to the results found by Coupe (2003) for MongsenAo (10 to 20 Hz). The findings of the Khezha are not unique among tone languages in terms of typology, and according to the findings of Rietveld and Gussenhoven (1985), pitch variations of 1.5 semitones (about 10 Hz) or more are reliably interpreted as prominent distinctions, i.e. a 10 Hz separation is adequate to identify two tonal groups. In the present study, we can state that the

tones of Khezha contrast in pitch height rather than pitch movement, as evidenced by the fact that all three tones were mostly level.

In literature, it is found that the mean F0 is not an absolute value of pitch rather, it is the speaker's own pitch range and the pitch of surrounding tones that is why a normalized F0 was done in the present study. Statistical results of the normalized F0 indicated a significant difference between the three tones: low vs. mid, mid vs. high and high vs. low of Khezha. Hence, we can state that the three tones of Khezha are different from each other and that F0 plays a role in identifying the three tone of Khezha.

5.2 Comparison of duration of three lexical tones in Khezha

The results of the duration of Khezha's low tones, mid tones, and high tones indicated significant difference between the three tones. The mid tone had the greatest length at 276.65ms, followed by the low tone at 232.38ms and the high tone at 208.4ms, being the shortest. Similarly, in Thai dialects, Gandour (1997) found that vowels with high tones had shorter duration than vowels with low tones. The same could be noticed for Khezha duration of tones. Although there are a few considerations, research has shown that duration plays a role in identifying acoustic cues for tones throughout time (Gandour, 1977; Joseph & Burling, 2001, Liu & Samuel 2004; Sarmah& Wiltshire, 2010; Kwon 2011). In the present study, we can say that duration plays a role in identifying the three tones of Khezha.

5.3 Comparison of Fundamental frequency (F0) of lexical tones in Tenyidie

In the literature, Tenyidie tones are identified as five tones: high, high-low, mid, low-high, and low (Ravindran, 1974; Burling, 1960; Kuolie, 2006). However, Dutta et al. (2012) conducted a statistical study and reported only four tones as phonetically unique. Meyase (2014) reported the fifth tone being a bi-tonal, which is

a combination of the mid and the high tone, but it was more of a phonological tone than a phonetic tone. The present study identified four tones similar to Dutta et al. (2012) and Blankenship et al. (1993).

The current study found a difference in the mean F0 of Tenyidie's four tones. The extra high tone had the highest mean F0, followed by the high tone and mid tone, while the low tone had the lowest mean F0. But with bilingual female speakers, the mean F0 of extra high tone 241.87Hz was lower than the high tone 244.36 Hz by 3 Hz. This could be because the high tone had the average value of only two words, whereas the extra high had nine words. Statistical results of the normalized F0 also indicated a significant difference between the low tones, mid tone, high tone and extra high tone of Tenyidie. The extra high tone had the highest normalized F0 1.10 value, followed by high tone 0.54, mid tone -0.31 and low tone F0 -1.04.

The interval between the four tones was around 15-50 Hz for Tenyidie tones which was similar to the findings by Blankenship *et al.* (1993) in the Khonoma dialect of Angami/ Tenyidie, where the four level tones were separated by intervals of between 20 to 30 Hz. Based on Rietveld and Gussenhoven (1985), we can say that the four tones of Tenyidie were prominent as they have a pitch variation of greater than 10 Hz.

The F0 does play a role in tone identification; however, this varies depending on the language type and tone system (level or contour tone). Sarmah and Wiltshire (2010) reported no difference in the average F0 for the rising vs. low tones and the falling vs. high tones in identifying the tone types in Mizo. In contrast, Veikho, Lemaina, and Sarmah (2018) reported differences in the average F0 of all four tones: high-falling, mid-falling, rising-falling and low-falling and that the average F0 is

highly linked to the tone type. Based on the current findings and literature, we can conclude that F0 plays a role in the tone identification of Tenyidie tones.

5.4 Comparison of duration of lexical tones in Tenyidie

Statistical results of the duration of tones in Tenyidie indicated no significant difference between the duration of the low tone, mid tone, high tone, and extra tone of Tenyidie. Similar findings were found by Sarmah, Wiltshire, and Hong (2013) for the two contour tones of Tiwa. On the other hand, Teo (2014) found duration differences for the three level tones of Sumi.

The duration of the tone-bearing unit does get affected by many contextual factors (Kong, 1987; Svantesson, 1988; Xu, 1997; Joseph & Burling, 2001; Samrah& Wiltshire, 2010; Samrah, Wiltshire, & Hong 2013) and in the present study different consonants and vowels were used to produce the tone, and this could have affected the duration of the tone.

5.5 Comparison of lexical tone between monolingual and bilingual Khezha

The results of the current study showed that there was a significant difference in the two groups. Although the mean F0 of both groups differed by 10- 15 Hz, both groups exhibited high tone as the highest mean F0, followed by mid tone, and low tone as the lowest mean F0. Statistical results of the normalized F0 indicated difference in between the two groups but not with respect to thethree tones: low, mid, and high.

The interval between the low and mid tones, mid and high tones of the bilingual group was 20-30Hz, which was similar to the monolingual group intervals 20Hz. Based on the results, we can say that the bilingual speakers produced the same tones as monolingual speakers.

5.6 Comparison of duration of lexical tone between monolingual and bilingual Khezha

The results of the present study revealed no significant difference between the duration of the tones of the bilingual and monolingual groups. The duration pattern for both the group was mid tone being the longest, followed by the low tone and high tone being the shortest. Results from both the F0 and duration indicates that the monolingual and bilingual speakers of Khezha produced the same tones and that the L2 (Tenyidie) tones of bilingual speaker do not affect the L1 (Khezha) tone of a bilingual speaker.

5.7 Comparison of lexical tones between monolingual and bilingual Tenyidie

The results of the current study showed that there was no difference in the tones produced by monolingual and bilingual Tenyidie speakers. Both the groups had an extra high tone as the highest mean F0, followed by a high tone, mid tone, while the low tone had the lowest mean F0. Statistical results of the normalized F0 indicated no difference between the four tones: low, mid, high and extra high tones of a monolingual and bilingual speaker. The interval between the four tones of the bilingual group (10-20Hz) was similar to the interval of the monolingual group (15-50Hz). This indicated that the intervals between the four tones are similar for both groups.

Both the Tenyidie and Khezha fall under the same language family: Angami-Pochuri, and the tones in Khezha and Tenyidie shows phonetic similarity, and this could be one reason why the tones were similar for the two groups. The L1/L2 phonetic similarity is important because L2 learners often need to map/ assimilate L2 sounds to their first language (L1) and how such mapping/assimilation takes place shapes the learning of L2 speech sounds (Flege, 1987, 1995). A noteworthy

observation made from the comparison of Tenyidie and Khezha word list was the mirroring of tones. A low tone in Khezha is produced as a high or extra high in Tenyidie. For example: 'Short'/dzə/ in Khezha is low tone whereas in Tenyidie it is produced as a high tone, 'tell'/pu/ in Khezha it is a low tone whereas in Tenyidie it is an extra high tone. Similar findings were found by Teo (2014) for the Angami-Pochuri language family.

Another reason for similar tone production between the monolingual and bilingual groups could be that the acquisitions of L2 sounds are influenced by the amount of L1's sound inventory in comparison to L2 and Khezha has greater vowel inventory / a, e, i, o, u, ə, ɵ / (Kapfo, 2005) compared to Tenyidie: 6 vowel inventory of / a, e, i, o, u, ə / (Kuolie, 2006). According to studies on vowel perception, the L2 learners who have a larger and more complex L1 vowel inventory were better at L2 vowel learning than those who have a smaller L1 vowel inventory (Iverson & Evans, 2007, 2009).

The majority of the study participants have also been exposed to the Tenyidie (L2) language for more than 15 years, which may have caused bilingual speakers to produce tones comparable to monolingual speakers. According to Zhang et al. (2018), when L2 is exposed to a high variable, the speaker becomes more sensitive to pitch height and learns tones that are not available in L1. Hao (2012) reported that second language (L2) learners from tonal backgrounds perceive and articulate pitch contours appropriately. Based on the results and literature, we can say that bilingual speakers produce the same tones as monolingual speakers.

5.8 Comparison of duration of lexical tones between monolingual and bilingual Tenyidie

The results of the present study revealed no significant difference between the duration of the four tones of the bilingual and monolingual groups. There was no durational difference between the four tones. Results from both the F0 and duration indicates that the monolingual and bilingual speakers of Tenyidie produced the same tones and that the L1 (Khezha) tones of bilingual speaker do not affect the L2 (Tenyidie) tone of a bilingual speaker.

Overall we can conclude that the bilingual speakers (L1 Khezha and L2 Tenyidie) produced the same tones as a monolingual speaker of Khezha and monolingual speaker of Tenyidie and the reason for the bilingual groups to produce tones like the monolingual could be due to three factors: One, it could be due to the L1/L2 phonetic similarity, two it could be due to L1/L2 sound inventory size and the years of exposure to the language.

CHAPTER 6

SUMMARY AND CONCLUSION

The present study was conducted with the aim to compare the acoustic features of lexical tones in two Naga (Tenyidie and Khezha) languages and to compare the acoustic characteristics between monolingual and bilingual speakers of above mentioned languages.

To attain the goal forty-two adults in the age range of 20-78 years were recruited as participants for the study and were divided into three groups; Group T- Tenyidie, Group K- Khezha and Group TK- Tenyidie and Khezha. Language proficiency of the participants was assessed using LEAP-Q. The participants were asked to produce ten monosyllabic word lists together with the minimal pairs and the words were recorded. Each of the words was further segmented into consonants and vowel using Praat (version 6.1.49), then a Praat script was used on the segmented vowel to get the mean F0, duration and F0 at every 2%, 4%...100%. The F0 at every 2%, 4%...100% was further run in the R programming software (version 4.1.1) and a normalized F0 based on the z-score scale was produced. The normalized z-score was further used to identify the tones and produce the pitch contour. The mean F0, duration and normalized F0 was used to provide the acoustic feature for Khezha and Tenyidie lexical tones and to compare between monolingual and bilingual speakers of the language.

The findings of statistical analysis revealed statistically significant differences between the mean F0, normalised F0, and duration of the tones of Khezha's three lexical tones. The mean F0 and the normalised F0 of the four lexical tones of Tenyidie were likewise significantly different. The duration of Tenyidie's tones was

not statistically different for the four tones. When Khezha's monolingual and bilingual groups were compared, significant differences were found, but no variations in tones or duration were found. Tenyidie's monolingual and bilingual groups showed no significant differences in terms of the tone or duration of the tones.

Hence, the present study concluded that the three lexical tones: low, mid and high of Khezha are different from each other and the F0 and duration are cues for tone identification whereas, for Tenyidie the four lexical tones: low, mid, high and extra high are different from each other and only F0 plays a role in tone identification. Bilingual speakers (L1 Khezha and L2 Tenyidie) produced the same tones as a monolingual speaker of Khezha and monolingual speaker of Tenyidie and the reason for the bilingual groups to produce tones like the monolingual was due to the L1/L2 phonetic similarity, L1/L2 sound inventory size and the years of exposure to the language.

6.1 Implications of the study

1. The findings of the study enable the researcher to document the acoustic features of tones in Tenyidie and Khezha language and provide more insight into the acoustic characteristics of the two languages.

2. The study will provides more information on the acoustic cues for tone identification

3. The information is useful in assessment and intervention of communication disorders for individuals speaking tonal languages

4. The study extends the literature of bilingual phonology by furthering our understanding of an under-studied bilingual population

5. The study provides more frameworks for creating Cochlear Implant coding strategies for tonal language speakers

6.2 Limitations of the study

1. Unequal distribution of the words in between the tones of the language
2. Different vowels and consonants were present in the word list and this could have affected the tone and duration of the words
3. Focus was only on adult population
4. The L2 learners were exposed to the language from earlier age and this could have led them to be more proficient.

6.3 Future directions

1. The study can be done with equal number of words in each tone.
2. Comparing different vowels and consonants to see the effects on tone
3. Consider learners who had acquired L2 for shorter period of time
4. Considering tonal speakers with impaired hearing
5. Comparing different age groups tonal features
6. Considering a wider range of participants

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APPENDIX

LANGUAGE EXPERIENCE AND PROFICIENCY QUESTIONNAIRE

Name:
Participant code:
Age:
Gender: Male / Female
Date:

Instructions:
Please read the questions carefully and choose the most appropriate choice wherever applicable.

1. Name all the languages you know beginning with the language that you learnt first.

Using the below mentioned scale, answer the questions below.
(1- L1, 2 - L2, 3 - L3, 4 - Combination of any of the languages)
L1 - First language that you learnt
L2 - Second language that you learnt in your life,
L3 - Third language

2. When you were a child, which language did you speak
   - At Home 1 2 3 4
   - With your father 1 2 3 4
   - With your mother 1 2 3 4
   - With siblings 1 2 3 4
   - With guardians 1 2 3 4
   - With neighbours 1 2 3 4
3. Native Language of
   - Father 1 2 3 4
   - Mother 1 2 3 4
   - Siblings 1 2 3 4
   - Guardians 1 2 3 4
4. Language spoken with you by your
   - Father 1 2 3 4
   - Mother 1 2 3 4
   - Siblings 1 2 3 4
   - Guardians 1 2 3 4
   - Neighbours 1 2 3 4
5. Which language did you learn first for
   - Understanding 1 2 3 4
   - Speaking 1 2 3 4
   - Reading 1 2 3 4
   - Writing 1 2 3 4
6. Mention the age when you first started using each of the languages for each of the following parameters:

	Understanding	Speaking	Reading	Writing
L1				

L2
L3

7. Mention the age when you became proficient for each of the following parameters:

	Understanding	Speaking	Reading	Writing
L1				
L2				
L3				

8. How many years of formal education do you have? (please specify your qualification)

What was the medium of instruction?	1	2	3	4
Which language was used maximally?	1	2	3	4
Which language did you speak with teachers	1	2	3	4
Which language did you speak with classmates	1	2	3	4
Which language was spoken by your teachers with you	1	2	3	4
Which language was spoken by your classmates with you	1	2	3	4
Did you change your medium of instruction?	Yes		No	
If yes, specify the changed medium of instruction. At what age did you change your medium of instruction?	1	2	3	4

9. Have you changed your state? If yes, which language do you use to communicate? 1 2 3 4

10. On a scale from one to four, mark your level of proficiency in each of the skill.

(1 - Zero proficiency, 2 - Low, 3 - Good, 4 - Native like/perfect)

Language	Understanding	Speaking	Reading	Writing
L1				
L2				
L3				

11. How many dialects can you speak in each of the languages?

L1: L2: L3:

12. On a scale from one to four, mark your level of proficiency in each of the skill for each of the dialects in L1, L2, L3 ***(1 - Zero proficiency, 2 - Low, 3 - Good, 4 - Native like/perfect)***

	L1			L2			L3		
Dialect	D1	D2	D3	D1	D2	D3	D1	D2	D3
Understanding									
Speaking									

13. On a scale from one to four, mark your level of proficiency in shifting from one language to the other:

1-Zero proficiency **2- Low**

3- Good **4- Perfect**

14. Use the rating scale mentioned below, indicate which language you used maximum for the following:

(1- L1 , 2 - L2, 3 - L3, 4 - Combination of any of the languages)

Interaction with family	1	2	3	4
Education/ work	1	2	3	4
Listening to instruction tapes at school	1	2	3	4
Text books	1	2	3	4
Dictionary	1	2	3	4
Story books	1	2	3	4
Newspapers	1	2	3	4
Historical books	1	2	3	4
Internet source	1	2	3	4
Writing	1	2	3	4
Interacting with friends	1	2	3	4
Interacting with neighbours	1	2	3	4
Watching TV	1	2	3	4
Listening to the radio	1	2	3	4
Market places	1	2	3	4

15. On an average, mention below the time you are exposed to each of the languages.

Languages	Number of days per week	Number of hours per day
L1		
L2		
L3		

16. Mention the number of years you spent in each language environment:

Languages	Family	School	State	Work place
L1				
L2				
L3				

17. Using the rating scale mentioned below, indicate the extent to which you are currently exposed to each of the languages in the following contexts in a day.

(1- never, 2- sometimes, 3- most of the time, 4- always)

	L1	L2	L3
Interaction with family			
Schooling / work			
Listening to instruction tapes at school			
Text books			
Dictionary			
Story books			
Newspapers			
Historical books			
Internet source			
Writing			
Interacting with friends			
Interacting with neighbours			
Watching television			
Listening to the radio			
Market places			

18. Rate how frequently others identify you as a native speaker based on your accent or pronunciation in the language ***(1- Never, 2- Sometimes, 3- Most of the time, 4- Always)***

L1: L2: L3: