

The Phonetics and Phonology of Tones in Mizo



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Declaration

I declare that, the dissertation titled, “The Phonetics and Phonology of Tones in Mizo”, submitted by me to the Indian Institute of Technology Guwahati, for the award of the degree of Doctor of Philosophy in Linguistics, is an original work carried out by me under the supervision of Dr. Priyankoo Sarmah. I have not submitted the dissertation in any form to another university or institute for the award of a diploma or degree.

All external sources used for the completion of this dissertation have been acknowledged and cited according to the rules and regulations given by the Indian Institute of Technology Guwahati.



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Certificate

This is to certify that the dissertation titled, “The Phonetics and Phonology of Tones in Mizo”, submitted by Wendy Lalhminghlui (Registration Number: 146141014) is an authentic work carried out by her under my supervision. The dissertation fulfills all the requirements for the award of the degree of Doctor of Philosophy in Linguistics as prescribed by the Indian Institute of Technology Guwahati. The results of this thesis have not been submitted to any university or institute.



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*This thesis is dedicated to my family
and
the Mizos around the world*



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Abstract

This dissertation provides a comprehensive description of the tonal phonetics and phonology of Mizo, a Tibeto-Burman language. Previous studies have confirmed four lexical tones in Mizo, namely, high, low, rising, and falling. Since lexical tones can have different characteristics, this thesis attempts to characterize the four Mizo tones in terms of phonology and phonetics. The phonological analysis of the Mizo tones using the four distinct Mizo tones embedded in different contexts with certain word classes and morphological domains revealed that tones in Mizo could have tonal alterations. Specifically, the tones with prominent dynamic contours, such as falling and rising in Mizo, are more inclined towards tone alteration. The phonological tonal process called tone sandhi is attested in this dissertation, whereby a rising tone becomes a low tone when followed by a high or a falling tone. The investigation of rising tone sandhi domains provided evidence that the tonal context entirely triggers this phenomenon. Furthermore, the results of the production and perception tests of rising tone sandhi revealed that the derived low tone from rising tone sandhi is distinct from the canonical Mizo low tone, and the native speakers of Mizo were able to perceive the two tones categorically. Phonetic analysis of the Mizo tones using acoustic features such as fundamental frequency, duration, and dynamic nature in five contexts confirmed four lexical tones. This study also presents the gender differences in producing Mizo tones. The comparative analysis of the five contexts conveyed that tones produced in a more natural speaking style have smaller ranges of fundamental frequency and duration. Furthermore, the automatic classification of the tones in Mizo conducted using Quadratic Discriminant Analysis (QDA) and Random Forest (RF) revealed that the slope feature plays a crucial role in classifying the four Mizo tones. Besides the acoustic characteristics of the canonical tones in Mizo, this dissertation also provided the changes to the tone contours due to the effect of stop consonants and vowel types. The study of Mizo stop consonants revealed that the stops in Mizo conformed to the universal Voice Onset Time (VOT) patterns whereby the voiceless aspirated velar stop has the longest positive VOT, and the voiced unaspirated bilabial

stop has the highest negative VOT. The analysis of the formant frequencies of Mizo vowels also substantiated that there are five distinct vowels in Mizo with long vowel counterparts, namely, /a, i, e, u, o/. Further investigation confirmed the significant interaction between Mizo tones and segments.



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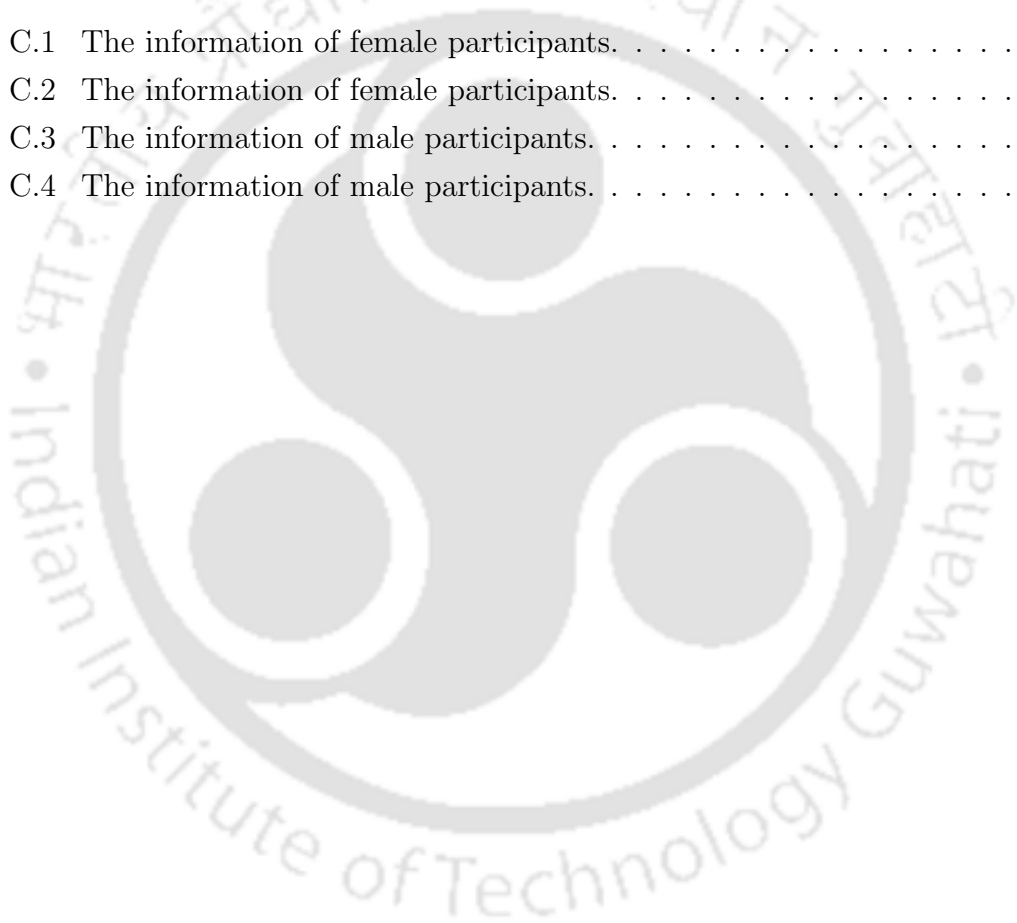
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Chapter 1

The Mizo Language

1.1 Introduction

This dissertation provides a phonetic and phonological description of tones in Mizo, a language spoken by the language community of the same name in the state of Mizoram in northeast India. As with several languages of the Tibeto-Burman subfamily, Mizo is a lexical tone language. In such a language, one syllable can be associated with specific lexical meanings, depending on the tone, i.e., the systematic variation of pitch. Some of the well-known lexical tone languages are Mandarin Chinese, Cantonese, Thai, etc., and a large body of studies on tones is dedicated to these major languages. Hence, little has been reported on the Tibeto-Burman languages spoken in South and Southeast Asia. Considering this, in this dissertation, a detailed systematic study of tones in Mizo is attempted with an emphasis on acoustic-phonetic aspects of the tones in the language.

Apart from filling up the void from the absence of systematic linguistic studies on Mizo, this work also has pedagogical implications. For instance, from linguistic descriptions, it is seen that the verbs in Mizo can have two forms caused by consonant alteration and tonal change. However, in the prescriptive grammar books of Mizo, this phenomenon is stated only as a consonant alteration, ignoring the tonal change. Hence, such pedagogical materials are incomplete without including studies on the

characteristics of segmental and suprasegmental phonemes in Mizo. Therefore, this research focuses primarily on the acoustic characteristics of segments and tones in Mizo, with the help of a large quantity of speech data obtained from native speakers. The first part of this dissertation details the phonological changes noticed in the realization of Mizo tones. The following part of this work focuses on the acoustic characteristics of tones and the interaction of tones with vowels and consonants. With the help of the acoustic studies, the final part of this work attempts at the automatic classification of tones in Mizo. The results of this work are expected to contribute to linguistics, speech signal processing, and language pedagogy.

The following Section 1.1.1 briefly describes the nomenclature of the Mizo language. The next Section 1.1.2 deals with the linguistic area of the Mizo-speaking community. Section 1.2 discusses the phylogeny of Mizo, and Section 1.3 presents the studies of the Mizo language. The research objectives and motivation of the dissertation are presented in Section 1.4. Section 1.5 discusses the methodology used for achieving the research objectives. Subsequently, Section 1.6 provides the organization of the dissertation.

1.1.1 The nomenclature used for the Mizo language

Many Tibeto-Burman languages are known to have alternative names. Mizo also belongs to the group of languages with two alternative names, namely, Lushai/Lusei and Duhlian/Dulien. Mizo is a term used for an ethnic group and the language spoken by the ethnic group. The native speakers of Mizo refer to the language as ‘Mizo Tawng’ and the ethnicity as Mizo. In the initial days of British colonial rule around the 1820s, the Mizos were referred to as Lushais. Hence, in the early works on the language, the Mizo language is referred to as Lushai or Lusei. It is reported that while several dialects of the Mizo language were spoken in the Lushai hills, the Duhlian dialect came to be recognized as the standard variety of Mizo. These dialect

speakers were the first who came in contact with the British officials. The patronage for the Duhlian dialect came from government officials and missionaries, as it was a variety spoken by the Sailos. The Sailo clan enjoyed superiority over the other Mizo clans as they occupied larger geographical areas.

Lewin (1874) mentions that the term ‘Lushai’ probably means ‘the decapitators,’ derived from ‘lu’ *a head* and ‘sha’ or ‘shat’ (sat is the correct spelling) *to cut*. He further supported this by stating that the Lushais have the custom of beheading enemies whose heads are considered trophies. Often, the Mizos also asserted that they were headhunters. On the other hand, Shakespear (1909) states that Lushai or Lusei covers a large number of clans belonging to various chiefs of the Thangur family who became influential in the 18th century. Thangur is a family name under which Rokhum, Rivung, Palian, Zadeng, Thangluah, Sailo, and Chenkual clans are subsumed. The Luseis attacked the Kukis and made several Kuki clans their subjects. While the Luseis referred to themselves as Duhlian, all the clans under them, conquered or otherwise, were referred to as Mizos (Shakespear, 1909). Furthermore, the term Duhlian is also used to refer to the language spoken by the Lushais; the language is called Lushai or Duhlian. Grierson (1904) also reported that the Lushais conquered the hills occupied by the tribes such as Ralte, Mhar (Hmar)¹, Paite, Vanchia (Vangchhia), Kolhring (Khawlhiring), Ngente, Powtu (Pautu), and many more. These tribes were not only conquered but were also absorbed by the Lushais, and thus, they must have adopted the Lushai language over their language (Grierson, 1904).

A similar observation is made by Vumson (1986). According to Vumson, a Sailo chieftain named Lallula was considered one of the most powerful rulers among the Mizos who spoke the Duhlian language. He gave an order to his subjects that everyone should speak only in the language he was using. Thus, he popularized Duhlian through his power as a chieftain in the 16th century.

¹The correct spellings of the tribe names in Mizo are provided in the brackets.

According to Lalthangliana (2018), the chiefs who ruled the Mizos were mostly the Sailos, who spoke Mizo. He mentioned that the Sailo chiefs were able rulers who knew how to win the hearts of their people. The efficiency of the Sailo chiefs created interest among the people to adopt the language spoken by their chief. Since Sailo chiefs were significant rulers of the broader demographic area, Mizo became the most widely used language in Mizoram. In addition, it is observed that the original works carried out by the government officials and the missionaries on the language spoken in the then Lushai Hills were on Lushai or Lusei. Therefore, Mizo became popular among the people in oral and written forms, resulting in its position as the lingua franca in Mizoram. Lushai is the anglicized form of Lusei, the British colonial term in literature. This must be true since there is no post-alveolar fricative /ʃ/ in Mizo consonantal phoneme inventory. The information on the different terms of Mizo in the literature regarding the usage of Lushai/Lushei/Lusei, Duhlian/Dulien, and Mizo are more or less similar. These terms are still unresolved, and there seems to be no action to resolve them. It is observed that the history, language, or political studies on the people in Mizoram are currently referring to the language spoken in the area as Mizo. Most people in Mizoram accept to call the language they speak Mizo. In 1974, the Mizoram Legislative Assembly passed the Mizoram Official Language Bill, which came into force in 1977. The Government of Mizoram declared Mizo the state's official language in 1987. Therefore, without any doubt, I also adopted the term Mizo in this dissertation.

1.1.2 The linguistic area of the Mizo language

Mizo is spoken mainly in the state of Mizoram and its neighboring states such as Manipur, Nagaland, Assam, Meghalaya, and Tripura in the northeast of India. The map indicating the state of Mizoram is provided in Figure 1.1. Mizo is also spoken within the international borders of the Chittagong Hill Tracts in Bangladesh and the Chin



Figure 1.1: Map of Mizoram showing its location in India and with its capital indicated in the inset.

state in Myanmar. As per the Census of India (2011), there are 830,846 Mizo native speakers in India, where 412,349 are male, and 418,497 are female (Chandramouli, 2018). According to Ethnologue, there are about 12500 speakers of Mizo in Myanmar (Simons and Fennig, 2017). As observed from the official records of Bangladesh, the Mizo-speaking population is recognized as Lushai. Some Mizos use Lushai as their surnames to date. As also mentioned in Ethnologue, there are 250 speakers of Mizo in Bangladesh, while there were 662 Lushais in 1991, as reported in Chittagong Hill Tracts Regional Council Act 1998 and Small Ethnic Groups Cultural Institutes Act 2010 (Chowdhury, 2014). On the other hand, unconfirmed reports stated that there are about 1500 to 2000 ethnic Mizos who are living in the Chittagong Hill Tracts.

Lalthangliana (2018) mentioned that the usage of Mizo was spread to Burma, Tripura, Chittagong hills, Manipur, and Halflong (Assam) during the gospel revival in 1913. During this time, the church elders and some village chiefs left to propagate the gospel in those places. They used Mizo as a medium of communication. They started opening schools where they taught the Mizo language. Lalthangliana (2018) also reported that in Burma, several gospel boxes containing the gospel written in Mizo were sent in 1946 and 1948. The Mizos from Mizoram delivered the boxes to at least 9 villages in Chin state and taught the people how to read and write in Mizo. It is also mentioned that they taught some Mizo songs as well. Additionally, as reported by Lalthangliana (2018), one Mizo pastor went to Chin state in Burma, where he established 23 schools in 1961. Mizo is taught as one of the subjects in these schools. These must have helped popularize Mizo in Burma.

Presently, it is observed that Bawm absorbs the Mizo-speaking population in Bangladesh. As reported in Chittagong Hill Tracts Regional Council Act 1998 and Small Ethnic Groups Cultural Institutes Act 2010, there were 13471 Bawm speakers in 1991. On the other hand, there were only 662 Lushais in 1991, as stated earlier (Chowdhury, 2014). It is also reported that the two ethnic groups live in the same districts of Rangamati and Bandarban. Hence, there seems to be language contact between the Mizos and Bawms, where Bawms have subsumed the Mizos as the former is the larger and dominant group among the two. It can be assumed from this that the Bawm and Mizo languages are closer to each other than the other Kuki-Chin languages spoken in the area, such as Pangkhua, Khumi, and Khyang. Through a social media interview with one of the Mizos in Bangladesh, I was informed that the Mizos could understand Mizo; however, they prefer to use Bawm as a lingua franca. In contrast, in Myanmar, the Mizo population thrives with substantial use of the Mizo language.

1.2 The phylogeny of Mizo

Mizo is a language belonging to one of the primary language families called the Sino-Tibetan. Mizo is grouped under the Tibeto-Burman language subfamily within the Sino-Tibetan language family. In further sub-grouping of the Tibeto-Burman languages, Mizo was placed in the Central Kukish branch of the Kuki-Chin subgroup. However, since the nineteenth century, various language phylogenies have been proposed for the Tibeto-Burman language family. Considering that, the placement of Mizo in the language phylogenies has been changing.

The initial studies on the Mizo language were conducted by the officials of the then British government by using the Hunterian transliteration system (Saha, 1884). Later, the Christian missionaries, posted in the Lushai Hills, now called Mizoram, introduced the Mizo alphabet primarily based on the Hunterian transcription system (Lorrain and Savidge, 1898b). While the interest in writing a Mizo grammar and developing a script for the language was prompted by administrative and evangelical requirements, the efforts suffered from Eurocentric and Indocentric biases. For example, Lewin (1874) follows the prevailing European wisdom and considers Lushai an Altaic language. However, the underlying principle behind the creation of the Altaic family is based on anthropology rather than linguistics. On the other hand, Saha (1884) attempts to describe the grammar of Mizo with the assumption that the language operates just as any other Indo-European language does. Additionally, Saha (1884) also viewed the language and the people with disdain, referring to the complex grammatical features of the Lushai language as contrastive to the ‘barbaric’ and ‘savage’ tribe that speaks it.

In terms of traditional language phylogeny, Mizo is considered a Tibeto-Burman language of the Sino-Tibetan family of languages. However, the exact sub-grouping of Mizo differs across different works. While Benedict (1972) considers Mizo to be a part of the Kuki-Naga sub-group, Matisoff (2003) considers Mizo as part of the Kuki-

Chin sub-group. VanBik (2009) has placed Mizo as part of the central Kuki-Chin sub-group. In a model agnostic to hierarchical language phylogeny, van Driem argues that the Tibeto-Burman languages can be considered parts of a language family that have inherent relations with each other, however, not in a hierarchical fashion (van Driem, 2002). Considering that Mizo has the highest number of speakers in the Kuki-Chin language sub-family, the investigation into the language has provided insights into the sub-family as a whole. In VanBik (2009), Mizo was used to represent the central Kuki-Chin subgroup for constructing the phonemes and tones of proto Kuki-Chin. A detailed discussion of the attempts at proposing different phylogenies for Mizo is discussed in this section.

As mentioned before, in the first work on Mizo in 1874, Lewin wrongly assumed Mizo to be an Altaic language; based on his observations, there are similarities between Mizo and Persian (Lewin, 1874). By the beginning of the 20th century, more detailed empirical evidence pointed towards Mizo, Burmese, and Tibetan being in the same language family, namely, the Tibeto-Burman language family. Sten Konow, in his work, reported in Grierson (1904) compared the numerals of Burmese, Tibetan, and Lushei². Konow systematically compared Kuki-Chin languages, Tibetan, and Burmese by considering their phonological and morphological features. This comparison showed more substantial correspondence of the Kuki-Chin languages with Burmese than Tibetan. Based on the linguistic evidence, Konow divided Kuki-Chin languages into two primary branches, namely, Meithei and the Kuki-Chin languages proper. He further grouped the Kuki-Chin proper languages into four subgroups: Northern Chin, Central Chin, Old Kuki, and Southern Chin. Finally, as shown in Figure 1.2, Konow placed Mizo under the Central Chin subgroup along with Tashon, Lai, Banjogi, and Pankhu. This sub-grouping of Kuki-Chin languages, proposed by Konow (Grierson, 1904) is known to be the first where Mizo is classified as a Tibeto-

²In this section, the terms Lushai, Lushei, and Lusei are synonymous with the term used for the language Mizo.

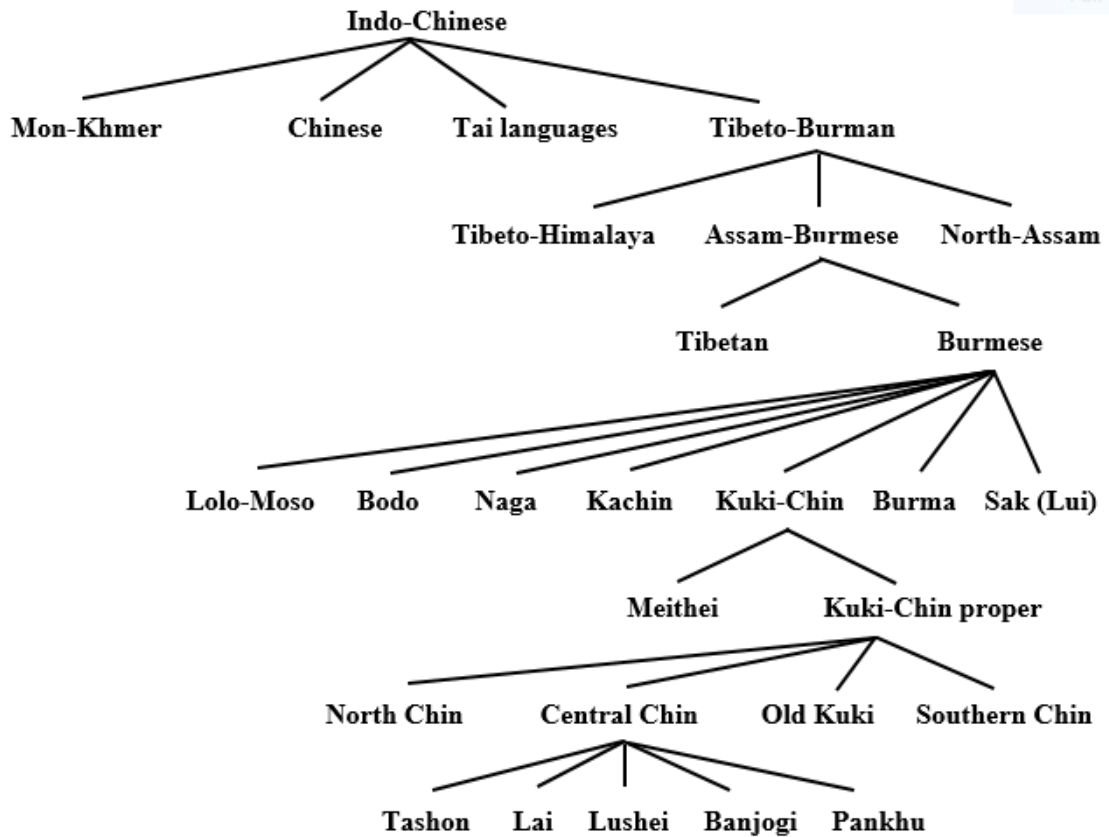


Figure 1.2: Schema of Indo-Chinese language family, constructed based on Grierson (1904).

Burman language under the erstwhile Indo-Chinese languages. Since then, Mizo has been consistently reported as a Tibeto-Burman language, as evident in Lorrain (1940) and in other exhaustive sub-groupings such as, Benedict (1972), Bradley (1997), Post and Burling (2017) and Matisoff (2003).

In the latter part of the 20th century, with the availability of typological data on the Tibeto-Burman languages, more detailed and exhaustive sub-groupings of the Tibeto-Burman language family were proposed. Shafer (1955) came up with a more systematic way of constructing the phylogeny tree for the Sino-Tibetan languages. Shafer used a large amount of data which helped him incorporate more subtle morphological, phonetical, and semantic features in determining the classes and sub-classes of the Sino-Tibetan phylogeny. In his work, Shafer placed Mizo (referred to as Lusei) in the Sino-Tibetan language family under the Burmic division. As seen in Figure

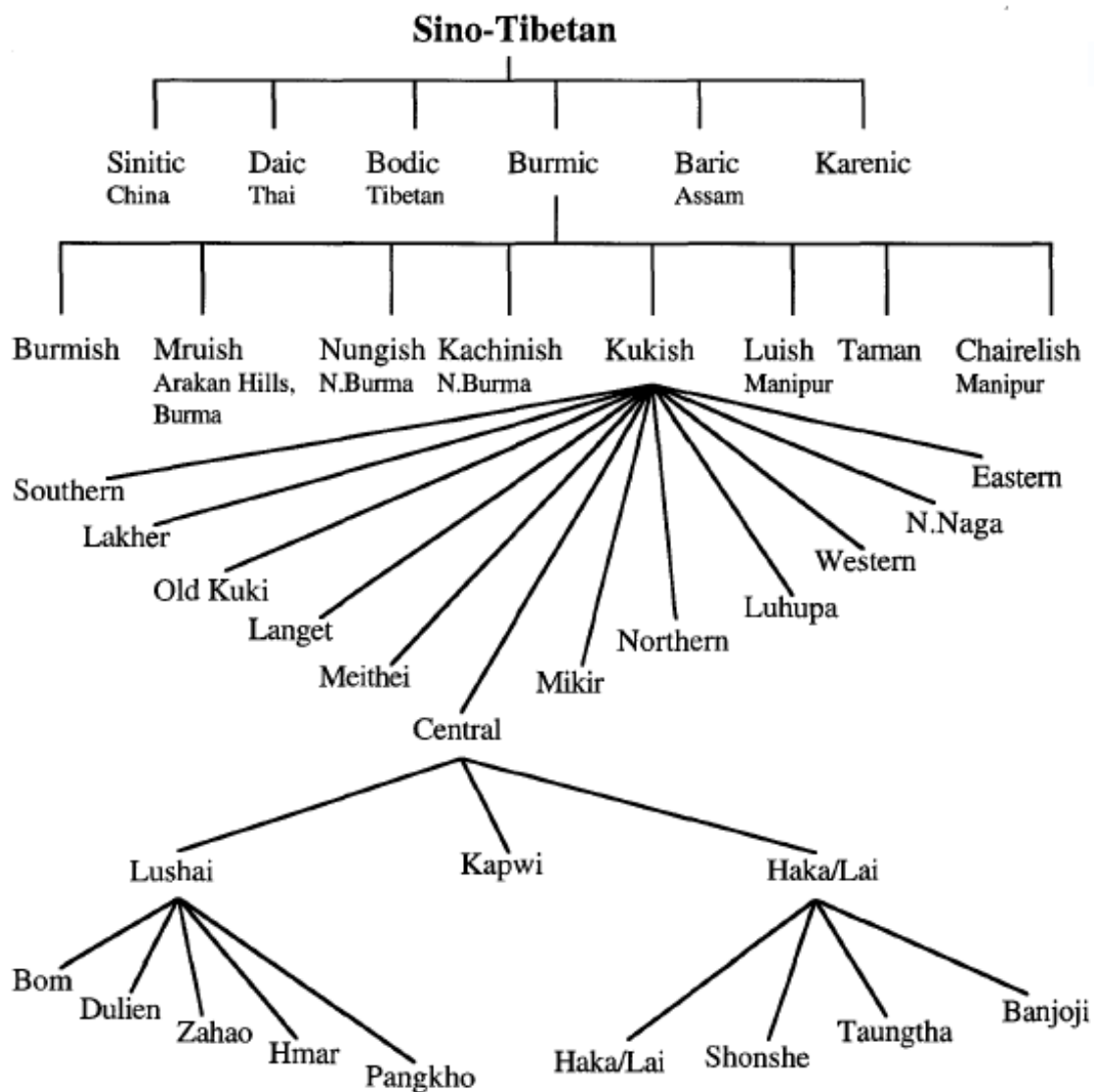


Figure 1.3: Shafer's schema of the Sino-Tibetan language family in 1955 obtained from VanBik (2009).

1.3, under the Burmic division, Mizo belongs to the Lusei Unit under the Central Branch of the Kukish Section. The phylogeny proposed by Shafer corroborates the findings of Konow (Grierson, 1904) regarding the Kuki-Chin phylogeny.

Benedict (1972) pointed out that the reason for placing Tibeto-Burman languages under Indo-Chinese in the past was due to the importance given to the syllable types and the tones during the analysis. He emphasized that the lexical evidence should also be taken into consideration. In Benedict (1972), Mizo was placed under the Central Kuki sub-types of the core Kuki languages proper. Kuki languages proper

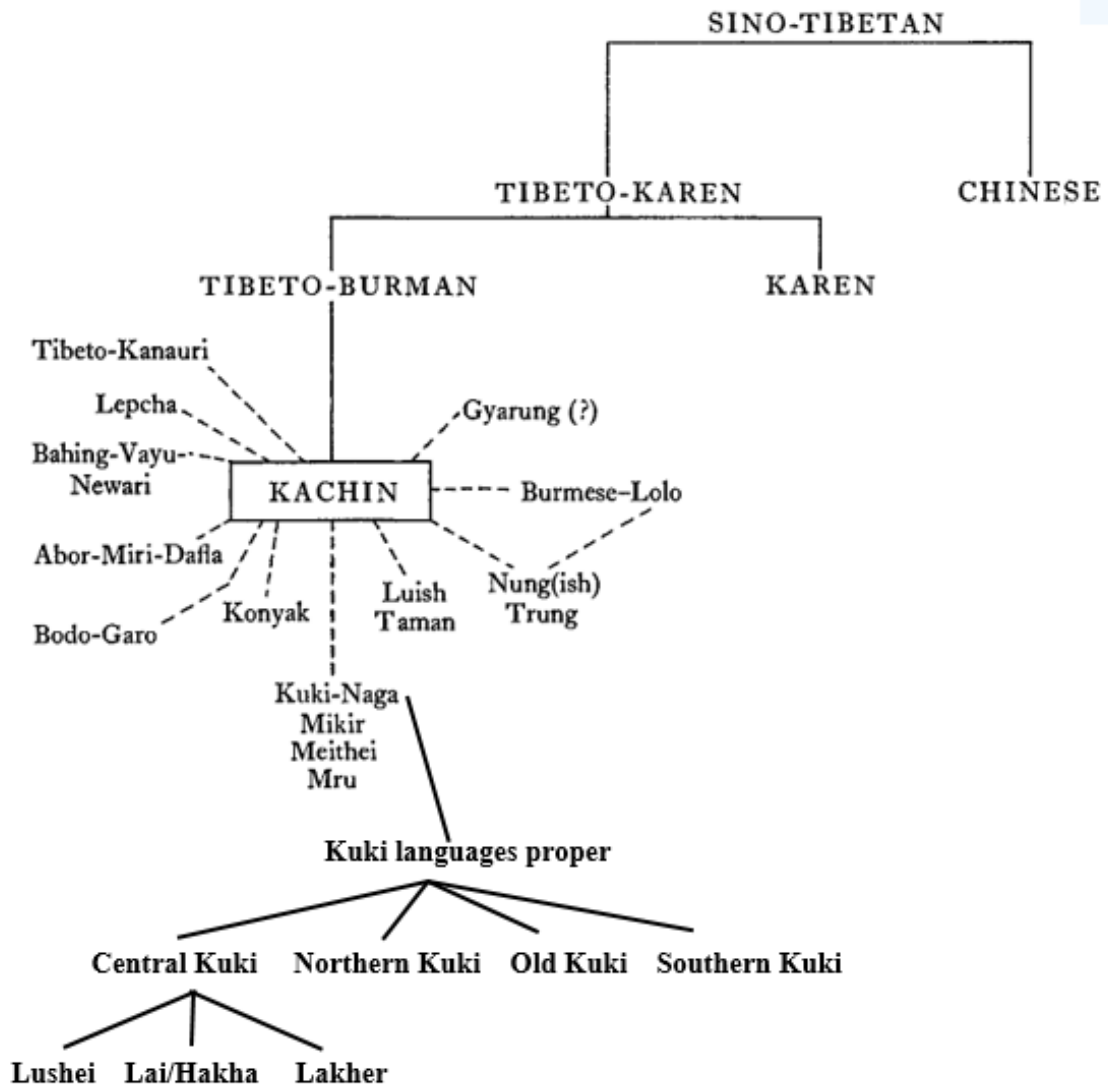


Figure 1.4: Schema of Sino-Tibetan language family obtained from Benedict (1972) with the Kuki languages extended by the author.

come under the Kuki-Naga (Kukish) division of the Tibeto-Burman languages, as seen in Figure 1.4. In Benedict (1972), there is no usage of the term Kuki-Chin unlike in Konow's classification. Benedict used Kuki-Naga instead, and he justified that Kuki and Naga should be under a single rubric since both languages do not have a linguistically precise distinct feature. Benedict's grouping of Kukish is more or less similar to Konow's. Both have placed Mizo under Central Kuki (Benedict) or Chin (Konow).

Bradley (1997) pointed out that the data he obtained from China and northeast

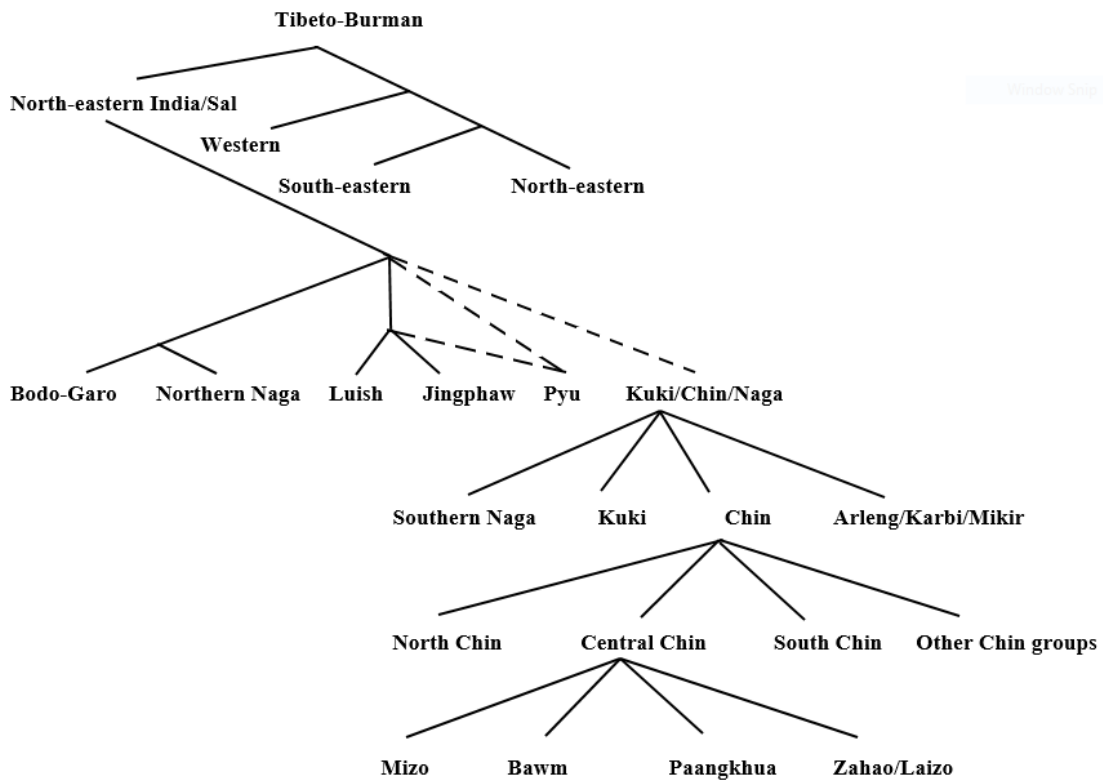


Figure 1.5: Schema of Sino-Tibetan language family based on Bradley (1997) with Kuki/Chin/Naga extended by the author.

India suggested the requirement of revisions of the classification of Tibeto-Burman languages. In Bradley's classification, some languages classified under certain language divisions or groups in the previous literature are placed under new divisions or groups. Some of these include the languages classified as 'other' by Benedict (1972), and the same languages as 'Burmic' by Shafer (1955) are placed within the Northeastern Tibeto-Burman languages group in Bradley's classification. Another instance is that the languages considered under the Baric group by Shafer, Sal by Burling (1983) and Bodo-Garo-Konyak group by Benedict (1972)'s Kuki-Chin-(Southern)-Naga, the Karen subgroup and the Burmese-Lolo subgroup are regarded as the South-eastern group in Bradley's classification. Although revisions of sub-groupings are done at the upper level, Mizo has retained the same place under Central Chin Bradley (1997) as shown in Figure 1.5.

Post and Burling (2017) classified the Tibeto-Burman languages of northeast India

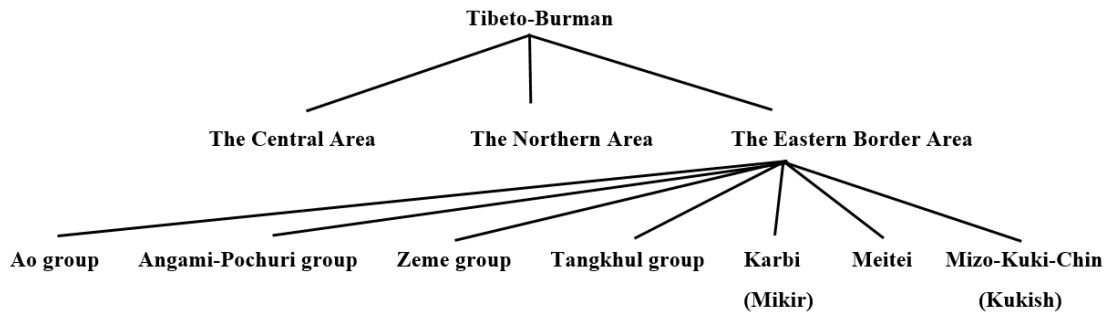


Figure 1.6: Schema of Tibeto-Burman language family based on Post and Burling (2017).

by comparing the similarity of the lexicon of the languages. Burling has placed Mizo under the Mizo-Kuki-Chin (Kukish) group of the Eastern Border Area under the Tibeto-Burman languages, as shown in Figure 1.6. Matisoff (2003) has also placed Mizo under Chin in the subgroup of Kuki-Chin-Naga under Kamarupan of Tibeto-Burman languages as shown in Figure 1.7.

So far, we have seen that Mizo has been placed as one of the languages under certain sub-groupings represented by tree diagrams. Mizo is always placed under Kuki-Chin or Kuki-Chin-Naga subfamilies under Tibeto-Burman languages. As cited in van Driem (2007), unlike in the previous studies on the phylogeny of Tibeto-Burman languages, van Driem proposed the term Trans-Himalayan in 2004 for the Tibeto-Burman or Sino-Tibetan language family. He explained that the Tibeto-Burman or Sino-Tibetan languages are spoken in the geographical region of the southern and northern flanks of the Himalayan range and, therefore, Trans-Himalayan. van Driem further mentioned the inconvenience of including the non-Sinitic languages under the term Sino-Tibetan. He claimed that roughly three-fourths of the major Trans-Himalayan subgroup of languages and 300 unique Tibeto-Burman languages are present in the southern parts of the Himalayas, and the speakers of the Trans-Himalayan languages live in the north and east region of the Himalayan divide. According to van Driem (2015), forty-two Tibeto-Burman subgroups or leaves have fallen from the Trans-Himalayan tree. As seen in Figure 1.8, Van Driem has placed Mizo

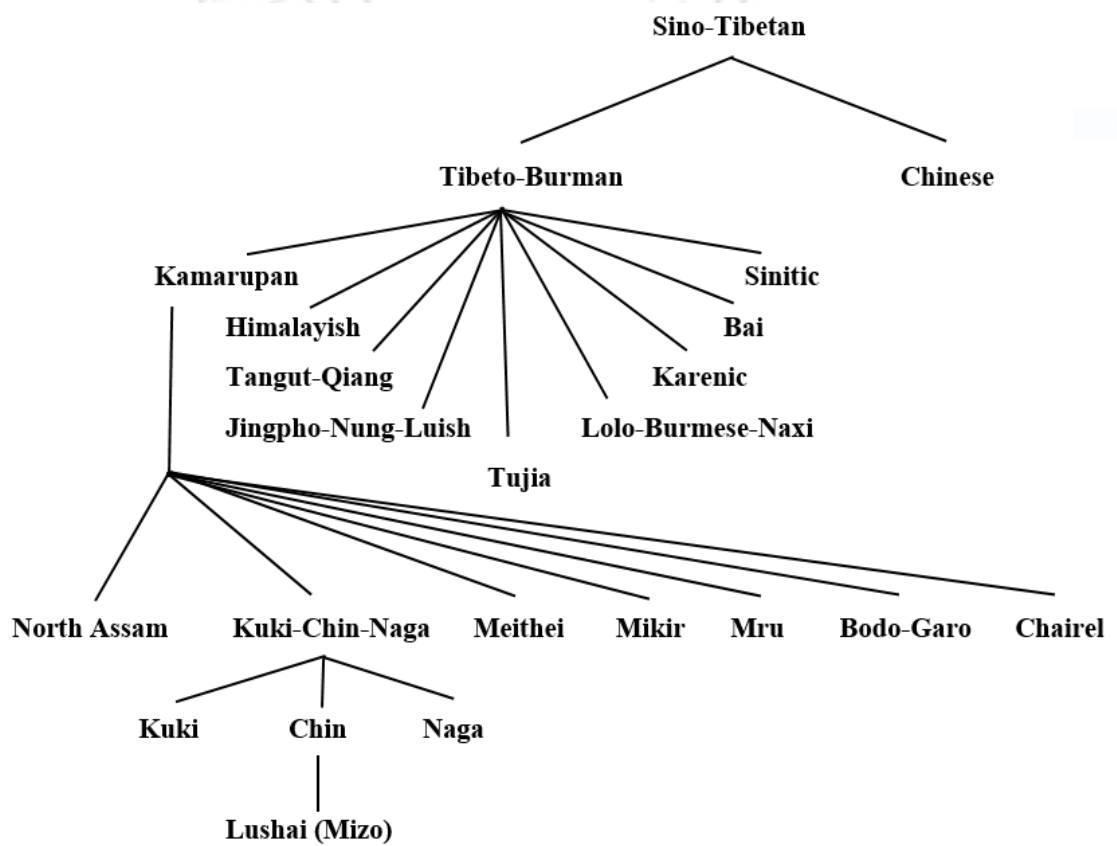


Figure 1.7: The schema of the Tibeto-Burman language family is based on the system of decimal numerals used in the STEDT database as presented in Matisoff (2003).



Figure 1.8: The 2012 version of Van Driem's agnostic Fallen Leaves model obtained from van Driem (2015).

within Kukish leaf. He indicates that Kukish languages are spoken in Mizoram and the bordering areas of India and Burma.

VanBik (2009) has reconstructed Proto-Kuki-Chin by examining the sound systems of Kuki-Chin languages. He compared the initial consonants, rhymes, and nominal tones from twelve Kuki-Chin languages. Mizo also represents the Central Chin group and Hakha Lai and Falam Lai. VanBik (2009) have used the center/periphery model in place of the geography based-model, as also suggested by Peterson (2000) to represent the Kuki-Chin subgroups. VanBik (2009) has placed Lushai under the Central Chin subgroup of Mizo. He further divided the Mizo group into another Mizo and Hmar subgroup in his further sub-grouping of the Central Chin group. Under the last Mizo branch, he placed Lushai, the old name of Mizo, as shown in Figure 1.8. It is observed that although there are two models for sub-grouping Kuki-Chin

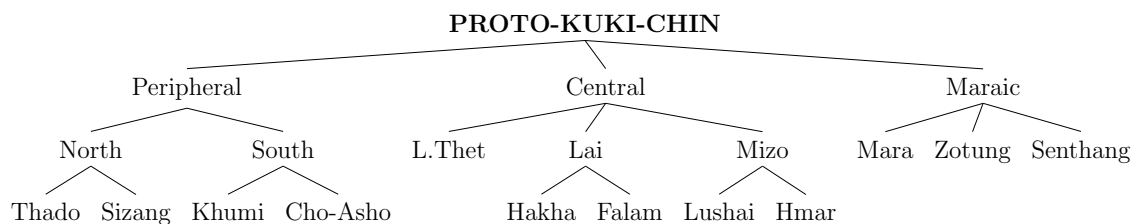


Figure 1.9: Schema for Proto-Kuki-Chin taken from VanBik (2009).

languages, the geographical and the central/periphery models (Peterson, 2017), Mizo is consistently classified under the Central Kuki-Chin subgroup of the Tibeto-Burman language family by all the classifications.

From the summary of the phylogenies discussed in this section, it is clear that Mizo belongs to the Tibeto-Burman language family or the Trans-Himalayan languages. Further, Mizo can be grouped as one of the Kuki-Chin languages. However, as the aim of the current work is not to propose a suitable phylogeny of Mizo, we will not further explore this topic.

1.3 The studies of the Mizo language

The first work on the Mizo language was published in 1874 by Captain Thomas Herbert Lewin, the then Deputy Commissioner of the Chittagong Hills (Lewin, 1874). The name of the book is ‘Progressive Colloquial Exercises in the Lushai Dialect of the ‘Dzo’ or ‘Kuki Language with Vocabularies and Popular Tales (Notated)’. Lewin (1874) stated all the tribes living in the hilly region to the east of Chittagong district in Lower Bengal, ‘who wear their hair in a knot resting on the nap of the neck’ are termed ‘Dzo.’ However, the same people and the rest living in the hills who engaged in jhum cultivation are termed Kuki by the people living in the plains, Bengallees, and others. Lewin further mentioned that the Dzo people are, as per the observations made from their physique, character, and traditions, seemingly ‘sprung from the great Turanian stock of Central Asia’ who have arrived at the Chittagong district from the southern

part of the Himalayan range. His work has attempted to provide a suggestion that the Lushai tribes have originated from the 'same stock as the Ghurkhas and other Himalayan tribes (Mongoloid of Huxley)' by providing a comparative list of 21 unique words in Dzo (southern) and Ghurk or Nepalese (Himalayan). The Dzo (southern) is represented by Lushai, Hill Arracanese, the patois of Burmese, and Kumi. Ghurk or Nepalese (Himalayan) includes Thappa, Subah, Rae, and Manipore. Lewin further mentioned that the Dzo was divided and sub-divided into many tribes and clans, ruled by chiefs who belonged to the Lushai tribe in the majority. Due to this, the Lushai dialect is common and understood by all. Thus, it is the lingua franca of the area. Lewin has mentioned that the Dzo language 'existed only in the form of speech'. Hence, he used the transliteration system adopted by the Indian Government to write the Dzo. He further claimed that there are many 'soft sounds and lingual euphonies' in Lushai, which makes it 'difficult to denote the various gradations in the expression of sound by the limited range prescribed in the Jonesian system'. This has made him use new combinations of letters to represent certain sounds.

Brojo Nath Saha, an assistant surgeon serving as a civil medical officer at the Chittagong Hill Tracts, wrote a book in 1884, 'A Grammar of the Lushai Language, to which an appended a few illustrations of the Zau³ or Lushai popular songs and translations from Aesop's Fables'. Saha (1884) is the first work on Lushai grammar. Saha stated that there are 49 simple and compound sounds in Lushai or Dzo. The 49 unique sounds in Lushai are provided with their corresponding Bengali and English sounds. It is mentioned that compound consonants like hm, ng, thl, hn mainly occur in the initial position of a word or syllable. Saha has given the term 'aspirated double consonants' to hm and hn sounds. Out of the 49 sounds, /d/ is reported as in English 'do' and /nk/ as in 'thank' are reported as foreign sounds. The work of Saha has three main parts: the first part is the orthography, where the sounds in Mizo are given;

³Zau here is same as Mizo.

the second part is etymology, where nouns, adjectives, numerals, pronouns, verbs, adverbs, prepositions, conjunctions, interjections, prefixes, and affixes are discussed, and the last part is on Lushai syntax. Apart from these three parts, it includes the grammar description using popular Lushai songs or *zai* and 8 *vai than* (thawn) *thu* or foreign fables.

It is reported in Grierson (1904) that there were 40,539 people using Lushai/Lushei, including Ngente. 239 speakers in Cachar Plains, 18,000 in Lushai Hills, and 22,300 in Lushai Hills (Lungleh). Ngente is treated as a dialect of Lushai. Grierson has grouped Lushai under the Central Chin Sub-group and Shunkla or Tashon, Zahao, Lai, Lakher, Banjogi, and Pankhu. As per the information gathered by Grierson (1904) from Major J. Shakespear, the term Lushai includes different families such as Sailo, Thanglua, Rivung, Jadeng, Rokum, Palian, Pachua, Haonar, Chenkual, Choa-hang, Changte, Chongte, Hualngo, and Hualhang. Apart from these, it is mentioned that there is a probability that other families that can come under Lushai. As mentioned earlier, it is stated that the term Duhlien is also used to refer to the Lushai families and hence the language spoken by them as Lushai or Duhlien. Grierson mentioned several tales and songs in Lushai. However, there is no written literature. He has also mentioned the grammar of Lushai based on the works of Brojo Nath Shaha and the Missionaries, J. Herbert Lorrain and Fred W. Savidge.

Some of the language features observed in Grierson (1904) are as follows. We observed that different vowels are used for the exact meaning of the word are interchanging used. For example, 'to come' is written as hong, hon, ho, or hang, and thou is written as nang or nung. Likewise, sh and s are also used interchanging. It is also reported that long vowels generally occur in the final position of a word or syllable. G occurs in the initial position of foreign words. J is reported as a foreign sound. However, it is used in Ngente in place of Z. The liquids l, m, n, and r are followed by the letter h, reported as aspirated. The presence of the letter h at the

end of the syllable indicates the abruptly shortened sound. Phonetical changes are also observed where *ei* becomes *e* as in *nei*, *ne* ‘to have’ and *e* ‘to eat’. A euphonic *v* insertion happens when a word ends in *o* or *oh* when a vocalic suffix is added as in */lo/* ‘field’ becomes */lova/* ‘in the field’. Final consonants in a word are often silent, like *po* or *pok* ‘even’. The work also briefly discussed the Lushai grammatical categories like nouns, gender, number, case, adjectives, numerals, pronouns, verbs, and word order. Two specimens of Lushai or Dulien are provided in the same work. The first is a translation of the Parable of the Prodigal Son contributed by missionaries Lorrain and Savidge; the second is of the southern dialect obtained from the then Superintendent of the South Lushai Hills, Mr. Sneyd Hutchinson.

In 1948, Henderson described the syllable structure, the segments, and suprasegments of Mizo based on one Mizo native informant (Henderson, 1948). Weidert accounted for an extensive study on Lushai phonology in 1975 (Weidert, 1975). This work focuses on the phonology of Mizo segments and tones in different phonological paradigms. The phonological paradigm includes the Mizo speaker’s phonology, the phonology of loanwords in Mizo, and non-Mizos speaking in Mizo.

The early '90s have seen the emergence of native Mizo linguists, mainly research scholars like Fanai, Chhangte, and Lalthangliana. Fanai’s work in 1992 is mainly on the description of Mizo tones using autosegmental phonology (Fanai, 1992). This work is also an extensive study on Mizo tones and tone realization in different contexts and environments with well-represented phonological rules for segment changes and suprasegments levels. The work of Chhangte (1993) is mainly on the syntactic structures of Mizo. Lalthangliana carried out a study on the aspects of Mizo in the structural paradigm in 1997. These works are mainly descriptive and are merely based on native intuition.

The introduction of instrumental studies of Mizo using an acoustic study by Sarmah and Wiltshire (2010b) has set a landmark in the development of Mizo in

terms of technology. Sarmah and Wiltshire (2010b) acoustically proved that Mizo has four lexical tones, namely, high, low, falling, and rising, along with the five Mizo vowels, namely, /a, i, u, o, e/. Govind et al. (2012) also work on Mizo tone, which suggested that the perception correctness of synthetic rising tone in Mizo increases with the extension of the duration. The same study also reported that the slope of f_0 is an essential parameter in enhancing the perceptual identification of the three synthesized Mizo tones: falling, low, and rising. Further, it has been reported by Sarmah et al. (2015) that the Mizo canonical tones can have different realizations when they are in contact with other tones. Sarmah et al. (2015) have attested contextual variations of tones in Mizo. This work has shown that Mizo tones have bidirectional variations where carryover and anticipatory effects are observed. This work also mentioned the presence of tone sandhi in Mizo, where the rising tone becomes a low tone if followed by either a high or falling tone. Sreenivasan (2015) also accounted for Mizo tones at the intonational level. The presence of a downtrend called declination in high and low tones is reported to be present in Mizo (Sreenivasan, 2015).

Apart from the mentioned acoustic analyses of Mizo tones and vowels, there are works on Mizo motivated by the speech signal processing approaches. Based on the characteristics of Mizo tones obtained from the linguistic studies mentioned above, language technologies are built for Mizo, such as tone detection methods for Mizo tones and phoneme recognition systems. Sarma et al. (2015) introduced a method to detect the four Mizo tones by considering two parameters, the pitch slope for rising and falling tones and the pitch height for high and low tones. The overall accuracy of this method is 70%. Dey et al. (2017) built an automatic phone recognition of Mizo segments. These works are upgraded to build different technological systems in several works such as Sarma et al. (2018), Kothapalli et al. (2018) and Gogoi et al. (2020) by implementing different technological frameworks.

The linguistic study of the Mizo language can be categorized historically into

several phases. The first phase consisted of the description of the language and the grammar of Mizo by the government officials, based on the oral form of the language they encountered, such as Lewin (1874). The second phase started after the missionaries introduced the Mizo writing system in 1894. This phase was characterized by linguistic analysis of the Mizo language and grammar by non-Mizo scholars, such as Lorrain and Savidge (1898a), Henderson (1948) and Weidert (1975). The third phase was characterized by linguistic descriptions authored by the native Mizo scholars, such as Fanai (1992), Chhangte (1993) and Lalthangliana (1997). These three phases of linguistic research have paved the way for acoustic and statistical analyses of Mizo phonetics in the later era.

1.4 Research objectives and motivations

The tones in Mizo are not widely studied compared to other tonal languages like Mandarin Chinese, Vietnamese, Thai, and other African tonal languages. Hence, the main objective of the research is to investigate the phonological and acoustic phonetic properties of tones in Mizo. While analyzing the tones in Mizo, the interaction of tones and segments is also investigated. Hence, the detailed objectives of this work are as follows.

- The first objective of the current research is to study the phonological behavior of tones in various morphological structures in Mizo.
- To support the observations made in the phonological study of Mizo tones, the second objective of the research is to examine the acoustic-phonetic properties of the Mizo tones using speech data from native speakers of the language.
- The third objective of this study is to see the interaction between the tones and segments. As part of this goal, acoustic-phonetic properties of some of the consonants and vowels are also investigated in this work.

- This work has proposed some acoustic-phonetic features that characterize the tones in Mizo. Hence, the fourth objective of this study is to see how successful machine learning algorithms are in classifying the Mizo tones produced in various speaking environments.

1.5 Methodology

The data used in this research are the native Mizo recorded speech data. These data lists for the production and perception test stimuli are mainly gathered from my native intuition. The read passages from Experiment 1 and parts of the data for phonological analysis of tones in Chapter 3 are taken from the existing literature of Mizo. The data collection took place in Aizawl, Guwahati, and Shillong. The recorded speech data are acoustically analyzed, and the observations are plotted using different visual representations. Statistical analyses are further carried out to support these observations and findings. Below are the objectives of each experiment, and the methods are presented in the following subsections.

- Experiment 1: This experiment investigates the phonetic properties of Mizo tones in different contexts by using different data sets. The number of lexical tones in Mizo, the nature of the f_0 contours, the f_0 slope, and the duration are examined to provide a comprehensive knowledge of Mizo tones. This is for Section 4.4 of Chapter 4.
- Experiment 2: In this experiment, the rising tone sandhi is examined in terms of production. This experiment aims to see if the rising tone sandhi and the canonical low tone have similarities in their f_0 contours. In other words, it analyzes if there is a neutralization of the rising tone sandhi to the canonical low tone. This experiment appears in Section 4.5.1 of Chapter 4.

- Experiment 3: This experiment appears in Section 4.5.2 of Chapter 4 to examine the perception of rising tone sandhi by the native speakers of Mizo. This means whether the Mizo native could differentiate the canonical low tone from the low tone derived from the rising tone sandhi.
- Experiment 4: In this experiment, the main objective is to see the interaction between the stop consonants and the tones in Mizo. Besides this, this experiment also examines the characteristics of stop consonants in Mizo. This is for Section 5.2.2 and Section 5.3 of Chapter 5.
- Experiment 5: The main aim of this experiment is to see the effect of vowels on tones and vice versa in Mizo. The acoustic characteristics of Mizo vowels are also studied in this experiment. This is for Section 6.2.2 and Section 6.3 of Chapter 6.

1.5.1 Data lists

The primary source of the speech data used in this work was collected as part of a project titled **Acoustic and Tonal Features Based Analysis of Mizo** funded by the Department of Electronics & Information Technology (DeitY), Ministry of Communication & Information Technology (MC&IT), Government of India. Apart from that, I have also collected speech data for this work with my own efforts. To prepare text materials for speech data collection, text resources were obtained from existing literature, such as, Chhange (1993) and Khiangte (2002).

Since the current work consists of several experiments, the data collection methodology was different for each experiment. Hence, information about the speech data collected for various experiments is stated in the following sections separately.

1.5.1.1 Experiment 1: The phonetics of Mizo tones

Three different types of data are used for analyzing the phonetics of tones in Mizo. The first is the tonal minimal and near tonal minimal sets data which consisted of four Mizo lexical words with a four-way tonal contrast. The four Mizo lexical tones are high (H), low (L), rising (LH), and falling (HL). Out of the four words, two are tonal minimal sets (/t^haŋ/, /vai/) and another two are near tonal minimal sets that have vowel length differences (/bel/, /lem/) resulting in 16 unique words. These tonal minimal sets are provided in Table 4.1 of Chapter 4. These 16 words are embedded in 16 meaningful sentences with random tone environments, referred to as semantic context. The words are also embedded in another 16 meaningful sentences, with the same preceding and the following tones: falling and low, respectively, and are regarded as sentence context. Hence, along with the citation form, three different contexts are obtained from the minimal sets: the words in isolation, the words embedded in semantic sentences, and another common sentence context. The data lists of semantic and sentence contexts are available in Table A.10 of Appendix A. Table 1.1 shows the distribution of tones within the tonal minimal and near tonal minimal sets.

Table 1.1: The distribution of Mizo tones in minimal sets data.

Tones	Isolation	Semantic	Sentence	Total
Falling	110	116	115	341
High	117	117	117	351
Low	114	114	115	343
Rising	118	115	116	349
Total	459	462	463	1384

The second type of data used for the same experiment is Mizo trisyllabic phrases comprised of three monosyllabic words with all the possible combinations of the four Mizo lexical tones. This results in 64 distinct tone combinations. This data list

Table 1.2: The distribution of Mizo tones in three different data sets.

Tones	Minimal sets	Trisyllabic phrase	Read passage
Falling	341	11234	875
High	351	10977	2551
Low	342	11349	2251
Rising	350	7965	530
Rising tone sandhi (RTS)	Nil	3612	345
Total	1384	45137	6551

is available in Appendix A, from Table A.1 to Table A.9. Each tone combination consists of five phrases, which are recorded three times by each speaker, resulting in 18,240 unique phrases. Hence, the total token is 54,720 (19 speakers x 64 tonal combinations x 5 trisyllabic phrases x 3 syllables x 3 repetitions). However, 45,137 tokens were considered for the study since some data lacked pitch tracks. It has been noticed that there cannot be a combination of the canonical Mizo rising tone followed by either a falling or high tone due to the presence of a sandhi tone. Hence, 64 unique tone combinations were reduced to 47.

The third type of data is read passages data. This data set comprises 9 Mizo passages, 8 Mizo folktales, and an appreciation of one Mizo folktale resulting in 6551 tokens. These passages are obtained from Khiangte (2002) and are available in the Appendices, from Appendix D to Appendix L. The average time taken for reading one passage is 3 minutes and 95 seconds. The distribution of tones in the three different types of data is tabulated in Table 1.2.

1.5.1.2 Experiment 2: Production of rising tone sandhi

An acoustic analysis of the contextual variation of Mizo tones substantiated that there is a rising tone sandhi in Mizo (Sarmah et al., 2015). The acoustic property of the tone derived from the tone sandhi is analyzed in the current work. The data used in the study of the production of rising tone sandhi is the same as the data used in Experiment 1, the read passages, and the trisyllabic phrases. Low, rising, and rising

Table 1.3: The distribution of the canonical low, rising, and rising tone sandhi (RTS).

Tones	Trisyllabic phrase	Read passage
Low	11349	2251
Rising	7965	530
Rising tone sandhi (RTS)	3612	345
Total	22926	3126

tone sandhi (RTS) are considered. The distribution of the data is tabulated in Table 1.3.

1.5.1.3 Experiment 3: Perception of rising tone sandhi

This data is for testing if the low tone derived from the rising tone sandhi can be identified by the native speakers of Mizo. The rising tone perception stimuli data are shown in Table 1.4 and Table 1.5. Each table consists of five Mizo disyllabic phrases which are homographs. In Table 1.4, the second syllable in each disyllabic word is a high tone, and the first syllables can bear two tones each, namely, low and rising tones. Hence, in Table 1.4, there are two-tone sets: Low-High (L-H) and Rising-High (S-H). Rising-High is expected to trigger tone sandhi. Likewise, in Table 1.5, the second syllable in each disyllabic word is falling tones, and the first syllables can bear two tones each, namely, low and rising tones. Therefore, in Table 1.5, there are two-tone sets: Low-Falling (L-F) and Rising-Falling (S-F). It is expected that Rising-Falling (S-F) set will trigger tone sandhi. These stimuli are recorded by a female native Mizo speaker in a sound-attenuated recording booth. The initial syllables from each disyllabic phrase are extracted for stimuli. Hence, the test stimuli are low tone and another low tone derived from the tone sandhi process. Praat was used to create multiple forced-choice experiments in which the first syllables of the 20 different stimuli were played randomly. There were ten repetitions of each syllable in total, which results in 200 tokens.

Table 1.4: Stimuli set with a high tone in the second syllable

Mizo phrases	L-H (Low + High)	S-H (Rising + High)
lei var /lei var/	white bridge	white soil
ral hma /ral ma/	front of the other side	before it gets over
tho hma /t ^h ou mai/	wake up face	face of fly
kir rei /kir rei/	takes time to return	curly for a long time
kawr thar /kor t ^h ar/	new drainage	new shirt

Table 1.5: Stimuli set with a falling tone in the second syllable.

Mizo phrases	L-F (Low + Falling)	S-F (Rising + Falling)
tlan chhuak /tlan ts ^h uak/	saved (redeem + out)	escape (run + out)
vai nghal /vai ŋal/	become dark soon	search soon
bul tawk /bul tok/	very short	very near
kang lut /kaŋ lut/	arrive with fire	entered while lifting
eng en /eŋ en/	what do you see	looking at the light

1.5.1.4 Experiment 4: Stop consonants and the interaction of tones with stop consonants

The data used for investigating stop consonants consist of 8 stops in Mizo, namely, /b, d, p, t, k, p^h, t^h, k^h/. These stops were produced in the CVV syllable. Each stop is followed by the 5 Mizo vowels, namely, /a, e, i, o, u/ assigned each with the 4 Mizo tones, namely, falling, high, low and rising tone resulting in 160 nonword tokens.

The data for analyzing the interaction of tones and consonants uses the same data set which is used to analyze stop consonants. The CVV nonwords are considered since it is impossible to have meaningful CVV syllables with consistent vowels and tones in Mizo. For correct production of tones, each tone target was preceded by a meaningful Mizo word in the syllable /bel/ (Falling-‘to stick’, high-‘pot’, low-‘to rely on’, rising-‘thorough’) to cue correct tone production in the nonword syllables. Each nonword token was produced three times in citation form by the 10 participants in this study. 4785 tokens were considered out of 4800 for the study. The distribution of Mizo stop consonants in the four Mizo tones is tabulated in Table 1.6.

Table 1.6: The distribution of Mizo stop consonants in four tones.

Stops	Falling	High	Low	Rising	Total
/b/	150	149	148	150	597
/d/	150	149	149	150	598
/k/	149	150	148	150	597
/k ^h /	150	150	150	150	600
/p/	150	150	149	149	598
/p ^h /	150	150	149	150	599
/t/	150	150	149	149	598
/t ^h /	150	150	149	149	598
Total	1199	1198	1191	1197	4785

Table 1.7: The distribution of long and short vowels.

Vowels	Long	Short	Total
/a/	739	406	1145
/e/	769	190	959
/i/	584	583	1167
/o/	378	384	762
/u/	759	389	1148
Total	3229	1952	5181

1.5.1.5 Experiment 5: Vowels and the interaction of tones with vowels

The acoustic characteristics of monophthongs in Mizo were analyzed using 27 unique words (14 long vowels, 13 short vowels) with VC, CVC, and CV:C syllables. These meaningful words are assigned one of the four Mizo tones, namely, high, low, rising, and falling. The data lists are provided in Table A.11 of Appendix A. Each word is repeated thrice by all the speakers in citation form, resulting in 5181 vowel tokens. The distribution of vowels for analyzing the acoustic characteristics is provided in Table 1.7. It is seen that there are 3229 long vowels and 1952 short vowels.

The data for analyzing the interaction of tones and vowels consists of 5 Mizo vowels /a, i, e, u, o/ in a nonword VV syllable. These nonwords are produced in isolation with each of the 4 tones in Mizo, namely, high, low, rising, and falling tones. As also in Experiment 5, a real Mizo word in the syllable /bel/ (Falling-‘to stick’, high-‘pot’, low-‘to rely on’, and rising-‘thorough’) was provided to help the participants in

Table 1.8: The distribution of Mizo vowels in four Mizo tones.

Vowels	High	Low	Rising	Falling	Total
/a/	23	24	23	22	92
/e/	23	24	23	19	89
/i/	24	24	23	23	94
/o/	24	18	22	23	87
/u/	23	23	24	24	94
Total	117	113	115	111	456

producing the correct tone of the nonword syllables. Each participant produced all the vowels with the four tones three times each, resulting in 480 tokens. However, 24 tokens were mispronounced, leaving 456 tokens for the analysis. Table 1.8 shows the number distributions of vowels in each tone category.

1.5.2 Fieldwork and data collection

The data used in this dissertation are collected from Aizawl, Mizoram; Shillong, Meghalaya; and Guwahati, Assam, in northeast India. These cities are chosen because Aizawl is the city where the highest number of native speakers of Mizo live, and the participants from Shillong and Guwahati are also native speakers of Mizo. All of them were born and brought up in Mizoram. The speech recordings were mainly in an attenuated sound booth and a quiet room using a TASCAM DR 100 MK II voice recorder connected to a Shure SM - 10 unidirectional head-mounted microphone.

- Experiment 1 and 2: For the study of the phonetics of Mizo tones, the participants were given the printed data list on a sheet of paper and were asked to read it out as naturally as possible.
- Experiment 3: The stimuli for the perception test were given on a laptop PC running Windows XP, with Praat as the experiment software. The test window showed a prompt to the participants to click anywhere on the screen once the participant was ready to take the perception test. The experiment began when

the subject clicked on the screen. The participants sat in an attenuated sound booth and wore headphones to listen to the stimuli. The participants selected the most suitable response based on the syllable they heard by clicking on the computer screen. There was a third button labeled “Both” in case the subjects classified the stimuli into both categories. The participants were only permitted to playback the sounds two times. After completing a test, the results were exported to a spreadsheet for further study. The task took roughly 60 minutes on average to complete.

- Experiment 4: The data list was displayed randomly on a computer screen, one token at a time. On the screen, the meaning of the word ‘bel’ in English with the four Mizo tones, namely, high - ‘pot’, low - ‘to rely on’, rising - ‘thorough’, and falling - ‘to stick’ was displayed. This was done so that the Mizo speakers could get enough orientation on the target tone. The nonword CVV syllable also appears on the screen along with /bel/, and the speakers were instructed to produce the nonword syllable with the tone of the preceding word ‘bel.’
- Experiment 5: The participants for the analysis of monophthongs were provided a list of target words with the corresponding English meaning on a sheet of paper. For the analysis of the interaction of tones and vowels, a meaningful Mizo word /bel/ with four different meanings represents the four Mizo tones, namely, high - ‘pot,’ low - ‘to rely on, rising - ‘thorough’ and falling - ‘to stick’ was shown to the participants in a computer screen to assist them in producing the correct Mizo tones on the nonword VV syllables. To avoid the listing effect, each token was displayed randomly on the screen. The participants produce the nonword VV syllable by eliciting the same tone of /bel/ shown on the screen with all the five Mizo vowels, namely, /a, i, o, e, u/.

1.5.3 Participants

The participants of this dissertation are different from one experiment to another. All the participants are free from speech and hearing impairment. All of them are native speakers of Mizo. The participants whose speeches were recorded in Shillong and Guwahati were students in different colleges in the respective cities. The details of the participants are available in Appendix C.

- Experiment 1, 2, and 3: 19 native speakers of Mizo (10 male, 9 female) participated in the recording of trisyllabic phrases. All of them are bilinguals fluent in Mizo and can understand and speak English. 10 Mizo native speakers (5 male, 5 female) participated in the minimal sets of speech data recording. The 9 passages are obtained from 3 male native speakers of Mizo. For the rising tone sandhi perception test, there are 11 Mizo native speakers (6 male, 5 female) who have participated. The participants' ages ranged from 24 to 35 years. They were born and brought up in Mizoram and were bilinguals, with Mizo as their first language and English as their second language.
- Experiment 4: For the analysis of stop consonants and their interaction with Mizo tones, 5 male and 5 female Mizo native speakers participate. They were born and brought up in Mizoram. The average age of the 10 participants is 27 years. They could understand English. Although the Mizos are aware of the tone in their language, proper linguistic information regarding the four lexical tones is not imparted in educational institutions. Because of this reason, although the participants naturally produce the four Mizo tones, the distinction between these tones was unknown to them until the investigator gave the recording instruction for the present study.
- Experiment 5: For the analysis of monophthongs, 67 Mizo native speakers (34 female, 33 male) participated in recording the speech. They can speak and

understand English. For the analysis of tone and vowel interaction, there are 8 native speakers of Mizo (4 male, 4 female) who were born and brought up in Mizoram. Their age range is between 20 and 40 years.

1.5.4 Data segmentation

The recorded speech was transferred to a PC for analysis. Segmentation and annotation of speech data were done manually using Praat 6.1.21 (Boersma, 2001) by visual and auditory examination of the spectrogram and waveforms. For tone analysis, the starting and ending of the Tone Bearing Units (TBU) in Mizo are marked with the help of the pitch tract shown in the Praat window (Refer to Section 4.4.2 of Chapter 4 for detail information on Mizo TBUs). For the study of VOT in stop consonants, the initial stops are marked with the beginning of the release burst and the onset of regular pitch pulses in the waveform by using automatic VOT detection called Dr. VOT (Shrem et al., 2019). Dr. VOT marked the VOT boundaries for three-way laryngeal contrasts in Mizo: voiced unaspirated, voiceless aspirated, and voiceless unaspirated stops. I cross-checked the VOT boundaries and annotations derived from Dr. VOT, and the errors were corrected manually. Moreover, for analyzing vowels, the acoustic features include the first two formants, F1 and F2, correlated to vowel height and frontness, respectively.

1.5.5 Acoustic analysis

The segmented and annotated data are subjected to acoustic analyses. The values of the fundamental frequencies for tones, the formant frequencies of vowels, the Voice Onset Time for the stop consonants, and the temporal values are extracted from Praat using Praat scripts.

1.5.5.1 Tones

Acoustic analysis of tones is done by measuring the fundamental frequency, duration, and dynamic properties of the Tone Bearing Units (TBU) in Mizo. The pitch values were extracted at every 2% of the total duration of the TBU in Hertz. z-score normalization was carried out for the raw f0 values to avoid the effect of speaker differences (Rose, 1991). The equation 1.1 shows the formula for the normalization where μ represents the mean f0, and σ is the standard deviation of the f0 values considered for mean f0.

$$x = \frac{x - \mu}{\sigma} \quad (1.1)$$

The raw pitch values were subjected to Discrete Cosine Transform (DCT) to see the pitch contour characteristics and develop smooth pitch contours for the Mizo tones. In terms of DCT coefficients, the Discrete Cosine Transform (DCT) can represent the temporal behavior of sequences in a compact manner. The few initial DCT coefficients are frequently of large magnitude, allowing the original, long sequence to be represented using only a few DCT coefficients. The discrete cosine transform was presented as a basis for describing speech contours of the fundamental frequency (Teutenberg et al., 2008). Yin et al. (2016) proved using a finite number of DCT coefficients to smooth the trend of f0 patterns of intonation phrases to synthesize higher-quality speech. DCT can characterize the f0 contours of a tone language, particularly when the language has both contour and register tones, as in Mizo. The DCT transform produces a sequence of DCT coefficients of the same length given a sequence of f0 values (length 51 in this case). The initial coefficient C0 determines the tone contour's mean f0. C1 compares a given pitch contour to a cosine curve's falling half cycle and calculates similarity in positive or negative numbers. As a result, a falling contour tone has a high positive C1 value, whereas a rising contour tone has

a negative C1 value. C2 compares the given f0 contour to one complete cycle of the cosine curve, indicating whether the f0 contour has a peak or a valley. As a result, for a falling–rising f0 contour, C2 will be positive, while for a rising–falling f0 contour, C2 will be negative. Since the f0 contour of a Mizo TBU can have a modest peak or valley, the first three DCT coefficients were considered to represent the f0 contour of a TBU in this study. Hence, we extracted the first three coefficients for better visual characterization of the Mizo tones and generated a reconstructed f0 contour utilizing the first three coefficients in this work. f0 measurements are changed using Discrete Cosine Transform (DCT) and three DCT coefficients, C0, C1, and C2, to compute the average f0 and f0 slope of the pitch contours. The mean f0 of the tone contour is provided by C0, whereas C1 and C2 represent the dynamic character of the f0 contour.

1.5.5.2 Stop consonants

In this experiment, Voice Onset Time (VOT) is used to categorize the 8 Mizo stop consonants. From the wide-band spectrograms of the speech recordings, VOT was measured as the time between the end of the stop closure (beginning of the release burst) and the onset of voicing in the following vowel (the onset of regular pitch pulses in the waveform). For voiced stops, the VOT was measured from the beginning of the occlusion till the onset of the vowel including the burst, it is characterized by the presence of glottal buzz during the interval of occlusion. For voiceless aspirated and voiceless unaspirated stops, the duration of aspiration was measured from the onset of the burst till the onset of voicing. The VOT values are extracted in milliseconds using a Praat script. Following Lisker and Abramson (1964), the voiceless stops are assigned positive values, while voiced stops are assigned negative values. The mean VOT and the standard error are calculated for further analysis.

1.5.5.3 Vowels

The acoustic study of vowels is primarily based on the first and second formant frequencies (F1 and F2), correlated to vowel height and frontness or backness, respectively. Apart from these, F3 values are also considered. The formant values in Hertz are extracted at the vowel midpoint for steady-state formants. All the normalization of data within the speaker was done using the Lobanov normalization method (Thomas and Kendall, 2007). The temporal feature of vowels is also considered. For the analysis of the interaction of tones and vowels, the formant frequencies and the fundamental frequencies of the vowels are extracted in Hertz at every 25% of the total duration.

1.5.6 Statistical analysis

Statistical analyses for the experiments were conducted in R (R Core Team, 2019) using Linear Mixed Effect (LME) models (Bates et al., 2007), Analysis of Variance (ANOVA), and posthoc Bonferroni tests (Lenth, 2019). Since all the LME models are different from one experiment to another, the statistical methods are described in each chapter when they are presented.

1.5.7 Data visualization

The extracted numerical values of different experiments for tones and segments are represented using graphs and boxplots for visual examination. These graphic representations are mainly done in R using the packages like ggplot2 (Wickham, 2016) and phonR (McCloy, 2016). Graphs show the f0 contours, boxplots represent the durations or the temporal values, and the F1 and F2 of vowels are represented in charts.

1.6 Organization of the dissertation

The structure of the dissertation, chapter-wise, is as follows. Chapter 1 accounts for the different names of the Mizo language, the information about the places where Mizo is spoken, and the phylogeny of Mizo. This chapter also highlights some of the studies of the Mizo language over time. The research objectives and the methodology applied in this dissertation are also elaborated in this chapter.

Chapter 2 describes the literature reviews on tones and segments. It provides information on tones in general, the characteristics of tones in Tibeto-Burman languages, and further presents the features of tones in Kuki-Chin languages. The previous descriptions of Mizo tones and segments are also discussed in this chapter.

Chapter 3 discusses the observations made on the phonology of Mizo tones. It highlights the tonal alternations in Mizo using different morphological contexts. Furthermore, this chapter examined the rising tone sandhi of Mizo in different grammatical contexts.

Chapter 4 elaborates on the phonetic analysis of tones in Mizo. It provides the Mizo tonal minimal and near minimal sets with a suitable f_0 contour plot. The Tone Bearing Units of Mizo are also discussed in this chapter. It primarily focuses on the f_0 realization of Mizo tones in different contexts by examining the fundamental frequency, duration, and dynamic properties. It also reports the production and perception test of rising tone sandhi to see if the tone sandhi in Mizo is neutralized phonetically and phonologically.

Chapter 5 describes the interaction between the tones and the stop phonemes in Mizo. To ensure that the stops and the tones are compatible for analyzing their interactions, the stop phonemes are initially analyzed based on Voice Onset Time (VOT). Subsequently, the effect of Mizo tones on the stop phonemes and vice versa are discussed in this chapter.

Chapter 6 presents the interaction between the tones and the vowels in Mizo.

To make sure that the Mizo tones and the vowels are suitable for studying their interactions, the acoustic study on Mizo vowels was carried out by measuring the vowel formants and duration. Consequently, this chapter discusses the effect of vowels on tones and vice versa in Mizo.

Chapter 7 provides the automatic classification of the four Mizo tones using Quadratic Discriminant Analysis (QDA) and Random Forest (RF). The classification is based on the coefficients of the Discrete Cosine Transform (DCT). Finally, **Chapter 8** concludes the dissertation and discusses the future research prospects.



Chapter 2

Literature review

2.1 Introduction

This research aims to describe the Mizo tones and their interaction with consonants and vowels. Hence, the current chapter provides a literature survey on tones and segments that built the foundation of the current study and reveals the research gaps. The characteristics of tones and their development are described in the literature on well-known tone languages such as Mandarin Chinese, Vietnamese, Khmer, etc., in Section 2.2. Subsequently, the overviews of tones in Tibeto-Burman and Kuki-Chin languages are provided in Section 2.3 and Section 2.4, respectively. The phonological and phonetic descriptions of Mizo tones in the literature are summarized in Section 2.5. Furthermore, the description of Mizo consonants in the literature is summarized in Section 2.6. Section 2.7 outlines Mizo vowels in the literature. The research gaps observed from the literature survey and the conclusion of this chapter are presented in Section 2.8.

2.2 Tones in the world's languages

A tonal language is a language in which pitch variation determines the meaning of a given word with two or more lexical meanings. According to Yip (2002), a language

can be called a tone language if at least two contrasting surface tones exist. Mandarin Chinese is one of the most well-known tonal languages. As cited by Jongman et al. (2006), Chao (1948) stated that there are four phonemically contrastive tones in Mandarin Chinese, namely, Tone 1 - high-level (/ma/ 'mother'), Tone 2 - high-rising (/ma/ 'hemp'), Tone 3 - low-dipping (/ma/ 'horse') and Tone 4 - high-falling (/ma/ 'scold'). Yip (2002) reported that 60–70% of the world's languages are considered tonal. The same has been reported that tonal languages are found mainly in Africa, East and Southeast Asia, the Pacific, and America. Sub-Saharan Africa is the area where tones are concentrated the most. In terms of East and Southeast Asia, the Sino-Tibetan and the Mon-Khmer language families are considered to be highly tonal languages. In America, the Otomanguean family in Central America is reported to have numerous tonal languages (Yip, 2002).

Tones in languages can be broadly classified into two types based on the dynamic property: level and contour. The register tone system is mainly associated with the African tonal languages, while the Asian tonal languages are attributed to the contour tone system. There can be different contrastive level tones depending on the language. Besides level tone contrasts, some tones contrast in terms of the contours. These contour tones are fall or rise. The falling contour tone is reported to be more common than the rising one. Contour tones are mainly found in tonal languages that have to use tone heavily to convey the meanings of lexical words. These contour tones are primarily found in heavy syllables, where the vowel is long or the rhyme of the syllable has a sonorant coda. Some languages can have contour tones only in polysyllabic words. In this case, the contour tones are derived from sequences of level tones of each syllable. In another language with contour tones, the contour tones can be assigned to any type of syllable. Additionally, there are two types of contours, simple and complex. The simple contours are those with a simple rise and fall, while complex contours are concave and convex. Concave contours have a falling and then

rising pitch movement, while convex contours have a rise and fall movement of the pitch (Yip, 2002).

Yip (2002) has provided the phonological and structural characteristics that are specific to tones. The first characteristic is mobility, where the tone migrates from its origin and ends up three or more syllables away. This tone movement can be in two directions: rightward and leftward. Many Bantu languages are attributed to this feature of mobility. Chizigula is reported to have rightward tonal mobility, and a leftward tone movement is attested in Sierra Juarez Zapotec. The second characteristic of tone is stability, where the tone remains in its origin while the segments delete, move, or reduplicate. In other words, the tone does not copy the segment that changes. This phenomenon is attested in African and Asian tonal languages such as Haya and Cantonese. The third characteristic of tone is one-to-many tone spreading. In this phenomenon, one tone is associated with many vowels or syllables. This tonal characteristic is attributed to languages such as Barasana, Vai, Bade, Chilungu, and many more. Contrary to this, the fourth tonal characteristic is many-to-one, where more than one tone appears in sequence on a single segment, resulting in contour tones. Such phenomena are found in Ibibio, Siane, and Mende's and Cantonese nouns. The final tonal characteristic of a tone language is the toneless syllables, where the features of tone are missing both at the underlying and the surface levels. Like in Mandarin, the possessive marker /-de/ and the classifier /-ge/ are toneless morphemes. As per these characteristics, tone languages are categorized into two broad types, the African and the Asian tonal systems. Yip (2002) has stated that the features of African tonal languages have the property of mobility, meaning the tone in a morpheme can spread to adjacent morphemes. The tone can go through phonological processes like tonal deletion, metathesis, downstep, downdrift, and spreading, mainly not attributed to the Asian tonal languages. Tonal association in African tone languages is based on phonological constraints, unlike the Asian tonal languages, where the association of

tones is controlled by lexical association to a tone-bearing unit. Most tones have a level f_0 pitch in African languages, while Asian tonal languages have a contour f_0 pitch. Asian tonal languages have a larger tonal inventory than African.

The development of tone in a language can be due to various reasons. The loss of some speech properties and features of the segment and the whole segment itself, the interaction with other languages, hypo-correction and hyper-correction, the presence and interactions of certain consonantal phonemes with the neighboring vowels and their qualities, and fast speech production are some of the common explanations. It is reported that there is a correlation between the initial consonant and tone whereby contrastive tones on vowels emerge due to the loss of a voicing distinction on obstruents in the prevocalic position. The voiceless stops trigger a high tone on the following vowels, and the voiced stops trigger a low tone on the following vowels regardless of their place of articulation. This phenomenon is attested in Yoruba, a tonal language belonging to the Niger–Congo language family (Hombert, 1977; Hombert et al., 1979). In an Indo-Aryan language called Punjabi, Gill and Gleason (1969) and Haudricourt (1972) reported low tone derived from the loss of breathy voiced consonants. The breathy-voiced consonants became voiceless and unaspirated, assigning a low tone to the following vowel. In another Indo-Aryan language called Hindi, it is reported that the onset of a vowel f_0 after the breathy voiced consonant is prominently lower after any other consonant (Ohala, 1974; Kagaya and Hirose, 1975). Likewise, Glover (1970) also claimed that in Tibeto-Burman languages, the breathy voiced consonants are stronger depressors than simple voiced obstruents. On the other hand, in Ndebele, a language belonging to the Niger–Congo language family, breathy voiced consonants have the same pattern as voiced obstruents resulting in lowering the pitch of the following vowels (Ladefoged, 1967). Besides obstruents, the glottalized sequences are also reported to develop higher tones than the voiceless or voiced series in Lolo–Burmese (Greenberg, 1970). The effect of voiced or voiceless

consonants on the f_0 of the preceding vowel is reported to be another reason for tone development. In some dialects of Jingphaw, it is claimed that postvocalic consonant gives a clue to the preceding vowel (Maran, 1971,9). As cited in Hombert et al. (1979), the studies done by Hanson (1975) and Jeel (1975) suggested that f_0 of the preceding vowel is lowered by both the voiced and the voiceless consonants. The presence and absence of glottal stop is also reported to contribute to tone development. A rising tone in Vietnamese replaced a glottal stop. The study by Maran (1971) states that Jingphaw glottal stop correlates to high tone in Burmese. In Vietnamese and Middle Chinese, the falling tone is developed from the glottal stop when it is in the final position of a syllable (Pulleyblank, 1962). In Arabic, the glottal approximant lowers the f_0 of the preceding vowel, whereas the glottal plosive induces a rise in the f_0 (Hombert et al., 1979). The correlation between vowel height and tone is also mentioned in Pilszczikowa-Chodak (1972) on Hausa. According to this, the tone for verb and noun plurals in Hausa can be predicted by the height of the final vowel. Spears (1968) also shows the correlation between tongue height and tone height in Maninka, where a high tone raises the vowel. This relationship works only in a one-way direction where tone affects vowel height, not vice versa. Phonetically, it means high vowels have a higher f_0 than low vowels. Minh (1999) has reported a sound change in Khmer spoken in Vietnam in which consonant + [r] clusters in the onset position of the main syllables lose the [r], which results in inducing a falling tone on the following vowel. Wayland and Guion (2007) provides the emergence of tones in Khmer spoken in Cambodia to see whether the same sound change has happened. It was concluded that sound changes and the emergence of tone in Khmer are due to the aerodynamic effect, which originated from fast speech. Hence, the relationship between the speaker and the listener also played an important role in developing sound change. Such sound change may occur due to hypo-correction and hyper-correction of the listener triggered by the action of articulatory and auditory constraints (Ohala,

1993).

2.3 Tones in Tibeto-Burman Languages

The Tibeto-Burman languages are considered to be fully-fledged tone systems. It comprises all or most languages within the following Tibeto–Burman divisions: Tamang, North Assam, Mishmi, Kuki-Naga-Chin, Eastern Barish, including Jinghpaw (Kachin), Nung–Trung, Luish, Karen, and Lolo–Burmese (Weidert, 1987). However, Matisoff (1999) reported that there are languages belonging to the Tibeto–Burman language family, that do not have tones at all. Such languages are found in the Qiangic, Kamarupan, and Himalayish branches. Matisoff (1999) has given the typology of Tibeto-Burman tone systems from the perspective of an areal context. In terms of syllables, he claimed that the Sinospheric Tibeto-Burman languages like Lahu are “tone prone” since they are mostly monosyllabic, and they keep the final consonants and the prefixes in comparison to the Indospheric Tibeto-Burman languages¹. Contrary to this, those Tibeto-Burman languages with complex monosyllables are reported to be minimally tonal, or some may even be atonal (Matisoff, 1999). This means that the tonal languages of Tibeto-Burman are different from each other in the size of their Tone Bearing Unit (TBU). Some languages have just a single syllable as the TBU. At the same time, some languages, like the Risiangku dialect of Tamang, can have more than two phonological words as the TBU. Hildebrandt (2008) is also of the opinion that Tamang, Manange, and Gurung have the phonological words as the TBU. Besides the syllable structure, Matisoff (1999) stated that the tones in Tibeto-Burman tonal languages differ in terms of their phonation. Chepang and Burmese are considered to be phonation-prominent languages. Matisoff (1999) also pointed out that Tibeto-Burman tonal languages have tone sandhi. In terms of the Tibeto-Burman languages spoken in the Northeast of India, tones are less studied to bring out a neat

¹Refer to Matisoff (2003) for Sinospheric and Indospheric Tibeto-Burman languages

typology. It is commonly believed that the Tibeto-Burman languages spoken in this area have tones. However, Post and Burling (2017) reported that one language might have tones among the closely related languages while the other may not. Pasi-Padam and Upper Minyong Adi are mutually intelligible; however, the former has no tone while the latter has tones (Post and Burling, 2017). It is also mentioned that the tones in these languages are difficult to analyze due to their polysyllabic nature, and tone usually interacts with rhythm and intonation. Keeping these issues in mind, the findings and observations in this dissertation are expected to contribute to the description of tones spoken in this area.

2.4 Tones in Kuki-Chin languages

Since Mizo is categorized under the Kuki–Chin subgroup of the Tibeto-Burman language family, an overview of Proto Kuki–Chin tones is provided in this section. Van-Bik (2009) has done a reconstruction of Proto Kuki–Chin tones primarily based on seven languages: three from the Central Chin group: Falam Lai, Hakha Lai, Mizo; two from the Northern Chin group: Tedim, Thado-Kuki; one from the Southern–Plains Chin group: Khumi; and one from the Maraic group, Mara. The reconstruction was done based on the syllable types in nouns: smooth syllables, which include CVV, CVR, and CVVR (R–sonorant); checked syllables with short vowels, i.e., CVS (S–stop); and checked syllables with a long vowel (CVVS). According to this reconstruction, there are four contrasting tones in smooth syllables and in checked syllables in Proto Kuki–Chin. The four contrasting tones in smooth syllables are Tone 1, Tone 2, Tone 3, and Tone 4, corresponding to rising, falling, low and high tones in Mizo. Regarding checked syllables, Tone 3 corresponds to a low tone in CVS syllables in Mizo, while Tone 1, Tone 2, and Tone 4 correspond to rising, falling, and high tones in CVVS syllables. Kuki–Thado is another Tibeto–Burman language belonging to

the Kuki–Chin subgroup, spoken mainly in northeast India and parts of Myanmar. Hyman (2007) stated that Kuki–Thado has three distinct tones, namely, high, low, and falling. It is reported that a high tone is realized as a rising tone in the citation form. The same work has provided some similar tonal behaviors of the African tonal system in Kuki-Thado. Such tonal changes include downstep, tone spreading, floating tones, more level tones than contours, contour tones are clusters; contour tones are often limited to the last syllable, no dissimilation of contour tones, no metathesis of contour tones, and tone can function as lexical as well as grammatical. The primary tone rules operating in Kuki-Thado are contour simplification and tone spreading. The falling tone becomes a level high tone through contour simplification, which can be represented by delinking the low from its syllable whenever another syllable follows it. The downstep phenomenon is seen if the following syllable of a falling tone triggered by the contour simplification process is another falling tone; this falling tone begins at a lower pitch. The downstep process occurs whenever a free or floating low tone is preceded by a high tone syllable and is followed by either a high or falling syllable. High and low tone spreading also happened. The proclitics have an underlying low tone when followed by a falling or high tone but a falling tone when followed by a low tone. The tonal morpheme is found within complex noun phrases, termed as genitive high tone, where a sequence of a low tone noun followed by one or more low tone modifiers is realized as low tone. These observations have confirmed that Kuki-Thado has the characteristics of the African tonal system, which are rarely found in South-East Asian tonal languages. The observations in Hyman (2007) are instrumentally examined by Sreenivasan (2015), where the downtrends in Thadou are discussed in particular. Declination is observed only for low tones, and very few are seen for high tones. Downstep and downdrift are reported as prominently present in Thadou. Another Kuki-Chin language is Paite, spoken mainly in northeast India’s Churachanpur district of Manipur. It is also spoken in some parts

of the neighboring states like Assam, Mizoram, Meghalaya, Arunachal Pradesh, and Nagaland (Yumnam, 2010). Like most Tibeto-Burman languages, Paite is a tone language with different descriptions in the existing literature. Singh (1985) has stated that the Lamzang variety has five contrastive tones, namely, Rising, Rising-Falling, Falling, Falling-Rising, and Level. It is also reported that there is tonal change when an open syllable having either a falling-rising tone or the falling tone is followed by a syllable having one of the five tones, the tone of the preceding syllable changes to a rising tone. If the second syllable is open, the falling tone of the first syllable does not change. On the other hand, Yumnam (2010) reported that Paite has two lexical tones, namely, level and falling. Thuamkhanmang et al. (2018) carried out an acoustic analysis of Paite tones in the Dapzal variety. This work shows three tones in the Dapzal variety of Paite, namely, rising, level, and falling tones. The tones of three Kuki-Chin languages spoken in the Barak Valley of Assam, namely, Sahriem, Hrangkhawl, and Ranglong, are described in Haokip (2019). This work reported that there are four tones in Sahriem and Ranglong. The four tones are high, low, rising, and falling. On the other hand, hrangkhawl is reported to have only three tones, high, low, and falling.

2.5 Tones in Mizo

The tones in Mizo have been analyzed by several researchers previously. However, the description of Mizo tones in these works is inconsistent with one another. This section provides an overview of these studies of tones in Mizo. One of the first works on Mizo tones was carried out in Henderson (1948). Henderson (1948) stated that Mizo tone is a syllabic feature as a whole and is therefore not said to have a 'place'. According to him, Mizo has five tones, namely, High Level, High Falling, Low Rising, Low Falling, and Low-Level tones as seen in Table 2.1. The High-Level tone rises

slightly at the end when occurring in list intonation. The high Falling tone has a fall in pitch from a fairly high starting point. Low Rising tone has its pitch rising from a low level of voice to a fairly high one. Low Falling tone starts on a mid or low pitch and falls to a very low pitch. When a Low Falling tone is produced on a syllable containing a final open vowel or a final nasal or liquid, the tone is often accompanied by breathy voice quality. The low-Level tone has about the same starting point as the Low Falling tone, which is believed to be a variant of the Low Falling tone. Low-Level tone occurs only on syllables containing a short vowel and ends in a final stop consonant.

Table 2.1: Mizo tonal inventory (Henderson, 1948)

High Level	High Falling	Low Rising	Low Falling
va:y	\va:y	/va:y	va:y
foreigner'	'to wave'	'to perplex'	'to search'
fam	\fam		fam
'to die' (poetic)	'to dress up'		'also'
ley		/ley	ley ley [?]
'tongue		'to buy'	'bridge' 'to pour'
ka:k	\ka:k		kak
'cackle'	'to fork'		'crack'

Weidert (1987) on the other hand, has come up with a different approach to analyzing Mizo tones. He grouped Mizo tone types into Type I (full) and Type II (reduced) as seen in Table 2.2. Type I consists of high, low, falling, and rising tones. Type II has reduced tones of high and low tones. Reduced tones do not have long vowels in the nucleus of a syllable and thus can have only two places in a syllable (CV type syllable). The full tone series are found in syllables with nasals or continuants in the coda position and the nucleus with a complex vowel. The tone of a syllable

can be either full or reduced in the case of final single vowels. Weidert (1987) also mentioned the presence of tonal changes in Mizo, which is discussed more in detail in the next chapter.

Table 2.2: Mizo tonal inventory (Weidert, 1987)

I (full)	$\overline{/ /}$	high	$/- /$	Low
	$/, /$	rising	$/' /$	falling
II (reduced)	$/\sim /$	high	$/\sim /$	low

Fanai (1992) claimed four contrastive tones in Mizo, namely, high, low, falling, and rising tones, as shown in Table 2.3. These tones are grouped into three different types: a level (high tone), a contour (low tone), and two complex tone clusters (rising and falling tones). According to Fanai (1992), the high tone is the only static tone phonetically, while the other three are dynamic. It is also reported that Mizo has an extra-low tone, which is considered the allophonic variant of the low tone. The extra low tone occurs whenever the glottal stop is in the coda of a syllable. The high and low tones can occur in long or short syllables while rising and falling tones can occur only in a syllable with more than one sonorant in the rhyme. The existence of a complex tone cluster argues for the pre-linking of the right-most tone to a post-nucleus sonorant in the underlying representation. The same study claimed that tone association in Mizo must be right-to-left because of the nature of the tonal patterns and their subsequent derivations. Furthermore, Fanai considered the low tone as the default tone in Mizo. The same work also carries out an extensive study on Mizo verb Form I and Form II.

Table 2.3: Mizo tonal inventory (Fanai, 1992)

Word	Meaning	Tone
/lei/	‘slanting’	High
/lei/	‘a bridge’	Low
/pa:/	‘mushroom’	Rising
/pa:/	‘father’	Falling

A considerably different approach towards describing tones in Mizo is seen in Chhangte (1993). According to this work, Mizo tones are divided into two series: the plain series and the glottal series, as tabulated in Table 2.4. The plain series includes high, low, rising, and falling tones; the glottal series consists of low glottal, high glottal, and falling glottal tones characterized by an abrupt ending with a pitch falling slightly. A high tone is a level tone starting at a relatively high pitch and remaining there without any perceptible drop-in pitch. The rising tone starts fairly low and rises to a relatively high pitch, but not to the same level tone. The falling tone starts at a relatively high pitch and falls to a mid-low pitch. A low glottal tone is a mid-low pitch cut off abruptly occurring in open syllables and syllables ending in liquids and glides (/ha?/ ‘tired’). A high glottal tone is a high pitch cut-off abruptly found mainly in adverbials and occurs only in the following sequences: /ew, ey, ow, oy, aw, ay, ia, ua/ (/cia?/ ‘just now’). A falling glottal tone is a falling tone that begins at about the same pitch as a falling plain tone and is cut off abruptly, occurring mainly in the loan from Chin languages (/boy?/ ‘slave’) and in adverbials (/cia?/ ‘exactly’). Chhangte has treated the glottal stop as a tone feature, not a segment. She claimed that the plain tones contrast with the glottal tones. Further, she has mentioned two major tone sandhi rules: Derivational Prefixing and Contour Tone Levelling. The derivational prefixing rule is incorporated when a common noun (e.g., /sa:/ ‘animal’) or part of it becomes a prefix for another word; the nucleus

becomes short and retains only the endpoint of its tone. The Contour Tone Leveling rule is applied when a rising tone loses its endpoint and becomes a low tone when followed by a high tone. This tone sandhi rule is also observed in the acoustic study of contextual variations of Mizo tones by Sarmah et al. (2015) and Weidert (1987) where the rule is applied when the rising tone is followed by either falling or high tone. The same literature has mentioned the absence of tone in the underlying pronominal agreement prefixes; the pronominal prefix gets the tone assignment depending on the following syllable tone in the surface representation. Another description of Mizo tones is provided by Lalthangliana (1997). According to him, Mizo has five tones: high-rising, high-falling, falling-rising, low-rising, and low-falling.

Table 2.4: Mizo tonal inventory (Chhangte, 1993).

Tone	Word	Meaning
High (H)	/pââ/	‘basket’
Low (L)	/paa/	‘male’
Rising (LH)	/páá/	‘mushroom’
Falling (HL)	/pàà/	‘father’
Low Glottal (L)	/haʔ/	‘tired’
High Glottal (H)	/cîâʔ/	‘just now’
Falling Glottal (HL)	/òòyʔ/	‘steep’

An acoustic study of Mizo tones was carried out by Sarmah and Wiltshire (2010b) measuring the f0 values of each tone and the duration of the rhymes. This work has confirmed the existence of four contrastive tones in Mizo acoustically. However, this work is based on only one Mizo female speaker's speech. Sarmah et al. (2015) analyzed the variations of Mizo tones in different tonal contexts. The results show that Mizo has bidirectional contextual variation. The same study also reported the presence of tone sandhi in Mizo, where the rising tone changes to a low tone when it precedes either a high or a falling tone. This phenomenon is the same tonal alteration reported in Weidert (1975) and Chhangte (1993). Additionally, an exceptional case that could not undergo the tone sandhi process is also reported in Sarmah et al. (2015). The detailed survey of these acoustic analyses on Mizo tones is reported in Section 4.4 of Chapter 4.

2.6 Consonants in Mizo

The consonantal phonemes provided by Henderson (1948); Weidert (1975); Fanai (1992); Chhangte (1993) and Lalthangliana (1997) are tabulated in Table 2.5. Henderson (1948); Fanai (1992) and Lalthangliana (1997) claimed that there are 30 consonantal phonemes in Mizo. On the other hand, Weidert (1975) Mizo has 32 consonantal phonemes and Chhangte (1993) reported that there are 31. The main differences between the consonantal inventories and the phoneme descriptions of the existing literature are summarized in this section. In Henderson (1948), the voiceless unaspirated nasals reported in Bhaskararao and Ladefoged (1991) are labeled aspirated in this study. Likewise, /tlh, trh, hl, hr/ are considered aspirated, and /ts, tl, tr/ are grouped as voiceless. Henderson claimed that /p, t, k/ in the final position of Mizo syllables are pronounced as voiceless stops, sometimes without release, but mostly held for a while and then released very quietly so that a weak plosive is

heard. The /t/ in the coda of a syllable is dental, and /r/ has one or two taps and is usually rolled. /hr/ produces considerable friction, sometimes accompanied by a voiceless roll. Palatograms of /riam/ showed narrowing caused by two very narrow arms of lateral contact on a level with the first premolars. A single palatogram for /hriam/ showed the opening widened by the disappearance of one of the arms. The palatograms of /l/ in the word /pal/ show contact to be alveolar, but further than /l/ in /la:y/ which suggested that final /l/ may be slightly retroflex and initial /l/ has a mid-vowel resonance. /tl/, on the other hand, showed a wipe-off further back, over nearly the same area as for /tra:m/, but the band is narrower and asymmetric, more retracted in the middle of the mouth. The glottal stop is the realization of syllable shortness and a final plosive. Palatograms of /tey/ showed a wide area wipe-off, extending from about the middle of the central incisors to a line on a level with the back of the first premolars. /tra:m/, on the other hand, showed a narrow band of contact extending at its most forward point from a line on a level with the middle of the canines to one on a level with the middle of the first premolars. A palatogram of /tsiap/ showed no complete obstruction but a very close narrowing mid-way between the two canines, with a lateral wipe-off extending back from the lateral incisors. Thus, there is no actual contact of /t/ in /ts/ (Henderson, 1948). According to Weidert (1975), Mizo has 32 consonantal phonemes, as seen in Table 2.5. There are two new phonemes, /r² and /l²/ which are not listed in Henderson (1948). According to Weidert (1975), three distinct glottal stops are present in Mizo. These glottal stops occur in the final place of syllables: plosive, lateral, and rolled plosives which are phonemic. According to Fanai (1992), Mizo has 30 consonantal phonemes, similar to the inventory of Henderson (1948) shown in Table 2.5. /hŋ, hn, hm/ are labeled as homorganic voiceless nasal followed by voiced nasal conforming to the descriptions of Bhaskararao and Ladefoged (1991) and Chhangte (1993). /r/ is labeled as trill, which is flap according to Chhangte (1993), Henderson (1948) and

Weidert (1975) labeled as rolled. Fanai (1992) has used a mixture of phonetic symbols and a slightly modified version of the letters of Mizo orthography in presenting the Mizo phonemes. She claimed that aspiration in Mizo is phonemic. Chhangte (1993) claimed that there are 31 consonantal phonemes in Mizo as tabulated in Table 2.5. This work labeled /hŋ, hn, hm/ as voiceless nasals, conforming to the findings in Bhaskararao and Ladefoged (1991). Glides /w, y/ are present in the same study while the glottal stop is absent. Dental stops and nasals are pronounced with the tip of the tongue against the back of the front teeth, often protruding between the front teeth. Alveolar fricatives and affricates are articulated with the blade of the tongue against the alveolar region, and the tip of the tongue does not touch the teeth. Palato-alveolar stops are produced with the tip of the tongue in the palatal region. The same study has mentioned that the southern region dialect has the tip of the tongue further back, and often a flap is heard as the tongue is released. It is mentioned that [j] and [g] are used only in loanwords (Chhangte, 1993).

Table 2.5: Mizo consonantal phonemes

Consonants	Henderson (1948)	Weidert (1975)	Fanai (1992)	Chhangte (1993)	Lalthangliana (1997)
p	✓	✓	✓	✓	✓
p^h	✓	✓	✓	✓	✓
b	✓	✓	✓	✓	✓
t	✓	✓	✓	✓	✓
t^h	✓	✓	✓	✓	✓
d	✓	✓	✓	✓	✓
k	✓	✓	✓	✓	✓
k^h	✓	✓	✓	✓	✓
ʔ	✓	✓	✓	X	✓
tl	✓	✓	✓	✓	✓
tl^h	✓	✓	✓	✓	✓
tr	✓	✓	✓	✓	✓
tr^h	✓	✓	✓	✓	✓
ts	✓	✓	✓	✓	✓
ts^h	✓	✓	✓	✓	✓
m	✓	✓	✓	✓	✓
n	✓	✓	✓	✓	✓
ng (ŋ)	✓	✓	✓	✓	✓
hm (ṁ)	✓	✓	✓	✓	✓
hn (ṅ)	✓	✓	✓	✓	✓
hng (ṅ)	✓	✓	✓	✓	✓
l	✓	✓	✓	✓	✓
hl (l̥)	✓	✓	✓	✓	✓
r	✓	✓	✓	✓	✓
hr (r̥)	✓	✓	✓	✓	✓
f	✓	✓	✓	✓	✓
v	✓	✓	✓	✓	✓
s	✓	✓	✓	✓	✓
z	✓	✓	✓	✓	✓
h	✓	✓	✓	✓	✓
w	X	X	X	✓	X
y	X	X	X	✓	X
l^ʔ	✓	X	X	X	X
r^ʔ	✓	X	X	X	X

2.7 Vowels in Mizo

The description of Mizo vowels also differs from one literature to another. According to Henderson (1948), Mizo has five vowels /i, e, a, o, u/, as seen in Table 2.6. /i/ is a close front vowel, /e/ is a half-open front vowel, /a/ is an open back vowel, /u/ is a close back vowel, and /ɔ/ is a half-open back vowel. Apart from these monophthongs, Henderson (1948) reported eight diphthongs in Mizo, /ei, ai, oi, ui, iu, eu, au, ou/. Additionally, he also stated that /ua, ia/ are vowel sequences (/u + a, i + a/) that are treated as one of the constituents of syllables.

Table 2.6: Mizo vowel inventory (Henderson, 1948).

	Front	Back
Close	i	u
Half open	e	o
Open		a

According to Weidert (1975), Mizo has five simple vowels /i, e, a, o, u/ with their long vowel counterparts, and /ia, ua/, which are considered complex vowels. He also mentioned the existence of seven diphthongs /ei, ai, oi, ui, eu, au, ou/ in the language. Fanai (1992) also reported five Mizo pure vowels /a, i, e, u, o/ as shown in Table 2.7. Ten diphthongs /ui, iu, ia, ai, au, ua, ei, eu, oi, ou/ and 4 triphthongs /iai, uai, uau, iau/ are also reported to exist in Mizo in the same work.

Table 2.7: Mizo vowel inventory (Fanai, 1992)

	Front	Central	Back
High	i		u
Mid	e		o
Low		a	

According to Chhangte (1993), there are five Mizo vowels /i, u, ε, ɔ, a/ as shown

in Table 2.8. She has mentioned two vowel sequences, which are called diphthongs /ia/ and /ua/ as in Henderson (1948), which are termed ‘complex vowels’ by Weidert (1975). The front vowels /i/ and /e/ are produced with spreading lips. The back non-low vowels /u, o/ are rounded, and the low /a/ is produced fairly back, with the lips slightly spreading. Chhangte claimed that Mizo vowels occur in all syllable types and in all tones. She has also mentioned the reduction of diphthongs /ia/ and /ua/ into /e/ and /o/, respectively, which occur when the diphthongs are followed by another syllable only with a consonantal onset.

Table 2.8: Mizo vowel inventory (Chhangte, 1993)

	Front	Back
High	i	u
Mid	ɛ	ɔ
Low	ɑ	

Sarmah and Wiltshire (2010b) conducted an acoustic study of Mizo vowels by measuring the first two formant frequencies and the perceptual differences between the vowels. The results have shown five distinct Mizo vowels /i, u, ɛ, ɔ, ɑ/, with the long vowel counterparts twice as long as the short vowels. The vowels keep an average perceptual difference of 187 mels.

2.8 Conclusions

This chapter provided a general overview of tones in world languages, followed by specifics of tonal phenomena in Tibeto-Burman and Kuki-Chin languages. The chapter also provided a literature review of the studies on tones and segments in Mizo. It is seen that the Tibeto-Burman languages spoken in the northeast of India are barely explored. Likewise, Kuki-Chin languages are under-resourced languages with not much information on grammar. The existing works of literature on these languages are merely subjective analyses, with no instrumental evidence. Therefore, the

absence of studies on the linguistic aspects of these languages has made it difficult to draw a conclusion on the linguistic typology.

From the discussion on Mizo tones and segments in this chapter, indeed the previous literatures provide insightful information for further analysis of Mizo tones. At the same time, it is also noticed that the descriptions vary from one work to the other. It is observed that the naming convention or the terminology of the tones in Mizo differs from one literature to another. For instance, Henderson (1948) and Lalthangliana (1997) preferred more of a phonetic convention such as high level and high-rising tone, respectively. On the other hand, Weidert (1975); Fanai (1992) and Chhangte (1993) use the simple term 'high' tone for the corresponding high level and high-rising tone. Also, it is observed that the number of tones suggested varies from one another. Lalthangliana (1997) and Henderson (1948) claimed as many as five tones in Mizo, while the other works reported four tones. It is also seen that the tonal minimal sets in these literatures are suffering from two limitations. The first one is that the word /pa:/ meaning 'basket' is a less common term that has less frequency of usage. Such a word results in confusing the participants of the current work. The second drawback is that the loanword 'vai' meaning 'a foreigner' from Hindi 'bhai' meaning 'brother' are categorized together in Henderson (1948) to show the Mizo tonal inventory. On the other hand, Fanai (1992) stated that loanwords in Mizo have a different system of tone realization. Hence, mixing Mizo native words and loanwords could lead to wrong tonal analysis. There is also confusion between vowel length and tone categories. The vowel length differences are considered as two distinct tones in Lalthangliana (1997). For instance, the high-falling tone is a low tone with a long vowel, and the low-falling tone is a low tone with a short vowel.

In terms of consonants, the previous works have provided articulatory phonetic descriptions. The consonantal phonemic inventories are also different from one work to another. For instance, Chhangte (1993) is of the opinion that the glottal stop

in Mizo is a tone feature and not a segment, while the other researchers claimed it as a phoneme. At this point, since one of the objectives of our research is to look into the interaction between tones and stop consonants in Mizo, we will not look further into the rest of the consonantal phonemes. However, we observed that no acoustic study is available for the stop consonants to compare them with the tones. In the case of vowels, all the existing literature claimed the same number of vowels in Mizo, namely, /a, i, e, o, u/. However, we observed that the terminology and the International Phonetic Alphabet (IPA) used in these works differ from one another. Chhangte (1993) and Sarmah and Wiltshire (2010b) used an open-mid front vowel IPA /ɛ/ and an open-mid back vowel /ɔ/ while the other literature such as Henderson (1948); Weidert (1975) and Fanai (1992) were using a close-mid front vowel /e/ and a close-mid back vowel /o/.

All the previous works lack acoustic analysis of Mizo phonemes and tonemes, except in Sarmah and Wiltshire (2010b). However, the acoustic analysis of Mizo vowels and tones in Sarmah and Wiltshire (2010b) is also not comprehensive enough since it was based on only one native female Mizo speaker's speech. Additionally, it is seen that the previous analysis on Mizo tones and segments depends primarily on the native intuition of the speakers and the researchers. It is also observed that the tones in Mizo are analyzed in a few morphological contexts such as disyllabic compounds and disyllabic phrases. Hence, the current work attempts to fill these voids by analyzing the phonetics and phonology of Mizo with the quantitative method. Therefore, in the following chapters, a description of the phonology of tones in Mizo is examined using different grammatical structures, followed by acoustic phonetic analysis of tones in different contexts. This dissertation further analyzed the interaction of tones and segments in Mizo.

Chapter 3

The phonology of Mizo Tones

3.1 Introduction

The phonology of Mizo tones is of utmost interest to scholars working on the Mizo language. Several scholars, such as, Henderson (1948), Weidert (1975), Fanai (1992), Chhangte (1993), Lalthangliana (1997) and Sreenivasan (2015), have provided accounts of the phonology of Mizo tones. Henderson (1948) provided an account of the Mizo tones for the first time, with data elicited from one Mizo speaker. Almost thirty years later, Weidert (1975) described the phonological processes involved in the emergence of tones in Mizo in various contexts. Considering the data obtained from the native speakers of Mizo, Weidert (1975) provided the tonal inventory of the language and categorized the tones into reduced and full tone series. He also described the phonological environments leading to tonal changes. Weidert's work was followed by Fanai (1992) which is an autosegmental approach in describing Mizo tone realization. Fanai also proposed the tonal inventory of Mizo and described the derivation and assignment of tones from an autosegmental perspective. Notably, this work also regarded the low tone as the default tone in Mizo and proposed a right-to-left tone association pattern in the language. She also posited a Mizo verb conversion phenomenon, from Form I to Form II, involving both segmental and tonal changes. Fanai (1992) further claimed that these changes happened with the augmentation of

segments and subsequent application of cyclic phonological rules. Apart from these, she has also reported certain restrictions in the possible sequences of tones in Mizo. For example, according to Fanai, the sequence of a rising tone followed by a high or a falling tone is ungrammatical. This observation prepared the ground for the later claims regarding tone sandhi processes in the Mizo language.

Even though Chhangte (1993)'s Ph.D. dissertation was on Mizo syntax, she dedicated a chapter of her thesis to Mizo tones. She also presented the tonal inventory of Mizo and further classified them into plain and glottal series. She is the first to use the term 'tone sandhi' for the tone alteration in Mizo that was earlier reported in Fanai (1992) as tone sequence restrictions.

Later, Lalthangliana (1997) provided a slightly different tonal inventory for Mizo. He provided an account of the Mizo tones and their allotones in disyllabic words and phrases. Sreenivasan (2015) has provided instrumental evidence for Mizo tones and showed the alternation of tones in Mizo by using disyllabic phrases. She further examined the downtrends in Mizo and concluded that the high and low tones in Mizo show declination while there is no downdrift and downstep in the language. A summary of the tonal inventories proposed in these works is tabulated in Table 3.1. Table 3.1 also reveals that the examples used for the tonal inventories suffer from two serious shortcomings. Firstly, most examples do not form perfect, minimal sets for tonal contrasts. Secondly, several words used in the example sets are low-frequency words not commonly used by Mizo speakers. For example, words such as /paa/ for 'basket' are unfamiliar to a common speaker of the language. The table also shows the inconsistencies in the nomenclature used for the tone categories in Mizo. Apart from that, there are errors in the data, such as the word for 'to search' is written as /va:y/ with a low-rising tone in Weidert (1975). The tone provided is actually for /va:y/ which means 'to perplex.' Likewise, in Lalthangliana (1997), the specified tones and the meanings of the lexical words are interchanged. In this work, /buk/

Table 3.1: The tone inventories of Mizo obtained from the literature as transcribed in the original texts.

Authors	Tones				
Henderson (1948)	High level <i>va:y foreigner</i>	High falling <i>\va:y to wave</i>	Low rising <i>/va:y to perplex</i>	Low falling <i>va:y to search</i>	Low level
Weidert (1975)	High <i>pa basket</i>	Low <i>pa male</i>	Rising <i>pa mushroom</i>	Falling <i>pa father</i>	–
Fanai (1992)	High <i>lei slanting</i>	Low <i>lei a bridge</i>	Rising <i>pa: mushroom</i>	Falling <i>pa: father</i>	–
Chhangte (1993)	High <i>paa basket</i>	Low <i>paa male</i>	Rising <i>paa mushroom</i>	Falling <i>paa father</i>	–
Lalthangliana (1997)	High-rising <i>buk hut/camp</i>	Falling-rising <i>buk to tip up</i>	High-falling <i>buk to weigh</i>	Low-rising <i>buk sound of sudden incident</i>	Low-falling <i>buk bushy</i>

meaning ‘sound of sudden incident’ is wrongly associated with a high-rising tone. In contrast, the correct tone for the lexical entry should have been a low-rising tone. Similarly, works such as Henderson (1948) have failed to distinguish between native Mizo words and loanwords while investigating tone assignments in the language. For example, in Henderson (1948), the word /*va:y*/ with a high-level tone is used to show lexical tone contrasts in Mizo. However, /*va:y*/ with a high-level tone which means ‘a foreigner’ is a loanword from Hindi, /*b^hai*/ meaning ‘brother’. It is important to consider loanwords in Mizo separately as it has a different tone assignment mechanism (Fanai, 1992).

The inconsistencies in the description of Mizo tones motivated us to undertake definitive acoustic studies of the tones in the following chapters. While doing that, in the following chapters of this thesis, we also include minimal sets for tones made of words familiar to a common speaker of the language. As discussed in the previous section, a large number of phonological studies in Mizo have dedicated tone alteration in various grammatical categories and derivations in the language. Considering this, this chapter will initially provide an overview of the findings of the previous studies in Section 3.2. This will be followed by an analysis of tone alteration in Mizo using my intuition as a native speaker of the language. These findings are provided in Section 3.3 and Section 3.4. Section 3.5 summarizes the findings and concludes the chapter.

3.2 Tone alternation in Mizo from the literature

As mentioned in the previous section, tone alternation in Mizo has been a recurring topic in the previous works on Mizo phonology. In the following subsections, I summarize the previous studies on the topic.

3.2.1 Weidert (1975)

Weidert (1975) mentioned instances where there are changes in the Mizo tone phonologically. He claims that there cannot be a rising tone in phonemic representation when a rising tone precedes a syllable with a high or falling tone. However, *expressive adverbs* can be an exception in bringing the rising tone to the surface level. Invoking consonantal restrictions in Mizo tone assignment, Weidert (1975) reports that closed, non-checked syllables with short vowels with either rising or falling tone change their tone to a high-level tone when followed by an initial vowel syllable. Weidert (1975) also observes that personal pronouns are assigned a high tone when followed by a syllable with either a low or a falling tone. They are assigned a low tone followed by a syllable with either a high or a rising tone. These high and low tones are reduced tones. A full-toned syllable with final vowel changes to a syllable with a reduced tone. In such reductions, a high or a rising tone changes to a reduced high tone, and a low or a falling tone changes to a reduced low tone. These reduced tone syllables are characterized by short vowel length and stop coda consonants, including glottal stops.

3.2.2 Fanai (1992)

The tone changes observed in Fanai (1992) are based on Mizo compounding and Mizo verb conversion, where verb Form I changes to verb Form II. In compounding, Fanai mentioned that combining a rising tone followed by a high or a falling tone

(LH+H/HL) is ungrammatical. She also stated that an HL melody is changed to a single L melody and accompanied by vowel shortening. This tone and segmental change occur when generic terms for birds or animals are combined with other morphemes to refer to some specific names of animals or birds. The observations made from verb conversion are summarized as follows. The initial tones of Form I are almost completely wiped out, and Form II verbs get new tonal specifications. There is a general lowering of tone in Form II, and even if the derived tone is a complex tone cluster, only an HL melody is possible where the rightmost tone is low. The tonal changes observed in different verb conversions can be summarized as follows.

1. Type 1 - L, H, LH \rightarrow L

In this type of verb conversion, there is a glottal stop /ʔ/ insertion in the coda of a syllable which may or may not be accompanied by vowel shortening processes coalescence. This changes L, H, and LH tones to L tones.

2. Type 2 - L, HL \rightarrow L

Here, the process of glottal stop /ʔ/ alternation in the coda of a syllable takes place. Vowel shortening is also seen along with the glottal stop alternation for some words.

3. Type 3 - (a) L \rightarrow HL, (b) H, LH \rightarrow L

There is /k/ insertion in the coda of a syllable in terms of 3 (a). In the case of 3 (b), non-derived verbs with /k/ coda with H and LH tone change to L.

4. Type 4 - (a) H \rightarrow L, (b) LH \rightarrow HL

In terms of both 4 (a) and 4 (b), the process of /t/ insertion is seen. This /t/ insertion may or may not be accompanied by vowel shortening in the case of 4 (a).

5. Type 5 - (a) H, LH \rightarrow L, (b) H \rightarrow HL, (c) L \rightarrow HL

In the case of 5 (a), tonal changes happened in the morphological conversion,

whereby changes in the tone are seen with or without any segmental process. Nasal alternation is seen if there is segmental alternation. In terms of 5 (b), there are two processes involved, vowel shortening and nasal alternation. Vowel shortening is also involved in 5 (c).

3.2.3 Chhangte (1993)

Chhangte (1993) provided the following tonal changes in Mizo. She stated that pronominal prefixes do not have their tones in Mizo. The assignment of tones in the pronominal prefixes depends on the final tone of the following syllable. Hence, when the following syllable has a high (H) or rising (LH) tone, by virtue of the final tone being H, the prefix will be assigned a low (L) tone. Examples of such polarized tone assignments are provided from 6) to 9). The pronominal prefix tone assignment occurs before tone sandhi and derivational prefixing processes.

6. a + paa → a paa
 $\emptyset + HL \rightarrow H HL$
 PRO(3PS) + father → 'his/her father'
7. a + paa → a paa
 $\emptyset + LH \rightarrow L LH$
 PRO(3PS) + mushroom → 'his/her mushroom'
8. a + paa → a paa
 $\emptyset + LL \rightarrow H LL$
 PRO(3PS) + masculine → 'she/he is masculine'
9. a + booy? → a booy?
 $\emptyset + HL \rightarrow H HL$
 PRO(3PS) + slave → 'his/her slave'

Chhangte (1993) has also mentioned two types of tone sandhi in Mizo: Derivational Prefixing (DP) and Contour Tone Levelling. Both sandhi rules level the contour tones. When a common noun or a part of it becomes a prefix (it is like a morpheme boundary) for another word, the nucleus shortens and retains only the endpoint of its tone; this is called a Derivational Prefixing sandhi. This rule occurs in prefixing, as a result of which the prefix retains its endpoint regardless of the tone of the following word. In other words, the DP occurs only when a syllable is reduced or considered reduced. The contour tone leveling tone sandhi makes a rising tone lose its endpoint and makes it a low tone when followed by a high tone. This rule affects only the rising tone and is a post-lexical rule. It can occur regardless of the length of the nucleus.

3.2.4 Lalthangliana (1997)

Lalthangliana (1997) has mentioned allotonic tones in Mizo. In this work, these allotones are attested in Mizo disyllabic words and phrases, which are summarized as follows. Lalthangliana has considered Mizo tones to be five, namely, Tone 1 to Tone 5. Tone 1 corresponds to a high-rising tone, Tone 2 is a falling-rising tone, Tone 3 is high-falling, Tone 4 is a low-rising tone and Tone 5 is a low-falling tone.

Lalthangliana considers Tone 1 as a high-rising tone and reports that it has two allotones. The first allotone has a rising pitch from the mid-level to the high-level range. I consider this tone as a high tone with a long vowel in the current work. The second allotone is a rising-falling tone and is characterized by a rising pitch with a slight fall at the end of the articulation. According to Lalthangliana, the first syllable has a rising-falling tone when it is followed by T1, T2, T3, T4, or T5. The following tones remain the same in their canonical forms except for the combination of T1+T5. The examples of each tone combination are provided from 10) to 14). I have observed that T1 in 14 /beŋ/ is with a short vowel, thus, it should be T4. Also, T5 does not become T4. This could be a typo.

10. T1 + T1 → rising-falling + high-rising
/bo:mra:ŋ/ ‘man’s basket’, /zi:ŋzu:/ ‘morning glass of beer’
11. T1 + T2 → rising-falling + falling-rising
/ma:upa:/ ‘a kind of mushroom’
12. T1+T3 → rising-falling +T3
/ts^ho:lbuk/ ‘hut’
13. T1+T4 → rising-falling +T4
/ŋa:ɪdam/ ‘to forgive’
14. T1 + T5 → rising-falling + T4
/beŋbeʔ/ ‘earring’

Tone 2 is considered a falling-rising tone and is also reported as having two allotones by Lalthangliana. Falling-rising is the first allotone of Tone 2, which has a falling pitch from a high level to the mid-level range, immediately followed by a rising pitch terminating at the high level. The second allotone is a falling-rising 2, and the auditory correlates a falling pitch from a high level to the mid-level followed by a slight rise which does not quite reach the high level. The examples are provided from 15) to 19).

While Lalthangliana has proposed the tone alteration for allotonic variations, some of his observations are off the mark. For example, in 16), it is seen that /po:ŋ/ is not T2 but T1, going by Lalthangliana’s nomenclature. Similarly, in 17), it is observed that /ve:l/ must be a typo; it might be /he:l/, also /nun/ is not T3, it is T5. Hence, in the data for T2 + T3, no tone change is observed provided that if /ve:l/ is considered as /he:l/. Again in 18), /t^hi:r/ is not T4, but T1.

15. T2 + T1 → falling-rising 2 + T1
/luŋlu:/ ‘precious stone’, /sa:ŋt^hum/ ‘three thousand’

16. T2 + T2 → falling-rising 2 + T2

/po:ŋron/ ‘to be aggressive’

17. T2 + T3 → falling-rising + T3

/ve:lnun/ ‘to prowl about’

18. T2 + T4 → falling-rising 2 + T4

/fiant^hi:r/ ‘a dipper/ladle’

19. T2 + T5 → falling-rising 2 + T5

/tuilian/ ‘flood’

According to Lalthangliana, Tone 3 is a high-falling tone with two allotones. The first allotone is high-falling which has a falling pitch from the high level to the mid-level range. The second allotone is a mid-falling tone that has a falling pitch from the high mid-level to the low mid-level range. However, this falling pitch does not quite reach the low level. The tone specifications of T3, followed by all the other tones, are provided from 20) to 24). It is seen that T3 changes to the second allotone, that is, the mid-falling tone when all the tones follow it. However, no such tonal changes are observed in our reanalysis of these tone combinations.

20. T3 + T1 → mid-falling + T1

/pu:k kou/ ‘edge of a cave’

21. T3 + T2 → mid-falling + T2

/bo:ŋpui/ ‘cow’

22. T3 + T3 → mid-falling + T3

/riatsiak/ ‘quiz competition’

23. T3 + T4 → mid-falling + T4

/laksan/ ‘a spider’, /lakkhou/ ‘basket’

24. T3 + T5 → mid-falling + T5

/bu:kts^hak/ ‘above the hut’

Tone 4 is considered a low-rising tone with a short vowel and has two allotones. The first allotone is a low-rising tone with a rising pitch from the very low level to the high low-level range. The second allotone is a low-rising level tone with a rising pitch from a very low level to a mid-low level followed by a relatively steady mid-low level pitch. No tone change is observed in the examples from 25) to 29). However, we noticed that in 28), /ra:l/ is not T4 but it is T1 since it has a long vowel.

25. T4 + T1 → low-rising level + T1

/zou saŋ/ ‘high land’

26. T4 + T2 → low-rising level + T2

/maŋ zou/ ‘to spend every penny’

27. T4 + T3 → low-rising level + T3

/vombal/ ‘a poisonous tree’

28. T4 + T4 → low-rising level + T4

/ral do/ ‘to go for battle’

29. T4 + T5 → low-rising level + T5

/triŋtraŋ/ ‘a guitar’

Lalthangliana considered Tone 5 as a low-falling tone, and it has two allotones. The first allotone is a low-falling tone with a falling pitch from the high-low level to the low-low level range. The second allotone is a low-falling level tone with a falling pitch from the high-low level, terminating in the mid-low level in relative perceptual terms and maintaining a level thereafter. The examples provided from 30) to 34) show that no tone change is involved when all the tones follow T5. Additionally, we

observed that /sa/ in 32), which bears T5, is derived from the process of Derivational Prefixing mentioned in Chhangte (1993). Hence, the vowel is long, and it bears T3 underlyingly. Also, it is noted that /t^hiŋ/ in 33) is not T4, but it is T1.

30. T5 + T1 → low-falling level + T1

/baibi:ŋ/ ‘a bud of yam’

31. T5 + T2 → low-falling level + T2

/balla:/ ‘banana’

32. T5 + T3 → low-falling level + T3

/sava:/ ‘birds’

33. T5 + T4 → low-falling level + T4

/t^hakt^hiŋ/ ‘cinnamon’

34. T5 + T5 → low-falling level + T5

/bokbo:n/ ‘brinjal’

Lalthangliana’s description of tones in Mizo shows clear evidence of mixing up between T1 and T4. He has used T1 and T4 in the data lists interchangeably. We found that T1 and T4 are not two distinct tones, but they differ in vowel length, that is, high tone with either a long or a short vowel. Hence, the allotones mentioned here could be a phonetic realization due to vowel length distinction. On the other hand, a phonological tone change is seen in T2 in the contexts of T2+T1 and T2+T4. In this tone change, the falling-rising tone (T2) becomes a falling-rising 2 (the second allotone). This phenomenon is also seen in the previous works such as Weidert (1975) and Chhangte (1993).

3.2.5 Sreenivasan (2015)

Sreenivasan (2015) has provided the alternation of tones in Mizo by using disyllabic

phrases. These tonal alternations are provided from 35) to 50). No tonal change is observed when the L tone precedes all four Mizo tones, as seen from 35) to 38). From 39) to 42), there is no change in the tone when all the tones follow the H tone. When the HL tone precedes all four tones from 43) to 46), the HL tone changes to an H tone.

35. L + HL → L HL
 /(ká) kè:l mî:t/
 ‘(my) goat’s gallbladder’

36. L + LH → L LH
 /kè:l tē:/
 ‘small goat’

37. L + L → L L
 /kè:l trà:/
 ‘good goat’

38. L + H → L H
 /kè:l nēm/
 ‘soft goat’

39. H + HL → H – HL
 /(kà) zó:ŋ mî:t/
 ‘(my) monkey’s gallbladder’

40. H + LH → H – LH
 /bé:l tē:/
 ‘small pot’

41. H + L → H – L
 /bé:l trà/

‘good pot’

42. $H + H \rightarrow H - H$

/bé:l né:m/

‘soft pot’

43. $HL + HL \rightarrow H - HL$

/(ká) pá: mî:t/

‘(my) father’s gallbladder’

44. $HL + LH \rightarrow H - LH$

/(ká) pá: ïi/

‘(my) father’s dog’

45. $HL + L \rightarrow H - L$

/(ká) pá: kè:l/

‘(my) father’s goat’

46. $HL + H \rightarrow H - H$

/(ká) pá: bél/

‘(my) father’s pot’

In terms of an LH tone preceding all four tones, Sreenivasan stated that the LH tone, when followed by an H or an HL tone, becomes an L tone by delinking and deleting the H tone from its syllable. Examples of this phenomenon are provided in 47) and 50). She further claimed that this could be attributed to Obligatory Contour Principle (OCP). Additionally, Sreenivasan also stated that this tonal alternation in Mizo applies only to noun phrases. As seen in 48) and 49), the LH tone does not change when it precedes another LH and L tone respectively. The same work also examined the downtrends in Mizo. It is reported that the high and low tones in Mizo show declination while there is no downdrift and downstep.

47. LH + HL → L – HL
 /(kà) ùi mì:t/
 ‘(my) dog’s gallbladder’
48. LH + LH → LH – LH
 /ũi tẽ/
 ‘small dog’
49. LH + L → LH – L
 /ũi trà:/
 ‘good (breed) dog’
50. LH + H → L – H
 /ùì né:m/
 ‘soft dog’

The discussion from the literature survey in this section shows the tone alterations reported in the previous studies. Previous studies have reported tone alterations in the contexts of disyllabic compounds and phrases and have concluded that tone alterations in Mizo can be both phonological and phonetic. While Weidert (1975) and Fanai (1992) have reported systematic tone alterations depending on verb types and morphological conditions, Chhange (1993) has also provided evidence for tone sandhi in Mizo. On the other hand, Lalthangliana (1997) attempted to show that certain tonal variations in Mizo are context-induced, prompting him to consider such variations as phonetic changes, resulting in allotones of the primary tones in Mizo. Nevertheless, tone alterations in Mizo need to be investigated more systematically and with support from acoustic studies. Hence, in the following sections, I explore tone realization in various grammatical contexts in Mizo and investigate the rising tone sandhi in various morphological contexts.

3.3 Tone alterations in Mizo

Considering the findings and observations mentioned in Section 3.2, more systematic studies are required on the analysis of the behavior of Mizo tones in various grammatical and phonological constructions. Hence, in the following sections, I look into combinations of tones in different grammatical environments. In Section 3.3.1, I look into the behavior of Mizo tones when they are contiguous but belong to separate grammatical categories such as nouns and adjectives. Additionally, I investigate the tone alteration in the pronominal clitics in Section 3.3.2.

3.3.1 Nouns and adjectives

In this section, the tonal behavior of the Mizo tones is analyzed by investigating the combinations of nouns and adjectives. The analysis is done based on three different environments, namely, nouns followed by adjectives in disyllabic phrases, nouns followed by another noun in disyllabic phrases, and nouns-adjectives-nouns combination in trisyllabic phrases. The combinations of nouns-nouns and nouns-adjectives are presented simultaneously from Table 3.12 to Table 3.10, and the summary of nouns-adjectives-nouns combination is provided from Table 3.9 to Table 3.12¹.

The nouns and adjectives, along with their tone specifications used for the present work are tabulated in Table 3.2. As seen in the table, the first nouns are the names of animals and the generic word for animals and meat /sa:/. The second type of noun is the name of the parts of the body. These nouns and adjectives are specified with the four Mizo tones, namely, high (H), low (L), falling (HL), and rising (LH).

The nouns and the adjectives with the four Mizo tones in Table 3.2 are further used to form disyllabic phrases to see the tone realization. Table 3.3 shows the noun with a low tone /ke:l/ 'goat' followed by the adjectives and nouns with the four Mizo tones in the first and second column, respectively. Hence, there are two environments:

¹The data is tabulated in Appendix B Table B.1

Table 3.2: Four Mizo tonal contrastive monosyllabic words in nouns, adjectives, and other nouns.

Tones	Nouns	Meaning	Adjectives	Meaning	Nouns	Meaning
HL	/sa:/, /bo:ŋ/	meat/animal, cow	/zoi/	feeble	/mi:t/	gall bladder
LH	/ui/	dog	/tse:r/	thin	/ta:i/	lower abdomen
H	/zo:ŋ/	monkey	/sa:ŋ/	tall	/beŋ/	ear
L	/ke:l/	goat	/lian/	big	/t ^h in/	heart

Table 3.3: Adjectives and nouns follow a noun with a low tone in contrasting tones.

Noun	Adjective	Noun	Noun
/ke:l	zoi/	/ke:l	mi:t/
L	HL	L	HL
L	HL	L	HL
‘a feeble goat’		‘the gall bladder of a goat’	
/ke:l	tse:r/	/ke:l	ta:i/
L	LH	L	LH
L	LH	L	LH
‘a thin goat’		‘the lower abdomen of a goat’	
/ke:l	sa:ŋ/	/ke:l	beŋ/
L	H	L	H
L	H	L	H
‘a tall goat’		‘the ear of a goat’	
/ke:l	lian/	/ke:l	t ^h in/
L	L	L	L
L	L	L	L
‘a big goat’		‘the heart of a goat’	

noun-adjective and noun-noun combinations. As seen in Table 3.3, when a noun with a low tone precedes all four tones in the nouns and adjectives, no tonal change is observed. In other words, the low tone does not change its realization when all the four Mizo tones follow it, and its following tones also remain the same.

In Table 3.4, a noun with a high tone, /zo:ŋ/ meaning ‘monkey’, is followed by all four tones in adjectives and nouns. In this grammatical construction, tone alteration is not seen.

In Table 3.5, a noun with an HL tone /sa:/ meaning ‘meat/animal’ followed by other nouns and adjectives bearing the four tones in Mizo are tabulated. The data in the table shows that an HL tone in /sa:/ changes to an L tone. This happens

Table 3.4: High-tone nouns are followed by adjectives and nouns of four contrastive tones.

Noun	Adjective	Noun	Noun
/zo:ŋ	zoi/	/zo:ŋ	mi:t/
H	HL	H	HL
H	HL	H	HL
‘a feeble monkey’		‘the gall bladder of a monkey’	
/zo:ŋ	tse:r/	/zo:ŋ	ta:i/
H	LH	H	LH
H	LH	H	LH
‘a thin monkey’		‘the lower abdomen of a monkey’	
/zo:ŋ	sa:ŋ/	/zo:ŋ	beŋ/
H	H	H	H
H	H	H	H
‘a tall monkey’		‘the ear of a monkey’	
/zo:ŋ	lian/	/zo:ŋ	t ^h in/
H	L	H	L
H	L	H	L
‘a big monkey’		‘the heart of a monkey’	

due to the shortening of the nucleus in /sa:/ resulting in the simplification of an HL tone to an L tone when adjectives and nouns with all four tones followed. The same kind of tonal alteration is mentioned in Fanai (1992). However, Fanai’s analysis is subjected to only disyllabic compound words. Hence, the present analysis shows that this phenomenon is also attested at the phrase level.

Since there is tone alteration in the case of an HL tone with a CVV syllable as

Table 3.5: Falling tone noun followed by adjectives and nouns of four contrasting tones. For the gloss, please refer to Table 3.2.

Noun	Adjective	Surface	Noun	Noun	Surface
/sa:	zoi/	/sa zoi/	/sa:	mi:t/	/sa mi:t/
HL	HL	L HL	HL	HL	L HL
/sa:	tse:r/	/sa tse:r/	/sa:	ta:i/	/sa ta:i/
HL	LH	L LH	HL	LH	L LH
/sa:	sa:ŋ/	/sa sa:ŋ/	/sa:	beŋ/	/sa beŋ/
HL	H	L H	HL	H	L H
/sa:	lian/	/sa lian/	/sa:	t ^h in/	/sa t ^h in/
HL	L	L L	HL	L	L L

Table 3.6: Falling tone noun followed by adjectives and nouns of four contrasting tones. For the gloss, please refer to Table 3.2.

Noun	Adjective	Surface		Noun	Noun	Surface	
/bo:ŋ HL	zoi/ HL	/bo:ŋ HL	zoi/ HL	/bo:ŋ HL	mi:t/ HL	/bo:ŋ HL	mi:t/ HL
/bo:ŋ HL	tse:r/ LH	/bo:ŋ HL	tse:r/ LH	/bo:ŋ HL	ta:i/ LH	/bo:ŋ HL	ta:i/ LH
/bo:ŋ HL	sa:ŋ/ H	/bo:ŋ HL	sa:ŋ/ H	/bo:ŋ HL	beŋ/ H	/bo:ŋ HL	beŋ/ H
/bo:ŋ HL	lian/ L	/bo:ŋ HL	lian/ L	/bo:ŋ HL	t ^h in/ L	/bo:ŋ HL	t ^h in/ L

in /sa:/ ‘animal’, another HL noun in a CVVC syllable /bo:ŋ/ meaning ‘cow’ is also analyzed to see if the same tone change happens. Table 3.6 provides an HL noun /bo:ŋ/ followed by adjectives and nouns with the four tones. Unlike in Table 3.5, the HL noun retains its canonical tone when followed by all four tones in nouns and adjectives. Additionally, when /sa:/ ‘meat/animal’ or /bo:ŋ/ ‘cow’ is replaced by another HL tone generic morphemes, such as /va:/ meaning ‘bird’ and /mi:/ meaning ‘people’, their tonal realization is same as in /sa:/. Hence, the mentioned vowel shortening and tone simplification processes are attributed mainly to an HL tone generic morphemes in CVV syllable since /bo:ŋ/ ‘cow’ does not show any tonal alteration. At the same time, all four tones in adjectives and the second nouns that follow /sa:/ and /bo:ŋ/ do not show tone changes.

Another tonal alteration is observed in the case of an LH tone noun. In Table 3.7, an LH tone noun /ui/ meaning ‘dog’ is followed by all four tones in adjectives and nouns. It is seen that when /ui/ ‘dog’ is followed by an H and an HL tone, the LH tone of /ui/ is realized as an L tone. On the other hand, the tones of the following nouns and adjectives do not show tonal alteration.

The summary of the tonal alternations in Mizo disyllabic phrases in the present work is summarized in Table 3.8. From the table, it is seen that the second syllables in each data set, noun-noun, and noun-adjectives assigned with all four lexical tones,

Table 3.7: Rising tone noun followed by adjectives and nouns of four contrastive tones. For the gloss, please refer to Table 3.2.

Noun	Adjective	Surface		Noun	Noun	Surface	
/ui	zoi/	/ui	zoi/	/ui	mi:t/	/ui	mi:t/
LH	HL	L	HL	LH	HL	L	HL
/ui	tse:r/	/ui	tse:r/	/ui	ta:i/	/ui	ta:i/
LH	LH	LH	LH	LH	LH	LH	LH
/ui	sa:ŋ/	/ui	sa:ŋ/	/ui	beŋ/	/ui	beŋ/
LH	H	L	H	LH	H	L	H
/ui	lian/	/ui	lian/	/ui	t ^h in/	/ui	t ^h in/
LH	L	LH	L	LH	L	LH	L

Table 3.8: Summary of tonal alternation of Mizo in noun-noun and noun-adjective domain.

Noun Isolation	Noun/Adjective			
	HL	LH	H	L
HL	L/HL - HL	L/HL - LH	L/HL - H	L/HL - L
LH	L - HL	LH - LH	L - H	LH - L
H	H - HL	H - LH	H - H	H - L
L	L - HL	L - LH	L - H	L - L

do not show any tonal changes. Thus, as far as the data considered is concerned, the grammatical category does not play a role in tonal alteration in the final syllable of disyllabic phrases in Mizo since they retained their canonical tones when preceded by all four tones in the noun words. On the other hand, the first syllable nouns bearing an HL tone and an LH tone have undergone tonal changes. The processes of vowel shortening and tone simplification are involved in the case of the former, and there is tone simplification in the latter case.

The third type of environment, the noun-adjective-noun combination (trisyllabic phrases), is further examined to see the tonal alteration in Mizo. Table 3.9 to Table 3.12 summarizes the realization of all the possible combinations of tones in the sequences of three monosyllables using the same words from Table 3.2.

In Table 3.9, the first syllables in the trisyllabic phrases are HL tone nouns /sa:/ meaning ‘meat/animal’ and /bo:ŋ/ meaning ‘cow’, followed by adjectives and then

Table 3.9: Summary of tonal alternation of Mizo in noun-adjective-noun domain with initial HL tone.

Underlying representation			Surface representation		
Noun	Adjective	Noun	Noun	Adjective	Noun
HL	HL	HL	L/HL	HL	HL
HL	HL	LH	L/HL	HL	LH
HL	HL	H	L/HL	HL	H
HL	HL	L	L/HL	HL	L
HL	LH	HL	L/HL	L	HL
HL	LH	LH	L/HL	LH	LH
HL	LH	H	L/HL	L	H
HL	LH	L	L/HL	LH	L
HL	H	HL	L/HL	H	HL
HL	H	LH	L/HL	H	LH
HL	H	H	L/HL	H	H
HL	H	L	L/HL	H	L
HL	L	HL	L/HL	L	HL
HL	L	LH	L/HL	L	LH
HL	L	H	L/HL	L	H
HL	L	L	L/HL	L	L

another noun. These adjectives and the latter nouns bear all four Mizo tones. From the table, it is seen that two tonal alterations occurred. The first one is that the initial HL tone noun /sa:/ becomes an L tone in all the contexts regardless of the following tones. The second tonal alteration happens to an adjective-noun in the mid-syllable with an LH tone /ui/ meaning ‘dog’, which changes to an L tone when followed by an H or an HL tone noun. The processes involved in these tonal changes are similar to the tonal alterations found in the nouns-nouns and nouns-adjectives disyllabic phrases.

The tonal behavior of Mizo tones when an LH tone noun is in the initial position of the trisyllabic phrases followed by all the four tones in adjectives and nouns is presented in Table 3.10. From this table, it is seen that there is one tonal alteration phenomenon that occurred in two places. The first is in the initial LH noun /ui/ meaning ‘dog’, and the second one is in the mid-syllable LH adjective /tse:r/ meaning

Table 3.10: Summary of tonal alternation of Mizo in noun-adjective-noun domain with initial LH tone.

Underlying representation			Surface representation		
Noun	Adjective	Noun	Noun	Adjective	Noun
LH	HL	HL	L	HL	HL
LH	HL	LH	L	HL	LH
LH	HL	H	L	HL	H
LH	HL	L	L	HL	L
LH	LH	HL	LH	L	HL
LH	LH	LH	LH	LH	LH
LH	LH	H	LH	L	H
LH	LH	L	LH	LH	L
LH	H	HL	L	H	HL
LH	H	LH	L	H	LH
LH	H	H	L	H	H
LH	H	L	L	H	L
LH	L	HL	LH	L	HL
LH	L	LH	LH	L	LH
LH	L	H	LH	L	H
LH	L	L	LH	L	L

‘thin’. In both cases, the initial LH noun and the mid-LH adjective become an L tone when they precede either an H or an HL tone noun or adjective.

In terms of an H tone noun in the initial position of the trisyllabic phrases followed by all the four tones in adjectives and nouns as shown in Table 3.11, only one tone alteration is present. This tonal alteration occurred in the mid-syllable bearing an LH tone in adjective /tse:r/ meaning ‘thin,’ which becomes an L tone when it precedes either an H or an HL tone noun.

Table 3.11 provides the tonal behavior of Mizo where an L tone noun is in the initial position of the trisyllabic phrases followed by all the four tones in adjectives and nouns. From the table, it is seen that only the mid-syllable bearing an LH tone in adjective /tse:r/ meaning ‘thin’ undergoes tonal alteration resulting in an L tone. This tone change occurs when an LH tone adjective is followed by either an H or an HL tone noun.

Table 3.11: Summary of tonal alternation of Mizo in noun-adjective-noun domain with initial H tone.

Underlying representation			Surface representation		
Noun	Adjective	Noun	Noun	Adjective	Noun
H	HL	HL	H	HL	HL
H	HL	LH	H	HL	LH
H	HL	H	H	HL	H
H	HL	L	H	HL	L
H	LH	HL	H	L	HL
H	LH	LH	H	LH	LH
H	LH	H	H	L	H
H	LH	L	H	LH	L
H	H	HL	H	H	HL
H	H	LH	H	H	LH
H	H	H	H	H	H
H	H	L	H	H	L
H	L	HL	H	L	HL
H	L	LH	H	L	LH
H	L	H	H	L	H
H	L	L	H	L	L

Table 3.12: Summary of tonal alternation of Mizo in noun-adjective-noun domain with initial L tone.

Underlying representation			Surface representation		
Noun	Adjective	Noun	Noun	Adjective	Noun
L	HL	LH	L	HL	LH
L	HL	H	L	HL	H
L	HL	L	L	HL	L
L	LH	HL	L	L	HL
L	LH	LH	L	LH	LH
L	LH	H	L	L	H
L	LH	L	L	LH	L
L	H	HL	L	H	HL
L	H	LH	L	H	LH
L	H	H	L	H	H
L	H	L	L	H	L
L	L	HL	L	L	HL
L	L	LH	L	L	LH
L	L	H	L	L	H
L	L	L	L	L	L

From the analysis of the Mizo tonal behavior in noun-adjective-noun trisyllabic phrases, it is seen that two tonal alterations are present. The LH tone noun and adjective undergo tonal change to an L tone whenever they are followed by either an H or an HL tone. It is also seen that an HL tone in the CVV syllable changes to an L tone. None of the final syllable tones are changed.

3.3.2 Pronominal clitics

We further investigate the tonal alteration of Mizo tones using pronominal clitics (proclitics) in Mizo in this section. The proclitics in Mizo are reported as toneless in Chhange (1993). In the present analysis, the Mizo proclitics are followed by nouns or verbs of all four Mizo tones. Hence, there are two environments: proclitics-nouns and proclitics-verbs disyllabic phrases. The data used in the current analysis: proclitics, the nouns, and the verbs in Mizo with their tonal specifications are tabulated in Table 3.13.

Table 3.13: Proclitics followed by noun and verb.

Proclitics	Nouns	Verbs	Tone of noun/verb
ka/i/a/kan/in/an/mi/min	ke:l 'goat'	pe: 'to give'	L
	zo:ŋ 'monkey'	zoŋ 'to search'	H
	sa: 'meat'	duat 'to care'	HL
	ui 'dog'	tuam 'to wrap'	LH

In Table 3.14, the summary of the tonal behavior of the proclitics when followed by the nouns or verbs in all the tones is provided. The table shows that the toneless proclitics in CV syllable /ka, i, a, mi/ surfaced with two types of tones, namely, an H tone and an L tone. This tone realization depends on the tone of the following nouns or verbs. The proclitics /ka, i, a, mi/ surfaced as an H tone when they are followed by a verb or a noun with an L or an HL tone. Contrary to this, the proclitics /ka, i,

Table 3.14: Summary of proclitic tones followed by noun or verb.

Grammatical Category	Proclitics	L (N/V)	H (N/V)	HL (N/V)	LH (N/V)
1st per.sg.	ka	H	L	H	L
2nd per.sg.	i	H	L	H	L
3rd per.sg.	a	H	L	H	L
1st per.pl.	kan	LH	L	L	LH
2nd per.pl.	in	LH	L	L	LH
3rd per.pl.	an	LH	L	L	LH
1st per.obj.	mi	H	L	H	L
2nd per.obj.	min	LH	L	L	LH

a, mi/ surfaced as an L tone when they precede an H or an LH tone verb and noun. This phenomenon of a toneless word being assigned the opposite tone of the following syllable is called tonal polarity. Hence, the CV syllable type of proclitics in Mizo have tonal polarity. The other proclitics /kan, in, an, min/ have an LH tone when they are followed by an L or an LH tone noun and verb. On the other hand, these proclitics become an L tone when they are followed by an H or an HL tone. This tonal alteration suggested that the proclitics /kan, in, an, min/ are underlyingly an LH tone. No tonal change is observed in the nouns and verbs when preceded by the proclitics.

The results of the tonal behavior of Mizo tones using the nouns and adjectives in this section show two main tonal alterations. The first one is the tonal change of an HL tone noun /sa:/ meaning ‘meat/animal’ to an L tone when all the four Mizo tones follow it in both the nouns and adjectives. This tone change undergoes vowel shortening and contour simplification processes (Fanai, 1992). Additionally, this phenomenon is primarily attested in other generic morphemes in Mizo, CVV syllables with an HL tone. The second tonal alteration is seen in the LH tone noun /ui/ meaning ‘dog’ in the initial syllable in both the disyllabic and trisyllabic phrases and an adjective with an LH tone /tse:r/ meaning ‘thin’ in the mid-syllable of the trisyllabic phrases. This tonal alteration occurs when LH tone noun and adjective are preceded by either an H or an HL tone. The tones of the final syllables in both

the nouns-nouns and nouns-adjectives in disyllabic and in the nouns-adjectives-nouns trisyllabic phrases do not change. Additionally, the results of the analysis of the tonal behavior of toneless proclitics in Mizo show that there are two main tonal specifications. The first one is the presence of tonal polarity in the proclitics /ka, i, a, mi/. The second one is the tonal alteration of proclitics /kan, in, an, min/ whereby they are assigned an LH tone when followed by an L or an LH tone. The same proclitics /kan, in, an, min/ are assigned a different tone L when they precede either an H or an HL tone. None of the verbs or nouns preceded by the proclitics show tonal alteration. This reveals that the tones in the rightmost position of the phrases are dominant in Mizo.

Hence, the results of the analyses of the behavior of the Mizo tones in the nouns-adjectives and the proclitics show that there is a common tone alteration whereby an LH tone changes to an L tone when it precedes either an H or an HL tone. This phenomenon is attested to all the grammatical and phonological constructions considered in this section. I use rising tone sandhi (RTS) to represent this phenomenon. Due to the prominence of this phenomenon, the following section provides a more profound analysis of RTS in different contexts.

3.4 Rising Tone Sandhi in Mizo

As mentioned earlier, apart from the four lexical distinct tones, namely, high (H), low (L), rising (LH), and falling tones (HL), a rising tone sandhi (RTS) is present in Mizo. Tone sandhi is a phonological process that changes the canonical tone of a syllable into unpredictable pitch contours through the effects carried out by either the preceding or the following tones or the morphosyntactic environment in which a tone appears. Tone sandhi in Mandarin Chinese is a well-known phenomenon where a sequence of two falling-rising tones changes into a sequence of rising and falling-rising

tones (Wang and Li, 1967). On the other hand, Beijing Mandarin has an L tone sandhi whereby the first element of the two adjacent low tones changes into a rising tone (Li and Chen, 2015). The domain of tone sandhi can differ from one language to another. In Shanghai Chinese, the tone sandhi phenomenon can occur only in lexical words like nouns, verbs, adverbs, and adjectives. In contrast, grammatical words like pronouns, classifiers, prepositions, determiners, and tense/aspect markers do not undergo the tone sandhi process (Duanmu, 2005). On the other hand, the same study reported that Mandarin Chinese tone sandhi could occur in any word, compound word, and phrase.

The rising tone sandhi in Mizo is described as the process where an LH tone is realized as an L tone before an H or an HL tone (Sarmah et al., 2015). The presence of RTS in Mizo is posited by Sarmah et al. (2015) by analyzing the behavior of the four tones in trisyllabic phrases. The same study has reported the exceptional case where an adverb /reŋ/ meaning ‘continuously’ in the final syllable of the trisyllabic phrase does not trigger RTS on the preceding LH tone. Chhangte (1993) also mentioned that this phenomenon is seen when a high tone follows a rising tone. Additionally, Sreenivasan (2015) observed the same and claimed that RTS in Mizo happened only in noun phrases.

Duanmu (1992) stated that it is by looking at the multisyllabic constructions in a tone language that the tone sandhi rules are enumerated. Hence, this section focuses on the rising tone sandhi phenomenon in Mizo and its realization in different morphological structures: compounds such as disyllabic and trisyllabic, numerals, trisyllabic phrases, artificial adjectives, verb and auxiliary verbs, degree of comparison and double adjectives. Some of the data used for this section are adapted from Chhangte (1993). We also extended our investigation into the direction of RTS and further discussed the exceptional cases.

Table 3.15: Disyllabic compound words with their tone specifications.

Compound word	Meaning	Canonical tone	Surface tone
(1) <i>luŋ + sen = luŋsen</i>	stone + red = Lungsen (a village name)	LH - H	RTS - H
(2) <i>luŋ + rem = luŋrem</i>	stone + to arrange = arranged stones	LH - HL	RTS - HL
(3) <i>luŋ + lei = luŋlei</i>	stone + bridge = Lunglei(a town name)	LH - L	LH - L

3.4.1 RTS in compounds

Compounding is a productive process in Mizo since multisyllabic words are combination of two or more free morphemes. This section analyzes the disyllabic and trisyllabic compound nouns in Mizo to see if RTS operates in these domains. Table 3.15 provides the disyllabic compounds in Mizo. It is seen from the table that the first element /*luŋ*/ meaning ‘stone’ in each of the three compound words is underlyingly an LH tone followed by an H, an HL, and an L tone. The first word in Table 3.15 (1) and (2) undergo RTS since an LH tone is followed by an H and an HL tone respectively. However, no RTS is seen in (3) since the following tone is an L tone, it does not meet the condition required for RTS. In Figure 3.1, the canonical tone of the first morpheme, in each of the compound words /*luŋ*/ meaning ‘stone’ produced by a native Mizo female speaker is provided, and it is seen that the pitch contour shows a little fall for about 40% and begins to rise until the termination point. This provides evidence that /*luŋ*/ ‘stone’ has an LH tone. The pitch contours for the three compound words in Table 3.15 are provided in Figure 3.2, Figure 3.3, and Figure 3.4. In Figure 3.2 and Figure 3.3, it is seen that the first morphemes, underlyingly an LH pitch contour have undergone RTS. The reason is that in both cases, an LH tone is followed by an H and an HL tone, respectively. Therefore, an LH pitch contour changes to an L pitch contour. When the same lexeme /*luŋ*/ ‘stone’ is followed by an L tone, the LH pitch contour of /*luŋ*/ retains its canonical pitch contour as seen in Figure 3.4. This analysis shows that RTS can happen in Mizo disyllabic compound words.

Furthermore, the Mizo trisyllabic compounds presented in Table 3.16 are analyzed

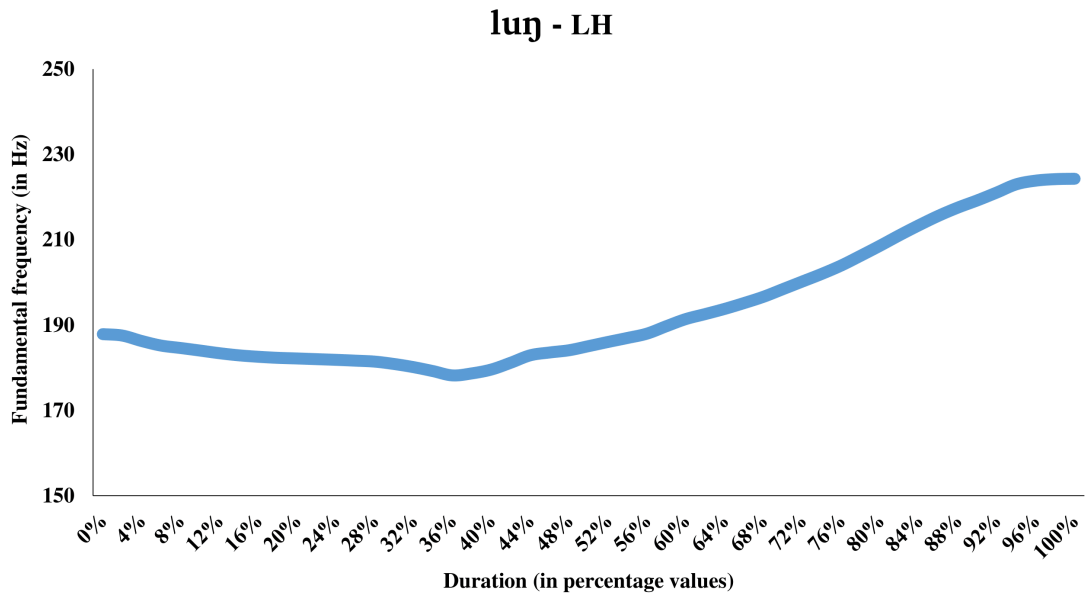


Figure 3.1: Canonical LH contour of /luŋ/

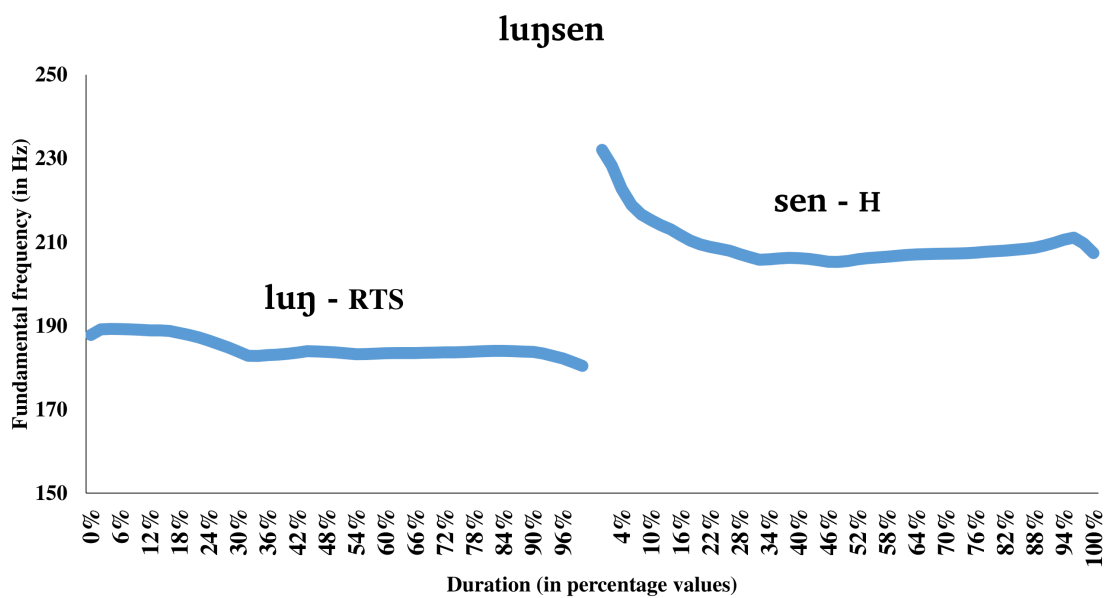


Figure 3.2: RTS in disyllabic compound /luŋsen/.

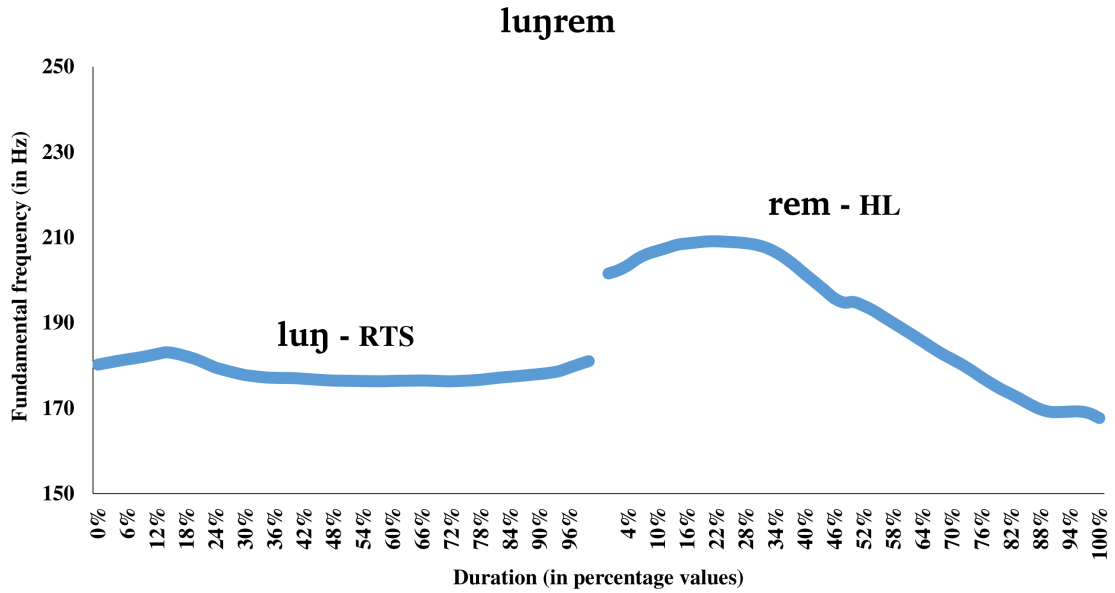


Figure 3.3: RTS in disyllabic compound /luŋrem/.

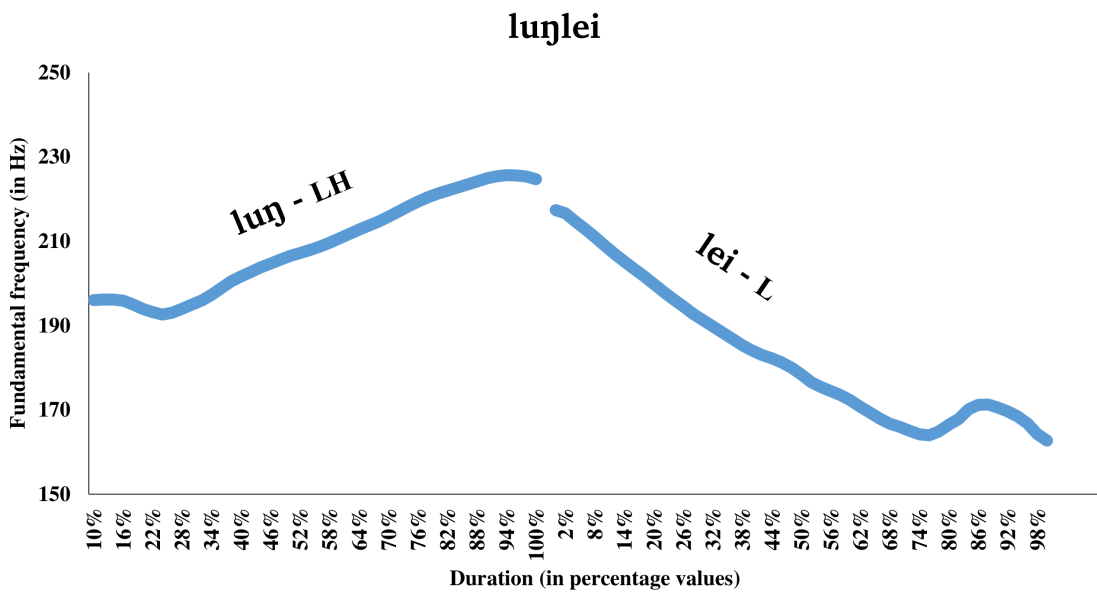


Figure 3.4: RTS in disyllabic compound /luŋlei/.

Table 3.16: Trisyllabic compound words with their tone specifications

Compound word	Meaning	Canonical tone	Surface Tone
(1) kut + zuŋ + traŋ = kutzuŋtraŋ	hand + root + branch = finger	L - LH - H	L - RTS - H
(2) t ^h iŋ + t ^h u: + pui = t ^h iŋt ^h upui	wood + stinky + intensifier = dysoxylum gobar	LH - HL - LH	LH - L - LH

to see if RTS attests to this domain. In Table 3.16 (1), the second or the middle morpheme bears an LH tone followed by an H tone. Hence, the RTS condition is met, and thus, an LH tone in /zuŋ/ meaning ‘root’ changes to an L tone. This is supported by the pitch contours provided in Figure 3.5 and Figure 3.6. In Figure 3.5, the pitch contour of /zuŋ/ ‘root’ clearly shows an LH pitch contour. This LH pitch contour changes to an L pitch contour due to RTS, as seen in Figure 3.6. In terms of the second trisyllabic compound, the first morpheme /t^hiŋ/ meaning ‘wood’ has an LH tone which is expected to undergo RTS since it is followed by /t^hu:/ meaning ‘stinky’, an HL tone. However, the vowel length in /t^hu:/ is shortened and the process of contour simplification takes place. This results in an HL tone of /t^hu:/ changes to an L tone which could no longer trigger RTS for the preceding LH tone. As seen in Figure 3.5, the canonical tone of /t^hiŋ/ ‘wood’ has an LH pitch contour. This LH pitch contour remains in Figure 3.7 since the following HL tone becomes an L tone. The tone of the final morpheme in each phrase also remains the same.

This analysis shows that RTS is attested in trisyllabic compounds in Mizo. Additionally, it indicates that the surface tone is responsible for the process of RTS as in the case of /t^hiŋt^hupui/ meaning ‘dysoxylum gobara’.

3.4.2 RTS in numerals

The numerals in Mizo are analyzed in this section to see if RTS is applied. The numerical units in Mizo are /pa/ in a unit place (L tone), /so:m/ ‘tens’ (L tone), /za:/ ‘hundreds’ (L tone), /sa:ŋ/ ‘thousands’ (LH tone), and /si:ŋ/ ‘ten thousand’ (LH tone). /kua/ ‘nine’ (LH tone), /sa:ŋ/ ‘thousands’ (LH tone), and /si:ŋ/ ‘ten

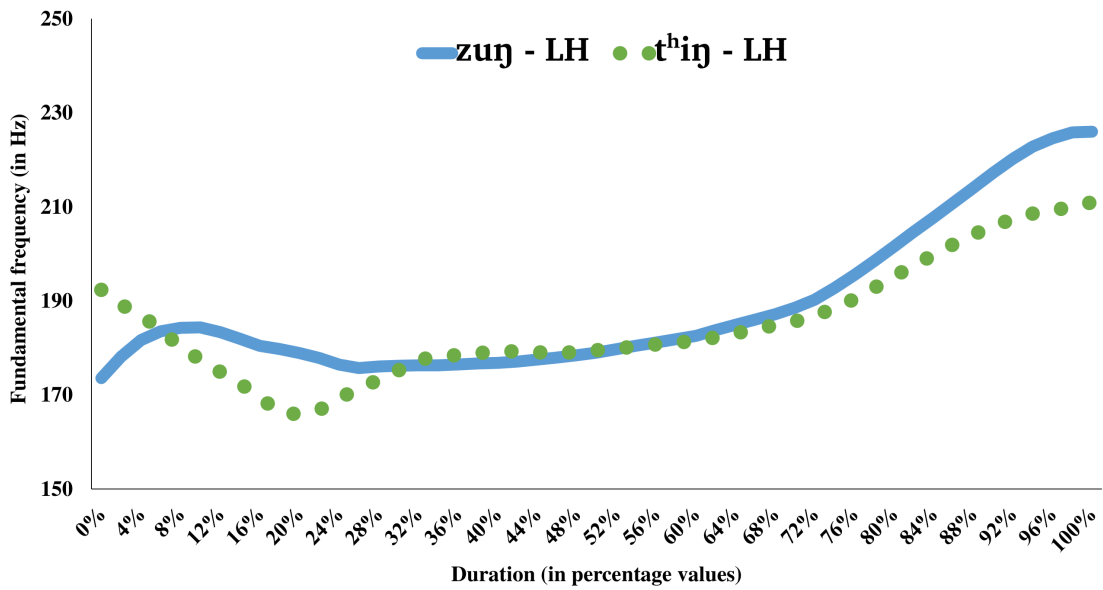


Figure 3.5: Canonical pitch contour of the LH tone words.

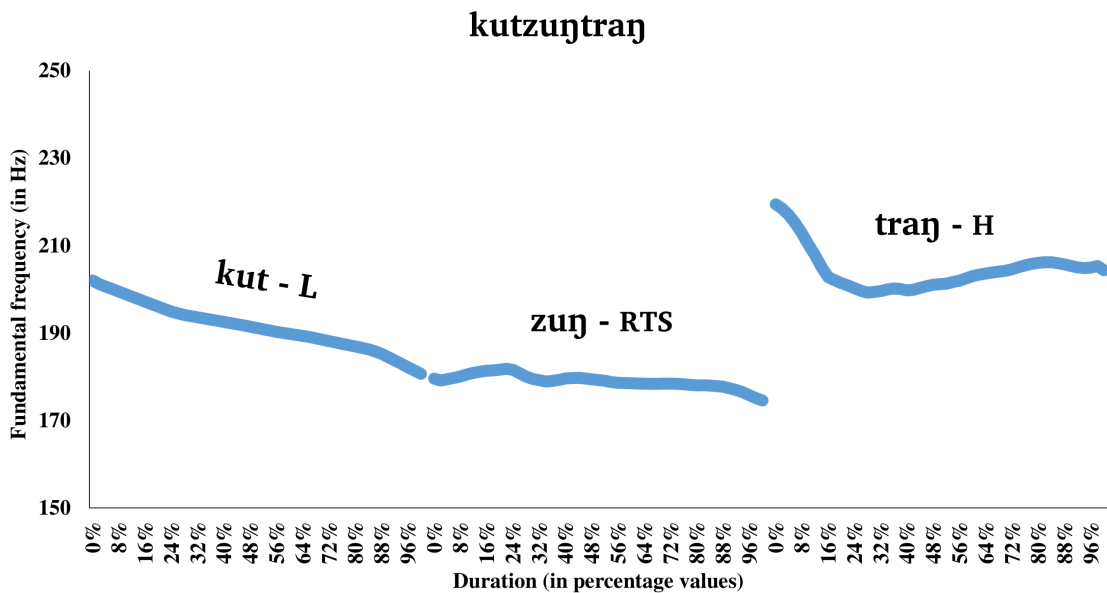


Figure 3.6: RTS in the middle syllable of a trisyllabic compound triggered by H tone in the third element.

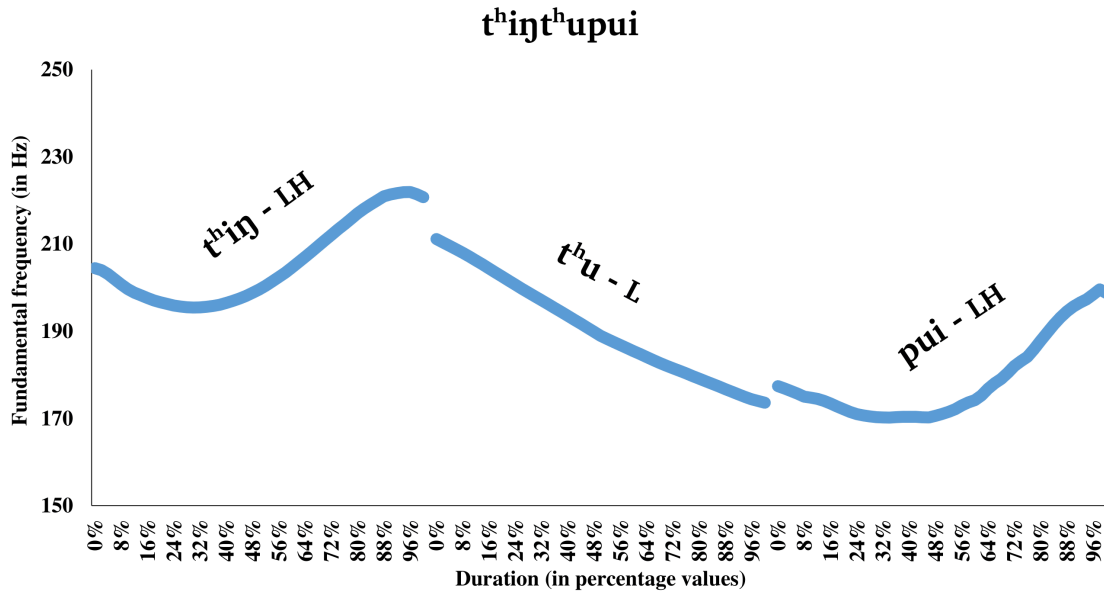


Figure 3.7: The absence of RTS in the first morpheme is due to vowel shortening and contour simplification of the following morpheme, which results in an L tone.

Table 3.17: Numeral compounds with their tone specifications

Compound word	Meaning	Canonical tone	Surface tone
(1) sa:ŋ + t ^h um = sa:ŋt ^h um	thousand + eight = eight thousand	LH - H	RTS - H
(2) sa:ŋ + k ^h at = sa:ŋk ^h at	thousand + one = one thousand	LH - L	LH - L

thousand' (LH tone) are the only numbers in Mizo that have an LH tone. Out of these, /sa:ŋ/ 'thousands' (LH tone) is analyzed in the present work. Table 3.17 provides the tonal specifications of the Mizo numeral compounds. From Table 3.17 (1), it is seen that RTS occurs when there is a sequence of an LH and an H tone in the compounded word /sa:ŋriat/ meaning 'eight thousand'. The pitch contours support the RTS in this context, plotted in Figure 3.8 and Figure 3.9. Figure 3.8 shows the canonical LH pitch contour of /sa:ŋ/ 'thousands', while Figure 3.9 provides evidence for RTS whereby the same lexeme, the LH tone morpheme /sa:ŋ/ changes to an L pitch contour. On the other hand, Table 3.17 (2) shows that RTS could not happen for the same lexeme /sa:ŋ/ since an L tone follows it.

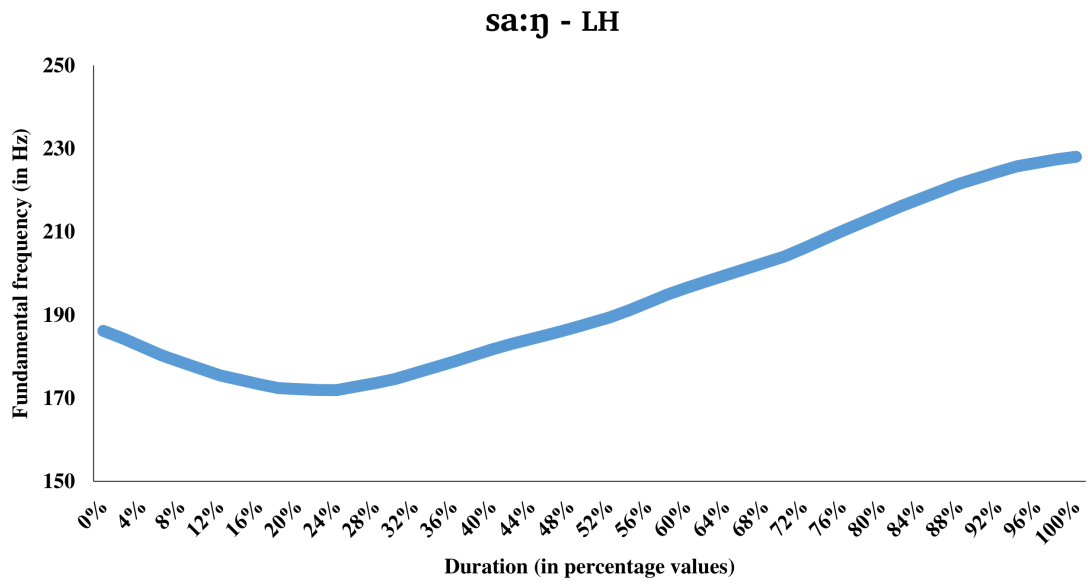


Figure 3.8: Canonical LH pitch contour of /sa:ŋ/.

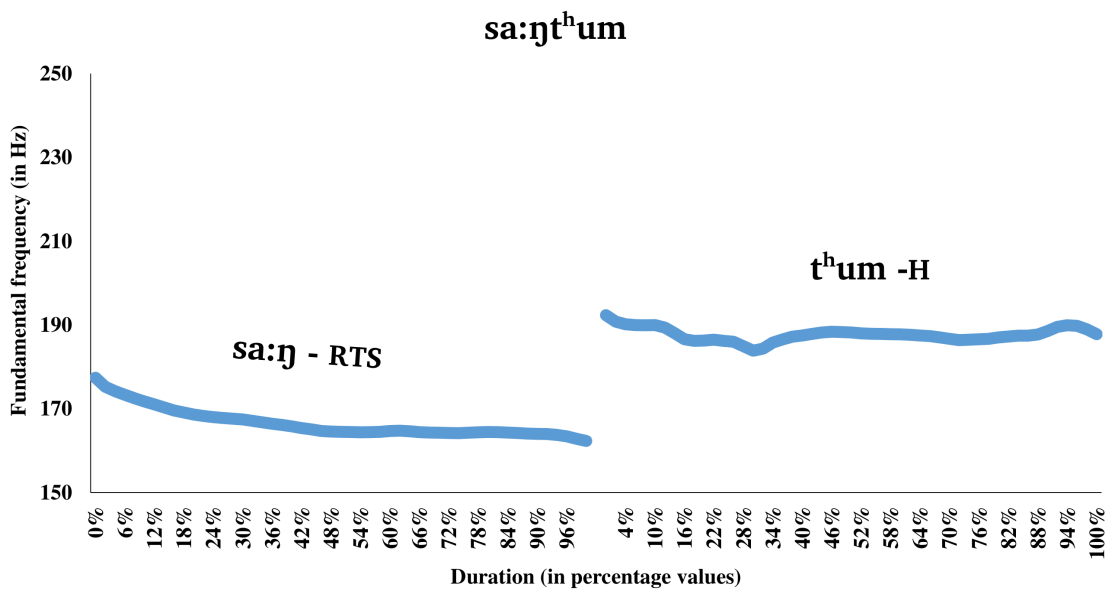


Figure 3.9: RTS in the first element triggered by H.

3.4.3 RTS in trisyllabic phrases

The trisyllabic phrases in Mizo are further analyzed to see if this domain could have RTS. Table 3.18 provides the trisyllabic phrases which are considered for the present study. The trisyllabic phrases in Table 3.18(1), (2), and (3)(b) show that RTS happened in the first and second syllables. This is due to the presence of the following H tone and HL tone preceded by an LH tone in all the phrases. Figure 3.10 provides the canonical pitch contours of all the words with an LH pitch contour that have undergone RTS. The evidence of RTS in Table 3.18 (1) is also seen in the pitch contours presented in Figure 3.11, where the first syllable of an LH pitch contour /an/ meaning ‘they’ changes to an L pitch contour. Figure 3.12 also shows that an LH pitch contour of the middle syllable /in/ meaning ‘house’ in Table 3.18 (2) changes to an L pitch contour. Likewise, Figure 3.14 provides the evidence of RTS in the middle syllable /ha:l/ meaning ‘to burn’ in Table 3.18 (3)(b).

Additionally, Table 3.18 (3) presents the exceptional case mentioned in Sarmah et al. (2015), where the presence of an adverb /reŋ/ meaning ‘continuously,’ which bears an HL tone in the final syllable of a trisyllabic phrase, cannot trigger RTS. The results of the present investigation show that /reŋ/ meaning ‘continuously’ can have two tonal specifications, either an L or an HL tone. When it is produced with an L tone, as in Table 3.18 (3)(a), RTS is inapplicable. The evidence of the pitch contour is provided in Figure 3.13 where an LH pitch contour of the middle syllable /ha:l/ meaning ‘to burn’ is maintained when followed by an L pitch contour. On the other hand, when /reŋ/ meaning ‘continuously’ is produced with an HL tone as in Table 3.18 (3)(b), the preceding LH tone undergoes RTS. Furthermore, we noticed that /reŋ/ is a homograph. When produced with an L and an HL tone, it means ‘continuously,’ while it means ‘already’ when it is produced with an HL tone. Hence, when /reŋ/ is produced with an HL tone, the preceding LH pitch contour undergoes RTS, showing an L pitch contour as seen in Figure 3.14. The analysis in this section

Table 3.18: Trisyllabic phrases with their tone specifications

Word	Meaning	Canonical tones	Surface tones
(1) an kal do:n	They will go	LH - H - H	RTS - H - H
(2) k ^h oi in ɲe:	Which house is it?	L - LH - HL	L - RTS - HL
(3) an ha:l ɲeɲ	They are burning continuously/already	(a) LH - LH - L	LH - LH - L
		(b) LH - LH - HL	LH - RTS - HL

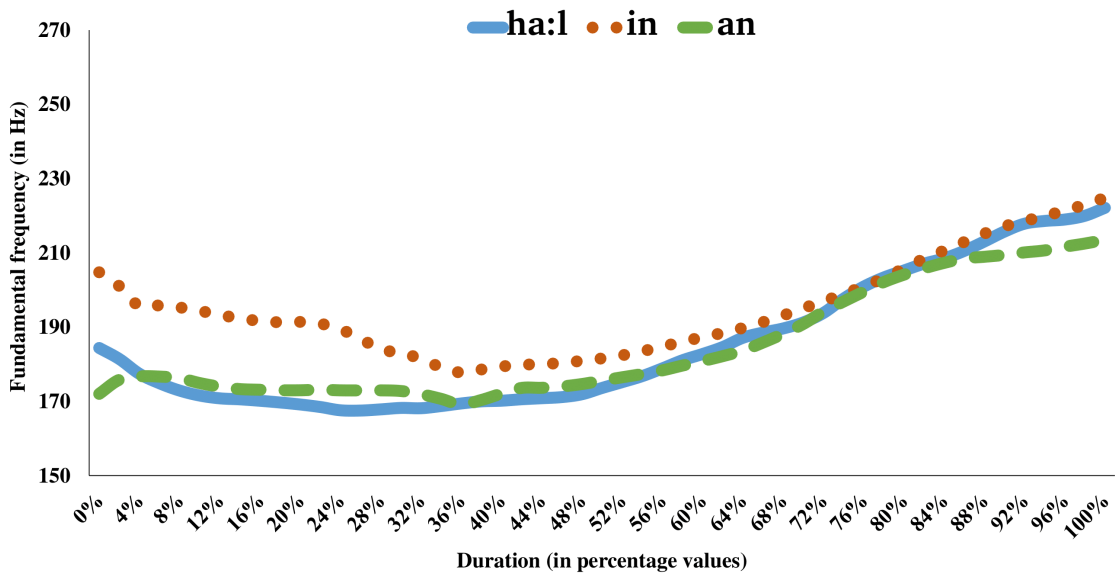


Figure 3.10: The canonical LH contours of the target words.

shows that RTS is present in trisyllabic phrases in Mizo, and the explanation for the exceptional case is also provided.

3.4.4 RTS in other grammatical constructions

In this section, we explore other different grammatical constructions such as artificial adjectives, verbs with auxiliary verbs, degree of comparison, and double adjectives to analyze if RTS is applied in these domains. Firstly, we analyzed the artificial adjectives in Mizo, which are adopted from Chhange (1993). Combining an adjective and a noun in Mizo can form another adjective; hence, such phrases are artificial

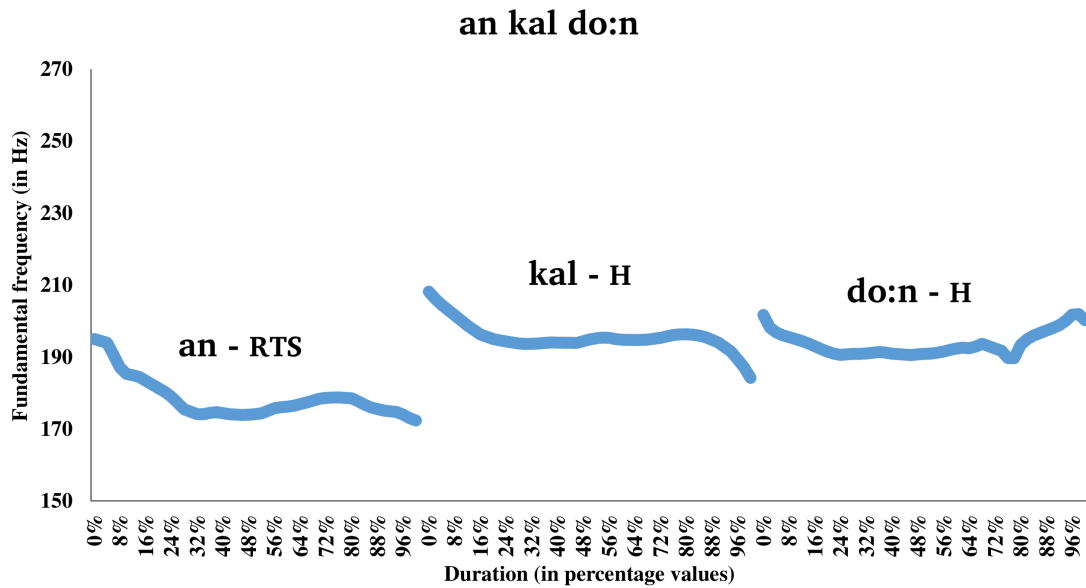


Figure 3.11: RTS in the first element triggered by H

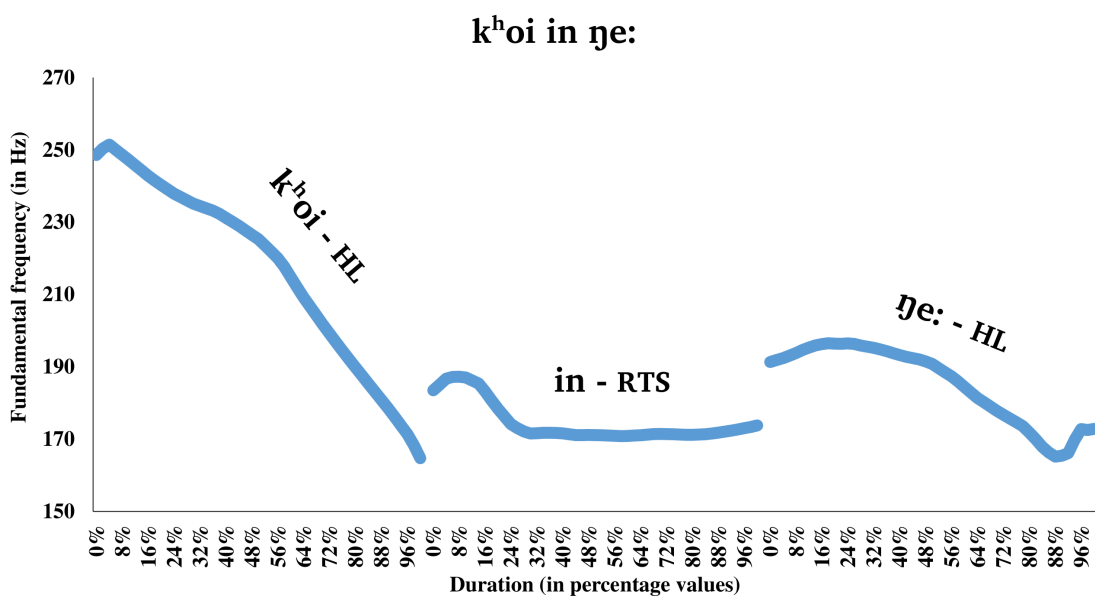


Figure 3.12: RTS in the second element triggered by HL.

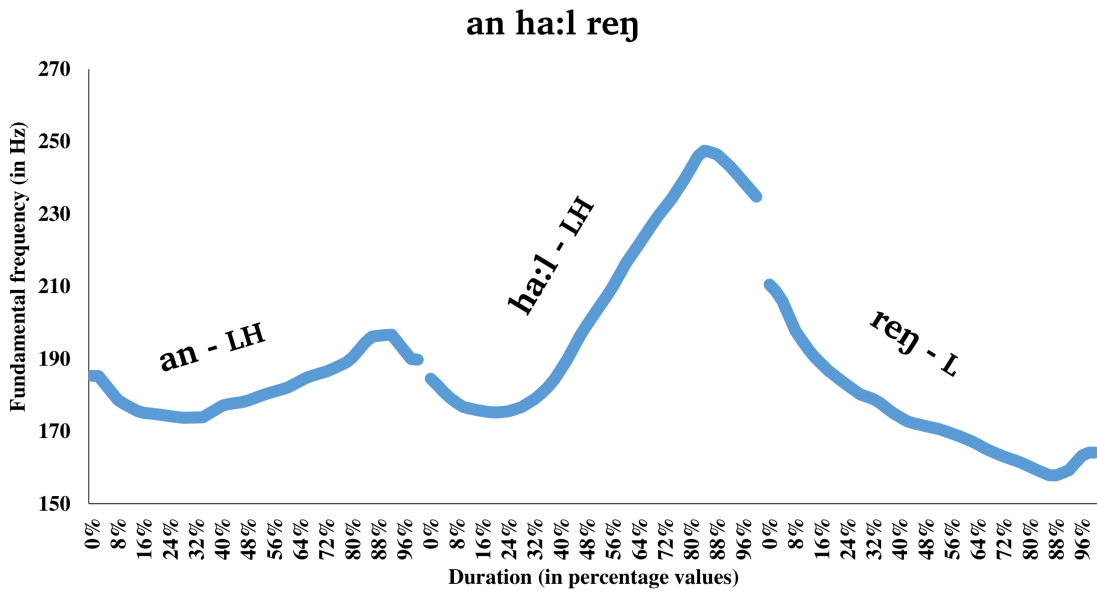


Figure 3.13: RTS is blocked in the second element by L.

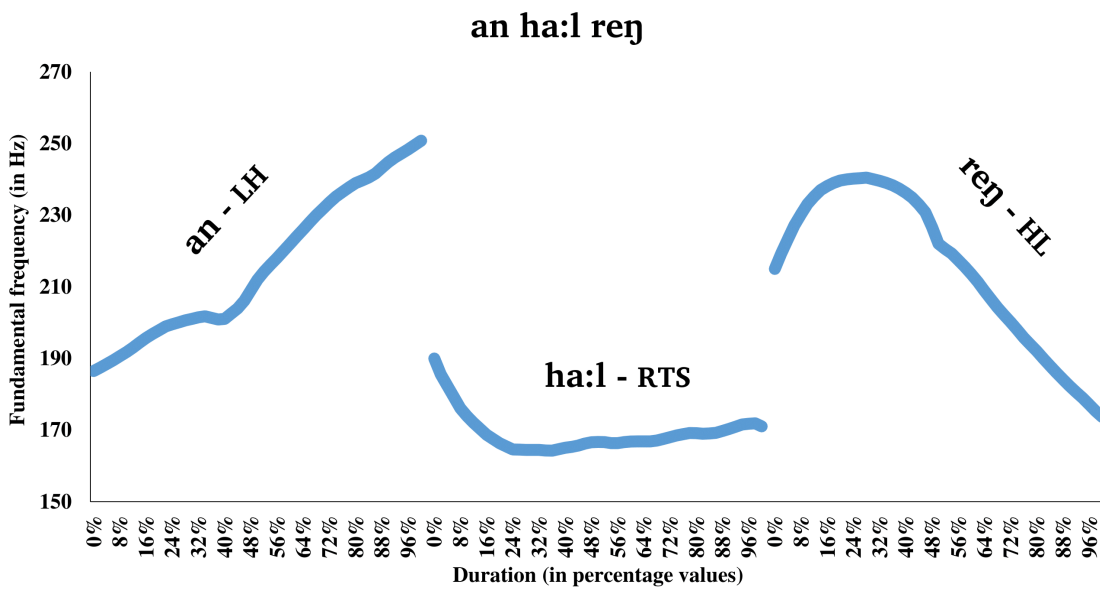


Figure 3.14: HL triggers RTS in the second element.

Table 3.19: Adjective (artificial) followed by noun adopted from Chhangte (1993).

Adjective	Noun	Meaning
t ^h iŋ	koŋk ^h ar	<i>wooden door</i>
<i>wood</i>	<i>door</i>	
LH	H - L	
RTS	H - L	
t ^h iŋ	be:lbo:m	<i>wooden cupboard</i>
<i>wood</i>	<i>cupboard</i>	
LH	H - H	
RTS	H - H	
t ^h iŋ	tr ^h utt ^h ŋ	<i>wooden chair</i>
<i>wood</i>	<i>chair</i>	
LH	L - L	
LH	L - L	
t ^h iŋ	in	<i>wooden house</i>
<i>wood</i>	<i>house</i>	
LH	LH	
LH	LH	

adjectives. Table 3.19 provides the tonal specifications of an adjective /t^hiŋ/ meaning ‘wood’, which bears an LH tone, followed by nouns with an initial L, H, and LH tones. The table shows that RTS occurs as an adjective with an LH tone changes to an L tone when it precedes an H tone.

An LH verb /lei/ meaning ‘to buy’ followed by auxiliary verbs in LH, L, and H tones are provided in Table 3.20. The table shows that a verb /lei/ does not change its tone when it precedes either an L or an LH tone. However, when it precedes an H tone auxiliary verb /do:n/ meaning ‘will’, we see RTS whereby the LH tone verb changes to an L tone.

Table 3.21 provides an LH tone adjective /ŋiam/ meaning ‘short’ in the context of the degree of comparison in Mizo. For both the comparative and the superlative degree, an LH tone is followed by an HL tone in the adjectives /zo:k/ and /ber/. Hence, RTS is applied to an LH tone adjective /ŋiam/ meaning ‘short’ and it becomes an L tone. On the other hand, it is also seen that the superlative adjective /ber/ can also be produced with an L tone which results in another exceptional case. Hence,

Table 3.20: Verb with LH tone followed by auxiliary

Verb	Auxiliary	Meaning
lei	t ^h iam	<i>good at buying</i>
<i>buy</i>	<i>good at</i>	
LH	LH	
LH	LH	
lei	t ^h ei	<i>able to buy</i>
<i>buy</i>	<i>able</i>	
LH	L	
LH	L	
lei	do:n	<i>will buy</i>
<i>buy</i>	<i>will</i>	
LH	H	
RTS	H	

Table 3.21: Degree of comparison

Positive degree	Comparative degree	Superlative degree
n̄iam 'short' LH	n̄iam zo:k 'shorter'	n̄iam ber 'shortest'
	LH - HL	LH - HL/L
	RTS - HL	RTS - HL, LH - L

when /ber/ is produced with an L tone, it blocks RTS; thus, the preceding LH tone adjective /n̄iam/ retains its canonical tone. The explanation for this exceptional case is similar to that of /reŋ/, where there can be two tonal specifications for /ber/, an L, and an HL tone.

Further analysis on the double adjective in Mizo is conducted to see if RTS is applied when it is followed by meaningful words with all four Mizo tones. In the present study, we analyzed a double adjective with an LH tone sequence /hel hel/ meaning 'raw'. In Table 3.22, the double adjective /hel hel/ is embedded in two sentences; the double adjective is followed by an H and an HL tone. The table shows that in both sentences, RTS is applied to the repeated adjectives (or the second syllable). Hence, only the second syllable in /hel hel/ changes from an LH tone to an L tone when followed by an H or an HL tone. This analysis confirmed that RTS is attested in the second morpheme of Mizo double adjectives. All the considered

Table 3.22: Double adjective with LH tone followed by all the four tones.

Double adjectives	Meaning
a - hel - hel - t ^h aŋ - roʔ	<i>Choose the raw ones</i>
L - LH - LH - H - L	
L - LH - RTS - H - L	
a - hel - hel - t ^h a:k - roʔ	<i>Change/Drop the raw ones</i>
L - LH - LH - HL - L	
L - LH - RTS - HL - L	

morphological structures in this chapter in examining the domain of RTS in Mizo show that RTS is solely dependent on the tonal contexts and not on the grammatical categories.

3.5 Conclusions

This chapter investigates the behavior of the four lexical tones in Mizo, namely, high (H), low (L), rising (LH), and falling (HL), using various phonological and grammatical constructions. The results of the analyses conclude that tonal alterations are present in Mizo. These tonal alterations include the change of an HL tone in a CVV syllable to an L tone when it is followed by a syllable regardless of the tone. This phenomenon happens when the nucleus is shortened, resulting in the contour simplification of an HL tone to an L tone. In such tonal change, the CVV syllable is usually the generic term of certain nouns. This tonal alteration is also reported by Weidert (1975); Fanai (1992) and Chhangte (1993). The second type of tonal alteration observed in this chapter is tonal polarity found in the CV syllable proclitics. In this tonal change, the toneless proclitics in CV syllables are assigned the opposite tone of the following syllable-final. The third type of tonal alteration found in the present analysis of Mizo tones is the rising tone sandhi (RTS). In such a tonal change, an LH becomes an L tone when it precedes an H or an HL tone. Further investigation regarding the behavior of tones in different grammatical constructions in Mizo reveals

that the process of RTS could happen in any combination of different grammatical and phonological constructions. It is seen that RTS counts for the surface tone to trigger the process. Suppose the resulting surface tone of the following syllable of an LH tone is neither H nor HL. In that case, it cannot trigger rising tone sandhi, even if the other conditions are fulfilled. No exceptional case is found in disyllabic compounds and numerical compounds so far. Therefore, rising tone sandhi in Mizo is widely attested within and beyond morpheme boundaries. From the results of the various grammatical constructions examined in this chapter, rising tone sandhi in Mizo is considered independent of different grammatical constructions. Hence, it is merely the interaction of an LH tone and the other tones, an H and an HL tone, that conditioned the change of the canonical form of an LH tone to an L tone in Mizo. In all the various domains examined in this chapter, it is seen that in Mizo, the tone at the rightmost in every construction remains the same. Hence, the investigation of Mizo tones in this chapter also concluded that Mizo is a right dominant tone language. Additionally, it is seen that the rightmost tone conditions the tone changes in Mizo, and thus, the tonal changes occur towards the left triggered by the tones at the right. Hence, the tonal alterations described in this chapter also substantiate that Mizo has a right-to-left linking convention of tone conforming to Fanai (1992). This chapter also addressed the exceptional cases in RTS like adverb /rej/, which blocked RTS in Sarmah et al. (2015) and the superlative degree marker /ber/. The investigation in this regard concludes that these words can have two tonal specifications where an L tone specification blocks RTS and an HL tone specification facilitates RTS.

Chapter 4

Phonetics of Mizo Tones

4.1 Introduction

The phonological analysis of tones reported in Chapter 3 confirmed that Mizo shows a four-way contrast in terms of its lexical tones. These tones are considered as high (H), low (L), rising (LH), and falling (HL). In the previous chapter, we have seen that the high and the low tones in Mizo consist of unitary tonemes, namely, H and L, while the rising the falling tones are considered to be combinations of H and L, LH and HL, respectively. Considering this, in this chapter, we investigate how the tones are characterized in terms of their acoustic and temporal features. Additionally, the existence of Mizo rising tone sandhi (RTS) is also confirmed in Chapter 3. Hence, in the current chapter, we also look into the acoustic-phonetic characteristics of the RTS and argue that the low tone resulting from the RTS is distinct, acoustically, and perceptually. I also introduce new sets of tonal minimal and near minimal sets in this chapter, and a brief discussion on the tone-bearing unit in Mizo is presented.

The report in this chapter begins with a brief description of the phonetics of tones as seen in the world's languages in Section 4.2. This is followed by a literature review on the previous acoustic analysis of tones in Mizo in Section 4.3. Following that, I present an acoustic analysis of tones in Mizo in Section 4.4. The phonetic analysis of

RTS in Mizo is further investigated in Section 4.5 ¹. Finally, Section 4.6 summarizes the contributions of this chapter and concludes the chapter.

4.2 The phonetics of tones

In a tonal language, lexical tones are varying pitch patterns that create lexical contrasts in the language. Each tone is characterized by a pitch which is the rate of the vocal fold vibration during the production of speech sounds. This rate of vibration in the vocal folds is achieved by controlling the tension in the vocal folds, and the degree of the tension in the vocal fold is determined by the laryngeal muscles, such as the cricothyroid and thyroarytenoid muscles. The cricothyroid is reported to be associated with the pitch rising and falling, while the sternohyoid is reported to be linked to the lowering of the pitch (Sagart et al., 1986). The resulting pitch is the function of the vibration of the vocal cords per second, typically expressed in Hertz (Hz) (Yip, 2002). Hence, when analyzing the phonetic properties of tones, the fundamental frequency is considered a primary acoustic correlate.

While fundamental frequency (f_0) is the primary acoustic correlate of tones, the way it is used to characterize tones depends on the type of tones in the language. For example, the acoustic measurements for tones in a register tone language differ from that of contour tones. Mandarin Chinese, one of the most widely studied tone languages, has both register and contour tones. Hence, Jongman et al. (2006), upon the study of Mandarin Chinese tones based on the measurements of the fundamental frequency, report that the f_0 contour and f_0 height are the primary acoustic parameters to characterize the four tones in Mandarin, namely, Tone 1: high-level (register), Tone 2 high-rising (contour), Tone 3 low-dipping (contour), and Tone 4 high-falling (contour). Hence, f_0 contour and f_0 height are determiners of the tonal phonemic

¹This part of the chapter was published as a paper titled “Production and Perception of Rising Tone Sandhi in Mizo”, published in the Proceedings of the 6th International Symposium on Tonal Aspects of Languages, 2018.

contrasts in Mandarin Chinese. In Mandarin Chinese, Tone 1 is reported to have a high and relatively level contour throughout the total duration of the tone. Tone 2 manifests a rise in the mid area of the f_0 contour, which continues until the termination point. The f_0 contour of Tone 3 has the lowest f_0 compared to the other three tones. The initiation point of Tone 4 is the highest, which falls throughout the total duration. In terms of perception, f_0 contour is regarded as the primary cue in discriminating different tones in tonal languages such as Mandarin Chinese, Thai, Yoruba, and Swedish (Gandour, 1978; Yip, 2002). Apart from f_0 contour, Massaro et al. (1985) also reported that f_0 height also plays a role in identifying Tone 1 and Tone 2 in Mandarin Chinese. Likewise, in Waromung Mongsen dialect of Ao Naga, the f_0 height is reported as the sole perceptual cue in identifying the three-way tonal contrasts (Coupe, 1998). Moore and Jongman (1997) reported that the f_0 turning point and the f_0 rate of change are the other parameters that serve as cues in distinguishing similar f_0 contours like the Mandarin Chinese Tone 2 and Tone 3. The f_0 turning point refers to the point where the contour changes its direction from fall to rise in a given time, and the f_0 rate of change is the change in the f_0 from the beginning of the tone to the turning point. The amplitude contour is also reported to be an important cue in identifying tones in Mandarin Chinese (Chuang and Hiki, 1972; Whalen and Xu, 1992; Fu and Zeng, 2000). Chuang and Hiki (1972) reported that Tone 3 has the lowest amplitude while Tone 4 has the highest amplitude in Mandarin Chinese. Whalen and Xu (1992) also stated that the amplitude contour alone can serve as a cue in identifying Tone 2, Tone 3, and Tone 4 of Mandarin. Fu and Zeng (2000) also reported that listeners can still recognize Chinese tones with a 60% accuracy rate when only the amplitude contour is given as a cue.

The temporal information also plays an important role in distinguishing tones in the production and perception tests. In Mandarin Chinese, all four lexical tones differ in duration, where Tone 4 is the shortest while Tone 2 and Tone 3 are the

longest (Howie and Howie, 1976; Nordenhake and Svantesson, 1983). Similarly, ambiguous stimuli between Tone 2 and Tone 3 were identified more often as Tone 3 when lengthened (Blicher et al., 1990).

Besides the properties mentioned above, the knowledge of the intrinsic f_0 range of the speakers can also be one of the cues in identifying tones. The f_0 range differs from male to female and also from person to person. The fundamental frequency is also considered a reliable acoustic parameter to distinguish between two genders. Female pitch is reported to have a higher mean fundamental frequency and a larger f_0 range than males (Takefuta et al., 2017; Chen, 2007). In terms of the f_0 range, the gender difference is more pronounced when expressed in Hertz units than in semitones (Pépiot, 2014). Henton (1989) and Autumn (1969) show that the female f_0 range is larger than the male f_0 range when Hertz is used; however, there does not seem to be such differences when the analysis is carried out using semitones. This is primarily because semitones are relative to each speaker's f_0 . On the other hand, the Hertz scale provides the actual rate of vibration of the vocal cords, which can be idiosyncratic. Nevertheless, the cross-gender speech differences can be explained by the fact that male speakers have thicker and longer vocal folds, which produce lower fundamental frequency speech sounds (Kahane, 1978). In addition, the length of the vocal tract is claimed to be another parameter responsible for the gender difference in speech production. The resonance frequency is lower if the length of the vocal tract is long (Fant, 1970). Since male speakers have vocal tracts longer than female speakers (Simpson, 2009), they tend to produce a lower frequency resonance.

As evident from the discussion in this section, the acoustic analysis of tones in the current chapter needs to involve the following considerations.

1. Considering Mizo has both register and contour tones, the average f_0 and the slope of the f_0 contour should be calculated for phonetic characterization of the Mizo tones.

2. Considering speaker variability arising due to idiosyncratic f0 properties, f0 contours of tones need to be normalized for speaker effects.
3. Considering potential f0 variation due to varying data types such as tones produced in isolation vs. in sentence frame etc., tonal acoustic data need to be analyzed separately.

The following section discusses the previous works on the phonetics of Mizo tones. Based on the observations from Section 4.2 and Section 4.3, acoustic analysis of Mizo tones produced in various sentence contexts and isolation are presented in Section 4.4.

4.3 Previous works on the phonetics of Mizo tones

One of the first acoustic studies of Mizo tones was carried out by Sarmah and Wiltshire (2010b) by measuring the f0 values of each tone and the duration of rhymes. This work has acoustically characterized and confirmed the existence of four contrastive tones in Mizo. As reported in this work, the high tone realization is conformed to Fanai (1992) which remains relatively level, while the low tone is reported to have a falling contour. The falling tone begins from the same initiation point as the high tone. The rising tone has an initial downward dip and then rises from about 40% of the total duration. The rhyme durations of different Mizo syllables were calculated since the rising tone is found to occur only on TBUs that have at least two constituents. The result has shown that all the moras with sonorants in Mizo bimoraic and trimoraic rhymes are longer than rhymes that have non-sonorants as the final mora. In terms of the tone duration in different rhymes, only the falling tone differs from the other three tones, and the high, low, and rising tones do not show differences among them. This study also indicates that in Mizo, the f0 onset following a voiceless consonant is higher than after a voiced consonant. The place of articulation of consonants has

shown effects on the beginning of f0, whereas the alveolar has the maximum effect on the following f0 onset. The manner of articulation of Mizo consonants is also reported to affect the onset f0 of the following f0 contour where stop consonants have the highest effect. The same study has shown that consonantal effects can spread up to 20% of the initial f0 contour. Similarly, the consonant following an f0 contour can also affect 20% of the preceding f0 contour. This study has also highlighted the non-reliability of examining the difference between the Mizo tones by their average f0 values since the Mizo tones are dynamic. Therefore, the study has strongly suggested calculating the slope of the f0 contour for effective identification of the four Mizo tones.

Sarmah et al. (2015) looked into Mizo-connected speech production since the realization of the pitch in isolation can differ from pitch characteristics in continuous speech due to contextual effects. They investigated whether Mizo has an anticipatory or carryover effect and the f0 contour of the effects. Mizo trisyllabic phrases with all the possible tone combinations resulting in 64 different combinations which are all grammatical are used in the study. Four native Mizo speakers' data are recorded. For the carryover effect, all four Mizo tones in the final place of the trisyllabic phrase followed by all possible tones are examined. For anticipatory effect, the four Mizo tones of the initial syllables of the trisyllabic phrase are followed by all possible tones. The result has shown that contextual variations are bidirectional in Mizo, which means that a tone can influence the preceding and the following tones. A statistical test has shown that Mizo has both anticipatory and carryover effects extending to 100% of the total duration of the preceding and following tones. It is claimed that it could be due to the overall height levels of the neighboring tones getting affected by the tone in context. The same study has concluded that contour tones have more anticipatory effects than those on the level tones in Mizo. In terms of carryover effects, they have reported that the onset of the tone is significantly affected by the offset

of the preceding tone. Carryover effects are reported as assimilatory. However, in anticipatory effects, high tones following falling, rising, and high tones show dissimilatory effects on the preceding tone. Low tones primarily show assimilatory effects. Statistical analyses show that both anticipatory and carryover effects significantly affect the neighboring tones. As mentioned in the previous chapter, the same study has argued for the existence of tone sandhi in Mizo. However, they also pointed out that some exceptional cases could not undergo the tone sandhi phonological process.

Based on the findings reported in Sarmah and Wiltshire (2010b) and Sarmah et al. (2015), several attempts were made to identify and classify the tones in Mizo. One of the first such attempts was done by Govind et al. (2012), they carried out identification and acceptance perception tests on the native speakers of Mizo by using synthesized low tone of Mizo, which has falling and rising tone counterpart words. This study also confirms that the average f_0 information is insufficient to recognize Mizo tones. It shows that the information of the f_0 average and f_0 slope brings a better result in identification and acceptance tasks. The same study also confirms that the duration information enhances the identification of the rising tone in Mizo since the accuracy rate of the rising tone improves when the stimuli have a longer duration in the identification test. Sarma et al. (2015) designed a method for the automatic detection of Mizo tones solely depending only on two parameters: the f_0 slope and f_0 height. As mentioned in the earlier section, Mizo has a level and contour tone. This tone detection method grouped the level tone and contour tones by using variants of pitch values. Based on the height parameter obtained by fitting the pitch values to a line, level tones are further classified into high and low tones. At the same time, contour tones are classified into rising and falling tones based on the slope parameter. The overall correctness of tone identification becomes better when the consonantal effect of the first and last 20% of the pitch values is removed. However, the level tones improved the identification with the removal of consonantal effects.

At the same time, the presence of the first and last 20% of the pitch values enhances the identification of contour tones. The proposed method of tone detection in this work has achieved a 70% accuracy rate. Following this work, several attempts were made to identify and classify Mizo tones based on acoustic-phonetic features (Sarma et al., 2018; Kothapalli et al., 2018; Gogoi et al., 2020; Das et al., 2020; Gogoi et al., 2021).

While the acoustic analysis of tones was attempted in Sarmah and Wiltshire (2010b) and in Sarmah et al. (2015), these works were limited due to the small number of speakers or the limited contexts in which the tones were produced. Hence, in the current chapter, I intend to improve upon the previous works by considering data from more speakers recorded in various speech styles and sentential contexts. In the present work, tonal acoustics is investigated using data from 32 native Mizo speakers resulting in 53,072 unique tokens. The data analyzed also contains the tones produced in isolation, carrier phrases, passages, and trisyllabic phrases. The results of the analysis are presented in the following Section 4.4.

4.4 Acoustic analysis of tones in Mizo

In this section, I first present the tonal inventory of Mizo tones with new tonal minimal and near minimal sets in Section 4.4.1. In the next Section 4.4.2, a brief discussion on the TBU in Mizo is presented. Following this, Section 4.4.3 describes the acoustic analysis on the production of Mizo tones carried out on three types of data sets using the tonal minimal and near minimal sets. Section 4.4.4 provides the results of the production of Mizo tones in trisyllabic phrases and Section 4.4.5 discusses the acoustic characteristics of Mizo tones in the read passage. The phonetic analysis of RTS in Mizo is presented in the next Section 4.5.

4.4.1 The tonal inventory of Mizo

The tonal inventories of Mizo in the literature are seen in Chapter 3 in Table 3.1. From the table, it is seen that the Mizo tonal inventories provided by different researchers are inconsistent in their numbers and representations. Henderson (1948) and Lalthangliana (1997) used a detailed description of tones, more like the phonetic accounts of tones. Interestingly, the comparison of Table 3.1 in Chapter 3 has shown that the two distinct tones of Lalthangliana, namely, high-rising and low-rising, are grouped under the same tone, that is, a high tone. The reason is that a high-rising tone is a high tone with a long vowel, while a low-rising tone represents a high tone with a short vowel. He used the two tones interchanging throughout the thesis. Such confusion of tone with vowel length is common in Mizo. For instance, a circumflex is used for tone marking in some Mizo writings; however, there is clear evidence of vowel length and tone being confused. As mentioned earlier, the given Mizo lexical words to show the minimal tonal sets in the literature have different forms. The high-level tone /va:y/ ‘foreigner’ is a loanword from Hindi /bhai/ ‘brother’, the high tone /paa/ ‘basket’ is an uncommon lexical word, and the tonal inventory provided in Fanai (1992) is near minimal sets.

Motivated by these Mizo tone analysis shortfalls, we introduced new sets of minimal and near minimal tonal words in Mizo tabulated in Table 4.1. The tonal minimal sets are /vai/ and /t^haŋ/, and the near minimal sets are /bel, be:l, lem, le:m/. These Mizo words are attested to four distinct lexical tones in Mizo, namely, high, low, falling, and rising. Although the sets for /bel/ and /lem/ have vowel length differences, it is still preferable since vowel length does not affect tone in Mizo (Lalthangliana and Sarmah, 2020). Undoubtedly, the minimal tonal sets of /t^haŋ/ and /vai/ have drawn more compelling evidence of the existence of the four distinct lexical tones in Mizo. This analysis also conformed to the analyses of Weidert (1975); Fanai (1992) and Chhangte (1993) which reported the existence of four lexical tones

Table 4.1: The minimal and near minimal sets of Mizo tones.

Words	High (H)	Low (L)	Falling (HL)	Rising (LH)
/be:l/	‘pot’	‘to rely on’	–	–
/bel/	–	–	‘to stick’	‘thorough’
/le:m/	‘to attract’	–	–	‘particularly’
/lem/	–	‘fake’	‘to swallow’	–
/t ^h aŋ/	‘known’	‘greasy’	‘gone away’	‘a trap’
/vai/	‘chaff’	‘dazzle’	‘brandish’	‘all’

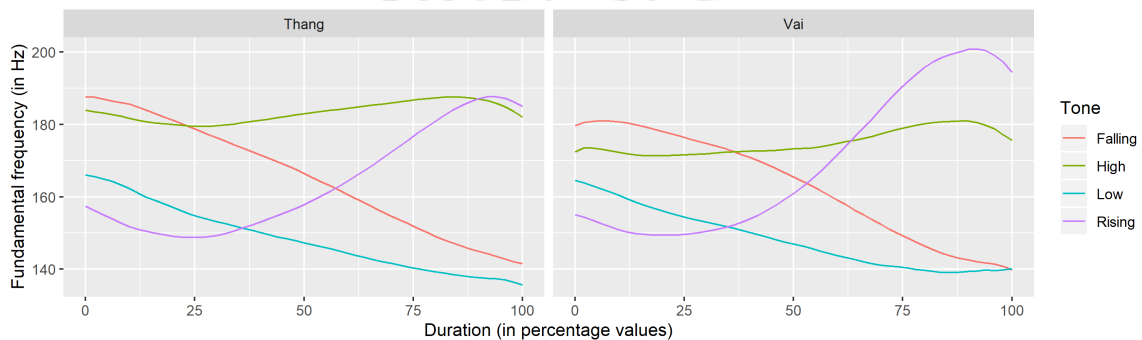


Figure 4.1: The mean f0 contours of /t^haŋ/ and /vai/ in isolation obtained from 10 Mizo speakers.

in Mizo. Additionally, this dissertation follows the naming convention of the tonal inventories in Weidert (1975); Fanai (1992) and Chhangte (1993) to reduce confusion. Hence, the terms and representation of tones such as high (H), low (L), falling (HL), and rising (LH) are considered.

For instrumental evidence, the mean f0 contours of /vai/ and /t^haŋ/ produced by 10 native Mizo speakers are plotted in Figure 4.1. From the figure, we can see that Mizo has four distinct lexical tones, which are dynamic.

4.4.2 Tone Bearing Unit

The Tone Bearing Unit (TBU) is the potential linguistic element or phoneme(s) associated with a language’s tone. The TBU in a language can be either the syllable, the segments, the mora, the rhyme, or the sonorous rhyme. Yip (2002) stated that no segment is the TBU; hence, ‘TBU must be the mora or the syllable’ and therefore ‘it

seems that tone always associates to prosodic entities'. Gussenhoven et al. (2004) also stated that if the mora is the TBU in a language, then the moras that bear tones are required to be sonorants. Conforming to these statements, Fanai (1992) also claimed that all sonorants within the rhyme of a syllable are the potential TBU(s) in Mizo.

The analysis of the TBU in this dissertation further confirmed that a rhyme with one or more sonorants could bear tones in Mizo. The evidence from the pitch tracks in the Praat window is provided in Figure 4.2. The figure shows the pitch tracks of the four tones of Mizo in the word /t^haj/ (falling - 'to be gone', rising - 'a trap', high - 'known' and low - 'greasy'). In all the four tones, the dynamic nature of the f0 is attested clearly for every phoneme in the rhyme. The pitch tracks in blue color initiate from the nucleus /a/ and terminate at the coda /ŋ/. In terms of falling tone, the f0 starts to fall gradually from the nucleus /a/ to the coda /ŋ/. In a rising tone, the nucleus falls from the beginning and then gradually rises only from the coda. In high tone, the f0 continues to rise within the rhyme. The f0 in the low tone also gradually falls from the nucleus and continues on the coda. Considering the falling and rising tone, breaking up the nuclei and the sonorant codas would provide the wrong f0 contours. In a falling tone, the nucleus has only the high f0 level, and the actual falling f0 contour happens only at the coda. Likewise, the nucleus has only the falling or dipping f0, and the actual rising f0 begins from the coda in the rising tone. The same pitch track patterns are also seen in all the other vowels in Mizo, namely, /i, e, o, u/ and other sonorant codas, /m, n, l, r/. Hence, the pitch tracks in Praat convinced that the TBUs in Mizo is the syllable rhyme with sonorants.

4.4.3 Minimal and near minimal data sets

In this section, the f0 contours of Mizo are provided using tonal minimal and near minimal sets, which are produced in three different contexts: in isolation, in semantic context, and in sentence frame. Figure 4.3 shows the f0 contours of the four Mizo

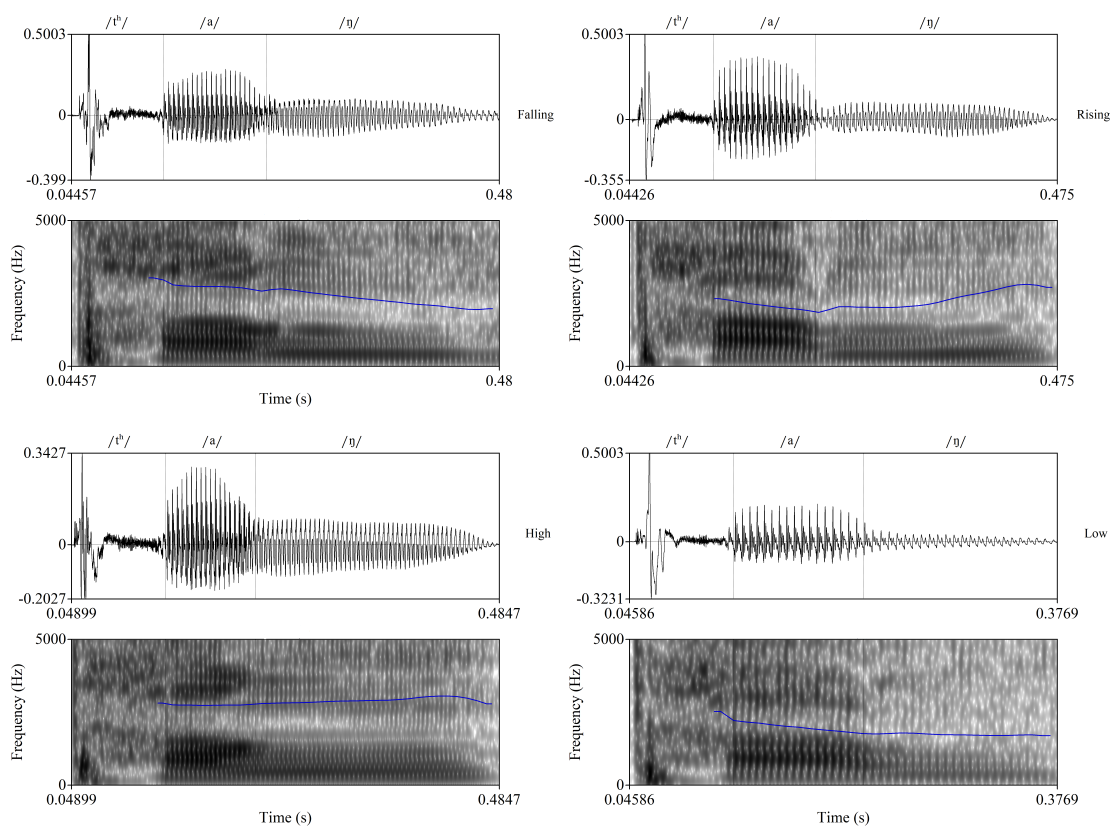


Figure 4.2: The pitch tracks of /tʰaŋ/ tonal minimal sets with the waveforms and spectrograms obtained from a female Mizo speaker.

tones obtained from the raw values in isolation, semantic, and sentence contexts. It is observed from Figure 4.3 that the four Mizo tones, namely, high, low, rising, and falling tones, have similar f0 contours in all contexts.

In terms of the isolation context, the high tone shows a fairly level f0 contour compared to the other tones. The initiation point of high tone is 175Hz, indicating a moderate rise until 92% of the total duration. A high tone has a lower f0 initiation than a falling tone. A little falling contour is observed towards the termination of a high tone, starting from 74% of the total duration. This termination point is also lower than the termination point of rising tone. The falling tone begins with 180Hz, the highest initiation f0 value among the four Mizo tones. As seen in Figure 4.3, the falling tone immediately starts to fall gradually until the termination point. Thus, the falling tone in Mizo has a dynamic f0 contour. The termination point of a falling tone with f0 of 139Hz is just above the ending point of a low tone. The low tone begins with 164Hz, which is higher than the start of the rising tone. As in the falling tone, the low tone also shows a dynamic f0 contour that falls gradually from the initiation point. However, the event of falling ends at around 80% of the total duration, and from here, the low tone has a level f0 contour until the termination point, which is about 10% before the ending point. The low tone has the lowest f0 termination among the four Mizo tones, which is 137Hz. On the other hand, the rising tone has the lowest f0 initiation among the four tones, which is 155Hz. The rising tone immediately falls from the starting point until 25% of the total duration, and it begins to rise from this point until 94% of the total duration. There is a slight fall at the end of the rising tone, which lasted for about 6% before the termination point. The rising tone has the highest degree of changes in the shape of the f0 contour compared to the other tones in Mizo. Hence, it can be considered that all four tones in Mizo, namely, high, rising, falling, and low, are dynamic. Although the high tone has not shown a prominent change in the pitch shape, it is somehow showing a rising contour. Therefore, there

are no phonetic level tones in Mizo.

The f0 contours of all four Mizo tones in the semantic context are closely similar to the contours in the isolation context. The rising and low tones in the semantic context have almost the same initiation point, 168Hz, and 167Hz, respectively. It is observed that the rising tone has a less prominent dipping contour at the beginning. The high tone shows a gradual rise from the beginning until about 78% of the total duration, and the f0 contour falls from this point until the end. The falling tone has a falling contour from the initiation to the termination point. The low tone has shown a peculiar contour where leveling is seen. It has a falling contour from the beginning until 54% of the total duration. A level contour is observed for some time between 56% and 78% of the total duration. From 80% of the total duration, there is a slight fall until the termination point in the low tone.

In terms of the sentence context, the f0 contours of the four Mizo tones are similar to that of the contours in the isolation and the semantic contexts. The high tone gradually rises and then falls from about 84% of the total duration. The falling tone shows a little level contour in the beginning until about 16% of the total duration of the falling tone has shown a level f0 contour which eventually starts to fall until the endpoint. The rising tone begins with a little lower f0 compared to the low tone, which is 158Hz. It shows a falling contour and then rises from 26% to 94% of the total duration and the remaining duration shows a falling contour. The low tone gradually falls from the starting point until the termination point.

Since the target words in these three different contexts: isolation, semantic, and sentence are the same, the f0 contours are comparable. In Figure 4.3, the f0 contour of rising tone is prominently dynamic in the isolation context compared to the semantic and sentence contexts. The proximity of the termination points for low and falling tones is closer in the isolation context than in the other contexts. Sentence context also has proximity to the initiation of the same tones. However, the initiation points

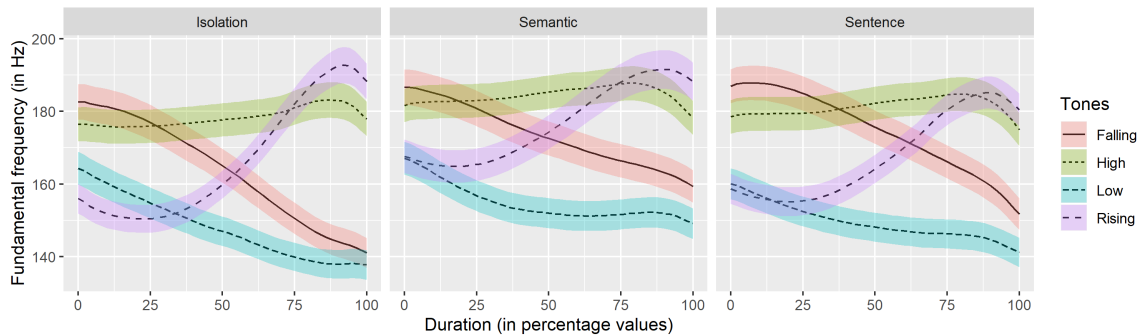


Figure 4.3: F0 contours of four Mizo tones in isolation, semantic, and sentence context.

for low and rising tones in an isolation context are not close to each other. The comparison between the f0 contours in the three data sets suggests that the f0 contours in the semantic context have the smallest f0 range. In contrast, the f0 contours in isolation contexts have a larger f0 range, especially at the termination points. The possible explanation for this is that the f0 contours in the semantic contexts are affected by the preceding and the following ones, known as contextual effects.

To avoid the speaker's intrinsic effect on the fundamental frequency, the f0 values are normalized. Figure 4.4 provides the normalized f0 contours of the tones in minimal and near minimal sets produced in three contexts: isolation, semantic, and sentence. The normalized f0 contours of the four Mizo tones in Figure 4.4 show similar f0 patterns in the three contexts. However, they differ from the raw f0 contours as in Figure 4.3. It is observed that the normalized f0 contour of high tone in each context no longer looks as level as in the non-normalized in Figure 4.3. There is a little rise in the mid-portion of the contours in each context. This rise is less prominent in the isolation context, while the semantic and sentence contexts have a higher f0 rise. The termination points of high tone in the sentence and semantic contexts are lowered from about 65% of the total duration of the f0 contour. At the same time, it remains level in the isolation context. This suggests that the little rise in the mid-portion of the f0 contours in high tones for both sentence and semantic contexts

may be due to the contextual effects; the preceding and the following tones of the target words may have lowered the f0 contour in high tones. Figure 4.6 to Figure 4.8 provide evidence for this claim where the f0 contours of the target words are separately plotted, indicating the four Mizo tones. In Figure 4.7, /lem, t^haŋ, vai/ is preceded by low tone words, and they are also followed by low f0 starting point, rising and low tone words ². Therefore, four low tones out of five tokens precede the high tone target words in the semantic context, and three words with a low f0 initiation follow the target high tone words except in /be:l/, which is followed by a high tone. Likewise, in sentence contexts, the target words are always followed by a low tone and preceded by a falling tone. This shows that the prominent high f0 in the mid of the total duration in high tones for the sentence and semantic contexts is due to the effect of the preceding and the following tones, which lower the high tone at the initiation and the termination points. Figure 4.6 shows that the f0 contours of the Mizo words in isolation do not show tone change.

The falling tone in the three contexts shows the same f0 pattern in their falling contour. In isolation and sentence contexts, the falling tones do not fall immediately as in the semantic context. A level contour is seen for about 12% from the initiation point in the isolation context, and there is a slight rise for about 12% of the beginning of the high tone in the sentence context. The falling tones in isolation and semantic contexts have a level contour just before the termination point, which is about 15% before the end. The initiation and termination points are higher in the semantic and sentence contexts than in isolation. This is because the preceding tones of the target words in both the semantic and sentence contexts are high-tone words which raise the f0 of falling tone in the beginning. In semantic context, the target falling tone words are followed by three high tone words that have raised the termination point. While in the sentence context, low tone follows the target falling tone ³.

²See Appendix A, Table A.10

³See Appendix A, Table A.10

The rising tone in all three contexts also shows a similar pattern where there is a rise from about 13% of the total duration. The f0 initiation and the f0 termination are highest in the semantic context for rising tone. The semantic context also has a less prominent rising f0 contour compared to the isolation and sentence contexts. This can be explained by looking into the preceding and the following tones of the target words for the rising tone in semantic context. Figure 4.7 provides the f0 contours of the four Mizo tones produced in four unique words in the semantic context. It can be seen that the rising tone produced in /t^haŋ/ in the semantic context shows a similar f0 contour of the high tone. Although there is a slight f0 rise in this rising tone, it is not similar to the other rising tones produced in other words. The reason is that in the semantic context, the target word which bears a rising tone /t^haŋ/ is preceded by another rising tone and is followed by a low tone word. As per my preliminary investigation on this, when a rising tone is followed by a low or another rising tone in Mizo, the first rising tone changes to a high tone provided that it is in VVC or CVS(sonorant) syllable structure. Since this condition is met, the target rising tone becomes a high tone.

In terms of the rising tone in /vai/ in the semantic context, the f0 initiation is higher than the high tone. This could be due to the effect of the preceding rising tone, which ends with a high f0 termination, raising the f0 initiation of its following rising tone. For both rising tones in /le:m/ and /bel/ in the semantic context, the preceding and the following tones are low tones which must have lowered the f0 initiation and the termination points ⁴. These reasons explained how the f0 contour of rising tone in the semantic context in Figure 4.4 differs from the rising tones in the isolation and sentence contexts.

Low tones in isolation, semantic and sentence contexts in Figure 4.4 show almost similar f0 contours. In all three contexts, the low tone begins to fall from the initiation

⁴See Appendix A, Table A.10

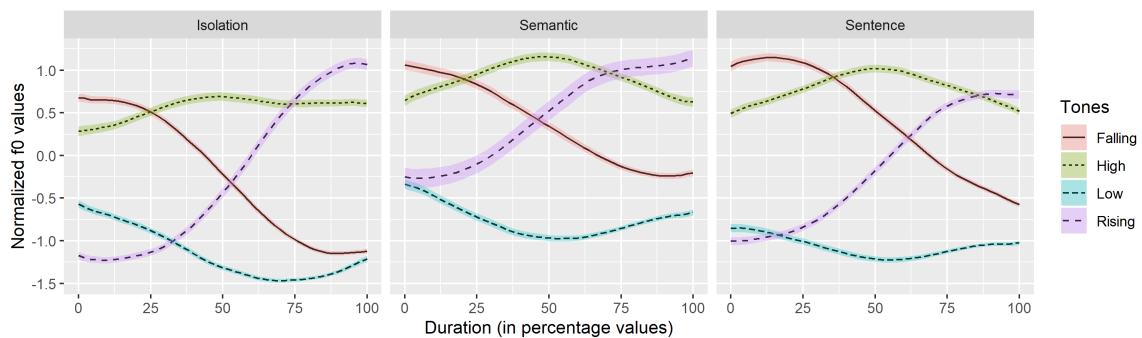


Figure 4.4: The normalized f0 contour of four Mizo tones in isolation, sentence, and semantic context.

point and is raised at the end. There is a dip in all three contexts. In isolation, the dip takes place between 62% and 80% of the total duration. The dip in semantic context takes place at around 50% of the total duration, while in sentence context, it takes place at about 59% of the total duration. The low tone in the semantic context has a higher f0 contour throughout the total duration compared to the other contexts. In Figure 4.7, the target low tone is preceded by a high tone in /be:l, t^haŋ, vai/ which results in raising the following target f0 initiation of low tone. Additionally, the low tone targets are followed by high tones in /vai/ and /lem/, raising the termination point of the preceding low tone. Figure 4.8 presents the four unique words produced in all four tones in Mizo in the sentence context. In this figure, we see no tonal change.

The DCT converted values of the f0 contours of the four Mizo tones in three different contexts are shown in Figure 4.5. It is seen that the f0 contours in Figure 4.5 are smoother than the f0 contours in Figure 4.3 and Figure 4.4.

The comparison between the f0 contours of the four Mizo tones in isolation, semantic, and sentence contexts conforms to the finding in Sarmah et al. (2015) that there are contextual variations in Mizo. Among the three contexts, the semantic context has shown the most variation of f0 contours the most while sentence and isolation contexts do not show any peculiar f0 contours.

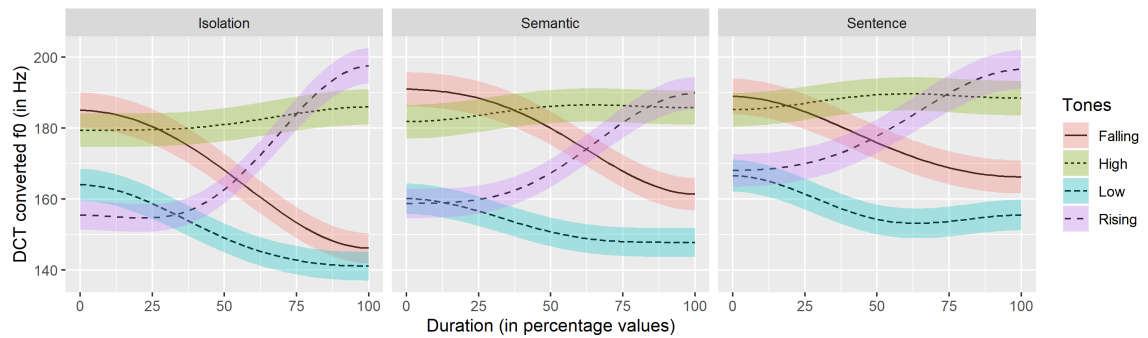


Figure 4.5: The f_0 contours of four Mizo tones reconstructed using DCT coefficients in isolation, sentence, and semantic context.

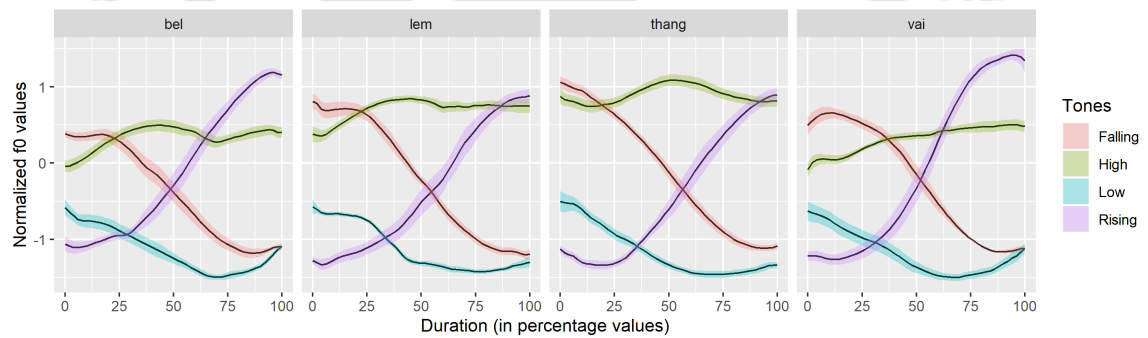


Figure 4.6: The normalized f_0 contours of the four Mizo tones produced in four words in isolation.

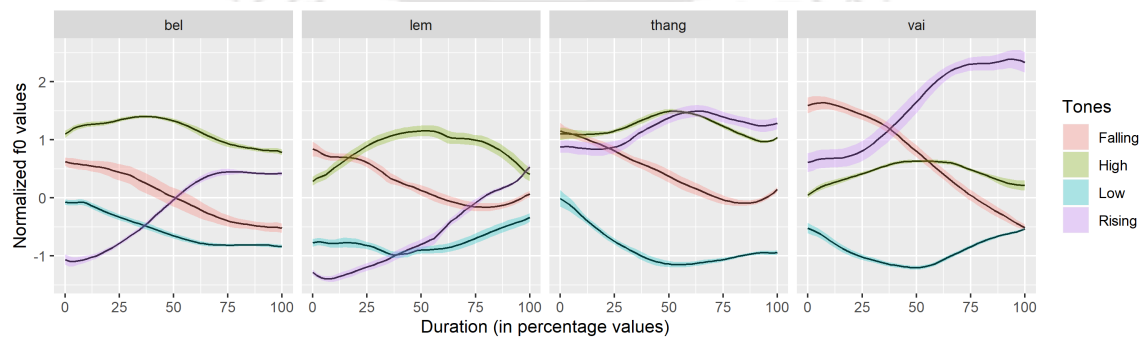


Figure 4.7: The normalized f_0 contours of the four Mizo tones produced in four words in semantic context.

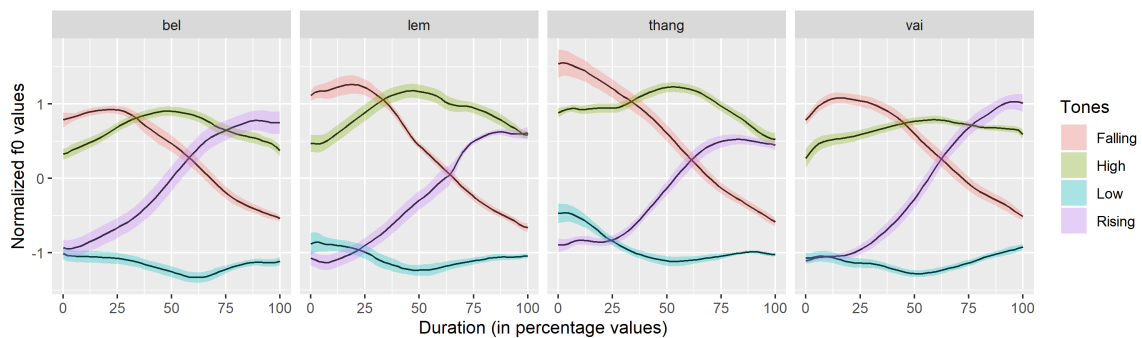


Figure 4.8: The normalized f0 contours of the four Mizo tones produced in four words in sentence context.

To examine the gender differences, the male and female averaged raw f0 contours of the four Mizo tones in isolation context are provided in Figure 4.9. This figure shows evidence of gender-specific differences in the f0 ranges. From Figure 4.9, it is seen that the fundamental frequency for all four Mizo tones is higher in female speakers than the male speakers. Additionally, it is observed that the f0 range of the female speakers is broader than the male speakers. This is prominently present in the first half of the total duration. Table 4.2 shows the highest and the lowest fundamental frequency at the initial and termination points for both male and female speakers. The falling tone has the highest f0 initiation point, and the rising tone has the lowest f0 initiation for both males and females. In terms of the termination points, the rising tone has the highest f0 while the low tone has the lowest f0 in both males and females. For female speakers, the f0 difference at the initial point is 31Hz, and 17Hz for males. The f0 difference at the termination point is 53Hz for females and 48Hz for males. And across the gender, the f0 differences at the initial point are 14Hz and 5Hz for the termination point. These differences in values support the observation made from the visual examination of Figure 4.9. The f0 range of the female speakers is broader than the male speakers in both the initiation and the termination points. Table 4.2 also provides the information that the highest f0 is 230Hz for females while for male speakers, it is 144Hz. The difference between the highest f0 for both male

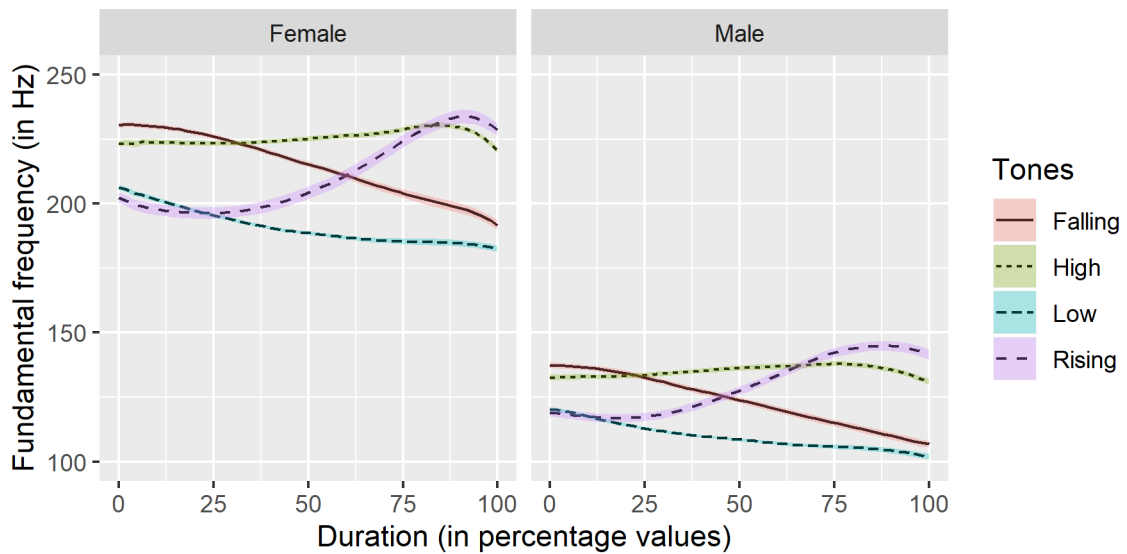


Figure 4.9: The male and female f0 contours of four Mizo tones in isolation context.

and female speakers is 86Hz. The lowest f0 in female speakers is 177Hz and 96Hz for male speakers. The difference between the lowest f0 for both male and female speakers is 81Hz. This conformed to the f0 differences among males and females during the production of tone due to anatomical and physiological differences. As cited in Pépiot (2014), Takefuta et al. (1972) and Chen (2007) claimed that the f0 range is larger for female speakers. The physiological difference is that male speakers have thicker and longer vocal folds than female speakers, producing lower f0 (Kahane, 1978). The length of the vocal tract also plays a role in the cross-gender f0 differences; a longer vocal tract has lower resonant frequencies (Fant, 1970). Simpson (2009) also reported that the average length of the adult male vocal tract is about 17 to 18 cm, while the average female vocal tract is 14.5 cm long. Hence, female speakers produce higher f0 than male speakers generally. Figure 4.10 shows the DCT converted f0 of the four tones plotted gender-wise, and Table 4.3 shows the f0 value. The observations from these are similar to that of the averaged raw f0 values, except that just by 1Hz, the raw f0 has a higher initiation point. The termination point difference is higher in the DCT converted f0 than the raw f0 by 3Hz.

Table 4.2: F0 ranges (in Hz) of male and female in the initial and the termination points.

	Male			Female			
	Highest	Lowest	(a) Diff	Highest	Lowest	(b) Diff	(b)-(a)
Initial	132	115	17	227	196	31	14
Final	144	96	48	230	177	53	5

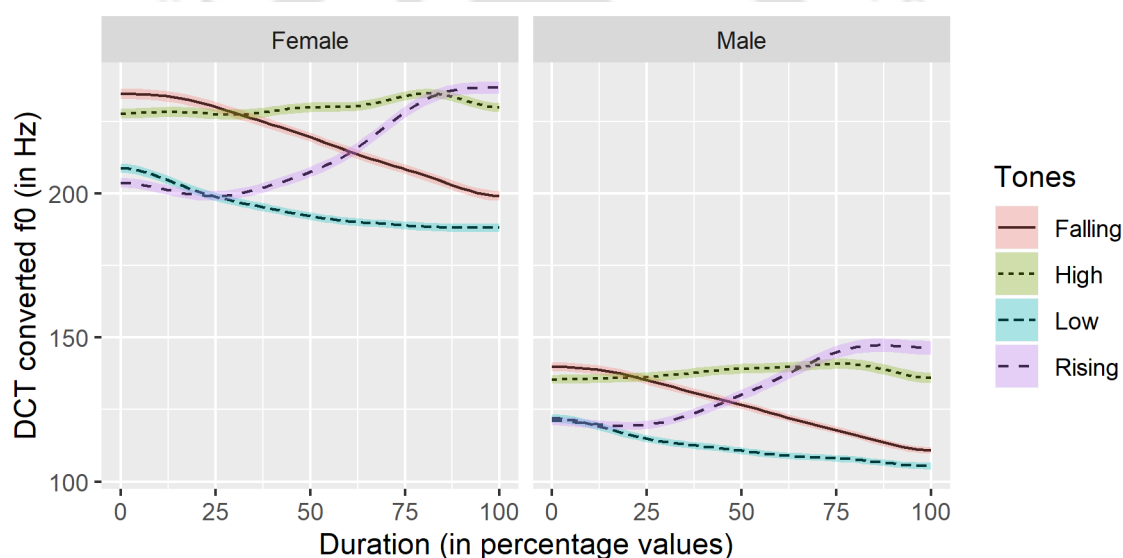


Figure 4.10: The DCT converted f0 contours of four Mizo tones in isolation context by gender.

Table 4.3: DCT converted f0 ranges (in Hz) of male and female in the initial and termination points.

	Male			Female			
	Highest	Lowest	(a) Diff	Highest	Lowest	(b) Diff	(b)-(a)
Initial	134	113	21	230	196	34	13
Final	153	100	53	241	180	61	8

Table 4.4: Type II Wald Chisquare test on the LME model for C0, C1, and C2 in isolation in Mizo tones showing the interaction of tones and gender.

p-values: ***: p < 0.000, **: p < 0.001, *: p < 0.05, n.s.: not significant

Factors	C0	C1	C2	Duration
Tones	1193.1***	2782.0***	804.9***	124.3***
Gender	56.5***	0.9 ^{n.s.}	13.3***	16.8***
Tones x gender	75.6***	35.3***	193.1***	1.7 ^{n.s.}

Table 4.5: Results of pairwise comparison of C0, C1 and C2 in male and female.

Coefficients	Tones	Contrast	Estimate	SE	df	t ratio	p value
C0	Falling	Female-Male	86.94	12.45	12.8	6.983	<.0003
	High	Female-Male	90.14	12.45	12.7	7.242	<.0002
	Low	Female-Male	79.74	12.45	12.7	6.406	<.0007
	Rising	Female-Male	76.7	12.45	12.7	6.163	<.001
C1	Falling	Female-Male	157.3	55.9	23.3	2.813	0.2747
	High	Female-Male	-21.7	55.4	22.3	-0.392	1
	Low	Female-Male	100.5	55.6	22.7	1.807	1
	Rising	Female-Male	-62.3	55.3	22.1	-1.126	1
C2	Falling	Female-Male	-43.1	19.6	24.7	-2.197	1
	High	Female-Male	55.55	19.4	23.5	2.861	0.2438
	Low	Female-Male	32.53	19.5	24	1.668	1
	Rising	Female-Male	168.71	19.4	23.4	8.701	<.0001

To see the differences in the tone features across the gender, three LME models were built where the fixed and the random effects are the same. Tones and gender were the fixed effects; the speaker was considered a random effect, and C0, C1, and C2 are the dependent variables for each model. The models were subjected to a Type II Wald- χ^2 analysis of deviance test. The results show a significant effect of gender on tones as seen in Table 4.4. Furthermore, to see the gender-wise differences, the models were subjected to pairwise variability tests using the emmeans function with Bonferroni posthoc tests. The results of the pairwise comparisons are provided in Table 4.5. The results indicate that the male and female f0 are significantly different in terms of the C0 in all the tones, and in C2 for the rising tone. On the other hand, no significant gender differences are found in C1 for all the tones. Hence, the mean f0 (C0) is best in categorizing the gender differences of f0 in Mizo.

Table 4.6: The mean duration of Mizo tones (in milliseconds) in isolation, semantic and sentence contexts with standard deviations in parenthesis.

Tones	Isolation	Semantic	Sentence
Falling	255.61 (43.85)	178.91 (37.40)	179.55 (33.75)
High	300.74 (45.05)	186.34 (38.85)	189.34 (33.54)
Low	259.37 (52.32)	177.83 (29.38)	186.47 (26.52)
Rising	275.37 (41.92)	175.72 (36.70)	177.81 (35.28)

Table 4.6 provides the mean duration of the four Mizo tones in isolation, semantic and sentence contexts. The tone duration is calculated from the TBU: the vowel, and the subsequent sonorant rhyme. From the table, it is seen that the high tone is the longest in isolation context, followed by a rising tone, low tone, and falling tone is the shortest. The same order of the duration of different tones in Mizo is reported in Sarmah and Wiltshire (2010a) where the high tone has the longest rhyme duration, and the falling tone has the shortest duration. On the other hand, the rising tone is the shortest, and the high tone is the longest, followed by the falling and low tone in the semantic context. In sentence context, the high tone is the longest, followed by the low and falling tones, while the rising tone has the shortest duration. Hence, in all three contexts, the duration of high tone is the longest. This may be due to the requirement to reach the target f_0 in producing a high tone in Mizo, which needs more time than other tones in Mizo. The falling tone has the shortest duration in an isolation context. The reason could be that there is a less articulatory effort in producing a falling tone which requires less time to achieve the target f_0 . The difference in this temporal property of the four tones in Mizo implies that the duration of Mizo tones depends on the context. In other words, the duration of the four Mizo tones does not remain constant, but they keep changing as per the context except for the high tone, which robustly has the longest duration in all the contexts in this experiment

In Table 4.7, the slope information of the four Mizo tones in the three contexts is provided based on the first and the second DCT coefficients, C1 and C2, along

Table 4.7: The average C0, C1, and C2 values of the four Mizo tones in the three contexts.

Tones	Isolation			Sentence			Semantic		
	C0	C1	C2	C0	C1	C2	C0	C1	C2
High	178.38	-84.01	21.48	181.41	-50.07	-30.12	184.51	-41.3	-33.2
Low	147.95	293.27	44.17	149.47	157.62	40.56	154.69	141.56	86.47
Falling	163.68	495.87	-32.32	174.69	377.27	-48.67	173.39	289.74	21.25
Rising	166.36	-537.44	176.69	167.76	-397.76	89.45	176.60	-363.9	58.5

with the mean value of the fundamental frequency, C0. The dynamic nature of the two contour tones in Mizo, falling and rising tones, is well attested by the C1 values. From the C1 values, it is also observed that the low tone in Mizo has a falling contour. High tones in all the contexts have negative values, which means that it is fairly a level tone. In terms of C2 values, the rising tone in isolation has high positive values, meaning there is a little falling-rising contour. Out of the three contexts, it is clear that the isolation context has a prominent tone categorization based on the dynamic nature of the four Mizo tones.

To support the findings on the analysis of the Mizo four tones, a statistical test was conducted on the isolation context. Isolation context is purposefully selected for statistical analysis as of now since the pitch contours in this context are considered less affected by other factors. Four LME models were built to investigate the effect of tones and gender on the four Mizo tones. We use duration, C0, C1, and C2 as the dependent variables for each model; tone and gender as fixed factors, and the speaker is considered a random variable. The LME model was subjected to a backward elimination of random and fixed effects by using the *step()* function of the *lmerTest* package (Kuznetsova et al., 2017). The results tabulated in Table 4.8 revealed a significant effect of tones in all the features. The LME models were subjected to a between-tone types comparison of duration, C0, C1, and C2. The Kenward-Roger method computed the degrees of freedom with p-values adjusted using the Bonferroni method. The results of the pairwise comparison of tone types are tabulated in Table

Table 4.8: Type II Wald Chisquare test on the LME model for the duration, C0, C1, and C2 in isolation in Mizo tones.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant

Factors	Duration	C0	C1	C2
Tones	124.3***	1193.1***	2782.0***	804.9***
Gender	16.8***	56.5***	0.9 ^{n.s.}	13.3***
Tones:Gender	1.7 ^{n.s.}	75.6***	35.3***	193.1***

4.9. From the table, it is seen that falling and low tones do not differ from one another in duration while the rest of the tones are significantly different from each other. In terms of C0, C1, and C2, all four tones in Mizo are significantly different from each other. This shows that duration, the mean f_0 , and the dynamic properties of Mizo tones in isolation are all important in categorizing the four Mizo tones.

4.4.4 Trisyllabic phrases

The raw f_0 contours plot of the four tones of Mizo, namely, low, high, falling, and rising tones produced in trisyllabic phrases, is provided in Figure 4.11. In Figure 4.11, the high tone begins from 172Hz and gradually rises until about 86% of the total duration. The high tone also shows a falling contour for 22% before the termination point. The last point is 171Hz, which is the highest f_0 among the four Mizo tones in trisyllabic phrases. In terms of falling tone, the f_0 contour begins at 174Hz and immediately falls until the termination point, which is 157Hz. The falling tone has the highest starting point among the four tones in the trisyllabic phrases. On the other hand, the rising tone has the lowest initiation with 153Hz, which falls right from the start. This falling contour lasted until 14% of the total duration and then began to rise until 96% of the total duration. The last two percent of the total duration of the rising tone shows a level contour that eventually terminated at 168Hz. The low tone begins at 157Hz and starts to fall until the termination point at 145Hz. Undoubtedly, the low tone has the lowest termination of the f_0 contour. The f_0 contours of the four Mizo tones obtained from the trisyllabic phrases show that all the tones are dynamic

Table 4.9: Results of pairwise comparison of Mizo tones in isolation.

Factors	Contrast	Estimate	SE	df	t ratio	p value
Duration	Falling-High	-50.15	4.88	455	-10.272	<.0001
	Falling-Low	-9.21	4.91	455	-1.873	0.3699
	Falling-Rising	-25.59	4.87	455	-5.252	<.0001
	High-Low	40.94	4.83	455	8.47	<.0001
	High-Rising	24.56	4.79	455	5.126	<.0001
	Low-Rising	-16.38	4.82	455	-3.396	<.0045
C0	Falling-High	-15.69	0.894	455	-17.543	<.0001
	Falling-Low	14.29	0.9	455	15.877	<.0001
	Falling-Rising	-3.94	0.893	455	-4.416	<.0001
	High-Low	29.98	0.886	455	33.858	<.0001
	High-Rising	11.75	0.878	455	13.384	<.0001
	Low-Rising	-18.23	0.884	455	-20.635	<.0001
C1	Falling-High	575	21.4	455	26.875	<.0001
	Falling-Low	199	21.5	455	9.243	<.0001
	Falling-Rising	1027	21.3	455	48.128	<.0001
	High-Low	-376	21.2	455	-17.747	<.0001
	High-Rising	453	21	455	21.556	<.0001
	Low-Rising	828	21.1	455	39.199	<.0001
C2	Falling-High	-52	7.82	455	-6.65	<.0001
	Falling-Low	-75.1	7.87	455	-9.544	<.0001
	Falling-Rising	-206.3	7.81	455	-26.428	<.0001
	High-Low	-23.1	7.74	455	-2.986	<.0179
	High-Rising	-154.3	7.68	455	-20.099	<.0001
	Low-Rising	-131.2	7.73	455	-16.973	<.0001

and have no level tone. Although a high tone may look a little like a level contour, it is seen gradually rising until 86% of the total duration. Figure 4.12 shows the normalized f0 contours of the four Mizo tones in trisyllabic phrases. It is seen from Figure 4.12 that the high tone has a rising contour that begins from the beginning of the contour until 86% of the total duration. It gradually falls from 86% of the total duration until the termination. The highest f0 of the high tone is even higher than any of the initiation and termination points of the four tones. The falling tone also shows a different f0 contour from the raw f0 values in Figure 4.11. In the normalized f0 contour in Figure 4.12, the falling tone rises for about 16% of the total duration and begins to fall gradually until the termination point. The degree of the falling contour begins to reduce a little from about 82% of the total duration until the termination point. Low tone also shows a falling contour from the beginning until about 88% of the total duration. It begins to rise a little just before the termination point. The rising tone has a falling contour for a while in the first 22% of the total duration and begins to rise until the endpoint gradually. The degree of the rising contour decreases near the termination point.

The reconstructed f0 contours of the four Mizo tones using DCT coefficients are plotted in Figure 4.13. This figure shows a smoother f0 contour compared to the raw and normalized f0 contours. In Figure 4.13, the high tone gradually rises from the initiation point until 76% of the total duration and falls from this point until the termination point, which is 176Hz. The high tone has the highest f0 among the four tones at the termination point. Regarding the initiation of f0, the falling tone begins with the highest f0, 177Hz. In falling tone, the f0 contour immediately starts to fall from the beginning until the termination point with 48Hz. On the other hand, the rising tone has the lowest f0 initiation, which is 153Hz. The rising tone shows a little dip in the f0 contour from the beginning until about 24% of the total duration. It rises from here until the termination point, which is 169Hz. The low tone starts at

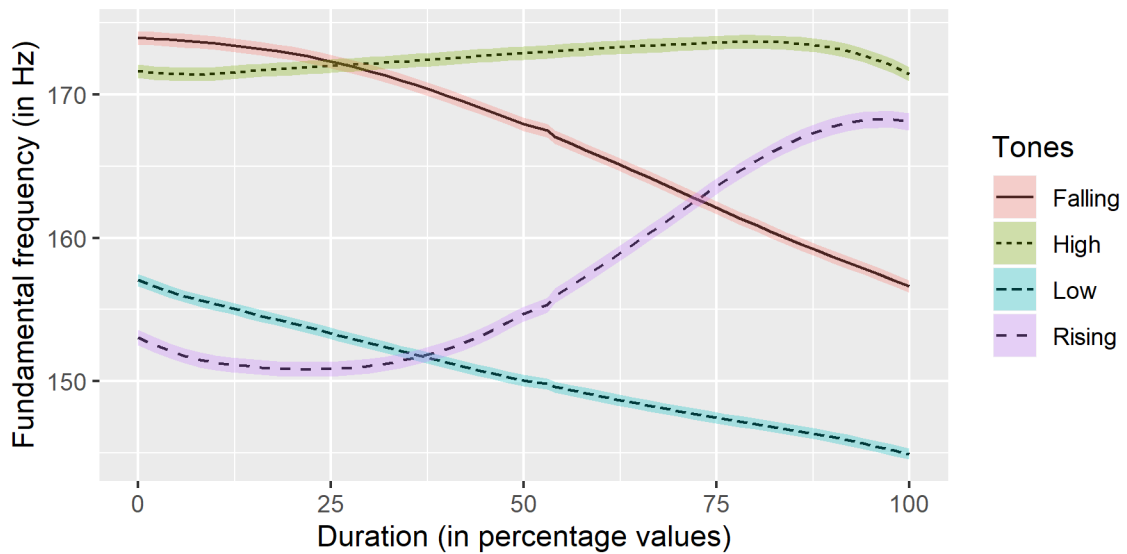


Figure 4.11: The raw f0 contour of four Mizo tones in trisyllabic phrases.

Table 4.10: The mean duration of Mizo tones (in milliseconds) in trisyllabic phrases with standard deviations in parenthesis.

Tones	Duration
Falling	118.10 (69.29)
High	165.08 (64.59)
Low	117.93 (59.66)
Rising	166.33 (55.88)

160Hz, which immediately falls throughout the total duration. The low tone has the lowest termination f0, which is 149Hz.

The temporal information of the four Mizo tones in trisyllabic phrases is provided in Figure 4.14 and Table 4.10. It can be seen that high and rising tones have a similar duration in Figure 4.14. However, Table 4.10 shows that the rising tone is longer than the high tone by 1.25ms. Likewise, falling and low tone has similar duration visually; as indicated in Table 4.10, there is only a 0.17ms difference. Hence, in terms of duration in trisyllabic phrases, the rising tone has the longest duration, followed by the high tone, falling tone, and low tone has the shortest duration.

The information on the f0 slope in trisyllabic phrases is provided in Table 4.11 using the C1 and C2 of DCT along with the mean values of the fundamental frequency,

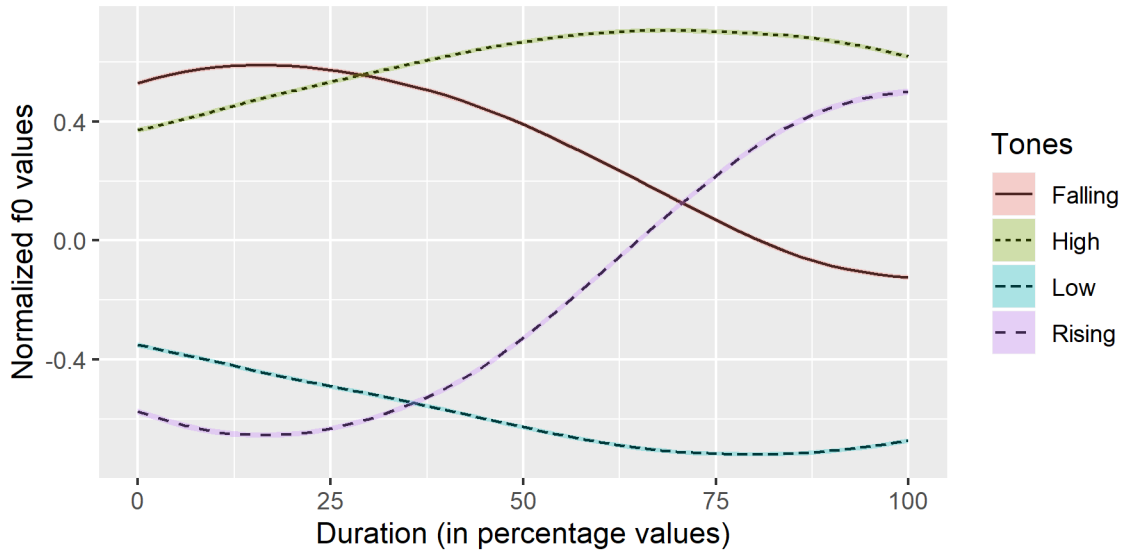


Figure 4.12: The normalized f0 contour of four Mizo tones in trisyllabic phrases.

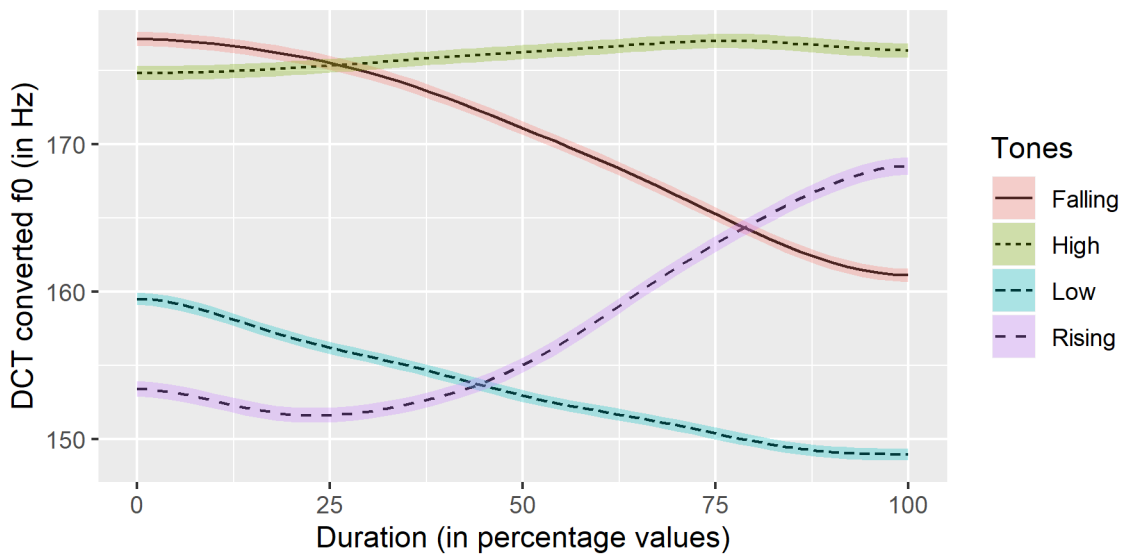


Figure 4.13: The reconstructed f0 contour of four Mizo tones using DCT coefficients in trisyllabic phrases.

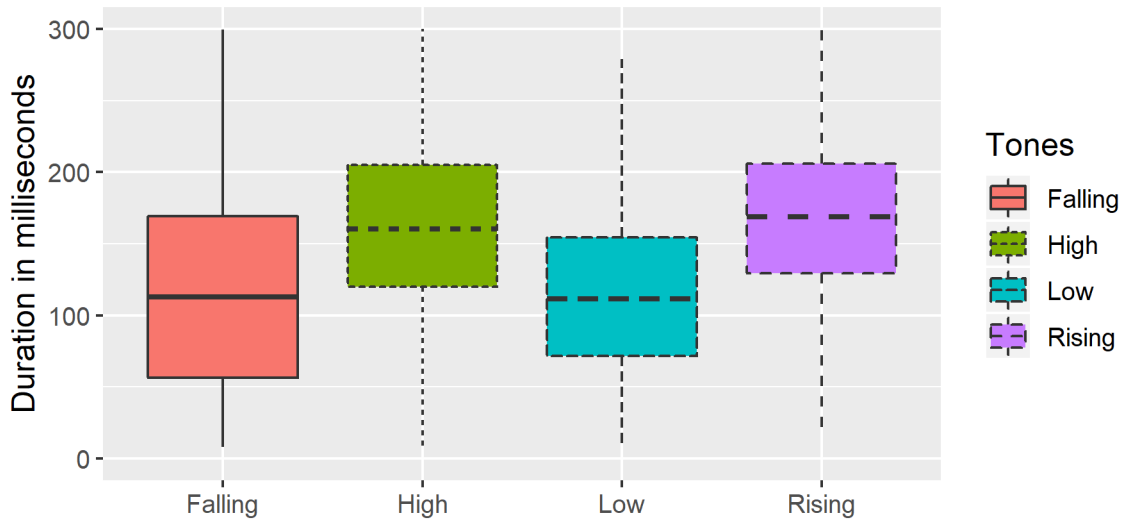


Figure 4.14: The duration of f0 contour of four Mizo tones in trisyllabic phrases.

Table 4.11: Average C0, C1, and C2 values of Mizo tones in trisyllabic phrases.

Tones	C0	C1	C2
Falling	166.95	195.31	-25.97
High	172.64	-24.70	-8.04
Low	150.49	121.03	13.35
Rising	154.71	-202.09	71.80

C0. The C1 values in Table 4.11 show that falling and low tones have falling contours with high positive values, out of which the degree of the falling contour is more in the falling tone. On the other hand, the C1 values of high and rising tones show negative values, which means both have rising contours. The degree of the rising contour in high tone is minimal while the rising tone has a -202.09 value. In terms of C2, falling and high tones show negative values, which means both have a rising-falling contour. However, the high tone has shown a less falling contour with only a -8.04 value. Low and rising tones show a falling-rising contour with positive C2 values. The negative C2 values in high tone and the positive C2 values in low tone may be due to the falling contour present at the later half of the duration in both tones. Hence, C1 and C2 values clearly show that the four tones in Mizo are dynamic to different degrees.

4.4.5 Read passages

In this section, Mizo tones are analyzed using the read speech data obtained by reading the Mizo passages, mainly folktales⁵. Figure 4.15 shows the f0 contour of the four Mizo tones in read speech. The f0 contour of high tone in Figure 4.15 shows a fairly level contour. It begins at 131Hz and gradually rises until about 60% of the total duration. Before the termination, the f0 contour of high tone falls for a short period of time and ends at 129Hz. In terms of falling tone, the f0 contour begins at 136Hz, the highest point of initiation among the four tones in read passages. The falling tone begins immediately after the initiation until the termination point at 118Hz. The rising tone begins with the lowest f0 initiation at 118Hz, showing a little dip at about 10% of the total duration. It starts to rise gradually from about 10% of the total duration until about 94% of the total duration, which is at 128Hz, and it slightly falls and ends at 127Hz. The terminations of high and rising tones are almost similar. The low tone shows a falling f0 contour. It begins at 120Hz and starts to fall gradually until the termination point, which is 112Hz.

The normalized f0 contours of the four Mizo tones produced in read passages are provided in Figure 4.16. The high tone in Figure 4.16 shows a prominent f0 rising contour. It begins to rise right from the initiation point until about 92% of the total duration. In terms of falling tone, it begins with a high f0 and remains level for about 12% of the total duration. From here, it begins to fall until the termination point. The rising tone, on the other hand, begins with a low f0 and rises from the initiation point until the termination. Low tone also shows a falling f0 contour which becomes a little level between 72% and 88% of the total duration and rises a little before the termination.

In Figure 4.17, the f0 contours of the four Mizo tones are reconstructed using DCT coefficients in read passages. The high tone begins at 134Hz, showing a little fall for

⁵Refer to Appendix D to Appendix L.

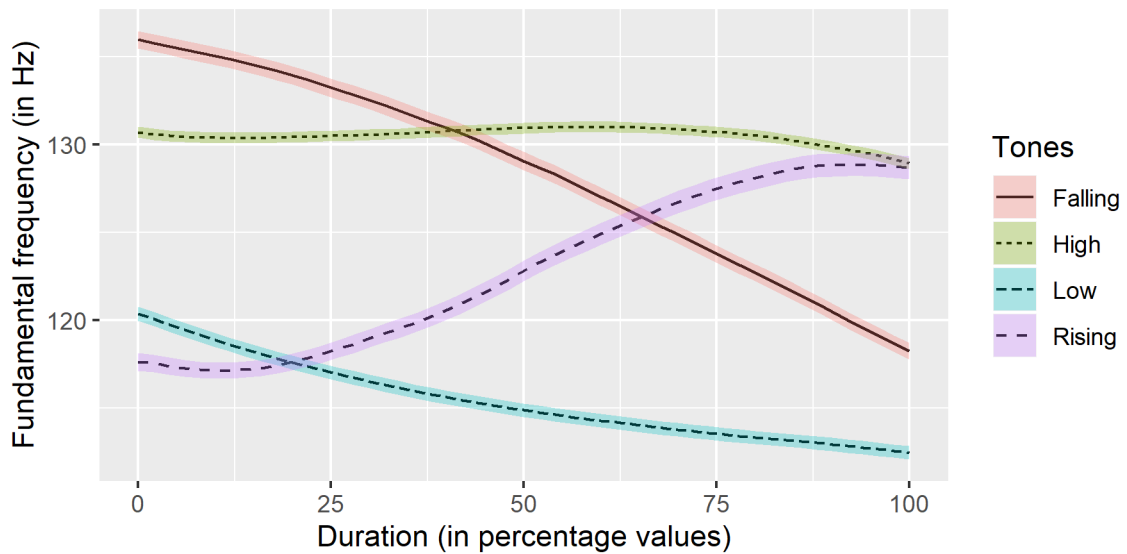


Figure 4.15: The f0 contour of four Mizo tones in read passages.

Table 4.12: The mean duration of Mizo tones (in milliseconds) in read passages with standard deviations in parenthesis.

Tones	Duration
Falling	131.78 (51.81)
High	112.56 (58.79)
Low	89.37 (52.11)
Rising	121.12 (52.09)

some time until the first 18% of the total duration, and then it becomes level until 66%. It gradually falls from 66% until the termination point at 133Hz. The falling tone begins at 139Hz and immediately falls until the termination point at 122Hz. The rising tone begins from 119Hz and remains level until 20% of the total duration. It starts to rise until the termination point, which meets the termination of high tone at 133Hz. The f0 initiation of low tone is 123Hz, and it has a falling contour until about 78% of the total duration. There is a level contour just before the termination of the low tone.

The temporal information of the four tones in Mizo produced in passages is shown in Figure 4.18 and Table 4.12. The falling tone has the longest duration, followed by the rising and the high tone. It is seen that a low tone has the shortest duration.

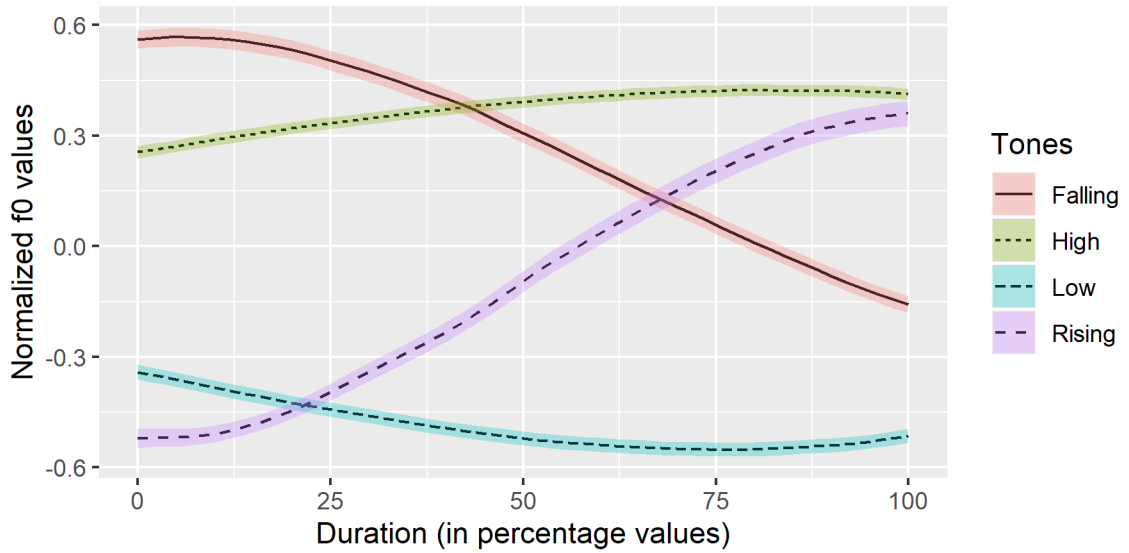


Figure 4.16: The normalized f0 contour of four Mizo tones in read passages.

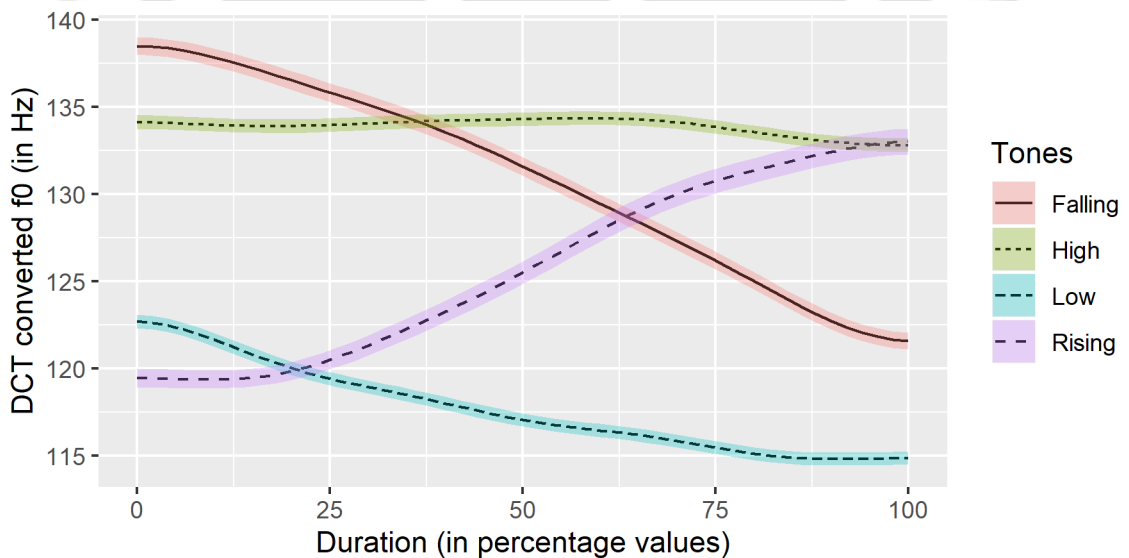


Figure 4.17: The reconstructed f0 contour of four Mizo tones using DCT coefficients produced in read passages.

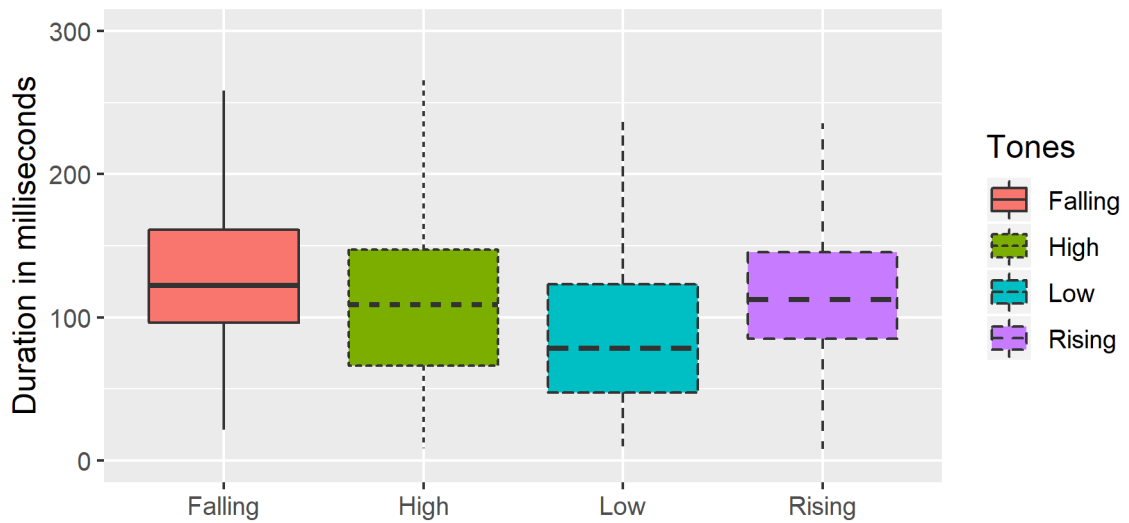


Figure 4.18: The duration of f0 contour of four Mizo tones in read passages.

The dynamic nature of the four Mizo tones in read passages is provided in Table 4.13. C1 and C2 of DCT coefficients, along with the mean value of the fundamental frequency, C0. Except for the rising tone, all three tones show a positive C1 value. The falling tone has a high C1 value which is 190.68, which indicates that the falling tone has a prominent falling f0 contour. Low tone also shows a falling contour with a C1 value of 75.51. However, the slope of low tone is not as steep as in falling. The high tone has a low positive value which could be due to a little falling contour at the beginning and the latter part of the f0 contour, as seen in Figure 4.17. On the other hand, the rising tone indicates a rising contour with a negative C1 value of -161.87. In terms of C2, low and rising tones have shown positive values, meaning they have a falling-rising contour. However, the values of low tone are less; hence, there is not much rising contour. Falling and high tone has negative C2 values, meaning both have rising-falling contours.

Table 4.13: Average C0, C1, and C2 values of Mizo tones in read passages.

Tones	C0	C1	C2
Falling	128.40	190.68	-19.33
High	131.32	2.77	-10.21
Low	115.42	75.51	19.00
Rising	123.33	-161.87	6.56

4.4.6 Comparison of the three types of data

In this section, I compare the four Mizo tones produced in the three types of Mizo data sets: the minimal and near-minimal sets, the trisyllabic phrases, and the read passages discussed in earlier sections. Figure 4.19 shows the mean f0 contours of the four Mizo tones produced in five different contexts: isolation, semantic, sentence, trisyllabic phrases, and read passages. Figure 4.20 shows the normalized f0 contours of the same, and the reconstructed f0 contours using DCT coefficients are given in Figure 4.21.

As seen in Figure 4.19, the high tone in all five data shows a little rising contour. In all the cases, the falling tone has the highest f0 initiation and immediately starts to fall until the termination. This is also observed in Figure 4.20 and Figure 4.21. The termination of the falling tone is higher than the termination of the low tone. Rising tone, on the other hand, begins with the lowest f0 compared to all the other tones except in semantic context. As already discussed in the earlier section, the preceding and the following tones affect the rising tone in the semantic context. Rising tone also has the highest termination point for all the data types except in trisyllabic phrases. Figure 4.20 and Figure 4.21 also show the same f0 termination of the rising tone, the highest f0 in all the data types except in trisyllabic phrases. The low tone in all the data types shows a falling contour, as in the falling tone. Falling tone and low tone have a parallel-like f0 contour at least for more than half of the total duration in each data set. The f0 contours in the isolation context have the most prominent f0 contours for all four tones compared to the other four data types. This is due to how

the speakers produce the four Mizo tones with utmost care in the citation form. From Figure 4.19, Figure 4.20, and Figure 4.21, it is seen that the f₀ contours of the Mizo tones in read passages and trisyllabic phrases have less prominent f₀ contours than the f₀ contours of the other data type. The f₀ ranges in read passages and trisyllabic phrases are also narrower than the other f₀ ranges in the other data sets. Out of the two, read passages have an even narrower f₀ range. This can be explained by saying that read passages are produced naturally with a faster speed while the other data types are less natural. This also indicates that the longer the given data sets are produced, the ranges of the f₀ contours tend to become smaller. Hence, the f₀ contours are less prominent in read passages. It is also observed that the f₀ contours in read passages are produced with lower f₀ compared to the other contexts, as seen in Figure 4.19 and Figure 4.21. The reason is that only male speakers participated in read passages, and hence their fundamental frequency is low. However, the f₀ contours in all the data types have similar f₀ contours except for the rising tone in the semantic contexts. Hence, the rising tone seems most affected by context differences or contextual variations. Figure 4.22 provides the mean f₀ contours for all the four tones obtained from the three data types.

To compare the temporal feature of the four Mizo tones produced in isolation, semantic, sentence, trisyllabic phrases, and read passages, the duration of the four tones is tabulated in Table 4.14, and Figure 4.23 provides the box plot of the same for a visual examination. The high tone in all the contexts except for read passages and trisyllabic phrases has the longest duration. Falling has the longest duration in read passages while rising tone has the longest duration in trisyllabic phrases. In both the read passages and trisyllabic phrases, the low tone has the shortest duration. On the other hand, the rising tone is shortest in semantic and sentence contexts, and the falling tone is shortest in isolation contexts. The isolation context has the highest range of duration, where all the tones are more than 200ms, while the rest of the

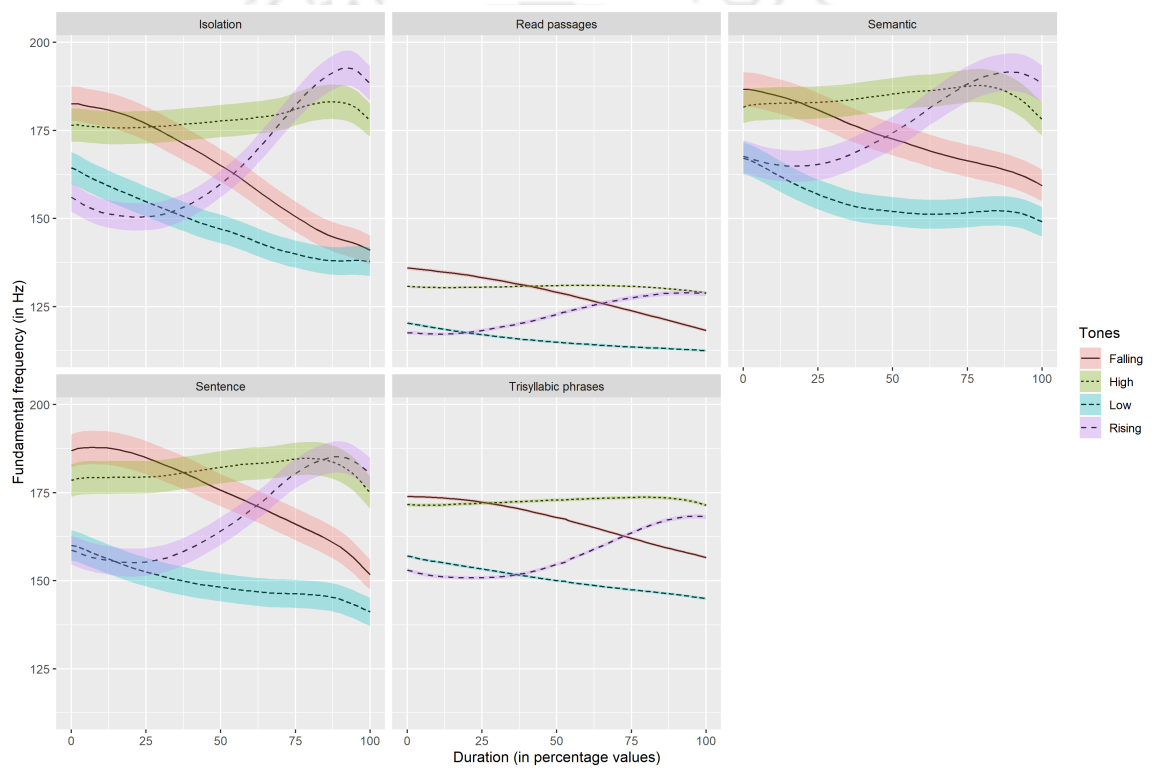


Figure 4.19: The mean f0 contour of four Mizo tones in minimal sets, read passages, and trisyllabic phrases.

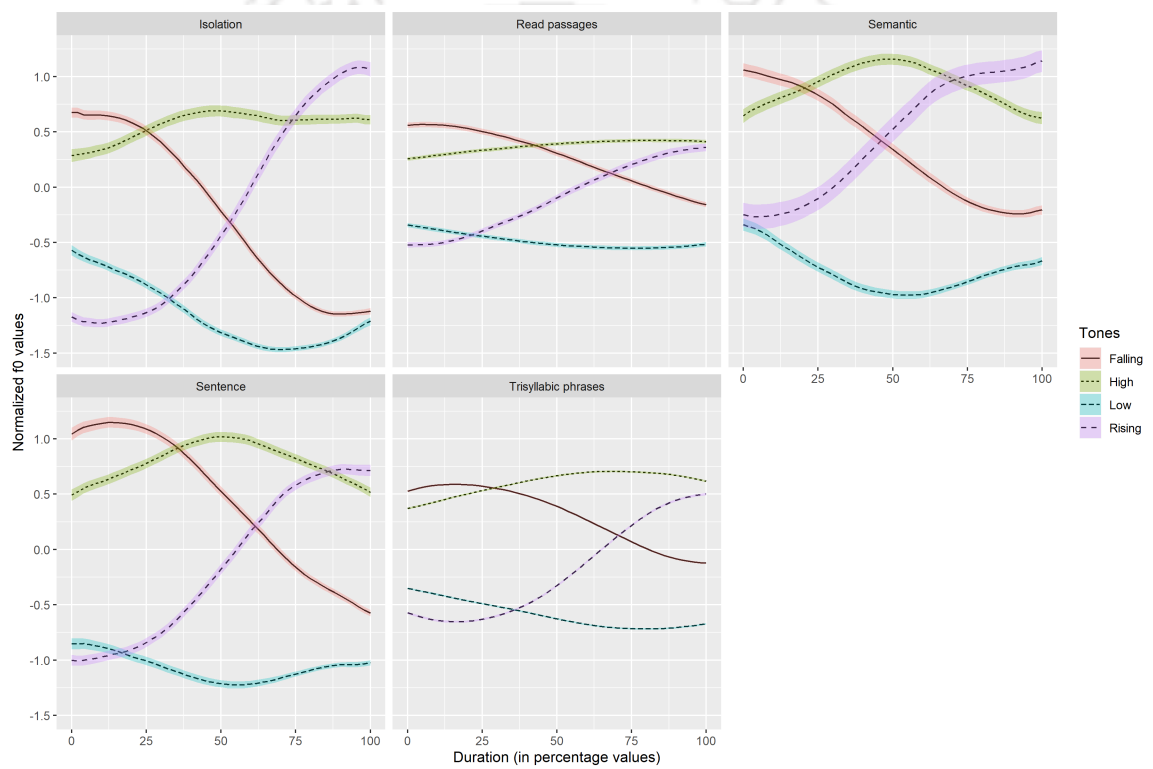


Figure 4.20: The normalized f0 contour of four Mizo tones in minimal sets, read passages, and trisyllabic phrases.

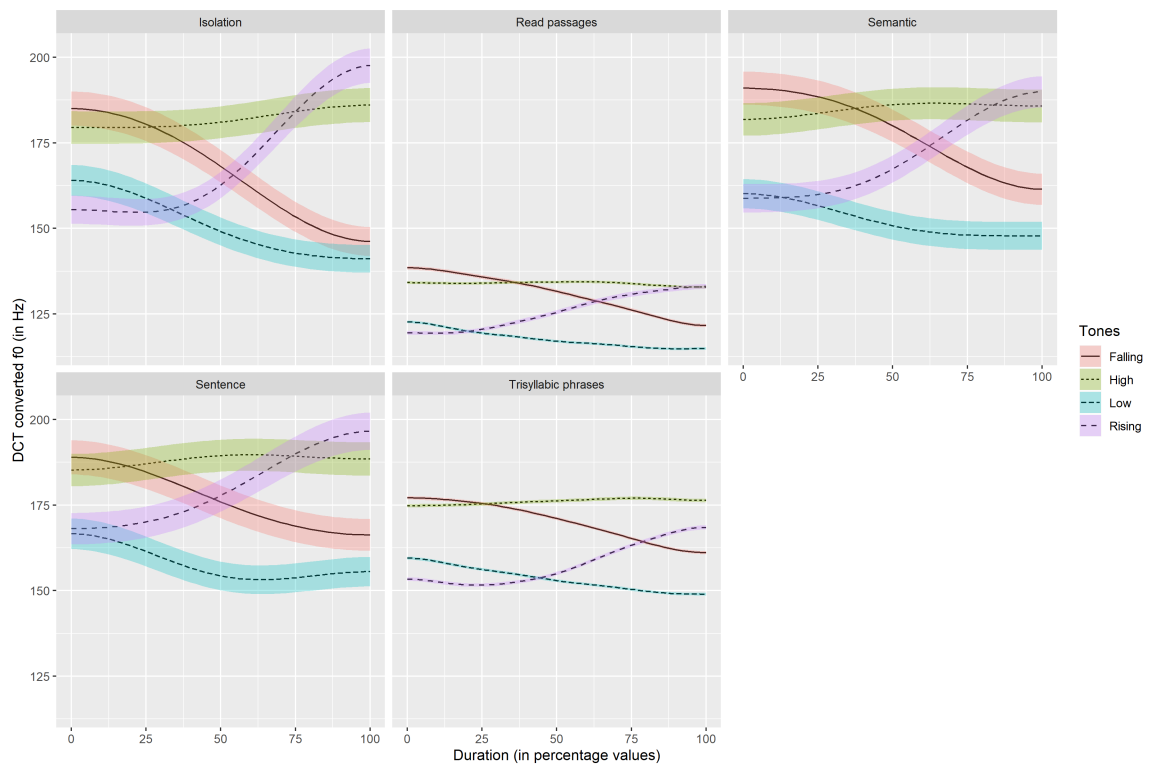


Figure 4.21: The reconstructed f0 contour of four Mizo tones using DCT coefficients produced in minimal sets, read passages, and trisyllabic phrases.

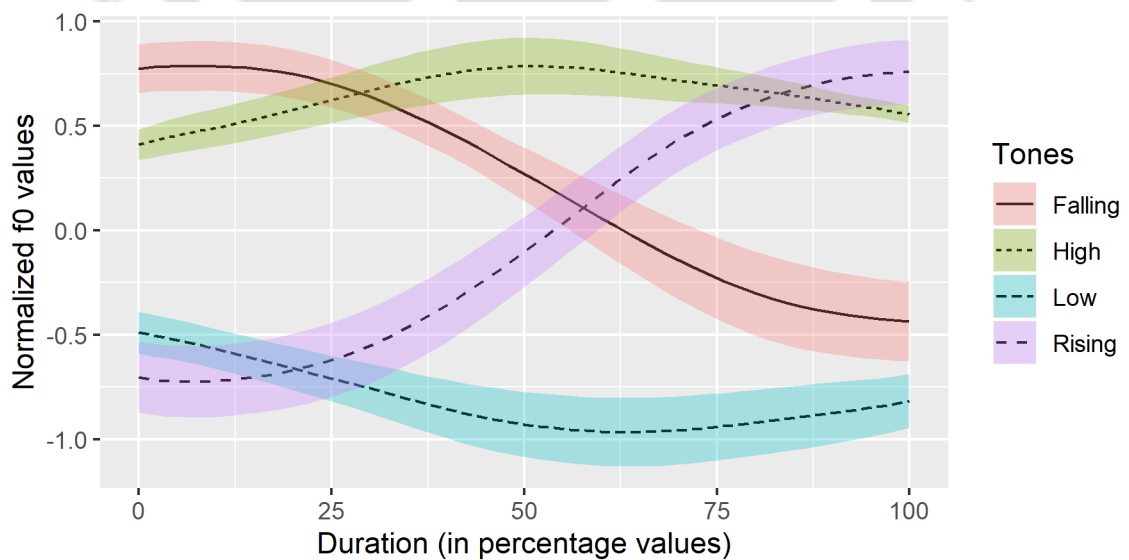


Figure 4.22: Normalized f0 contours of Mizo tones extracted from minimal sets, read passages, and trisyllabic phrases.

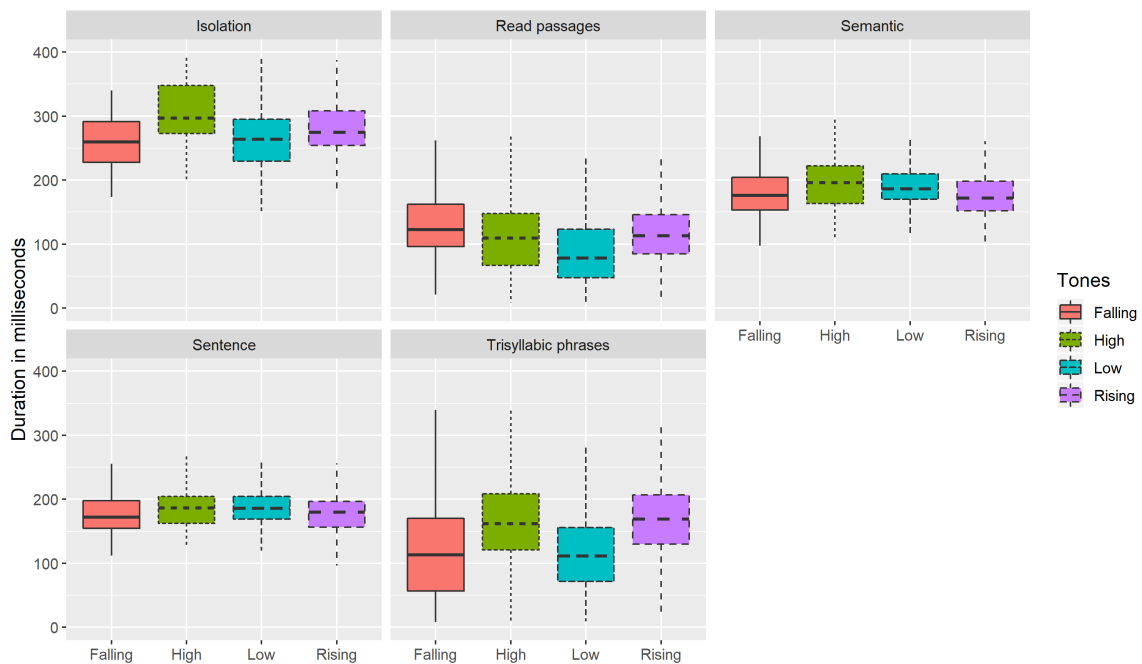


Figure 4.23: The duration of f0 contour of four Mizo tones in isolation, semantic, sentence, read passages, and trisyllabic phrases.

Table 4.14: The mean duration of the five data types (in milliseconds) with standard deviations in parenthesis.

Tones	Isolation	Semantic	Sentence	Trisyllabic phrases	Read passages
Falling	255.61 (43.85)	178.91 (37.40)	179.55 (33.75)	118.10 (69.29)	131.78 (51.81)
High	300.74 (45.05)	186.34 (38.85)	189.34 (33.54)	165.08 (64.59)	112.56 (58.79)
Low	259.37 (52.32)	177.83 (29.38)	186.47 (26.52)	117.93 (59.66)	89.37 (52.11)
Rising	275.37 (41.92)	175.72 (36.70)	177.81 (35.28)	166.33 (55.88)	121.12 (52.09)

contexts show below 200ms for all the tones. Read passages and trisyllabic phrases have an even shorter duration for all the tones compared to the other contexts. Read passages have a shorter duration compared to all the contexts. As mentioned earlier in the explanation for the f0 contours, the duration in read passages yields the shortest due to its natural way of producing the tones in passages. The duration of all the four tones differs from one data type to another. This shows that the contexts highly affect the temporal quality of the four Mizo tones. The duration of high tone seems to be the least affected by contexts.

To compare the slope of the four Mizo tones produced in the five different contexts,

each context's C1 and C2 values are tabulated in Table 4.15 along with the mean value of the fundamental frequency, C0. The high tone has negative C1 values in all the data types except in read passages which means that the high tone has a rising contour. As mentioned earlier, the C1 value of high tone in read passages is only 2.77, which can be less regarded as having a falling contour. The high tone has negative C2 values, which means the high tone has a rising-falling contour in all the data types except in isolation. In terms of low and falling tone, the C1 values are highly positive and, therefore, have a prominent falling contour. The low tone has low positive C2 values meaning there is a little falling-rising contour. This falling-rising contour is observed in the later part of the total duration. The falling tone has negative C2 values in all the data types except in semantic contexts, which means the falling tone has a rising-falling contour in most cases. The positive C2 value for falling tone in the semantic contexts is also relatively low, which is 21.25; hence, it can be less regarded as having a falling-rising contour. In terms of rising tone, the C1 values are negative in all the data types, and therefore this indicates that rising tone has a rising contour prominently. The positive C2 values of rising tone in all the data types also reaffirmed that rising tone has a falling-rising contour.

Table 4.15: Average C0, C1, and C2 values of Mizo tones in five data sets.

Tones	Isolation			Sentence			Semantic			Read passages			Trisyllabic phrases		
	C0	C1	C2	C0	C1	C2	C0	C1	C2	C0	C1	C2	C0	C1	C2
High	178.38	-84.01	21.48	181.41	-50.07	-30.12	184.51	-41.3	-33.2	131.32	2.77	-10.21	172.64	-24.70	-8.04
Low	147.95	293.27	44.17	149.47	157.62	40.56	154.69	141.56	86.47	115.42	75.51	19.00	150.49	121.03	13.35
Falling	163.68	495.87	-32.32	174.69	377.27	-48.67	173.39	289.74	21.25	128.40	190.68	-19.33	166.95	195.31	-25.97
Rising	166.36	-537.44	176.69	167.76	-397.76	89.45	176.60	-363.9	58.5	123.33	-161.87	6.56	154.71	-202.09	71.80

Table 4.16: Type II Wald Chisquare test on the LME model for C0, C1, C2 and duration in Mizo tones.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant

Factors	C0	C1	C2	Duration
Tones	14353.7***	24770.3***	4388.6***	6175.8***
Context	72.9***	4.9***	42.3***	987.9***
Tones x Context	315.1***	1067***	331.6***	987.5***

To see the differences in the duration, C0, C1, and C2 across the three contexts, four LME models were built where the fixed and the random effects were similar. Tones and context were the fixed effects, the speaker was the random effect and the dependent variables were the duration, C0, C1, and 2 for each model. The models were subjected to a Type II Wald- χ^2 analysis of deviance test. The results showed a significant effect of context on the tones in Mizo for all the dependent variables as seen in Table 4.16. Hence, this indicates that the four tones in Mizo varied when they are in different contexts.

4.5 The phonetics of tone sandhi

Tone sandhi is a phonological process in which the canonical tone of a syllable is changed to a different one when a neighboring tone occurs (Zhang, 2014). The four properties of tone sandhi as reported by Shen (1992), Chen (2000) and Chen et al. (2017) are summarized here. To begin with, tone sandhi is used consistently by all speakers. Second, there is a categorical shift from one canonical tone to another, or even to a new canonical tone distinct from the others. Third, the tone sandhi phenomena should affect the tone entirely, and last, the resulting tone sandhi should be perceptually similar to the canonical tone. Tone sandhi is usually associated with Chinese languages since they have a large tonal inventory with complicated contours that can induce tone sandhi in certain contexts. It is also worth noting that most tone sandhi literature is based on Chinese languages. The most commonly cited example

of tone sandhi is in Mandarin Chinese, where the first tone in a sequence of two third tones (T3) becomes a second tone (T2).

There are two types of Chinese tone sandhi patterns: right-dominant and left-dominant. The right-dominant sandhi keeps the underlying tone on a sandhi domain's last syllable while changing the tone of the non-final syllables. As in Standard Chinese, it also involves local or paradigmatic tone changes. On the other hand, left-dominant sandhi preserves tone on the first syllable in a sandhi domain and often involves the rightward extension of the initial tone, as in Changzhou (Northern Wu) (Zhang, 2014). Only one tone sandhi (T1 + T1) is acoustically neutralized with T2, according to an acoustic examination of six tone sandhis documented in disyllabic phrases in Tianjin Chinese. The other sandhis (T3 + T3, T4 + T1, T3 + T2, and T3 + T4) are non-neutralized, and the T4 + T4 sandhi is obsolete (Zhang and Liu, 2011). Qiu-wu and Yuan (2006) found that two of the six Tianjin Chinese tone sandhis (Two Half-Third Sandhi), where T3 becomes T1 when followed by either T2 or T4, are not neutralizing, keeping the rising contour of T3.

According to a perceptual study conducted on Tianjin Chinese in Qiu-wu and Yuan (2006), the participants could distinguish between T1 and sandhi T3 with an accuracy above 85%. According to acoustic investigations on the Third Tone Sandhi in Standard Chinese, the Third tone did not entirely neutralize T2 (Zee, 1980a; Shen, 1990; Xu, 1993; Zhang and Liu, 2011). At the same time, perceptual experiments were carried out, Wang and Li (1967) and Peng (2000) found that native Standard Chinese speakers could not distinguish between T2 and T3 sandhi. Acoustic investigations, on the other hand, have produced inconsistent conclusions in the instance of Taiwanese Mandarin. While Peng (2000) have detected acoustic differences between T2 and T3 sandhi, Myers and Tsay (2003) have found no significant difference between the two tones. As a result, researchers have found that the resultant tone in a tone sandhi may or may not be acoustically similar to any of the language's phonological tones.

Additionally, research has found that native speakers of the tone language may not be able to perceive acoustic changes in the sandhi tone categorically.

As discussed in Chapter 3, tone sandhi is noticed in Mizo rising tone when it is followed by a high or a falling tone (Weidert, 1975; Chhangte, 1993; Sarmah et al., 2015). According to Weidert (1975) and Chhangte (1993), the tone sandhi is said to neutralize the rising tone in Mizo, resulting in a low tone. Hence, in the following Section 4.5.1, I analyze the production and the perception of rising tone sandhi in Mizo in Section 1.5.1.3.

4.5.1 Production of Mizo rising tone sandhi

The production of rising tone sandhi in Mizo is examined in this section by analyzing tones from two data sets: trisyllabic phrases and read passages. The acoustic characteristics of the canonical low and rising tone, and the derived low tone from tone sandhi are considered. Low and rising tones are to compare and contrast the low tone derived from the rising tone sandhi. In other words, low and rising tones are considered to see if the rising tone sandhi is neutralized to a canonical low tone. Firstly, the f_0 contours of these tones are analyzed, followed by the temporal information and then the slope.

Figure 4.24 shows the mean f_0 contours of low, rising, and rising tone sandhi in read passages and trisyllabic phrases. It is observed that in both the data types, tone sandhi has more or less similar f_0 contours. However, in terms of read passages, tone sandhi yields the lowest f_0 throughout the duration compared to low and rising tones. It begins at 119Hz and then gradually falls until about 54% of the total duration. From here, it rises a little until the termination point, which is 115Hz. On the other hand, in the case of trisyllabic phrases, the initiation of tone sandhi is between the starting point of rising and low tone, which is 155Hz. It starts to fall until 56% of the total duration, gradually rises to about 90%, and then falls a little towards the end at

152Hz, which is higher f0 than the low tone termination. Low tone and tone sandhi have a parallel f0 contour in read passages for at least 25% of the total duration, however, while low tone continues to fall throughout the duration, tone sandhi tends to rise a little. Tone sandhi has no f0 contour similarity with rising tone in both the data type.

The z-score normalized f0 contours for the low, rising, and tone sandhi in read passages and trisyllabic phrases provided in Figure 4.25 shows a similar f0 pattern of tone sandhi. In both data types, tone sandhi has a prominent curvy f0 contour that falls from the beginning slowly and then rises gradually from the mid until the termination. In the normalized f0 contours, tone sandhi in read passages has its termination higher than the canonical low tone. Likewise, the termination of tone sandhi in trisyllabic phrases is prominently higher than in the low tone.

The f0 contours of both the read passages and trisyllabic phrases, as shown in Figure 4.24 and 4.25, the low tone derived from the rising tone that has undergone tone sandhi is phonetically distinct from the canonical low tone. Similarly, the f0 contour of the tone sandhi has no similar contour to the canonical rising tone. Hence, although it is claimed that a rising tone sandhi is neutralized to a low tone, it can be determined from the f0 contours that this low tone is not the canonical low tone in Mizo. The tone sandhi has an even lower f0 than the low tone in read passages. It also yields a higher f0 than the low tone from about half of the total duration in trisyllabic phrases. The f0 contour patterns of tone sandhi in both the data types are similar to one another. However, the f0 ranges are different due to the results of the distinct data sets. Read passages have only male speakers; thus, all tones remain at the lower f0 while male and female speakers participate in trisyllabic phrases.

The duration of tone sandhi, along with the duration of low and rising tone produced in read passages and trisyllabic phrases, are provided in a box plot in Figure 4.26. From the figure, in both the data sets, the rising tone has the longest duration,

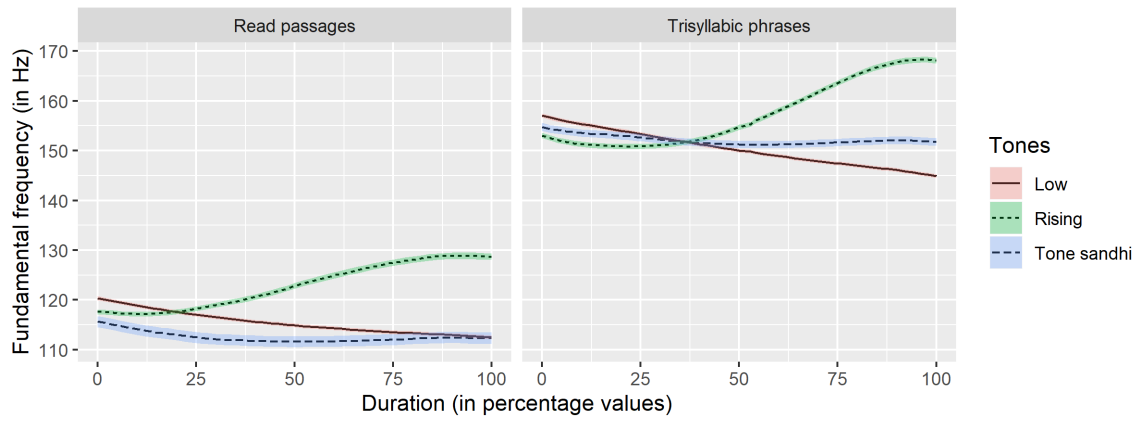


Figure 4.24: The mean f0 contours of low, rising, and tone sandhi in read passages and trisyllabic phrases.

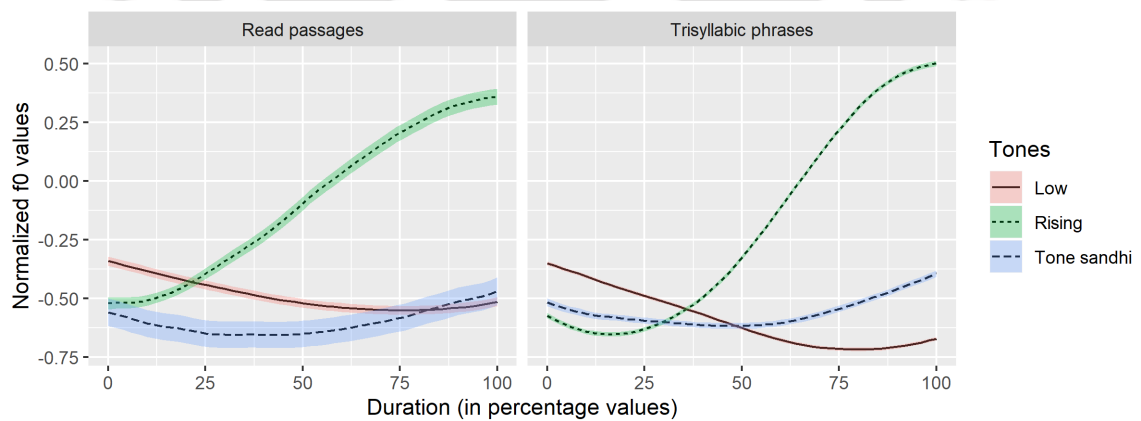


Figure 4.25: The normalized f0 contours of low, rising, and tone sandhi in read passages and trisyllabic phrases.

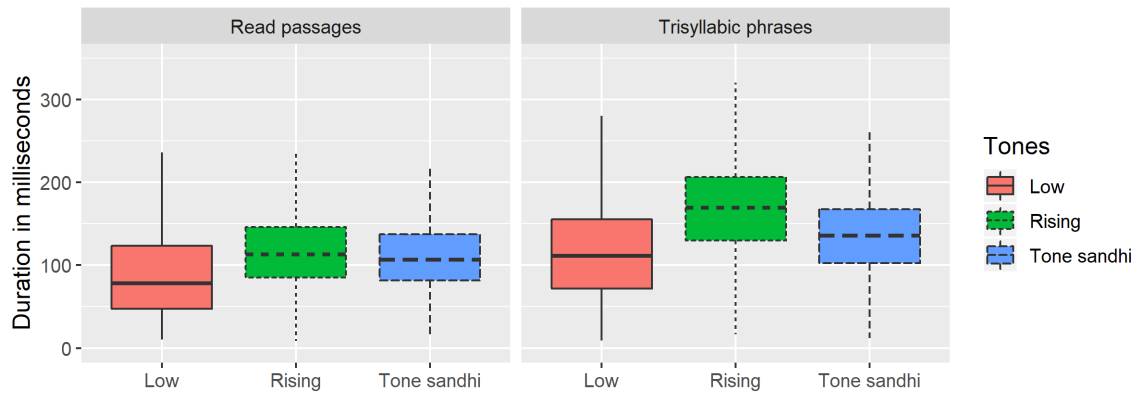


Figure 4.26: The duration of low, rising, and tone sandhi in Mizo in read passages and trisyllabic phrases.

Table 4.17: The mean duration of low, rising, and tone sandhi (in milliseconds) in trisyllabic and read passages with standard deviations in parenthesis.

	Duration (in milliseconds)	
Tones	Read passages	Trisyllabic phrases
Low	89.37 (52.11)	117.83 (59.64)
Rising	121.12 (52.09)	168.09 (56.40)
Tone sandhi	112.31 (44.50)	136.11 (48.65)

followed by the tone sandhi, and the low tone has the shortest duration. The mean value of tone sandhi duration along with low and rising tone tabulated in Table 4.17 clearly shows that in both read passages and trisyllabic phrases, tone sandhi has a longer duration than the low tone and it has a shorter duration than the rising tone.

To see the dynamic nature of tone sandhi, the low and rising tone produced in read passages and trisyllabic phrases, the C1 and C2 of DCT coefficients are tabulated in Table 4.18 along with the mean value of the fundamental frequency, C0. Tone sandhi has the lowest C0 value in read passages and the highest value in trisyllabic phrases. Tone sandhi has a positive C1 value in both read passages and in trisyllabic phrases, 18.88 and 16.50, respectively, which means it has a falling contour. However, considering the low positive value, it can be said that the falling contour is not prominent while the low tone has a higher positive C1 value. This also indicates that tone sandhi is completely different from rising tone, which has negative

Table 4.18: Average C0, C1, and C2 values of low, rising, and tone sandhi in read passages and trisyllabic phrases.

Tones	Read passages			Trisyllabic phrases		
	C0	C1	C2	C0	C1	C2
Low	115.42	75.51	19.00	150.49	121.03	13.35
Rising	123.33	-161.87	6.56	154.71	-202.09	71.80
Tone sandhi	112.77	18.88	29.26	158.40	16.50	24.00

Table 4.19: Type II Wald Chisquare test on the LME model for the duration, C0, C1, and C2 in read passages and trisyllabic phrases.

p-values: ***: p < 0.000, **: p < 0.001, *: p < 0.05, n.s.: not significant.

Factors	Duration	C0	C1	C2
Tones	4057.3***	1051.3***	12907.8***	1099.5***
Context	3.3 ^{n.s.}	1.3 ^{n.s.}	1.1 ^{n.s.}	0.9 ^{n.s.}
Tones:Context	45.8***	16.7***	43***	152.6***

C1 values. In terms of C2, tone sandhi has low positive values in both read passages and in trisyllabic phrases, 29.26 and 24, respectively. This shows that tone sandhi has a falling-rising contour as seen from the f0 contours in Figure 4.24 and Figure 4.25, there is a little falling-rising f0 contour in each figure.

A statistical test was conducted to see the effect of context on the duration, C0, C1, and C2 of the three tones. Four LME models were built. We use duration, C0, C1, and C2 as the dependent variables for each model; tones and context are used as fixed factors, and speaker is considered a random variable. The LME models were subjected to a backward elimination of random and fixed effects by using the *step()* function of the *lmerTest* package (Kuznetsova et al., 2017). The results tabulated in Table 4.19 revealed that there is no effect of context in all the features. However, it is seen that tones have an effect. Hence, we further conduct statistical analysis for the tones in read passages.

Again, four LME models were built to investigate the effect of tones on the duration, C0, C1, and C2 in read passages. We use duration, C0, C1, and C2 as the dependent variables for each model; tones are used as fixed factor, and speaker is considered a random variable. The LME models were subjected to a backward elimi-

Table 4.20: Type II Wald Chisquare test on the LME model for the duration, C0, C1, and C2 of RTS, low and rising tone in read passages.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant.

Factor	Duration	C0	C1	C2
Tones	197.5***	112.2***	2120.3***	35.2***

Table 4.21: Results of pairwise comparison of the duration, C0, C1 and C2 of tones in read passages.

Features	Contrast	Estimate	SE	df	t ratio	p value
Duration	Low-Rising	-31.8	2.38	Inf	-13.383	<.0001
	Low-Tone sandhi	-19.8	3.23	Inf	-6.125	<.0001
	Rising-Tone sandhi	12.1	3.73	Inf	3.229	<.0037
C0	Low-Rising	-7.78	0.769	3039	-10.118	<.0001
	Low-Tone sandhi	1.74	1.044	3039	1.664	0.2889
	Rising-Tone sandhi	9.52	1.207	3039	7.887	<.0001
C1	Low-Rising	267	5.81	3043	45.994	<.0001
	Low-Tone sandhi	54	7.89	3042	6.846	<.0001
	Rising-Tone sandhi	-213	9.12	3042	-23.391	<.0001
C2	Low-Rising	11.4	2.82	3040	4.045	<.0002
	Low-Tone sandhi	-14.2	3.83	3040	-3.72	<.0006
	Rising-Tone sandhi	-25.6	4.42	3040	-5.797	<.0001

nation of random and fixed effects by using the *step()* function of the *lmerTest* package (Kuznetsova et al., 2017). The results are shown in Table 4.20. From the table, it is seen that the duration, C0, C1, and C2 in read passages are significantly different in terms of tone types. The LME models were further subjected to a between tone types comparison of duration, C0, C1, and C2. The Kenward-Roger method computed the degrees of freedom with p-values adjusted using the Bonferroni method. The results of the pairwise comparison of tone types are tabulated in Table 4.21. From the table, it is seen that all three tones: low, rising, and tone sandhi are significantly different from each other in terms of duration, C1, and C2. In the case of C0, low and tone sandhi are not significantly distinct. This analysis shows that duration, C1, and C2 could categorize low and tone sandhi while the mean f0 shows no difference between the two tones.

As far as the production of rising tone sandhi in Mizo is concerned, it can be

said that the low tone derived from the tone sandhi process is phonetically different from the canonical low and rising tones. Additionally, the f0 range of tone sandhi differs across the data type. In read passages, tone sandhi has the lowest f0 contour throughout the duration. In contrast, tone sandhi in trisyllabic phrases has a higher f0 contour than the canonical low tone from about the mid of the total duration. However, the statistical results suggested that there is no significant difference between the slope of the tone sandhi in the two data types. In terms of duration, tone sandhi is between low and rising tones. The dynamic nature of tone sandhi indicates that it is different from both low and rising tones. Additionally, the results of the statistical analysis also show that the slope and the duration could categorize the low and the tone sandhi. These results indicate that rising tone sandhi in Mizo is not neutralized to the canonical low tone as claimed in Weidert (1975) and Chhangte (1993).

4.5.2 Perception of rising tone sandhi

This section addresses the rising tone sandhi perception test among Mizo native speakers to see whether the sandhi tone is heard differently from the canonical low tone. The percentage of accurate answers for all 11 participants was averaged and presented in a bar graph in Figure 4.27.

The results of the perception test revealed that native Mizo speakers had a strong categorical perception of the stimuli. Given the low percentage of “Both” (2.4%) responses in the perception test, Mizo speakers are likely to be aware of the phonological variations between a low tone and a tone sandhi. The individual results for rising tone sandhi and low tones show that the native Mizo speakers have perceived the sandhi tones a little better than the counterpart low tones. They can accurately identify tone sandhi more than 65% of the time in the lexical identification task. In terms of low tones, on the other hand, they can detect more than 60% of the time.

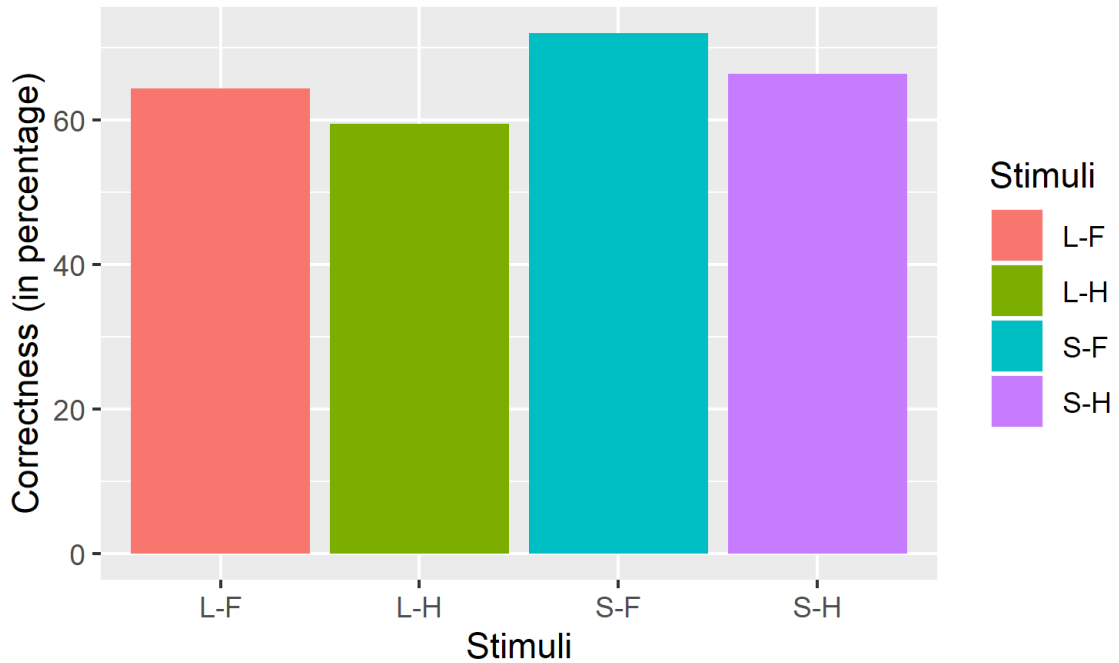


Figure 4.27: *Correct responses of four contrastive stimuli sets.*

As per this perception test results, we can conclude that the Mizo speakers categorically perceive the rising tone sandhi. Furthermore, the Mizo speakers are likely phonologizing the distinct f0 contour of tone sandhi during its production.

4.6 Conclusions

This chapter contributes to the description of Mizo tones by presenting the new tonal minimal and near-minimal sets. This has strongly established that there are four lexical tones in Mizo, namely, high, low, rising, and falling. This chapter also substantiates that the TBU in Mizo is the sonorant rhyme and supports this claim by showing the pitch tracks in Praat that represent the pitch contours. The primary contribution of this chapter is the acoustic analysis of Mizo tones with huge data and diverse categories of data providing the information that Mizo tones have different realizations of f0 contour where phonological and phonetic tone variations are seen. The results of this analysis suggested that all four tones in Mizo have dynamic f0

contours. It is also observed that there is a potential tone sandhi as seen in the semantic context. In this tone change, a CVS syllable /t^haŋ/ with a rising tone is realized as a high tone when it precedes a low tone. This further suggests that out of the four tones in Mizo, the rising tone has phonological variations the most. In addition, this chapter concluded that when Mizo words are produced in a more natural environment, as in read passage, the f₀ range, and the duration range shrink. It is also seen that the falling and low tone have parallel-like f₀ contours from the initiation until half of the total duration. This chapter also contributes to the description of gender variations in the production of Mizo tones. The female Mizo speakers have a greater f₀ range and a higher f₀ than the male Mizo speakers which is due to the physiological differences. Hence, the analysis reveals that the mean f₀ is the optimal feature in categorizing gender differences in producing the Mizo tones. The tones produced in isolation revealed that high tone has the longest duration in Mizo while falling tone has the shortest duration. This is thought to be due to the requirement of a high tone to reach a specific f₀ value, which requires more time, whereas a falling tone needs less articulatory effort to reach the target f₀, and thus it requires less time. In addition, the duration of high tone in Mizo is least affected by contexts since it remains the longest in all the contexts except in read passages. This chapter also concluded that the dynamic nature of tones plays a crucial role in differentiating the Mizo tones, as seen from the C1 and C2 values of the tones obtained from DCT coefficients.

The tone sandhi phenomenon in Mizo is also discussed in this chapter. The findings contradict earlier research suggesting that the Mizo rising tone sandhi is just a toneme change phenomenon that occurs when a rising tone is followed by a high or a falling tone. However, the acoustic analysis of rising tone sandhi reveals that a rising tone that has experienced tone sandhi in the language has not simply become a low tone. It has given rise to a new tone with specific phonetic properties.

These phonetic cues connected with the sandhi are so strong that Mizo speakers can categorically perceive the tone sandhi from a low tone. Our findings are consistent with a growing body of research on notable tone sandhi phenomena, in which acoustic differences between the tone sandhi and the canonical toneme have been identified. In Mandarin Chinese, for example, it has been established that the T2 that emerges as a result of tone sandhi has subtle acoustic differences with the canonical T2. The same study concludes that the third tone sandhi in Standard Chinese is not just a transition of one toneme to another toneme, as phonological descriptions claim.

This chapter also concludes that in Mizo, as in many Chinese languages, rising tone sandhi is a right-dominant sandhi in which the tone of a syllable changes before the final syllable, resulting in rising tone contour simplification. As a result, in Mizo, the rising tone sandhi is dissimilatory. In right-dominant sandhi systems, such as Tianjin Chinese, this type of dissimilation pattern in tone sandhi is well documented. That is, even while the canonical rising tone in Mizo reaches a high f_0 when it is followed by a high or a falling tone, both begin with a high f_0 , and there is a tendency for lowering rather than integrating the preceding f_0 contour. This also suggests that the rising tone sandhi phenomena have substantial physiological foundations, probably due to the necessity for gestural modifications before producing a tone starting with a high f_0 . The pitch contour of the low tone formed from sandhi is not neutralized with the canonical low tone. This is also in line with prior findings for Mizo, which show that contextual effects of the following tone begin around halfway through the complete duration (Sarmah et al., 2015). As a result, the low tone formed from a tone sandhi has a different pitch contour realization compared to the phonologically low tone in Mizo.

Chapter 5

The Interaction of Mizo Tones with Consonants

5.1 Introduction

The fundamental frequency representing tone in a tone language is produced with the tension in the vocal folds. Likewise, the same vocal folds vibration determines the voicing contrast of stop consonants preceding the tone. Having the same source of production for tone and voicing contrasts suggested that there must be co-articulatory effects between the stop consonants and the following f_0 of the vowels. Hence, the interaction of tones and stop consonants are analyzed in this chapter. The four Mizo tones, namely, high, low, rising, and falling tones, and the 8 pure stop consonants of Mizo /p, b, t, d, k, p^h, t^h, k^h/ are considered for the present study. However, there is no study on the voicing contrasts of the Mizo stops based on the Voice Onset Time (VOT). Therefore, before analyzing the interaction of tone and VOT of stop consonants in Mizo, an investigation into the VOT of Mizo stops is carried out. The f_0 contours obtained from the vowels that followed the Mizo stops are further analyzed to give a clear picture of the interaction between tones and stop consonants. Hence, the following Section 5.2 describes voicing contrast in Mizo stop consonants based on VOT. The interaction between tone and stop consonants in Mizo is provided in the

subsequent Section 5.3 ¹. Finally, a conclusion is made in Section 5.4 by stating the main observations and findings of this chapter.

5.2 Voicing contrasts in Mizo stop consonants

Mizo has 8 pure stop consonants, namely, /p, b, t, d, k, p^h, t^h, k^h/ (Henderson, 1948; Weidert, 1975; Fanai, 1992; Chhangte, 1993; Lalthangliana, 1997). These stop consonants are contrasted in terms of their place of articulation and the voicing property. /p, t, k, p^h, t^h, k^h/ are voiceless stops while /b/ and /d/ are voiced stops. Mizo has asymmetrical stop consonants where the voiced velar /g/ is absent. In terms of aspiration, only the voiceless stops in Mizo are aspirated. The 8 Mizo stops occur in three different places of articulation, namely, bilabial, alveolar, and velar. There are different descriptions of the Mizo stops such as /t, d, t^h/. Weidert (1975), Fanai (1992) and Lalthangliana (1997) considered these stops as dental stops while Henderson (1948) regarded as denti-alveolar. On the other hand, Chhangte (1993) considered them as alveolar stops. Despite the differences in labeling the place of articulation, the Mizo stops /t, d, t^h/ are considered alveolar stops in this dissertation.

5.2.1 Acoustic characteristics of voicing contrasts in stop consonants

Voicing contrasts in stop consonants can be categorized by using Voice Onset Time (VOT). VOT, the acoustic cue used to measure the timing of voicing, was first described by Lisker and Abramson (1964) in their well-known cross-language study of voicing in initial stops in 11 languages. They defined VOT as ‘the time interval

¹A part of this chapter is published as a paper titled “Interaction of Tone and Voicing in Mizo” in the Proceedings of INTERSPEECH, 2020.

between the burst that marks the release of the stop closure and the onset of quasi-periodicity that reflects laryngeal vibration'. VOT serves to show the stop categories of several languages in which both the number and phonetic characteristics of such categories are said to differ. Acoustically, voiced and voiceless stops can be distinguished by their spectrographic patterns. For voiced stops, the formantless segment corresponding to the closure interval is traversed by a small number of low-frequency harmonic components. In contrast, the closure interval is essentially blank in the case of voiceless stops (Lisker and Abramson, 1964). Aspiration is also seen as noise, mainly at the frequencies of the second and third formants of contiguous pattern segments. This noise feature of aspiration is regarded simply as the automatic concomitant of a considerable delay in voice onset, which is found in English. Lisker and Abramson (1964) stated that in certain positions, the presence of aspiration noise indicates the absolute magnitude of delay in the onset time following /p, t, k/ releases. The measure of VOT is sensitive to the place of articulation because the velar stops have consistently higher values than the labial or the apical stops (Lisker and Abramson, 1964). This suggests that velar stops will have the longest VOT, second the alveolar stops, followed by the labial stops. The primary function of VOT is its ability to identify the stops in running speech. The embedded stops in sentences show that the VOT values of voicing lead (the measurement of VOT before the release, which is stated as negative numbers) and voicing lag (measurements of VOT after the release, which are stated as positive numbers) tend to be a bit compressed in comparison with the values measured in the citation forms of words (Lisker and Abramson, 1964). Undoubtedly, VOT varies to some extent with the place of articulation. The primary finding is that the further back the stop closure, the longer the VOT; and the more extended the contact area, the longer the VOT, and the faster the movement of the articulator, the shorter the VOT (Lisker and Abramson, 1964). Cho and Ladefoged (1999) reported the causes of VOT variations due to the place of articulation on

several factors, including the laws of aerodynamics, articulatory movement velocity, differences in the mass of the articulators, and a temporal adjustment between stop closure duration and VOT. The relatively smaller volume of the supralaryngeal cavity in velar stops causes a greater pressure, which will take longer to fall and allow an adequate transglottal pressure for the initiation of the vibration of the vocal folds. The greater mass of the contained air in front of the velar stops causes a greater obstruction to release the pressure behind the velar stop. This pressure will take longer to fall, resulting in a greater delay in producing adequate transglottal pressure. A faster articulatory velocity allows a more rapid decrease in the pressure behind the closure, thus, a shorter time before building up an appropriate transglottal pressure. The more extended contact area in laminal dental and velar stops is reported to have a slower release because the Bernoulli Effect pulls the articulators together. These characteristics are based on a general principle of aerodynamics and hold better for unaspirated or slightly aspirated stops. The glottal opening area after the release will decrease less rapidly for the velar than for the alveolar or labial because the intraoral pressure drops more slowly for the velar, which holds for aspirated stops. There is a trade-off between the closure duration and the VOT so that there is a fixed duration of vocal fold opening, which hold for both aspirated and unaspirated stops (Cho and Ladefoged, 1999).

5.2.2 Acoustic characteristics of voicing contrasts in Mizo

To determine the VOT in Mizo stops, this experiment considers the Voice Onset Time of the 8 Mizo stops in CVV syllables in isolation. The VOT values of the 8 Mizo stops are tabulated in Table 5.1. It is seen that the voiceless aspirated velar /k^h/ has the longest VOT, which is 102.72ms, while the voiceless aspirated alveolar /t^h/ and the voiceless aspirated bilabial /p^h/ have almost similar VOTs, 85.29ms and 85.94ms respectively. The voiceless unaspirated velar has the longest VOT in

Table 5.1: Mean VOT and standard deviations of Mizo stops.

Stops	VOT (in ms)
/p/	15 (7)
/p ^h /	85.94 (37)
/b/	-102 (31)
/t/	17 (7)
/t ^h /	85 (33)
/d/	-101 (37)
/k/	34 (12)
/k ^h /	103 (37)

terms of the voiceless unaspirated stops in Mizo, which is 33.58ms, followed by the alveolar stop /t/, which yields 17.45ms, and the bilabial stop has the shortest VOT which is 14.88ms. In terms of voiced stops in Mizo, bilabial stop /b/ has a shorter VOT, which is -101.74ms, compared to the alveolar stop /d/, which is -100.50ms. Hence, the voiceless aspirated velar stop in Mizo has the longest VOT, while the voiced bilabial stop has the shortest VOT. This finding conformed to the universal pattern where the further the place of articulation, the longer the VOT (Lisker and Abramson, 1964).

Figure 5.1 presents the VOT in 8 Mizo stops, namely, /b, d, p, t, k, p^h, t^h, k^h/. In terms of place of articulation (POA), as seen in Figure 5.1, the velar stop in Mizo has the longest VOT, followed by the alveolar, and the bilabial stop has the shortest VOT. Regarding the voicing and aspiration, the voiceless aspirated stop in Mizo has the longest VOT, followed by the voiceless unaspirated stop and voiced unaspirated stop.

An LME model was built to investigate the interaction between VOT and the laryngeal contrast. We use VOT as the dependent variable; voicing, aspiration, and POA as fixed factors and; speaker and gender are considered random variables. The LME model was subjected to a backward elimination of random and fixed effects by using the *step()* function of the *lmerTest* package (Kuznetsova et al., 2017). A reduced model is obtained with voicing, aspiration, and POA as fixed factors, and

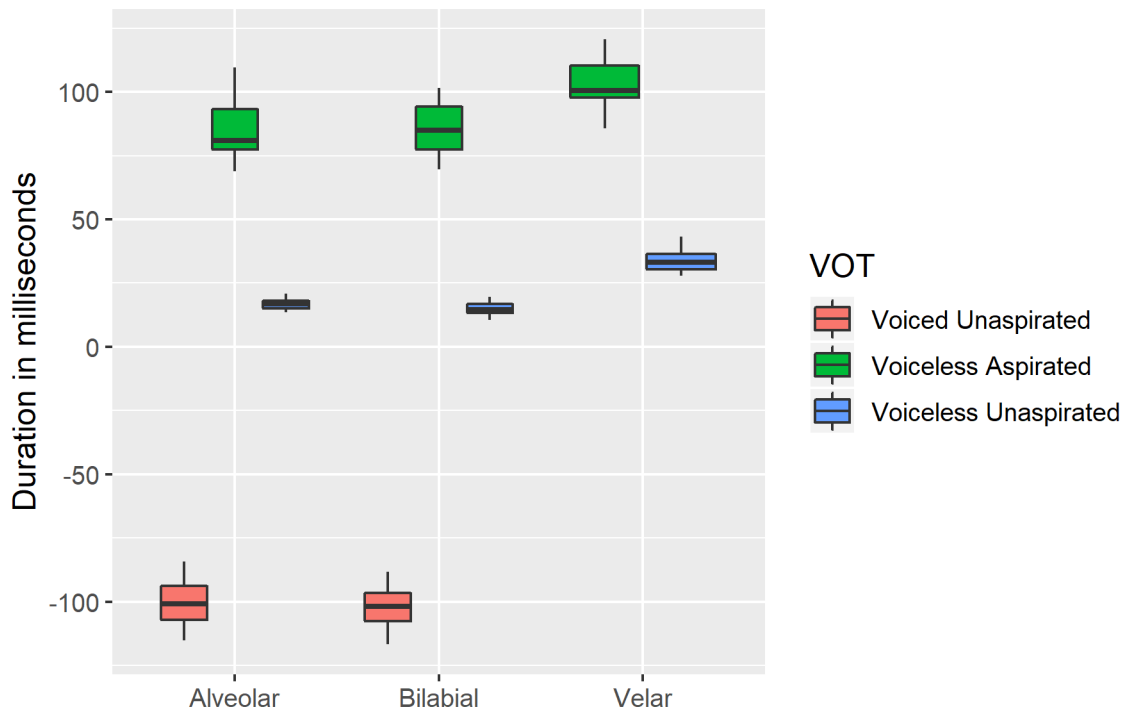


Figure 5.1: The VOT of Mizo stops.

the random factor is speaker. The reduced model is subjected to a type II Wald chi-square test. The results tabulated in Table 5.2 revealed a significant effect of voicing, aspiration, and POA on the VOT of laryngeal contrast of Mizo. However, no significant interaction is found across these factors. The LME model was subjected to a between stop consonant types comparison of VOT. The Kenward-Roger method computed the degrees of freedom with p-values adjusted using the Bonferroni method. The results of the pairwise comparison of VOT are tabulated in Table B.2 of Appendix B. The comparison of VOT by each stop shows that all the stops are significantly different from each other except for the bilabial and alveolar voiced stops (/b/ and /d/), the voiceless unaspirated bilabial and alveolar unaspirated stops (/p/ and /t/), and the voiceless bilabial and alveolar aspirated stops /p^h/ and /t^h/. This shows that the Mizo stops produced with the same voicing quality are close to each other are relatively similar to one another in their VOTs.

Table 5.2: Type II Wald Chisquare test on the LME model for VOT in Mizo stops.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant

Factors	VOT
Voicing	11230.1***
Aspiration	5887***
POA	326.9***
Voicing x POA	0.4 ^{n.s.}
Aspiration x POA	2.1 ^{n.s.}
Voicing x aspiration	0 ^{n.s.}
Voicing x aspiration x POA	0 ^{n.s.}

Table 5.3: Type II Wald Chisquare test on the LME model for VOT in Mizo stops and nonwords.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant

Factors	VOT
Stops	16492.7***
Tone	35.5***
Word type	0.4 ^{n.s.}
Stops x word type	7.1 ^{n.s.}

In the data set, 3170 tokens are nonwords and 1615 are meaningful words. Therefore, to see if there is any significant difference between the nonwords and the meaningful words, a statistical analysis is carried out. An LME model was created with VOT as the dependent variable. The fixed variables are word type, and stops; speaker and vowel are the random variables. The model was subjected to a Type II Wald- χ^2 test and the results are tabulated in Table 5.3. The results reveal no significant interactions between the word type and the stops. Hence, all the tokens are suitable for this experiment.

Since the material used in this study are nonwords, to make sure that the four Mizo lexical tones are well replicated, the f0 contours of the four Mizo tones produced in nonwords are shown in Figure 5.2. It is seen that the nonwords have f0 contours of the four Mizo tones, which have similar f0 contours in Chapter 4. The normalized f0 contours of the four Mizo tones in Figure 5.2 show that the high tone has a rising-falling contour, the falling tone has the highest f0 initiation and shows a falling contour with a little level contour before the termination. The rising tone also shows a rising

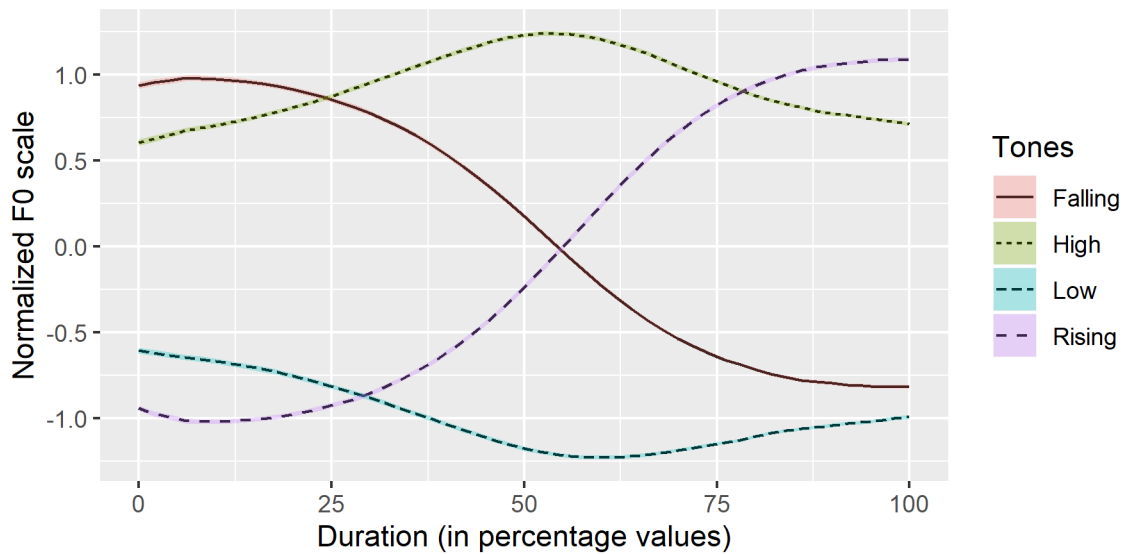


Figure 5.2: Mean and standard error of normalized F0 contours of Mizo tones in nonwords.

f0 contour and its termination is the highest among the four tones while it begins with the lowest f0. Low tone also has a falling contour which rises after the first half of the total duration until the termination point. The information on the f0 contours of the four Mizo tones produced in the nonwords confirmed that the nonwords are suitable for analyzing the interaction between the laryngeal contrasts and tones in Mizo.

The density of the VOT derived from the 8 Mizo stops are analyzed and are presented in Figure 5.3. It is seen from Figure 5.3 that the data set has a normal distribution of VOT values for all tones, vowels, and POA combinations. It also shows that voiced stops have a high negative VOT, whereas voiceless aspirated stops have a high positive VOT. On the other hand, voiceless unaspirated stops have a short positive VOT (median = 19 m.s.).

5.3 Interaction of tones and stop consonants

Tone languages use fundamental frequency (f0) to differentiate lexical tones, and laryngeal contrasts in consonants preceding a vowel onset may affect the f0. Co-

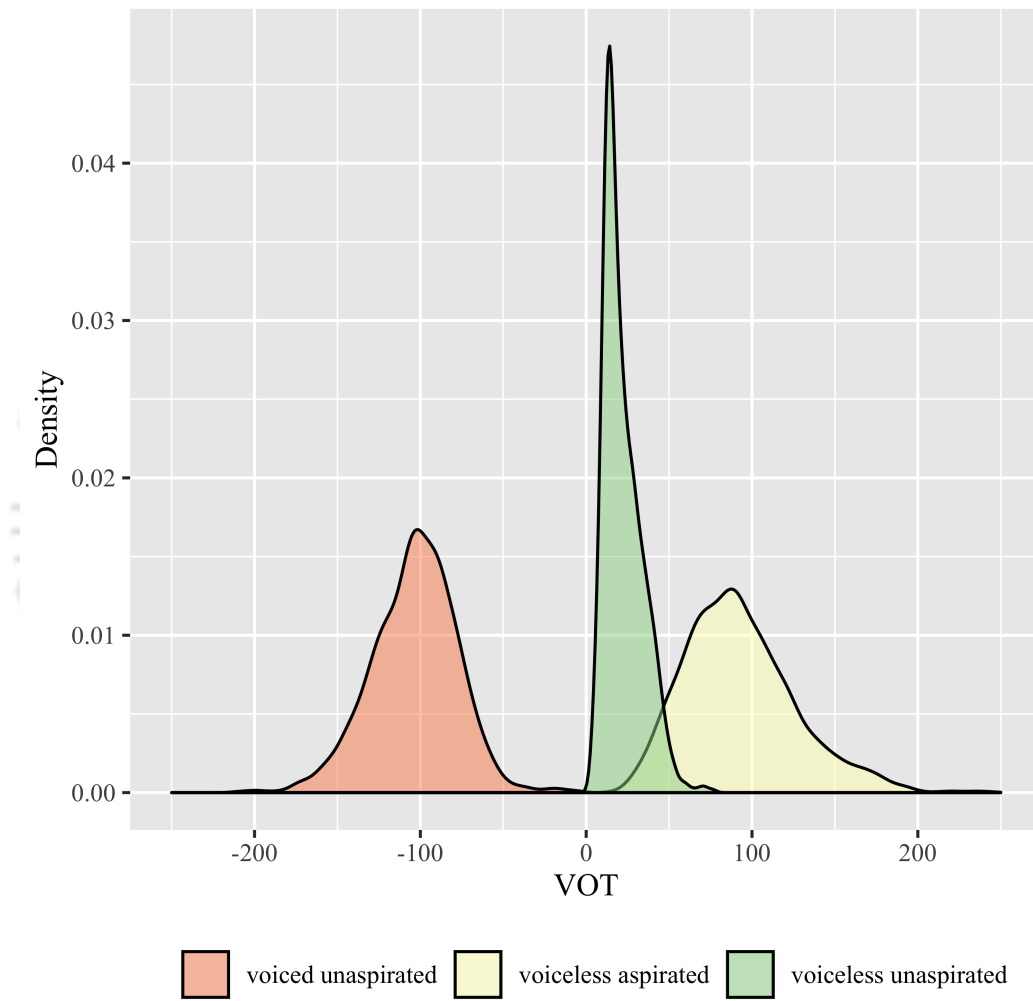


Figure 5.3: Density plot of VOT in three voicing types in Mizo.

intrinsic pitch (CF0) is a term for such onset-specific f0 effects that assist in the discrimination of voicing changes in the onset (Lisker and Abramson, 1964; Kirby, 2018). In a recent study of tone languages, it was observed that CF0 behaves slightly different. It was reported that the effect of CF0 is stronger in citation forms than in connected speech in tone languages. Furthermore, Kirby (2018) stated that in tones with a higher f0, the effects are more prominent. Meanwhile, the voicing contrast is a phonological phenomenon in which voicelessness is associated with no phonation, and voicing is associated with modal phonation of the vocal cords. At the same time, vocal cords are also responsible for producing f0, in addition to the phonation contrasts (Yip, 2002). Hence, it is interesting to study how tone production and laryngeal differences correspond in a tone language like Mizo because the speaker must regulate both VOT and tone. According to the aerodynamic explanation for the influence of tone on VOT, Narayan and Bowden (2013); Ohala (1973); Stevens (1977) mentioned that an increase in f0 is correlated to longer VOTs. In Tibetan, Geissler (2019) reported that the aspirated stops in high tones are said to have a longer VOT than the aspirated stops in low tones. In contrast, a voiceless stop produced with a mid or low f0 in English has a longer VOT than the one produced with a high f0. In terms of voiced stops, however, McCrea and Morris (2005) stated that the pitch influence on VOT was not significant. In both Korean and English, the increase in pitch during the production of aspirated stops causes the VOT to become shorter (Narayan and Bowden, 2013). The pitch variation effect on VOT in the tense and voiced stops in Korean and voiced stops in English was also non-significant in the same study. A lower tone with a longer VOT is assumed to associate with a stronger downward movement in the larynx, which takes a longer duration for the air to leave the oral cavity (Tse, 2005). Liu et al. (2008) reported that the effect of tone on VOT is seen in Mandarin, where a high-falling tone is associated with a shorter VOT than a mid-rising or falling-rising tone. The same study states that the rising contour

increases the vocal fold tension and delays the initiation of the vocal fold vibration in the rising-falling tones, resulting in a longer VOT. According to Lam (2010) and Tse (2005), the higher tones have a shorter VOT than the lower tones in Cantonese. It is also reported in Lam (2010) that Cantonese tones with rising contours have a longer VOT as also seen in Mandarin tones. Faytak and Alan (2011) reported that for 20 out of the 26 languages with level tones, there is a negative correlation between tone height and vowel duration; the remaining 6 languages are believed to have contour tones.

These works show a substantial voicing and tone correlation in tone languages. The initial pitch contour in tone languages is affected by the voicing-induced CF₀, and tones also cause tone-specific variation in the VOT of the pretonal stop consonants (Abramson and Whalen, 2017; Tse, 2005; Liu et al., 2008; Lam, 2010). Hence, the correlation between tone and VOT in Mizo is analyzed in the following section. The objectives of this study are to see:

- How Mizo tones affect the VOTs of voiced unaspirated, voiceless unaspirated, and voiceless aspirated stops in Mizo.
- How the pitch contours of the four tones in Mizo are affected by the voicing types.

5.3.1 The effect of tones on stop consonants in Mizo

The results of the investigation of the effect of tone on VOT are tabulated in Table 5.4 and Table 5.5. Table 5.4 shows the mean VOT of 8 Mizo stops produced with the four Mizo tones. The mean VOT of the Mizo stops categorized into three laryngeal contrasts produced with the four Mizo tones are also tabulated in Table 5.5. From the tables, the effect of tones on VOT is not readily noticeable. However, at least in the case of voiceless aspirated stops, the following falling and high tones have shorter

Table 5.4: Mean VOT and standard deviation for Mizo stops with four tones.

Stops	Falling	High	Rising	Low
/p/	15(6)	16(7)	15(8)	15(7)
/p ^h /	83(35)	85(38)	92(36)	90(39)
/b/	-106(32)	-98(29)	-108(33)	-101(28)
/t/	17(6)	18(7)	18(8)	18(7)
/t ^h /	84(35)	81(30)	90(32)	87(36)
/d/	-108(40)	-98(31)	-101(35)	-107(39)
/k/	32(12)	34(9)	36(13)	34(12)
/k ^h /	102(38)	101(39)	109(33)	108(39)

Table 5.5: Mean VOT of stops and standard errors in four tones by laryngeal contrasts.

Voicing	Falling	High	Rising	Low
Voiced	-107(36)	-98(30)	-101(34)	-107(34)
Voiceless aspirated	90(37)	89(36)	97(34)	95(39)
Voiceless unaspirated	21(11)	23(11)	23(14)	22(12)

VOT. On the other hand, other stop categories do not have the same consistency.

An LME model was built with VOT as the dependent variable and laryngeal contrast types, tone, interaction of laryngeal contrasts x tones, and POA as fixed factors to investigate how VOT is affected by tones. Vowel type, gender, and speaker are considered random variables. The LME model was subjected to a backward elimination of random and fixed effects by using the *step()* function of the *lmerTest* package (Kuznetsova et al., 2017). A reduced model is obtained with laryngeal contrast type, POA, and tone as fixed factors, and the random factors include vowel type and speaker. The reduced model is subjected to a type II Wald chi-square test which revealed a significant effect of tone on VOT [$\chi^2(3, N = 4789) = 26.6, p < 0.001$]. Additionally, the interaction of laryngeal contrasts x tones also showed a significant effect on VOT [$\chi^2(6, N = 4789) = 56.5, p < 0.001$], confirming the effect of tones on VOT. The LME model was subjected to a between tone types comparison of VOT and adjusted for POA and laryngeal contrast types. The Kenward-Roger method computed the degrees of freedom with p-values adjusted using the Bonferroni method.

Table 5.6: Results of the pairwise comparison of VOT.

Contrast	Estimate	SE	df	<i>t</i> ratio	<i>p</i> value
Falling - High	-3.29	0.963	4787	-3.420	0.0038
Falling - Low	-1.68	0.963	4787	-1.748	0.4832
Falling - Rising	-4.99	0.962	4787	-5.181	< 0.0001
High - Low	1.61	0.964	4787	1.669	0.5709
High - Rising	-1.69	0.963	4787	-1.759	0.4715
Low - Rising	-3.30	0.963	4787	-3.428	0.0037

The results of the pairwise comparison of VOT are tabulated in Table 5.6. In terms of VOT, as shown in Table 5.6, VOT significantly decreases in the falling tone context. The comparison of VOT by each onset stop shows that falling tones are shorter than the rising tones in all onset conditions significantly.

5.3.2 The effect of stop consonants on tones in Mizo

The pitch contours for four Mizo tones categorized by eight stops in the onset position are plotted in Figure 5.4 to see the effect of the stop consonants on the following pitch contours. Figure 5.4 shows that the *f*₀ contour is affected by the onset types. For all the four tones, it is observed that the aspirated stops have raised the *f*₀ at the beginning of the pitch contours. Similarly, the *f*₀ of the initial part of the pitch contour is lowered when the voiced stop is in the pretonal position. Additionally, the initial *f*₀ is also raised by the voiceless unaspirated stops, albeit at a lower degree than the voiceless aspirated stops.

An LME model with initial *f*₀ as a dependent variable; tone types and laryngeal contrast types as fixed factors, and vowel, speaker, and gender as random factors was built to examine the effect of stop types on the initial *f*₀. Using the *step()* function of the *lmerTest* package (Kuznetsova et al., 2017), a backward elimination of random and fixed effects of the LME model results in a reduced model with tone type and onset types as fixed factors, and vowel type as a random factor was performed. The LME model was subjected to a between laryngeal contrasts comparison of the initial

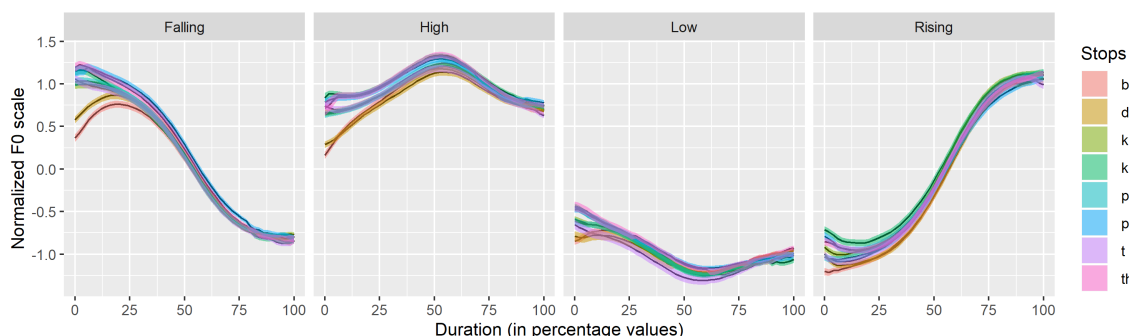


Figure 5.4: Normalized F0 contours and standard errors of the four Mizo tones obtained from the 8 stops.

Table 5.7: Results of pairwise comparison of initial F0.

Contrast	Estimate	SE	df	<i>t</i> ratio	<i>p</i> value
Voiced Unaspirated - Voiceless Aspirated	-0.482	0.0211	4785	-22.823	<.0001
Voiced Unaspirated - Voiceless Unaspirated	-0.329	0.0211	4785	-15.558	<.0001
Voiceless Aspirated - Voiceless Unaspirated	0.153	0.0189	4785	8.116	<.0001

f0 value by tone types. The Kenward-Roger method computed fractional degrees of freedom with *p*-values adjusted using the Bonferroni method. The results of the pairwise comparison of the initial f0 are tabulated in Table 5.7. As seen in Table 5.7, the three laryngeal contrasts in Mizo have a significant effect on the initial f0 of the following tone contours. The initial f0 following a voiced stop has the lowest f0, whereas the voiceless aspirated stop has the highest f0.

5.4 Conclusions

The acoustic characteristics of the consonantal stops in Mizo are analyzed in the initial part of this chapter by looking at the Voice Onset Time (VOT) feature. The data considered in this study consists of 8 Mizo consonantal stops, which are in three-way laryngeal contrasts, namely, voiceless unaspirated, voiced unaspirated, and voiceless aspirated. These Mizo stops occur in three different places of articulation, namely, bilabial, alveolar, and velar, and they are analyzed in CVV syllable. From this chapter, it can be concluded that the voiceless aspirated velar stop in Mizo has

the longest VOT (102.72ms), as also the same for Thai and Korean. It is also seen that in Mizo, the voiced bilabial stop has the shortest VOT (/b/ = -101.74ms, /d/ = -100.50ms). This finding conformed to the universal pattern where the further the place of articulation, the longer the VOT (Lisker and Abramson, 1964). Additionally, in terms of POA and voicing contrasts, this chapter contributes that the Mizo stops follow the universal phenomenon of VOT, where the velar stop has the longest VOT and the voiceless aspirated stop has the longest VOT. Hence, this chapter confirms that the VOT feature can differentiate the 8 Mizo stops.

The latter part of this chapter investigates the interaction between tones and stop consonants in Mizo. The findings of this analysis contribute that, like non-tone languages, Mizo, a tone language, exhibits consonantal perturbation on the following f₀ contour. This chapter shows that in Mizo, there is clear evidence of CF₀ in all the four Mizo tones. The onset stops, which are three-way laryngeal contrast in Mizo, show three different patterns of effect on the initial f₀ contour of the Mizo tones. Voiceless aspirated stops induced high f₀, voiced stops induced low f₀, and f₀ contours of the voiceless unaspirated stops remain in the middle of the voiceless aspirated and the voiced stops

The presence of tonal effects on VOT in Mizo is also reported in this chapter. It is concluded that the effect of tone on VOT is more pronounced in the aspirated stops. A short VOT is induced by falling and high tones in terms of aspirated stops. The statistical results revealed that rising tones are associated with long VOT, whereas falling tones are attributed to short VOT. This means that tones that start at a high f₀, like the falling or high tones in Mizo, have a shorter VOT. Rising tones that start at a lower f₀ range, on the other hand, are associated with a longer VOT. As seen in Tse (2005), non-tone languages like English and Korean, as well as tone languages like Mandarin Chinese and Cantonese, show a similar inverse relationship between f₀ height and VOT duration. This could be due to the increased vocal fold tension,

which slows down the vibration of the vocal folds during the production of a rising tone.



Chapter 6

The Interaction of Mizo Tones with Vowels

6.1 Introduction

In the previous chapter, it is seen that there is an interaction between tones and stop consonants in Mizo. Likewise, since the speakers of a tone language have to use vocal folds vibration to produce both vowels and tones, this chapter provides the interaction between Mizo tones and vowels. While the information on the acoustic characteristics of tones in Mizo is already presented in the previous chapters, the acoustic study on the vowels of Mizo is lacking. Therefore, before looking into the interaction between tones and vowels in Mizo, the vowels in Mizo are first described in the first part of this chapter using the acoustic properties to be comparable with the Mizo tones.

The existing literature reported five vowels in Mizo, namely, [a, i, o, e, u] (Henderson, 1948; Weidert, 1975; Fanai, 1992; Chhangte, 1993; Lalthangliana, 1997). These works on Mizo vowels are based mainly on a subjective approach where the investigators would make a judgment by perceiving the speech sounds. The only accessible literature based on an acoustic study on Mizo vowels was carried out by Sarmah and Wiltshire (2010b). However, the analysis was based on the data obtained from one female native speaker of Mizo; hence, there are insufficient participants for better results. Therefore, this chapter presents the acoustic analysis of Mizo vowels with

more participants of balanced gender.

The first three formant frequencies of vowels, F1, F2, and F3, are considered the primary acoustic cues of vowel quality. Hence, the acoustic analysis of Mizo vowels in this chapter is also primarily based on this parameter. Apart from the formant frequencies, the temporal information of the vowels is considered since Mizo is reported to have vowel length distinction, which is phonemic (Fanai, 1992; Chhange, 1993). Gender differences in producing Mizo vowels are also analyzed in the present study. Since the data used in the latter part of the chapter for the tone and vowel interaction study are nonwords, the f0 contours and the formant frequencies of the nonwords are also examined. This ensures that the nonwords replicate Mizo tones presented in Chapter 4 and the vowels in the first part of this chapter.

As mentioned in the previous chapter, tone is represented by fundamental frequency, produced by the tension in the vocal folds. Likewise, the production of vowels also uses the same articulatory organ to produce different vowel qualities. This means that the vibration of the vocal folds implements both the production of tones and vowels. It is reported that there is a positive correlation between fundamental frequency and vowel height. This relation is termed intrinsic f0 (IF0). IF0 is attested in English and tonal languages like Standard Chinese, Ibibio, Dschang, and Kunama (Whalen and Levitt, 1995; Connell, 2002; Hoole and Hu, 2004). Mizo, as a language with tones and vowels, the speakers have to manage the f0 for the optimum manifestation of the lexical tones. Also, they must ensure that the vowels are produced with different qualities. Therefore, this has motivated me to look into the interaction between tones and vowels in Mizo in the latter part of this chapter. This experiment examines the four distinct f0 contours of each Mizo tone with the five Mizo vowels.

To achieve these objectives, the following Section 6.2 describes the vowels in Mizo, followed by the explanation of the acoustic properties of vowels in Section 6.2.1. Subsequently, Section 6.2.2 provides an acoustic analysis of the Mizo vowels. Section

6.3 presents the relationship between tones and vowels in Mizo ¹. Lastly, Section 6.4 provides the main observations and findings of this chapter and thus concludes the chapter.

6.2 Vowels in Mizo

Previous studies reported that there are 5 vowels in Mizo, namely, /a, i, u, ə, o/ (Henderson, 1948; Weidert, 1975; Fanai, 1992; Chhangte, 1993; Lalthangliana, 1997). Fanai (1992) and Chhangte (1993) reported that each vowel in Mizo has its corresponding long vowel. Chhangte (1993) stated that every syllable in Mizo has a vowel nucleus, and all the vowels can bear all the four tones of Mizo, namely, low, high, falling, and rising. A preliminary acoustic study of Mizo vowels was done based on the five vowels by measuring the F1, F2, duration, and perceptual distinctiveness using the recorded speech of a native female Mizo speaker (Sarmah and Wiltshire, 2010b). The study reported that the five vowels in Mizo are distinct in terms of height and frontness. The same study has reported that the duration of the long vowels is at least two times longer than their counterpart short vowels. In terms of perceptual distinctiveness, all five vowels in Mizo are distinct from each other, where [i] and [a] have the highest difference (187mels), while [a] and [o] are closest (77mels). Although acoustic analysis of Mizo vowels was investigated previously, it was based on only one female Mizo speaker's speech. Hence, to better understand Mizo vowels and have the background of the Mizo vowel property for the later part of the analysis on the interaction of vowels with tones, this chapter attempts to provide the analysis of Mizo vowels with more speakers.

¹The first part of the analysis in this section is published as "Vowel-Tone Interaction in Two Tibeto-Burman Languages" in the Proceedings of INTERSPEECH, 2019.

6.2.1 Acoustic characteristics of vowels

The shape of the vocal tract determines the quality of different vowels in vowel production. The pulses of air from the vocal folds set the vocal tract in vibration. The air in the vocal tract vibrates in more than one way since the vocal tract has a complex shape. In the production of vowels, the air behind the raised tongue is considered to vibrate in one manner, and the air in front of it is also vibrating in another manner. These vocal tract resonances are called formants, groups of overtone pitches determined by the shape of the vocal tract. Hence, the resonance produced by the vibration of the air in the back of the vocal tract is known as the first formant (F1), and the second formant (F2) is the resonance produced by the vibration of the air in the front of the vocal tract. F1 is inversely correlated with the height of the tongue, which means high vowels have low F1 values. Likewise, F2 is inversely correlated with the backness of the tongue, which means back vowels have low F2 values. Also, the distance between F1 and F2 provides information regarding the backness of the vowel; the front vowels have a relatively large F2-F1 difference compared to the back vowels. Apart from the first and the second formants, there is a third formant (F3) which is less changing, and thus, F3 has little function in differentiating vowel quality in certain languages. However, the vocal tract lengthens during the production of rounded vowels due to lip rounding. Due to this, all the formants are lowered, narrowing the distance between F3 and F2 in rounded vowels compared to the contrasting unrounded vowels. Therefore, F3 is an important cue to distinguish vowels in German, Dutch, French, and Swedish languages, where unrounded vowels are contrasted with rounded vowels. Hence, formant frequencies, namely, F1, F2, and F3 are considered to be the primary acoustic cues to vowel quality which provides distinct information about a particular vowel based on the properties such as frontness, height, and rounding (Reetz and Jongman, 2009; Ladefoged and Disner, 2012; Wayland, 2018).

The temporal information of vowels also serves as one of the acoustic cues. The distance between the articulatory excursion of the tongue and the roof of the mouth while producing a vowel is considered to determine the vowel length. The greater the distance between the two places, the longer the duration. Therefore, high vowels are usually shorter than low vowels. Nicolaidis (2003) reported that high vowels /i/ and /u/ in Greek spontaneous speech have a shorter duration than the low vowel /a/. The duration of vowels is also reported to vary, subject to the type of consonant it occurs. In such cases, the vowel that appears before a voiced consonant is usually longer than the vowel before a voiceless consonant. Apart from these, the steady-state portion of lax vowels is also reported to be usually shorter than the tense vowels. Additionally, vowel distinctions within the same type of vowel, solely based on the duration, exist in many languages. Estonian is reported to distinguish short, long, and very long vowels of the same vowel quality (Reetz and Jongman, 2009; Wayland, 2018).

In terms of gender differences in the production of vowels, the formant frequency values are reported to be higher for females than males. This is due to the vocal tract length differences between males and females. The vocal folds of male speakers are thicker and longer than female speakers resulting in slower vibration of the vocal folds. Therefore the resonant frequencies are lower for male than for female speakers. In terms of the temporal differences, the duration of vowels are shorter for males than for females (Hillenbrand et al., 1995). Pépiot (2014) reported that the vowel formant frequencies among French and English speakers are generally higher for women. However, this difference differs from one formant frequency to another and from one vowel to another. There is no significant difference in F1 among the French speakers, while English female speakers have a significant difference in the open vowel compared to male speakers. F2 is significantly different between male and female speakers in both languages. This difference is seen prominently in the close front vowels. In terms of F3, female speakers of both languages have higher values

than male speakers. However, none of the vowels differ in terms of F3. This work also shows that cross-gender acoustic variation is language-dependent Pépiot (2014). Additionally, the back vowel /u/ is reported to have no prominent speaker differences in terms of the formant frequencies in Greek vowels Nicolaidis (2003). Considering these literatures and the vowel properties, the following Section 6.2.2 provides the acoustic study on Mizo vowels.

6.2.2 Acoustic characteristics of Mizo vowels

The Mizo vowels obtained from 5181 tokens from 67 speakers are examined to see the acoustic characteristics of vowels in Mizo by considering the formant frequencies, the temporal quality, and the gender differences. The data used in this section are meaningful Mizo words. Figure 6.1 provides the normalized mean F1 and F2 within one standard deviation (represented by ellipses) of all the long and short vowels in Mizo. This figure confirms that there are 5 distinct vowels, namely, /a, i, e, u, o/ in Mizo. The F1, F2, and F3 values in the Hz scale with the standard deviation in parentheses for long and short Mizo vowels are tabulated in Table 6.1. As the first formant values indicate the tongue height, which is inversely related to vowel height, F1 values for /a/ and /a:/ are the highest among the five Mizo vowels; hence, they are low or open vowels. /e/ and /o/ with their corresponding long vowels have F1 values in between the /a/ and /i, u/ values which shows that they are mid vowels. The lowest F1 values are for vowels /i/ and /u/ and their corresponding long vowels; therefore, they are close or high vowels. The F2 of /o, o:, u, u:/ have the lowest values, implying that they are produced with the tongue at the back of the oral cavity. Hence, these are back vowels in Mizo. F2 values of /a/ and /a:/ lie in between /i, e/ and /o, u/, and therefore, they are central vowels. Since /i, i:, e, e:/ have higher F2 values, they are front vowels. In terms of F3, although it is often attributed to vowel roundedness, no consistent F3 value pattern is observed in Mizo vowels. This shows that F1 and F2

Table 6.1: The mean F1, F2, and F3 values (in Hz) of long and short vowels in Mizo.

Vowels	F1	F2	F3
/a/	706(103)	1443(212)	2752(304)
/a:/	761(101)	1278(169)	2688(276)
/e/	535(79)	1952(272)	2823(282)
/e:/	493(70)	2158(287)	2833(249)
/i/	370(85)	2355(273)	2953(261)
/i:/	359(64)	2339(281)	2907(244)
/o/	545(78)	1020(307)	2805(318)
/o:/	511(68)	953(252)	2835(328)
/u/	415(96)	1062(260)	2758(279)
/u:/	402(64)	928(311)	2784(274)

values can categorize Mizo vowels efficiently, resulting in five distinct vowels. Based on the F1 and F2 plots of each vowel in Figure 6.1 and the values tabulated in Table 6.1, Mizo vowels are described below. Each vowel has its long vowel counterpart. Hence, there are 10 vowels in Mizo with 5 pure/short vowels and their five long vowel counterparts.

- /i/ is a close/high front unrounded vowel.
- /a/ is an open/low central unrounded vowel.
- /e/ is a mid-close/high front unrounded vowel.
- /u/ is a close/high back rounded vowel.
- /o/ is a mid-close/high back rounded vowel.

Additionally, Figure 6.1 reveals the presence of long and short vowels in Mizo. The mean duration values of each vowel in Mizo are tabulated in Table 6.2. The mean duration of short vowels is 84.8ms and 156ms for long vowels. Hence, the long vowels in Mizo are almost twice the duration of the short vowel counterparts, as also observed in Sarmah and Wiltshire (2010b). The present study, therefore, conforms to the previous works Fanai (1992); Chhangte (1993); Sarmah and Wiltshire (2010b)

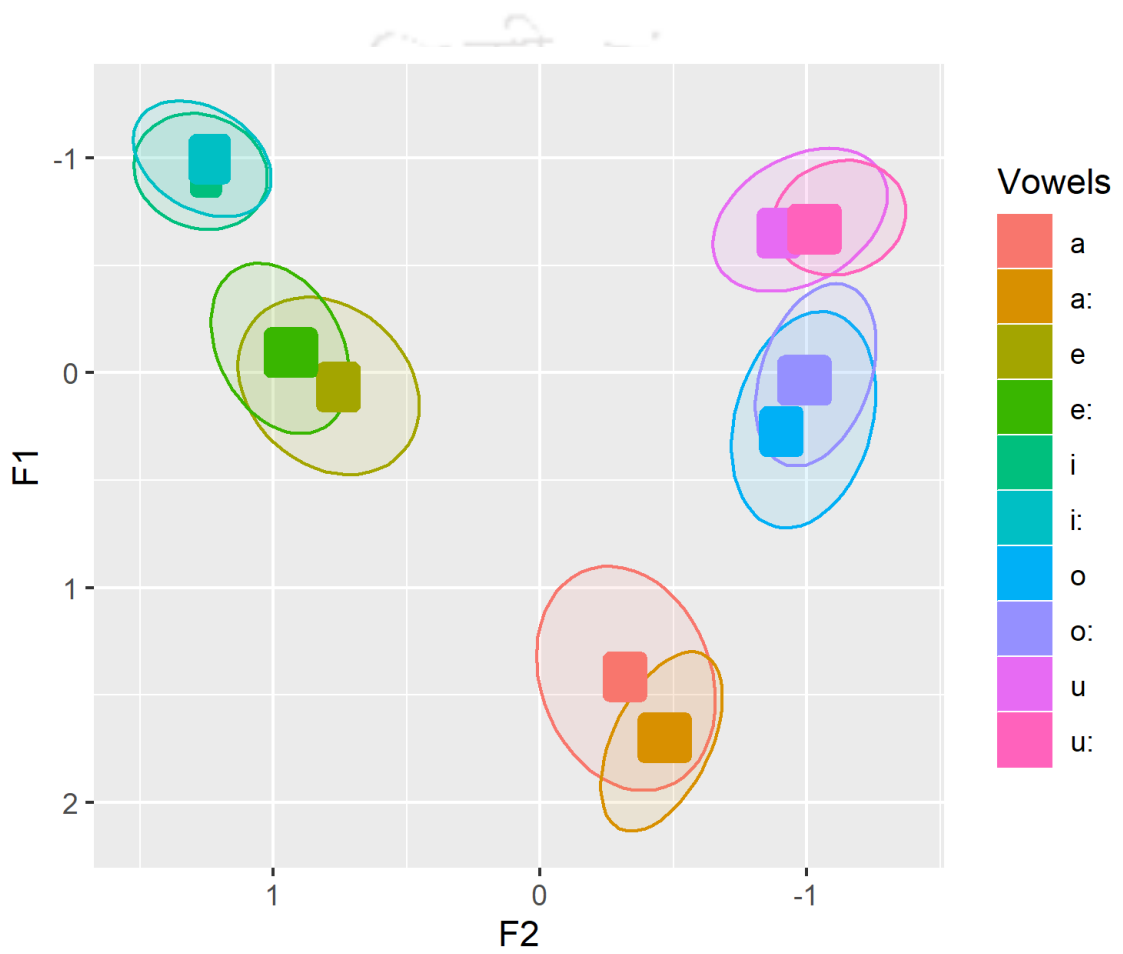


Figure 6.1: The normalized mean F1 and F2 plots for Mizo long and short vowels plot with one standard deviation ellipses.

Table 6.2: The mean duration (in milliseconds) and the standard deviation of the long and short vowels in Mizo.

Vowels	Short	Long
/a/	86(46)	166(53)
/e/	84(35)	147(50)
/i/	81(35)	152(52)
/o/	83(30)	172(49)
/u/	90(41)	143(44)

Table 6.3: Type II Wald Chisquare test on the LME model for the duration in Mizo vowels.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant

Factors	Duration
Vowel length	216.6***
Vowel type	8.8 ^{n.s.}
Gender	0.0 ^{n.s.}
Vowel length x vowel type	6.8 ^{n.s.}
Vowel length x gender	4.7*
Vowel type x gender	8.8 ^{n.s.}
Vowel length x vowel type x gender	7.9 ^{n.s.}

regarding the five Mizo vowels having their corresponding long vowels. To examine this claim, a statistical analysis is conducted based on the duration of the vowels. A full LME model is formed for vowel duration. Vowel length, vowel type, and gender are fixed effects, while iteration, word, and speaker are random effects. The model is subjected to the Type II Wald- χ^2 test, and the results are shown in Table 6.3. The results strongly suggested that vowel length significantly affects the duration of the five Mizo vowels. On the other hand, vowel types are not significant from each other in duration as seen in the results of the short vowel pairwise comparison in Table 6.4. In addition, it is also observed that vowel length and gender have significant interaction in terms of duration.

Statistical tests are conducted further based on the formant frequencies to confirm the presence of five vowels in Mizo. Three separate full LME models are made for normalized F1, F2, and F3. Each model has the same fixed and random effects. Vowel length, vowel type, and gender are fixed effects. The random effects include

Table 6.4: Results of pairwise comparison of the duration of the five vowels within the short vowel categories.

Contrast	Estimate	SE	df	t ratio	p value
a-e	0.979	13.9	17.1	0.07	1
a-i	6.058	10.4	17.1	0.584	1
a-o	2.504	11.4	17.1	0.22	1
a-u	-3.956	11.4	17.1	-0.348	1
e-i	5.079	13.1	17.1	0.387	1
e e-o	1.525	13.9	17.1	0.109	1
e-u	-4.935	13.9	17.1	-0.354	1
i-o	-3.555	10.4	17.1	-0.342	1
i-u	-10.015	10.4	17.1	-0.964	1
o-u	-6.46	11.4	17.1	-0.568	1

iteration, word, and speaker. Each model was subjected to a Type II Wald- χ^2 test. Table 6.5 shows the results, which reveal significant interactions between the factors. From Table 6.5, it is seen that vowel length has no significant effect on F1 and F3, while it has a significant difference in terms of F2. This means that the distinction between the Mizo long and short vowels is attested to the degree of backness of the tongue during the production of vowels. Vowel type has a significant effect on F1, F2, and F3, which implies that all the five Mizo vowels are distinct in mainly the position of the tongue, the tongue height, and backness. The interaction between vowel length and vowel type is significant for F1 and F2. Gender shows no significant effect on the formant frequencies since we use the normalized values. A significant effect of vowel type and gender is also found for F1, F2, and F3, which means that males and females have produced vowels of the same quality differently. The interaction between vowel length, vowel type, and gender is observed for all three formant frequencies.

Furthermore, to see the vowel length-wise differences, the models were subjected to pairwise variability tests using the emmeans function with Bonferroni posthoc tests. The results of the pairwise comparisons are provided in Table B.3 of Appendix B. From Table B.3 (a), in short vowels, it is seen that the vowel pairs /e/ and /o/, and /i/ and /u/ do not differ in terms of their height, while the other vowels significantly

Table 6.5: Type II Wald Chisquare test on the LME model for F1, F2, and F3 in Mizo vowels.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant

Factors	F1	F2	F3
Vowel length	0.8 ^{n.s.}	12.6 ^{***}	0.5 ^{n.s.}
Vowel type	2833.4 ^{***}	6665.1 ^{***}	73.3 ^{***}
Gender	0.3 ^{n.s.}	0.1 ^{n.s.}	0.0 ^{n.s.}
Vowel length x vowel type	35.5 ^{***}	59.8 ^{***}	4.9 ^{n.s.}
Vowel length x gender	4.5 [*]	8.5 ^{**}	29.2 ^{***}
Vowel type x gender	301.1 ^{***}	171.8 ^{***}	75.5 ^{***}
Vowel length x vowel type x gender	9.8 [*]	10.6 [*]	17.0 ^{**}

Table 6.6: The mean F1, F2, and F3 values of the five Mizo vowels.

Vowels	F1	F2	F3
/a/	742(105)	1337(201)	2711(288)
/e/	501(74)	2117(296)	2831(256)
/i/	365(75)	2347(277)	2930(254)
/o/	528(75)	986(283)	2820(323)
/u/	407(76)	973(301)	2775(276)

differ from one another. In the case of F2, only the back vowels do not show any significant differences. The same results are seen for the long vowel counterparts as in Table B.3 (b). Table B.3 (c) provides the comparison across the long and short vowels. From the table, it is seen that only the vowel /a/ is distinctly different in a long and short vowels in terms of vowel height. In the case of vowel frontness, /a/ and /e/ show significant differences in long and short vowels.

The mean formant frequencies of the five Mizo vowels obtained from all the tokens are plotted together in Figure 6.2. It is seen that there are two prominent variations for both front vowels, namely, /i/ and /e/, represented by two rings. The mean of the first three formant frequencies of the Mizo vowels is tabulated in Table 6.6. The universal pattern of vowel formants is seen in Table 6.1 where low vowels have the highest F1 value, and mid vowels and high vowels have the lowest F1 values. Likewise, the F2 value for back vowels is low, while the F2 values are high for front vowels. F3 values do not show any pattern.

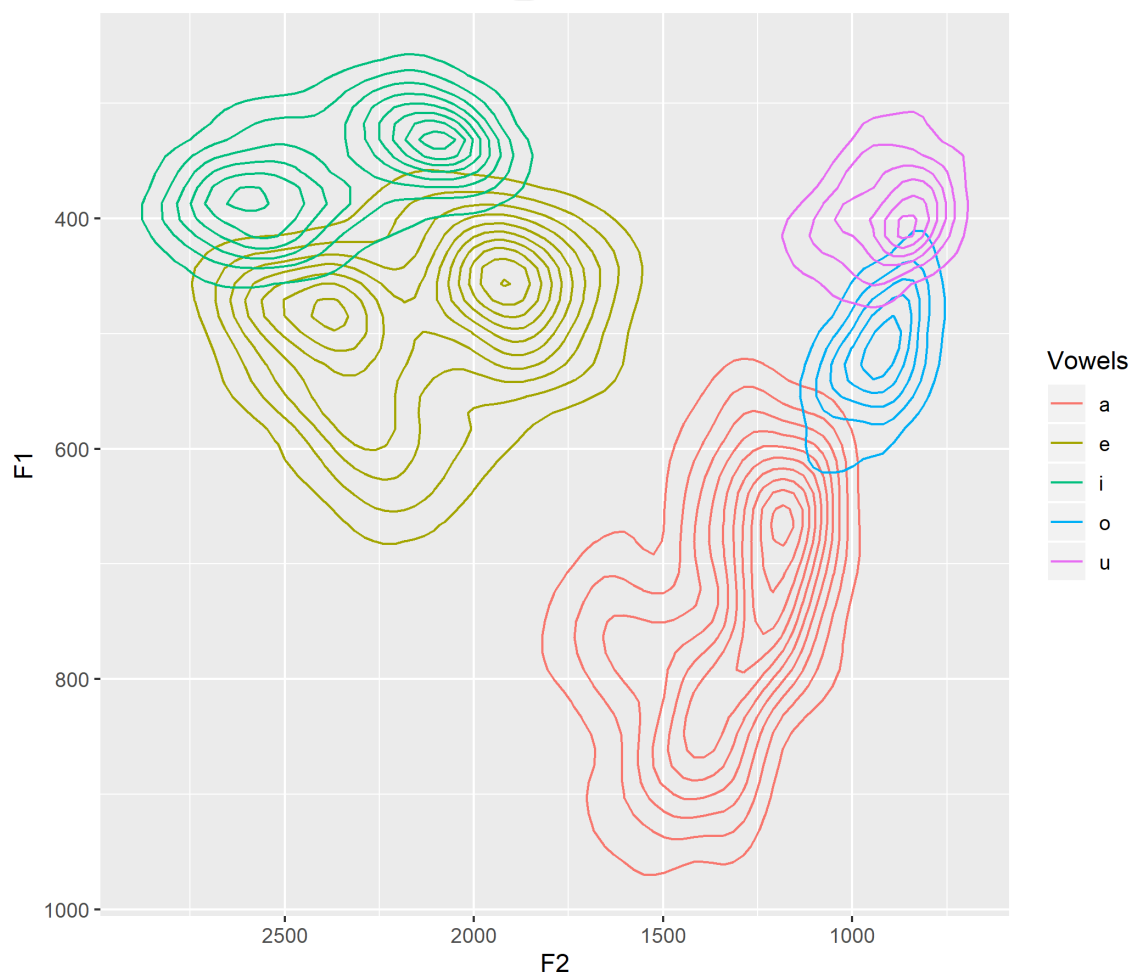


Figure 6.2: The mean F1 and F2 plots for Mizo vowels with one standard deviation ellipses.

Table 6.7: The mean values of F1, F2, and F3 of the five Mizo vowels by gender.

Vowels	Female			Male		
	F1	F2	F3	F1	F2	F3
/a/	807(85)	1453(201)	2861(276)	682(84)	1232(131)	2576(224)
/e/	542(75)	2292(259)	3000(205)	464(49)	1962(233)	2682(197)
/i/	392(39)	2532(214)	3067(214)	340(89)	2182(222)	2809(223)
/o/	535(62)	985(106)	2964(265)	522(84)	987(375)	2692(317)
/u/	421(43)	945(134)	2873(208)	394(95)	998(392)	2689(299)

The formant frequencies are normalized using Lobanov's method, and the plots for mean F1 and F2 for the five Mizo vowels are presented in Figure 6.3. It is observed that the two rings, which are the variations of the front vowels disappeared in Figure 6.3. This suggests that the variation is due to gender differences. Hence, in Table 6.7, the mean formant frequencies values with a standard deviation of the five Mizo vowels are tabulated gender-wise. The F1 and F2 values for both males and females have shown the universal pattern of high vowels with low F1 values, low vowels with high F1 values, and F2 values high for front vowels and low for back vowels. As usual, F3 shows no pattern. Moreover, the F1 and F2 values provide more information regarding the variation of front vowels, where the difference between male and female values is huge for front vowels compared to the other vowels. To have a clear comparison, the F1 and F2 differences between the gender are provided in Table 6.8. In terms of F1, /a, e, i/ have a huge difference compared to the back vowels. Furthermore, the same phenomenon is seen for F2, where front vowels /i/ and /e/ have shown huge differences, followed by /a/, and back vowels /u/ and /o/ are incomparable to the other vowels. This supports that the two variations found for the front vowels in Figure 6.2 are due to gender differences. Additionally, it is seen that F2 has shown a more substantial effect than F1.

To see the differences in the vowels across the gender, three LME models were built where the fixed and the random effects are the same. Vowel and gender were the fixed effects; speaker was considered a random effect and, F1, F2 and F3 are the

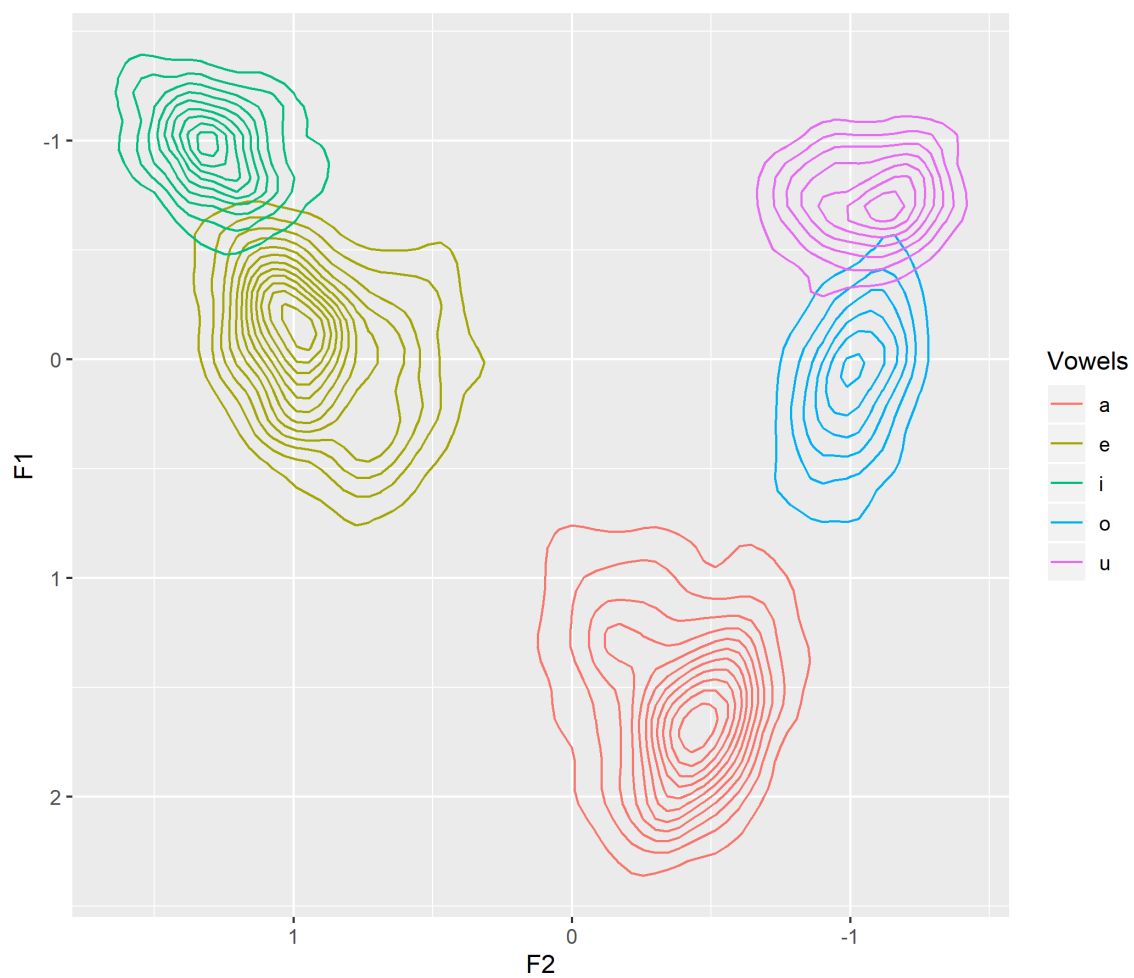


Figure 6.3: Mizo vowel plot with normalized averaged F1 and F2.

Table 6.8: The F1 and F2 (in Hz) differences between males and females for the five Mizo vowels.

Vowels	F1	F2
/a/	125	221
/e/	78	330
/i/	52	350
/o/	13	2
/u/	27	53

Table 6.9: Type II Wald Chisquare test on the LME model for F1, F2, and F3 in gender.

p-values: ***: $p < 0.000$, **: $p < 0.001$, *: $p < 0.05$, n.s.: not significant

Factors	F1	F2	F3
Vowels	2507.2***	6494.2***	77.9***
Gender	46.6***	80.0***	67.2***
Vowels x gender	516.1***	752.5***	72.4***

Table 6.10: Results of pairwise comparison of F1, F2, and F3 in gender.

Features	Vowels	Estimate	SE	df	t ratio	p value
F1	a	123.43	9.6	90.2	12.863	<.0001
	e	84.81	10.13	112.4	8.374	<.0001
	i	51.48	9.52	87.3	5.409	<.0001
	o	11.61	9.88	101.5	1.176	1
	u	27.81	9.61	90.8	2.894	0.2145
F2	a	236.8	23.3	131.7	10.169	<.0001
	e	318.5	26	205.4	12.247	<.0001
	i	349.8	22.9	122.4	15.296	<.0001
	o	-5	24.7	168.4	-0.202	1
	u	-42.3	23.4	133.4	-1.813	1
F3	a	290.46	33.6	87.5	8.646	<.0001
	e	325.52	35.2	106.3	9.236	<.0001
	i	254.92	33.3	84.9	7.644	<.0001
	o	268.16	34.5	97.1	7.78	<.0001
	u	194.15	33.6	87.9	5.772	<.0001

dependent variables for each model. The models were subjected to a Type II Wald- χ^2 analysis of deviance test. The result showed a significant effect of gender on the vowels as seen in Table 6.9. Furthermore, to see the gender-wise differences, the models were subjected to pairwise variability tests using the emmeans function with Bonferroni posthoc tests. The results of the pairwise comparisons are provided in Table 6.10. The results indicate that the male and female f0 are significantly different in terms of the F1, F2, and F3 for all the vowels, except for the back vowels in F1 and F2.

For a better visual examination, Figure 6.4, Figure 6.5, and Figure 6.6 show the density plots of F1, F2, and F3 in five Mizo vowels with gender and vowel length distinction. In terms of F1, /a/ is distinct from the rest of the vowels with a relatively low density, as seen in Figure 6.4 except for the short vowels spoken by male speakers.

It is also seen that there is overlapping across the front vowels and the mid vowels. As far as F1 is concerned, long vowels show a more prominent distinction among the five Mizo vowels than the short vowel counterparts. Also, short vowels obtained from male speakers have made the least distinction between the five Mizo vowels. In F2, as in Figure 6.5, it is seen that long vowels have clearly shown the difference between the five Mizo vowels, as also observed in F1. Overlapping across front vowels is also seen, and the back vowels are overlapped. The low vowel is in between the back and front vowels. Short vowels have provided the difference among the five vowels, with only the back vowels overlapping. The prominent overlapped among the back vowels in F2 regardless of gender and vowel length, and the absence of variation for back vowels in Figure 6.3 provides the information that back vowels in Mizo are least affected by gender and vowel length differences. This can be explained by the physiology of the speech organ whereby, during the production of back vowels, there is less articulatory movement at the back side of the tongue to create variations. On the other hand, the tongue has more room for certain movements during the production of front vowels, and thus the variation is prominent. All vowels in both vowel length and gender categories are overlapped for F3; therefore, no meaningful information can be provided.

The above analysis of Mizo vowels using acoustic cues convinced us that five Mizo vowels, namely /a, e, i, o, u/, are distinctly different in terms of the first two formant frequencies. Besides this, another five corresponding long vowels are almost twice the short ones. The results also show that the gender difference is prominent in the front vowels due to the possibility of free articulatory movement during the production of front vowels. On the other hand, back vowels are steady and thus make no gender variation due to the restricted movement of the back of the tongue. These observations and findings establish the acoustic characteristics of Mizo vowels and assist in studying the interaction between tones and vowels in Mizo, which is

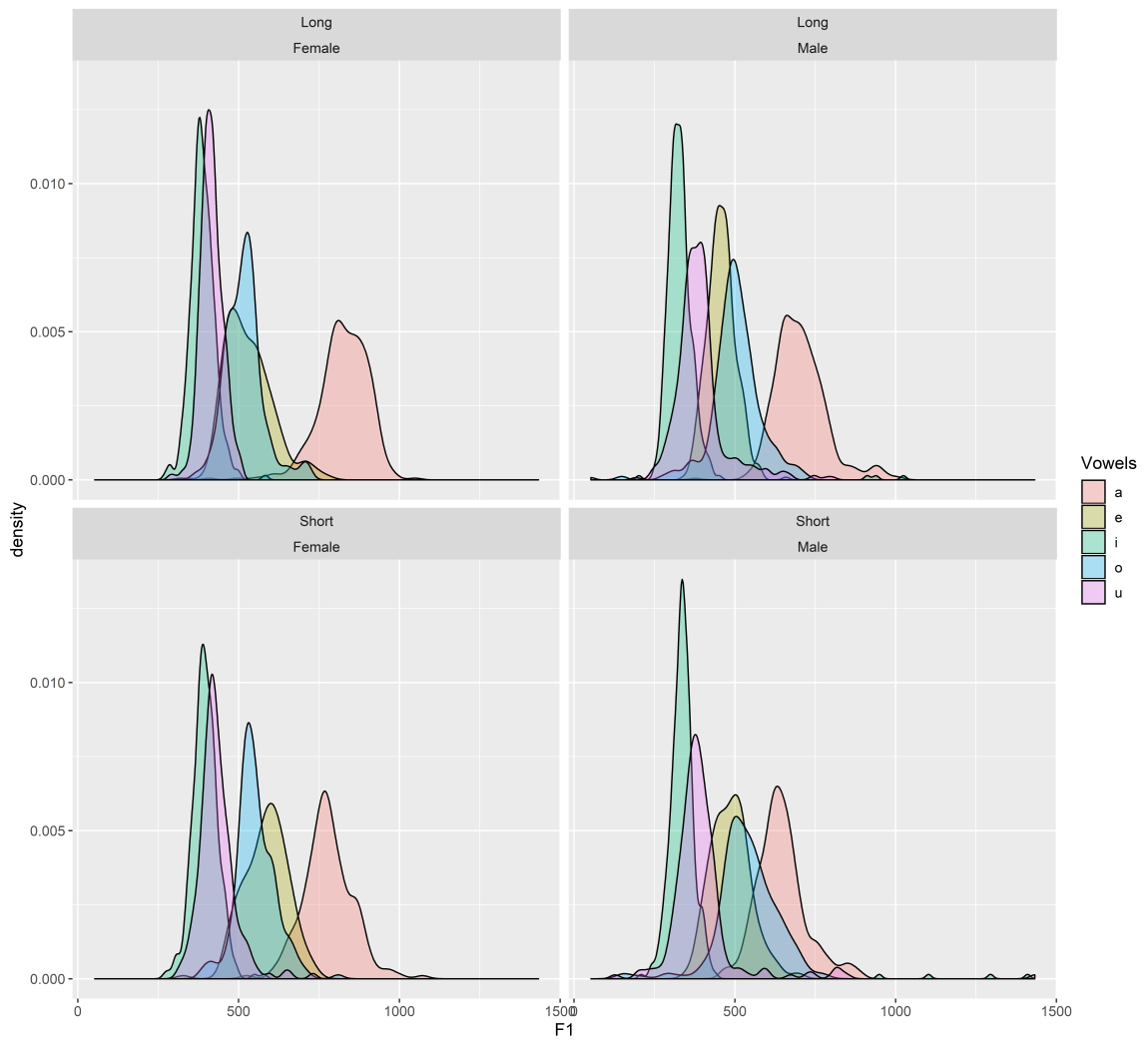


Figure 6.4: Density plot of F1 in five Mizo vowels with gender and vowel length distinction.

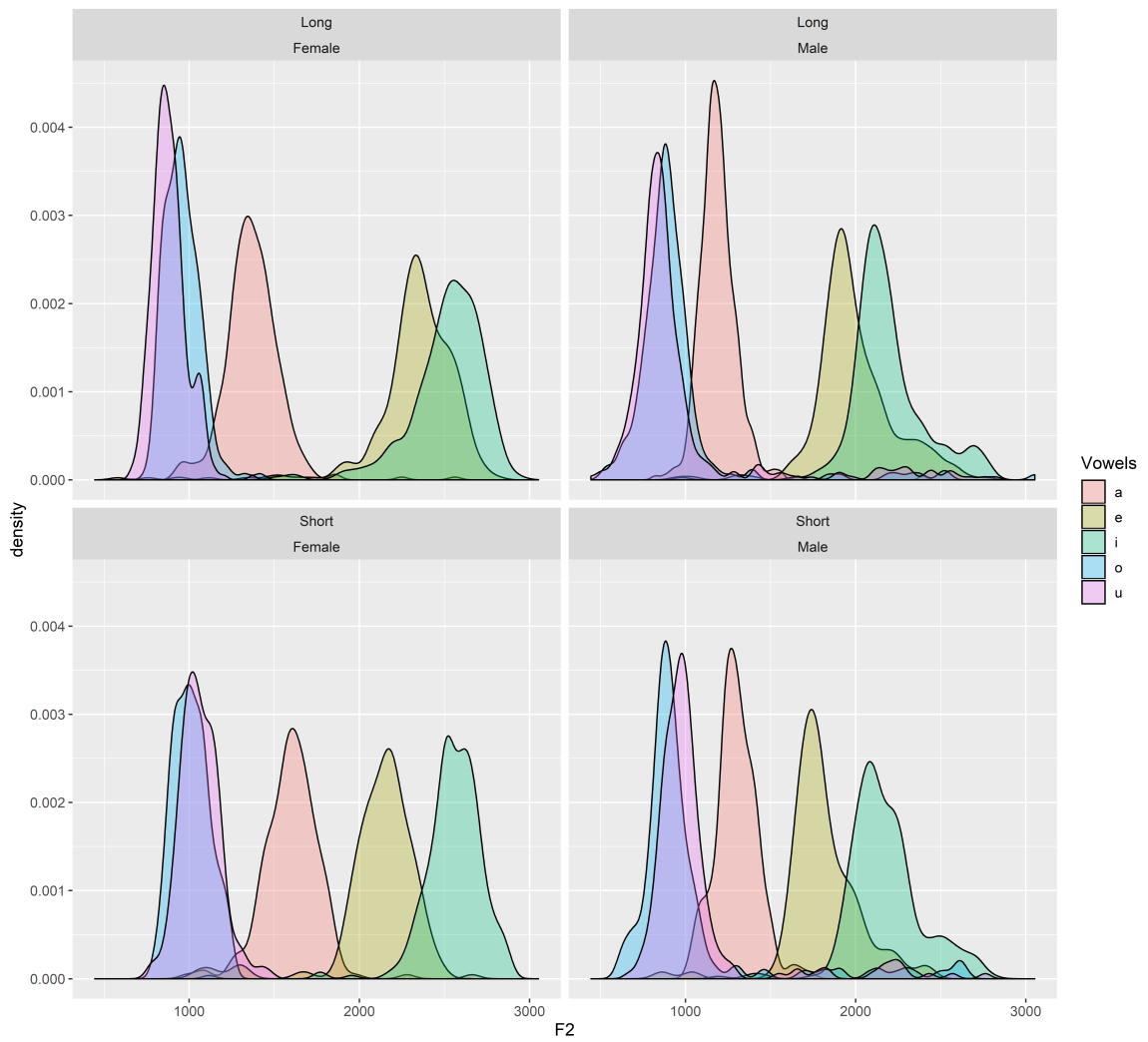


Figure 6.5: Density plot of F2 in five Mizo vowels with gender and vowel length distinction.

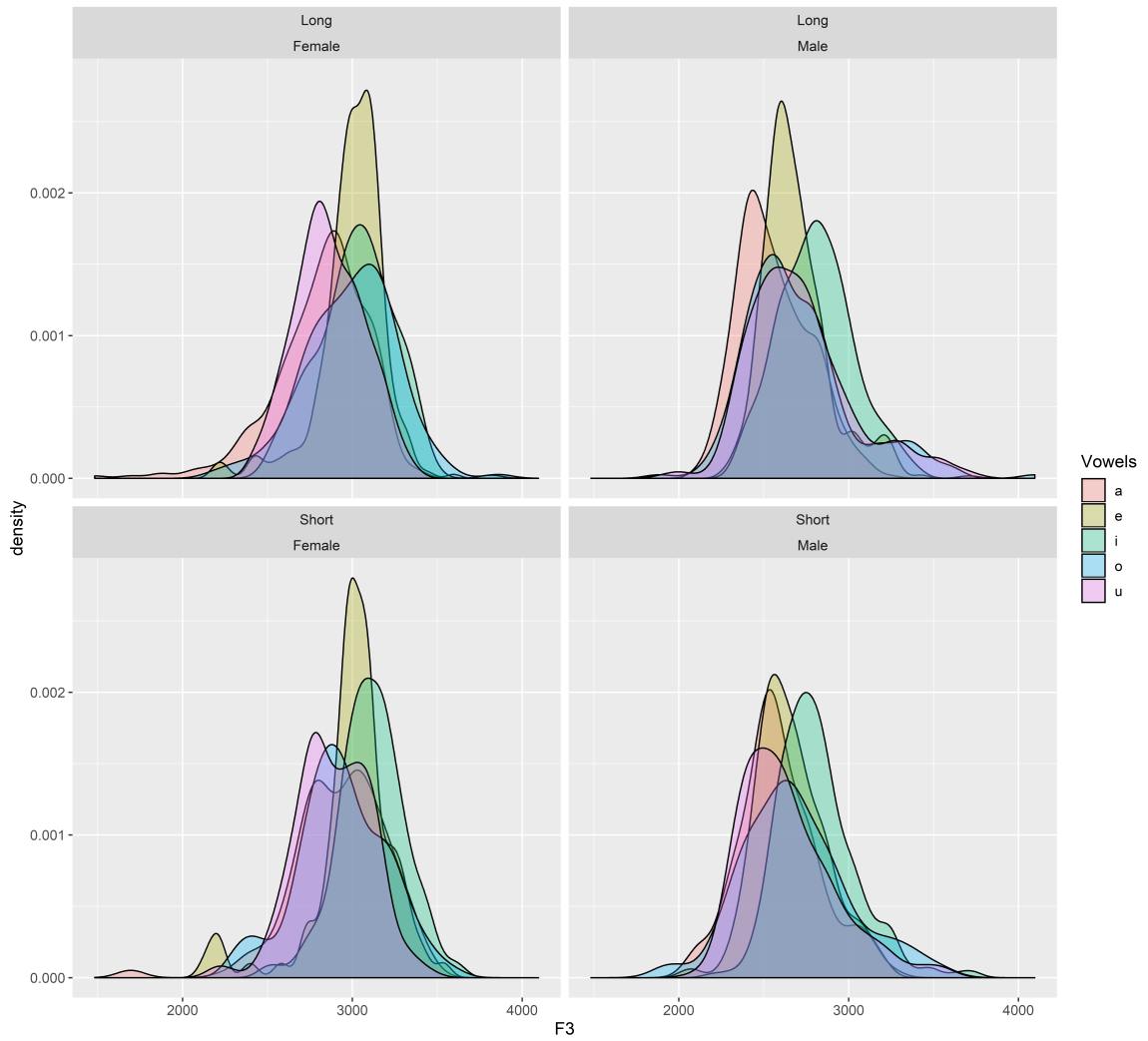


Figure 6.6: Mizo vowel plot with F3 density

presented in the following section.

6.3 Tone and vowel interaction in Mizo

Intrinsic f_0 (IF0) is the positive correlation between vowel height and the fundamental frequency. Lieberman (1970) stated that a coupling effect could cause IF0, in which the shape of the vocal tract during the production of vowels regulates the degree of vibration of the vocal folds. On the other hand, it is also claimed that the tension on the vocal folds is directly related to the raising of the tongue in the production of high vowels. According to this, when the tongue pulls on the larynx to produce high vowels, the vocal folds become tense, resulting in higher f_0 values (Ladefoged, 1964; Lehiste, 1970). The bite block experiment in Ohala and Eukel (1987) presented strong evidence for the tongue pull hypothesis, making it the dominant explanation for IF0 in the years to come. However, it is unclear how much control a speaker has over IF0.

The enhancement hypothesis proposes that IF0 variation is voluntary and meant to enhance auditory salience (Diehl and Kluender, 1989). It claims that IF0 is another feature used to improve vowel contrast perception. To put it another way, languages with a large vowel inventory may require IF0 to enhance the perception of various vowel categories. While earlier studies found no link between IF0 differences and vowel inventory size (Whalen and Levitt, 1995), a more recent study reveals that the two have a direct relationship (Van Hoof and Verhoeven, 2011). Contrary to popular belief, Jacewicz and Fox (2015) stated that the IF0 differences in the variety of American English found that the sources of f_0 control may not be regarding the size of the vowel inventory but rather the socio-cultural factors reflecting regional diversity in speech. Furthermore, this study also found IF0 only in the vowels of prominent syllables but not much in the vowels of non-prominent syllables.

In the case of tone languages, intrinsic vowels complicate the matter even more. The f_0 needs to be regulated by the speakers for the best realization of the lexical tones. Whalen and Levitt (1995) makes a few intriguing observations in tone languages. While IF0 is noticeable in tone languages, the IF0 differences observed in low tones and lower F0 ranges are minimal. The IF0 should decrease as tones become lower in languages with more than two-tone levels. As in non-tone languages, it is reported that while articulating vowels in Standard Chinese, a high tongue position induces higher tones (Hoole and Hu, 2004). Connell (2002) revealed clear evidence for IF0 in three African register tone languages, namely, Ibibio, Kunama, and Dschang. In Mambila, the same study found no significant evidence of IF0. However, in Shona, a language related to Mambila, IF0 was found to be significant (Gonzales, 2009).

In terms of the effect of tones on vowels, Ohala (1973) reported that a higher larynx position is required to produce a tone with a higher fundamental frequency which can affect the vowel quality. This is due to the raised larynx shortening the vocal tract length from the glottis to the lips. Zee (1980b) reported that due to the formant frequencies inversely proportional to the length of the vocal tract, the acoustic effects of different larynx heights should increase or decrease all formant frequencies in general. Therefore, lowering the larynx will result in low formant frequencies, and higher formant frequencies will be seen for the raised larynx. Hence, this has strongly suggested that there is a possibility of the presence of the effect of tones on vowel quality. In non-tonal languages such as English, French, and Spanish, the X-ray examination reported in Parmenter et al. (1933) shows that the larynx is raised during articulating a vowel when the pitch is raised to an octave. They stated that when the pitch is raised, certain muscle contractions occur in the larynx, resulting in the push of other organs or direct irradiation of muscular tension. This may be one reason behind the change in the position of the larynx during the production of a vowel with a high pitch. As per the acoustical explanation, when the fundamental

pitch is raised, the size and shape of the supraglottal cavities change to maintain the optimum resonance for the overtones that determine vowel quality (Parmenter et al., 1933). Zee (1980b) also shares the opinion that the length of the pharynx can be altered by the raised or lowered larynx resulting in the length of the vocal tract leading to changes in the formant frequencies. During the production of Swedish vowels in the raised larynx position, according to Sundberg and Nordström (1976), the F2 in high front vowels has a considerable rise. There is also a rise in the F1 and F2 in open vowels. Additionally, some vowels are also reported to have a rise in the F3 and F4 (Sundberg and Nordström, 1976).

In Taiwanese, a tone language, Zee (1980b) reported that the formant frequencies associated with high tones are not always higher than the formant frequencies with low tones. This suggested that the rise of the larynx involved and indicated that shifts in other articulators had taken place. This has been supported by the findings in Parmenter et al. (1933) where the articulatory shifts during the production of change in pitch of one high octave involved not only the larynx but also the width of the pharynx, the epiglottis, the hyoid bone, the tongue, the jaw, and the lips. Zee (1980b) therefore, stated that these articulatory shifts are seemed to be the impact of the interaction between the larynx movement and the articulatory configuration necessary for the production of vowels with certain tones. The vowels /i, e, u, ɔ/, which are associated with high tone in Taiwanese, are reported to have occupied different areas in the acoustic vowel space, distinct from the vowels with low tone. Hence, the tonal difference has affected vowels in a non-systematic way for various speakers in Taiwanese (Zee, 1980b). Shaw et al. (2016) experimented on Mandarin Chinese, another tone language, to see the influences of tone on vowels using electromagnetic articulography (EMA). The results show that T2-rising tone and T3-low tone, which begins with low f_0 , are reported to lower the tongue body for low vowel /a/. The opposite phenomenon happened for vowel /i/, where the tongue body is raised when

it is produced with tone starting with a low f0 (T2 and T3). Considering the presence of IF0 in tone languages as seen in the literature and the effect of tone on the vowel in non-tone and tone languages, the following sections analyzed the same in Mizo. The questions below are addressed in the following sections.

1. Is there any evidence of vowel effect on the f0 of tones in Mizo or vice versa?
2. Do vowel effects occur evenly throughout the tone or vice versa in Mizo?

6.3.1 Mizo vowels and f0 contours in the experiment

The data used in the experiment to see the effect of Mizo vowels on the tones of Mizo and vice versa are nonwords in the CVV syllable. Nonwords are used for this analysis due to insufficient and imbalance of meaningful Mizo words with the four tones and the five vowels of Mizo. Therefore, to validate these nonwords, the F1, F2, and f0 are analyzed by visual examination in this section. Hence, to see whether the nonwords replicate the Mizo vowels in Section 6.2.1, the F1 and F2 values obtained from 8 Mizo speakers with 456 nonword tokens are plotted in Figure 6.7. Likewise, to know if the f0 contours of the nonwords used in Section 6.3.2 are comparable to the Mizo f0 contours of the four lexical tones in Chapter 4, Figure 6.8 provides the f0 contours of the nonwords at every 25% of the total duration of the TBU.

The normalized mean F1 and F2 plots with one standard deviation ellipses for the five vowels in Figure 6.7 are undoubtedly similar to the vowel plots in Section 6.2.2. This figure clearly shows five Mizo distinct vowels, namely, /a, e, i, u, o/. The mean F1, F2, and F3 values with the standard deviation are tabulated in Table 6.11. From the table, it is seen that /i/ and /u/ vowels have low F1 values, which means they are high vowels, /a/ has the highest F1 value, and thus it is a low vowel. The F1 values for /e/ and /o/ are between the low and high vowel ranges, and hence they are mid vowels. In terms of F2, /o/ and /u/ have low values so they are back vowels while

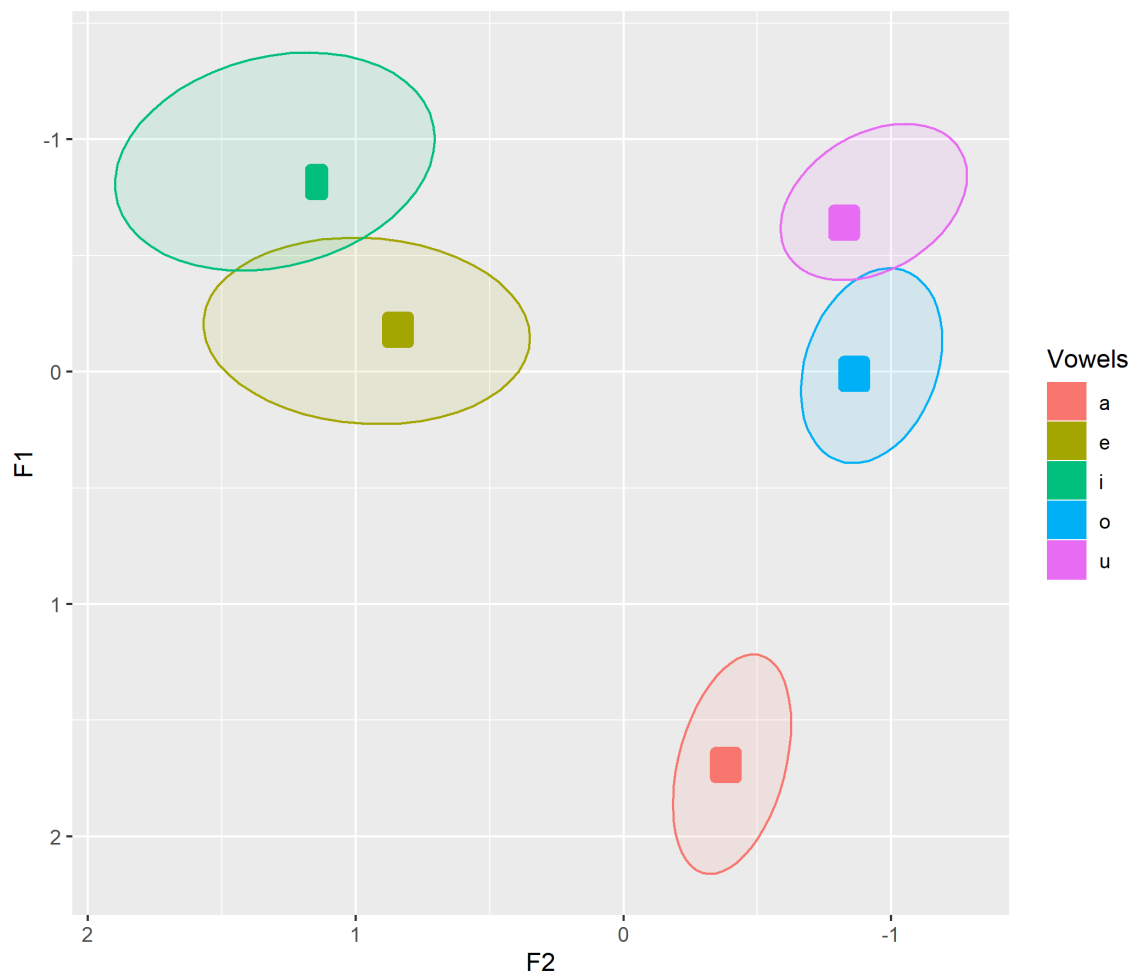


Figure 6.7: The five Mizo vowels in nonwords.

/e/ and /i/ are front vowels due to their high F2 values. F3, on the other hand, does not show a systematic pattern.

Figure 6.8 shows the normalized f0 contours of the four Mizo tones at every 25% of the total duration. This figure replicates the f0 contours of the four Mizo tones in Chapter 4. High tone shows a level contour that begins just below the initiation of falling tone and continues to maintain the f0 contour almost until the termination point. The falling tone has a falling contour with its termination point higher than the termination point of the low tone. The rising tone has the lowest f0 initiation, the dip is also prominent, and it begins to rise till the end, which is the highest f0 termination among the four tones. The low tone starts just above the rising tone and

Table 6.11: The mean F1, F2, and F3 values of the five Mizo vowels in nonwords.

Vowels	F1	F2	F3
/a/	754(100)	1210(141)	2637(336)
/e/	460(69)	1992(431)	2728(282)
/i/	363(114)	2233(483)	3153(377)
/o/	492(84)	883(252)	2760(291)
/u/	389(90)	903(323)	2621(231)

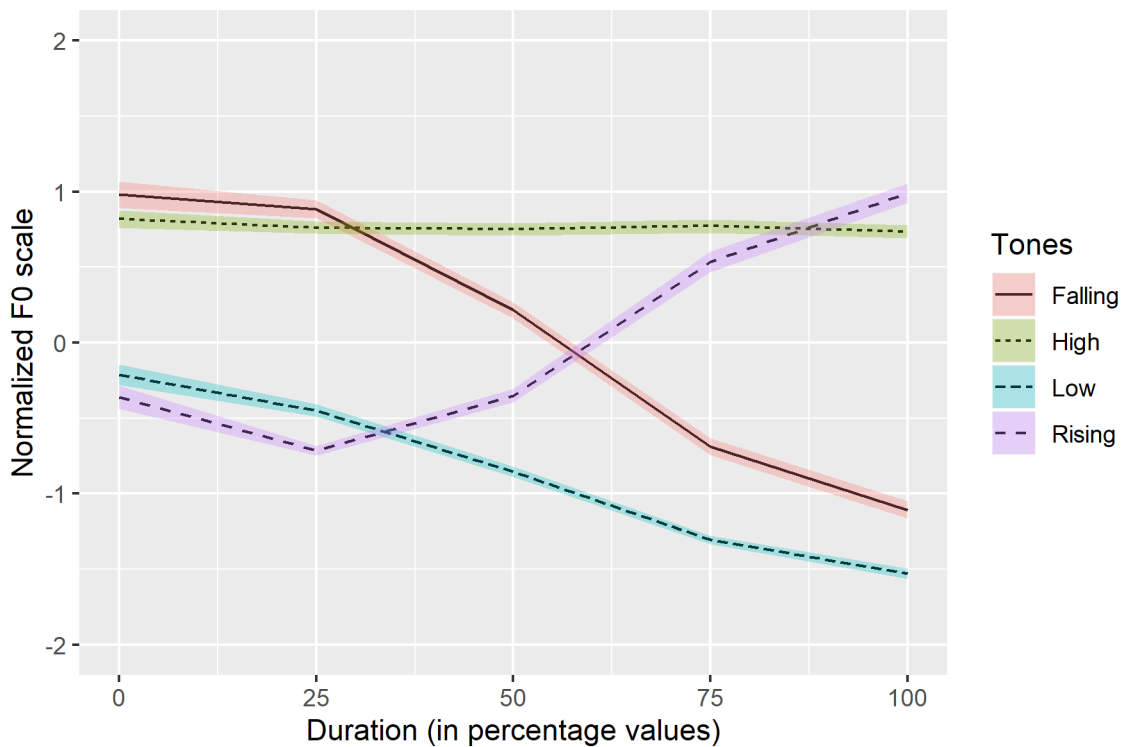


Figure 6.8: Average F0 contours of four Mizo tones in nonwords.

has a falling contour with its termination point as the lowest f0 among the four tones.

These analyses show that the nonword CVV syllables doubtlessly replicate the Mizo vowels and tones. Hence, the data lists of the same are acceptable for further analysis of the interaction of tones and vowels in Mizo. Therefore, the following sections examine the effect of vowels on tones and vice versa in Mizo.

6.3.2 The effect of vowels on tones in Mizo

The results of the analysis are presented from Figure 6.9 to Figure 6.12. These figures show a significant effect of vowel type on the f0 contours of the Mizo tones. It is observed that higher f0 is induced by the high vowels /i/ and /u/, while low vowels induce low f0 at the initial point (0% of the total duration). As seen in Figure 6.9 and Figure 6.12, vowel height-specific effects are seen for low and falling tones at 25% of the pitch contour. However, the vowel category-induced differences are reduced as the pitch falls. On the other hand, the vowel category-specific differences are present over the complete duration of the pitch contour in the case of the high tone as in Figure 6.10. The reason is that the pitch contour remains consistently high throughout the total duration of the f0 contour in a high tone. In terms of rising tone in Figure 6.11, the vowel category differences in the pitch contour are prominent until 25% of the total duration and become more noticeable again when the pitch contour rises to higher f0 levels in 75% of the overall duration.

The mid vowels /e/ and /o/ are in the middle of the two extreme f0 values in all four tones. The mid vowels overlap from the beginning till the end of the f0 contour in the contexts of low and rising tones. The mid vowels in high tones begin with distinct f0 and begin to overlap with /a/ after 25% of the total duration till the termination. From about 25% of the total duration, /a/ and /o/ overlap in falling tones. It is also noticed that high vowels /i/ and /u/ are overlapped from 25% of the total duration in low, high, and falling tones.

The LME tests on Mizo tones revealed that the f0 values for the four tones in Mizo interact significantly with the vowel categories, as shown in Table 6.12. The vowel category effect on the f0 contour is significant from the start to 75% of the total duration, while it is absent at the termination of the pitch contour (100%).

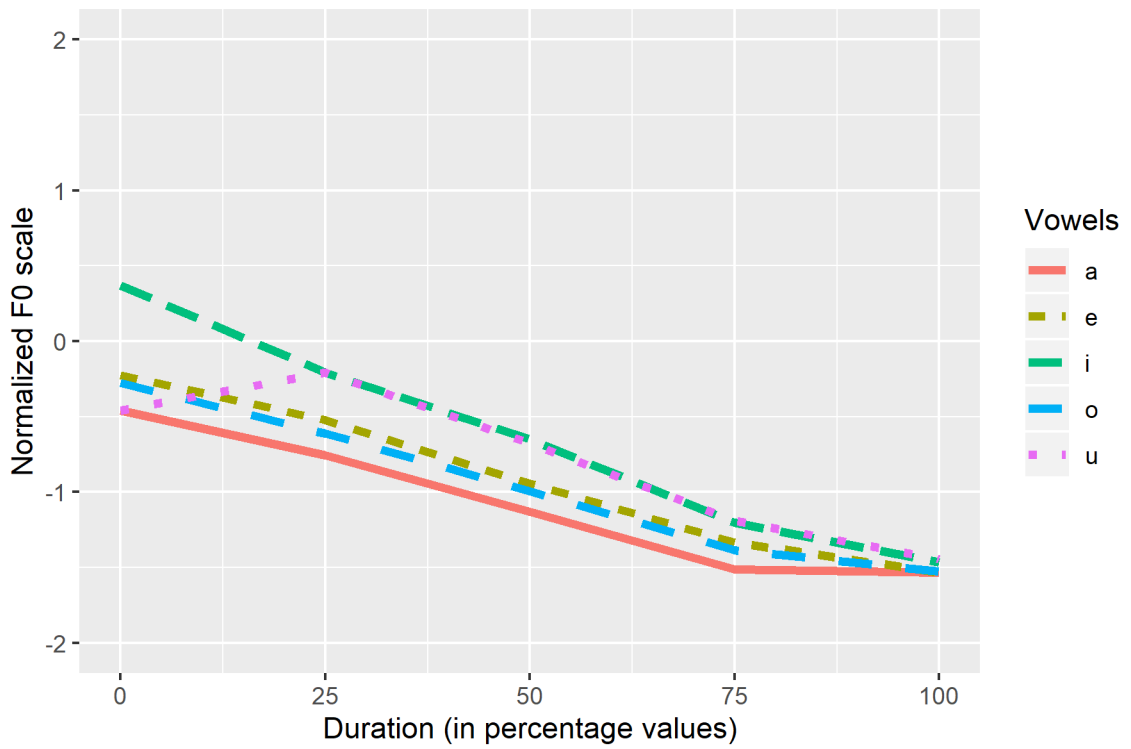


Figure 6.9: F0 contours of low tones with five Mizos vowels.

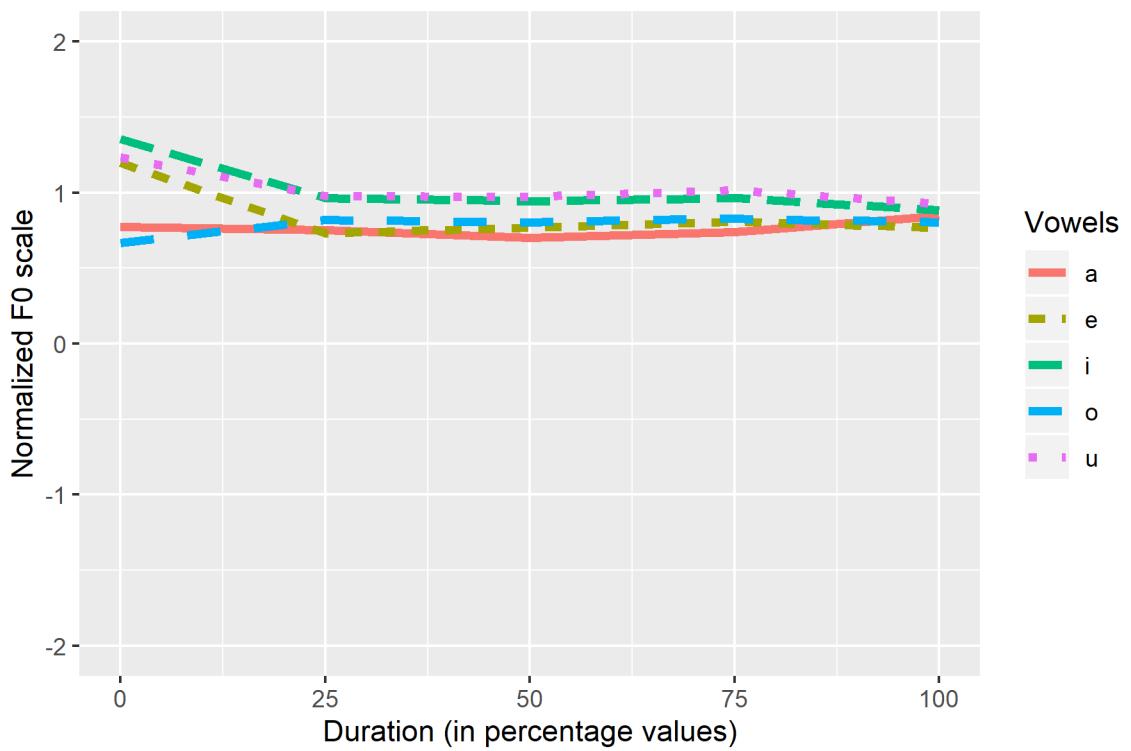


Figure 6.10: F0 contours of high tones with five Mizos vowels.

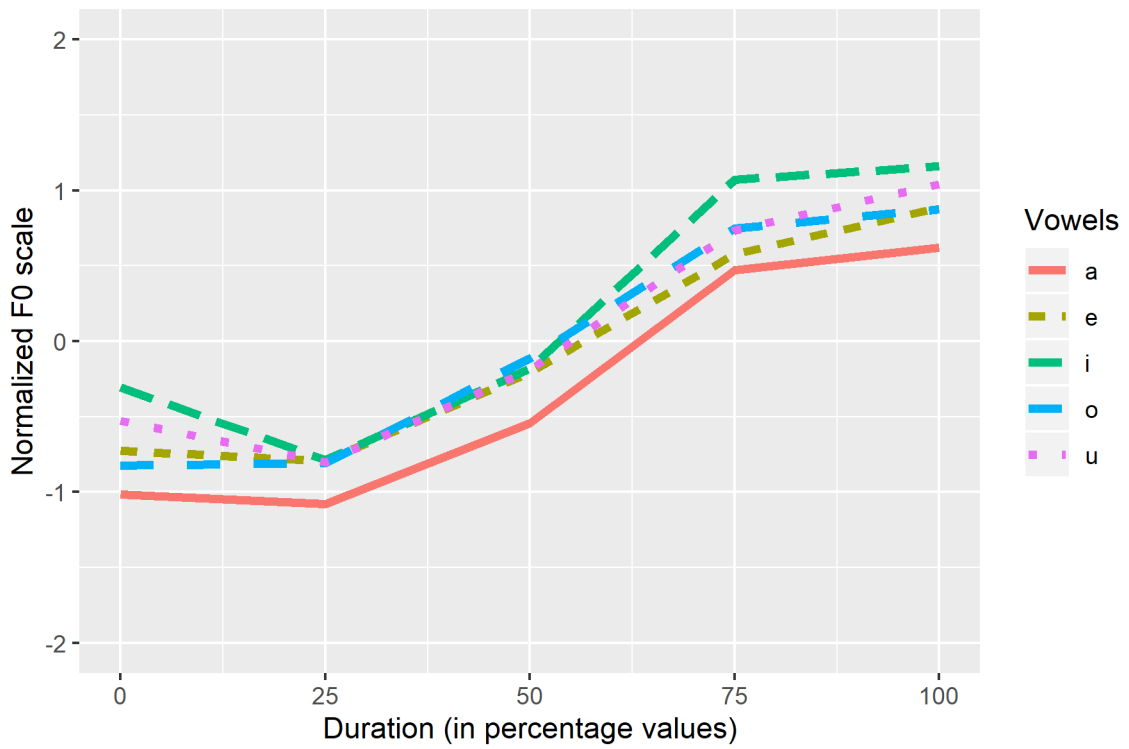


Figure 6.11: F0 contours of rising tones with five Mizo vowels.

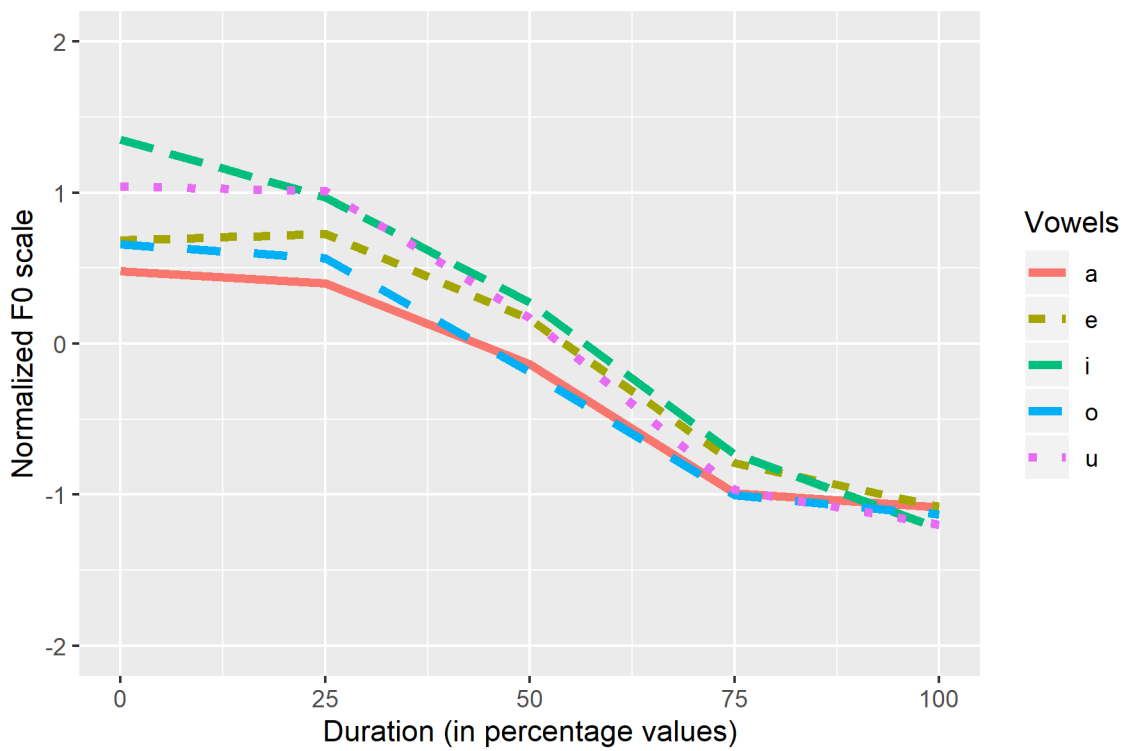


Figure 6.12: F0 contours of falling tone with five Mizo vowels.

Table 6.12: Result of LME test in Mizo tones

	0%	25%	50%	75%	100%
$\chi^2(4)$	58.72	53.29	43.30	26.23	1.34
p	< 0.001	< 0.001	< 0.001	< 0.001	0.86

6.3.3 The effect of tones on vowels in Mizo

In this section, the analysis of the effect of tones on vowels in Mizo is provided by obtaining the F1 and F2 values from the same data lists in the previous section. The values are obtained at every 25% of vowel duration; hence, there are five points. The normalized mean F1 and F2 values of the five Mizo vowels with the four Mizo tones are plotted for 5 different points of the total duration. The F1 and F2 with the tones at 0% are plotted in Figure 6.13, at 25% in Figure 6.14, at 50% in Figure 6.15, at 75% in Figure 6.16 and 100% in Figure 6.17. The mean F1, F2, and F3 values of the five Mizo vowels at five points produced in all the four tones are also tabulated in Table 6.13.

Figure 6.13 shows that the vowels /i, e, u, o/ in rising tone have the highest F2 values. Hence, these vowels with rising tones are more front than in the other tones. In terms of F1, no systematic pattern is seen for the effect of tones on vowels at 0%. The variation of tone is more for the front vowels.

In Figure 6.14, vowels with falling tones have low F1 values for high vowels /i/ and /u/. No consistent pattern for the influence of tone on vowels is observed in F2. The tone variation is less for back and low vowels in both F1 and F2.

In Figure 6.15, the front vowels /i, e/, and the back vowel /o/ with low tone have low F1 values. In terms of F2, vowels /e, u, o, a/ produced with falling tones have low values. Interestingly, the mid vowels /e/ and /o/ with all the four tones have the same F2 pattern. Vowels with low tones have the highest F2 values, while the vowels with rising and high tones overlapped, and vowels with falling tones have the lowest F2 values. Less variation is seen for the back and low vowels.

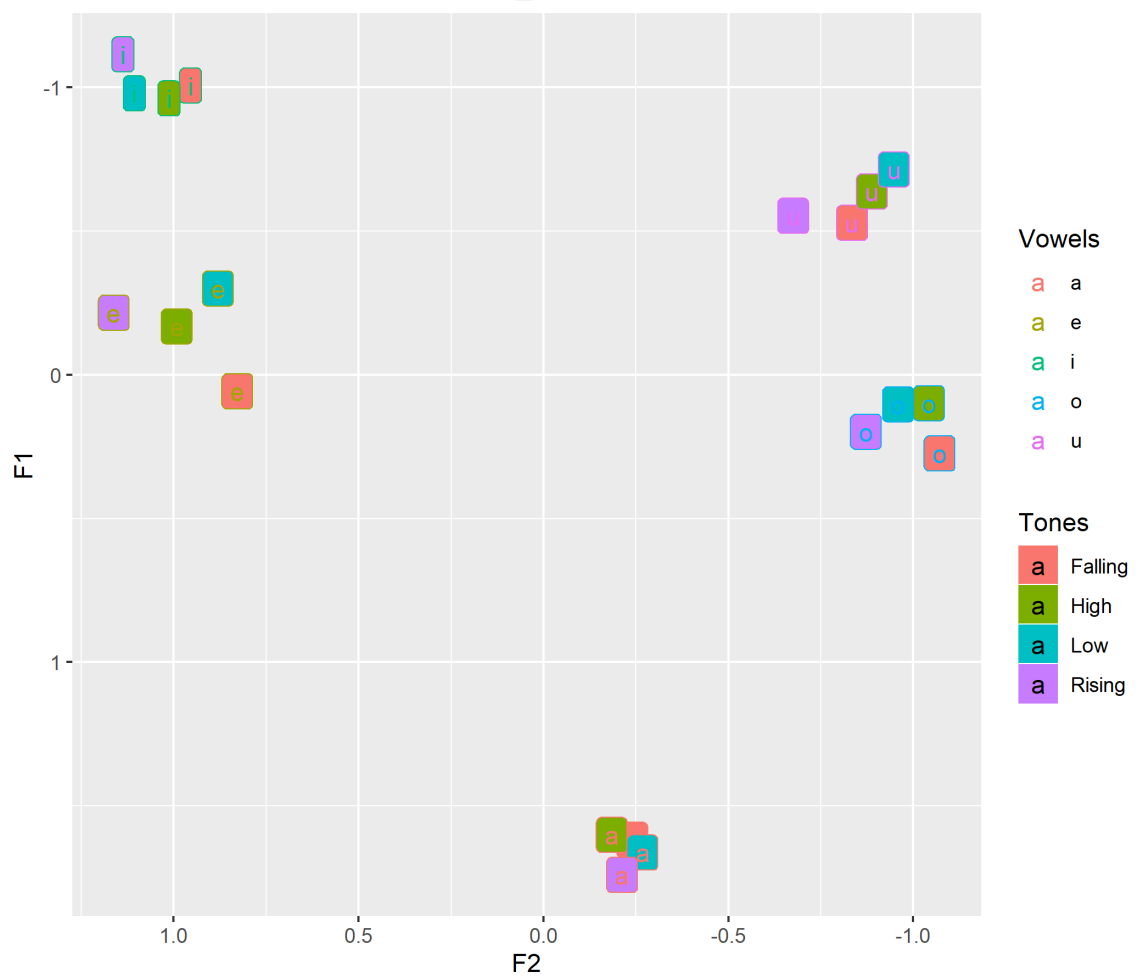


Figure 6.13: The mean F1 and F2 of the five Mizo vowels plotted with the four Mizo tones at the initial part of the vowel.

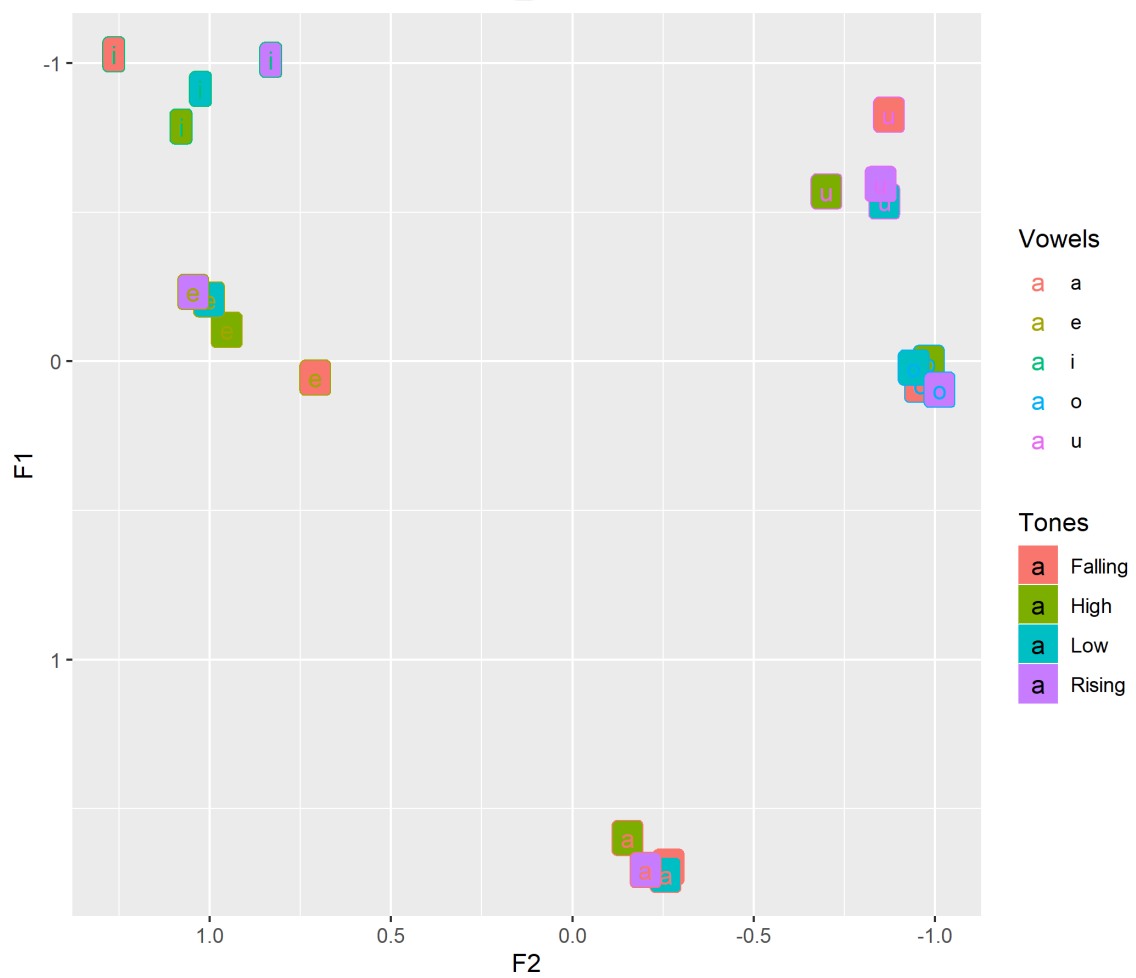


Figure 6.14: The mean F1 and F2 of the five Mizo vowels plotted with the four Mizo tones at 25%.

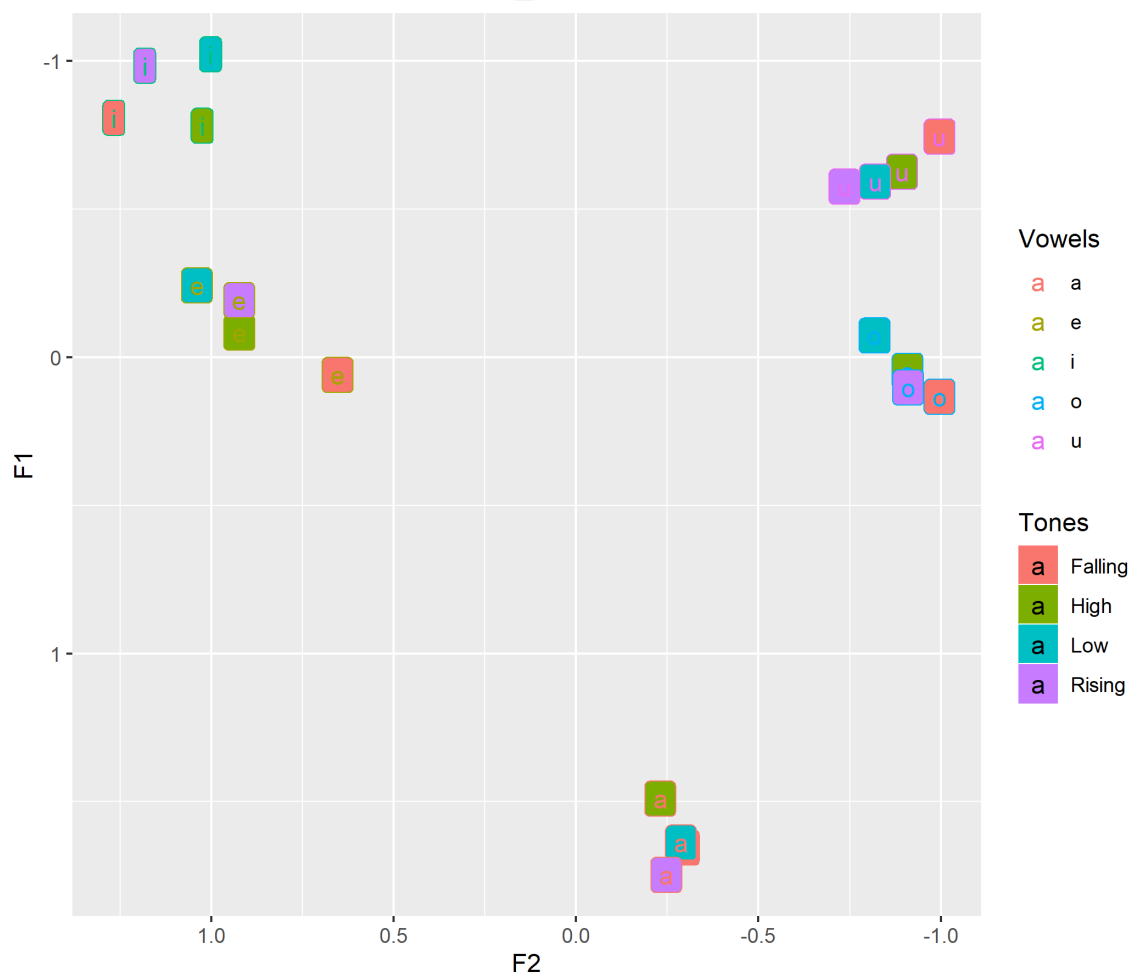


Figure 6.15: The mean F1 and F2 of the five Mizo vowels plotted with the four Mizo tones at 50%.

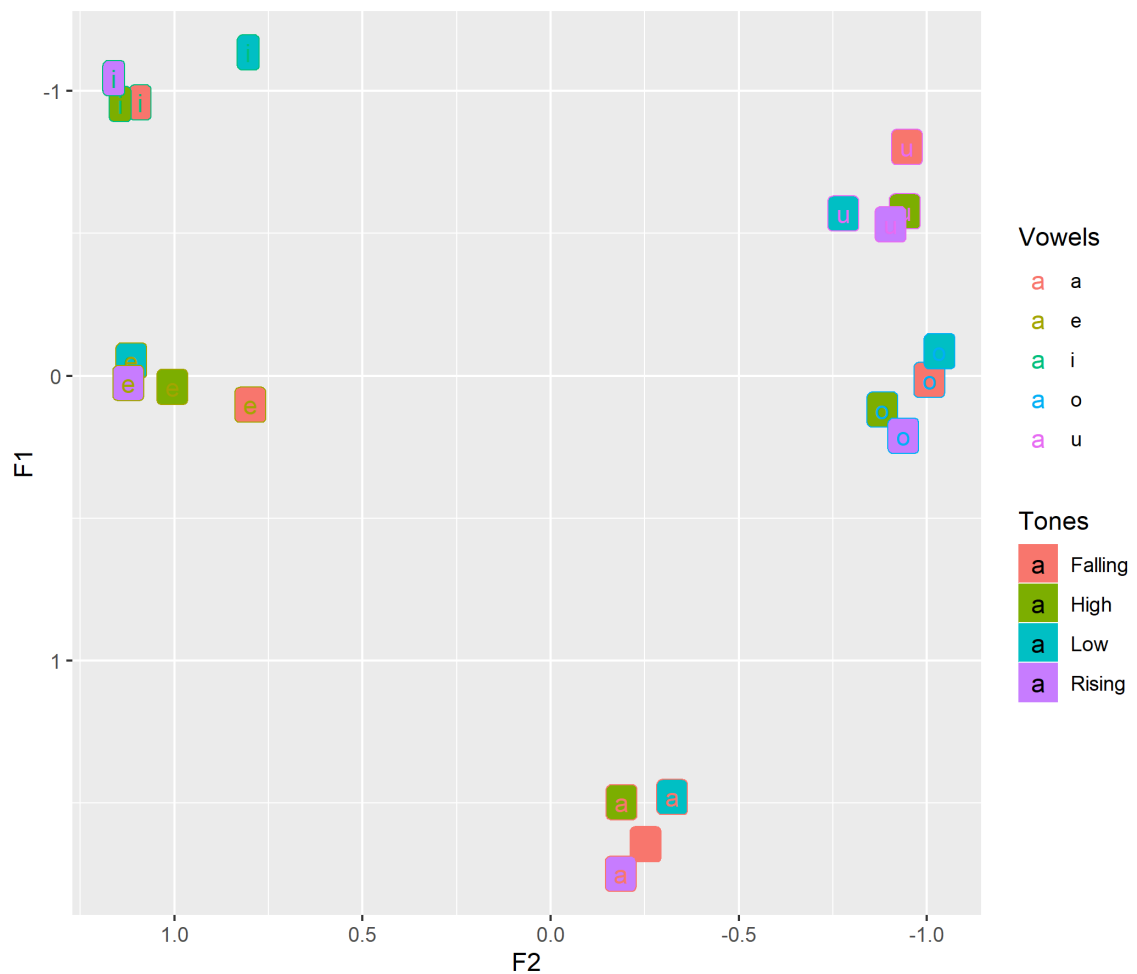


Figure 6.16: The mean F1 and F2 of the five Mizo vowels plotted with the four Mizo tones at 75%.

The F1 and F2 values at 75% of the total vowel duration in Figure 6.16 show that vowels /i, e, a, o/ with low tones have the lowest F1 values. In terms of F2, no consistent pattern is seen. Front vowels are seen to be more dispersed than the other vowels.

In Figure 6.17, high vowels /i/ and /u/ with rising tones have low F1 values. Mid and low vowels with high tones have low F1 values. Mid vowels /e/ and /o/ have a similar pattern in F1, where high and low tones have low F1 values, followed by a falling tone and rising tone with the highest F1 values. No consistent pattern is observed in F2.

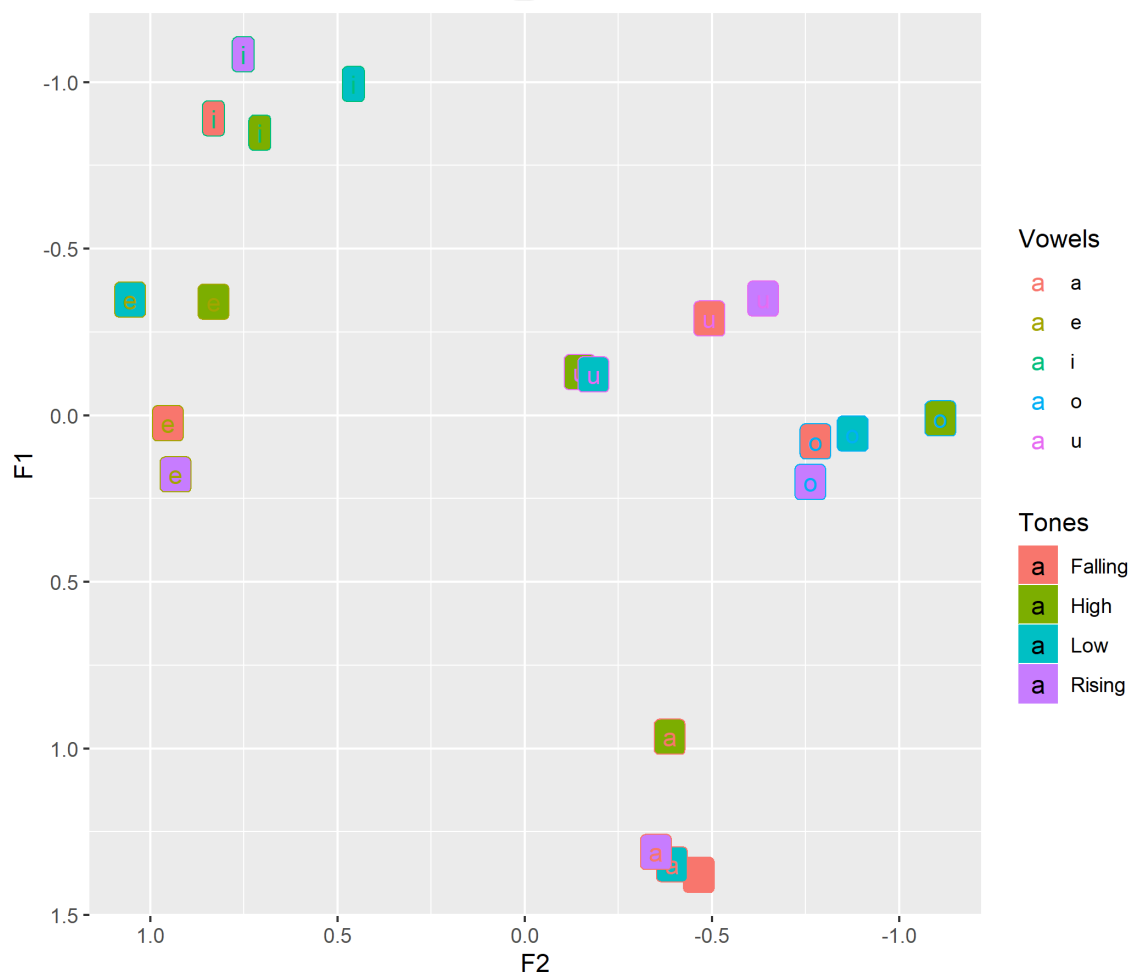


Figure 6.17: The mean F1 and F2 of the five Mizo vowels plotted with the four Mizo tones at 100%.

Table 6.13: The mean F1, F2, and F3 values of the five Mizo vowels produced with the four Mizo tones at five points along the standard deviation in parenthesis.

Points	Tones	Vowels	F1	F2	F3
0%	Falling	a	485(38)	651(47)	964(50)
		e	353(39)	835(105)	976(68)
		i	264(27)	861(105)	1016(54)
		o	370(32)	509(43)	980(36)
		u	305(38)	544(90)	956(44)
	High	a	482(48)	659(51)	975(51)
		e	335(35)	860(82)	981(45)
		i	267(61)	871(103)	1043(55)
		o	356(27)	513(41)	975(45)
		u	294(36)	531(118)	938(77)
	Low	a	489(41)	645(42)	962(41)
		e	324(33)	840(134)	995(40)
		i	266(34)	887(74)	1046(57)
		o	357(27)	526(73)	970(40)
		u	287(36)	523(102)	946(33)
	Rising	a	496(38)	654(43)	965(45)
		e	329(36)	893(50)	1002(50)
		i	253(36)	892(92)	1043(53)
		o	368(44)	544(111)	990(47)
		u	302(36)	574(129)	968(51)
25%	Falling	a	484(44)	631(46)	950(88)
		e	347(35)	801(120)	965(58)
		i	256(41)	909(72)	1053(58)
		o	348(29)	506(34)	979(40)

		u	273(32)	521(90)	972(51)
	High	a	475(57)	653(79)	979(59)
		e	333(32)	846(104)	993(52)
		i	275(61)	876(136)	1051(53)
		o	341(27)	503(31)	985(41)
	Low	u	297(59)	549(124)	973(51)
		a	486(39)	633(40)	974(45)
		e	323(22)	856(109)	992(54)
		i	265(42)	865(146)	1044(57)
		o	345(31)	509(45)	977(43)
	Rising	u	296(43)	523(87)	958(38)
		a	486(41)	642(48)	967(48)
		e	322(33)	865(91)	1009(71)
		i	254(48)	831(154)	1031(56)
		o	352(44)	498(37)	979(38)
		u	291(28)	526(99)	963(35)
50%	Falling	a	479(37)	634(37)	939(92)
		e	349(35)	794(126)	971(50)
		i	280(45)	913(59)	1055(50)
		o	355(31)	510(31)	987(52)
		u	285(37)	505(76)	957(38)
	High	a	465(57)	644(52)	977(56)
		e	338(41)	845(112)	987(53)
		i	282(61)	874(150)	1048(48)
		o	348(39)	521(64)	979(50)
		u	294(51)	519(85)	967(42)
	Low	a	477(37)	634(38)	967(38)

		e	325(30)	867(78)	985(45)
		i	261(38)	866(109)	1038(51)
		o	342(43)	533(105)	986(49)
		u	296(39)	535(104)	951(45)
	Rising	a	487(46)	640(42)	974(40)
		e	329(38)	846(115)	991(41)
		i	266(81)	900(94)	1053(59)
		o	355(51)	520(85)	981(36)
		u	296(63)	547(128)	959(39)
75%	Falling	a	476(52)	639(49)	955(79)
		e	351(39)	813(112)	976(50)
		i	270(39)	874(103)	1032(46)
		o	345(33)	512(35)	972(41)
		u	282(37)	518(77)	952(42)
	High	a	463(54)	649(53)	966(52)
		e	348(48)	852(69)	973(65)
		i	270(44)	881(131)	1051(42)
		o	353(49)	530(64)	987(45)
		u	298(40)	517(83)	961(34)
	Low	a	458(78)	629(44)	964(41)
		e	340(35)	874(56)	983(55)
		i	254(19)	827(116)	1019(56)
		o	339(28)	508(58)	965(30)
		u	299(43)	548(109)	960(32)
	Rising	a	484(47)	651(43)	979(42)
		e	347(46)	874(60)	1000(57)
		i	262(37)	882(107)	1015(73)

		o	364(46)	524(60)	983(36)
		u	301(31)	528(89)	966(40)
100%	Falling	a	493(63)	649(60)	960(70)
		e	371(66)	844(101)	985(44)
		i	291(76)	834(74)	992(45)
		o	381(82)	601(142)	997(68)
		u	345(96)	650(140)	980(61)
	High	a	455(93)	660(90)	972(55)
		e	340(68)	828(74)	972(58)
		i	291(95)	817(94)	1010(42)
		o	369(68)	567(76)	969(49)
		u	356(101)	688(147)	1008(67)
	Low	a	488(55)	660(76)	961(54)
		e	335(52)	859(55)	984(50)
		i	278(92)	780(81)	990(50)
		o	375(80)	593(148)	982(60)
		u	364(107)	679(158)	995(64)
	Rising	a	488(69)	667(63)	990(48)
		e	389(78)	843(46)	991(42)
		i	276(92)	821(89)	998(46)
o		392(80)	611(123)	974(48)	
u		335(87)	632(129)	975(59)	

From these figures and Table 6.13, it is seen that the F1 and F2 values differ from one point to another for most of the vowels. Vowel /i/ at 50%, 75%, and 100% are produced with tones starting with low f₀ resulting in low F1 values. Hence, low and

rising tones in Mizo have influenced the close front vowel /i/ to have low F1 values. This could mean that the production of low f0 results in raising the tongue during the production of the vowel /i/ in Mizo. This phenomenon is also seen in Mandarin Chinese. Mid vowels /e/ and /o/ have similar F2 patterns at 50% and almost similar F1 patterns at the termination point. Mid vowels in Mizo seem to have shared many common patterns within the category, which means the effect of tone on mid vowels is more or less consistent. Except at 100% of the total vowel duration, the effect of tones on the vowels is less dispersed for the back and low vowels in Mizo compared to the front vowels. Hence, the effect of tone on the vowel is more prominent at the front vowels in Mizo, and the low vowel has an almost negligible effect of tones. Additionally, it is observed that the low vowel /a/ has low F1 values constantly when it is produced with a high tone. This means that the production of a high tone raised the tongue.

Statistical analysis is conducted to see the effect of tones on vowels in Mizo by taking F1, F2, and F3 at every 25% of the total duration. Three full LME models are made where F1, F2, and F3 are the dependent variables for each model. All the models have the same fixed and random effects. Vowel type and tones are fixed effects, while speaker is the random effect. The models are subjected to Type II Wald- χ^2 test, and the results are shown in Table 6.14. Although some effects of tones on vowels are observed in the F1 and F2 plots and values, the statistical results suggested no significant effect of tone on the vowel, except at the 25% in F2 and at the 100% in F3.

6.4 Conclusions

A detailed description of the vowels of Mizo and their interaction with Mizo tones is presented in this chapter. The acoustic analysis of the formant frequencies of Mizo

Table 6.14: Type II Wald Chisquare test on the LME model for F1, F2, and F3 (of vowel x tone) in Mizo vowels at 5 points.

p-values: ***: p <0.000, **: p <0.001, *: p <0.05, n.s.: not significant

Duration(%)	Factors	F1	F2	F3
0	Tones	7.7 ^{n.s.}	9.6*	5.9 ^{n.s.}
	Vowels	3192.0***	1561.3***	173.8*
	Tones x vowels	17.6 ^{n.s.}	6.4 ^{n.s.}	13.7 ^{n.s.}
25	Tones	1.0 ^{n.s.}	1.5 ^{n.s.}	4.9 ^{n.s.}
	Vowels	2760.8***	1358.7***	168.3***
	Tones x vowels	24.6*	16 ^{n.s.}	13.6 ^{n.s.}
50	Tones	3.9 ^{n.s.}	3.4 ^{n.s.}	3.8 ^{n.s.}
	Vowels	1998.0***	1444.8***	255.6***
	Tones x vowels	17.6 ^{n.s.}	14 ^{n.s.}	9.6 ^{n.s.}
75	Tones	8.2*	5 ^{n.s.}	7.5 ^{n.s.}
	Vowels	2210.8***	1860.6***	151.9***
	Tones x vowels	16 ^{n.s.}	18.1 ^{n.s.}	15.9 ^{n.s.}
100	Tones	2.6 ^{n.s.}	0.2 ^{n.s.}	1.1 ^{n.s.}
	Vowels	532.8***	450.7***	12.0*
	Tones x vowels	18.8 ^{n.s.}	17.2 ^{n.s.}	21.5*

vowels revealed that there are five distinct Mizo vowels, namely, /i/ - a close/high front unrounded vowel, /a/ - an open/low central unrounded vowel, /e/ - a mid-close/high front unrounded vowel, /u/ - a close/high back rounded vowel and /o/ - a mid-close/high back rounded vowel. The temporal information of these vowels shows that Mizo has long vowels, almost twice the duration of the corresponding short vowels. This has confirmed that vowel length is contrastive in Mizo. For instance, /beŋ/ is ‘ear’ and /be:ŋ/ is ‘to slap’, both words are of high tone. /baŋ/ - ‘wall’ and /ba:ŋ/ - ‘left over’, both are in a rising tone. The vowel length difference is seen to be prominent in F2. This chapter also contributes to the gender difference in producing Mizo vowels. The front vowels are more prone to gender effects than the back vowels. The density plots supported that back vowels in Mizo are less prone to get affected by vowel length and gender differences. The same difference in terms of the backness of the tongue is also observed in French and English (Pépiot, 2014). This could be due to limited articulatory excursion at the back of the tongue to make variations during the production of back vowels. The density plots and the results of the statistical

analysis also show that F1 and F2 contributed the most in differentiating the vowel qualities in Mizo, while F3 shows overlapped vowels.

This chapter also provides the information that there is a strong association between vowel quality and f0. In Mizo, high vowels cause f0 to rise, whereas low vowels cause f0 to fall. At the initial part of the f0 contour, the effect of vowels on tones is prominent. The speakers do not regulate the tone-specific pitch in the utterance at the beginning. Hence IF0 is prominent in that area. Speakers begin to control pitch for tone-specific values by the next quarter of the pitch contour. This results in minimizing the vowel-specific f0 differences. It is also seen that vowel differences are more prominent in high tones or higher pitch registers. However, vowel-specific differences become insignificant as the tone or pitch contour lowers. These findings also support previous studies on tone vowel interaction and strengthen that tone languages show evidence for IF0. However, the IF0 differences are decreased by tone-specific values as speakers attempt to achieve the tone targets over time. As a result, the effect of vowels may not be seen equally throughout the tone. The opposite phenomenon is also seen in Mizo, where tones affect vowels. Tones starting with low f0 like low and rising tones in Mizo lower the F1 values of vowel /i/ as also seen in Mandarin Chinese. Also, a high tone lowers the F1 values of the vowel /a/. Back vowels and low vowels have a more negligible tone effect.

Chapter 7

Classification of Mizo tones

7.1 Introduction

Acoustic phonetic studies on Mizo tones revealed that the f_0 contours of the four lexical tones of Mizo are distinct. Using Mizo speech data collected from various sources, it has been shown that despite the changes in the spoken context, the Mizo tones can be modeled in terms of the height and the curvature of the tones, as shown in Figure 7.1.

As noticed, the high tone in Mizo is relatively level in all three types of data; namely, minimal sets, read passages, and trisyllabic phrases. Falling tone initiates from f_0 higher than the onset of high tone in all the data types, the fall of f_0 throughout the duration is steeper in minimal sets than in other sets. The termination of falling tone surpasses the offset of low tone in read passages, while it does not reach the offset of low tone in minimal sets and trisyllabic phrases. The f_0 contour of low tone is dynamic and thus shows a falling contour from the beginning and then rises slightly at around 74% of the total duration in minimal sets and trisyllabic phrases and at about 50% in reading passages. The rising tone is another dynamic tone that falls moderately from the start for a short period, rises from about 16% of the total duration until the termination point, and surpasses high tone in minimal sets. At the same time, the termination never reaches a high tone in the other two data sets.

The rising tone is less gradual in minimal sets than in read passages and trisyllabic phrases.

Considering these four categories of tones differ in terms of their f₀ level and f₀ contours in Chapters 4 to 6, we showed that the first 3 DCT coefficients could characterize the tone categories robustly. DCT can help characterize the f₀ contours of a tone language, specifically when the language has a combination of contour and register tones, as in the case of Mizo. We considered the first 7 coefficients in this study to see how effective each is. However, the previous chapter already showed that the first three coefficients of the DCT help characterize the f₀ contours of tones. DCT has been successfully used in other languages for parametric representation, tone recognition of f₀ contours in synthetic (Teutenberg et al., 2008), and natural speech in tone languages like Dene Suline (Chipewyan) and Tlicho Yatii (Dogrib) of Athabaskan languages (Schellenberg and McDonough, 2014) and Mandarin Chinese (Wu et al., 2008,0).

However, we also noticed that the canonical tone characteristics difference depends on tone contexts, segmental contexts, and speaking styles. In Chapter 4, it is seen that there is an interaction of tone and onset consonants where voiceless aspirated stops have raised all the four tones. In contrast, voiced stops have the lowest f₀, and falling tone has the shortest VOT in voiceless aspirated stops. Additionally, Chapter 6 presents the interaction of tones with vowels where high vowels induced higher f₀ and low vowels induced lower f₀ prominently at the initial portions of the f₀ contours. Hence, this chapter explores how effective the DCT features are in classifying Mizo tones across speaking styles and various phonetic contexts. Additionally, we also add durational features in the classification of Mizo tones. The automatic classification of tones is attempted using two methods in this chapter: Quadratic Discriminant Analysis (QDA) and Random Forest (RF). The following section, Section 7.2 describes the database used for tone classification. Section 7.3 describes the two classification

methods used in this chapter and briefly describes the features considered. Section 7.4 and Section 7.5 describe the results obtained from QDA and RF classification methods, and finally, Section 7.6 concludes the chapter.

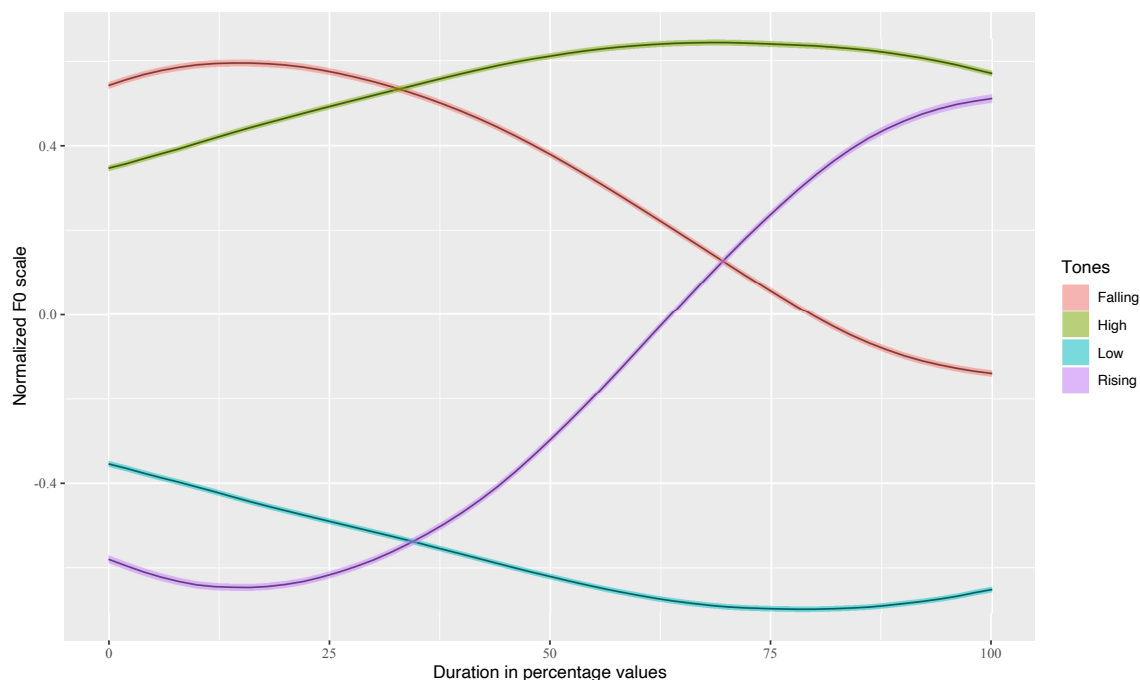


Figure 7.1: Normalized F0 contours of Mizo tones extracted from minimal sets, read passages, and trisyllabic phrases.

7.2 The database used for tone classification

We used three types of data collected from 32 Mizo speakers to perform automatic tone classification. The three types of speech data consisted of minimal tonal sets, tones in trisyllabic phrases, and tones associated with words in read passages. These are the same data used in Chapter 4. Table 7.1 shows the details of the data types and is categorized by tone types. Figure 7.2 indicates the number of iterations of tones in each tonal category categorized by the gender of the speakers. The figure shows that the number of tokens for tones is very similar except for the rising tone. Similarly, the tokens are almost uniformly distributed between the two sexes.

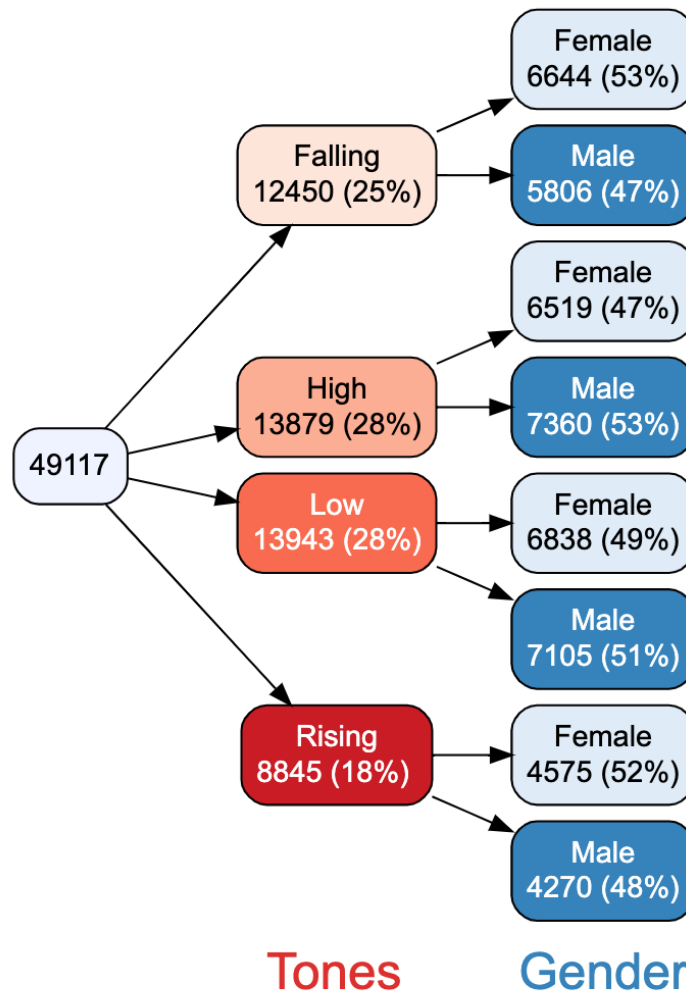


Figure 7.2: Distribution of tone data.

Table 7.1: Details of the tone data.

Type	Speakers	Falling	High	Low	Rising	Total
4 minimal sets	10	341	351	342	350	1385
9 passage	3	875	2551	2251	530	6207
64 trisyllabic phrases	19	11234	10977	11349	7965	41525
Total	32	12450	13879	13943	8845	49117

7.3 Classification methods and features

As mentioned previously, two classification methods were used to conduct automatic tone classification of the Mizo data: QDA and Random Forest. Both methods were implemented using R (R Core Team, 2019). The QDA classification was performed using the `MASS` package on R (Venables and Ripley, 2002). The QDA classification was conducted on a laptop computer running Mac OS 11.6.5 with 8 GB RAM.

The RF classifications used the `randomForest` (Liaw and Wiener, 2002) package on R. Considering the high processing power required for the RF classification and for parameter tuning, the high-performance computing facility at IIT Guwahati with the Param Ishan cluster was used (Param Ishan, 2022). For the RF classification, 10-fold classification was attempted keeping the `nodesize` constant at 14. Initially, the `mtry` parameter was varied from 2 to 100 and the optimal `mtry` value was determined to be 37. Keeping the `nodesize` and `mtry` constant, the `maxnode` parameter was varied from 100 to 3000. The optimal `maxnode` was found to be 1820. Finally, the `ntree` was varied from 250 to 2300, keeping `nodesize`, `mtry` and `maxnode` constant. The optimal `ntree` was found to be 1196. Further 10-fold classification was attempted using the following optimal parameters: `nodesize= 14; mtry= 37; maxnode= 1820; maxtree: 1196`.

For modeling tones in this study, we used 7 DCT coefficients (C0 to C6) extracted for the f0 contour of the tones and tone duration as input feature vectors. The data grid included information about the gender, the speaker, and the data type (minimal sets, trisyllabic phrases, and read passages). This feature set was used both in the QDA and RF classifications. For both QDA and RF, a 10-fold classification method was adopted. As seen in Table 7.1, there are 49117 tokens obtained from 14 female and 18 male speakers.

7.4 Results of QDA classification

The results for the QDA classification are presented in Table 7.2. The results show that the average accuracy in correctly classifying the tones using the seven DCT coefficients and the temporal feature is 54.85%. In the case of QDA, the accuracy in classifying the tones depends on the nature of the tone. For example, the falling tone in Mizo is the least accurately recognized, and it is misrecognized as the low tone. This misrecognition is possibly the tonal contour of the falling and the low tone of Mizo.

Table 7.2: QDA classification of Mizo tones in % values.

		Predicted			
		Falling	High	Low	Rising
Actual	Falling	35.4	5.7	57.7	1.3
	High	3.8	58.8	34.9	2.5
	Low	6.8	8.2	83.3	1.7
	Rising	1.5	32.2	24.5	41.9

A look at the Figure 7.1 shows that both the low tone and the falling tone in Mizo have a significant falling F0 contour. Hence, the QDA classification is inaccurate and biased towards the low tone. In the case of the other tone categories, errors are also biased towards the low tone category. This is primarily because the low tone category has the highest data points, and QDA is sensitive to imbalanced data sets (Tischio and Weiss, 2019). That is precisely why the low tone also has the highest accuracy among all the tonal categories in the QDA classification. Compared to the

class imbalance-induced bias in the QDA classifications, the Random Forest (RF) classifications fare better (Tischio and Weiss, 2019). Hence, the results of the Mizo tones' RF classification are described in the following section.

7.5 Results of Random Forest classification

The results of the RF classification of Mizo tones using the first seven DCT coefficients and duration yielded an accuracy of 79.73%. The results with the confusion matrix are summarized in Table 7.3. The high tones are best recognized with an accuracy of 82.4% while the contour tones, rising and falling, yielded an accuracy of about 77%. The results of this classification do not influence the amount of data in each category. In other words, from the results, this classification does not seem to be affected by data imbalance. The errors are also not biased toward the tone categories with more data. Nevertheless, the errors clearly show that the low and the falling tones are constantly wrongly recognized as each other. As seen in Table 7.3, the low and the falling tones have identification accuracies of 80.8% and 77.8%, respectively. However, the error analysis of these two categories shows that 13.6% of the falling tones are wrongly recognized as low tones, and on the contrary, 10.9% of the low tones are wrongly recognized as falling tones.

Table 7.3: Random Forest classification of Mizo tones in % values.

		Predicted			
		Falling	High	Low	Rising
Actual	Falling	77.8	7.7	13.6	0.9
	High	7.8	82.4	6.2	3.6
	Low	10.9	5.7	80.8	2.6
	Rising	3.0	10.2	8.9	77.9

To estimate the contribution of each of the variables in the Random Forest in classifying the tones, we subjected the RF models to yield Mean Decrease Accuracy and Mean Decrease Gini measures. The Mean Decrease Accuracy measure shows the reduction of accuracy in classification when a particular variable is excluded from the model. Hence, the higher the Mean Decrease Accuracy is, the more important the variable is for accurate classification. On the other hand, the Mean Decrease Gini measure shows the contribution of each variable to the homogeneity of the nodes and leaves of the random forest. Hence, a higher Mean Decrease Gini score for a variable implies higher importance of the variable in the model. The Mean Decrease Gini and Mean Decrease Accuracy values are shown in Figure 7.3 and Figure 7.4, respectively. The two plots represent the variables descending in terms of importance.

Figure 7.3 shows that among all the variables in the RF model, the DCT coefficient C1 plays the most crucial role in classifying the Mizo tones. This coefficient is followed by C0, C2, duration, speakers, C3, C4, C5, C6, data type, and gender in descending order. Hence, it is clear that the slope of the tone contour, as represented by C1, is the

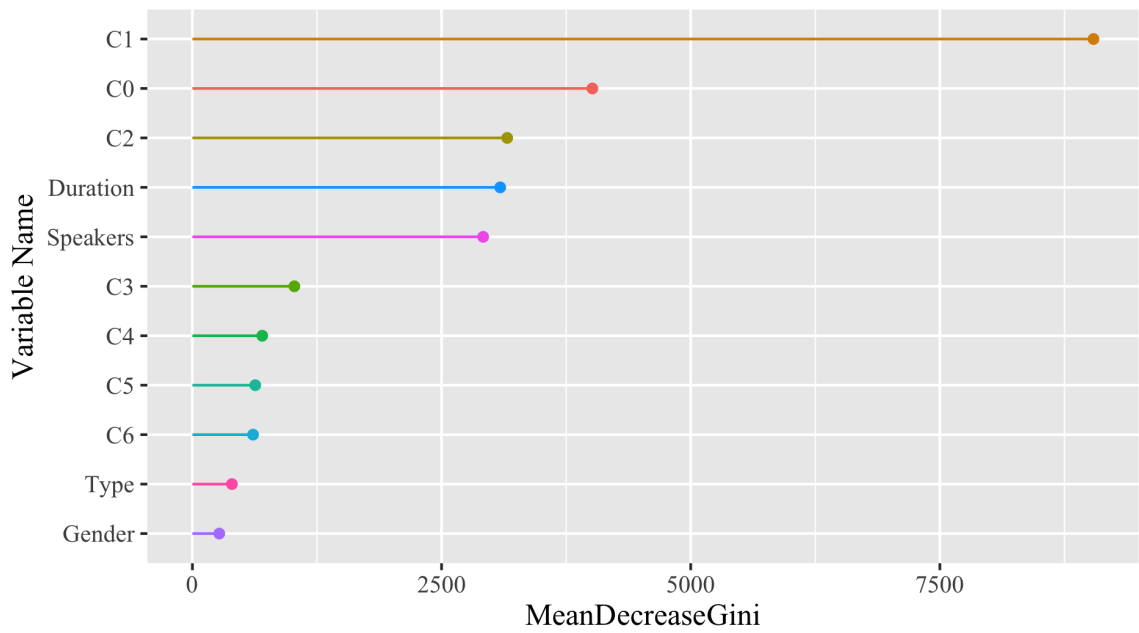


Figure 7.3: The performance of the 11 predictor variables using mean decrease Gini.

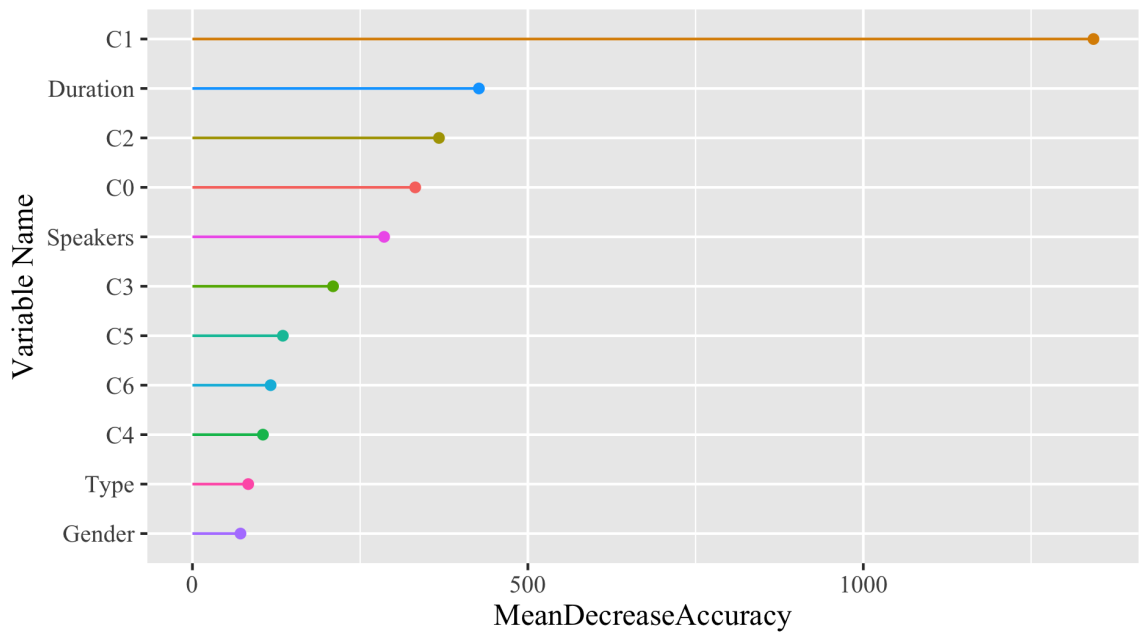


Figure 7.4: The performance of the 11 predictor variables using mean decrease accuracy.

most important factor in classifying the Mizo tones. The average tone, represented by C0, also plays a role in deciding on the tonal category classification. This also shows that factors such as speaker and gender do not contribute much to classifying the Mizo tones. In other words, the acoustic properties of tones remain uniform across speakers and gender.

Figure 7.4 also provides a similar conclusion regarding the variables in the RF model. The Mean Decrease Accuracy coefficients show that the DCT coefficient C1 is the most important variable in the model. Apart from that, it also considers tone duration as one of the important factors. DCT coefficients C0 and C2 follow duration in terms of importance. Overall, from the Mean Decrease Accuracy and Mean Decrease Gini measures, it is clear that four features, namely, C0, C1, C2, and duration, are the most important features in the classification of tones in Mizo.

7.6 Conclusion

In this chapter, we attempted to automatically classify the tones of Mizo using two classifiers, namely, QDA and Random Forest. This chapter aimed to see if the findings of the previous chapters about the acoustic characteristics of the Mizo tones can be corroborated using machine learning. In the previous chapters, we have shown that the DCT coefficients can capture the pitch contour characteristics for the Mizo tones. The characteristics of the entire length of the pitch contour of a Mizo tone can be reduced to a few coefficients using Discrete Cosine Transform (DCT). DCT can help characterize the f0 contours of a tone language, specifically when the language has a combination of contour and register tones, as in the case of Mizo. Given a sequence of f0 values (length 51 in the present study) of a TBU, the DCT transform yields a sequence of DCT coefficients of the same length. The initial coefficient C0 provides the mean f0 of the tone contour. C1 compares the given pitch contour to a falling half cycle

of a cosine curve and provides similarity measurements in positive or negative values. Hence, a tone with a falling contour would have a high positive C1 value, whereas a rising tone will have a negative C1 value. C2 compares the given f0 contour with one full cycle of the cosine curve and thus provides information about the presence of a peak or a valley in the f0 contour. Hence, the value of C2 will be positive for a falling–rising f0 contour and negative for a rising–falling f0 contour. Since the f0 contour of a Mizo TBU may contain utmost a minor peak or valley, the first three DCT coefficients are helpful in this work to model the f0 contour of a TBU. We have also shown in this chapter that higher DCT coefficients, C3 to C6, do not impact the classification of the tones in Mizo. However, the classification experiments also showed that besides the pitch features, the addition of tone duration also improves the classification accuracy.

Chapter 8

Conclusions

This dissertation aims to describe the characteristics and behavior of tones in Mizo. To achieve this, the phonetics and phonology of tones in Mizo were analyzed in this work. The phonological analyses in this thesis were based on the native speakers' intuition by the author and other speakers of the Mizo language. Wherever required, the intuitive judgments were confirmed using instrumental evidence. An acoustic-phonetic study further supported the observations made in the phonological analysis of Mizo tones. To carry out phonetic analyses on Mizo tones, an extensive amount of data was collected and processed in this work. Apart from exploring the acoustic-phonetic properties of tones, the interaction of tones with vowels and consonants was also investigated in the thesis. Hence, besides examining the characteristics of tones in Mizo, the investigation in this dissertation was also extended to analyzing vowels and stop consonants of Mizo. Finally, machine learning-based automatic classification of the Mizo tones in various contexts was also attempted using the knowledge gathered from the phonetic and phonological studies. The outcome of the classification experiment showed the effectiveness of the acoustic features proposed for characterizing Mizo tones.

The following sections, Section 8.1, of this chapter provide an outline of the main contributions of this dissertation. The chapter is concluded in Section 8.2 by discussing the implications of the current study and suggesting future research paths in

this area of study.

8.1 Major findings

The experiments conducted in this dissertation were aimed at discovering new phonological and phonetic phenomena associated with tones in Mizo. As part of this investigation, data was collected from a large number of speakers with the consideration that the spoken material used was familiar to a typical Mizo speaker. The phonetic and phonological analyses have revealed several new findings regarding Mizo tones. Tone alteration patterns discussed in this dissertation demonstrated that Mizo shows evidence of tonal polarity in the pronominal clitics. Similarly, it was confirmed that the falling contour simplification rule proposed in Fanai (1992) is not restricted to compound words with noun-noun combinations but could apply to other morphosyntactic structures such as noun-adjective phrases. This work also explored the domain of rising tone sandhi that is first recorded in Weidert (1975). By looking at tone sequences of rising-high and rising-falling syllables, it was shown that this phenomenon can be attested in various morphological structures such as compound words, phrases, and other grammatical constructions. Both the falling tone simplification and the rising tone sandhi phenomena revealed that tone alteration in Mizo is a purely suprasegmental phenomenon, and morphological or syntactic categories do not affect such alterations. The tonal alterations in Mizo attested in this dissertation show that the tones in the right-most syllable do not undergo any tone changes. This revealed that Mizo is a right dominant tone language. An acoustic analysis of rising tone sandhi revealed that the low tone derived from the sandhi is not neutralized to the canonical low tone; hence, it is phonetically distinct. Additionally, the native speakers of Mizo could categorically perceive the low tone derived from the rising tone sandhi. The analysis of the interaction of tones and segments revealed that the relationship

between tones and segments is bidirectional in Mizo.

The significant findings of this dissertation are provided in the subsections below.

8.1.1 Falling tone simplification

The disyllabic and trisyllabic phrases in noun-adjective combinations revealed that the generic terms of certain nouns in CVV syllables with falling tones undergo tone simplification, resulting in a low tone. This tone simplification is seen when a CVV syllable with a falling tone is followed by another syllable with any of the four Mizo tones. In this phenomenon, the vowel length is shortened, resulting in the falling tone being simplified to a low tone. This tone simplification is also observed in the earlier studies on Mizo tones such as Weidert (1975); Fanai (1992) and Chhange (1993). However, these works were confined only to compound nouns. Hence, this dissertation revealed that the falling tone simplification is also attested at the phrase level.

8.1.2 Tonal polarity in pronominal clitics

The toneless pronominal clitics in CV syllable show tonal polarity when followed by nouns or verbs with any of the four Mizo tones in this dissertation. In this phenomenon, a toneless CV syllable proclitic is assigned the opposite tone of the following syllable. Hence, the toneless proclitic will be assigned a low tone if it precedes a syllable with a high tone. The same phenomenon is also observed in Chhange (1993). However, it is not described as tonal polarity.

8.1.3 The domain of rising tone sandhi

In the work of Chhange (1993), it is mentioned that rising tone sandhi occurs when the rising tone follows a high tone. However, the analysis of the rising tone sandhi

in this dissertation and in Sarmah et al. (2015) attested this process when the rising tone precedes either a falling or a high tone. Additionally, Sreenivasan (2015) claimed that the rising tone sandhi happens only in noun phrases. However, the analysis of the rising tone sandhi using different morphosyntactic structures in this dissertation shows that grammatical structures do not determine rising tone sandhi. This work revealed that rising tone sandhi operates whenever the required tone sequence is met: a rising tone followed by either a high or a falling tone.

8.1.4 Acoustic correlates of Mizo tones

In this dissertation, a four-way contrasting tonal minimal sets in the words (/t^haj/ and /vai/) are introduced. The acoustic characteristics of Mizo tones were analyzed with a large number of speech-recorded data obtained from the native Mizo speakers in this dissertation. Five contexts were considered: tonal minimal and near tonal minimal sets in isolation, sentence and semantic contexts, trisyllabic phrases, and read passages. The acoustic analysis of the Mizo tones based on the f₀ contours, the f₀ mean, the f₀ slopes, and the temporal information have convinced us that there are four distinct lexical tones in Mizo, namely, high, low, falling, and rising. The different realizations of the four Mizo tones depending on the contexts were also seen where there were phonological and phonetic tone variations. The comparison between the five data sets confirmed that the f₀ and duration ranges are smaller in a more natural speech than in citation form. Additionally, the evidence of gender differences in f₀ is also seen where the f₀ range in Hz is higher and greater for female than male speakers due to physiological differences. The temporal information of the four Mizo tones suggested that a high tone requires more time to achieve its f₀ target, and therefore, it has the longest duration. In contrast, a falling tone has the shortest duration due to less requirement for articulatory efforts to reach the target f₀. The second and third DCT coefficients, namely, C1 and C2, also confirmed that Mizo tones are dynamic.

8.1.5 The acoustics of Mizo stops

The Voice Onset Time for the three-way laryngeal stop contrasts in Mizo, which occurs in three places of articulation, namely, bilabial, alveolar, and velar, revealed that the voiceless aspirated velar stop has the longest VOT. In contrast, the voiced unaspirated bilabial stop has the shortest VOT. Hence, this study laid out the information that Mizo corroborates with the universal pattern: the further back the place of articulation, the longer the VOT; aspirated stops have longer VOT, and voiced stops have shorter VOT. Additionally, the analysis of Mizo stop consonants based on the VOT revealed that VOT is reliable for categorizing the voicing contrasts in the 8 Mizo stops.

8.1.6 Interaction of stops with Mizo tones

The analysis of the interaction of stops with tones in Mizo revealed a consonantal effect on the following f_0 of the vowel (CF₀). It also revealed that the VOT of the preceding stops is affected by the following tones. The effect of tones on stop consonants in Mizo is reported where the aspirated stop has a short VOT when it precedes a falling or a high tone. It is also confirmed that falling tones in Mizo tend to have a shorter VOT while rising tones induce a longer VOT. However, the effect of tones on stop consonants in Mizo is not robust. On the other hand, evidence for the effect of stop consonants on tones (CF₀) in Mizo is prominent. This analysis revealed that in Mizo, the initial f_0 that follows a voiceless stop has the highest f_0 , while the initial f_0 of the tone that follows a voiced stop has the lowest f_0 . This work also confirmed that aspirated stops had raised the f_0 at the initial point of the pitch contours for all the four Mizo tones.

8.1.7 The acoustics of Mizo vowels

An acoustic analysis of Mizo vowels in this dissertation based on the formant frequencies and the temporal information revealed that the front vowels /i/ and /e/ is prominently affected by vowel length and gender differences. On the other hand, the back vowels /u/ and /o/ are less affected. The back vowels remain stable due to the limitation of the articulatory movement at the back of the oral cavity. The analysis of the duration of the long and short vowels in Mizo revealed that the long vowels (average duration is 156 ms) are almost twice the duration of the short vowels (average duration is 85 ms). Vowel length differences affect the backness property of the vowels significantly. It was noticed that the short vowels are significantly centralized compared to the long vowels.

8.1.8 Interaction of vowels with Mizo tones

This dissertation confirmed that there is intrinsic f_0 (IF0) in Mizo which means there is a positive correlation between vowel height and the fundamental frequency. The results of the analysis of the effect of vowels on tones in Mizo attested that high vowels induced high f_0 while low vowels lowered the f_0 values. This effect is more prominent in the initial part of the vowel and when the tones have higher f_0 values. This prominent effect of vowels on tones in Mizo is diminished by the next quarter of the pitch contour. In terms of the effect of tones on vowels in Mizo, this dissertation concludes that the tongue is raised during the production of the low vowel /a/ with a high tone. Rising and low tones also raised the tongue during the production of the high vowel /i/. Hence, the tones with low initial f_0 in Mizo lower the F1 of the vowel /i/, while the high tone lowers the F1 of the vowel /a/. The degree of tone effect on vowels in Mizo is weak in the low and back vowels.

8.1.9 Automatic classification of Mizo tones using acoustic features

The four tones in Mizo can have different realizations depending on the contexts, the environment, and the style of speaking, as seen in Chapter 4. This dissertation attempted to automatically classify the four Mizo tones spoken in these different conditions by using methods such as Quadratic Discriminant Analysis (QDA) and Random Forest (RF). This classification is based on the first seven coefficients of DCT and the tone duration obtained from the data used in Chapter 4: tonal minimal and near minimal sets, read passages, and trisyllabic phrases. As per the results, the QDA method could classify the four Mizo tones with an average accuracy rate of 54.85%, and the RF method obtained an accuracy of 79.73%. From these two methods, it is seen that falling and low tones in Mizo are often confused. This is because both falling and low tones have the same tone contours, which is falling. The Mean Decrease Gini score and the Mean Decrease Accuracy coefficients concluded that the slope of the tone contour represented by C1 is the most well-grounded factor in classifying the four Mizo tones. Besides C1, the factors such as the mean values of tone, duration, and C2 also played a significant role in classifying Mizo tones.

8.2 Implications and future works

This dissertation contributes to the knowledge of tones in Mizo through phonological and phonetic analyses. This work confirmed that there are four distinct lexical tones in Mizo, namely, high, low, falling, and rising. Hence, the outcome of this work has two broad implications. Firstly, the pedagogical implication of this work directs one to introduce the teaching of the four Mizo tones in the curriculum for Mizo language teaching. Secondly, the orthographic implication of this work states that if tone marking in orthography is introduced in the Mizo writing system, three tones may be

marked, and the fourth, more common tone can be left unmarked in the orthography.

The methodology and the findings of this dissertation are expected to help conduct more fine-grained phonetic research on the tone languages of the Kuki-Chin subfamily of languages spoken in the northeast of India. This is particularly important as most of the Kuki-Chin languages and the Tibeto-Burman languages of northeast India are understudied.

The current work has investigated tone alteration in different morphological domains in Mizo. However, tone assignment at the sentence level needs more detailed analysis. Hence, it would be interesting to examine the behavior and characteristics of Mizo tones at the sentence level, supported by instrumental analysis. This will also pave the way for analyzing the interaction of tone and intonation in Mizo.

The acoustic phonetic study on Mizo tones in this dissertation has identified the acoustic features of the four tonal categories in Mizo. Apart from that, this work also documented the interaction of tones and segments in Mizo. However, the effect of tones on segments and vice versa are analyzed only in the environment of stop consonants and vowels. This aspect of tone analysis in Mizo may be extended by looking into other consonantal phonemes.

Apart from the Mizo tones, this dissertation also described the acoustic characteristics of a few Mizo segments. VOT characteristics of 8 stop consonants and formant and temporal characteristics of 5 pure vowels in Mizo were investigated. Hence, the acoustic analysis of the remaining consonantal phonemes, diphthongs, and triphthongs is still not completed. Hence, in the future, the acoustic characterization of these remaining segments and their interaction with the Mizo tones will be an interesting area of research. It is hoped that this work has been able to answer some of the questions about the acoustic characteristics of tones and tone assignment in Mizo. While this account may not be complete, it is expected that the work reported will be a basis for many more research works on the acoustics of Mizo speech sounds.

Appendix A

Data lists used in the thesis



Table A.1: The trisyllabic phrases used in the Experiments 1, 2, and 6.

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
1.	H	diŋ	stand	L-H-L	ron diŋ ro?	come and stand
2.	H	kal	to go	L-H-L	ron kal su?	do not come here
3.	H	au	scream	L-H-L	ron au su?	do not scream here
4.	H	ba:ŋ	quit	L-H-L	ron ba:ŋ su?	do not quit
5.	H	di:l	ask	L-H-L	ron di:l ro?	ask for it
6.	H	lei	tongue	H-H-H	zo:ŋ lei sei	the long tongue of a monkey
7.	H	a:r	chicken	H-H-H	lal a:r sa:ŋ	the king's tall chicken
8.	H	me:l	face	H-H-H	zou me:l moi	beautiful Zo face
9.	H	ŋuŋ	back	H-H-H	sial ŋuŋ sa:ŋ	buffalo's tall back
10.	H	bo:k	tumor	H-H-H	lu bo:k moi	beautiful head
11.	H	lai	middle	HL-H-HL	a lai reŋ	it is medial
12.	H	diŋ	stand	HL-H-HL	a diŋ tsa:k	I want to stand
13.	H	ba:ŋ	quit	HL-H-HL	i ba:ŋ mo	are you quitting?
14.	H	mu:	eagle	HL-H-HL	k ^h oi mu: ŋe:	where is the eagle from?
15.	H	k ^h ua	village	HL-H-HL	k ^h oi k ^h ua ŋe:	which village?
16.	H	kal	to go	LH-H-LH	in kal em?	did you go?
17.	H	mu:	eagle	LH-H-LH	k ^h i: mu: k ^h i	that eagle
18.	H	tsa:m	stay	LH-H-LH	an tsa:m aŋ	they will stay
19.	H	re:l	plan	LH-H-LH	an re:l aŋ	they will plan
20.	H	keŋ	carry	LH-H-LH	an keŋ em	did they carry?
21.	H	daŋ	mouth	HL-H-L	ka daŋ pil?	my sore mouth
22.	H	diŋ	stand	HL-H-L	ka diŋ du?	I want to stand
23.	H	diŋ	stand	HL-H-L	a diŋ zoŋ	those who are standing
24.	H	kal	To go	HL-H-L	a kal lou	he did not go
25.	H	lai	middle	HL-H-L	a lai tak	the exact middle

Table A.2: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

26.	H	daŋ	mouth	HL-H-H	ka daŋ na:	my painful mouth
27.	H	a:r	chicken	HL-H-H	mi: a:r lu:	someone's chicken head
28.	H	diŋ	stand	HL-H-H	la diŋ la:	remain standing
29.	H	mu:	eagle	HL-H-H	mi: mu k ^h oi	someone's domesticated eagle
30.	H	lei	tongue	HL-H-H	i lei sen	your red tongue
31.	H	daŋ	mouth	HL-H-LH	ka daŋ nou	my soft palate
32.	H	diŋ	stand	HL-H-LH	i diŋ em	did you stand?
33.	H	kal	to go	HL-H-LH	i kal em	did you go?
34.	H	lai	middle	HL-H-LH	i lai em	is it medial?
35.	H	lai	middle	HL-H-LH	a lai bul	near the middle
36.	H	mu:	eagle	L-H-HL	eŋ mu: ŋe:	what kind of eagle is it?
37.	H	a:r	chicken	L-H-HL	eŋ a:r ŋe:	what kind of chicken is it?
38.	H	koŋ	road	L-H-HL	eŋ koŋ ŋe:	which road is it?
39.	H	k ^h ua	village	L-H-HL	eŋ k ^h ua ŋe:	which village is it?
40.	H	sen	red	L-H-HL	eŋ sen ŋe:	what kind of red is it?
41.	H	di:l	ask	L-H-LH	t ^h ai di:l aŋ	let's ask for vegetable
42.	H	au	scream	L-H-LH	in au aŋ	let's call each other
43.	H	kal	to go	L-H-LH	ron kal aŋ	will come
44.	H	di:l	ask	L-H-LH	mə? di:l aŋ	let's ask for curry
45.	H	li:ŋ	chase	L-H-LH	kel li:ŋ aŋ	let's chase goat
46.	H	koŋ	road	L-H-H	zun koŋ na:	pain of urinal track
47.	H	li:ŋ	chase	L-H-H	ron li:ŋ la:	chase it
48.	H	le:ŋ	visit	L-H-H	ron le:ŋ la:	come and visit me
49.	H	beŋ	ear	L-H-H	ke:l beŋ na:	the infected ear of a goat
50.	H	man	arrest	L-H-H	ron man la:	come and arrest it
51.	H	si:r	side	H-H-HL	ka si:r hou	those near my side
52.	H	nuŋ	back	H-H-HL	zo:ŋ nuŋ hi:	the back of a monkey
53.	H	nuŋ	back	H-H-HL	lal nuŋ sei	the long back of a king
54.	H	nuŋ	back	H-H-HL	ka nuŋ hou	those at my back
55.	H	beŋ	ear	H-H-HL	sial beŋ k ^h a	that buffalo's ear
56.	H	muɑŋ	slow	H-H-L	kal muɑŋ ro?	go slowly
57.	H	beŋ	ear	H-H-L	zo:ŋ beŋ ru?	the ear bone of a monkey
58.	H	ban	sticky	H-H-L	t ^h il ban lou	something not sticky
59.	H	bo:k	tumor	H-H-L	lu bo:k lian	big headed
60.	H	mu:	sleep	H-H-L	nau mu: du?	sleeping well baby
61.	H	piɑi	pinch	H-H-LH	nau piɑi aŋ	let's pinch the baby
62.	H	he:k	accuse	H-H-LH	ka he:k aŋ	I will accuse him
63.	H	moi	beautiful	H-H-LH	ka moi aŋ	I will be beautiful
64.	H	moi	beautiful	H-H-LH	ram moi lei	the soil of a beautiful land
65.	H	re:l	plan	H-H-LH	kal re:l aŋ	let's plan to go

Table A.3: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
66.	H	a:r	chicken	LH-H-HL	he a:r hi	this chicken
67.	H	a:r	chicken	LH-H-HL	in a:r e:k	your chicken's excreta
68.	H	a:r	chicken	LH-H-HL	kan a:r za:t	the number of our chicken
69.	H	muəŋ	slow	LH-H-HL	an muəŋ reŋ	they are always slow
70.	H	him	save	LH-H-HL	an him hi:	they are saved
71.	H	diŋ	stand	LH-H-L	lou diŋ ro?	stand there
72.	H	kal	to go	LH-H-L	lou kal ro?	come here
73.	H	kal	to go	LH-H-L	kan kal lou	we did not go
74.	H	kal	to go	LH-H-L	lou kal su?	do not come here
75.	H	lai	between	LH-H-L	in lai tat	in between
76.	H	a:r	chicken	LH-H-H	an a:r bou	their lost chicken
77.	H	a:r	chicken	LH-H-H	kan a:r bou	our lost chicken
78.	H	au	scream	LH-H-H	an au do:n	they are going to scream
79.	H	di:l	ask	LH-H-H	an di:l don	they are going to ask
80.	H	kal	to go	LH-H-H	an kal do:n	they are going to go
81.	LH	daŋ	another	HL-LH-HL	a daŋ k ^h a	another one
82.	LH	daŋ	another	HL-LH-HL	a daŋ reŋ	its always another one
83.	LH	kal	kidney	HL-LH-HL	i kal mo:	your kidney?
84.	LH	fai	clean	HL-LH-HL	ka fai tsa:k	I want to become clean
85.	LH	in	house	HL-LH-HL	k ^h oi in ŋe	which house?
86.	LH	fai	clean	L-LH-L	mit fai lou	unclean eyes
87.	LH	ki:r	return	L-LH-L	ron ki:r ro?	come back
88.	LH	ki:r	return	L-LH-L	ron ki:r su?	do not come back
89.	LH	lei	buy	L-LH-L	ron lei ro?	buy it
90.	LH	daŋ	prevent	L-LH-L	ron daŋ ro?	prevent it
91.	LH	daŋ	another	H-LH-H	lal daŋ ram	another king's land
92.	LH	in	house	H-LH-H	zo in moi	beautiful Zo house
93.	LH	ka:ŋ	lift	H-LH-H	tsoi ka:ŋ la:	lift it up
94.	LH	baŋ	wall	H-LH-H	lal baŋ moi	the king's beautiful wall
95.	LH	pa:	mushroom	HRH	ram pa: tui	delicious forest mushroom
96.	LH	lau	afraid	LH-LH-LH	an lau aŋ	they will be afraid
97.	LH	e:ŋ	bright	LH-LH-LH	an e:ŋ aŋ	they will shine
98.	LH	ha:l	burn	LH-LH-LH	an ha:l aŋ	they will burn
99.	LH	ŋiam	short	LH-LH-LH	an ŋiam em	are they short?
100.	LH	fai	clean	LH-LH-LH	an fai em	are they clean?
101.	LH	kal	kidney	HL-LH-L	mi: kal ru?	someone's kidney bone
102.	LH	kal	kidney	HL-LH-L	bo:ŋ kal lian	big kidney of a cow
103.	LH	daŋ	Another	HL-LH-L	ti daŋ ro?	do another one
104.	LH	fai	clean	HL-LH-L	ti fai ro?	clean it
105.	LH	ka:ŋ	lift	HL-LH-L	ti ka:ŋ ro?	lift it up

Table A.4: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
106.	LH	daŋ	prevent	HL-LH-H	ka daŋ do:n	I am going to prevent
107.	LH	lei	buy	HL-LH-H	ka lei do:n	I am going to buy
108.	LH	ka:ŋ	lift	HL-LH-H	ka ka:ŋ do:n	I am going to be lifted
109.	LH	ŋai	close	HL-LH-H	ti ŋai la:	make it near
110.	LH	pai	carry	HL-LH-H	i pai tsuan	if you carry
111.	LH	pai	carry	HL-LH-LH	i pai em	do you carry?
112.	LH	lau	afraid	HL-LH-LH	i lau em	are you afraid?
113.	LH	ha:l	burn	HL-LH-LH	i ha:l em	do you burn?
114.	LH	i:p	shrink	HL-LH-LH	i i:p em	do you shrink?
115.	LH	fai	clean	HL-LH-LH	i fai em	are you clean?
116.	LH	in	house	L-LH-HL	eŋ in ŋe:	what kind of house is it?
117.	LH	kor	shirt	L-LH-HL	eŋ kor ŋe	what kind of shirt is it?
118.	LH	maŋ	dream	L-LH-HL	eŋ maŋ ŋe:	what kind of dream?
119.	LH	e:ŋ	bright	L-LH-HL	eŋ e:ŋ ŋe:	What light is it?
120.	LH	baŋ	wall	L-LH-HL	eŋ baŋ ŋe:	What wall is it?
121.	LH	lei	buy	L-LH-LH	tlai lei aŋ	let's buy vegetable
122.	LH	lei	buy	L-LH-LH	in lei aŋ	let's buy for each other
123.	LH	ba:ŋ	Left over	L-LH-LH	meh ba:ŋ aŋ	let's keep some
124.	LH	lau	afraid	L-LH-LH	in lau aŋ	let's fear each other
125.	LH	ki:r	return	L-LH-LH	in ki:r aŋ	let's return each other
126.	LH	ki:r	return	L-LH-H	ron ki:r la	return it
127.	LH	daŋ	prevent	L-LH-H	ron daŋ la:	prevent it
128.	LH	ŋai	near	L-LH-H	ron ŋai la:	come closer
129.	LH	pai	carry	L-LH-H	ron pai la:	carry it
130.	LH	ha:l	burn	L-LH-H	ron ha:l la:	burn it
131.	LH	ha:l	burn	H-LH-HL	ram ha:l hou	those who burn forest
132.	LH	daŋ	another	H-LH-HL	a:r daŋ sa:	another chicken meat
133.	LH	daŋ	another	H-LH-HL	t ^h il daŋ hou	another things
134.	LH	fai	clean	H-LH-HL	a:r fai hou	the clean chicken
135.	LH	lei	buy	H-LH-HL	a:r lei hou	those who buy chicken
136.	LH	ŋai	near	H-LH-L	kal ŋai ro?	go near
137.	LH	kal	kidney	H-LH-L	zo:ŋ kal ru?	kidney bone of monkey
138.	LH	in	house	H-LH-L	ka in huan	my house garden
139.	LH	ha:l	burn	H-LH-L	zoŋ ha:l su?	do not burn monkey
140.	LH	in	house	H-LH-L	ka in tlu:	my collapsed house
141.	LH	daŋ	another	H-LH-LH	lal daŋ in	another king's house
142.	LH	ki:r	return	H-LH-LH	kal ki:r ra:m	please go back
143.	LH	in	house	H-LH-LH	lal in daŋ	another house of the king
144.	LH	ŋai	same	H-LH-LH	riŋ ŋai ze:l	guessing the same thing always
145.	LH	ha:l	burn	H-LH-LH	zu ha:l aŋ	let's burn alcohol

Table A.5: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
146.	LH	ha:l	burn	LH-LH-HL	an ha:l reŋ	they burn it always
147.	LH	daŋ	prevent	LH-LH-HL	an daŋ reŋ	they are preventing always
148.	LH	fai	clean	LH-LH-HL	an fai reŋ	they are clean always clean
149.	LH	daŋ	another	LH-LH-HL	lei daŋ hou	another soil
150.	LH	in	house	LH-LH-HL	an in hou	their houses
151.	LH	kal	kidney	LH-LH-L	an kal ts ^h ia	their bad kidneys
152.	LH	ha:l	burn	LH-LH-L	lou ha:l ro?	burn the field
153.	LH	ha:l	burn	LH-LH-L	min ha:l su?	do not burn me
154.	LH	fai	clean	LH-LH-L	an fai du?	they want to become clean
155.	LH	in	house	LH-LH-L	kan in huan	our house garden
156.	LH	fai	clean	LH-LH-H	an fai do:n	they are going to become clean
157.	LH	in	house	LH-LH-H	an in moi	their beautiful house
158.	LH	in	house	LH-LH-H	an in sei	their long house
159.	LH	ha:l	burn	LH-LH-H	min ha:l la	burn me
160.	LH	ki:r	return	LH-LH-H	an ki:r do:n	they are going to return
161.	L	dai	cold	HL-L-HL	tso dai k ^h a	that cold food
162.	L	fiŋ	wise	HL-L-HL	a fiŋ reŋ	he is wise
163.	L	sik	pinch	HL-L-HL	ka sik tsa:k	I feel like pinching
164.	L	ha:ŋ	brown	HL-L-HL	mi ha:ŋ hou	the brown people
165.	L	k ^h u:r	shiver	HL-L-HL	i k ^h u:r mo:	are you shivering
166.	L	ip	bag	HL-L-HL	k ^h oi ip ŋe:	which bag
167.	L	eŋ	what	HL-L-HL	hei eŋ ŋe:	what is this
168.	L	la:	take	L-L-L	ron la ro?	come and take it
169.	L	fiŋ	wise	L-L-L	mit fiŋ lou	bad taste of eyes
170.	L	ha:ŋ	brown	L-L-L	ron ha:ŋ su?	do not become tan
171.	L	k ^h u:r	shiver	L-L-L	kut k ^h u:r zia?	written with shivering hand
172.	L	dik	correct	L-L-L	lai dik ro?	dig it correctly
173.	L	me?	curry	L-L-L	se? me? ne:n	with the curry
174.	L	me?	curry	L-L-L	za:n me? tu:r	for supper curry
175.	L	fiŋ	wise	H-L-H	zo:ŋ fiŋ ha:	the teeth of a wise monkey
176.	L	fiŋ	wise	H-L-H	lal fiŋ ram	the land of a wise king
177.	L	ip	bag	H-L-H	zo ip moi	Zo's beautiful bag
178.	L	pa:	male	H-L-H	sial pa: tsal	matured male buffalo
179.	L	paŋ	side	H-L-H	tla:ŋ paŋ tlaŋ	down the side of a hill
180.	L	man	price	H-L-H	t ^h i:l man sa:ŋ	the price of expensive things
181.	L	bu:k	weigh	LH-L-LH	an bu:k aŋ	they will weigh
182.	L	fiŋ	wise	LH-L-LH	an fiŋ em	are they wise
183.	L	lai	to dig	LH-L-LH	lei lai aŋ	let's dig the ground
184.	L	lai	to dig	LH-L-LH	an lai em	do they dig
185.	L	puan	announce	LH-L-LH	t ^h u puan toi	short announcement

Table A.6: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
186.	L	kiu	elbow	HL-L-L	ka kiu ru?	the bone of my elbow
187.	L	kiu	elbow	HL-L-L	mi: kiu ru?	the elbow bones of others
188.	L	fiŋ	wise	HL-L-L	i fiŋ lou	you are not wise
189.	L	sik	pinch	HL-L-L	ka sik du?	I want to pinch
190.	L	t ^h uam	dress	HL-L-L	i t ^h uam ba:l	your dirty dress
191.	L	ip	bag	HL-L-L	he: ip hi	this bag
192.	L	dik	correct	HL-L-L	ti dik ro?	correct it
193.	L	mit	eye	HL-L-L	bo:ŋ mit lian	big eyes of a cow
194.	L	pei?	To do	HL-L-L	ti pei? lou	not willing to do
195.	L	so:m	ten	HL-L-L	mi: so:m rual	a group of ten people
196.	L	bil?	sprain	HL-L-L	ke bil? pal?	spraining leg accidentally
197.	L	la:	take	HL-L-H	ka la do:n	I will take
198.	L	bu:k	weigh	HL-L-H	ka bu:k do:n	I will weigh
199.	L	dai	cold	HL-L-H	a dai do:n	it will be cold
200.	L	k ^h u:r	shiver	HL-L-H	ke k ^h u:r kal	shivering legged person
201.	L	nei?	to have	HL-L-H	i nei? tsuan	if you have
202.	L	kua	hole	HL-L-H	zu kua sei	long rat hole
203.	L	lou	Not to	HL-L-H	ti lou la:	don
204.	L	hup	cover	HL-L-LH	i hup em	did you cover
205.	L	dai	cold	HL-L-LH	tsia? dai aŋ	let
206.	L	dai	cold	HL-L-LH	ti dai aŋ	let
207.	L	fiŋ	wise	HL-L-LH	I fiŋ em	are you wise
208.	L	t ^h uam	dress	HL-L-LH	ka t ^h uam fual	my long dress
209.	L	lui	river	L-L-HL	tut lui ŋa	the fish of Tut river
210.	L	ban	post	L-L-HL	eŋ ban ŋe:	what post is it
211.	L	eŋ	what	L-L-HL	nun eŋ ŋe:	what is life
212.	L	eŋ	what	L-L-HL	ke:l eŋ ŋe:	what is a goat
213.	L	eŋ	what	L-L-HL	ip eŋ ŋe:	what is a bag
214.	L	mit	eye	L-L-HL	ke:l mit mu:	the eyeball of a goat
215.	L	lou	not to	L-L-HL	ni lou zo:k	not that one
216.	L	la:	take	L-L-LH	t̩lai la: aŋ	let's take vegetable
217.	L	bu:k	weigh	L-L-LH	in bu:k aŋ	let
218.	L	lai	to dig	L-L-LH	t̩la:n lai aŋ	let's dig the grave
219.	L	mit	eye	L-L-LH	t ^h o mit tle:	a fly
220.	L	lui	river	L-L-LH	tloŋ lui tui	the water of tlawng river
221.	L	la:	take	L-L-H	ron la: la:	come and take it
222.	L	lui	river	L-L-H	tut lui kam	the shore of Tut river
223.	L	bun	pour	L-L-H	ron bun la:	come and pour it
224.	L	nei?	to have	L-L-H	me? nei? tsuan	if we have curry
225.	L	mit	eye	L-L-H	kel mit na:	the infected eyes of a goat

Table A.7: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
226.	L	hup	cover	H-L-HL	ka hup hou	those who covered their mouth
227.	L	ke:l	goat	H-L-HL	ram ke:l sa:	the meat of a wild goat
228.	L	dik	correct	H-L-HL	zir dik ta:	studied the correct one at last
229.	L	ej	what	H-L-HL	hei ej ɲe:	what is this
230.	L	nei?	to have	H-L-HL	pem nei? hi	to have wound
231.	L	hup	cover	H-L-L	ha hup ro?	cover your mouth
232.	L	kiu	elbow	H-L-L	zoŋ kiu ru?	the monkey
233.	L	bu:k	weigh	H-L-L	a:r bu:k ro?	weigh the chicken
234.	L	op	rule	H-L-L	ram op ro?	rule the land
235.	L	sik	pinch	H-L-L	beŋ sik ro?	pinch your ear
236.	L	bu:k	weigh	H-L-LH	zoŋ bu:k aŋ	like weighing of a monkey
237.	L	dik	correct	H-L-LH	ka:l dik ɾam	please go in the right path
238.	L	dik	correct	H-L-LH	riŋ dik zel	guessing right the correct answer always
239.	L	bil?	ferment	H-L-LH	zu bil? aŋ	let's ferment wine
240.	L	bil?	ferment	H-L-LH	zu bil? thou	the ready fermented wine
241.	L	la:	take	LH-L-HL	an la: reŋ	they are always taking
242.	L	bu:k	weigh	LH-L-HL	an bu:k reŋ	They are always weighing
243.	L	fiŋ	wise	LH-L-HL	mi fiŋ hou	the wise people
244.	L	lai	to dig	LH-L-HL	lei lai hou	those who dig the ground
245.	L	ban	post	LH-L-HL	in ban p ^h un	the post that you have built
246.	L	ka:ŋ	burning	LH-L-HL	in ka:ŋ k ^h u:	the smoke of house on fire
247.	L	hup	cover	LH-L-L	lou hup ro?	cover it
248.	L	bu:k	weigh	LH-L-L	min bu:k su?	do not weigh me
249.	L	dai	cold	LH-L-L	tui dai a?	in the cold water
250.	L	ban	post	LH-L-L	in ban tlu:	the collapsed post of a house
251.	L	bun	pour	LH-L-L	lou bun ro?	pour it
252.	L	me?	curry	RLL	Kan me? huan	our vegetable garden
253.	L	bu:k	weigh	LH-L-H	an bu:k do:n	they are going to weigh
254.	L	t ^h uam	dress	LH-L-H	min t ^h uam moi	they dressed me well
255.	L	ip	bag	LH-L-H	in ip moi	your beautiful bag
256.	L	ke:l	goat	LH-L-H	in ke:l lu:	the head of your goat
257.	L	pui	assist	LH-L-H	min pui la:	assist me
258.	L	lei	bridge	LH-L-H	an lei sei	their long bridge
259.	HL	bun	wear	HL-HL-HL	a bun hi:	he has worn it
260.	HL	bun	wear	HL-HL-HL	ka bun tsa:k	I want to wear it
261.	HL	koŋ	waist	HL-HL-HL	ka koŋ hi:	my waist
262.	HL	mi:	people	HL-HL-HL	a mi: hou	his people
263.	HL	ɲu:k	pull	HL-HL-HL	ka ɲu:k tsa:k	I want to pull
264.	HL	bun	ear	L-HL-L	ron bun ro?	come and wear it
265.	HL	ha:k	choke	L-HL-L	ron ha:k su?	do not choke it

Table A.8: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
266.	HL	lu:t	enter	L-HL-L	ron lu:t ro?	come in
267.	HL	ṅu:k	pull	L-HL-L	ron ṅu:k su?	do not pull
268.	HL	en	Look	L-HL-L	ron en su?	do not look
269.	HL	ko:ŋ	Waist	H-HL-H	zo:ŋ ko:ŋ saŋ	monkey's high waist
270.	HL	ko:ŋ	Waist	H-HL-H	zo:ŋ ko:ŋ na:	monkey's back pain
271.	HL	ra:t	often	H-HL-H	lal ra:t do:n	will go often
272.	HL	ru:k	steal	H-HL-H	a:r ru:k bou	stolen chicken
273.	HL	pu:k	cave	H-HL-H	ram pu:k sa:ŋ	high cave in the mountain
274.	HL	bun	wear	LH-HL-LH	an bun aŋ	they will wear
275.	HL	bun	wear	LH-HL-LH	an bun em	did they wear?
276.	HL	ha:k	choke	LH-HL-LH	an ha:k em	did they choke?
277.	HL	maŋ	extinct	LH-HL-LH	an maŋ em	did they extinct?
278.	HL	ṅu:k	pull	LH-HL-LH	an ṅu:k em	did they pull?
279.	HL	ṅu:k	pull	HL-HL-L	i ṅu:k lou	you did not pull
280.	HL	ṅu:k	pull	HL-HL-L	i ṅu:k ba:l	you pull it dirty
281.	HL	ha:k	choke	HL-HL-L	i ha:k lou	you did not choke
282.	HL	ha:k	to wear	HL-HL-L	i ha:k bal?	your dirty cloth
283.	HL	bun	wear	HL-HL-L	i bun lou	you did not wear
284.	HL	ṅu:k	pull	HL-HL-H	ka ṅu:k do:n	I am going to pull
285.	HL	ha:k	choke	HL-HL-H	ka ha:k do:n	I am about to choke
286.	HL	bun	wear	HL-HL-H	ka bun do:n	I am going to wear
287.	HL	lu:t	enter	HL-HL-H	ka lu:t do:n	I am going to enter
288.	HL	ban	reach out	HL-HL-H	a ban do:n	he will reach out
289.	HL	ṅu:k	pull	HL-HL-LH	i ṅu:k em	did you pull
290.	HL	ha:k	choke	HL-HL-LH	i ha:k em	did you choke?
291.	HL	bun	wear	HL-HL-LH	i bun em	did you wear?
292.	HL	lu:t	enter	HL-HL-LH	a lu:t em	did it enter?
293.	HL	hun	time	HL-HL-LH	a hun em	Is it timing?
294.	HL	mi:	people	L-HL-HL	eŋ mi: nge:	what kind of person?
295.	HL	hun	time	L-HL-HL	eŋ hun nge:	What time/period?
296.	HL	haLk	choke	L-HL-HL	eŋ ha:k ŋe:	What choke is it?
297.	HL	ŋa	fish	L-HL-HL	eŋ ŋa ŋe:	what kind of fish?
298.	HL	mu:	seed	L-HL-HL	eŋ mu: ŋe:	what seed is it?
299.	HL	pe:k	give	L-HL-LH	in pe:k ra:m	please let's give
300.	HL	pe:k	give	L-HL-LH	in pe:k ze:l	giving continuously
301.	HL	mu:	seed	L-HL-LH	in mu daŋ	your another seed
302.	HL	ban	reach out	L-HL-LH	in ban ra:m	please reach out
303.	HL	ru:k	steal	L-HL-LH	in ru:k daŋ	another thing that you stole
304.	HL	bun	wear	L-HL-H	ron bun la:	come and wear it
305.	HL	bun	wear	L-HL-H	a bun tsuan	if he wears

Table A.9: The trisyllabic phrases used in the Experiments 1, 2, and 6 (*Cont.*).

Sl. No.	Tones	Mizo	Meaning	Tone contexts	Sentences/ phrases	Meaning
306.	HL	ɲu:k	pull	L-HL-H	ron ɲu:k la:	come and pull it
307.	HL	keu	hatch	L-HL-H	a keu tsuan	if it hatches
308.	HL	ru:k	steal	L-HL-H	a ruk tsuan	if he steals
309.	HL	ru:k	steal	H-HL-HL	t ¹ ru:k hou	those stolen things
310.	HL	ru:k	steal	H-HL-HL	a:r ru:k sa:	stolen chicken
311.	HL	ɲu:k	pull	H-HL-HL	a:r ɲu:k hou	those who pulled chicken
312.	HL	en	watch	H-HL-HL	a:r en hou	those who watched chicken
313.	HL	riak	sleepover	H-HL-HL	ram riak hou	those who sleepover in the paddy field
314.	HL	ru:k	steal	H-HL-L	a:r ru:k du?	wanted to steal chicken
315.	HL	an	watch	H-HL-L	a:r en du?	wanted to watch chicken
316.	HL	riak	sleepover	H-HL-L	ram riak ro?	sleepover in the paddy field
317.	HL	ɲu:k	pull	H-HL-L	zo:ɲ ɲu:k ro?	pull the monkey
318.	HL	ɲiat	to know	H-HL-L	ram ɲiat du?	wanted to know land
319.	HL	ɲu:k	pull	H-HL-LH	zo:ɲ ɲu:k aɲ	let's pull the monkey
320.	HL	en	watch	H-HL-LH	ram en aɲ	let's watch the land
321.	HL	en	watch	H-HL-LH	lal en aɲ	let's watch the king
322.	HL	ɲa:k	wait	H-HL-LH	lal ɲa:k aɲ	let's wait the king
323.	HL	pu:k	cave	H-HL-LH	lal pu:k in	the king's cave
324.	HL	en	watch	LH-HL-HL	an en rej	they always watch
325.	HL	en	watch	LH-HL-HL	in en rej	they always watch each other
326.	HL	riak	sleepover	LH-HL-HL	an riak hou	they sleepover together
327.	HL	ru:k	steal	LH-HL-HL	mi: ru:k hou	others stolen things
328.	HL	ɲa:k	wait	LH-HL-HL	an ɲa:k rej	they always wait
329.	HL	riak	sleepover	LH-HL-L	lou riak ro?	come t sleepover
330.	HL	en	watch	LH-HL-L	lou en ro?	come and watch
331.	HL	en	watch	LH-HL-L	an en du?	they want to watch
332.	HL	ɲa:k	wait	LH-HL-L	lou ɲa:k ro?	wait for it
333.	HL	ɲu:k	pull	LH-HL-L	lou ɲu:k ro?	come and pull it
334.	HL	riak	sleepover	LH-HL-H	an riak do:n	they will sleepover
335.	HL	en	watch	LH-HL-H	an en do:n	they will watch
336.	HL	ɲa:k	wait	LH-HL-H	min ɲa:k do:n	they will wait for me
337.	HL	ɲa:k	wait	LH-HL-H	min ɲa:k la:	will you wait for me
338.	HL	pu:k	cave	LH-HL-H	an pu:k sei	their long cave

Table A.10: The minimal and near minimal tonal sets data lists used in Experiment 1.

Sl. No.	Tones	Words	Sentences
1.	High	be:l 'pot'	tso ^L ts ^h um ^{HL} na ^H be:l ^H t ^h ar ^H an ^{LH} nei ^L 'They have a new rice pot'
2.	Low	be:l 'to rely on'	a ^L ni: ^H te ^H be:l ^L tu:r ^L in ^H a ^L kal ^H 'He/she left to rely on his/her aunt'
3.	Rising	bel 'thorough'	a ^H zir ^L lai ^H a ^L bel ^{LH} ɲe ^{ʔL} ɲe: ^{LH} a ^H ni ^L 'He/she is very much thorough with her studies'
4.	Falling	bel 'to stick'	baŋ ^H a ^{ʔL} mi ^L lem ^L a ^H bel ^{HL} kai ^H 'He/she stuck a picture on the wall'
5.	Rising	le:m 'particularly'	ar ^H tui ^H tui ^H ka ^H ti ^L le:m ^{LH} lou ^L 'I do not like egg particularly'
6.	High	le:m 'to attract'	a ^H fe ^L RTS na ^H in ^L min ^{RTS} le:m ^H ɲe: ^{LH} 'His/her goodness has attracted me very much'
7.	Low	lem 'fake'	mi: ^{HL} ze ^L lem ^L tak ^H a ^H ni ^L 'His/her personality is fake'
8.	Falling	lem 'to swallow'	ka ^H tr ^h el ^L re:t ^{LH} tr ^h ial ^L ka ^H lem ^{HL} dai ^{ʔH} 'I swallowed the gum I chewed right away'
9.	Rising	t ^h aŋ 'a trap'	an ^H t ^h aŋ ^H siam ^L in ^L sa: ^{HL} a ^H o:k ^{HL} t ^h ei ^L bi:k ^{HL} 'The trap they made could trap animals better'
10.	Falling	t ^h aŋ 'to be gone'	a pu: te k ^h uaa ^ʔ a t ^h aŋ me:k 'He/she has gone away to his grandfather's village'
11.	Low	/t ^h aŋ/ 'greasy'	sa: ^{HL} k ^h oi ^{ʔL} tsuan ^H kut ^L a ^H t ^h aŋ ^L tr ^h i:n ^L 'The hands used to become greasy when touching a meat'
12.	High	t ^h aŋ 'known'	a ^L miŋ ^H a ^L t ^h aŋ ^H tr ^h a ^L k ^h op ^H mai ^{LH} 'His/her name is very much well known'
13.	Rising	vai 'all'	kan ^{LH} vai ^{LH} kal ^L ta ^L mai ^{LH} 'All of us went'
14.	Falling	vai 'to brandish'	i ^L tsem ^H vai ^{HL} su ^{ʔL} 'Do not brandish your sword'
15.	High	vai 'chaff'	kan ^{LH} bu ^{ʔL} t ^ʃ hei ^{RTS} tsu ^H a ^L vai ^H a ^L tam ^{LH} 'There is a lot of chaff in the rice that we are winnowing'
16.	Low	vai 'dazzle'	ka ^H mit ^L a ^H vai ^L vek ^H 'My eyes are completely dazzled'
17.	Sentence		lal ^H in ^{HL} X ti ^{ʔL} hi ^H moi ^H a ^H ti: ^L 'Lali thinks the word X beautiful'

Table A.11: Data lists of vowels used in Experiment 5.

Sl. no.	Mizo	Vowels	Meaning	Tones
1.	in	/i/	to drink	H
2.	him	/i/	him	H
3.	sik	/i/	to pinch	L
4.	sen	/e/	red	H
5.	m̩e:l	/e:/	face	H
6.	ban	/a/	sticky	H
7.	sam	/a/	hair	LH
8.	a:r	/a:/	chicken	H
9.	op	/o/	to rule/govern	L
10.	toŋ	/o/	a measurement	L
11.	bu:k	/u:/	to weigh	L
12.	dum	/u/	black	H
13.	hun	/u/	time	HL
14.	si:r	/i:/	corner	H
15.	ts ^h i:n	/i:/	to shut/close	HL
16.	kir	/i:/	to return/give back	LH
17.	he:k	/e:/	to accuse	H
18.	ke:l	/e:/	goat	L
19.	pe:k	/e:/	to give	HL
20.	ha:l	/a:/	to burn	LH
21.	ba:n	/a:/	arm	H
22.	la:k	/a:/	to take	HL
23.	o:n	/o:/	to slant	LH
24.	to:k	/o:/	to be enough	HL
25.	p ^h u:ŋ	/u:/	ghost	HL
26.	lu:t	/u:/	to go in	HL
27.	k ^h u:r	/u:/	to shiver	L

Appendix B

Additional Table



Table B.1: Noun followed by adjectives and nouns of four contrastive tones. For the gloss, please refer to Table 3.2

Underlying			Surface		
Noun	Adjective	Noun	Noun	Adjective	Noun
kel	zoi		kel	zoi	mi:t
L	HL	HL	L	HL	HL
kel	zoi	tai	kel	zoi	tai
L	HL	LH	L	HL	LH
kel	zoi	beŋ	kel	zoi	beŋ
L	HL	H	L	HL	H
kel	zoi	t ^h in	kel	zoi	t ^h in
L	HL	L	L	HL	L
kel	tse:r	mi:t	kel	tse:r	mi:t
L	LH	HL	L	L	HL
kel	tse:r	tai	kel	tse:r	tai
L	LH	LH	L	LH	LH
kel	tse:r	beŋ	kel	tse:r	beŋ
L	LH	H	L	L	H
kel	tse:r	t ^h in	kel	tse:r	t ^h in
L	LH	L	L	LH	L
kel	sa:ŋ	mi:t	kel	sa:ŋ	mi:t
L	H	HL	L	H	HL
kel	sa:ŋ	tai	kel	sa:ŋ	tai
L	H	LH	L	H	LH
kel	sa:ŋ	beŋ	kel	sa:ŋ	beŋ
L	H	H	L	H	H
kel	sa:ŋ	t ^h in	kel	sa:ŋ	t ^h in
L	H	L	L	H	L
kel	lian	mi:t	kel	lian	mi:t
L	L	HL	L	L	HL

kel	lian	tai	kel	lian	tai
L	L	LH	L	L	LH
kel	lian	beŋ	kel	lian	beŋ
L	L	H	L	L	H
kel	lian	t ^h in	kel	lian	t ^h in
L	L	L	L	L	L
zo:ŋ	zoi	mi:t	zo:ŋ	zoi	mi:t
H	HL	HL	H	HL	HL
zo:ŋ	zoi	tai	zo:ŋ	zoi	tai
H	HL	LH	H	HL	LH
zo:ŋ	zoi	beŋ	zo:ŋ	zoi	beŋ
H	HL	H	H	HL	H
zo:ŋ	zoi	t ^h in	zo:ŋ	zoi	t ^h in
H	HL	L	H	HL	L
zo:ŋ	tse:r	mi:t	zo:ŋ	tse:r	mi:t
H	LH	HL	H	L	HL
zo:ŋ	tse:r	tai	zo:ŋ	tse:r	tai
H	LH	LH	H	LH	LH
zo:ŋ	tse:r	beŋ	zo:ŋ	tse:r	beŋ
H	LH	H	H	L	H
zo:ŋ	tse:r	t ^h in	zo:ŋ	tse:r	t ^h in
H	LH	L	H	LH	L
zo:ŋ	sa:ŋ	mi:t	zo:ŋ	sa:ŋ	mi:t
H	H	HL	H	H	HL
zo:ŋ	sa:ŋ	tai	zo:ŋ	sa:ŋ	tai
H	H	LH	H	H	LH
zo:ŋ	sa:ŋ	beŋ	zo:ŋ	sa:ŋ	beŋ
H	H	H	H	H	H

zo:ŋ	sa:ŋ	t ^h in	zo:ŋ	sa:ŋ	t ^h in
H	H	L	H	H	L
zo:ŋ	lian	mi:t	zo:ŋ	lian	mi:t
H	L	HL	H	L	HL
zo:ŋ	lian	tai	zo:ŋ	lian	tai
H	L	LH	H	L	LH
zo:ŋ	lian	beŋ	zo:ŋ	lian	beŋ
H	L	H	H	L	H
zo:ŋ	lian	t ^h in	zo:ŋ	lian	t ^h in
H	L	L	H	L	L
sa:	zoi	mi:t	sa	zoi	mi:t
HL	HL	HL	L	HL	HL
sa:	zoi	tai	sa	zoi	tai
HL	HL	LH	L	HL	LH
sa:	zoi	beŋ	sa	zoi	beŋ
HL	HL	H	L	HL	H
sa:	zoi	t ^h in	sa	zoi	t ^h in
HL	HL	L	L	HL	L
sa:	tse:r	mi:t	sa	tse:r	mi:t
HL	LH	HL	L	L	HL
sa:	tse:r	tai	sa	tse:r	tai
HL	LH	LH	L	LH	LH
sa:	tse:r	beŋ	sa	tse:r	beŋ
HL	LH	H	L	L	H
sa:	tse:r	t ^h in	sa	tse:r	t ^h in
HL	LH	L	L	LH	L
sa:	sa:ŋ	mi:t	sa	sa:ŋ	mi:t
HL	H	HL	L	H	HL

sa:	sa:ŋ	tai	sa	sa:ŋ	tai
HL	H	LH	L	H	LH
sa:	sa:ŋ	beŋ	sa	sa:ŋ	beŋ
HL	H	H	L	H	H
sa:	sa:ŋ	t ^h in	sa	sa:ŋ	t ^h in
HL	H	L	L	H	L
sa:	lian	mi:t	sa	lian	mi:t
HL	L	HL	L	L	HL
sa:	lian	tai	sa	lian	tai
HL	L	LH	L	L	LH
sa:	lian	beŋ	sa	lian	beŋ
HL	L	H	L	L	H
sa:	lian	t ^h in	sa	lian	t ^h in
HL	L	L	L	L	L
bo:ŋ	zoi	mi:t	bo:ŋ	zoi	mi:t
HL	HL	HL	HL	HL	HL
bo:ŋ	zoi	tai	bo:ŋ	zoi	tai
HL	HL	LH	HL	HL	LH
bo:ŋ	zoi	beŋ	bo:ŋ	zoi	beŋ
HL	HL	H	HL	HL	H
bo:ŋ	zoi	t ^h in	bo:ŋ	zoi	t ^h in
HL	HL	L	HL	HL	L
bo:ŋ	tse:r	mi:t	bo:ŋ	tse:r	mi:t
HL	LH	HL	HL	L	HL
bo:ŋ	tse:r	tai	bo:ŋ	tse:r	tai
HL	LH	LH	HL	LH	LH
bo:ŋ	tse:r	beŋ	bo:ŋ	tse:r	beŋ
HL	LH	H	HL	L	H

bo:ŋ	tse:r	t ^h in	bo:ŋ	tse:r	t ^h in
HL	LH	L	HL	LH	L
bo:ŋ	sa:ŋ	mi:t	bo:ŋ	sa:ŋ	mi:t
HL	H	HL	HL	H	HL
bo:ŋ	sa:ŋ	tai	bo:ŋ	sa:ŋ	tai
HL	H	LH	HL	H	LH
bo:ŋ	sa:ŋ	beŋ	bo:ŋ	sa:ŋ	beŋ
HL	H	H	HL	H	H
bo:ŋ	sa:ŋ	t ^h in	bo:ŋ	sa:ŋ	t ^h in
HL	H	L	HL	H	L
bo:ŋ	lian	mi:t	bo:ŋ	lian	mi:t
HL	L	HL	HL	L	HL
bo:ŋ	lian	tai	bo:ŋ	lian	tai
HL	L	LH	HL	L	LH
bo:ŋ	lian	beŋ	bo:ŋ	lian	beŋ
HL	L	H	HL	L	H
bo:ŋ	lian	t ^h in	bo:ŋ	lian	t ^h in
HL	L	L	HL	L	L
ui	zoi	mi:t	ui	zoi	mi:t
LH	HL	HL	L	HL	HL
ui	zoi	tai	ui	zoi	tai
LH	HL	LH	L	HL	LH
ui	zoi	beŋ	ui	zoi	beŋ
LH	HL	H	L	HL	H
ui	zoi	t ^h in	ui	zoi	t ^h in
LH	HL	L	L	HL	L
ui	tse:r	mi:t	ui	tse:r	mi:t
LH	LH	HL	LH	L	HL

ui	tse:r	tai	ui	tse:r	tai
LH	LH	LH	LH	LH	LH
ui	tse:r	beŋ	ui	tse:r	beŋ
LH	LH	H	LH	L	H
ui	tse:r	t ^h in	ui	tse:r	t ^h in
LH	LH	L	LH	LH	L
ui	sa:ŋ	mi:t	ui	sa:ŋ	mi:t
LH	H	HL	L	H	HL
ui	sa:ŋ	tai	ui	sa:ŋ	tai
LH	H	LH	L	H	LH
ui	sa:ŋ	beŋ	ui	sa:ŋ	beŋ
LH	H	H	L	H	H
ui	sa:ŋ	t ^h in	ui	sa:ŋ	t ^h in
LH	H	L	L	H	L
ui	lian	mi:t	ui	lian	mi:t
LH	L	HL	LH	L	HL
ui	lian	tai	ui	lian	tai
LH	L	LH	LH	L	LH
ui	lian	beŋ	ui	lian	beŋ
LH	L	H	LH	L	H
ui	lian	t ^h in	ui	lian	t ^h in
LH	L	L	LH	L	L

Table B.2: Results of the stops pairwise comparison of Mizo VOT.

Contrasts	Estimate	SE	df	<i>t</i> ratio	<i>p</i> value
b - d	-1.186	1.53	4814	-0.776	1
b - k	-135.303	1.53	4814	-88.559	<.0001
b - k ^h	-204.405	1.53	4814	-133.956	<.0001

b - p	-116.599	1.53	4814	-76.349	<.0001
b - p ^h	-187.62	1.53	4814	-122.905	<.0001
b - t	-119.132	1.53	4814	-78.007	<.0001
b - t ^h	-186.939	1.53	4814	-122.408	<.0001
d - k	-134.118	1.53	4814	-87.819	<.0001
d - k ^h	-203.219	1.53	4814	-133.234	<.0001
d - p	-115.413	1.53	4814	-75.603	<.0001
d - p ^h	-186.434	1.53	4814	-122.179	<.0001
d - t	-117.946	1.53	4814	-77.263	<.0001
d - t ^h	-185.753	1.53	4814	-121.681	<.0001
k - k ^h	-69.102	1.53	4814	-45.285	<.0001
k - p	18.705	1.53	4814	12.248	<.0001
k - p ^h	-52.317	1.53	4814	-34.271	<.0001
k - t	16.171	1.53	4814	10.589	<.0001
k - t ^h	-51.636	1.53	4814	-33.811	<.0001
k ^h - p	87.807	1.53	4814	57.568	<.0001
k ^h - p ^h	16.785	1.52	4814	11.009	<.0001
k ^h - t	85.273	1.53	4814	55.907	<.0001
k ^h - t ^h	17.466	1.53	4814	11.451	<.0001
p - p ^h	-71.022	1.53	4814	-46.544	<.0001
p - t	-2.533	1.53	4814	-1.66	1
p - t ^h	-70.341	1.53	4814	-46.078	<.0001
p ^h - t	68.488	1.53	4814	44.884	<.0001
p ^h - t ^h	0.681	1.53	4814	0.446	1
t - t ^h	-67.807	1.53	4814	-44.419	<.0001

Table B.3: Results of pairwise comparison of Mizo vowels in terms of vowel length.

Categories	Features	Contrast	Estimate	SE	df	t ratio	p value
(a) Short vowels	F1	a-e	1.1434	0.1371	42.1	8.34	<.0001
		a-i	2.241	0.1021	42.1	21.945	<.0001
		a-o	1.0615	0.1119	42.1	9.486	<.0001
		a-u	1.9418	0.1119	42.1	17.357	<.0001
		e-i	1.0976	0.1293	42.2	8.488	<.0001
		e-o	-0.082	0.1372	42.2	-0.598	1
		e-u	0.7984	0.1371	42.2	5.821	<.0001
		i-o	-1.1795	0.1022	42.1	-11.541	<.0001
		i-u	-0.2992	0.1022	42.1	-2.928	0.2467
		o-u	0.8803	0.112	42.1	7.863	<.0001
	F2	a-e	-0.8155	0.0901	42.6	-9.048	<.0001
		a-i	-1.4624	0.0671	42.5	-21.802	<.0001
		a-o	0.676	0.0735	42.6	9.194	<.0001

		a-u	0.6037	0.0735	42.5	8.214	<.0001
		e-i	-0.6469	0.0851	42.7	-7.606	<.0001
		e-o	1.4915	0.0902	42.7	16.531	<.0001
		e-u	1.4191	0.0902	42.7	15.733	<.0001
		i-o	2.1384	0.0672	42.6	31.82	<.0001
		i-u	2.066	0.0672	42.6	30.758	<.0001
		o-u	-0.0723	0.0736	42.6	-0.983	1
	F3	a-e	-0.2939	0.313 4	2.6	-0.94	1
		a-i	-0.8996	0.233 4	2.5	-3.862	<.017
		a-o	-0.2195	0.255 4	2.5	-0.86	1
		a-u	0.0174	0.255 4	2.5	0.068	1
		e-i	-0.6057	0.295 4	2.6	-2.053	1
		e-o	0.0744	0.313 4	2.6	0.238	1
		e-u	0.3113	0.313 4	2.6	0.995	1
		i-o	0.6801	0.233 4	2.6	2.917	0.253
		i-u	0.917	0.233 4	2.6	3.934	<.0136
		o-u	0.237	0.255 4	2.6	0.928	1
(b) Long vowels	F1	a-e	1.7573	0.0792	42.2	22.181	<.0001
		a-i	2.6516	0.0855	42.2	30.995	<.0001
		a-o	1.6422	0.097	42.2	16.923	<.0001
		a-u	2.3628	0.0789	42.7	29.948	<.0001
		e-i	0.8943	0.0855	42.1	10.459	<.0001
		e-o	-0.1151	0.097	42.2	-1.186	1
		e-u	0.6055	0.0788	42.7	7.679	<.0001
		i-o	-1.0094	0.1022	42.2	-9.873	<.0001
		i-u	-0.2888	0.0852	42.6	-3.389	0.0684
		o-u	0.7206	0.0967	42.5	7.449	<.0001
	F2	a-e	-1.4053	0.0521	42.8	-26.955	<.0001
		a-i	-1.7018	0.0563	42.7	-30.238	<.0001
		a-o	0.5183	0.0639	42.8	8.115	<.0001
		a-u	0.5565	0.0521	43.1	10.69	<.0001
		e-i	-0.2965	0.0562	42.6	-5.274	<.0002
		e-o	1.9236	0.0638	42.7	30.143	<.0001
		e-u	1.9617	0.052	43	37.734	<.0001
		i-o	2.22	0.0672	42.7	33.015	<.0001
		i-u	2.2582	0.0561	42.9	40.222	<.0001
		o-u	0.0382	0.0638	42.9	0.599	1
	F3	a-e	-0.6191	0.181 4	2.6	-3.425	0.0616
		a-i	-0.9506	0.195 4	2.6	-4.871	<.0007
		a-o	-0.6696	0.221 4	2.7	-3.024	0.1894
		a-u	-0.3775	0.180 4	3.1	-2.096	1
		e-i	-0.3315	0.195 4	2.6	-1.7	1
		e-o	-0.0505	0.221 4	2.6	-0.228	1
		e-u	0.2416	0.180 4	3.1	1.342	1
		i-o	0.2811	0.233 4	2.6	1.205	1

		i-u	0.5731	0.194 4	3	2.947	0.2327
		o-u	0.292	0.221 4	3	1.323	1
(c) Short-long	F1	a-a	0.3431	0.0969	42.1	3.54	<.0446
		i-i	-0.0675	0.0914	42.1	-0.738	1
		u-u	-0.0779	0.0967	42.5	-0.806	1
		e-e	-0.2708	0.1252	42.2	-2.162	1
		o-o	-0.2376	0.112	42.2	-2.122	1
	F2	a-a	-0.2626	0.0637	42.6	-4.123	<.0076
		e-e	0.3272	0.0824	42.7	3.972	<.0121
		i-i	-0.0232	0.0601	42.6	-0.387	1
		o-o	-0.1049	0.0737	42.7	-1.424	1
		u-u	-0.2154	0.0637	42.8	-3.383	0.0694
	F3	a-a	-0.2897	0.221 4	2.6	-1.311	1
		e-e	0.0355	0.286 4	2.6	0.124	1
		i-i	-0.2387	0.208 4	2.6	-1.145	1
		o-o	0.1603	0.256 4	2.6	0.627	1
		u-u	0.1053	0.221 4	2.9	0.477	1

Appendix C

The information of the participants



Table C.1: The information of female participants.

Sl. No.	Name	Age	Languages known	Education	Village
1.	LHPI	20	Mizo, English	Bcom	Aizawl
2.	LN MIR	20	Mizo, English	BA	Aizawl
3.	JLRTI	20	Mizo, English	HSSLC	Aizawl
4.	TLNPI	24	Mizo, English	BA	Aizawl
5.	LPLIK	25	Mizo, English	MA	Thingsulthlah
6.	ZTSI	22	Mizo, English	BSc	Aizawl
7.	LHPI	24	Mizo, English	BA	Aizawl
8.	CLNTI	24	Mizo, English	MA	Seling
9.	VLHI	23	Mizo, English	MA	Aizawl
10.	ZTPI	28	Mizo, English	Msc	Chawngtlai
11.	ZHPIH	20	Mizo, English	BA	Aizawl
12.	JHLVHI	22	Mizo, English	BA	Champhai
13.	LKTI	20	Mizo, English	BSc	Khuangleng
14.	LHMI	21	Mizo, English	BA	Rabung
15.	LRNI	25	Mizo, English	BA	Aizawl
16.	ZTPI	22	Mizo, English	BSc	Aizawl
17.	JRLNIH	24	Mizo, English	BCom	Bairabi
18.	PCLSPI	29	Mizo, English	MA	Chawngtlai
19.	RTHI	20	Mizo, English	BA	Chawngtlai
20.	LRSI	24	Mizo, English	MA	Aizawl
21.	HVLRI	25	Mizo, English	HSSLC	Khawhai
22.	RMSTI	24	Mizo, English	BA	Aizawl
23.	HLRDI	20	Mizo, English	BA	Aizawl
24.	LRAI	21	Mizo, English	HSSLC	Aizawl
25.	MLRSI	26	Mizo, English	BD	Aizawl

Table C.2: The information of female participants.

Sl. No.	Name	Age	Languages known	Education	Village
26.	BLNMI	26	Mizo, English	BSc	Aizawl
27.	JLTPI	28	Mizo, English	HSSLC	Aizawl
28.	VLAPI	23	Mizo, English	HSSLC	Khawzawl
29.	REZIR	48	Mizo, English	BA	Sialsuk
30.	RLNSA	23	Mizo, English	BSc, MLT	Lunglei
31.	MLHTLI	22	Mizo, English	HSSLC	Aizawl
32.	PLAPA	24	Mizo, English	HSSLC	Aizawl
33.	LNZI	22	Mizo, English	HSSLC	Aizawl
34.	LLRRI	20	Mizo, English	BSc, MLT	Aizawl
35.	VTPI	23	Mizo, English	BDS	Champhai
36.	RLRTI	22	Mizo, English	BDS	Aizawl
37.	LTMi	38	Mizo, English	BA	Aizawl
38.	BTPI	34	Mizo, English	BA	Zawngin
39.	LRCI	24	Mizo, English	BA	Thingsul
40.	ZRPI	38	Mizo, English	HSSLC	Aizawl
41.	TMI	36	Mizo, English	BA	Aizawl
42.	RRLI	44	Mizo, English	HSSLC	Champhai
43.	CLCKI	39	Mizo, English	HSLC	Aizawl
44.	CLAPI	24	Mizo, English	MA	Aizawl
45.	LRSI	25	Mizo, English	BA	Aizawl
46.	VRPIP	32	Mizo, English	MA	Aizawl
47.	LNPI	26	Mizo, English	BA	Aizawl
48.	RLTMI	23	Mizo, English	BA	Aizawl
49.	LNPI	24	Mizo, English	BA	Aizawl
50.	ZRTI	25	Mizo, English	Bcom	Aizawl
51.	MSDZI	22	Mizo, English	BDS	Aizawl
52.	LRRIR	21	Mizo, English	BA	Aizawl
53.	RLBFI	28	Mizo, English	MSc	Aizawl

Table C.3: The information of male participants.

Sl. No.	Name	Age	Languages known	Education	Village
1.	HSLA	20	Mizo, English	MSc	Reiek
2.	LNPAK	22	Mizo, English	MSc	Lunglei
3.	RZPA	24	Mizo, English	Mtech	Dampui
4.	KVLRRA	30	Mizo, English	BE Civil	Aizawl
5.	ZRTA	20	Mizo, English	BA	Aizawl
6.	LRRAF	20	Mizo, English	HSSLC	Aizawl
7.	LHSA	23	Mizo, English	BA	Zawngin
8.	BMSTA	22	Mizo, English	BA	Aizawl
9.	VLRRA	23	Mizo, English	MCA	Champhai
10.	LBSA	23	Mizo, English	BCA	Aizawl
11.	LHPA	23	Mizo, English	BE Civil	Aizawl
12.	PCRNLA	24	Mizo, English	BA	Chawngtlai
13.	LHTAF	26	Mizo, English	MSc	Aizawl
14.	LRDA	21	Mizo, English	BA	Khawzawl
15.	KLSBA	22	Mizo, English	BA	Champhai
16.	RLMPA	21	Mizo, English	BTech	Bungzung
17.	CVLDPA	21	Mizo, English	BA	Khawzawl
18.	LCHA	21	Mizo, English	BA	Aizawl
19.	CLHTA	27	Mizo, English	MA	Aizawl
20.	PCMSZA	27	Mizo, English	BA	Zawngin
21.	RLTHA	37	Mizo, English	BA	Chawngtlai
22.	LMPA	26	Mizo, English	BA, LLB	Champhai
23.	VLRRAK	29	Mizo, English	BA	Lungpher
24.	HLNSA	27	Mizo, English	BSc	Champhai
25.	VLBZA	21	Mizo, English	HSSLC	North Serzawl
26.	LSLA	23	Mizo, English	HSSLC	Phuaibuang
27.	PZNLA	48	Mizo, English	HSSLC	Aiduzawl
28.	LRKA	21	Mizo, English	BA	Aizawl
29.	LCHAS	23	Mizo, English	MA	Aizawl
30.	LCCA	24	Mizo, English	BA	Aizawl
31.	BLRPA	25	Mizo, English	BA	Aizawl
32.	JLBNA	24	Mizo, English	BA, LLB	Aizawl
33.	KLPMA	38	Mizo, English	HSSLC	Northeast Khawdungsei
34.	RLTFKA	23	Mizo, English	BDS	Kolasib
35.	BVLNA	22	Mizo, English	BA	Saitual
36.	MSKAK	22	Mizo, English	MBBS	Aizawl
37.	LKNA	46	Mizo, English	HSSLC	Aizawl
38.	KLRLA	39	Mizo, English	BA	Aizawl
39.	BLTA	21	Mizo, English	BSc	Aizawl
40.	PVLLA	40	Mizo, English	HSSLC	Aiduzawl

Table C.4: The information of male participants.

Sl. No.	Name	Age	Languages known	Education	Village
41.	ZTSA	18	Mizo, English	HSSLC	Aizawl
42.	JZMA	24	Mizo, English	BA	Aizawl
43.	GLSZA	20	Mizo, English	BA	Aizawl
44.	ZCMA	23	Mizo, English	BCom	Aizawl
45.	LRTAR	22	Mizo, English	BA	Aizawl
46.	LRTA	20	Mizo, English	BA	Aizawl
47.	MSTA	27	Mizo, English	BA	Aizawl
48.	VLHA	28	Mizo, English	MA	Aizawl
49.	LTPA	27	Mizo, English	MBA	Aizawl
50.	KLCHA	40	Mizo, English	BA	Aizawl
51.	LRPA	21	Mizo, English	BSc	Aizawl
52.	LRSA	29	Mizo, English	MA	Aizawl
53.	RSZA	25	Mizo, English	BSc	Aizawl

Appendix D

Passage “Kawrdumbela”

D.1 Mizo orthography

Kawrdumbela hi a hmel a chhe em em mai a. Vawikhat chu a vauah thang a kam a, nitin hian a en thin a, nimahsela a awk chu a chang ngai hauh lova, Kawrdumbela chuan a chang ta a. Nakinah chuan Vazuntei hi a lokal a, thangawk chu a la ta vek a, chutia a lak lai tak chuan Kawrdumbela chuan aman ta a. Vazuntei chuan, ‘Min thlah la, i thatna tur ka hrilh ang che,’ a ti a. Kawrdumbela chuan, ‘Ka thatna tur chu sawi rawh,’ a ti a. Vazuntei chuan, ‘Nakin zanah lal kawmchhakah kal la, ‘Lalpa, lalpa, i fanu Kawrdumbela i neihtir loh chuan ralin an that ang che, i khuate pawh an that vek ang, ti la, chutianga zan thum i tih chuan a tha ang,’ a ti a. Kawrdumbela chuan a thlah ta a, inah a haw ta vang vang a.

Zanah chuan Vazuntei sawi ang khan lal in kawmchhakah a kal a, ‘Lalpa, i fanu Kawrdumbela i neihtir loh chuan ralin an that ang che, i khuate pawh an hal vek ang,’ a ti a. Lal chuan a hriat hmasak ber zan chuan tak tak niin a ring lova. Nimahsela zan thum lai a hriat tak avangin a hlau ta hle mai a, nimahsela a fanu chu a hmel a that em avangin Kawrdumbela, tlangval zinga chhe ber han neihtir chu a ui hle si a. ‘Chemte, i pa leh khuate zawng zawng chan vek nge i duh, Kawrdumbela neiha i pa leh i khuate chan loh?’ a ti a. Lal fanu chuan thlan ngaihna a hre mang lova, Kawrdumbela chu a duh lo em em si a; a neih loh chuan a khua te leh a pa te chu a chan dawn si a, hreh tak chungin a nei ta a.

Kawrdumbela chu a lawm em em a, nimahsela lal fanu chuan a haw em em thin a, a kianga awm te hi a ning em em thin a.

Tuk khat chu Kawrdumbela chuan, ‘I pa len va hawh la, luiah sangha ka zu man ange,’ a ti a. Lal fanu chu len hawh tur chuan a kal ta a, Kawrdumbela a hmuh hreh avangin rei tak a awm a. A pa chuan, ‘Va haw thuai thuai rawh,’ a ti a, hreh tak chuan len chu Kawrdumbela chu a va pe a.

Kawrdumbela chu luiah a kal ta a. Len chu a han deng a, Nghan-giai hi a man a. Nghan-giai chuan, ‘Min thlah rawh, i thatna tur ka hrilh ang che,’ a ti a. Kawrdumbela chuan, ‘Min hrilh ta che,’ a ti a. Nghan-giai chuan, ‘Zuk inbual la, lung mam takin innawt innawt la a tha e,’ a ti a, a zu inbual a, Nghan-giai sawi ang chuan lung mam in a innawt a, a inbual zawh chuan a han inen vel a, a lo ngovin a lo tha ta em em mai a.

Inah chuan a han hawng a, a nupui chuan a pasal kha a ni tih a hre hauh lova. A nupui chuan, ‘Mi fate tha tak tak hi kan hmu kan hmu a, kan hmelchhepa kha a lo hawng leh awm sia, a hmel hmuh ka ning em mai’ a ti a. A pasal chuan, ‘Keimah hi Kawrdumbela kha ka ni alawm,’ a ti a, a nupui chuan mak a ti em em a, a pasal chu a hmangaih ta em em a. A pate len a hawh kha a va pe leh a, nidanga a thangrei thin nen, kawngka atangin, ‘Kha u in len,’ a ti a, a paih lut thuai a, a hawng leh thuai a. A pa chuan, ‘Engtizia nge ni dangah kan inah a lokal in rei tak tak a awm thin si a, a va hmanhmawh em!’ a ti a. An inah a va kal a, a pasal Kawrdumbela chu a va hmu a, chutia a lo that tak dan zawng zawngte chu a zawt a. Ani chuan Nghan-giai a man thu te, a inbual thu te kha a hrilh vek a.

Lal chuan hmelthat ve a duh a, luiah a zu kal ve a. Nghahrah hi a zuk man ve a, ‘Min thlah rawh, i thatna tur ka hrilh ang che. Zu inbual la lung chikin innawt ang che,’ a ti a. Lal chu lawm takin a zu inbual a, lung chikin a innawt a. A inbual zawh chuan a han in en a, a taksa zawng zawng chu a chik chhe ta vek a, hlauhawm khawpin a chik ta a. Inah a hawng ta a. In a thlen chuan a hmel hmu apiang chu, an tlanche ta zel a. An hlau em em a, Lal chu a mangang ta em em a. ‘Mite chuan, ‘Lalpa eng i ti ta nge ni, i hmel a va chhe ta em!’ an ti a. Lal chuan Kawrdumbela a mawhchhiat a, ‘Kawrdumbela sawi angin luiah ka zuk kal a, Nghahrah ka man a, ‘Inbual la, lungchikin innawt rawh,’ a ti a. A sawi angin ka ti a, nimahsela that a hnekin ka lo chhe ta em em a nih hi,’ a ti a.

D.2 Phonetic transcription

kor^{LH}dum^Lbe:l^Ha^L hi:^H a^L me:l^H a^H ts^{he}^L e:m^{HL} e:m^{HL} mai^H a^H voi^{HL}k^hat^L tsu^H a^H va^La[?]^L t^ha[?]^{RTS} a^H kam^{HL} a^H ni^Htin^L hian^H a^H en^{HL} tr^{hi}:n^L a^H ni^Lma[?]^Lse^Hla^H a^H o:k^{HL} tsu^H a^L tsa[?]^{LH} ɣai^{LH} hau[?]^L lo^Lva^H kor^{LH}dum^Lbe:l^Ha^L tsuan^{HL} a^H tsa:ɣ^L ta:^{HL} a^H na^Lki^Hna[?]^L tsuan^H va^Lzu:n^Lte^{HL}i^H hi^H a^L lou^{RTS} kal^H a^H t^ha[?]^{RTS} o:k^{HL} tsu^H a^H la^L ta^L vek^H a^H tsu^Htia^H a^H la:k^{HL} lai^H tak^L tsuan^H kor^{LH}dum^Lbe:l^Ha^H tsuan^{HL} a^Lman^H ta:^{HL} a^H va^Lzu:n^Lte^{HL}i^H tsuan^{HL} min^{LH} t^hah^L la^H i^H t^hat^Lna^H tu:r^L ka^H ɾil[?]^L a[?]^{RTS} tse^H a^H ti:^{HL} a^H kor^{LH}dum^Lbe:l^Ha^L tsuan^{HL} ka^H t^hat^Lna^L tu:r^L tsu^H soi^{LH} ro[?]^L a^H ti:^L

a^H va^L zu: n^L te^{HL} i^H tsuan^{HL} na^L kin^H zan^{HL} a^L lal^H kom^L ts^h ak^L a^L kal^H la: ^H lal^H pa: ^{HL}
lal^H pa: ^{HL} i^H fa^L nu: ^L kor^{LH} dum^L be: ^l H a^L i^H nei[?] L ti: ^r H lo[?] L tsuan^H ra: ^l H in^L an^{LH} t^h at^L
aj^{RTS} tse^H i^L k^h ua^H te^H po[?] L an^{LH} t^h at^L vek^H aj^{LH} ti: ^L la: ^H tsu^H tia[?] a^H za: ⁿ L t^h um^H
i^H ti[?] L tsuan^H a^H tr^h a^L aj^{RTS} a^H ti: ^L a^H kor^{LH} dum^L be: ^l H a^L tsuan^{HL} a^H t^l ^h a[?] L ta: ^{HL}
a^H in^{RTS} a[?] L a^L ho: ^{LH} ta: ^L va: [?] L va: [?] L a^H za: ⁿ L a[?] L tsuan^H va^L zu: n^L te^{HL} i^H soi^L aj^L
k^h a: ⁿ H lal^H in^{LH} kom^L ts^h ak^L a[?] L a^L kal^H a^H lal^H pa: ^{HL} i^H fa^L nu: ^L kor^{LH} dum^L be: ^l H a^L
i^H nei[?] L ti: ^r H lo[?] L tsuan^H ra: ^l H in^L an^{LH} t^h at^L aj^L tse^H i^L k^h ua^H te^H po[?] L an^{LH} ha: ^L
vek^H aj^{LH} a^H ti: ^L a^H lal^H tsuan^{HL} a^H ri^{at} ^{HL} ma^H sak^L ber^{HL} za: ⁿ L tsuan^H tak^L tak^L
ni^L in^H a^L ri[?] H lo^L va^H ni^L ma[?] L se^H la: ^H zan^L t^h um^H lai^H a^H ri^{at} ^{HL} ta: ^k ^{HL} a^H va[?] L in^H
a^L lau^{LH} ta: ^L le: ^{LH} mai^H a^H ni^L ma[?] L se^H la^H a^H fa^L nu: ^L tsu^H a^L me: ^l H a^H tr^h at^L e: ^m ^{HL}
a^H va: [?] L in^H kor^{LH} dum^L be: ^l H a^L t^l aj^{RTS} va: ^l H zi: [?] H a^H ts^h e: ^L ber^{HL} han^L nei[?] L ti: ^r H tsu^H
a^L ui^H le: ^{LH} si: ^L a^H tsem^L te: ^{HL} i^H pa: ^{HL} le[?] L k^h ua^H te^H zo[?] L zo[?] L tsa: ⁿ L vek^H [?] e: ^{HL}
i^H du[?] L kor^{LH} dum^L be: ^l H a^L nei[?] L a^H i^L pa: ^{HL} le[?] L i^L k^h ua^H te^H tsa: ⁿ L lou[?] L a^H ti: ^L a^H
lal^H fa^L nu: ^L tsuan^{HL} t^l ^h an^L [?] ai[?] L na^H a^L [?] e^H ma[?] L lo^L va^H kor^{LH} dum^L be: ^l H a^L tsu^H a^H
du[?] L lou^L e: ^m ^{LH} e: ^m ^{LH} si: ^L a^H a^H nei[?] L lou[?] L tsuan^H a^L k^h ua^H te^H le[?] L a^H pa: ^{HL} te^H
tsu: ^H a^L tsa: ⁿ H do: ⁿ H si: ^L a^H [?] e[?] L tak^H tsu[?] H in^H a^H nei^L ta: ^{HL} a^H kor^{LH} dum^L be: ^l H a^L
tsu: ^H a^L lo: ^m ^{RTS} e: ^m ^{HL} e: ^m ^{HL} a^H ni^L ma[?] L se^H la: ^H lal^H fa^L nu: ^L tsuan^{HL} a^H ho^H e: ^m ^{HL}
e: ^m ^{HL} tr^h: ⁱ ⁿ L a^H a^L kia[?] H a^H om^{RTS} te^H hi: ^H a^L ni[?] ^{RTS} e: ^m ^{HL} e: ^m ^{HL} tr^h: ⁱ ⁿ L a^H
tu: ^k ^{HL} k^h at^L tsu: ^H kor^{LH} dum^L be: ^l H a^L tsuan^{HL} i^H pa: ^H le: ⁿ L va^H ho[?] L la: ^H lui^L a[?] L
sa^L [?] a: ^{HL} ka^H zu^L man^H a^H [?] e: ^H a^H ti: ^L a^H lal^H fa^L nu: ^L tsu^H le: ⁿ L ho[?] L tu: ^r L tsuan^H
a^H kal^H ta: ^{HL} a^H kor^{LH} dum^L be: ^l H a^L a^H mu[?] L [?] e[?] L a^H va: [?] L in^H rei^H tak^L a^L om^H a^H
a^H pa: ^{HL} tsuan^{HL} va^H ho: ^{LH} t^h uai^L t^h uai^{HL} ro[?] L a^H ti: ^L a^H [?] e[?] L tak^H tsuan^H le: ⁿ L
tsu: ^H kor^{LH} dum^L be: ^l H a^L tsu: ^H a^L va^H pe: ^L a^H kor^{LH} dum^L be: ^l H a^L tsu^H lui^L a[?] L a^L kal^H
ta: ^{HL} a^H le: ⁿ L tsu^H a^H han^L de: [?] H a^H [?] a^L [?] [?] ai^H hi: ^H a^L man^H a^H [?] a^L [?] [?] ai^H tsuan^{HL}
min^{LH} t^l ^h a[?] L ro[?] L i^H tr^h at^L na^H tu: ^r L ka^H ri[?] L aj^{RTS} tse^H a^H ti: ^L a^H kor^H dum^L be: ^l H a^L
tsuan^{HL} min^{LH} ri[?] L ta^L tse: ^{HL} a^H ti: ^L a^H [?] a^L [?] [?] ai^H tsuan^{HL} zuk^L in^L bual^H la^H lu[?] ^{RTS}
ma: ^m ^H tak^L in^H in^L no: ^t ^{HL} in^L no: ^t ^{HL} la: ^H a^H tr^h a: ^L e^H a^H ti: ^L a^H a^H zu^L in^L bual^H a^H
[?] a^L [?] [?] ai^H soi^L aj^L tsuan^H lu[?] ^{RTS} ma: ^m ^H in^H a^H in^L no: ^t ^{HL} a^H a^H in^L bual^L zo[?] L tsuan^H
a^H han^L in^L en^{HL} ve: ^l ^{HL} a^H a^L lou^{RTS} nou^H vin^H a^L lou^{LH} tr^h a^H ta^L e: ^m ^{LH} e: ^m ^{LH} mai^H
a^H in^H a[?] L tsuan^H a^H han^L ho: [?] ^{RTS} a^H a^H nu^L [?] ^{RTS} tsuan^{HL} a^H pa^L sal^{RTS} k^h a^H a^H ni^L
ti[?] L a^H [?] e^H hau[?] H lo^L va^H a^H nu^L [?] ^{RTS} tsuan^{HL} mi^H fa: ^{HL} te^H tr^h a^L tak^L tak^H hi^H kan^H
mu: ^L kan^{LH} mu: ^L a^H kan^{RTS} me: ^l H ts^h e^L pa: ^{HL} k^h a^H a^L lou^{LH} ho[?] L le[?] L o: ^m ^L sia^H a^H
me: ^l H mu[?] L ka^L ni[?] ^{RTS} e: ^m ^{HL} mai^{LH} a^H ti: ^L a^H a^H pa^L sal^{RTS} tsuan^{HL} kei^{LH} ma[?] L hi^H
kor^{LH} dum^L be: ^l H a^L k^h a^H ka^H ni: ^L a^H lo: ^m ^{LH} a^H ti: ^L a^H a^H nu^L [?] ^{RTS} tsuan^{HL} mak^L a^H
ti^L e: ^m ^{LH} e: ^m ^{LH} a^H a^H pa^L sal^{RTS} tsu: ^H a^H ma^H [?] [?] L ta^L e: ^m ^{HL} e: ^m ^{HL} a^H a^H pa: ^{HL} te^H
le: ⁿ L a^H ho[?] L k^h a: ^H a^L va^H pe^L le[?] L a^H ni^H da[?] ^{RTS} a^H a^H t^h a[?] ^{HL} rei^{RTS} tr^h in^{HL} ne: ⁿ L

koŋ^Hka:^H a^Htraŋ^Hin^H k^ha:^{HL} u^H in^{LH} le:n^L a^H ti:^L a^H a^H pai[?]^L lu:t^{HL} t^huai:^L a^H a^L
 ho:ŋ^{LH} le[?]^L t^huai:^L a^H a^H pa:^{HL} tsuan^{HL} eŋ^Lti:^Lzia:^L ŋe:^{HL} ni:^Hdaŋ^Ha[?]^L kan^{RTS} in^Ha[?]^L
 a^L lou^{LH}kal^Lin^H rei^H tak^H tak^H a^L om^{LH} tr^hi:n^L si:^{RTS} a^H a^L va^H maŋ^{HL}mo[?]^L e:m^{HL} a^H
 ti:^L a^H an^{RTS} in^Ha[?]^L a^L va^H kal^H a^H a^H pa^Lsal^{LH} kor^{LH}dum^Lbe:l^Ha^L tsu^H a^L va^H mu:^L
 a^H tsu^Htia^H a^L lou^{LH} tr^hat^L ta:k^{HL} dan^L zoŋ^L zoŋ^{HL}te^H tsu:^H a^H zo:t^{HL} a^H a^Hni^{HL}
 tsuan^{HL} ŋa^Lŋjai^H a^H man^L t^hu:^{RTS} te^H a^H in^Lbual^L t^hu:^{RTS} te^H k^ha:^H a^H ri:[?]^L vek^H
 a^H lal^H tsuan^{HL} me:l^Htr^hat^L ve:^L a^H du[?]^L a^H lui^La[?]^L a^H zu^L kal^H ve:^L a^H ŋa^Lra[?]^L hi:^H
 a^H zuk^L man^H ve:^L a^H min^{LH} t^ha[?]^L ro[?]^L i^H tr^hat^Lna^H tu:r^L ka^H ri:[?]^L aŋ^{RTS} tse^H zu^L
 in^Lbual^H la:^H luŋ^{LH} tsik^Lin^H in^Lno:t^{HL} aŋ^{RTS} tse^H a^H ti:^L a^H lal^H tsu^H lo:m^{LH} tak^Lin^H
 a^H zu^L in^Lbual^H a^H luŋ^{LH} tsik^Lin^H a^H in^Lno:t^{HL} a^H a^H in^Lbual^L zo[?]^L tsuan^H a^H han^L
 in^L en^{HL} a^H a^H tak^Lsa:^{HL} zoŋ^L zoŋ^{HL} tsu^H a^H tsik^L ts^he^L ta^L vek^H a^H lau[?]^Lom^{LH}
 k^hop^Lin^H a^H tsik^L ta:^{HL} a^H in^Ha[?]^L a^L hoŋ^{RTS} ta:^{HL} a^H in^H a^H t^hen^{HL} tsuan^H a^L me:l^H
 mu:^L a^Hpiag^H tsu:^H an^{LH} tla:n^{LH}ts^he^L ta^L ze:l^{LH} a^H an^{LH} lau^{RTS} e:m^{HL} e:m^{HL} a^H lal^H
 tsu^H a^L maŋ^{LH}aŋ^L ta^L e:m^{HL} e:m^{HL} a^H mi:^{HL}te^H tsuan^{HL} lal^Hpa:^{HL} eŋ^L i^H ti:^L ta:^{HL}
 ŋe:^{HL} ni:^L i^L me:l^H a^L va^H ts^he^L ta^L e:m^{HL} an^{LH} ti:^L a^H lal^H tsuan^{HL} kor^{LH}dum^Hbe:l^La^L
 a^H mo[?]^Lts^hiat^{HL} a^H kor^Ldum^Hbe:l^La^H soi^L aŋ^Lin^H lui^La[?]^H ka^H zuk^L kal^H a^H ŋa^Lra[?]^L
 ka^L man^H a^H in^Lbual^H la:^H luŋ^{LH}tsik^Lin^H in^Lno:t^{HL} ro[?]^L a^H ti:^L a^H a^H soi^L aŋ^Lin^H ka^H
 ti:^L a^H ni^Lma[?]^Lse^Hla^H tr^hat^L a^H ŋe:k^{HL}in^H ka^L lou^{LH} ts^he^L ta^L e:m^{HL} e:m^{HL} a^H ni[?]^L
 hi^H a^H ti:^L a^H

D.3 Translation by Khiangte (2002)

Once upon a time, there lived a black and ugly man called Kawrdumbela. One day, he caught a small bird which turned out to be very gifted. The bird pleaded to be let out and told Kawrdumbela that it would enable him to marry the Chief's beautiful daughter if he did so. The strange bird then told him to go near the chief's house at midnight and for three successive nights cry out that should Kawrdumbela not marry his daughter, the chief would face a disaster. Kawrdumbela carried out the instructions of the bird and subsequently married the chief's daughter and lived very happily. The wife of Kawrdumbela was far from happy, however, and found all sorts of excuses to stay out of the house, much to the embarrassment of her husband. One day, Kawrdumbela sent his wife to fetch the fishing net of his father-in-law and set out to fish in the river. He caught a small fish, which turned out to be an enchanted one, as was the bird. On the advice of the fish Kawrdumbela rubbed himself with a smooth stone and was transformed into a handsome young man. When he returned home, his wife failed to recognise him at a distance, but when she came to realise

the truth she became mightily pleased. She had to return the fishing nets and in her eagerness to return home, she just threw them into her father's house from the doorway and hastened back to her husband. Her strange behaviour so amazed her father that he proceeded at once to his son-in-law's house and was there acquainted with the good fortune of Kawrdumbela. Now as the chief too longed to be handsome, he also went to the river and caught the same fish. The fish then told him to rub himself with a rough stone which the chief did. After doing so he returned home, full of confidence and pride at his expectant new change. Instead of being welcome, he found that he repulsed the people he met, because the poor Chief had been changed for the worse, much to his dismay, while Kawrdumbela and his wife lived happily ever after.



Appendix E

Passage “Pu Chhurbura an tih chu”

E.1 Mizo orthography

Mizo thawnthu khawvela a chanchin ngaihnaawm tawp thei lo chu Chhurbura chanchin hi a ni a, miin Mizo thawnthu hi hre viau mahsela Chhurbura chanchin hi an hriat tel loh chuan a kim thei ngai lo. Dik taka kan sawi duh chuan Mizo thawnthu khawvelah hian Chhura ang tluka lar leh chanchin ngah leh a chanchin ngaihnaawm bawk si hi tumah an awm thei lovang tih a chiang a ni.

A chanchinah hian thil inkawkalh tak tak leh mak danglam tak tak a awm a, naupang leh pitar leh putar chena ngaihnaawm tih theih tur thil chi hrang hrang a in phan kual vel a ni. Kawng khata kan ngaihtuah chuan a atna lam hian rilru a kaihruai thui hle a, hmanlai thawnthua mi hmang larte zingah pawh a mawl ber tuan chhuak a ni awm mang e tih tur khawp a ni.

Kawng lehlama kan thlir leh thung chuan a finna lai chharchhuah tur a tam hle thung. A thiltih zawng zawng leh a nungchangte hi ngunthluk zawka kan ngaihtuah chuan a buang angin lang thin tak mahse, a atna chhan hi kan hriat tam tak hi chu a u Nahaia a khawngaih leh hmangaihna vang liau liau a ni tih a hriat theih. Naa lah hi mi thatchhia leh zelhel thiam tak a lo ni ve nen. Chhura chanchina ngaihnaawm tak takte hi Nahaia nen an thiltih dun leh an pahniha chung a thil thlengte a ni tlangpui.

Nahaia nena an chettlatna kawng hrang hrangah hian Chhura chuan thil hrehawm leh vanduaina eng eng emaw a tawk chho deuh reng a. Chu chu Nahaian a bum fin vang a ni a. Naa tel lohnaah erawh chuan Chhura hi a hlawhtling thei em em a ni.

A chanchin hi khawilai aṅang pawn sawi ṅan dawn ila ngaihnaawm tak a ni thei zel a, chanchin tawi leh hlimawm tak tak sawi tur a nei thluah a ni. Chhura chanchin danglamna tak chu, thawnthu dang anglo takin a khawilai aṅang pawhin sawi ṅan ila

a inlalawn chho thei zel a, a ngaihnawmna a nep chuang lo. Khawi aṭangin nge sawi ṭan leh tih tawp ṭha zawk ang aw tih hi mi tam tak rilru tibwaitu a ni mah mah zawk a ni.

Mi tam takin an sawi ṭhin dan chuan khawvel hmun ṭhenkhat zawl diai duai hote hi Chhura vuak zawl anga sawi a ni ṭhin a. Tuboh lian tak a nei a, chu chuan lei sakhat leh lungte a vaw kehdarh vek a, zawlah a siam a, hmun ṭhenkhat a lo vaw khuar nasa deuhva, luikawr leh phaikuamah a lo chang a, a vuak zawl ṭhat peih loh lai leh a kalsan laite chu tlang pawngah a lo chang ta nia ngai an awm a, chung a tih hnu a thih dan pawh hi mi tam takin an hrechiang thei lova, a thih dan chungchangah hian ngaihdan hrang pawh a tam thei hle.

A thihdan chungchang hi ṭhenkhat sawi dan chuan, a zinna ṭumkhatah tawhsual a tawk nia ngai an awm a. ṭhenkhat sawi dan chuan a zinna Mawngping khuaah lal ni zuiin nuamsa takin a thi niin an sawi bawk.

Chubakah chuan a thihdan chungchang hi sawi dan chi khat a la awm leh a. Vawikhat chu an khuaah mite chu hlim takin an infiam a. Chhura chuan nuam a ti em em mai a, tel reng mai chu a duh a, mite chuan an inlamah chaw te an va ei a, an va inhrai puar leh te te ṭhin a. Chhura erawh chuan haw nachang pawh a hre lo reng reng a. Chutia engmah ei leh in lova hun rei tak chu intihhlimnaa a tel avang chuan rilṭam leh taksa chauh luat tuar lovin a thi niin an sawi bawk.

A thihdan hi a enga pawh chu nise Chhura hi a thih lai vel chuan khawkhata mi langsar leh mite hriat lar tak niin a thi a ni tih chu a chiang hle.

He khawvel hi siam anih laia tel ve angin sawina awm ṭhin mahse kum zabi 14-na lai vel bawr khan Mizoram chhaklam khawi hmun hmunah emaw hian a khawsa niin hriat a ni a, chung hmunah chuan a sulhnu thil chi hrang hrang - a fa rep te, a se khalh te, a talhtum tihte hmuh tur tam tak tun thleng hian a la awm.

E.2 Phonetic transcription

mi^Lzou^H t^hon^Lt^hu^H k^ho^Hve:l^{HL}a^H a^H tsan^Ltsin^{HL} ṇai[?]L nom^{HL} to:p^L t^hei^L lou^L tsu^H ts^hu:r^Hbu:r^Ha^H tsan^Ltsin^{HL} hi^H a^H ni:^L a^H mi:^H in^L mi^Lzou^H t^hon^Lt^hu^H.RTS hi^H ṛe^H viau^H ma[?]Lse^Hla^H ts^hu:r^Hbu:r^Ha^H tsan^Ltsin^{HL} hi^H an^{RTS} ṛiat^{HL} tel^L lo[?]L tsuan^H a^L kim^{LH} t^hei^L ṇai^{LH} lou^L dik^L tak^Ha^H kan^{LH} soi^L du[?]L tsuan^H mi^Lzou^H t^hon^Lt^hu^H k^ho^Hve:l^{HL}a[?]L hian^H ts^hu:r^Ha^L aṅ^L tluk^La^H la:r^{LH} le[?]L tsan^Ltsin^{HL} ṇa[?]L le[?]L a^H tsan^Ltsin^{HL} ṇai[?]L nom^{HL} bok^H si:^{RTS} hi^H tu:^Lma[?]H an^{LH} om^{LH} t^hei^L lo^Lvaṅ^{LH} ti[?]L a^L tsiaṅ^H a^H ni:^L a^H tsan^Ltsin^{HL}a[?]L hian^H t^hi^H in^Lko^Lkal[?]L tak^L tak^H le[?]L mak^L daṅ^{LH}lam^{LH} tak^L tak^L a^L om^H a^H nau^Hpaṅ^{LH} le[?]L pi^Htar^H le[?]L pu^Htar^H tsen^{LH}a^H

ɲai?Lnom^{HL} ti?L t^hei?L tu:r^L t^hil^H tsi^L ɾaj^H ɾaj^H a^L in^L p^han^{RTS} kual^H ve:l^{HL} a^H
 ni^L koŋ^H k^hat^La^H kan^{LH} ɲai?Ltua?L tsuan^H a^H a:t^{HL}na^H lam^{RTS} hian^{HL} ril^Hru:^{HL} a^H
 kai^Lruai^H t^hui^H ɲe:^{RTS} a^H ma:n^{RTS}lai^H t^hon^Lt^hu:^{RTS} a^H mi^L miŋ^H la:r^{RTS}te^H ziŋ^Ha?L
 po?H a^L mo:l^{LH} ber^L tluan^L ts^huak^{HL} a^H ni^L o:m^L maŋ^L e^H ti?L tu:r^L k^hop^L a^H ni^L
 koŋ^H le?L lam a^H kan^{LH} t^hi:r^L le?L t^huŋ^{HL} tsuan^H a^H fin^{HL}na^H lai^H ts^har^Lts^hua?L
 tu:r^L a^L tam^{LH} ɲe:^{RTS} t^huŋ^{HL} a^L t^hil^Hti?L zoŋ^L zoŋ^{HL} le?L a^H nuŋ^{LH}tsaŋ^{RTS}te^H hi^H
 ɲun^{HL}t^hu:k^{HL} zo:k^{HL}a^H kan^{LH} ɲai?Ltua?L tsuan^H a:^{LH} buaŋ^{LH} aŋ^Lin^H laŋ^L tr^hi:n^L
 tak^L ma?Lse:^H a^H a:t^{HL}na^H ts^han^{HL} hi:^H kan^{RTS} ɾiat^{HL} tam^{LH} tak^L hi^L tsu^H a^L u:^H
 na:^Hhai^Ha^L a^H k^ho^Hɲai?L le?L ma^Hɲai?Lna^H va:ŋ^L liau^H liau^H a^H ni:^L ti?L a^H ɾiat^{HL}
 t^hei?L na:^Ha^L la?L hi:^H mi^L t^hat^Lts^hia^L le?L zel^{HL}t^hel^{HL} t^hiam^{LH} tak^L a^L lou^{LH} ni^L
 ve:^L ne:n^L ts^hu:r^Ha^H tsan^Ltsin^{HL}a^H ɲai?Lnom^{HL} tak^L tak^H te^H hi:^H na:^Hhai^Ha^L ne:n^L
 an^{RTS} t^hil^Hti?L dun^{HL} le?L an^{LH} pa^Lni?L a^H tsuŋ^Ha^H t^hi:l^H t^hej^Hte^H a^H ni:^L tla:ŋ^Hpui^{LH}
 na:^Hhai^Ha^L ne:n^L a^H an^{RTS} tset^{HL} tlat^Lna^H koŋ^H ɾaj^H ɾaj^Ha?L hian^H ts^hu:r^Ha^L tsuan^{HL}
 t^hil^H ɾe?Lom^{LH} le?L va:n^Lduai^Lna^H eŋ^L eŋ^{HL} e^Hmo^L a^H to:k^{HL} ts^hou^L deu?H ɾeŋ^H a^H
 tsu^{HL} tsu^{HL} na:^Hhai^Han^{HL} a^H bum^{HL} fin^{HL} vaŋ^L a^H ni:^L a^H na:^Ha^H tel^{LH}lo?Lna^Ha?L
 e^Hro?L tsuan^H ts^hu:r^Ha^L hi:^H a^H lo?Ltliŋ^{LH} t^hei^L e:m^{HL} e:m^{HL} a^H ni:^L a^H tsan^Ltsin^{HL}
 hi:^H k^hoi^Llai^H a^Htraŋ^H pon^H soi^{RTS} tran^{HL} do:n^H i^Lla^H ɲai?Lnom^{HL} tak^L a^H ni^L t^hei^L
 ze:l^{RTS} a^H tsan^Ltsin^{HL} toi^{LH} le?L ɲim^Lom^{LH} tak^L tak^{HL} soi^L tu:r^L a^H nei^L t^hua?H a^H
 ni^L ts^hu:r^Ha^H tsan^Ltsin^{HL} daŋ^Hlam^Lna^H tak^L tsu^H t^hon^Lt^hu^H daŋ^{LH} aŋ^L lou^L tak^Hin^H
 a^H k^hoi^{HL}lai^H a^Htraŋ^H po?H in^H soi^{RTS} tran^{HL} i^Hla^H a^H in^Lla^Llo:n^H ts^hou^L t^hei^L ze:l^{RTS}
 a^H a^H ɲai?Lnom^{HL}na^H a^H ne:p^{HL} tsuaŋ^{LH} lou^L k^hoi^{HL} a^Htraŋ^Hin^H ɲe:^{HL} soi^{RTS} tran^{HL}
 le?L ti?Lto:p^L tr^ha^L zo:k^{HL} aŋ^{RTS} o:^H ti?L hi^H mi^L tam^{LH} tak^L ril^Hru:^{HL} ti^Lbuai^{RTS}tu^{HL}
 a^H ni^L ma?L ma?H zo:k^{HL} a^H ni^L mi^L tam^{LH} tak^Lin^L an^{LH} soi^{RTS} tr^hin^{HL} da:n^L tsuan^H
 k^ho^Hve:l^{HL} muŋ^{HL} tr^hen^Hk^hat^L zo:l^H diai^L duai^L hou^{HL}te^H hi^H ts^hu:r^Ha^H vuak^{HL} zo:l^L
 aŋ^La^H soi^L a^H ni^L tr^hi:n^L a^H tu^Lbou?L lian^L tak^H a^H nei^L a^H tsu^{HL} tsuan^H lei^{LH}
 sa^Lk^hat^L le?L luŋ^{RTS}te^H a^H vo^L ke?Ldar?L vek^H a^H zo:l^Ha?L a^L siam^H a^H muŋ^{HL}
 tr^hen^Hk^hat^L a^L lou^{LH} vo^L k^huar^H na^Hsa^H deu?Lva^H lui^Lkor^L le?L p^hai^Hkuam^{LH}a?L a^L
 lou^{RTS} tsaj^H a^H a^H vuak^{HL} zo:l^L tr^hat^L pei?L lou^L lai^H le?L a^H kal^Lsan^{HL} lai^Hte^H
 tsu:^H tla:ŋ^H po:ŋ^{LH}a?L a^L lou^H tsaj^{RTS} ta:^{HL} ni^L a^H ɲai^H an^{LH} om^H a^H tsu:ŋ^{HL} a^H
 ti?L nu:^{HL} a^H a^H t^hi?L da:n^L po?H hi^H mi^L tam^{LH} tak^Lin^L an^{RTS} ɾe^Htsiaŋ^H t^hei^L
 lo^Lva^H a^H t^hi?L da:n^L tsuŋ^{RTS}tsaŋ^Ha?L hian^H ɲai?Lda:n^L ɾaj^H po?H a^L tam^{LH} t^hei^L
 ɲe:^{RTS} a^H t^hi?Lda:n^L tsuŋ^{RTS}tsa:ŋ^H hi^H tr^hen^Hk^hat^L soi^L da:n^L tsuan^H a^H zin^{RTS}na^H
 trum^{LH}k^hat^La?L to?Lsual^L a^H to:k^{HL} ni^L a^H ɲai^H an^{RTS} om^H a^H tr^hen^Hk^hat^L soi^L da:n^L
 tsuan^H a^H zin^{RTS}na^H moŋ^{HL}piŋ^{RTS} k^hua^Ha?L lai^H ni^L zui^{HL}in^H nuam^Lsa^L tak^Hin^H a^L
 t^hi:^H ni:^L in^H an^{LH} soi^{RTS} bok^H tsu:^{HL}bak^{HL}a?L tsuan^H a^H t^hi?Lda:n^L tsuŋ^{RTS}tsa:ŋ^H
 hi^H soi^L da:n^L tsi^L k^hat^L a^L la^H om^{LH} le?L a^H voi^{HL}k^hat^L tsu:^H an^{RTS} k^hua^Ha?L

mi:HL te^H tsu^H lim^H tak^Lin^H an^{LH} in^Lfiam^H a^H ts^hu:r^{HaL} tsuan^{HL} nuam^{HL} a^H ti^L
e:m^{HL} e:m^{HL} mai^H a^H tel^{RTS} rej^{HL} mai^{RTS} tsu^H a^H du^{ʔL} a^H mi:HLte^H tsuan^{HL} an^H
in^{RTS}lam^{HaʔL} tso:HLte^H an^{RTS} va^H ei^H a:^H an^{RTS} va^H in^Lrai^{RTS}puar^H le^{ʔL} te:^{LH} te:^{LH}
tr^hi:n^L a^H ts^hu:r^{HaL} e^Hro^{ʔL} tsuan^{HL} ho:^{RTS} na^Htsaj^H po^{ʔH} a^L re^H lou^L rej^{LH} rej^{LH}
a^H tsu^Htia^H ej^Lma^{ʔH} ei^H le^{ʔL} in^H lo^Lva^H hun^{HL} rei^H tak^L tsu^H in^Lti^{ʔL}lim^Lna^H a^H a^H
tel^{RTS} a^Hva:ɲ^L tsuan^H ril^Htram^H le^{ʔL} tak^Lsa^L tsau^{ʔL} luat^{HL} tuar^L lo^Lvin^H a^L thⁱ:^H
ni:^L in^H an^{RTS} soi^L bok^H a^H thⁱ:^{ʔL}da:n^L hi^H a^H ej^La^L po^{ʔH} tsu^H ni:^Lse^H ts^hu:r^{HaL}
hi:^H a^H thⁱ:^{ʔL} lai^H ve:l^{HL} tsuan^H k^ho^Hk^hat^La^H mi^L laɲ^Lsa:r^L le^{ʔL} mi:HLte^H riat^{HL}
la:r^L tak^H ni:^L in^H a^H thⁱ:^H a^H ni:^L ti^{ʔL} tsu^H a^L tsiaɲ^H le:^{LH} he:^{RTS} k^ho^Hve:l^{HL} hi:^H
siam^L a^Hni^{ʔL} lai^Ha^H tel^{LH} ve^L aɲ^Lin^H soi^{RTS}na^H om^{LH} tr^hi:n^L ma^{ʔL}se:^H kum^L za^Lbi^H
so:m^{HL} pa^Lli^Lna^H lai^H ve:l^{HL} bo:r^H k^ha:n^H mi^Lzou^Hram^H ts^hak^Llam^{RTS} k^hoi:^{HL} m^omun^{HL}
m^omun^{HL}a^{ʔL} e^Hmo^L hian^H a^L k^ho^Hsa:^{HL} ni:^L in^H riat^{HL} a^H ni:^L a^H tsuɲ m^omun^{HL}a^{ʔL} tsuan^H
a^L su:l^{RTS}nu:^{HL} thⁱ:^{LH} tsi^L raɲ^H raɲ^H a^H fa^L re:p^L te:^H a^L se^H k^hal^{ʔL} te:^H a^H tal^{ʔL}tum^L
ti^{ʔL}te^H mu^{ʔL} tu:r^L tam^{LH} tak^L tu:n^{RTS} t^hej^H hian^H a^L la^H om^{LH}

E.3 Translation by Khiangte (2002)

The most interesting and memorable personality in the world of Mizo folklore would undoubtedly be the great Chhurbura. The reading and study of Mizo tales would be incomplete and much less meaningful if the name of Chhura were left out in the whole milieu. He is, in fact, the unchallenged hero of the Mizo folk world. There is a great paradox in his character, which makes him all the more interesting for young and old. He must be considered, without doubt, as the silliest of all simpletons among the Mizo folk characters. On the other hand he could be considered as the cleverest of all the wise men. And all his actions and behaviours on account of which he was considered foolish, were in fact, all due to his abiding love and affection for his elder brother, Nahaia, who happened to be one of the laziest of all men. A good number of stories about Chhura pertain to his relations and activities with his elder brother, Nahaia. In all these heroic undertakings with Nahaia, Chhura invariably came out of the worse sufferer, whereas in all other adventures where Nahaia was not a counterpart, he came out successful with flying colours. Each episode in the story is rather short and crisp but it has a good lesson and moral to impart to the reader or listener. One may start telling the story of Chhura from any part and it never lose its interest. In fact it is rather difficult to know exactly where to start or where to end the story. It is also said that Chhura played an important role when the shape of the world was made. He shaped the world by beating and hitting the solid earth with his big stone

club, levelling parts of its thereby creating hills, mountains, plains and valleys. The account of his death, once again is quite confusing and controversial. One version says that he died accidentally in one of his long travels. Some suggest that he died as a chief, rich and powerful in society. Still another version says he died playing one entertaining game called Nghengtawlah-Saiawnah. Chhura once was so absorbed in his game played on a special festival, that he totally forgot to eat anything for a long time, and out of fatigue and physical exhaustion he died while playing this game. All these versions, however agree that Chhura was a prominent citizen at the time of his death and enjoyed a life of respect. Although he was considered as one of the creators of this world, according to another tale he was still alive in the 14th century AD, living in eastern part of Mizoram, where most of his legendary monuments have been preserved and can still be seen till today.



Appendix F

Passage “Chemtatravta”

F.1 Mizo orthography

Hmanlai hian Chemtatravta an tih hi a awm a, ani chuan an chenna thlang lawka tui tichip chiapah chem a tat rawt rawt a. Chutia chem a tah lai chuan Kaikuangin a sazu-ah a chep ta hlawk mai a, na a ti hle mai a.

Chemtatravta chu a thinur a, a kianga Kha-um zamna rawpui a sat fik zawk a. A hnuaia Ramar tla chu a ngumah a deng khawl mai a.

Tichuan Ramar thin a ur a, Taivang bu a thai darh ta vak mai a. Chutia an bu a lo darh tak vek avang chuan Taivangte chu an thin a ur a. Sanghal chu an seh rawn ta chiam mai a. Sanghal pawh chu a thinrim ta em em a.

Taivang thin a ur a, Sanghal kapah a seh a; Sanghal pawh a thinur a, Bak awmna changel a nghovin a tai tlu ta pheng phung a. Changel hunga lo tawm Bak chu loh theih lohvin a thlawk chhuak ta a. Chutia Bak thlawk chuan tawm himna hmun thim tha panin Sai hnarah a thlawk lut ta a. Sai chu a thinurin a mangang ve ta hle mai a, a phi ruai a. Pitarte in a chilchhia a, chu Pitar mangang chu a vir vel ruai a, an khaw tuikhur hnarah a va daikal ta ringawt mai a.

Daikalna hmun tur pangngai ni lova pitarte a daikal avang chuan an khua chu an buai ta hle mai a. Pitar hnenah chuan, ‘Engatinge kan tuikhur tlan lai i tihbawlhhlawh vek?’ an ti a. Pitarte chuan, ‘Engatinge Saiin ka awmna in a chil chhiat?’ a ti a. Sai chu an han zawt veleh a. ‘Engatinge Saia i chilchhiat?’ an ti a. Sai chuan, ‘Engah nge ka hnarah Bak a luh ei,’ a ti a. ‘Engatinge Baka Sai hnara i luh?’ an ti a. Bak chuan, ‘Engah nge Sanghalin ka awmna changel a tai tluk teh ei,’ a ti a. ‘Engahnge Nghala i tai tluk ni?’ an ti a. Sanghal chuan, ‘Engah nge Taivangin min seh ei,’ a ti a. ‘Engatinge Taivang i seh?’ an ti a. Taivang chuan, ‘Engahnge Ramarin ka bu a thaichhiat teh ei’ a ti a. ‘Engatinge Ramar i thaichhiat?’ an ti a. Ani chuan, ‘Engah nge ka ngumah Kha-umin a den,’ a ti a. ‘Engatinge Kha-um i den?’ an ti leh a. Ani

chuan, ‘Engahnge Chemtatrawtan ka zamna rawpui a sah thluk’ a ti a. ‘Engahnge Chemtatrawt i sah thluk?’ an ti a. Ani chuan, ‘Engahnge Kaikuangin ka tilah mi cheh ei,’ a ti a. ‘Engahnge Kaikuang i cheh?’ an ti ve leh a.

Chutia an inchhualchhal zel hnuah chuan Kaikuang chuan chhuanlam tur a hre ta hauh lo mai a. A zahzel chuan, ‘Ih, ih, ih, meia min rawh leh naupang lawmah ka sen vit vet anga, tuia min thlak leh ka dang bim bem ang’ a ti a. Tichuan meiah an rawh a, a sen ta vit vet mai a, tuiah an thlak leh a, a dang ta bim bem mai a.

Hei hi Chemtatrawta thawnthu tawpna chu a ni. Amaherawhchu mi thenkhatin an sawi dan chuan Kaikuang tuia an dah leh khan, a nu leh pa khua a thlen hmian midangin an lo man hlauh mai a. Hnahtial kuangin vuakhlum an tum a, an vaw fuh hlei thei lo na a, a tawpah chuan a thi ta tho a ni awm e. Amaherawh chu, a thih tak tak hmian hnahtial kuang chu anchhia a lawh a. I chi chhual turte an puitlin hmian i thi zel ang, tiin anchhia a lo lawh a. Chuvang chuan hnahtial hi a pung chak lo hle niin an hre thin.

F.2 Phonetic transcription

ma:n^Hlai^H hian^H tsem^Hta:t^{HL}ro:t^{LH}a^L an^{LH} ti[?] hi^H a^L om^H a^H a^Hni^{HL} tsuan^{HL} an^{LH} tse:n^{Lna} t^haj^H lok^Ha^H tui^{LH} ti^L tsi:p^{HL} tsiap^{HL}a[?] tsem^H a^H ta:t^{HL} ro:t^{LH} ro:t^{RTS} a^H tsu^Htia^H tsem^H a^H ta[?] lai^H tsuan^H kai^Lkuaj^Hin^L a^H sa^Lzu:^{HL}a[?] a^H tsep^L ta^L lo^k mai^H a^H na:^H a^H ti^L je:^H mai^H a^H tsem^Hta:t^{HL}ro:t^{LH}a^L tsu^H a^H thⁱn^Lur^H a^H a^L kiaj^Ha^H k^ha^Lu:m^H za:m^{Lna} ro^Hpui^{RTS} a^H sa:t^{HL} fik^H zok^H a^H a^H n^uai^{RTS} a^H ram^H:a^r tla:^H tsu^H a^H n^um^La[?] a^L de:[?] k^ho:^H mai^H a^H ti^Ltsuan^H ram^H:a^r thⁱn^L a^L ur^H a^H tai^Hva:[?] bu:^{HL} a^L th^ai^{LH} dar[?] ta^L vak^H mai^H a^H tsu^Htia^H an^{RTS} bu:^{HL} a^L lou^{LH} dar[?] ta:k^{HL} ve:k^H a^Hva:[?] tsuan^H tai^Hva:[?]te^H tsu^H an^{LH} thⁱn^L a^L ur^H a^H sa^Lyal^L tsu^H an^{LH} se[?] ron^{HL} ta^L tsiam^H mai^H a^H sa^Lyal^L po[?] tsu^H a^H thⁱn^Lrim^{HL} ta^L e:m^{HL} e:m^{HL} a^H tai^Hva:[?] thⁱn^L a^L ur^H a^H sa^Lyal^L kap^La[?] a^H se[?] a^H sa^Lyal^L po[?] a^H thⁱn^Lur^H a^H ba:k^{LH} om^{RTS}na^H tsaj^He:ⁱ a^H n^uou^Lvin^H a^L tai^H tlu^L ta^L p^hej^L p^huj^{HL} a^H tsaj^He:ⁱ hu[?] a^H lou^{RTS} tom^H ba:k^{RTS} tsu^H lo[?] th^ei[?] lou[?]vin^H a^H t^ho:k^{HL} ts^huak^{HL} ta:^{HL} a^H tsu^Htia^H ba:k^{RTS} t^ho:k^{HL} tsuan^{HL} tom^L him^{Lna} mun^{HL} him^H tr^ha^L pan^{HL}in^H sai^H na:r^La[?] a^H t^ho:k^{HL} lu:t^{HL} ta:^{HL} a^H sai^H tsu^H a^H thⁱn^Lur^Lin^H a^L maj^{LH}aj^L ve^L ta^L je:^H mai^H a^H a^L p^hi:^H ruai^H a^H pi^Ltar^Hte^H in^{LH} a^L tsi:l^Hts^hia^L a^H tsu:^{RTS} pi^Htar^H maj^{LH}aj^L tsu^H a^L vir^{RTS} ve:l^{HL} ruai^H a^H an^L k^ho^H tui^{RTS}k^hur^H na:r^Ha[?] a^L va^H dai^Hkal^H ta^L ri^Lnot^H mai^H a^H dai^Hkal^{Lna} mun^{HL} tu:r^L pa^Hjai^{LH} ni^L lo^{Lva} pi^Htar^Hte^{LH} a^L dai^Hkal^L a^Hva:[?] tsuan^H an^{RTS} k^hua^H tsu^H an^{LH} buai^{LH} ta^L je:^{LH} mai^H a^H pi^Htar^H ne:n^{HL}a[?] tsuan^H ej^La^Hti^Lje:^{HL} kan^{LH} tui^{RTS}k^hur^H tlan^{HL}

lai^H i^H ti[?]bol[?]lo[?]lo[?] vek^H an^{LH} ti^L a^H pi^Htar^Hte^L tsuan^{HL} ej^La^Hti^Lɲe:^{HL} sai^H in^L
 ka^H om^{RTS}na^H in^{RTS} a^H tsi:^L ts^hiat^{HL} a^H ti:^L a^H sai^H tsu^H an^{LH} han^L zo:t^{HL} ve:^Lle[?]
 a^H ej^La^Hti^Lɲe:^{HL} sai^Ha^L i^H tsi:^Lts^hiat^{HL} an^{LH} ti:^L a^H sai^H tsuan^{HL} ej^La[?]ɲe:^{HL} ka^L
 ɲa:r^Ha[?]ba:k^{HL} a^H lu[?]ei^{HL} a^H ti:^L a^H ej^La^Hti^Lɲe:^{HL} ba:k^La:^L sai^H ɲa:r^La^H i^H lu[?]
 an^{LH} ti:^L a^H ba:k^{RTS} tsuan^{HL} ej^La[?]ɲe:^{HL} sa^Lɲal^Lin^L ka^H om^{RTS}na^H tsaj^He:^Li^H a^H
 tai^L tlu:k^{HL} te[?]ei^{HL} a^H ti:^L a^H ej^La[?]ɲe:^{HL} ɲal^La:^L i^H tai^L tlu:k^{HL} ni:^L an^{LH} ti:^L a^H
 sa^Lɲal^L tsuan^{HL} ej^La[?]ɲe:^{HL} tai^Hva:^ɲin^L min^{LH} se[?]ei^{HL} a^H ti:^L a^H ej^La^Hti^Lɲe:^{HL}
 tai^Hva:^ɲ i^H se[?]an^{LH} ti:^L a^H tai^Hva:^ɲ tsuan^{HL} ej^La[?]ɲe:^{HL} ram^Ha:r^Hin^L ka^H bu:^{HL}
 a^H t^hai^{RTS}ts^hiat^{HL} te[?]ei^{HL} a^H ti:^L a^H ej^La^Hti^Lɲe:^{HL} ram^Ha:r^{HL} i^H t^hai^{RTS}ts^hiat^{HL}
 an^{LH} ti:^L a^H a^H ni:^{HL} tsuan^{HL} ej^La[?]ɲe:^{HL} ka^H ɲu:m^La[?]k^ha^Lu:m^Hin^L a^H den^{HL} a^H
 ti:^L a^H ej^La^Hti^Lɲe:^{HL} k^ha^Lu:m^{HL} i^H den^{HL} an^{LH} ti:^L le[?]a^H a^Hni:^{HL} tsuan^{HL} ej^La[?]
 ɲe:^{HL} tsem^Hta:t^{HL}ro:t^{RTS}an^{HL} ka^H za:m^Lna^H ro^Hpui^{RTS} a^H sa[?]tl^hu:k^{HL} a^H ti:^L a^H
 ej^La[?]ɲe:^{HL} tsem^Hta:t^{HL}ro:t^{HL} i^H sa[?]tl^hu:k^{HL} an^{LH} ti:^L a^H a^Hni:^{HL} tsuan^{HL} ej^La[?]
 ɲe:^{HL} kai^Lkuaj^Hin^L ka^L til^Ha[?]mi^H tse[?]ei^{HL} a^H ti:^L a^H ej^La[?]ɲe:^{HL} kai^Lkuaj^{HL}
 i^H tse[?]an^{LH} ti:^L ve:^L le[?]a^H tsu^Htia^H an^{LH} ints^huah^Lts^ha:^L ze:^{LH} ɲu^{HL}a[?]tsuan^H
 kai^Lkuaj^H tsuan^{HL} ts^huan^Llam^L tu:r^L a^L ɾe^H ta^L hau[?]lou^L mai^H a^H a^H za[?]ze:^L
 tsuan^{HL} i[?]i[?]i[?]mei^Ha^H min^{LH} ro[?]le[?]nau^Hpaɲ^{LH} lo:m^La[?]ka^L sen^H vit^H
 ve:t^H aɲ^Ha^H tui^Ha^H min^{RTS} tl^ha:k^{HL} le[?]ka^L daɲ^H bi:m^H be:m^H aɲ^{LH} a^H ti:^L a^H
 ti^Ltsuan^H mei^Ha[?]an^{LH} ro[?]a^H a^L sen^H ta^L vit^H ve:t^H mai^H a^H tui^Ha[?]an^{RTS}
 tl^ha:k^{HL} le[?]a^H a^L da:^ɲta^L bi:m^H be:m^H mai^H a^H hei^{HL} hi^H tsem^Hta:t^{HL}ro:t^{RTS}a^H
 t^hon^Lt^hu^H to:p^Lna^H tsu^H a^H ni^L a^Hma[?]le^Hro[?]tsu^H mi^L tr^hen^Hk^hat^Lin^L an^{LH} soi^L
 da:n^L tsuan^H kai^Lkuaj^H tui^Ha^H an^{LH} da[?]le[?]k^ha:n^H a^H nu^{HL} le[?]pa:^H k^hua^H a^H
 tl^hen^L ma:^Hin^H mi^Ldaɲ^Hin^L an^{LH} lou^{RTS} man^H lau[?]mai^H a^H ɲa[?]tl^hial^L kuaj^{RTS} in^H
 vuak^{HL} lum^{HL} an^{RTS} tum^H a^H an^{LH} vo^L fu[?]le[?]lei^L t^hei^L lou^L na:^{HL} a^H a^H to:p^La[?]
 tsuan^H a^H t^hi^L ta^L t^hou^{LH} a^H ni^L o:m^L e^H a^Hma[?]le^Hro[?]tsu^H a^H t^hi[?]tak^L tak^H
 ma:^Hin^H ɲa[?]tl^hial^L kuaj^{RTS} tsu^H a:n^Lts^hia^{HL} a^H lo[?]a^H i^H tsi^L ts^huah^L tu:r^Lte^H
 an^{LH} pui^{LH}tlin^L ma:^Hin^H an^{RTS} t^hi^H ze:^{LH} aɲ^{LH} ti:^L in^H a:n^Lts^hia^{HL} a^L lou^{LH} lo[?]a^H
 tsu:^{HL}va:^ɲtsuan^H ɲa[?]tl^hial^L hi^H a^L puɲ^H tsak^L lou^L le:^{LH} ni:^L in^H an^{RTS} ɾe:^H tr^hi:n^L

F.3 Translation by Khiangte (2002)

Once upon a time, there was a man called Chemtatrwa (Sharpener of dao). He had gone down to a nearby stream and seeing a good useful looking stone he sat himself down near it to sharpen up his dao. But he had not been there long before he felt a severe pained and he found that a lobster had pinched one of his testicles, and he was infuriated. He seized a big bamboo nearby, upon which Kha-um creeper was climbing,

this so enraged the creeper that it struck a wild fowl with its vicious fruit. The wild-fowl became wild with fury likewise and scratched furiously at the earth with its foot. Within no time, it had scattered an ant nest, and the ant in desperation being in no mood for courtesy, nipped the testicles of a wild boar, who at once, in his pain uprooted a plantain tree which, crashing down, disturbed a peaceful bat having its daily snooze. The bat seeing an elephant perched right on the elephant's very trunk, and this so upset the elephant's dignity that he rushed at the house of a poor old woman, trampling it under foot and smashing it like a match-box. So, terrifying the poor old woman's indiscretion, surrounded her in anger and called on her to explain why she had done such a vile thing. So she told them what the elephant had done to her house. The villagers then went to the elephant and asked the elephant why he had trampled on the woman's house and the elephant quite quickly said because the bat had actually alighted on his nose. While the bat explained that he had been disturbed by the board who said he had been bitten on the testicles by the ants, who said they would have done nothing if they had been left alone by the wild fowl who said that he had only been upset because of the cruel assault of the Kha-um creeper, who blamed Chamtatrawta who then was also very angry and exclaimed that he only cut down the bamboo on account of the pain caused to him by the lobster who had nipped his testicle. So it came about that at last the lobster was called on to explain what he had meant by such an insolent assault/ act, which resulted in all those problems. The lobster now found himself in an awkward position and murmured hesitantly 'Ehmm-Ehmm-Ehmm- if you put me into fire I will become red, and if you put me back into the water again I will become pale.' So, the people not being satisfied put him into a fire the lobster became redder and redder as he predicted. Then they put him again into the water. He became paler and paler. The lobster very soon was able to recover from the painful test and so he swam off again trying to enjoy his river home. Here ends the story of Chemtatrawta. But in some corner some one said that before the lobster could reach its home, the men chased him and with a Hnahthial stick they tried to kill him. Although they could not do this the unfortunate lobster was so injured by the Hnahthial stick that he died. But before he actually died he cursed the Hnahthial stick saying : "Curse on you for your cruelty to me - you will die before your seeds can mature" which may account for the scarcity of such plants to this day and for the fact that they do not mature before they die.

Appendix G

Passage “Lengkawia”

G.1 Mizo orthography

Khaw pakhatah hian pa pakhat, maksak taka che thin hi a awm a, a hming chu Lengkawia a ni a. Ni khat chu a ram vahnaah thang mak danglam tak a kam a, a lang lo thei ang ber leh mi hriatloh theih tur ang berin a siam a. A thangkam a zo fel chauh tihah chuan Phungpuinu a lokal a, Lengkawia thiltih chu a hmuhin mak a ti hle a.

‘Lengkawi, kha engtihna nge ni ngai?’ a ti a. Ani Lengkawia chuan thangmak anih hi a ti mai a. Anih leh eng awhna atan nge i siam tiin a zawt zui a. Lengkawia chuan, ‘A rem apiang awh nan,’ tiin a chhang a. Phungpuinu chuan Lengkawia thangkam chu a thlir vawng vawng a, han awh chhin vel chu a chak ta tlat mai a. Lengkawia hnenah chuan, ‘A rem apiang awhna tur anih chuan ka lo awk chhin ang chu,’ a ti a.

Lengkawia chuan, ‘Mai maia, khawih pawh khawih reng reng suh,’ a ti mai a. Mahse, phungpuinu chuan chu thanga han awh chhin chu a chak riau aniang chu Lengkawia chu a dil a dil a, ka kutzungtang hi ka lo awk chhin ange, a ti a. Lengkawia chuan a phal chuang lova, anih leh ka kein ka lo awk chhin ange, a ti leh a. Lengkawia chuan a phal chuang lova. Phungpuinu chuan chu thanga han awh ngei chu a chak tlat ni tur a ni, anih leh ka nghawngin ka lo awk ange, a ti leh a. Lengkawia chuan a phal chuang si lo. A tawpah chuan, eng berin emaw a mawlh ni tur a ni, a nih a biling a balangin ka lo awk ange, a ti leh a. Chuti tak maia chak vawr vawr na na na chu i awk poh aniang chu a ti a, thangvalhah chuan a inphih awk ta a.

A tirah chuan na vak hek lo, Phungpuinu chuan nuam ti awm takin Lengkawia chu a melh chhova, amaherawhchu a lo awk rei deuhva a hrenna lai chu a na tial tial a. Chutihlai chuan Lengkawia chuan talhtum tur thing a sat a, a suih a suih ta mai a. Phungpuinu ngaihtha lo chuan, ‘Kha Lengkawi, eng atan nge i tih?’ tiin a zawt a. Lengkawia lah chuan, neihfaka rilbawmah leh a tihsan mai a.

A lo rei tak deuh hnuah chuan Phungpuinu chu a mangang rilru ta hle mai a, a tawh tawh e Lengkawia min phelh tawh rawh, an ti thin a. Lengkawia chuan a ngaihsak duh hauh lo mai a, a suih pangngai chuan a talhtum chu a suih tlat mai a. Phungpuinu chu a mangang ta hle mai a. Khaile Lengkawia min han phelh thuai teh, ka hawng duh tawh ania, an tih pawhin, i chak em kha i la kham lovang, a ti tlat mai a. A talhtum suih lai chu a zawh hnuah chuan Phungpuinu chu a pan phei ta a. Engdang sawi set set lovin a vawhlum ta der mai a. A ruang chu luikamah a hnuk thla a, a ril chu luiah chuan a su ta hauh hauh maia.

Chutia Phungpuinu ril a suk lai chuan Phung rual khat an lokal a, Lengkawia bulah chuan an rawn ding tlar thap a, 'Kha Lengkawia tua ril nge?' an ti a. Lengkawia chuan, 'Ar ril' a ti a. Phungrual chuan, 'Ar a ril rual va ni suh' an ti a, an kal liam san ta mai a. An liam chauh tihah Phungrual dang an rawn lang leh a, Lengkawia bulah chuan an rawn dingkual a. 'Kha Lengkawia, tua ril nge?' an rawn ti leh a. Lengkawia chuan, 'Kela ril' a lo ti leh mai a. 'Kela ril rual va ni suh, sin ta fik fek chu' an ti a. An kal liamsan leh ta mai a.

Chumi hnuah chuan Phungrual dang an lokal leh a. A hmaa mite ang bawkin, 'Kha, Lengkawia tua ril nge?' an ti a. Lengkawia chuan a ning ta deuhva thawhsan pahin, 'Buia ril' a ti ta a.

Phungpui ho chuan rang takin Buia ril chu damna an ti a, an inchuh sup sup a, an ei zo ta vek mai a. Vannei inti fahrarin leh tlaipuar takin an kal liam ta a.

Chumi hnuah chuan Lengkawia chu thinglerah a lawn a, chuta tang chuan mahni thiante ril ei e, tiin a au lauh lauh a, Phungrual ho chuan, ngawiteh u Lengkawia'n sawi a nei ania, an ti a. An ngaithla thap a.

Lengkawia chuan, 'Mahni thiante ril ei e,' a han ti leh a. Chumi hnuah chuan an han inbe rawn a. Ekhai, nichina kan thil ei kha Buia ril awzawng a lo ni love, kan thiante ril a lo nih zawk ngei chu, hawh u kan sa ril ei kha luak chhuak leh vek ila, i siampum leh ang u an ti a. An han inkawm luak a, an phungril ei chu an thiam tawka tha in an han rem khawm leh a. Amaherawhchu an siampum hlei thei lova, Phungpuinu chu an chhanchhuak zo ta lo a ni.

Thinrim takin an inrawnkhawm a, 'Hawh u Lengkawia kha i that ang u,' an ti a. A awmna lamah an pan ta a. Thinglera a awm daih avangin tih ngaihna an hre lova, thingah chuan an lawn ve thei bawh si lo. I kirsan mai ang u, an ti a. Hreipui la turin an intir ta a, 'Pakhatin hreipui va la u aw,' tiin a hotu deuh bera chuan mi a han tir dawn a, 'Pahnih lo chuan kan ngam lo,' an ti a. Chutah chuan, 'Pahnihin hreipui va la u aw,' an han inti leh a, 'Pathum lo chuan kan ngam lo,' an ti leh a. 'Pathumin hreipui va la u aw,' 'Pali lo chuan kan ngam lo,' 'Paliin hreipui va la u aw,' 'Panga

lo chuan kan ngam lo,' an inti zel a, a kal bik nih an hreh a, an inpun zau ta zel a. A tawpah chuan, 'Pakuain hreipui va la u aw,' an inti a, 'Sawm lo chuan kan ngam lo,' an ti zel a, tihngaihna dang awm hek lo le. Hreipui la tura sawm an kal dawn chuan, pahnih chauh an chuang tawh a, chung pahnih chuang a hmun nghak tura an tihte chu pakhat bengngawng a ni a, pakhat tawng thei lo a ni thung a. Tichuan, a mi pangngai sawmte chu hreipui la tur chuan an kal ta a.

An kal liam hlawt tihah chuan Lengkawia chu, thingler atang chuan a rawn tawlhthla par par a. A hmun thu pahnihte chu a insual tir a, ek cheh phungin an tang a. A tawpah chuan pakhat zawk lei a pawhdawh sak a, pakhat zawk chu ek a barh baw a, tichuan a kalsan ta a.

Hreipui la tura kalte an lo thlen chuan thingler lam an han en a, Lengkawia chu an hmu ta der lo mai a. A hmun thu tura an dah an thiante hnenah chuan, 'Khawiah nge Lengkawia hi a kal?' an han ti a. Anni chuan chhang tha mumal thei hek lo, le law lamah an ti ringawt a, zawhchian tlak lah an ni hek lo.

Tichuan, Lengkawia zawng tur chuan an chhuak ta a. A hniak chu an chhui a, a kalna apiangah an chhuikawi zel a. A tawpah chuan Buikuaah an chhui tut a. Chu Buikaw chhungah chuan Lengkawia chu chingal leh saum te, lakhuih leh a hmanraw dangte nen alo lut chu niin.

A hniak luhna anih avangin phungpuinu pakhat chuan, ka kawngah hian hruiin min hling ula, a kuaah hian ka zuk lut anga, hrui hi a chet det det chuan, rang takin min pawtchhuak dawn nia, an ti a. A thiante chuan, 'Awle' an ti ve mai a.

Tichuan Buikuaah chuan a zuk lut a, Lengkawia chuan a lakhuih ken chuan Phung hmai chu a lo hiat vak mai a, chingal leh saum a lo hnawiha chu phung chuan thip a ti em em a, a na baw si a, hmanhmawh takin a chhuak leh ta a. Lengkawia kut lo thlak chu an han en a, a hmai chu a inrin sung mai a, 'Ekhai! Lengkawia chuan ha a va han ngah tehreng em, inseh lamah chuan chomi anih loh hi,' an ti a.

Chumi hnuah chuan an zinga huaisen berin, 'Keiman ka zuk luhchilh ange,' a ti a, a zuk lut ve leh ta a. Lengkawia chuan Khuang leh Dar a ring thei ang berin a lo vuak khum a, a kawrawng khaw rum rum khawpin a bengchheng a.

A luhchilhtu Phung pawh chu rang takin a tlanchhuak leh ta a. A thiante hnenah chuan, 'Tlang chim ri rum rum ang maiin a bengchheng a ni,' tih thu a hrilh ta hlawm a, chuta tang chuan, Lengkawia chu thil chi hrang hrang thiam leh thiltithei tak niin an hria a, an hlau ta hle mai a. An tlandarh ta vek a ni. Chumi hnu lawkah chuan Lengkawia chu a lo chhuak a, zalen takin a teihawi leh thei ta a ni.

G.2 Phonetic transcription

k^ho^H pa^Lk^hat^La[?]hian^H pa^L pa^Lk^hat^L mak^Lsak^L tak^Ha^H tse^H thⁱ:n^L hi:^H a^L om^H a^H a^L
 miŋ^H tsu^H le:ŋ^Hkoi^{LH}a^L a^H ni:^L a^H ni^H k^hat^L tsu:^H a^L ram^H va[?]na^Ha[?] t^haŋ^{LH} mak^L
 daŋ^{LH}lam^{RTS} tak^H a^H kam^{HL} a^H a^H laŋ^L lou^L t^hei^L aŋ^L ber^{HL} le[?] mi:^H ɹiat^{HL}lo[?]
 t^hei[?] tu:r^L aŋ^L ber^{HL}in^H a^L siam^H a^H a^L t^haŋ^{RTS}kam^{HL} a^L zou^{LH} fel^L tsau[?] tⁱ?a[?]
 tsuan^H p^hu:ŋ^{HL}pui^{RTS}nu:^{HL} a^L lou^{RTS} kal^H a^H le:ŋ^Hkoi^{RTS}a^H t^hi[?] tⁱ? tsu^H a^H mu[?]in^H
 mak^L a^H ti^L ɛ:^{LH} a^H le:ŋ^Hkoi^{HL} k^ha:^{HL} eŋ^L tⁱ?na^H ɲe:^{HL} ni:^L ɲai^{LH} a^H ti:^L a^H a^Hni^{HL}
 le:ŋ^Hkoi^{LH}a^L tsuan^{HL} t^haŋ^{LH}mak^L a^Hni[?] hi^H a^H ti^L mai^H a^H a^Hni[?] le[?] eŋ^L o[?]na^H
 a^Hta:n^H ɲe:^{HL} i^H siam^L ti:^L in^H a^H zo:t^{HL} zui^{HL} a^H le:ŋ^Hkoi^{LH}a^L tsuan^{HL} a^L rem^H
 a^Hpiaŋ^H o[?] na:n^H ti:^L in^H a^L t^haŋ^H a^H p^hu:ŋ^{HL}pui^{RTS}nu:^{HL} tsuan^{HL} le:ŋ^Hkoi^{RTS}a^H
 t^haŋ^{RTS}kam^{HL} tsu^H a^L tⁱ hⁱ:r^H voŋ^L voŋ^{HL} a^H han^L o[?] t^hin^{HL} ve:l^{HL} tsu^H a^H tsa:k^{HL}
 ta^L tlat^H mai^H a^H le:ŋ^Hkoi^{RTS}a^H ɲe:n^{HL}a[?] tsuan^H a^L rem^H a^Hpiaŋ^H o[?]na^H tu:r^L
 a^Hni[?] tsuan^H ka^L lou^{RTS} o:k^{HL} t^hin^{HL} aŋ^{LH} tsu:^{LH} a^H ti:^L a^H le:ŋ^Hkoi^{LH}a^L tsuan^{HL}
 mai^L mai^Ha^L k^hoi[?] poi[?] k^hoi[?] re:ŋ^{LH} re:ŋ^{LH} su[?] a^H ti:^L mai^H a^H ma[?]se:^H p^hu:ŋ^{HL}
 pui^{RTS}nu:^{HL} tsuan^{HL} tsu:^{RTS} t^haŋ^H a^H han^L o[?] t^hin^{HL} tsu^H a^H tsa:k^{HL} riau^{RTS} a^Hnian[?]
 tsu^H le:ŋ^Hkoi^{LH}a^L tsu^H a^L di:l^H a^L di:l^H a^H ka^H kut^Lzui^{RTS}traŋ^H hi^H ka^L lou^{RTS} o:k^{HL}
 t^hin^{HL} a^Hɲe:^H a^H ti:^L a^H le:ŋ^Hkoi^{LH}a^L tsuan^{HL} a^L p^hal^H tsuaŋ^{LH} lo^Lva^H a^Hni[?] le[?]
 ka^H ke:^L in^H ka^L lou^{RTS} o:k^{HL} t^hin^{HL} a^Hɲe:^H a^H ti^L le[?] a^H le:ŋ^Hkoi^{LH}a^L tsuan^{HL} a^L
 p^hal^H tsuaŋ^{LH} lo^Lva^H p^hu:ŋ^{HL}pui^{RTS}nu:^{HL} tsuan^{HL} tsu:^{LH} t^ha:ŋ^{RTS}a^H han^L o[?] ɲei^{HL}
 tsu^H a^H tsa:k^{HL} tlat^H ni^L tu:r^L a^H ni^L a^Hni[?] le[?] ka^L ɲo:ŋ^Hin^H ka^L lou^{RTS} o:k^{HL} a^Hɲe:^H
 a^H ti^L le[?] a^H le:ŋ^Hkoi^{LH}a^L tsuan^{HL} a^L p^hal^H tsuaŋ^{LH} si:^{LH} lou^L a^H to:p^La[?] tsuan^H
 eŋ^L ber^{HL}in^L e^Hmo^L a^H mol[?] ni^L tu:r^L a^H ni^L a^H ni[?] a^L bi^Hliŋ^H a^L ba^Hlaŋ^Hin^H ka^L
 lou^{RTS} o:k^{HL} a^Hɲe:^H a^H ti^L le[?] a^H tsu^Hti^L tak^L mai^Ha^H tsa:k^{HL} vo:r^{LH} vo:r^{LH} na^L
 na:^{HL} na:^{HL} tsu^H i^H o:k^{HL} pou[?] a^Hnian^{RTS} tsu^H a^H ti:^L a^H t^haŋ^{RTS}val[?]a[?] tsuan^H
 a^H in^Lp^hi[?] o:k^{HL} ta:^{HL} a^H p^hu:ŋ^{HL}pui^{RTS}nu:^H ɲai[?] t^ha^L lou^L a^H tir^La[?] tsuan^H na^H
 vak^H hek^L lou^L p^hu:ŋ^{HL}pui^{RTS}nu:^{HL} tsuan^{HL} nuam^L ti^L o:m^{HL} tak^Hin^H le:ŋ^Hkoi^{LH}a^L
 tsu^H a^H mel[?] t^hou^Lva^H a^Hma[?]e^Hro[?]tsu^H a^L lou^{RTS} o:k^{HL} rei^H deu[?]va^H a^H re:ⁿna^H
 lai^H tsu^H a^L na^H tial^L tial^{HL} a^H tsu^Hti[?]lai^H tsuan^H le:ŋ^Hkoi^{LH}a^L tsuan^{HL} tal[?]tum^L
 tu:r^L t^hiŋ^{RTS} a^H sa:t^{HL} a^H a^H sui[?] a^H sui[?] ta^L mai^H a^H p^hu:ŋ^{HL}pui^{RTS}nu:^H ɲai[?]t^ha^L
 lou^L tsuan^{HL} k^ha:^{HL} le:ŋ^Hkoi^{HL} eŋ^L a^Hta:n^H ɲe:^{HL} i^H ti[?] ti:^L in^H a^H zo:t^{HL} a^H le:ŋ^Hkoi^{LH}a^L
 la[?] tsuan^{HL} nei[?]fa:k^{HL}a^H ri:^Hbo:m^Ha[?] le^H a^H ti[?]san^{HL} mai^H a:^H a^L lou^{LH} rei^L
 ta:k^{HL} deu[?] ɲu:^{HL}a[?] tsuan^H p^hu:ŋ^{HL}pui^{RTS}nu:^{HL} tsu^H a^L maŋ^{LH}aŋ^L ril^Hru^L ta:^L
 ɛ:^{LH} mai^H a^H a^H to:k^{HL} to[?] e^H le:ŋ^Hkoi^{HL} min^{LH} p^hel[?] to[?] ro[?] an^{HL} ti^L t^hi:n^L a^H
 le:ŋ^Hkoi^{LH}a^L tsuan^{HL} a^H ɲai[?]sak^L du[?] hau[?] lou^L mai^H a^H a^H sui[?] pa:^Hɲai^L tsuan^H
 a^H tal[?]tum^L tsu^H a^H sui[?] tlat^H mai^H a^H p^hu:ŋ^{HL}pui^{RTS}nu:^{HL} tsu^H a^H maŋ^{LH}aŋ^L ta^L

le:RTS mai^H a^H k^Hai^Lle:LH le:ɲ^Hkoi^{HL} min^{LH} han^L p^Hel[?]L t^Huai^{HL} te[?]L ka^H ho:ɲ^{LH} du[?]L
 to[?]L a^Hnia^H an^{LH} ti[?]L poh^Hin^H i^H tsa:k^{HL} em^{HL} k^Ha:^H i^L la^H k^Ham^{LH} lo^Lvaɲ^{RTS} a^H ti^L
 tlat^H mai^H a^H a^H tal[?]L tum^L sui[?]L lai^H tsu^H a^H zo[?]L nu^{HL}a[?]L tsuan^H p^Hu:ɲ^{LH} pui^{RTS} nu:^{HL}
 tsu^H a^H pan^{HL} p^Hei^H ta:^{HL} a^H eɲ^Ldaɲ^{LH} soi^{LH} set^L set^L lo^Lvin^H a^H vo^Llum^L ta^L de:r^L
 mai^H a^H a^L ruaj^{RTS} tsu^H lui^Lkam^Ha[?]L a^H nu:k^{HL} t^ha:^L a^H a^L ri:l^H tsu^H lui^La[?]L tsuan^H
 a^H su^L ta^L hau[?]H hau[?]H mai^Ha^H p^Hu:ɲ^{HL} rual^L tsu^Htia^H p^Hu:ɲ^{HL} pui^{RTS} nu:^H ri:l^H a^H
 su:k^{LH} lai^H tsuan^H p^Hu:ɲ^{HL} rual^L k^Hat^L an^{LH} lou^L kal^H a^H le:ɲ^Hkoi^{RTS}a^H bul^Ha[?]L
 tsuan^H an^{LH} ron^L diɲ^H tlar^H tr^hap^H a^H k^Ha:^{HL} le:ɲ^Hkoi^{HL} tu^La^H ri:l^H ɲe:^{HL} an^{LH} ti:^L
 a^H le:ɲ^Hkoi^{LH}a^L tsuan^{LH} a:r^H ri:l^H a^H ti:^L a^H p^Hu:ɲ^{HL} rual^L tsuan^{HL} a:^Hra^H ri:l^H rual^H
 va^H ni^L su[?]L an^{LH} ti:^L a^H an^{LH} kal^L liam^L san^{HL} ta^L mai^H a^H an^{LH} liam^L tsau[?]H
 ti[?]L a[?]L p^Hu:ɲ^{HL} rual^L daɲ^{LH} an^{LH} ron^L laɲ^L le[?]L a^H le:ɲ^Hkoi^{RTS}a^H bul^Ha[?]L tsuan^H
 an^{LH} ron^L diɲ^Hkual^H a^H k^Ha:^{HL} le:ɲ^Hkoi^{HL} tu:^La^H ri:l^H ɲe:^{HL} an^{LH} ron^L ti:^L le[?]L a^H
 le:ɲ^Hkoi^{LH}a^L tsuan^{HL} ke:l^La^H ri:l^H a^L lou^{LH} ti^L le[?]L mai^H a^H ke:l^La^H ri:l^H rual^H va^H
 ni^L su[?]L si:n^H ta^L fik^H fek^H tsu^H an^{LH} ti:^L a^H an^{LH} kal^L liam^L san^{HL} le[?]L ta^L mai^H
 a^H tsu^Hmi^L nu^{HL}a[?]L tsuan^H p^Hu:ɲ^{HL} rual^L daɲ^{LH} an^{LH} lou^{RTS} kal^H le[?]L a^H a^L ma:^Ha^H
 mi:^{HL}te^H aɲ^L bok^Hin^H k^Ha:^{HL} le:ɲ^Hkoi^{HL} tu:^La^H ri:l^H ɲe:^{HL} an^{LH} ti:^L a^H le:ɲ^Hkoi^{LH}a^L
 tsuan^H a^L niɲ^{LH} ta^L deu[?]H va^H t^ho[?]L san^{HL} pa[?]L in^H bui^Ha^H ri:l^H a^H ti:^L ta:^{HL} a^H
 p^Hu:ɲ^{HL} pui^{RTS} hou^{HL} tsuan^L raɲ^{LH} tak^Lin^H bui^Ha^H ri:l^H tsu^H dam^Lna^H an^{LH} ti:^L a^H
 an^{LH} in^Ltsu[?]L sup^L sup^{HL} a^H an^{RTS} ei^H zou^{LH} ta^L vek^H mai^H a^H va:n^Lnei^L in^Lti^L
 fa^Lra^{HL}in^H le[?]L t^hai^Hpuar^H tak^Hin^H an^{RTS} kal^H liam^{RTS} ta:^{HL} a^H tsu^Hmi^L nu:^La[?]L
 tsuan^H le:ɲ^Hkoi^{LH}a^L tsu^H t^hij^{LH}le:r^La[?]L a^L lo:n^H a^H tsu^Hta^H traɲ^H tsuan^H ma[?]L ni^H
 tr^hian^Lte^H ri:l^H ei^H e^H ti:^Lin^H a^L au^H lau[?]H lau[?]H a^H p^Hu:ɲ^{HL} rual^L hou^{HL} tsuan^{HL}
 ɲoi^Hte[?]L u^H le:ɲ^Hkoi^{RTS}an^{HL} soi^L a^H nei^L a^Hnia^H an^{LH} ti:^L a^H an^{RTS} ɲai^Ht^ha^L tr^hap^H
 a^H ma[?]L ni^H tr^hian^Lte^H ri:l^H ei^H e^H le:ɲ^Hkoi^{LH}a^L tsuan^{HL} ma[?]L ni^H tr^hian^Lte^H ri:l^H
 ei^H e^H a^H han^L ti:^L le[?]L a^H tsu^Hmi^L nu^{HL}a[?]L tsuan^H an^{LH} han^{LH} in^Lbe^Lro:n^H a^H
 e:^Hk^Hai^L ni^Ltsin^Ha^H kan^{RTS} t^hil^H ei^L k^Ha^H bui^Ha^H ri:l^H o^Lzo:ɲ^H a^L lou^{LH} ni^L lo^Lve^H
 kan^{LH} tr^hian^Lte^H ri:l^H a^L lou^{LH} ni[?]L zo:k^{HL} ɲei^L tsu^H ho[?]L u^H kan^{LH} sa^L ri:l^H ei^L k^Ha^H
 luak^{HL} ts^huak^{HL} le[?]L vek^H i^Hla^H i^L siam^Hpum^H le[?]L aɲ^L u^H an^{LH} ti:^L a^H an^{LH} han^L
 in^Lkom^L luak^{HL} a^H an^{RTS} p^Hu:ɲ^{HL}ri:l^H ei^L tsu^H an^{LH} t^hiam^{RTS} to:k^{HL}a^H tr^ha:^L in^H
 an^{LH} han^L rem^{HL} k^Ho:m^{HL} le[?]L a^H a^Hmah^Le^Hro[?]Ltsu^H an^{RTS} siam^H pum^H lei^L t^hei^L
 lo^Lva^H p^Hu:ɲ^{HL} pui^{RTS} nu:^{HL} tsu^H an^{LH} t^han^Lts^huak^{HL} zou^{LH} ta^L lou^L a^H ni^L t^hin^Lrim^{HL}
 tak^Lin^H an^{LH} in^Lro:n^Hk^Ho:m^{HL} a^H ho[?]L u^H le:ɲ^Hkoi^{LH}a^L k^Ha^H i^H t^hat^L aɲ^{RTS} u^H an^{LH}
 ti:^L a^H a^H om^{RTS}na^H lama[?]LH an^{RTS} pan^{HL} ta:^{HL} a^H t^hij^{LH}le:r^La^H a^H om^{RTS} dai[?]H
 a^Hva:ɲ^Lin^H ti[?]L ɲai[?]L na^H an^{RTS} re^H lo^Lva^H t^hij^Ha[?]L tsuan^H an^{RTS} lo:n^H ve:^L t^hei^L
 bok^H si:^{LH} lo^L i^H ki:r^{LH}san^{HL} mai^H aɲ^{RTS} u^H an^{LH} ti:^L a^H rei^Lpui^{LH} la^L tu:r^Lin^H an^{LH}
 in^Lti:r^H ta:^{HL} a^H pa^Lk^Hat^Lin^L rei^Lpui^{RTS} va^H la^L u^H o^H ti:^Lin^H a^H hou^{HL}tu^{HL} deu[?]H

ber^La^H tsuan^{HL} mi.^{HL} a^H han^L ti:r^H do:n^H a^H pa^Lni[?]lou^L tsuan^H kan^{RTS} ɲam^H
lou^L an^{LH} ti:^L a^H tsu^Hta[?]tsuan^H pa^Lni[?]lin^L rei^Lpui^{RTS} va^H la:^L u^H o^{HL} an^{LH} han^L
in^Lti:^L le[?]a^H pa^Lt^hum^H lou^L tsuan^H kan^{RTS} ɲam^H lou^L an^{LH} ti:^L le[?]a^H pa^Lt^hum^Hin^L
rei^Lpui^{RTS} va^H la:^L u^H o^H pa^Lli:^H lou^L tsuan^H kan^{RTS} ɲam^H lou^L pa^Lli:^Hin^L rei^Lpui^{RTS}
va^H la:^L u^H o^H pa^Lɲa:^H lou^L tsuan^H kan^{RTS} ɲam^H lou^L an^{LH} in^Lti:^L ze:^LRTS a^H a^L
kal^H bi:k^{HL} ni[?]an^{LH} re[?]a^H an^{LH} in^Lpun^L zau^H ta^L ze:^LRTS a^H a^H to:p^La[?]tsuan^H
pa^Lkua^Lin^L rei^Lpui^{RTS} va^H la:^H u^H o^H an^{LH} in^Lti:^L a^H so:m^L lou^L tsuan^H kan^{RTS} ɲam^H
lou^L an^{LH} ti:^L ze:^LRTS a^H ti[?]ɲgai[?]na^H da[?]om^{LH} hek^L lou^L le^H rei^Lpui^{LH} la^L tu:r^La^H
so:m^L an^{LH} kal^L do:n^H tsuan^H pa^Lni[?]tsau[?]an^{LH} tsua[?]to[?]a^H tsu:ɲ^{HL} pa^Lni[?]
tsua[?]a^H m^omun^L ɲak^{HL} tu:r^La^H an^{LH} ti[?]te^H tsu^H pa^Lk^hat^L be[?]ɲo[?]a^H ni:^L a^H
pa^Lk^hat^L tro[?]t^hei^L lou^L a^H ni^L t^hu[?]a^H ti^Ltsuan^H a^H mi^L pa[?]ɲai^{LH} so:m^Lte^H
tsu^H rei^Lpui^{LH} la^L tu:r^L tsuan^H an^{RTS} kal^H ta:^{HL} a^H an^{RTS} kal^H liam^{RTS} lo[?]ti[?]a[?]
tsuan^H le:ɲ^Hkoi^{LH}a^L tsu^H t^hij^{LH}ler^L a^Htra[?]tsuan^H a^H ron^L to[?]ti[?]a[?] par^L par^{HL}
a^H a^H m^omun^L tr^hu^H pa^Lni[?]te^H tsu^H a^H in^Lsua^L ti:r^H a^H e:k^{HL} tse[?]p^hu[?]in^H an^{RTS}
tra[?]a^H a^H to:p^La[?]tsuan^H pa^Lk^hat^L zo:k^{HL} lei^H a^H po[?]do[?]sak^L a^H pa^Lk^hat^L
zo:k^{HL} tsu^H e:k^{HL} a^H bar[?]bok^H a^H ti^Ltsuan^H a^H kal^Lsan^{HL} ta^{HL} a^H rei^Lpui^{LH} la^L
tu:r^La^H kal^Hte^H an^{LH} lou^{RTS} ti[?]h^{en}HL tsuan^H t^hij^{LH}le:r^L lam^{LH} an^{LH} han^L en^{HL} a^H
le:ɲ^Hkoi^{LH}a^L tsu^H an^{LH} m^ota^L de:r^L lou^L mai^H a^H a^H m^omun^L tr^hu^H tu:r^La^H an^{LH} da[?]
an^{LH} tr^hian^Lte^H ne:n^{HL}a[?]tsuan^H k^hoi^{HL}a[?]ɲe:^{HL} le:ɲ^Hkoi^{LH}a^L hi^H a^H kal^L an^{LH} han^L
ti:^L a^H an^{RTS}ni^{HL} tsuan^{HL} ts^ha[?]tr^ha^L mu:^Hmal^{LH} t^hei^L hek^L lou^L le^H lou^{RTS} lam^Ha[?]
an^{LH} ti:^L ri^Lɲot^H a^H zo[?]tsian^L tla:k^{HL} la[?]an^{LH} ni^L hek^L lou^L ti^Ltsuan^H le:ɲ^Hkoi^{LH}a^L
zo[?]tu:r^L tsuan^H an^{RTS} ts^huak^{HL} ta:^{HL} a^H a^H ɲiak^{HL} tsu^H an^{RTS} ts^hui^H a^H a^H
kal^Lna^H a^H pia[?]an^{RTS} ts^hui^Hkoi^{LH} ze:^LRTS a^H a^H to:p^La[?]tsuan^H bui^Hkua^La[?]
an^{RTS} ts^hui^H lu:t^{HL} a^H tsu:^{RTS} bui^Hko^L ts^hu[?]a[?]tsuan^H le:ɲ^Hkoi^{LH}a^L tsu^H tsij^Lal^H
le[?]sa^Lum^L te^H la^Lk^hui[?]le[?]a^H maⁿro^H da[?]ne:n^L a^L lou^{RTS} lu:t^{HL} tsu^H
ni^Lin^H a^H ɲiak^{HL} lu[?]na^H a^Hni[?]a^Hva:ɲ^Lin^H p^hu:ɲ^{HL}pui^{RTS}nu:^{HL} pa^Lk^hat^L tsuan^{HL}
ka^H ko:ɲ^{HL}a[?]hian^H rui^Hin^H min^{RTS} li:ɲ^H u^Hla^H a^H kua^La[?]hian^H ka^H zuk^L lu:t^{HL}
a[?]rui^{RTS} hi^H a^H tse:t^{HL} det^H det^H tsuan^H ra[?]tak^Lin^H min^{LH} pot^Lts^huak^{HL}
do:n^H nia^H an^{LH} ti:^L a^H a^H tr^hian^Lte^H tsuan^{HL} o^{HL}le^H an^{LH} ti:^L ve:^L mai^H a^H ti^Ltsuan^H
bui^Hkua^La[?]tsuan^H a^H zuk^L lu:t^{HL} a^H le:ɲ^Hkoi^{LH}a^L tsuan^{HL} a^H la^Lk^hui[?]ken^{HL}
tsuan^H p^hu:ɲ^{HL} mai^{RTS} tsu^H a^L lou^{RTS} hiat^{HL} vak^H mai^H a^H tsij^Lal^H le[?]sa^Lum^H
a^L lou^{LH} ɲoi[?]a^H tsu^{RTS} p^hu:ɲ^{HL} tsuan^{HL} t^hi:p^{HL} a^H ti:^L e:m^{HL} e:m^{HL} a^H a^L na^H
bok^H si:^L a^H maⁿmo[?]tak^Hin^H a^H ts^huak^{HL} le[?]ta:^{HL} a^H le:ɲ^Hkoi^{RTS}a^H kut^L
lou^{RTS} ti[?]ha:k^{HL} tsu^H an^{LH} han^L en^{HL} a^H a^L mai^{RTS} tsu^H a^H in^Lri:n^H su[?]mai^H
a^H e:^Lk^hai^L le:ɲ^Hkoi^{LH}a^L tsuan^{HL} ha:^H a^L va^H han^L ɲa[?]te[?]re[?]e:m^{HL} in^Lse[?]
lam^Ha[?]tsuan^H tsou^Lmi^{HL} a^Hni[?]lou[?]hi^H an^{LH} ti:^L a^H tsu^Hmi^L ɲu^{HL}a[?]tsuan^H

an^{RTS} zi:ŋ^Ha^H huai^Hsen^H ber^Lin^L kei^{LH}ma:n^L ka^H zuk^L lu[?]tsil[?] a^Hŋe^H a^H ti:^L a^H
a^H zuk^L lu:t^{HL} ve:^L le[?] ta:^{HL} a^H le:ŋ^Hkoi^{LH}a^L tsuan^{HL} k^huaŋ^H le[?] da:r^H a^L riŋ^H
t^hei^L aŋ^L ber^{HL}in^H a^L lou^{RTS} vuak^{HL} k^hum^{HL} a^H a^H ko^Lroŋ^H k^ho:k^{LH} rum^L rum^{HL}
k^hop^Lin^H a^L beŋ^Hts^hej^H a^H a^H lu[?]tsil[?]tu^{HL} p^hu:ŋ^{HL} po[?] tsu^H raŋ^{LH} tak^Lin^H a^H
tla:n^{RTS}ts^huak^{HL} le[?] ta:^{HL} a^H a^H tr^hian^Lte^H ne:n^{HL}a[?] tsuan^H tla:ŋ^H tsim^L ri^L rum^L
rum^{HL} aŋ^L mai^Hin^H a^L beŋ^Hts^hej^H a^H ni^L ti[?] t^hu:^{RTS} a^H ri[?] ta^L lom^{HL} a^H tsu^Hta^H
traŋ^H tsuan^H le:ŋ^Hkoi^{LH}a^L tsu^H t^hil^H tsi^L raŋ^H raŋ^H t^hiam^{LH} le[?] t^hil^Hti^Lt^hei^L tak^H
ni^Lin^H an^{LH} ri^a a^H an^{LH} lau^{LH} ta^L le:^{LH} mai^H a^H an^{LH} tla:n^{LH}dar[?] ta^L vek^{HL} a^H
ni^L tsu^Hmi^L nu:^{HL} lok^Ha[?] tsuan^H le:ŋ^Hkoi^{LH}a^L tsu^H a^L lou^{RTS} ts^huak^{HL} a^H za^Lle:n^L
tak^Hin^H a^H tei^{HL}hoi^{HL} le[?] t^hei^L ta:^{HL} a^H ni^L

G.3 Translation by Khiangte (2002)

There was once a peculiar man called Lengkawia. One day he made a very different kind of trap for catching something. As soon as he finished the trap, a hobgoblin or female ghost arrived. She inquired, ‘Lengkawia, for what purpose are you making this trap?’ Lengkawia, was reluctant to tell the exact purpose of the trap. However the hobgoblin inquired again and again and she also said that she wanted to test the trap with her forefinger. ‘No’, said Lengkawia, ‘Then let me test it with my hand, she went on. But Lengkawia did not want her to be trapped by her hands or legs or neck. ‘I’ll test it with my body rolled upside down’, she said again. Knowing the over enthusiastic attempt by the hobgoblin, Lengkawia allowed her to be caught in the trap. At first, it was not so bad. She could speak and laugh and enjoy it for sometime. In the meantime, Lengkawia prepared a big bat out of tree trunk. When she asked the reason for his preparing such a bat, Lengkawia said, ‘It will be used for reserve property’. After a long time, the pain caused by the trap began to increase and the hobgoblin did not enjoy it anymore. She asked Lengkawia to release her from the trap. However, he came and beat her to death much against the expectation of the hobgoblin. Then, Lengkawia took out the stomach portion of the hobgoblin and cleaned the intestine to be eaten. While he was cleaning the intestine with water in a nearby stream, a group of ghosts came and asked, ‘What intestine is that?’ ‘It’s a goat’s intestines,’ he replied. But they didn’t believe, ‘Its not a goat’s it has certain marks and lines.’ One group left and another group came, asking the same question. The washer, on each occasion mentioned different names for his answer, and the enquirers did not really accept the responses made by him. Lastly, one group of hobgoblins came to the bank of the stream and asked once again, ‘What

intestine is that'? Lengkawia told them 'It's Buia's (bamboo rat) intestine'. 'Oh! yes, Buia's intestine will be good for health and strength' and they began to eat for health and strength trying to get the major share each. While they were busy eating the intestine, the feeder climbed up a nearby tree. From the tree he called to them, 'Hey! You are eating the flesh of your own friend or eating your friend's intestine'. Then they stopped a while, 'Listen, Lengkawia is saying something'. However, Lengkawia said, 'Oh yes I said that the one in the middle is beautiful'. Then they tried to stay in the middle position. When Lengkawia mentioned the same thing, after two/three occasions, they realised that they had been eating the flesh of their own friend. So, they tried to make her come back to life and vomited out whatever they had eaten. But they could not gather all the parts of the body and they became very angry. They tried to capture Lengkawia. But he made the trunk so slippery that they could not climb it. They decided to cut down the tree and asked for a big hoe for the purpose. 'One of you, go get a big hoe for cutting' their leader ordered. 'Unless there are two of us we dare not go' they replied. Then he asked two persons to go. But they said again, 'We dare not to go unless we are three! They were detailed to do so. But they said 4,5,6 and so on up to 10. After that they decided to go all together. Only one blind and one deaf hobgoblin were left to guard the place. While all the others were gone to fetch the big hoe, Lengkawia came down and provoked the two to fight with each other. Then he tortured them until one of them involuntarily passed his stool and he put some of it into the other's mouth. Also he pulled out the other's tongue and left the place casually. When the others came back with the hoe, they didn't find Lengkawia and asked the two where he had gone. They didn't know his whereabouts and simply said, 'Towards nowhere!'. They asked again and again but they could not tell which way he had escaped. The hobgoblins therefore, set out in search of Lengkawia. Out of fear Lengkawia entered an earthen hole which had many instruments like drum, stick, hair comb, salty ash-water, potted oil of the Mizo's (sa-um) etc. Not knowing that Lengkawia was in the hole, the ghosts they stopped at the entrance and discussed what to do next. One of them wanted to check the hole and suggested, 'String me by my waist, and lower me into the hole, and if I move a bit, pull me out quickly'. Then they said 'yes' to their friend. So, one of them entered the hole, Lengkawia then pushed hard in her face, and put ash-water and oil of the potted meal. It became severely painful. When they saw the actual injury in the face, they said, 'Oh yes, Lengkawia has too many teeth. So we can't compete with him in biting. Next, another hobgoblin mustered up enough courage to enter the hole. Lengkawia, this time beat his drum as loud as possible. The entered had a

feeling that all the mountains were tumbling and even the hole would be completely blocked. She quickly ran out of the hole. And told her friends of the horrible noise of the mountains tumbling down and the resounding noise of drum. They were so frightened that they ran away from that area as quickly as possible. Then Lengkawia came out after they had all left the place and found himself quite safe in the area and went home to live a normal life. That is the end of the story of Lengkawia.



Appendix H

Passage “Rahtea”

H.1 Mizo orthography

Hmanlai hian Rahtea hi fahrah a ni a, a nu chu nuhrawn a ni a. A nuhrawn chuan a ti rethei em em ṭhin a, silhfen ṭha pawh a nei lova, kawr ṭet tak hi a ha ṭhin a, a chaw atan favai hram chauh hi a pe thin a, a cher em em a. A nuhrawn chuan hna harsa tak takte a thawhtir a, a hah changa a chawlh pawh a phal lova, a haw nasa em em a, Rahtea chu a khawngaihthlak em em a.

Rahtea chu a nuhrawn chuan a thihna tur a ngaihtuah nasa hle a, a tawpah chuan hetiang hian a lo ngaihtuah ta a, ‘Ka na der vak anga, inthawi nan, ‘Rahtea kan talh loh chuan ka thi ang’ ka ti anga, a ṭha ang,’ a ti a.

Tichuan a pum a tina der ta vak a, an sial te, kel te, ar te, vawk te, ui te chuan an thawi a, engmah a sawt lova. Inthawi nan an ran zawng zawng an talh zo ta si a.

Rahtea pa chuan, ‘Ran zawng zawngin kan thawi tawh chia, i dam thei chuang si lo, engtinngge kan tih ang le?’ a ti a. A nupui chuan, ‘Ran dang pawhin min thawi leh mah la, ka dam chuang lovang, Rahtea hian min thawi la ka dam ngei ngei ang,’ a ti a. Rahtea pa chuan a ngaihtuah nasa ta em em a.

Tin, Rahtea chuan a nuhrawn thusawi kha a rukin a lo hria a, a hlau em em a, ramhnuaiyah a tlanbo ta daih mai a. Tin, a tlanbo tih an lo hriat chuan pawh an ti em em mai a, ‘Rahtea chu engtinngge kan koh hawn leh theih ang aw! ‘Khuang kan chawi dawn’ ti ila, a lo haw mai ang’ an ti a. Rahtea u chu ko turin a va kal a, Rahtea chu Thingsiri kungah a lawn a, a parzu a lo tlan a, a u chuan : ‘Rahte, Rahte, lo hawng rawh, I nu’n khuang a chawi dawn e, I pa’n khuang a chawi dawn e, Rahte, Rahte, lo hawng rawh,’ a va ti a. Rahtea chuan, ‘Ka u, ka u, kir leh tawh, ka thin ka lung in ei ai chuan, Thingsiri par ka tlan e, ka puar e, ka fan e,’ a lo ti a. A haw duh lova, a u chu an inlamah a va haw a, a nu leh pa hnenah, ‘Ka koh pawhin a lokal duh lo,’ a ti a, a tihdan zawng zawng a sawi vek a. A nuhrawn chuan a pi a tir leh a, ‘Nangin

va ko la, Rahtea chu a lo hawng duh ang e,' a ti a. A pi chu a kal ve ta a. Rahtea u koh angin a ko ve a, Rahtea chuan, Ka pi, ka pi kir leh tawh, Ka thin ka lung in ei ai chuan, Thingsiri par ka tlan e, Ka puar e, ka fan e,' a lo ti leh ta mai a. A pi pawh chu a haw leh ta a.

Chumi hnuah chuan a pa in a va ko ve a, a u leh a pi a chhan dan bawkin a lo chhang leh ta mai a. A pa pawh chu beidawng takin a haw leh ta mai a, a nuhrawn chuan, 'Keiin ka ko ve ang e,' a ti a, ko turin a kal ta a. 'Rahte, Rahte lo hawng rawh, I nu'n khuang a chawi dawn e, I pa'n khuang a chawi dawn e, Rahte, Rahte, lo hawng rawh,' a ti a, Rahtea chuan, 'Ka nu mi ngai manang che, keiin ka ngai manang che... reng' a ti a. Therengah a chang a, a thlawk bo ta daih a.

H.2 Phonetic transcription

ma:n^Hlai^Hhian^Hraʔ^Lte:^{HL}a^Lhi:^Hfa^Lraʔ^La^Hni^La^Ha^Hnu^{HL}tsu^Hnu^Lron^{HL}a^Hni:^La^Ha^Hnu^Lron^{HL}tsuan^{HL}a^Hti^Lre^Lt^hei^Le:m^{HL}e:m^{HL}tr^hin^La^Hsil^ʔfe:n^Ltr^ha:^Lpoʔ^La^Hnei^Llo^Lva^Hkor^{LH}tret^Ltak^Hhi^Ha^Hha^Ltr^hi:n^La^Ha^Htso:^{HL}a^Hta:n^Hfa^Hvai^Hra:m^Ltsau^ʔhi:^Ha^Hpe^Ltr^hi:n^La^Ha^Ltse:r^{RTS}e:m^{HL}e:m^{HL}a^Ha^Hnu^Lron^{HL}tsuan^{HL}ɲa^Lhar^Hsa^Htak^Htak^Hte^Ha^Ht^ho^ʔti:r^Ha^Hha^ʔtsa:ɲ^Ha^Htsol^ʔpoʔ^Ha^Lp^hal^Hlo^Lva^Ha^Hho^Hna^Hsa^He:m^{HL}e:m^{HL}a^Hraʔ^Lte:^{HL}a^Ltsu^Ha^Lk^ho^Hɲai^ʔti^ha:k^{HL}e:m^{HL}e:m^{HL}a^Hraʔ^Lte:^{HL}a^Ltsu:^Ha^Hnu^Lron^{HL}tsuan^La^Ht^hi^ʔna^Htu:r^La^Hɲai^ʔtua^ʔna^Hsa^Hɬe:^{RTS}a^Ha^Hto:p^La^ʔtsuan^Hhe^Htian^Lhian^Ha^Llou^{LH}ɲai^ʔtua^ʔta:^{HL}a^Hka^Lna^Hder^Hvak^Haɲ^Ha^Hin^Lt^hoi:^{HL}na:n^Hraʔ^Lte:^{HL}a^Lkan^{LH}tal^ʔlou^ʔtsuan^Hka^Lt^hi:^Haɲ^{RTS}ka^Hti:^Laɲ^Ha^Htr^ha^Laɲ^{LH}a^Hti:^La^Hti^Ltsuan^Ha^Hpum^La^Hti^Lna:^Hder^Hta^Lvak^Ha^Han^{RTS}sial^Hte^Hke:^Lte^Ha:r^Hte^Hvok^Lte^Hui^{RTS}te^Htsuan^Han^{RTS}t^hoi^{RTS}a^Hej^Lma^ʔa^Hso:t^{HL}lo^Lva^Hin^Lt^hoi:^{HL}na:n^Han^{RTS}ran^Hzoɲ^Lan^{LH}tal^ʔzou^{LH}ta^Lsi:^La^Hraʔ^Lte:^{HL}a^Hpa:^{HL}tsuan^{HL}ran^Hzoɲ^Lzoɲ^{HL}in^Hkan^{RTS}t^hoi:^{HL}to^ʔtsi^Ha^Hi^Ldam^Ht^hei^Ltsuaɲ^{LH}si:^{LH}lou^Lej^Ltin^Hɲe:^{HL}kan^{LH}ti^ʔaɲ^{RTS}le^Ha^Hti:^La^Ha^Hnu^Lpui^{RTS}tsuan^{HL}ran^Hdaɲ^{RTS}po^ʔin^Hmin^{RTS}t^hoi:^{HL}le^ʔma^ʔla^Hka^Ldam^Htsuaɲ^{LH}lo^Lvaɲ^{LH}raʔ^Lte:^{HL}a^Lhian^Hmin^{RTS}t^hoi:^{HL}la^Hka^Ldam^Hɲei^Lɲei^{HL}aɲ^{RTS}a^Hti:^La^Hraʔ^Lte:^{HL}a^Hpa:^{HL}tsuan^{HL}a^Lɲai^ʔtua^ʔna^Hsa^Hta^Le:m^{HL}e:m^{HL}a^Htin^Hraʔ^Lte:^{HL}a^Ltsuan^{HL}a^Hnu^Lron^{HL}t^hu^Hsoi^{RTS}k^ha^Ha^Hru:k^{HL}in^Ha^Llou^{LH}ɾia^{RTS}a^Ha^Llau^{RTS}e:m^{LH}e:m^{LH}a^Hram^Hɲuai^{LH}a^ʔa^Ltla:n^{RTS}bou^Hta^Ldai^ʔmai^Ha^Htin^Ha^Ltla:n^{RTS}bou^Hti^ʔan^{LH}lou^{RTS}ɾiat^{HL}tsuan^Hpoi^Han^{LH}ti^Le:m^{HL}e:m^{HL}mai^Ha^Hraʔ^Lte:^{HL}a^Ltsu^Hej^Ltin^Hɲe:^{HL}kan^{LH}ko^ʔho:n^Lle^ʔt^hei^ʔaɲ^{LH}o:^Hk^huaɲ^Hkan^{RTS}tsoi^Hdo:n^Hti:^Li^Hla^Ha^Llou^{LH}ho^{RTS}mai^Haɲ^{LH}an^{LH}ti:^La^Hraʔ^Lte:^{HL}a^Hu^Htsu^Hkou^Ltu:r^Lin^Ha^Lva^Hka^La^Hraʔ^Lte:^{HL}a^Ltsu^Ht^hɲi^Hsi:r^Li^Hkuɲ^{HL}a^ʔa^Llo:n^Ha^Ha^L

pa:r^Hzu:^H a^L lou^{LH} tla:n^L a^H a^L u:^H tsuan^{HL} ra^{ʔL}te:^{HL} ra^{ʔL}te:^{HL} lou^{LH} ho:ŋ^{HL} ro^{ʔL}
i^H nun^{HL} k^huaŋ^H a^L tsoi^H do:n^H e^H i^H pan^{HL} k^huaŋ^H a^L tsoi^H do:n^H e^H ra^{ʔL}te:^{HL}
ra^{ʔL}te:^{HL} lou^{LH} ho:ŋ^{LH} ro^{ʔL} a^L va^H ti:^L a^H ra^{ʔL}te:^{HL} a^L tsuan^{HL} ka^L u:^{HL} ka^L u:^{HL}
ki:r^{LH} le^{ʔL} to^{ʔL} ka^H t^hin^L ka^L luŋ^H in^{LH} ei^L ai^H tsuan^H t^hiŋ^Hsi:r^Li^H pa:r^H ka^H tla:n^L
e^H ka^L puar^H e^H ka^L fa:n^H e^H a^L lou^{LH} ti:^L a^H a^L ho:^{LH} du^{ʔL} lo^Lva^H a^L u:^H tsu^H
an^{LH} in^Llam^Ha^{ʔL} a^L va^H ho:^L a^H a^H nu:^{HL} leh^L pa:^H nen^{HL}a^{ʔL} ka^H kou^{ʔL} po^{ʔL}in^H
a^L lou^{RTS} kal^H du^{ʔL} lou^L a^H ti:^L a^H a^H ti^{ʔL}da:n^L zoŋ^L zoŋ^{HL} a^L soi^{RTS} vek^H a^H a^H
nu^Lron^{HL} tsuan^{HL} a^H pi:^H a^L ti:r^H le^{ʔL} a^H naŋ^Hin^L va^H kou^L la:^H ra^{ʔL}te:^{HL} a^L tsu^H a^L
lou^{LH} ho:ŋ^{LH} du^{ʔL} aŋ^H e^H a^H ti:^L a^H a^L pi:^H tsu^H a^L kal^H ve:^L ta:^{HL} a^H ra^{ʔL}te:^{HL} a^H
u:^H kou^{ʔL} aŋ^Lin^H a^H kou^L ve:^L a^H ra^{ʔL}te:^{HL} a^L tsuan^{HL} ka^L pi:^{HL} ka^L pi:^{HL} ki:r^{LH}
le^{ʔL} ro^{ʔL} ka^H t^hin^L ka^L luŋ^H in^{LH} ei^L ai^H tsuan^H t^hiŋ^Hsi:r^Li^H pa:r^H ka^H tla:n^L e^H ka^L
puar^H e^H ka^L fa:n^H e^H a^L lou^{LH} ti:^L le^{ʔL} ta^L mai^H a^H a^L pi:^H po^{ʔL} tsu^H a^L ho:^{LH}
le^{ʔL} ta:^{HL} a^H tsu^Hmi^L nu^{HL}a^{ʔL} tsuan^H a^H pa:^{HL} in^L a^L va^H kou^L ve:^L a^H a^L u:^H le^{ʔL}
a^L pi:^H a^H ts^ha:n^L da:n^L bok^Hin^H a^L lou^{RTS} ts^haŋ^H le^{ʔL} ta^L mai^H a^H a^H pa:^{HL} po^{ʔL}
tsu^H bei^{LH}doŋ^L tak^Hin^H a^L ho:^{LH} le^{ʔL} ta^L mai^H a^H a^H nu^Lron^{HL} tsuan^{HL} kei^Hin^L ka^H
kou^L ve:^L aŋ^H e^H a^H ti:^L a^H kou^L tu:r^Lin^H a^L kal^H ta:^{HL} a^H ra^{ʔL}te:^{HL} ra^{ʔL}te:^{HL} lou^{LH}
ho:ŋ^{LH} ro^{ʔL} i^H nun^{HL} k^huaŋ^H a^L tsoi^H do:n^H e^H i^H pan^{HL} k^huaŋ^H a^L tsoi^H do:n^H e^H
ra^{ʔL}te:^{HL} ra^{ʔL}te:^{HL} lou^{LH} ho:ŋ^{LH} ro^{ʔL} a^H ti:^L a^H ra^{ʔL}te:^{HL} a^L tsuan^{HL} ka^H nu:^{HL} mi^L
ŋai^H ma^Lna:ŋ^L tse^H kei^Hin^L ka^L ŋai^H ma^Lnaŋ^L tse^H re:ŋ^H a^H ti:^L a^H t^he^Lreŋ^Ha^{ʔL} a^L
tsaŋ^H a^H a^H t^ʰo:k^{HL} bou^H ta^L dai^{ʔH} a^H

H.3 Translation by Khiangte (2002)

Once upon a time, Rahtea's stepmother was very cruel to him. She forced him to do the toughest chores in the house and gave him the smallest amount of food possible. He was also dressed in rags. In addition to this the woman gave him no time for leisure. In spite of that she planned to kill him. One day she was crying as if she had a great pain in her stomach. Her husband offered fowls and pigs to the angry spirits to appease them, but she continued howling with pain of her own imagination. She said : 'Animal sacrifice won't do'. 'Then what shall I do?' 'Human sacrifice! Cut Rahtea's throat and let his blood flow on the altar'. Rahtea heard what his father and stepmother were talking. He fled into the forest. His stepmother set his brother to bring him back with a promise to celebrate the most enjoyable festival of Khuangchawi in honour of his coming back. His brother found him sitting under a Thingsiri tree which has flowers with full sweet juice. He said in verse : Come back with me, Rahtea, The Khuangchawi shall be celebrated in your honour Rahtea

replied in verse too : Go back without me, brother dear, I now have as food the good Thingsiri flower. Only now can I eat all I want, And be happy with a full stomach. The stepmother sent his aunt to bring him back home. She failed too. At last the stepmother herself came and persuaded him to comeback. He replied that there was no love lost between the two of them and suddenly the boy turned into a dragon fly and flew away.



Appendix I

Passage “Sazaltepa leh Bakvawmtepu”

I.1 Mizo orthography

Hmanlai hian ramsa zawng zawng hi an inrawnkhawm a, ‘Kawngpui i siam ang u,’ an ti a. Sakhi te, Sanghal te, Sazuk te, sa zawng zawng an kal a. An zingah chuan Sazaltepa hi a tel ve a, mi vir tak a ni a. Kanwg chu an sial fai ta hun mai a, ‘Kan kawng rih fai hi tuman tihbawlhhlawh lohvah, a tibawlhhlawh apiang chu eiah,’ an ti a.

An kawng rih faiah chuan Sazaltepa chu a va kal a, Tlumpui hi kawngah chuan a lo baw a. Tlumpui chu a thau avangin a mawm deuh hmiar a, ei atan a it a, tihdan tur a ngaihtuah ta a. Kalkawng chu a va tibawlhhlawh a, tlumpui chu a ei ta daih mai a. Chumi hnu chuan sa dangte chu an kawngah khan an va kal leh a, ek an hmu ta a. ‘Sazaltepa, engahnge kalkawng i tihbawlhhlawh ni? Kawng tibawlhhlawh apiang chu eiah kan tih kha, kan ei ngei ngei ang che,’ an ti a. Sazaltepa chuan, ‘Ka tibawlhhlawh awzawng love, Tlumpui anih kha; keiman ka hmu a, ka ei daih tawh nghe nghe asin,’ a lo ti a.

Nimahsela an awih lova, ei chu an tum ta a; Sazaltepa chu a theihtawpin a tlan a, an um vak a. Nakinah chuan Bakvawmtepu hi a va hmu a, Aazaltepa chuan, ‘Ka pu, min hum rawh,’ tiin a mangan thu chu a hrilh a. Bakvawmtepu chuan, ‘Ka nau awmah i awm duh ang emaw chu?’ a lo ti a. ‘Duh e,’ tiin Bakvawmte pu inah chuan a awm ta a, a nau chu a awmsak ta a.

Bakvawmtepu chu nitin a feh thin a. Nikhat chu Sazaltepa chuan ar hi ei atan a it ta hle a, a pu feh hlan chuan a lo ei ta mai a. Tlaih chuan Bakvawmtepu feh chu a lo hawng a, a lo thlen veleh chuan a hnenah, ‘Ka pu, wawiinah ka nau a tlei thei lova, ar a ngen avangin ka talh ta mai,’ a ti a. Bakvawmtepu chuan, ‘A paw

hlel nem, i nauvin a ngen chuan,' a ti mai a. A tukah a zuk feh leh a, a feh hlan chuan Sazaltepa chuan vawk a lo ei leh a. 'Ka nauvin a ngen,' ti bawk chuan a lo hrilh leh a, Bakvawmtepu chuan, 'A pawl love, i nauvin a ngen zawngin,' a ti zel a. Bakvawmtepu chu a zuk feh leh a, chumi ni chuan Sazaltepa chuan a nau chu a lo ei ta daih mai a, a tlanbo ta daih a.

Tlaiah chuan Bakvawmtepu chu a lo hawng a, Sazaltepa chu a lo awm ta hauh lo mai a. Bakvawmtepu chuan a nau a lo ei a ni tih a hriat chuan a thinur nasa mai a, phuba lak mawlh a tum ta a. Sazaltepa pawh khan a chungah Bakvawmtepu a thinur nasa dawn tih a hria a, a theihtawpin a inveng ve bawk a. Sazaltepa chuan lo hi a nei ve a, chutah chuan a feh thin a ni tih Bakvawmtepu chuan a lo hria a, a thlamah chuan a lo chang ta a. Sazaltepa chu a lovah chuan a zuk feh a, ral atang chuan, 'Ka thlam khu ka kohva a ei chuan mi an awm lo a niang ang,' a ti a. 'Ka thlam' a han ti vak a. Bakvawmtepu khan a thusawi kha a lo hriat avangin, 'Ei' a ti ta vak a. Sazaltepa chuan mi an awm tih a hria a, a hawng ta daih a.

A tukah chuan a zuk feh leh a, thlam chhak fe atang chuan, 'Ka thlam khu ka kohva a ei loh chuan mi an awm a ni ang,' a ti leh ta thung a. 'Ka thlam' a han ti leh vak a. Bakvawmtepu chu a ei duh ta lova. Sazaltepa chuan mi an awm tih a hria a, a hawng leh ta daih mai a.

Bakvawmtepu chuan engtinmah a ti thei lo tih a hriatin a thlam bulah chuan sazu-ah a chang a, kua a hreuh ta a. Sazaltepa chu a zuk feh leh a, thlam bul a thlen chuan mi vir tak ngang kha anih avangin sazu kua a hmuh chuan a lawm ta hle a. Phur em em hian a lai sauh sauh a, a han zen vei rawk a, chutah Bakvawmtepu khan a kutah a lo seh vak a, a seh hlum ta der mai an ti zuk nia!

I.2 Phonetic transcription

m̩a:n^Hlai^H hian^H ram^Hsa:^{HL} zoŋ^L zoŋ^{HL} hi^H an^{LH} in^Lro:n^Hk^ho:m^{HL} a^H koŋ^Hpui^{LH} i^L siam^H aŋ^{RTS} u^H an^{LH} ti:^L a^H sa^Lk^hi:^H te^H sa^Lŋal^L te^H sa^Lzuk^L te^H sa:^{HL} zoŋ^L zoŋ^{HL} an^{RTS} kal^H a^H an^{RTS} zi:ŋ^Ha?^L tsuan^H sa^Lza:l^Hte^Hpa:^{HL} hi^H a^H tel^{LH} ve:^L a^H mi^L vi:^rH tak^L a^H ni:^L a^H koŋ^H tsu^H an^{RTS} sial^H fai^{LH} ta^L hun^H mai^H a^H kan^{RTS} koŋ^H ri?^L fai^L hi^H tu:^Lma:n^{HL} ti?^Lbol?^Llo?^L lo?^Lva?^L a^H ti^Lbol?^Llo?^L a^H piaŋ^H tsu^H ei^La?^L an^{LH} ti:^L a^H an^{RTS} koŋ^H ri?^L fai^{RTS}a?^L tsuan^H sa^Lza:l^Hte^Hpa:^{HL} tsu^H a^L va^H kal^H a^H tlum^Lpui^{RTS} hi^H koŋ^Ha?^L tsuan^H a^L lou^{LH} bok^L a^H tlum^Lpui^{RTS} tsu^H a^H t^hau?^L a^Hva:ŋ^Lin^H a^L mom^H deu?^H miar^L a^H ei^L a^Hta:n^H a^H i:t^{HL} a^H ti?^Lda:n^L tu:r^L a^H ŋai?^Ltua?^L ta:^{HL} a^H kal^Lkoŋ^H tsu^H a^L va^H ti^Lbol?^Llo?^L a^H tlum^Lpui^{RTS} tsu^H a^L ei^H ta^L dai?^H mai^H a^H tsu^Hmi^L ŋu:^{HL} tsuan^H sa^L daŋ^{RTS}te^H tsu^H an^{RTS} koŋ^Ha?^L k^ha:n^H an^{RTS} va^H kal^H le?^L

a^H e:k^{HL} an^{LH} mu^L ta:^{HL} a^H sa^Lza:l^Hte^Hpa:^{HL} ej^La[?]l[?]je:^{HL} kal^Lkoŋ^H i^H ti[?]l[?]bol[?]l[?]lo[?]l[?]
ni:^L koŋ^H ti[?]l[?]bol[?]l[?]lo[?]l[?] a^Hpiaŋ^H tsu^H ei^La[?] kan^{LH} ti[?]l[?] k^ha^H kan^{RTS} ei^H ŋei^L ŋei^{HL}
aŋ^{RTS} tse^H an^{LH} ti:^L a^H sa^Lza:l^Hte^Hpa:^{HL} tsuan^{HL} ka^H ti[?]l[?]bol[?]l[?]lo[?]l[?] o^Lzo:^ŋ lo^Lve^H
tlum^Lpui^{RTS} a^Hni[?]l[?] k^ha^H kei^{LH}ma:n^L ka^H mu:^L a^H ka^L ei^H dai[?]h[?] to[?]l[?] ŋe:^H ŋe:^H
a^Hsin^{HL} a^L lou^{LH} ti:^L a^H ni^Lma[?]l[?]se^Hla^H an^{RTS} oi[?]HL lo^Lva^H ei^L tsu^H an^{RTS} tum^H
ta:^{HL} a^H sa^Lza:l^Hte^Hpa:^{HL} tsu^H a^H t^hei[?]l[?]to:^pHLin^H a^L tla:n^{RTS} a^H an^{RTS} u:m^{HL} vak^H
a^H na^Lkin^Ha[?]l[?] tsuan^H ba:k^{RTS}vom^Hte^Hpu:^H hi^H a^L va^H mu:^L a^H sa^Lza:l^Hte^Hpa:^{HL}
tsuan^{HL} ka^L pu:^{HL} min^{RTS} hum^H ro[?]l[?] ti:^L in^H a^L maŋ^{RTS}an^{HL} t^hu:^{RTS} tsu^H a^H ri[?]l[?]
a^H ba:k^{RTS}vom^Hte^Hpu:^H tsuan^{HL} ka^L nau^H om^La[?]l[?] i^L om^{LH} du[?]l[?] a^Hŋ e^Hmo^L tsu:^{LH}
a^L lou^{LH} ti:^L a^H du[?]l[?] e:^H ti:^L in^H ba:k^{RTS}vom^Hte^Hpu:^H in^Ha[?]l[?] tsuan^H a^L om^{RTS}
ta:^{HL} a^H a^L nau^H tsu^H a^H om^{HL}sak^L ta:^{HL} a^H ba:k^{RTS}vom^Hte^Hpu:^H tsu^H ni^Htin^L a^H
fe[?]l[?] tr^h:i:n^L a^H ni^Hk^hat^L tsu^H sa^Lza:l^Hte^Hpa:^{HL} tsuan^{HL} a:r^H hi^H ei^L a^Hta:n^H a^H i:t^{HL}
ta^L le:^{RTS} a^H a^L pu:^H fe[?]l[?] la:n^L tsuan^H a^L lou^L ei^H ta^L mai^H a^H t^hai^{LH}a[?]l[?] tsuan^H
ba:k^{RTS}vom^Hte^Hpu:^H fe[?]l[?] tsu^H a^L lou^{LH} ho:^ŋl[?] a^H a^L lou^{RTS} t^hen^{HL} ve:^{HL}le[?]l[?] tsuan^H
a^H nen^{HL}a[?]l[?] ka^L pu:^{HL} vo^Lin^Ha[?]l[?] ka^L nau^H a^L t^hei^{LH} t^hei^L lo^Lva^H a:r^H a^H ŋen^{HL}
a^Hva:^ŋl[?]in^H ka^H tal[?]l[?] ta^L mai^{RTS} a^H ti:^L a^H ba:k^{RTS}vom^Hte^Hpu:^H tsuan^{HL} a^L poi^H
lei^L ne:m^{LH} i^L nau^Hvin^L a^H ŋen^{HL} tsuan^H a^H ti^L mai^H a^H a^H tu:k^{HL}a[?]l[?] a^H zuk^L fe[?]l[?]
le[?]l[?] a^H a^H fe[?]l[?] la:n^L tsuan^H sa^Lza:l^Hte^Hpa:^{HL} tsuan^{HL} vok^L a^L lou^{RTS} ei^H le[?]l[?] a^H
ka^L nau^Hvin^L a^H ŋe:n^L ti:^L bok^H tsuan^H a^L lou^{LH} ri[?]l[?]l[?] le[?]l[?] a^H ba:k^{RTS}vom^Hte^Hpu:^H
tsuan^{HL} a^L poi^H lo^Lve^H i^L nau^Hvin^L a^H ŋen^{HL} zoŋ^Lin^H a^H ti^L ze:^lRTS a^H ba:k^{RTS}vom^Hte^H
pu:^H tsu^H a^H zuk^L fe[?]l[?] le[?]l[?] a^H tsu^Hmi^L ni:^H tsuan^H sa^Lza:l^Hte^Hpa:^{HL} tsuan^{HL} a^L
nau^H tsu^H a^L lou^{RTS} ei^H ta^L dai[?]h[?] mai^H a^H a^L tla:n^{RTS}bou^H ta^L dai[?]h[?] a^H t^hai^{LH}a[?]l[?]
tsuan^H ba:k^{RTS}vom^Hte^Hpu:^H tsu^H a^L lou^{LH} ho:^ŋRTS a^H sa^Lza:l^Hte^Hpa:^{HL} tsu^H a^L lou^{LH}
om^{LH} ta^L hau[?]h[?] lou^L mai^H a^H ba:k^{RTS}vom^Hte^Hpu:^H tsuan^{HL} a^L nau^H a^L lou^{RTS} ei^H
a^H ni:^L ti[?]l[?] a^H ri[?]at^{HL} tsuan^H a^H t^hin^Lur^H na^Hsa^H mai^H a^H p^hu^Hba:^H la:k^{HL} mol[?]h[?] a^L
tum^H ta:^{HL} a^H sa^{RTS}za:l^Hte^Hpa:^{HL} poi[?]h[?] k^ha:n^{HL} a^L tsuŋ^Ha[?]l[?] ba:k^{RTS}vom^Hte^Hpu:^H a^H
t^hin^Lur^H na^Hsa^H do:n^H ti[?]l[?] a^L ri[?]a^L a^H a^H t^hei[?]l[?]to:^pHLin^H a^H in^Lve:^ŋ ve:^L bok^H a^H
sa^{RTS}za:l^Hte^Hpa:^{HL} tsuan^{HL} lou^{RTS} hi:^H a^H nei^L ve:^L a^H tsu^Hta[?]l[?] tsuan^H a^H fe[?]l[?] tr^h:i:n^L
a^H ni:^L ti[?]l[?] ba:k^{RTS}vom^Hte^Hpu:^H tsuan^{HL} a^L lou^{LH} ri[?]a^L a^H a^L t^hh[?]a:m^Ha[?]l[?] tsuan^H a^L
lou^{LH} tsa:^ŋRTS ta:^{HL} a^H sa^Lza:l^Hte^Hpa:^{HL} tsu^H a^L lo^Hva[?]l[?] tsuan^H a^H zuk^L fe[?]l[?] a^H ra:^l
a^Htraŋ^H tsuan^H ka^L t^hh[?]a:m^H k^hu^H ka^H kou[?]l[?]va:^H a^H ei^{RTS} tsuan^H mi:^{HL} an^{LH} om^{LH}
lou^L a^H ni^L aŋ^{RTS} a^H ti:^L a^H ka^L t^hh[?]a:m^{HL} a^H han^L ti^L vak^H a^H ba:k^{RTS}vom^Hte^Hpu:^H
k^ha:n^{HL} a^L t^hu^Hsoi^{RTS} k^ha^H a^L lou^{RTS} ri[?]at^{HL} a^Hva:^ŋl[?]in^H ei^{HL} a^H ti^L ta^L vak^H a^H
sa^Lza:l^Hte^Hpa:^{HL} tsuan^{HL} mi^{HL} an^{LH} om^{LH} ti[?]l[?] a^L ri[?]a^{RTS} a^H a^L ho:^ŋLH ta^L dai[?]h[?] a^H
a^H tu:k^{HL}a[?]l[?] tsuan^H a^H zuk^L fe[?]l[?] le[?]l[?] a^H t^hh[?]a:m^H ts^hak^L fe:^H a^Htraŋ^H tsuan^H ka^L
t^hh[?]a:m^H k^hu^H ka^H kou[?]l[?]va:^H a^H ei^{RTS} lou[?]l[?] tsuan^H mi:^{HL} an^{LH} om^{RTS} a^H ni:^L aŋ^{RTS} a^H

ti^L le^{2L} ta:^L t^hu^{HL} a^H ka^L t^ha:m^{HL} a^H han^L ti^L le^{2L} vak^H a^H ba:k^{RTS}vom^Hte^Hpu:^H
tsu^H a^L ei^{LH} du^{2L} ta^L lo^Lva^H sa^Lza:l^Hte^Hpa:^{HL} tsuan^{HL} mi:^{HL} an^{LH} om^{LH} ti^{2L} a^L rⁱa^{RTS}
a^H a^L ho:ŋ^{LH} le^{2L} ta^L dai^{2H} mai^H a^H ba:k^{RTS}vom^Hte^Hpu:^H tsuan^{HL} eŋ^Ltin^Hma^{2L} a^H
ti^L t^hei^L lou^L ti^{2L} a^H rⁱat^{HL}in^H a^L t^ha:m^H bul^Ha^{2L} tsuan^H sa^Lzu:^{HL}a^{2L} a^L tsaj^H a^H
kua^L a^H reu^{2L} ta:^{HL} a^H sa^Lza:l^Hte^Hpa:^{HL} tsu^H a^H zuk^L fe^{2L} le^{2L} a^H t^ha:m^H bul^H a^H
t^hen^L tsuan^H mi^L vi:r^H tak^L ŋaj^L k^ha^H a^Hni^{2L} a^Hva:ŋ^Lin^H sa^Lzu^L kua^H a^H mu^{2L}
tsuan^H a^L lo:m^{LH} ta^L le:^{RTS} a^H p^hu:r^{RTS} e:m^{HL} e:m^{HL} hian^H a^H lai^L sau^{2H} sau^{2H} a^H
a^H han^L zen^{HL} vei^L rok^H a^H tsu^Hta^{2L} ba:k^{RTS}vom^Hte^Hpu:^H k^ha:n^{HL} a^H kut^La^{2L} a^L
lou^{LH} se^{2L} vak^H a^H se^{2L} lum^L ta^L de:r^L mai^{LH} an^{LH} ti:^L zuk^L nia^H

I.3 Translation by Kiangte (2002)

Once upon a time all the animals assembled together in a conference to decide and make a highway through the forest and Szaltepa, who was very covetous, was one among those who attended. They resolved that the highway was to be kept spotlessly clean and that however was caught dirtying it would be killed and eaten. After, the road had been completed and cleaned, Szaltepa went along for a walk and espied a fat civet cat approaching from the opposite direction. Szaltepa determined to make a meal of him but as he could not kill him without proper cause, some pretext would have to be found out and it was not long before his cunning mind found a means. He quickly excreted on the highway himself and accusing the poor civet cat of doing the dirty deed, immediately pounced on it and devoured it. Some other beasts happened to pass by a little later and seeing the excrement on the road, they taxed him for it, saying, ‘Szaltepa, you have filthied the road and now we are going to kill and gobble you up,’ ‘It was not me at all but the civet cat,’ replied Szaltepa, ‘and I have just finished eating him’. They did not, however, believe a word of his as he was known all over as an inveterate liar; so he had to flee as fast as he could from the fury until at last something of a simpleton. ‘Oh sir, please protect me from my enemies who want to kill me,’ he begged of him. ‘I shall do so if you will agree to stay and look after my little son’ replied Bakvawmtepu to which Szaltepa readily assented. He was then given shelter and when Bakvawmtepu went to work in his jhum everyday Szaltepa would look after the child. One day he ate up a fowl which came close to him and when Bakvawmtepu returned from work he said, ‘Sir, the child was crying for the fowl, so I killed it and gave it to him and eat,’ to which Bakvawmtepu replied, ‘You did the right thing, the little boy must have been hungry’. This emboldened Szaltepa to eat a pig the next day and give Bakvawmtepu the same excuse when he returned, ‘Never mind,

since the child demanded it,' said the father. The wicked Sazaltepa killed and ate the boy the very next day and ran away before Bakvawmtepu came back. Bakvawmtepu was so enraged when he returned in the evening and discovered the foul deed that he swore to search Sazaltepa out at any cost and have his revenge. By and by, he came to learn that Sazaltepa was staying at a place not far from where he used to go to attend to his jhum daily. The wily Sazaltepa also knew of Bakvawmtepu's intention towards him and had taken necessary precautions to safeguard himself. When he thought the time was ripe, Bakvawmtepu went one day and lay in wait expectantly in Sazaltepa's jhum house. On returning from work in the evening and while still some distance away, the witty Sazaltepa burst out, 'If anyone replies to me from my jhum house it will mean the house is empty'. The foolish Bakvawmtepu immediately responded, 'Yes, it is empty' Whereupon Sazaltepa went away. On approaching the jhum house the following evening, he shouted, 'If there is no reply from my jhum house when I call, it will be a sign that there is someone in it,' and when there was again the same old foolish reply, he knew Bakvawmtepu was there; so he went away once more. When Bakvawmtepu found that his stupidity gained him nothing he transformed himself into a large rat and made a hole for himself near Sazaltepa's jhum house. The next day Sazaltepa saw the rat-hole on his return from his jhum and being a covetous creature, at once began digging furiously in anticipation of having a hearty meal of the rat. He then put his hand deep down into the hole to pull out the rat but was bitten severely by Bakvawmtepu. He died as he was covetous.

Appendix J

Passage “Rimenhawii”

J.1 Mizo orthography

Rimenhawii hi a hmel a ṭha em em a, a pasal chu Zawlhthia a ni a, an inngaina dun em em ṭhin a. Rimenhawii hmelṭhatzia chu a thang nasa hle a, a samsei mawlh hi a hming than phah ber chu a ni a, amah ngei pawh hian mawi a inti em em a, an in kiangah lui a awm a, inbualin a kal fova. Tuiah chuan a sam zai khat a ṭil a, tuiin a len zel a, sangha lian tak pakhat hian a lo lem a. A sei em avangin sangha lian tak pawh chuan a puar phah awl a.

Tin, lui mawng lam ram hla takah lal pakhat hi a awm a, a chhiahhlawhte chu sangha man turin a tir a. Samzai lemtu sangha kher chu an man fuh a, a lianin a puar nasa si a, ‘Engtizia nge ni?’ tiin a pum chu an khei a, samzai hlir a lo ni a, mak an ti em em a, zai khat mah ni se, pate a khah zova, an pu hnenah an phur hawng ta hial a.

Lal chuan a lo hmuhin mak a ti ve em em a, a sam putu zawng chhuak turin a chhiahhlawhte chu lui hnar lam ramah a tir ta a. Lui chu an zawh chho zel a, lui dung tluan chuan an dap chhova, a tawpah chuan Rimenhawihi in an han thleng ta a. A in chu thir in a ni a, luh an tum a, a pasal Zawlhthia zinbo hlan anih avangin kawng a in kalh khung tlat a, an lut thei lova, pawn atangin hla-in an auva :

‘In thira mi, in dara mi,

Tu maw i hming min hrilh rawh,’ an ti a. Ani chuan an aw a hriatin hla vek hian

:

‘Hming lem hming lem ka nei lo,

Tui-sik-ringi ka ni e,

An-tlak-ringi ka ni e,’ tiin a chhang a.

An hla chu an chhinchhiah a, an haw leh ta vang vang a. An pu hnenah chuan an zuk hrilh a, mahse lal chuan, ‘Chutiang hming va awm thei ngai suh,’ tiin a hming ngei zawt turin a tir leh a, an kal leh ta a.

Rimenhawii te in an thlen chuan a hmaa an tihdan pangngai bawkin an han ti leh a. Ani lahin a chhan ngai bawkin a lo chhang leh a, mahse lal chu a lungawi thei lova, vawi hnih vawi thum a tir nawn a, a tawpah zawng a hming a lo hrilh ta a :

‘Rimenhawii ka ni e,

Menchanghawii ka ni e,’ a ti a.

Chutah zet chuan an lawm ta em a, theihngihl leh an hlau khawp a, ‘Men, men, men’ an ti mawlh mawlh a, engnge tia an han petek palh chang pawhin, ‘men’ an ti zel mai a ni.

Tichuan an lal hnen chu an thleng a, an lal hmaah chuan a hming pum sawi thei awm ta hek lo, ‘Men ka ni a ti,’ an ti thuai thuai mai a. Lal chu a lungni thei chuang lova, ‘Chuti ngawt hming awm ngai suh, rang takin han tlan leh rawh u, a hming pum in rawn hriat loh hrim chuan in nasa mai ang,’ a ti a. Hmanhmawh deuhin an tlan leh ta a, tun hmaa an tihdan ngai bawkh an han ti leh a, ani pawh chuan a chhan dan ngai bawkin a lo chhang leh a. Chumi tum erawh chuan a hming pum an chhinchhiah thei ta a, a hming dik tak chu an han sawi a, lal chuan, ‘Chu zet chu a ni ta, khingpui nei a ni emaw, a ni lo emaw, han hruai rawh u,’ a ti ta tlut mai a.

Lal thupek ang chuan an han kal leh ta a. Mahse Rimenhawii pasal chu zan riakin a lo thang bo daih a, a nupui chu miin an ru ang tih hlauhvin kawng a kalhtir tlat a. Lal mi tirhte chuan in chu hawn tumin an vel an vel a, an hawng thei si lova, nakinah chuan in chung lamah an lawn a, lalin thei rah tinreng a kentir chu inchhungah an thlak a. Mahse Rimenhawii chuan barah a khawn duh lawk lova, theirah chi hrang hrang an thlak zel a, a tawpah chuan an thei neih tui ber serthlum an thlak a.

Rimenhawii chuan a nep zo ta lova, a han ban deuh deuh va. Chumi lai tak chuan pakhatin a samzai khat a zuk man hlauh mai a, a zaikhat tilh pawh a hlauh avangin a inmantir ta a. Finrawl thawhin Rimenhawii chuan a ui leh ar ho hnenah, miin an man tak zia leh an kal bo pui zia te, a kalkawngah lazai a zam zel turzia te, a pasal lo hawn ve leh a lo hrilh turin a chah diam a, tichuan an kalpui ta a.

A pasal ram kal chu an liam daih hnu chuan a lo hawng a. An ui leh arte chu an lo kalkhawm huai huai a, an pi chanchin chu a zawt a, a hmasa berin ui a zawt a, ‘Uia, khawngge i pi?’ a ti a.

‘Bauh, bauh, bauh,

Thlangtiang lenkawh a khum zo ta,

Lazai zui rawh,’ a ti a. Ar a han zawt leh a.

‘Ti ti ik ik,

Thlangtiang lenkaw! a khum zo ta,

Lazai zui rawh,’ a ti ve leh ta a.

A pasal Zaw!thlia chuan chaw pawh ei tha hman lovin an sulhnu chhui turin a vir ta vat a. Lazai inzam zel chu a chhui ta a, thui!e a chhui hnu chuan khua a thim ta a, mahse khaw lo thim chu a tan a remchang zawk a, a umpha ruai a lo ni bawk a. Zannah chuan a va nangching ta nge nge a: Rimenhaw!ihi mantute chu a va that vek a. An nupa chuan hlim takin an hawng dun leh ta a, an damchhungin tuman an tibuai ta lo.

J.2 Phonetic transcription

ri^Lme:n^Lhoi^Hi^H hi:^H a^L me:l^H a^H tr^ha^L e:m^{HL} e:m^{HL} a^H a^H pa^Lsal^{RTS} tsu^H zo:l^Lt^hi:^Ha^L
a^H ni:^L a^H an^{LH} in^Lŋai^Hna^H du:n^L e:m^{HL} e:m^{HL} tr^hi:n^L a^H ri^Lme:n^Lhoi^Hi^H me:l^Htr^hat^Lzia^L
tsu^H a^L t^haŋ^H na^Hsa^H le:^{RTS} a^H a^L sam^{RTS}sei^H mo^Lr^L hi^H a^L miŋ^H t^han^L p^ha^L ber^{HL}
tsu^H a^H ni:^L a^H a^Hma^Lŋe^{HL} po^L hian^{HL} mo^H a^H in^Lti^L e:m^{HL} e:m^{HL} a^H an^{LH}
in^{RTS} kiaŋ^Ha^L lui^L a^L om^H a^H in^Lbua^Hin^H a^L kal^H fo^Hva^H tui^Ha^L tsuan^H a^L sam^{RTS}
zai^H k^hat^L a^H tri:l^L a^H tui^Hin^L a^H le:n^L ze:l^{RTS} a^H sa^Lŋa^L lian^L tak^H pa^Lk^hat^L hian^{HL}
a^L lou^{RTS} lem^{HL} a^H a^L sei^L e:m^{HL} a^Hva:ŋ^Lin^H sa^Lŋa^L lian^L tak^H po^H tsuan^{HL} a^H
puar^L p^ha^L ol^{LH} a^H tin^H lui^L moŋ^{HL} lam^{RTS} ram^H ɰa^H tak^Ha^L la^H pa^Lk^hat^L hi^H
a^L om^H a^H a^H ts^hia^Lhlo^Lte^H tsu^H sa^Lŋa^L man^H tu:r^Lin^H a^H ti:r^L a^H sam^{RTS} zai^H
lem^{HL}tu:^{HL} sa^Lŋa:^{HL} k^he:r^{RTS} tsu^H an^{RTS} man^H fu^L a^H a^H lian^Lin^H a^L puar^H na^Hsa^H
si:^{RTS} a^H eŋ^Lti^Lzia^L ŋe^{HL} ni:^L ti:^L in^H a^H pum^L tsu^H an^{LH} k^he:l^L a^H sam^{RTS}zai^H ɰi:r^{LH}
a^L lou^{LH} ni^L a^H mak^L an^{LH} ti^L e:m^{HL} e:m^{HL} a^H zai^H k^hat^L ma^L ni:^L se:^H ip^Lte:^{RTS} a^H
k^ha^L zo^Hva^H an^{RTS} pu:^H ŋe:n^{HL}a^L an^{RTS} p^hur^H ho:ŋ^{LH} ta^L hial^H a^H la^H tsuan^{HL} a^L
lou^{LH} mu^Lin^H mak^L a^H ti^L ve:^L e:m^{HL} e:m^{HL} a^H a^L sam^{RTS} pu^Htu:^{HL} zoŋ^H ts^huak^{HL}
tu:r^Lin^H a^H ts^hia^Lhlo^Lte^H tsu^H lui^L ŋa:r^H lam^{RTS} ram^Ha^L a^L ti:r^H ta:^{HL} a^H lui^L
tsu^H an^{LH} zo^L ts^hou^L ze:l^{RTS} a^H lui^L duŋ^H tluan^L tsuan^H an^{LH} dap^L ts^ho^Lva^H a^H
to:p^La^L tsuan^H ri^Lme:n^Lhoi^Li^H in^{LH} an^{LH} han^{RTS} t^hej^H ta:^{HL} a^H a^L in^{RTS} tsu:^H
t^hi:r^{LH} in^{RTS} a^H ni:^L a^H lu^L an^{RTS} tum^H a^H a^H pa^Lsal^{LH} zo:l^Lt^hi:^Ha^H zin^L bou^L
ɰa:n^L a^Hni^L a^Hva:ŋ^Lin^H koŋ^H a^H in^L kal^L k^huŋ^{HL} tlat^H a^H an^{RTS} lu:t^{HL} t^he:l^L lo^Lva^H
po:n^H a^Htraŋ^Hin^H ɰa:^{RTS}in^H an^{LH} au^Lva:^H in^{LH} t^hi:r^{RTS} a^H mi:^{HL} in^{RTS} da:r^Ha^H mi:^{HL}
tu:^L mo:^{LH} i^L miŋ^H min^{LH} ri^L ro^L an^{LH} ti:^L a^H a^Hni:^{HL} tsuan^{HL} an^{RTS} o:^{HL} a^H
riat^{HL}in^H ɰa:^{LH} vek^{LH} hian^H miŋ^H lem^L miŋ^H lem^L ka^H nei^L lou^L tui^{LH} sik^Lriŋ^Hi^H ka^H
ni:^L e^H an^{LH}tlak^Lriŋ^Hi^H ka^H ni:^L e^H ti:^Lin^H a^L ts^haŋ^H a^H an^{LH} ɰa:^{RTS} tsu:^H an^{RTS}
ts^hin^{HL}ts^hia^L a^H an^{LH} ho:^{LH} le^L ta^L vaj^L vaj^{HL} a^H an^{RTS} pu:^H ŋe:n^{HL}a^L tsuan^H

an^{LH} zuk^L ril[?] a^H ma[?]se:^H lal^H tsuan^{HL} tsu^Htian^L mij^H va^H om^{LH} t^hei^L ɣai^{LH} su[?]
ti:^Lin^H a^L mij^H ɣei^L zo:t^{HL} tu:r^Lin^H a^L ti:r^H le[?] a^H an^{RTS} kal^H le[?] ta:^{HL} a^H

ri^Lme:n^Lhoi^Hi^H te^H in^{LH} an^{RTS} t^hen^{HL} tsuan^H a^L ma:^Ha^H an^{LH} ti[?]da:n^L pa^Hɣai^{RTS}
bok^Hin^H an^{LH} han^{LH} ti^L le[?] a^H a^Hni^{HL} la[?]in^L a^H ts^han^L ɣai^{RTS} bok^Hin^H a^L lou^{RTS}
ts^haɣ^H le[?] a^H ma[?]se:^H lal^H tsu^H a^L luɣ^Hoi^H t^hei^L lo^Lva^H voi^{HL} ni[?] voi^{HL} t^hum^H
a^L ti:r^H non^{HL} a^H a^H to:p^La[?] zoy^L a^L mij^H a^L lou^{LH} ril[?] ta:^{HL} a^H ri^Lme:n^Lhoi^Hi^H
ka^H ni:^L e^H me:n^Ltsaɣ^{LH}hoi[?]Li^H ka^H ni:^L e^H a^H ti:^L a^H tsu^Hta[?] zet^H tsuan^H an^{LH}
lo:m^{LH} ta^L e:m^{HL} e:m^{HL} a^H t^hei[?]ɣil[?] le[?] an^{LH} la[?] k^hop^L a^H me:n^L me:n^L me:n^L
an^{LH} ti^L mol[?] mol[?] a^H e^Lɣe:^{HL} ti:^La^H an^{LH} han^L pe^Htek^H pal[?] tsaj^H po[?]in^H
me:n^L an^{LH} ti^L ze:l^{LH} mai^{RTS} a^H ni:^L ti^Ltsuan^H an^{RTS} lal^H ne:n^{HL} tsu^H an^{RTS} t^hej^H
a^H an^{RTS} lal^H ma:^Ha[?] tsuan^H a^L mij^H pum^H soi^{LH} t^hei^L om^{LH} ta^L hek^L lou^L me:n^L
ka^H ni:^L a^H ti:^L an^{LH} ti:^L t^huai^L t^huai^{HL} mai^H a^H lal^H tsu^H a^L luɣ^Hni:^L t^hei^L tsuaj^{LH}
lo^Lva^H tsu^Hti^L ɣot^H mij^H om^{LH} ɣai^{LH} su[?] raj^{LH} tak^Lin^H han^{LH} tla:n^{LH} le[?] ro[?] u:^H
a^H mij^H pum^H in^{LH} ron^L ɣiat^{HL} lou[?] rim^L tsuan^H in^{RTS} na^Hsa^H mai^H aɣ^{LH} a^H ti:^L
a^H man^{HL}mo[?] deu[?]in^H an^{LH} tla:n^{LH} le[?] ta:^{HL} a^H tun^{RTS} ma:^Ha^H an^{LH} ti[?]da:n^L
ɣai^{RTS} bok^H k^ha:n^H an^{LH} han^L ti^L le[?] a^H a^Hni^{HL} po[?] tsuan^{HL} a^H ts^ha:n^L da:n^L
ɣai^{RTS} bok^Hin^H a^L lou^{RTS} ts^ha:ɣ^H le[?] a^H tsu^Hmi^L trum^{RTS} e^Hro[?] tsuan^H a^L mij^H
pum^H an^{RTS} ts^hin^{HL}ts^hia[?] t^hei^L ta:^{HL} a^H a^L mij^H dik^L tak^H tsu^H an^{LH} han^L soi^H a^H
lal^H tsuan^{HL} tsu^{HL} zet^H tsu^H a^H ni:^L ta:^{HL} k^hij^Hpui^L nei^L a^H ni:^L e^Hmo^L a^H ni:^L lou^L
e^Hmo^L han^{RTS} ruai^H ro[?] u:^H a^H ti:^L ta^L t^hut^H mai^H a^H lal^H t^hu^Hpe:k^{HL} aɣ^L tsuan^H
an^{LH} han^L kal^H le[?] ta:^{HL} a^H

ma[?]se:^H ri^Lme:n^Lhoi^Hi^H pa^Lsal^{RTS} tsu:^H za:n^L riak^{HL}in^H a^L lou^{RTS} t^haɣ^{HL} bou^H
dai[?] a^H a^H nu^Lpui^{RTS} tsu^H mi:^{HL}in^L an^{LH} ru:^L aɣ^{LH} ti[?] la[?]vin^H koɣ^H a^H kal[?]ti:r^H
tlat^H a^H lal^H mi:^L tir[?]te^H tsuan^{HL} in^{RTS} tsu^H hon^L tum^Hin^H an^{LH} ve:l^L an^{LH} ve:l^L
a^H an^{RTS} hoɣ^H t^hei^L si:^{LH} lo^Lva^H na^Lkin^Ha[?] tsuan^H in^{LH} tsuɣ^{RTS} lam^Ha[?] an^{RTS}
lo:n^H a^H lal^Hin^L t^hei^{LH} ra[?] tin^Lre:ɣ^H a^H ken^{LH} ti:r^H tsu^H in^{RTS}ts^hu:ɣ^Ha[?] an^{RTS}
t^ha:k^{HL} a^H ma[?]se:^H ri^Lme:n^Lhoi^Hi^H tsuan^{HL} ba:r^Ha[?] a^H k^hon^{HL} du[?] lok^H lo^Lva^H
t^hei^{LH}ra[?] tsi^L ɣaj^H ɣaj^H an^{RTS} t^ha:k^{HL} ze:l^{RTS} a^H a^H to:p^La[?] tsuan^H an^{LH} t^hei^{LH}
nei[?] tui^H ber^L se:r^Lt^hum^H an^{RTS} t^ha:k^{HL} a^H ri^Lme:n^Lhoi[?]Li^H tsuan^{HL} a^H ne:p^{HL}
zou^{LH} ta^L lo^Lva^H a^H han^L ban^{HL} deu^H deu^H va^H tsu^Hmi^L lai^H tak^L tsuan^H pa^Lk^hat^Lin^L
a^L sam^{RTS}zai^H k^hat^L a^H zuk^L man^H la[?]mai^H a^H a^L zai^Hk^hat^L tril[?] po[?] a^H la[?]
a^Hva:ɣ^Lin^H a^H in^Lman^{HL}ti:r^H ta:^{HL} a^H fin^{HL}ro:l^H t^ho[?]in^H ri^Lme:n^Lhoi[?]Li^H tsuan^{HL} a^L
ui^{LH} le[?] a^H hou^{HL} ne:n^{HL}a[?] mi:^{HL}in^L an^L man^{HL} ta:k^{HL} zia^L le[?] an^{LH} kal^L bou^L
pui^H zia^L te^H a^H kal^Lkoɣ^Ha[?] la^Lzai^H a^H za:m^{HL} ze:l^{LH} tur^L zia^L te^H a^H pa^Lsal^{LH}
lou^{LH} ho:n^L ve:^{HL}le[?] a^H lou^{LH} ril[?] tu:r^Lin^H a^H tsa[?] diam^H a^H ti^Ltsuan^H an^{LH}
kal^Lpui^H ta:^{HL} a^H a^H pa^Lsal^{RTS} ram^H kal^H tsu^H an^{RTS} liam^L dai[?] nu:^{HL} tsuan^H a^L

lou^{LH} ho:ŋ^{RTS} a^H an^{LH} ui^{LH} leʔ^L a:r^Hte^H tsu^H an^{LH} lou^{RTS} kal^Hk^Ho:m^{HL} huai^{HL} huai^{HL}
 a^H an^{RTS} pi:^H tsan^Ltsin^{HL} tsu^H a^H zo:t^{HL} a^H a^L ma^Hsa^L ber^{HL}in^H ui^{RTS} a^H zo:t^{HL}
 a^H ui^Ha^L k^ho^Hŋe^{HL} i^L pi:^H a^H ti:^L a^H bau^ʔH bau^ʔH bau^ʔH t^haj^Htiaŋ^L le:n^Lko:l^H
 a^H k^hu:m^{HL} zou^{RTS} ta:^{HL} la^Lzai^H zui^{HL} roʔ^L a^H ti:^L a^H a:r^H a^H han^L zo:t^{HL} leʔ^L
 a^H ti:^L ti^H i:k^{HL} i:k^L t^haj^Htiaŋ^L le:n^Lko:l^H a^H k^hu:m^{HL} zou^{RTS} ta:^{HL} la^Lzai^H zui^{HL}
 roʔ^L a^H ti^L ve:^L leʔ^L ta:^{HL} a^H a^H pa^Lsal^{LH} zo:l^Lt^hi:^Ha^L tsuan^{HL} tso:^{HL} poʔ^H ei^H
 tr^ha^L man^{HL} lo^Lvin^H an^{LH} su:l^{RTS}nu:^{HL} ts^hui^H tu:r^Lin^H a^L vir^{LH} ta^L vat^H a^H la^Lzai^H
 in^Lzam^{HL} ze:l^{LH} tsu:^H a^L ts^hui^H ta:^{HL} a^H t^hui^Hfe:^H a^H ts^hui^L nu:^{HL} tsuan^H k^hua^H
 a^L t^him^H ta:^{HL} a^H ma^ʔse:^H k^ho^H lou^{RTS} t^him^H tsu^H a^L ta:n^H a^L rem^Htsa:ŋ^H zo:k^{HL}
 a^H a^H u:m^{HL}p^ha^L ruai^H a^L lou^{LH} ni^L bok^H a^H zan^La^ʔL tsuan^H a^L va^H naj^Htsi:ŋ^{LH}
 ta^L ŋe:^{HL} ŋe:^{HL} a^H ri^Lme:n^Lhoi^Hi^H man^H tu^{HL}te^H tsu^H a^L va^H t^hat^L vek^H a^H an^{LH}
 nu:^Lpa:^L tsuan^H lim^H tak^Lin^H an^{LH} ho:ŋ^{LH} du:n^L leʔ^L ta:^{HL} a^H an^{LH} dam^Lts^hu:ŋ^Hin^H
 tu:^Lma:n^{HL} an^{LH} ti^Lbuai^{LH} ta^L lou^L

J.3 Translation by Khiangte (2002)

Once upon a time, there was a beautiful woman. Her name was Rimenhawii and she had a handsome husband called Zawlthlia. Zawlthlia was very proud of his wife, and Rimenhawii was equally conscious of her beauty. Her charm and beauty was further enhanced by her beautiful hair which was the envy of all the girls, and many people would come from distant villages to have a look at it. One day, as she was having a bath in a river, one strand of her hair came out and was carried down the river. After a while, the hair was swallowed by a fish. The hair was so long that the fish suffocated and died. Down the river in a distant land, there was a king. This king was very fond of fish and he would send his servants daily to catch fish from the river. One day, his servant brought the fish which had consumed Rimenhawii's hair. When the fish was cut open, one strand of very long human hair was found inside. They were greatly astonished and they took the hair to the king. The king was equally astonished and intrigued, and he decided to find out the owner of the hair. After carefully enquiring from his servants how they came by it, the king instructed them to follow the course of the river upstream till they found the proud possessor of the hair. He was sure that the owner was living somewhere up the hills and the hair must have floated down the river. After many days of travelling up the course of the river, they reached the village of Rimenhawii. She was at home, but her husband was away visiting relatives in some other village. Before going on this journey, the careful husband to Zawlthlia had built a strong house, and had locked Rimenhawii

inside the house so that no one could see her, far less abduct her in his absence. The visitors from the plains were at a loss about what to do. They dared not return home without at least ascertaining the name of the lady. So they sang to her. O thou, dweller in the house of steel and brass, Tell us what thy name is. Rimenhawii replied also in a song, which means, No name, no name have I, I live on pure water, I live on pure vegetables. So, the messengers committed this song to memory, returned to their king and told him what they had seen and heard. The king was not satisfied and he sent them back to get her name. The messengers came back and repeated the same request to Rimenhawii. Feminine pride in her beauty overtook her and she gave them her real name, saying : I am Rimenhawii, also called as Menchanghawii. For the messenger, Rimenhawii or Menchanghawii was too big a word to remember and they committed to memory only the syllable 'men'. This did not satisfy the king. He knew that 'men' was not the full word but only a part of it. Accordingly, he asked them to go again and not to come back without the full name of the lady. And on this occasion, the king told them to fetch the lady irrespective of whether she had a husband or not. The messengers took with them all kinds of delicacies, sweets and fruits and went back to Rimenhawii. This time too her husband was away. However, there was a small hole in the roof for light, and through this hole, the messengers passed down the delicacies they had brought with them. Rimenhawii was completely indifferent in the beginning but when an orange was thrown in, the temptation was too strong and she stood up to catch the orange. As she stood up, they caught her and pulled her out to be taken to their king. Interestingly, as she was being carried away, Rimenhawii told her dog and hen as to how her husband could trace her. When he returned and found his wife gone, Zawlthlia enquired his neighbors if they knew anything about what had happened to her, but no one could tell him. Disappointed on all sides in great dismay, he turned to his dog and hen who told him the marks by which he could trace his wife. Rimenhawii had left a trail of cotton thread as she was being carried away; and following this trail, Zawlthlia overtook the king's servants, killed them and returned home with his wife. Once again they lived happily ever after and were blessed with many children. The story of Rimenhawii may lead one to believe that this was the beginning of the contact between the people of the plains of the Mizos.

Appendix K

Passage “Thailungi”

K.1 Mizo orthography

Nikhat chu Thailungi nu hian puan a tah a, a puantah hnuaiiah chuan a fanu Thailungi chu a awm hreuh hreuh a. Thawm pawh a nei lo kher mai a, a nu chuan chumi hmuna a awm chu a hre hauh lova.

Chutihlai tak chuan Khawchhak khual hlah hlam zuar an lokal a, kawthlerah chuan, ‘Thirhlum ka zuar e, lei rawh u,’ tiin an au an au va. Thailungi nu chuan, ‘Duh chu kan duh ngang mai a, mahse leina kan nei si lo. Fanu tuium hnih khirh rual lek ka nei a, chu chu a man atan in pawm duh nghal loh chuan,’ tiin a puan tahna hmun aṭang chuan a chhang a.

Thailungi chuan mak a tih em avangin ngawih a chuh ta deuh deuh a, mikhualte chuan Thailungi nu lo dawn dan chu an bengkhawn hle a, an inremsiam ta a. Thailungi nu chuan, ‘Thailungi chu tui chawiah ka tir ang a, nangnin lo chang ula, in man mai ang chu,’ a ti a.

Thailungi chu a mangang ta em em mai a, tui chawi chu a hun ta a, tam laka tlanbo lah chu ramsa ilo a hlah avangin a ngam si lo, a nu tirh chu a hnial ngam si lo, a ngaihna hre lovin a inkhap thlu ta reng a, a nu lah chuan tui chawi turin a tir tlat si a. Hreh em em chung chuan tuikhur lam chu a pan ta a, an lo channa hmun tura ruat a thlen hmain an lo man ta thut mai a, an ram lamah an bo pui ta daih a.

Thailungi chuan nau mipa a nei a, khawlaiah thirhlum chu a chaih ṭhin a, mahse a ṭhianta chuan, ‘Mahni u te thirhluma hralh tu ni maw?’ tiin an au fova. Ani chu a ngaih a ṭha thei ta lova, a nu hnenah a ṭhianta au hla chu a zawt chiang ta a, a nu chuan Thailungi chanchin chu a hrilh ta vek a.

A u chanchin rapthlak tak a hriat chuan a ṭap ta zawih zawih a, a nu hnenah chuan, ‘Ka u zawng turin ka kal ang e,’ tiin a ngen a, a nu chuan, ‘I la te lu em a, rapchung i tawng hunah,’ a ti a. Rapchung tawnga sang a han nih chuan a u zawn

a ngen leh a, a nu chuan a la phal rih lova, nakinah chuan a lo puitling ve ta a, a u zawn chu a tum ta tlat a, a nu pawhin a hnial ta bik lova.

A u zawnga a kal chuan putar pakhat a hmu a, sum a lo suih tlut tlut a, ‘Ka pu, ka u awmna lam min hrilh theih lawm ni?’ a ti a. Ani chuan, ‘Ka sum hi mi han suih zawhpui phawt la ka hrilh ang che,’ a ti a. A sum chu a suih zawhpui ta a, a kalna tur kawng a kawh hmuh a.

Thui fe a kal a, pa pakhat se khalh hi a hmu leh a, ‘Ka pu, ka u Thailungi awmna min hrilh thei lawm ni?’ a ti a. Ani chuan, ‘Ka se khalh hi mi zui la, tam laka riah a ÷ul leh riak ve zel la, i u awmna chu ka hrilh mai ang che,’ a ti a. A se khalh chu a zui a, ramhnuaiah zan engemawzat a riahpui hnu chuan khua an lut ta a. Se khalh pa in ngeiah chuan a thleng ta a.

Chu in chu a u awmna ngei a lo ni a, naupan teta inthen an nih avangin, hmel inhre rual an ni tawh lova, nula pakhat hi a awm a, Thailungi tih reng a hre lova, engtin tin emaw an titi naah an inchhar chhuak ta a, an hlim em em a, rei pawh nghak lovin an khaw lam panin an tlanchhuak ru dun ta a. Lawm em em in chung unau inhloh tawhte chu an inchhar leh ta anih chu.

Thailungi te nufa inphuahna hla pawh hetiang hian kan hmu a :

Thailungi nu : “Thailungi, Thailungi

I tiangthirte lo nghak la,

I hlantaite lo nghak la,”

Thailungi : “Chhaktiang khi chen ka thlen chuan,

Tiangthir a tha bo ngai lo,

Hlantai a tha bo ngai lo” tiin.

K.2 Phonetic transcription

ni^Hk^hat^L tsu:^H t^hai^Hluŋ^Hi^H nu:^{HL} hian^{HL} puan^{RTS} a^H ta^{ʔL} a^H a^{HL} puan^{LH} ta^{ʔL} ɲuai^{LH} a^{ʔL}
 tsuan^H a^H fa^Lnu:^L t^hai^Hluŋ^Hi^H tsu:^H a^L om^{LH} ɾeu^{ʔL} ɾeu^{ʔH} a^H t^ho:m^{RTS} po^{ʔH} a^H
 nei^L lou^L k^her^{RTS} mai^H a^H a^H nu:^{HL} tsuan^{HL} tsu^Hmi^L ɲun^{HL} a^H a^L om^{RTS} tsu^H a^L
 ɾe^H hau^{ʔH} lo^Lva^H tsu^Hti^{ʔL}lai^H tak^L tsuan^H k^ho^Hts^hak^L k^hual^L ɭa^{ʔL} lam^L zuar^H an^{LH}
 lou^{RTS} kal^H a^H kot^Ltl^he:r^{LH}a^{ʔL} tsuan^H t^hi:r^{LH}ɭu:m^{LH} ka^L zuar^H e^H lei^{LH} ro^{ʔL} u^H ti:^Lin^H
 an^{RTS} au^H an^{RTS} au^H va^H t^hai^Hluŋ^Hi^H nu:^{HL} tsuan^{HL} du^{ʔL} tsu^H kan^{LH} du^{ʔL} ɲaŋ^L
 mai^H a^H ma^{ʔL}se:^H lei^Lna^H kan^{LH} nei^L si^{LH} lou^L fa^Lnu:^L tui^{RTS} u:m^H ɲi^{ʔL} k^hir^{ʔL} rual^H
 lek^H ka^H nei^L a^H tsu^{HL} tsu^H a^H man^L a^Hta:n^H in^{RTS} pom^H du^{ʔL} ɲa:l^{HL} lo^{ʔL} tsuan^H
 ti:^Lin^H a^L puan^{LH} ta^{ʔL}na^H ɲun^{HL} a^Htraŋ^H tsuan^H a^L ts^haŋ^H a^H t^hai^Hluŋ^Hi^H tsuan^{HL}
 mak^L a^H ti^{ʔL} e:m^{HL} a^Hva:ɲ^Lin^H ɲoi^{ʔL} a^H tsu^{ʔL} ta^{HL} deu^{ʔH} deu^{ʔH} a^H mi^Lk^hual^Lte^H

tsuan^{HL} t^hai^Hluj^Hi^H nu:^H lou^{LH} don^L da:n^L tsu:^H an^{RTS} bej^Hk^hon^{HL} le:^{RTS} a^H an^{LH}
 in^Lrem^Hsiam^L ta:^{HL} a^H t^hai^Hluj^Hi^H nu:^{HL} tsuan^{HL} t^hai^Hluj^Hi^H tsu^H tui^{RTS} tsoi^H a[?]
 ka^L ti:r^H aj^H a^H naj^{RTS} nin^{HL} lou^{LH} tsaj^L u^Hla^H in^{RTS} man^H mai^H aj^{RTS} tsu:^H a^H ti:^L
 a^H t^hai^Hluj^Hi^H tsu:^H a^L maj^{LH} aj^L ta^L e:m^{HL} e:m^{HL} mai^H a^H tui^{LH} tsoi^L tsu^H a^H hun^{HL}
 ta:^{HL} a^H ta:m^{LH} la:k^La^H tla:n^Lbou^L la[?] tsu^H ram^Hsa:^{HL} i^Llou^L a^L lau[?] a^Hva:[?]lin^H
 a^L ɲam^H si:^{LH} lou^L a^H nu:^H tir[?] tsu^H a^L ɲial^{RTS} ɲam^H si:^{LH} lou^L a^H ɲai[?]na^H ɾe^H
 lo^Lvin^H a^H in^Lk^ha:p^H t^hu^L ta^L rej^{HL} a^H a^H nu:^{HL} la[?] tsuan^{HL} tui^{RTS} tsoi^H tu:r^Lin^H
 a^L ti:r^H tlat^H si:^L a^H ɾe[?] e:m^{HL} e:m^{HL} tsuj^{RTS} tsuan^H tui^{RTS}k^hur^H lam^{RTS} tsu^H a^H
 pan^{RTS} ta:^{HL} a^H an^{LH} lou^{LH} tsa:n^Lna^H mun^{HL} tu:r^La^H ruat^{HL} a^H t^hen^L ma:^Hin^H an^{LH}
 lou^{RTS} man^H ta^L t^hut^H mai^H a^H an^{RTS} ram^H lam^Ha[?] an^{LH} bou^L pui^H ta^L dai[?] a^H
 t^hai^Hluj^Hi^H tsuan^{HL} nau^H mi:^Lpa:^L a^H nei^L a^H k^ho^Hlai^Ha[?] t^hi:r^{LH}lu:m^{RTS} tsu^H a^H
 tsai[?] tr^hi:n^L a^H ma[?]se:^H a^H tr^hian^Lte^H tsuan^{HL} ma[?]ni:^H u:^H te^H t^hi:r^{LH}lu:m^{RTS} a^H
 ɾa[?] tu:^{HL} ni^L mo^L ti:^Lin^H an^{RTS} au^H fo^Hva^H a^Hni:^{HL} tsu^H a^H ɲai[?] a^H tR^ha^L t^hei^L ta^L
 lo^Lva^H a^H nu:^H ɲe:n^{HL}a[?] a^H tr^hian^Lte^H au^L ɲa:^{RTS} tsu^H a^H zo:t^{HL}tsiaj^H ta:^{HL} a^H a^H
 nu:^{HL} tsuan^{HL} t^hai^Hluj^Hi^H tsan^Ltsin^{HL} tsu^H a^H ɾil[?] ta^L vek^H a^H a^L u:^H tsan^Ltsin^{HL}
 ra:p^{HL}t^ha:k^{HL} tak^H a^H ɾiat^{HL} tsuan^H a^H trap^L ta^L zoi[?] zoi^H a^H a^H nu:^H ɲe:n^{HL}a[?]
 tsuan^H ka^L u:^H zoj^H tu:r^Lin^H ka^L kal^H aj^H e:^H ti:^Lin^H a^H ɲe:n^L a^H a^H nu:^{HL} tsuan^{HL}
 i^H la:^H te:^{RTS} lu:^H e:m^{HL} a^H rap^Ltsuj^{RTS} i^H toj^{HL} hun^{HL}a[?] a^H ti:^L a^H rap^Ltsuj^{RTS}
 toj^{HL} a^H sa:[?] a^H han^L ni[?] tsuan^H a^L u:^H zon^L a^H ɲe:n^L le[?] a^H a^H nu:^{HL} tsuan^{HL}
 a^L la^H p^hal^H ri[?] lo^Lva^H na^Lkin^Ha[?] tsuan^H a^L lou^{LH} pui^{LH}tli^{LH} ve:^L ta:^{HL} a^H a^L u:^H
 zon^L tsu^H a^L tum^H ta^L tlat^H a^H a^H nu:^{HL} po[?]in^L a^L ɲial^{LH} ta^L bi:k^{HL} lo^Lva^H a^L u:^H
 zoj^H a^H a^L kal^L tsuan^H pu^Htar^H pa^Lk^hat^L a^H mu:^L a^H sum^{LH} a^L lou^{LH} sui[?] t^hut^H t^hut^H
 a^H ka^L pu:^{HL} ka^L u:^H om^{RTS}na^H lam^{LH} min^{LH} ɾil[?] t^hei^L lo:m^{LH} ni:^L a^H ti:^L a^H a^Hni:^{HL}
 tsuan^{HL} ka^L sum^{RTS} hi:^H mi^H han^L sui[?] zo[?]pu^H p^hot^H la:^H ka^H ɾil[?] aj^{RTS} tse^H a^H
 ti:^L a^H a^L sum^{RTS} tsu:^H a^H sui[?] zo[?]pu^H ta:^{HL} a^H a^H ka^Lna^H tu:r^L koj^H a^H ko[?]
 mu[?] a^L t^hui^H fe:^H a^L kal^H a^H pa^L pa^Lk^hat^H se^H k^hal[?] hi^H a^H mu^L le[?] a^H ka^L pu:^{HL}
 ka^L u:^H t^hai^Hluj^Hi^H om^{RTS}na^H min^{LH} ɾil[?] t^hei^L lo:m^{LH} ni:^L a^H ti:^L a^H a^Hni:^{HL} tsuan^{HL}
 ka^L se^H k^hal[?] hi:^H mi^H zui^{HL} la:^H ta:m^L lak^La^H ria[?] a^H tru:^L le[?] riak^{HL} ve:^L ze:^LRTS
 la^H i^L u:^H om^{RTS}na^H tsu^H ka^H ɾil[?] mai^H aj^{RTS} tse^H a^H ti:^L a^H a^L se^H k^hal[?] tsu^H
 a^H zui^{HL} a^H ram^Hɲuai^{LH}a[?] zan^L ej^Le^Hmo^Lza:t^{HL} a^L ria[?]pu^H ɲu:^{HL} tsuan^H k^hua^H
 an^{RTS} lu:t^{HL} ta:^{HL} a^H se^H k^hal[?] pa:^H in^{LH} ɲei^La[?] tsuan^H a^L t^hej^H ta:^{HL} a^H tsu:^{LH}
 in^{RTS} tsu^H a^L u:^H om^{RTS}na^H ɲei^L a^L lou^{LH} ni:^L a^H nau^Hpan^L te:t^{HL}a^H in^Ltr^hen^H an^{LH}
 ni[?] a^Hva:[?]lin^H ɲe:^H in^Lɾe^H rual^H an^{LH} ni^L to[?] lo^Lva^H nu^Lla:^H pa^Lk^hat^L hi^H a^H
 om^{RTS} a^H t^hai^Hluj^Hi^H ti[?] re:^{LH} a^L ɾe^H lo^Lva^H ej^Ltin^H tin^H e^Lmo^L an^{LH} ti:^L ti:^L
 na^H a[?] an^{LH} in^Lts^har^H ts^huak^{HL} ta:^{HL} a^H an^{RTS} ɲim^H e:m^{HL} e:m^{HL} a^H rei^H po[?]
 ɲa:k^{HL} lo^Lvin^H an^{RTS} k^ho^H lam^{RTS} pan^{HL}in^H an^{RTS} tla:n^Lts^huak^{HL} ru^L du:n^L ta:^{HL}

a^H lo:m^{RTS} e:m^{HL} e:m^{HL} in^H tsu:ŋ^{HL} u^Hnau^H in^Llou[?]L to[?]Lte^H tsu^H an^{LH} in^Lts^har^H
le[?]L ta:^{HL} ani[?]L tsu^H t^hai^Hluŋ^Hi^H te^H nu:^{HL}fa:^{HL} in^Lp^hua[?]Lna^H la:^{RTS} po[?]H he^Htiaŋ^L
hian^H kan^{LH} mu:^L a^H t^hai^Hluŋ^Hi^H nu:^{HL} t^hai^Hluŋ^Hi^H t^hai^Hluŋⁱ^H i^L tiaŋ^{LH}t^hi:r^{RTS}te^H
lou^{RTS} ŋa:k^{HL} la:^H i^L lan^Ltai^Hte^H lou^{RTS} ŋa:k^{HL} la:^H t^hai^Hluŋ^Hi^H ts^hak^Ltiaŋ^H k^hi:^{HL}
tsen^{HL} ka^H t^hen^L tsuan^H tiaŋ^{LH}t^hi:r^{RTS} a^H tr^ha:^L bou^H ŋai^{LH} lou^L lan^Ltai^H a^H tr^ha:^L
bou^H ŋai^{LH} lou^L ti^Lin^H

K.3 Translation by Khiangte (2002)

Many many years ago on a certain day, a little girl called Thailungi was lying down under the loom which her mother was weaving and her mother did not know that she was there. By and by, a man from the Eastern hills came along and offered to sell the woman an iron ball. Said the mother, ‘I have nothing else to buy it with, but if you like I will give my little daughter Thailungi as the price of the iron ball’. ‘Very well,’ said the seller, ‘But how am I to get her and take her away with me?’. The mother of Thailungi said, ‘I will send her to draw water at the well, and you can then catch her and take her away’. And so they agreed on that and the mother had that iron ball. Unfortunately at that time Thailungi had been listening, and she was very much afraid, especially when, very soon after, her mother sent her to the well to draw water. Thailungi did not know what to do. She could not run away for then the wild beast in the jungle would eat her, and if she went to the well the strange man would catch her, while if she went home her mother would do the same. Very slowly, full of fear, with feet dragging and with a heavy heart, she went to the well. There the man who had bargained with her mother suddenly caught her and took her away to his own country. Thailungi had a little brother, and this boy used to play in the village street with the iron ball. Sometimes the other children would not play with him, and at such times they would shout out, ‘Who sold his sister for an iron ball? Who sold his sister for an iron ball?’. The little boy did not know why they said this, so one day he asked his mother about it, and she told him what had happened to his sister. He was very sorry indeed and wept to think of the cruel fate of his dear sister, and he soon said to his mother, ‘I cannot bear to think that my sister is a captive in a strange land. I will go and search for her and bring her back,’ ‘No,’ Said his mother, ‘You cannot go now, you are too small’. Sometime afterwards, he said again that he wanted to go and search for his sister, but his mother gave him the same reply. Later on, when he had become quite a tall and strong young man, nothing could deter him, and at the first opportunity he set off for his long lost sister.

On the way he met an old man who was making a mortar for grinding rice. He said to the man, 'Please tell me where my sister is'. 'Finish making this mortar for me and I will tell you,' was the reply. He finished making the mortar and then the old man gave him directions as to the way he has to go. He went on accordingly until he met an old man from the Chin hills. 'Sir,' said the old man, 'Do you know where my sister is?'. This man was driving cattle and he said to young man, 'Follow my cattle wherever they go, sleep wherever they sleep, stay wherever they stay, and you will find your sister'. The young man did as he was told. He followed the cattle. He went wherever they went, slept wherever they sleep, stay wherever they stayed and at last they led him to a house. This was the house of his sister, but he did not yet know it. He entered the house and found a young woman there. They began to talk to each other and he soon found that she was his long lost and dear sister. They did not stay long after his arrival but ran away together and made their way back to their own village, where they lived a very happily and loved each other always.

Appendix L

Passage “Ngaiteii”

L.1 Mizo orthography

Hmanlai hian hmeichhe tleirawl pakhat hi a awm a, a hming chu Ngaiteii a ni a. Ngaiteii chuan pa a nei tawh lova, a pa chu tuiah a tlahlum a, a thi tawh a.

Ni khat chu Ngaiteii leh a pi chu lovah an feh a, bal an cho a, an lo mawngah chuan li thuk tak hi a awm a. Chu li chu Ngaiteii pa tlakhlumna a ni a, chuvangin Ngaiteii pa thlarau chu chu li-ah chuan awmin an ring a. Chumi ni chuan Ngaiteii chu a tui a hal chhen mai a, a pi chuan tui a zu chawi sak thin a. Nakin deuhah chuan Ngaiteii chu a tui a hal leh ta a, a pi chuan, ‘Ngaite, ka hah tawh em a, nangman tui zu chawi mai rawh, amaherawhchu, li i zu hmuhin ‘Ekhai’ zu ti hauh suh la, ngawi reng ang che’ a ti a. Ngaiteii chuan, ‘Aw le,’ a ti a, a kal ta a. Lo mawnga li a zu thlen chuan a lo dum kuk mai a, api thusawi kha a theihngilh a, ‘Ekhai’ a ti ta a. Chu veleh tuiah a tla ta a, a pi chuan Ngaiteii a lo haw har tak ema avangin tuiah a tla ta niin a ring a, amah zawng turin a kal ta a. Nakinah chuan sakhi nupa hi a hmu a, Ngaiteii an hmu em tih a zawt a, anni chuan heti hian an chhang a:

‘A hmuh chu kan hmu a,
Tuipui ral tiau ralah,
Ngaiteii pa’n va lak e,’ tiin.

Tichuan Ngaiteii pi chuan Ngaiteii chu a pa thlarauvin a la ta niin a ring a. Nakin deuhah chuan Varung nupa hi a hmu leh a, Sakhi nupa a zawh ang bawh khan a zawt a, anni pawh chuan sakhi nupa chhan ang bawh khan an chhang ve leh a. Ngaiteii pi chuan tui chhungah chuan Ngaiteii chu a hmu ta a.

‘Ngaite, ka lo zuangthla dawn’ a ti a, a zuangthla ve ta a. Ngaiteii chuan a pi a hmuh leh avangin a lawm hle mai a, tichuan a pi chuan, ‘Khawiahnge i pa thlarau chu a awm?’ tiin a zawt a, Ngaiteii chuan, ‘Tunah chuan a feh a, nakinah rulah a chang anga, a lo haw ang’ a ti a.

Tlaih chuan Ngaiteii pa thlarau chu rulah a chang a, a lo haw ta a, a inkual ta rui mai a, reilote-ah chuan mihringah a chang leh ta a. Ngaiteii pi chuan, ‘Ngaiteii hi ka hawn leh dawn e,’ a ti a. A pa chuan, ‘Awle, i kalpui dawn nia, amaherawhchu reilote-ah Ngaiteii chu lokal leh rawh se,’ a ti a. Tichuan Ngaiteii leh a pi chu lawm takin an haw dun ta a. Mahse, Ngaiteii chuan a pa hnena kal leh chu a duh ta lova, a pi hnenah chuan rei tak a awm ta a.

Ngaiteii pa chuan Ngaiteii a hnena a lo kal leh har tak em avang chuan, a awmna tui chu a tilian ta chiam mai a. Ngaiteii awmna khua chu a chim dawn ta mai a, tuilian ri chuan, ‘Ngai, Ngai, Ngai’ a ti a. Tichuan mite chuan, ‘Ngaiteii avangin kan khua tuin a chim tak ngial dawn e, engtinngge kan tih ang le?’ an ti a. Mi thenkhat chuan, ‘A puan kha thlak ula a t̄ha ang,’ an ti a. Ngaiteii puan chu tuiah an thlak a, tui chu a kam ta deuh a, mahse reiloteah tui chu a lo lian ta pung pung mai a, mite chuan, ‘Ngaiteii samkhuih kha tuiah thlak rawh u,’ an ti leh a. Ngaiteii samkhuih chu an thlak a, tui chu tlemin a kam leh ta a. Ngaiteii banbun te, a t̄hi te, a thil neih zawng zawng chu an thlak sak ta a, mahse tui chu a lian leh zel a. A tawpah chuan mite chuan, ‘Ngaiteii hi kan thlak mai loh chuan kan khua zawng zawng hi kan boral vek mai dawn si a,’ tiin ui tak chungin Ngaiteii chu tuiah chuan an thlak ta a. Tichuan tui chu a kam ta ruai ruai a, a kam hlen ta a; mahse mite chuan Ngaiteii chu an ui hle mai a, an t̄ap an t̄ap mai a. An t̄ah hla chu hei hi a ni :

’Ngaite hip,

Chhim thlipui maw i tuar a,

Khuang ruahsur maw i tuar a,

Ngaite hip’

He hla hi tun thlengin naupangin infiamna hlaah an la hmanng baw k t̄hin a ni.

L.2 Phonetic transcription

ma:n^Hlai^H hian^H me:^Lts^he^L tlei^{LH}ro:l^{LH} pa^Lk^hat^L hi:^H a^L om^H a^H a^L miŋ^H tsu:^H ŋai^Hte^{HL}i^H a^H ni:^L a^H ŋai^Hte^{HL}i^H tsuan^{HL} pa:^{HL} a^H nei^L to^ʔL lo^Lva^H a^H pa:^{HL} tsu^H tui^Ha^ʔL a^H tla^Llum^L a^H a^L t^hi^H to^ʔL a^H ni^Hk^hat^L tsu:^H ŋai^Hte^{HL}i^H le^ʔL a^L pi:^H tsu^H lo^Hva^ʔL an^{LH} fe^ʔL a^H ba:l^{LH} an^{LH} tsou^{RTS} a^H an^{LH} lou^{RTS} moŋ^{HL}a^ʔL tsuan^H li:^H t^hu:k^{HL} tak^L hi:^H a^L om^H a^H tsu:^{RTS} li:^H tsu^H ŋai^Hte^{HL}i^H pa:^H tla:k^{HL}lum^{HL}na^H a^H ni:^L a^H tsu^{HL}va:ŋ^Lin^H ŋai^Hte^{HL}i^H pa:^H t̄^ha^Hrau^{RTS} tsu:^H tsu:^L li:^Ha^ʔL tsuan^H om^Hin^H an^{RTS} riŋ^H a^H tsu^Hmi^L ni:^H tsuan^H ŋai^Hte^{HL}i^H tsu:^H a^L tui^{LH} a^L ha:l^{RTS} ts^he:n^{HL} mai^H a^H a^L pi:^H tsuan^{HL} tui^{LH} a^H zu^L tsoi^L sak^L tr^hi:n^L a^H na^Lkin^H deu^ʔa^ʔL tsuan^H ŋai^Hte^{HL}i^L tsu^H a^L tui^{LH} a^L ha:l^{LH} le^ʔL ta:^{HL} a^H a^L pi:^H tsuan^{HL} ŋai^Hte:^{HL} ka^H ha^ʔL

toʔL e:m^{HL} a^H naj^{LH} ma:n^L tui^{LH} zu^L tsoi^H mai^{LH} roʔL a^H maʔL e^H roʔL tsu^H li:^H i^H zu^L
 moʔL in^H e:^H k^h ai^L zu^L ti^L hau^{ʔH} su^{ʔL} la^H ɲoi^H reŋ^L aŋ^{RTS} tse^H a^H ti:^L a^H ɲai^H te^{HL} i:^L
 tsuan^{HL} o:^{HL} le:^H a^H ti:^L a^H a^L kal^H ta:^{HL} a^H lou^{RTS} moŋ^{HL} a^H li:^H a^H zu^L t^h en^{HL}
 tsuan^H a^L lou^{RTS} dum^H ku:k^{HL} mai^H a^H a^L pi:^H t^h u^H soi^L k^h a^H a^H t^h ei^{ʔL} ɲil^{ʔL} a^H
 e:^H k^h ai^L a^H ti:^L ta:^{HL} a^H tsu:^{HL} ve:^{HL} le^{ʔL} tui^H a^{ʔL} a^H tla^L ta:^{HL} a^H a^L pi:^H tsuan^{HL}
 ɲai^H te^{HL} i:^H a^L lou^{LH} ho^L har^L ta:k^{HL} e:m^{HL} a^H va:ɲ^L in^H tui^H a^{ʔL} a^H tla^L ta:^{HL} ni:^L in^H a^L
 riŋ^H a^H a^H ma^{ʔL} zoŋ^H tu:^L in^H a^L kal^H ta:^{HL} a^H na^L kin^H a^{ʔL} tsuan^H sa^L k^h i:^H nu:^L pa:^L
 hi^H a^H mo:^L a^H ɲai^H te^{HL} i:^H an^{LH} mo:^L em^{LH} ti^{ʔL} a^H zo:t^{HL} a^H an^{RTS} ni:^{HL} tsuan^{HL}
 he^H ti:^L hian^H an^{RTS} ts^h a:ɲ^H a^H a^H mo^{ʔL} tsu^H kan^{LH} mo:^L a^H tui^{LH} pu:^{LH} ra:^L triau^H
 ra:^L a^{ʔL} ɲai^H te^{HL} i:^H pan^{HL} va^H la:k^{HL} e:^H ti:^L in^H ti^L tsuan^H ɲai^H te^{HL} i:^L pi:^H tsuan^{HL}
 ɲai^H te^{HL} i:^L tsu:^H a^H pa:^H t^h a^H rau^{LH} vin^L a^H la^L ta:^{HL} ni:^L in^H a^L riŋ^H a^H na^L kin^H
 deu^{ʔH} a^{ʔL} tsuan^H va^L ruŋ^H nu:^L pa:^{HL} hi:^H a^H mo:^L le^{ʔL} a^H sa^L k^h i:^H nu:^L pa:^L a^L zo^{ʔL} aŋ^L
 bok^H k^h a:n^H a^H zo:t^{HL} a^H an^{RTS} ni:^{HL} po^{ʔH} tsuan^L sa^L k^h i:^L nu:^L pa:^L ts^h a:n^L aŋ^L bok^H
 k^h a:n^H an^{RTS} ts^h a:ɲ^H ve:^L le^{ʔL} a^H ɲai^H te^{HL} i:^H pi:^H tsuan^{HL} tui^{RTS} ts^h u:ɲ^H a^{ʔL} tsuan^H
 ɲai^H te^{HL} i:^H tsu^H a^H mo:^L ta:^{HL} a^H ɲai^H te:^{HL} ka^L lou^{RTS} zuaŋ^H t^h a^L do:n^H a^H ti:^L a^H
 a^L zuaŋ^H t^h a^L ve:^L ta:^{HL} a^H ɲai^H te^{HL} i:^H tsuan^{HL} a^L pi:^H a^H mo^{ʔL} le^{ʔL} a^H va:ɲ^L in^H a^L
 lo:m^{LH} le:^{LH} mai^L a^H ti^L tsuan^H a^L pi:^H tsuan^{HL} k^h oi^{HL} a^{ʔL} ɲe:^{HL} i^H pa:^H t^h a^H rau^{RTS}
 tsu:^H a^H om^L ti:^L in^H a^H zo:t^{HL} a^H ɲai^H te^{HL} i:^H tsuan^{HL} tu:n^{LH} a^{ʔL} tsuan^H a^H fe^{ʔL}
 a^H na^L kin^H a^{ʔL} ru:^L a^{ʔL} a^L tsaj^{RTS} a^H ɲa^H a^L lou^{LH} ho:^{LH} aŋ^{RTS} a^H ti:^L a^H t^h lai^{LH} a^{ʔL}
 tsuan^H ɲai^H te^{HL} i:^H pa:^H t^h a^H rau^{RTS} tsu:^H ru:^L a^{ʔL} a^L tsaj^{RTS} a^H a^L lou^{LH} ho:^{RTS} ta:^{HL}
 a^H a^H in^L kual^L ta^L rui^{HL} mai^H a^H rei^H lou^L te:^{LH} a^{ʔL} tsuan^H mi:^L riŋ^H a^{ʔL} a^L tsaj^{LH} le^{ʔL}
 ta:^{HL} a^H ɲai^H te^{HL} i:^L pi:^H tsuan^{HL} ɲai^H te^{HL} i:^H hi:^H ka^H ho:n^L le^{ʔL} do:n^H e:^H a^H ti:^L a^H
 a^H pa:^{HL} tsuan^{HL} o:^{HL} le^H i^H kal^L pu:^H do:n^H nia^H a^H ma^{ʔL} e^H ro^{ʔL} tsu:^H rei^H lou^L te:^{LH} a^{ʔL}
 ɲai^H te^{HL} i:^H tsu^H lou^{RTS} kal^H le^{ʔL} ro^{ʔL} se^H a^H ti:^L a^H ti^L tsuan^H ɲai^H te^{HL} i:^H le^{ʔL} a^L pi:^H
 tsu^H lo:m^{LH} tak^L in^H an^{LH} ho:^{LH} du:n^L ta:^{HL} a^H ma^{ʔL} se:^H ɲai^H te^{HL} i:^H tsuan^{HL} a^H pa:^H
 ɲe:n^{HL} a^H kal^L le^{ʔL} tsu:^H a^H du^{ʔL} ta^L lo^L va^H a^L pi:^H ɲe:n^{HL} a^{ʔL} tsuan^H rei^H tak^L a^L
 om^{RTS} ta:^{HL} a^H ɲai^H te^{HL} i:^H pa:^{HL} tsuan^{HL} ɲai^H te^{HL} i:^H a^H ɲe:n^{HL} a^H a^L lou^{LH} kal^L le^{ʔL}
 har^L ta:k^{HL} e:m^{HL} a^H va:ɲ^L tsuan^H a^H om^L na^H tui^{RTS} tsu^H a^H ti^L lian^L ta^L tsiam^H mai^H
 a^H ɲai^H te^{HL} i:^L om^{RTS} na^H k^h ua^H tsu^H a^H tsim^{HL} do:n^H ta^L mai^H a^H tui^{LH} lian^L ri:^{HL}
 tsuan^{HL} ɲai^H ɲai^H ɲai^H a^H ti:^L a^H ti^L tsuan^H mi:^{HL} te^H tsuan^{HL} ɲai^H te^{HL} i:^L a^H va:ɲ^L in^H
 kan^{RTS} k^h ua^H tui^H in^L a^H tsi:m^{HL} tak^L ɲial^{RTS} do:n^H e^H eŋ^L tin^H ɲe:^{HL} kan^{LH} ti^{ʔL} aŋ^{LH}
 le:^L an^{LH} ti:^L a^H mi:^L tr^h en^H k^h at^L tsuan^{HL} a^L puan^{RTS} k^h a^H t^h a:k^{HL} u^H la^H a^H tr^h a^L
 aŋ^{LH} an^{LH} ti:^L a^H ɲai^H te^{HL} i:^L puan^{RTS} tsu:^H tui^H a^{ʔL} an^{RTS} t^h a:k^{HL} a^H tui^{RTS} tsu^H
 a^L ka:m^H ta^L deu^{ʔH} a^H ma^{ʔL} se:^H rei^H lou^L te:^{LH} a^{ʔL} tui^L tsu^H a^L lou^{LH} lian^L ta^L puŋ^L
 puŋ^{HL} mai^H a^H mi:^{HL} te^H tsuan^{HL} ɲai^H te^{HL} i:^L sam^{LH} k^h uih^L k^h a^H tui^H a^{ʔL} t^h a:k^{HL} ro^{ʔL}
 u:^H an^{LH} ti^L le^{ʔL} a^H ɲai^H te^{HL} i:^H sam^{LH} k^h uir^L tsu^H an^{RTS} t^h a:k^{HL} a^H tui^{RTS} tsu^H

tle:m^Hin^H a^L ka:m^H leʔ^L ta:HL a^H ɲai^Hte^{HL}i^L ba:n^Hbun^{HL} te^H a^L tr^hi:^H te^H a^L t^hi^L
 neiʔ^L zoŋ^L zoŋ^{HL} tsu^H an^{RTS} t^ha:k^{HL} sak^L ta:HL a^H maʔ^Lse^H tui^{RTS} tsu^H a^H lian^L leʔ^L
 ze:l^{RTS} a^H a^H to:p^Laʔ^L tsuan^H mi:HLte^H tsuan^{HL} ɲai^Hte^{HL}i^H hi^H kan^{RTS} t^ha:k^{HL} mai^{LH}
 louʔ^L tsuan^H kan^{RTS} k^hua^H zoŋ^L zoŋ^{HL} hi^H kan^{RTS} bou^Hra^L RTS vek^H mai^{RTS} do:n^H
 si:RTS a^H ti:^Lin^H ui^H tak^L tsuŋ^Hin^H ɲai^Hte^{HL}i^L tsu^H tui^Haʔ^L tsuan^H an^{RTS} t^ha:k^{HL}
 ta:HL a^H ti^Ltsuan^H tui^{RTS} tsu:^H a^L ka:m^H ta^L ruai^L ruai^{HL} a^H a^L ka:m^H ɲen^{HL} ta:HL
 a^H maʔ^Lse:^H mi:HLte^H tsuan^{HL} ɲai^Hte^{HL}i^L tsu^H an^{RTS} ui^H ɲe:^{RTS} mai^H a^H an^{LH} trap^L
 an^{LH} trap^L mai^H a^H an^{LH} traʔ^L ɲa:^{RTS} tsu^H hei^{HL} hi^H a^H ni^L ɲai^Hte:^{HL} hi:p^H ts^him^L
 t^hi:^Lpui^{RTS} mo:HL i^H tuar^L a^H k^huaŋ^H rua^Lsu:r^H mo:HL i^H tuar^L a^H ɲai^Hte^{HL} hi:p^H
 he:^{LH} ɲa:^{RTS} hi^H tu:n^{RTS} t^hej^Hin^H nau^Hpaŋ^Hin^L in^Lfiam^Lna^L ɲa:^{LH}aʔ^L an^{RTS} la^H maŋ^H
 bok^L tr^hi:n^L a^H ni^L

L.3 Translation by Khiangte (2002)

In olden days there was once a comely young orphan girl named Ngaiteii who lived in a village with her grandmother. They used to dig for yams in their jhum which did not have much water and which was now said to be haunted by the ghost of Ngaiteii's father. They were both digging for yams one day when Ngaiteii said she felt very thirsty. Her granny fetched her some water to drink from the pool. However, she complained of feeling thirsty again a little while afterwards. Her granny told her to go and drink from the pool herself this time, but warned her to be very careful and never on any account utter the word, 'How!'. When she reached the pool and saw its dark waters, curiosity got the better of her and she called out 'How!' and no sooner had she done so than she toppled into the well. As a considerable time elapsed without Ngaiteii returning her granny was worried about what must have occurred; so she went down to look for her. On the way to the pool she met a pair of red deer and asked them, 'Oh! parents of Khite, (Khite - the young of red deer) have you seen my grand daughter, Ngaiteii?' They replied : 'Yes, we saw her on the other side of the Tuipui and Tiau rivers, where Ngaiteii's father has taken her.' So, she later met a pair of partridges and on questioning them they answered exactly as the red deer had done. At length she arrived at the great pool and on seeing Ngaiteii there, she also jumped in. 'Where is your father, child?' She enquired. And Ngaiteiin said he had gone to work in the form of serpent but would be back in the evening. He came back in due time and after he had changed into human form, Ngaiteii's granny said she would take the girl back to be with her. 'You may do so,' her father agreed, 'But only for a few days, mind, as I am quite lonely here and want her to stay with

me'. Ngaiteii had no intentions, however, of sharing a lonely life with her father in the gloomy waters of the deep pool; so she never bothered her head about returning from the village. Her father at last became impatient at her continued absence and demanded her return by suddenly causing the surrounding areas to overflow with angry sounds of water 'Ngai, Ngai, Ngai' rising from the rushing waters. The entire village was about to be submerged. Knowing the demand when some one threw a piece of cloth belonging to Ngaiteii into the waters, the flood subsided. However, after a short interval, the waters commenced rising again and on this occasion Ngaiteii's comb was thrown in and the flood abated. This proved but a short respite, however, as the waters started swelling rapidly once again to an alarming extent and with much greater turbulence. The dismayed people then realised that Ngaiteii's father would not rest content unless Ngaiteii herself was returned to him. It seems that there was no course left to save the whole village from total destruction other than to sacrifice Ngaiteii to the floods, and this the sorely distressed people were reluctantly compelled to do, although the girl was loved by everyone. Immediately after Ngaiteii was swallowed up by the raging waters, the floods subsided, with equal rapidity, and from then day on wards the village has never had to suffer from even a single high flood over all the years. The people of the village shed bitter tears over Ngaiteii's sad fate for long afterwards and she is yet remembered in this sorrowful song : Dearest Ngaiteii, we pray to you, the anger of the southern sky, and the heavily rushing waters high, have now been stayed and calmed, dear; you saved us all Ngaiteii, yes, you, so do not suffer anymore, do not fear, dearest Ngaiteii... oh! dear...The above haunting lines in memory of Ngaiteii are still being sung by children in the Mizo villages when they enjoy moonlight nights.

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