PROSODIC ASPECTS OF SYLHETI

BY

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A

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DECLARATION

This is to certify that the dissertation entitled "Prosodic Aspects of Sylheti", submitted by me to the Indian Institute of Technology Guwahati, for the award of the degree of Doctor of Philosophy in Linguistics, is an authentic work carried out by me under the supervision of Prof. Shakuntala Mahanta. The content of this dissertation, in full or in parts, have not been submitted to any other University or Institute for the award of any degree or diploma.

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CERTIFICATE

This is to certify that the dissertation entitled "Prosodic Aspects of Sylheti", submitted by Ms. Priti Raychoudhury (Registration Number: 146141012), a research scholar in the department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, is a record of an original research work carried out by her under my supervision and guidance. The dissertation has fulfilled all requirements as per the regulations of the institute and in my opinion has reached the standard need for submission. The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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To the pillars of my strength: Maa, Baba, Sanjiv, Tuhin, and Aadya.

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Abstract

This dissertation discusses the nature of prosodic features of Sylheti, an Indo-Aryan language (ISO 15924), also debatably a dialect of Bengali. It aims to present the correlation between components of the prosodic hierarchy in the language and the components of its grammar. It is an attempt to present a typological study of Sylheti that evolved into a tone language, independently from the group of the language family to which it genetically belongs. It presents an overall view of tone and intonation in the language and shows how these connect to sound systems and grammar. The language exhibits a three-way tonal contrast, distinguishing the High, Mid, and Low lexical tones. The tonogenetic factors contributed by the instability of the diachronic four-way laryngeal contrast conditioned a three-way tonal contrast in Sylheti depending on the voicing and syllabic position of the sound. Tonogenesis is one of the central aspects of the phonology of the language, as a detailed study on the phonetics and phonology of the three-way tonal system of the language reveals the factors behind the difference in the tonal behaviour at the post-lexical level such as the difference between the complex morphemes and compounds in the language.

Since the phonetic correlate of tone and prosodic hierarchy is variation in f0 (Beckman & Pierrehumbert, 1986; Nespor & Vogel, 1986), we study the tonal domain of phonological words to analyse the typological aspect of the language. This component of the grammar has been attested as one of the significant domains to understand the typology of tone languages (Ratliff, 2015). This dissertation thus makes one of the first attempts to study both the domains of complex stems and compound words in Sylheti. The study of these domains exhibits a predominant structure of tonal polarity represented by a polar LH or HL tone contours and a uniform LHL melody in compound stems. The inherent nature of the tonal polarity in complex stems is neutralised by the lexical Mid tone, which gives an interesting insight into the correlation between prosodic hierarchy and tonogenetic aspect in the language. The domain of compound words exhibits a canonical LHL tonal melody, and this structure is marked by a uniform rise (LH) on the leftmost word in majority of the compound stems regardless of their underlying tonal specifications. This aspect of these words provides a very interesting aspect of grammar and its correlation with prosody in the language.

This dissertation also presents a preliminary attempt to understand the intonational system of a language from a typological and descriptive perspective by studying the interaction between tone and intonation. This study thus primarily presents a detailed investigation into the phonetics and phonology of tone and its interaction with the components of grammar in Sylheti to provide a wide picture of the

prosodic hierarchy of a tonal language that genetically belongs to a non-tonal language family and is geographically surrounded by numerous tonal languages.

Contents

List of Abbreviations and symbols

ACC	Accusative case
Adj	Adjectivizer
CL	Classifier
Cop	Copula
DAT	Dative case
Fem	Feminine gender
FUT	Future tense
Gen	Genitive case
H	High tone
HAB	Habitual aspect
IP	Intonational Phrase
L	Low tone
M	Mid tone
Mas	Masculine gender
NOM	Nominaliser
NP	Noun Phrase
P	Person inflection
PERF	Perfective aspect
Pl	Plural
PP	Phonological Phrase
PRES	Present tense
PST	Past tense
VP	Verb Phrase
σ	Syllable
ω	Phonological word

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Chapter 1

Introduction

Languages may vary based on how they employ pitch variation to convey linguistically significant meanings. While intonational languages utilize pitch modulation to convey intonational meanings, tone languages primarily utilize contrastive pitch heights to differentiate between lexical or grammatical meanings. Tone languages have been attested to vary primarily in terms of the number of contrasts in tone height and their choice of tone-bearing unit (Clark, 1983; Hyman, 1978; Hyman & Leben, 2020). The earliest distinction within the group of tone languages is between those that have level tones, i.e., tonal contrasts with variation in pitch height of the syllable, and those that have contour tones, which contrast pitch movement within the syllable. Pike (1948) termed these two groups as 'register tone languages' and 'contour tone languages,' respectively. Additionally, tone languages are also classified based on their typology. In his analysis of the typology of tone languages, Matisoff (1973) observes two major characteristics of truly tone languages: firstly, these languages are mostly monosyllabic and thus syllable is the tone-bearing unit in these languages. He states that disyllabic or polysyllabic languages can achieve the status of a pitch accent language but could never be defined as purely tone language such as Japanese and Swedish. Secondly, the complexity of the tonal inventory of a language is inversely related to its consonantal system, i.e., the more intact a language's consonantal features are, the less complex its tonal system will be. Haudricourt (1954) shows that Vietnamese has a very complicated tonal system that originated from the merger of laryngeal contrast, i.e., the loss of voicing contrast from voiced and voiceless stops and voiceless and voiced sonorants. This merger of laryngeal contrasts leading to the origin of tones in a language, is a phenomenon commonly known as 'tonogenesis', a term first coined by Matisoff (1970; 1973). Although tonogenesis can also be triggered by the loss of phonological contrasts such as vowel height, some of the early accounts of tonogenesis like Haudricourt (1954), Maran (1973), and Matisoff (1970; 1973) focus on tonogenesis originating from laryngeal features of consonants.

1.1 The tonogenetic typology of languages

The tonogenetic aspect of tone has long been a centre of discussion for phonologists studying tone languages genetically belonging to a tonal group of languages as well as to a group of non-tonal languages. Studies such as Haudricourt (1954), Maran (1973), and Matisoff (1970; 1973) focus on stages of tonogenesis in different languages of Southeast Asian language families and argue that a language goes through a few common stages from being atonal to gradually acquiring a tonal system. These stages proposed in Maran's (1973) analysis can be summarised as follows:

- The reanalysis and realignment of pitch characteristics into a pair-wise contrastive paradigm mark the onset of tonogenesis.
- This stage is followed by the intermediate stage where the consonants conditioning the tonogenesis reach a full redundancy stage. Maran (1973) proposes that Jinghpaw has reached the intermediate stage, where syllable-final stops (-p, -t, -k, -ʔ) are voiceless under the high tone but voiced (-b, -d, -a, -ʔ).
- The intermediate stage is followed by the complete depletion of the initials, followed by the deletion of finals in most of the Tibeto-Burman languages like Central Burmese. There is simultaneous transitioning and cognitivization of tonal features into the lexical property, leaving the initial or final consonants largely dysfunctional.

An interesting way of understanding the stages of tonogenesis is to study tone languages still in their transitional stage. For instance, Tamang, a Sino-Tibetan language spoken in Nepal, marks the word as the Tone-Bearing Unit (TBU) and each syllable does not have a tone (Gao & Mazaudon, 2022; Mazaudon & Michaud, 2008; Mazaudon, 2014). Tonogenesis in the language has been reported to have originated from the merger of laryngeal contrasts in the aforementioned studies. It exhibits a four-way tone contrast: aspiration contrast is neutralized in the lower tones while it is retained in higher tones. It has been prosodically classified to be in a transitional stage (Mazaudon & Michaud, 2008; Mazaudon, 2014), which neutralizes the redundant consonantal features in one context and retains them in another; suffixes have no independent tones, and the tonal characteristics of the initial morpheme extend over the whole phonological word, constituting a word-tone system first described in (Pike, 1970) and (Mazaudon, 1973).

Both Maran (1973) and Matisoff (1973) observe an advanced stage of tonogenesis in pure tone languages. This stage involves a complete neutralisation or deletion of the initial and final consonants, leaving their intrinsic features on the vowels following or preceding them in languages like Lahu and Lisa, which lack phonetic finals and an active obstruent/continuant pair (Maran, 1973). Matisoff (1973) relates mergers or losses and the resulting homophony in a non-final stage that undergoes further tonal splits from the rudimentary tone. This corresponds to the advanced stage of tonogenesis proposed by Haudricourt (1954), where the basic tones split or multiply the number of lexical tones. It is thus often difficult to determine the sources of tonogenesis in fully developed languages in tonally complex languages. It is also attested cross-linguistically that purely tone languages do show evidence for the effect of inherent f0 (Whalen & Levitt, 1995). In his study on the tonogenesis of South Asian languages, Matisoff (1973), claims that the Bodo-Garo families and even the Kuki-Chin Naga (spoken by the ethnically related Naga people of Nagaland, the Chin people of Burma, and the Kuki people) group of languages of the Tibeto-Burman language family do not have a fully grown tonal system yet. Matisoff (1973) claims that purely tonal languages are strongly monosyllabic, and there are evident interactions between segments and tone within a word. However, recent studies such as those by Hyman (2006) and Watkins (2013; 2019) have contributed to our understanding of Kuki-Chin tonal systems and have provided valuable insights, particularly in highlighting the rich system of tonal contrasts and illuminating how these languages utilize tone to distinguish between different tenses, moods, and aspects, among other grammatical features.

Our chapters on tonogenesis and the three-way tone contrast in Sylheti show that it has surpassed the final stage proposed by Maran (1973), but it is yet to reach the advanced stage of evolution as a purely tone language. The typological aspect of tonogenesis is central to this dissertation and is expected to contribute to our understanding of the tonal system of Sylheti, a language that developed tone independently from a non-tonal language family to which it genetically belongs.

1.1.1 Prosodic hierarchy and typology

Pitch variation is also a significant factor in marking distinctions in the prosodic hierarchy (Beckman & Pierrehumbert, 1986; Nespor & Vogel, 1986). The domain of prosodic stems has been a scope of study to determine the typology of most tonal languages of the world (Ratliff, 2015). In their study on the prosodic typology of tone languages, Hyman & Leben (2017) propose that beyond contrasting tonal heights, languages may exhibit variation in terms of tonal mapping within a tonal domain, a characteristic intrinsic to the prosodic domain. Most tone languages exhibit tonal alternation but there also exist genetically tone languages, (here, genetically tone languages refer to languages descended from a language family in which most of the languages exhibit tonal contrast) such as Tangkhul Naga which have minimal morphotonemics; a high, mid, or low tone always surfaces on its syllable and does not undergo any change, nor does it have any effect on other tones (Hyman, 2014). On the other hand, studies on Bantu languages have shown that the reanalysis of the tonal system as an accentual system can essentially be traced through the reinterpretation of a prominent tone when two lexical tones co-occur, or when a word with a lexically specified tone occurs in proximity to toneless syllables, it is reinterpreted as an accent (Clements & Goldsmith, 1984).

In their study on complex stems in Sylheti, Mahanta & Gope (2018) show that the nominal suffixes are toneless in the language and derive tones from their hosts. Our analysis of the tone interaction in prosodic stems presented in this dissertation also offers an intriguing insight into the high level of lexical tone alteration at the prosodic domain of Sylheti, a language where not all words are marked for tones. At the same time, our attempt to understand the intonational structure of the language addresses the question of whether the prosodic typology of a language defines its tonal system.

1.2 An introduction to Sylheti

Sylheti is an Indo-Aryan language spoken mainly in the Surma and Kushiara valleys of the Sylhet Division in Bangladesh, and in the Barak valley region of Assam, India. The language has a substantial number of speakers in the Indian states of Meghalaya, Tripura, Manipur, and Nagaland, as well as in the United Kingdom, the United States, and the Middle East. It is spoken by approximately 11 million people, with 7 million in Bangladesh (Lewis et. al, 2015; Simard et. al, 2020) identifying it as their first language, but is debatably regarded as a dialect of Bengali (Rasinger, 2007). Being phonologically and grammatically different and unintelligible to other Bengali dialects, it is argued to be a separate language: ISO - 15924 (Chalmers, 1996; Chatterji, 1926). Known as the language of the Surma Valley during the 6th century A.D., Sylheti had a distinct script (Chowdhury, 1998; Gupta, 1968) - the Nagari script - claimed to have originated around the beginning of 14th century A.D. (Chatterji, 1926). It resembles spoken Sylheti to a large extent and has been revived for educational purposes (Simard et al. 2012).

Srihatta/Sylhet became a part of the newly formed state of Assam in A.D. 1874 and remained so until 1947 (Choudhury, 1910). The language is structurally related to both Assamese and the rural dialects of eastern Bengal but has its own distinct grammar with a high proportion of words derived from Persian and Arabic. Sylheti also has its own dialects, which differ regionally within the north-eastern India. In addition to the fundamental differences in the lexicon and morpho-syntactic structure, Sylheti also has a noticeably reduced inventory of phonemes as compared to its cognate languages.

Figure 1.1 Pre-Independent greater Sylhet, District of Assam (STAR, 1996-2018)

1.2.1 The language and its linguistic classification

Indian historians claim that the current Sylheti population comprises Nagar Brahmins from Gujarat, Maithil Brahmins of Bihar, and Brahmins from Odisha who settled in Srihatta (present-day Cachar in Assam, India, and the district of Sylhet in Bangladesh) during the 12^{th} to 15^{th} century. Srihatta and Cachar were formerly part of Bengal, and these communities have been influenced by the Bengali culture (Roy, 1998). Early studies of the languages of Srihatta and Brahmanbari (Chatterji, 1926) classified Sylheti as one of the subdivisions of the spoken dialects of Bengali. Chatterjee (1926) categorized Bengal into four major clusters: Radha, Varendra, Kamrupa, and Bongali or Vanga, with Sylheti subcategorized under Eastern and South-Eastern Vanga or Bongali.

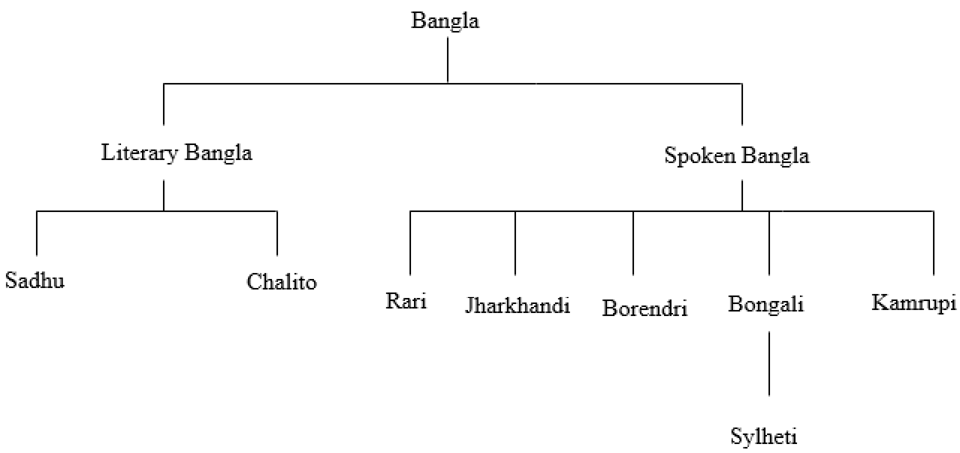


Figure 1.2 Linguistic division of Sylheti as a dialect of Bengali

Linguists such as Chatterjee (1926) and Roy (1998) classified Sylheti under the Bongali subdivision of spoken Bangla dialects, as shown in Figure 1.2, which rightfully belongs to Bangladesh's Khulna, Jessore, Bakergonj, Ganj, Faridpur, Mymensingh, Cumilla, Barisal, Noakhali, Chattogram, Srihatta, and India's Barak Valley (in South Assam) i.e., Cachar, Karimganj, Hailakandi, and Tripura. Among these dialects, the language predominantly spoken in the Surma valley, specifically in the Srihatta region and South Assam's Barak valley, was called the Sylheti dialect. Linguists such as Chatterjee (1926) and Roy (1998) reported that the Bongali/Vanga languages were phonologically and morphemically different from other dialects of Bangla, and that the languages of Srihatta and Brahmanbari were mutually unintelligible to other Bongali dialects as well. Linguistic studies on Sylheti over the years (Chalmers & Miah, 1996; Chatterji, 1926; Hamid, 2009) have confirmed that Sylheti and Standard Bengali are closely related but not mutually intelligible. Some of these studies (Roy, 1998) claim that even in medieval times, the language was found to vary vastly phonologically and morphologically from standard Bengali, despite being considered a dialect of Bengali. Studies like Sen (1960) and Chatterji (1926) claimed the absence of aspiration in Sylheti stops, the lack of nasal vowels in both the languages, the lenition of the sibilant /ʃ/, and the absence of glottal /h/ in the phonemic inventory of Sylheti. This dissertation investigates linguistic data elicited from the Sylheti population residing in India, specifically in the Cachar region of Assam.

1.2.2 The history of the Sylheti script and its political status

The history of the Sylheti script reveals that it was used independently, both in spoken and written forms, for administrative and religious purposes in the Surma valley in medieval India (Chowdhury, 1998). This script, known as Nidhanpuri Lipi originated from Nidhanpur Village in Karimganj and was used in the Surma Valley, which included the Barak Valley and the present-day Sylhet (known as Srihatta during that period). Copper plate inscriptions from the end of the Gupta era around the 6th century AD in Assam provide evidence of its usage. Bhooti Verma, the ruler of Srihatta and the Barak Valley at that time, donated barren lands to immigrant Brahmins from other states of India, and these lands were registered on these copper plates (R & Gupta, 1968) as Land Dalils. The copper plates contained details such as the names of the donor, receivers, and inscriber, as well as geographical descriptions of the surrounding rivers, such as the Trisrota River of Kamrup, and the trees and hills in the area. These details were specific to the Surma Valley (Chowdhury, 1998), and the names of the inscribers were of Khasi origin, further confirming that these copper plates were inscribed in the Surma Valley and not brought by the immigrants. The inscriptions on the copper plates and the temples built in the 6th century AD used the Nidhanpur script of the Surma Valley, which served as the script for the Sylheti language (Chowdhury, 1998) (Gupta, 1963).

Choudhury (1910) claims that it was only after the Mughal invasion around the thirteenth century A.D. that Shah Jalal brought the Jalalabadi script with him. This script was then recognized as the Siloti Nagari and was in use in printing and publishing, especially in the Sylhet division, until the independence of Bangladesh when Sylheti was reduced to the status of a dialect, and the use of this script was heavily discouraged. A close similarity of this script has been linked to that of Kaithai. Siloti Nagari was widely used in musical performances known as *puṯhi poṛa* for amusement and education in genres ranging from poetic fairy tales to romantic and religious stories (Kane, 2017). According to Kane (2017), from the 16th century onwards, the Sylheti puṯhi played an important role in communicating Islamic ideals to the people in the Sylhet region, as they were written in the spoken vernacular language.

Sylheti script, which had seen a remarkable progress in printing, was discouraged during the Bangladesh Liberation War of 1971 (STAR, 1996-2018). The government's intervention in promoting a homogeneous society also contributed to the choice of Bangla as the language of the 'developed community,' which in turn relegated Sylheti to the status of a 'dialect.' Similarly, the migrated Sylheti population in India preferred to align their identity with the majority population, resulting in its politically unrecognized and marginalized status. Languages often have political and historical roots that can give rise to multiple ethnic or linguistic diversities, which are not always documented or disclosed by the language speakers. The tendency of the minority population to identify themselves with the dominant population played a role in this situation. The discontinuation of its script and the subsequent lack of documentation over time led to the perception of Sylheti as a "colloquial or peasant corruption of Bengali" (STAR, 1996-2018).

Despite its large diaspora, Sylheti is still a vulnerable language, mostly due to its diglossic status in both native countries - India and Bangladesh. The language is politically unrecognized in both native nations due to its political history and is associated with lower prestige (Faquire, 2012; Simard et al. 2020). With time, the language lost its documented literature. The lack of a comprehensive printed dictionary or grammar led to the association of Sylheti with ‘low prestige’. Bengali is now the official language and is a perceived consanguineous prestige marker in both the native countries (Faquire, 2012; Simard et al. 2020). Speakers are encouraged to use the Bengali script rather than the Nagari script, which is closer to spoken Sylheti. Sylheti is often disregarded as a language by the older generation rather than the younger generation due to the unavailability of an active script of the language and lack of awareness of the fact that the language had its own script (Simard et al. 2020) which was discontinued due to political reasons. The number of speakers has been steadily dwindling in the native countries, and it is spoken in the Barak valley of Assam and in the northern parts of Tripura, only as a local vernacular (Mahanta and Gope, 2018).

The script has gained awareness in the younger generation due to ongoing projects that work extensively on the documentation and digitalization of Siloti Nagari, which is available for public learning (Simard et al. 2020; Simard et al. 2012). Siloti Nagari is closer to the phonology of spoken Sylheti and consists of 5 vowels and 28 consonants. This script has been claimed to belong to the group of scripts used in Northern India (Simard et al., 2020). In recent years, the status of Sylheti has been recognized as an endangered language, and the diaspora is receiving attention in linguistic and literary studies. There is an ongoing revival of old puthi (manuscripts) that were originally written in Siloti Nagari, and they have also been archived in the British Library Endangered Archives Programme Project Archiving Siloti Nagri Texts[1].

Studies on Sylheti have flourished in the past decade. The SOAS Sylheti project group aims to revive the script of the language and to teach the second and third generation Sylheti speakers in London. This group of researchers has made significant contributions to linguistic studies on Sylheti, providing insights into the linguistic and political status of the language (Simard, et. al., 2020), including a description of its phonology and structural grammar (Brown, 2020; Dopierala, 2020; Eden, 2020; Thaut et. al, 2020; Lau, 2020).

1.2.3 An overview of Sylheti Phonology

Early studies on Sylheti, such as Chatterji (1926) and Sen (1960), claimed an absence of aspiration in the stops in Sylheti and reported the lack of nasal vowels in the language. They also noted the lenition of the sibilant /ʃ/ and the absence of the glottal /h/ in the phonemic inventory of Sylheti. The morphological inflections were reported to be unique and different from those of other dialects of Bangla or Bongali. Chatterji (1926) reported that the verbal conjugations in Sylheti were completely different and unintelligible compared to nearby dialects of Bangla like the Chittagonian or Noakhali, which, despite their phonetic and

[1] https://eap.bl.uk/project/EAP071

phonological differences, shared similarities with other spoken Bangla dialects. Considering the unique linguistic properties such as phoneme inventory, allophony, and inflectional morphology, and lexicon in general, Sylheti is regarded as a separate language (Grierson 1928; Chatterjee 1939; Gordon 2005). It is a member of the Bengali-Assamese continuum (Lewis, Simons, & Fennig, 2015). The language is structurally related both to Assamese and to the rural dialects of eastern Bengal, but has its own distinct grammar (Simard et al. 2012).

Recent studies (Gope and Mahanta 2015; Gope 2018; Goswami 2016) on the inventory of Sylheti phonemes have reported a complete absence of the (+spread glottis) feature. The studies demonstrate a reduced and simplified phonemic inventory in the language. The Sylheti phonemic inventory was reported to consist majorly of fricative consonants, as the obstruents underwent lenition, and the vowel space was significantly reduced as compared to that in its cognate languages. Obstruents occur only in allophonic environments in the language. The velar fricative /x/ for instance occurs as a velar stop only when followed by high vowels /u/ or /i/ as in [kit] ‘notorious’ and the voiceless alveolar fricative surfaces as alveolar voiceless affricate [tʃ] in intervocalic geminate structures as in [kitʃtʃa] ‘tale’.

1.2.4 Tonogenesis in Indo-Aryan languages

The linguistic diversity of South Asia is currently witnessing a remarkable transformation: the emergence of tonal phenomena in languages historically regarded as non-tonal. This dissertation anchors itself in this captivating development within the Indo-Aryan languages. The central aim of our research is to comprehend the typological and phonological factors contributing to this tonal development through an in-depth study of Sylheti prosody.

This shift towards tonality is not an isolated phenomenon. Recent research has highlighted the emergence of tonogenesis, or the development of tone, in many of these languages such as Punjabi (Gill & Gleason, 1969) and Pahari (Khan, 2017), which have been subjects of linguistic research for decades. Comprehensive studies like Baart's (1997; 2003) on Pakistani languages like Hindko and Saraiki documents similar tonogenetic processes. These studies indicate that tone emerges as a result of the diachronic loss of certain phonological features, such as voiced aspirate stops. Research on the evolution of tone in these languages adds to the expanding corpus of research illustrating the emergence of tonal languages in South Asia. This dissertation focuses on this fascinating development within the Indo-Aryan languages, aiming to understand the phonological processes and factors driving this change, particularly the role of sound change in the evolution of tonal features in Sylheti.

By delving into the intricacies of Sylheti's tonal development, this research seeks to enhance our understanding of the processes and factors underlying its transition, offering valuable insights into the broader phonological landscape of the Indo-Aryan language family. The goal is to investigate the typological characteristics of Sylheti as it evolves into a tonal language, with a specific focus on the current stage of tonogenesis exhibited by the language.

1.2.4.1 Tonogenesis in Sylheti

This brings us to the central topic of this dissertation: tonogenesis in Sylheti. Recent research has established that that the merger of voiced unaspirated and voiced aspirated obstruents triggered tonogenesis in the language, which was further followed by a merger with their non-aspirated counterparts (Gope & Mahanta, 2014; Gope, 2016). The four-way laryngeal contrast inherent to the genetically non-tonal Indo-Aryan languages was reduced to a two-way distinction in Sylheti. The studies have demonstrated that the merger of aspirated and unaspirated obstruent onsets led to a two-way tonal contrast in Sylheti, which, genetically, belongs to an otherwise non-tonal language family. However, as elaborated previously in this section, the presence of tone in Indo-Aryan languages could be more prevalent than what has been traditionally assumed.

The diachronic voiced aspirated onset led to a lexical High tone as demonstrated in 1(a) and 1(b) the diachronic onset with voiced aspirated feature in /gail/ *'scolding'*, led to a contrastive, lexical Low tone as demonstrated in 1(b):

1. *Tonogenesis in Sylheti proposed by Gope (2016)*[2]*:*

a) /g^hail/ >> *gáil *'beater'*

b) /gail/ > *gàil *'scolding'*

In his study on the correlation between phonation and tone in Sylheti, Gope (2021) argues that the conditioning environment i.e., the feature [+spread glottis] has been completely lost in the language, and f0 patterns were phonologized and perceived as lexical tones by the native speakers. Building upon our previous discussion on the stages of tonogenesis proposed by Maran (1973) and Matisoff (1973), we hypothesise in this dissertation that, Sylheti is currently in a non-final stage of tonogenesis, and its tonal inventory has not undergone further splits from

[2] We have used the notation * for proto words of Sylheti in this dissertation, based on their synchronic reflexes in cognate languages; It should be noted that the example is from Gope (2016), but the notation was not used in his analysis of Sylheti tonogenesis.

rudimentary tones; indicating that the language thus may not exhibit a fully developed tonal system.

1.3 Hypothesis and objectives of this dissertation

Taking into consideration the aspect of tonogenesis in Sylheti discussed in the previous sections, this dissertation essentially seeks to explore the typological classification of Sylheti as a tone language by investigating the tonogenesis and the career of tone in both monosyllabic and disyllabic words. The following research hypotheses were designed to be analysed over the course of this dissertation:

1. Sylheti is at its non-final stage of tonogenesis, and thus, not all words may be marked for tone.
2. Tonogenesis triggered by the merger of aspiration contrast between aspirated and unaspirated voiceless onsets differs from the tonogenesis triggered by voiced onsets.
3. The loss of diachronic aspiration in the coda also played an important role in Sylheti tonogenesis.
4. Syllable position can contribute to the evolution of tones in a language.
5. In a language in its non-final tonogenetic stage, like Sylheti, a lexical tone might not represent a rigid surface form at the prosodic level, especially when in interaction with another word lexically marked for tone.
6. Sylheti is not densely marked for tones and thus, the interaction between a word lexically marked for tone and a toneless suffix might exhibit morphotonemics or dominance structure.
7. Interaction between lexical tones and intonation might give us an insight into the prosodic typology of the language.

This dissertation thus primarily aims to present a wider picture of the tonal inventory of Sylheti and investigate the typology and nature of tonogenesis in the language that resulted from the instability of the four-way laryngeal contrast and attempts to provide an insight into the organization of the components of grammar in the prosodic hierarchy by exploring the following research objectives:

1. The central aim of this dissertation is to present an investigation of the full–fledged, four-way laryngeal contrast in the diachronic origin of Sylheti, as well as their synchronic realization as lexical tones.

2. To present a revised hypothesis of the extensive contrast between the voiced aspirated and unaspirated consonants on the one hand and voiceless aspirated and unaspirated consonants on the other by expanding our study to investigate the tonogenesis triggered by both onset and coda positions in the language for the first time.
3. To investigate the nature of tone in Sylheti from a tonogenetic and typological perspective and to map the tonogenetic association between onsets and codas and between monosyllabic and disyllabic tonal pairs and triplets.
4. To expand our study beyond diachronic obstruent and studied tonogenesis triggered by diachronic aspirated sonorants reflected in synchronic NIA languages (Ohala & Ohala, 1992) which unfolds the factors leading to tone triplets in Sylheti, such as, [sáɽ] 'iron vessel', [sāɽ] 'earthen pieces', and [sàɽ] 'let go'.
5. To expand our study to disyllabic words and seek to analyze if the tonogenetic factors conditioning the monosyllabic tonal triplets are the same in the disyllabic triplet, such as, [ɸáʈá] *'buck goat'*, [ɸāʈā] *'grindstone'* and [ɸàʈà] *'crack'* and if the number of syllables affects the lexical tone in the language.
6. To investigate if the prosodic structure of Sylheti resembles that of a genetically tone language or does tone have only a minimal lexical role in the language.
7. To address another question that necessitates the next stage in the analysis of prosodic typology: how does tone behave when it is adjacent to a toneless morpheme or when two or more lexical tones are in contact?
8. To investigate the phonological domain of complex words and compound stems in Sylheti to investigate the prosodic typology of the language and to accommodate the high level of tonal alteration in prosodic stems.
9. To analyse the tonal behaviour exhibited by toneless suffixes vis-à-vis all three lexical tones.
10. To investigate the interaction between tone and intonation and presents a preliminary attempt to demonstrate the basic intonational structure of Sylheti

1.4 Layout of the dissertation

The remainder of this dissertation is as follows:

Chapter 2 introduces the phonemic inventory of Sylheti by providing a phonological insight into the sound system of the language. The chapter describes the distribution of the phonemes and contributes to our understanding of how the changes in its diachronic phonemic inventory led to the evolution of the language into a tone language from its atonal stage.

Chapter 3 introduces tonogenesis in Sylheti by summarizing the previous studies done on Sylheti tonogenesis. The chapter provides a phonological analysis of tonogenesis in the language, leading to a three-way tonal contrast in Sylheti. The chapter involves itself in a detailed acoustic analysis of the production test done on the three tones in monosyllables and analyses the results. The chapter finally discusses the results and concludes the tonal contrast in Sylheti from a typological perspective.

Chapter 4 describes the three-way tonal system of Sylheti with attention to the phonology of tonogenesis in Sylheti disyllables. This chapter primarily involves a detailed acoustic analysis of the production test done on the three tones in Sylheti disyllables. It also presents an elementary analysis of a perception test in Sylheti disyllables. The chapter finally analyses the results to summarize the tonal characteristics and tone assignment in Sylheti disyllables. It ends with a discussion on both the production and perception results and concludes with the possibility of the presence of a neutral tone in Sylheti.

Chapter 5 analyses complex morphemes in Sylheti. It discusses in detail the prosodic structure of complex words in Sylheti, including both inflectional and derivative words, and provides an analysis of the pitch tracks of both complex nominal and verb stems. The chapter concludes with a phonological discussion of the predominant tonal polarity in the language.

Chapter 6 presents both phonological and phonetic analyses of the domain of compound stems in Sylheti. It studies nominal compound stems as a domain of phonological processes and tonal alignment and involves a detailed acoustic analysis of its predominant LHL melody. It discusses the predominant tonal polarity in verbal compound stems with the help of a brief analysis of the pitch tracks. The chapter concludes with a discussion of the phonology of tonal alignment in compound stems.

Chapter 7 presents a preliminary attempt to analyze the interaction between tone and intonation in Sylheti. It is an attempt to investigate the peculiarities and similarities of the intonational pattern of the Sylheti language, as it is surrounded by tonal languages and the native speakers of this language are mostly bilingual and use its cognate non-tonal language. It discusses the basic intonation structure in Sylheti and investigates the pitch tracks of the intonation contours of basic declarative sentences in Sylheti.

Chapter 8 presents a discussion of the findings and concludes the dissertation with implications for future studies in the language.

Chapter 2

Phonology of Sylheti

Introduction

This chapter contributes to our understanding of the phonological evolution of an earlier atonal stage of Sylheti into a language with a tonal system. It discusses the phonology of Sylheti from a diachronic and synchronic point of view, investigates its sound changes, particularly the loss of a certain manner of articulation of the segments leading to the emergence of the three-way tonal system in the language, and discusses how the four-way laryngeal system is reconstructed in its proto-sound system. It studies the diachronic reflexes of the synchronic words in the language to understand its segmental and syllabic structure with the help of cognate words. The chapter is primarily an analysis of the simplification of the phonemic inventory leading to tonogenesis in Sylheti and also an attempt to understand the syllabic structure of the language, which plays a major role in its three-way tonal system. It analyses the language's phonotactic constraints to understand the syllable's internal structure, sets the prerequisite to understand the diachronic factors behind the scarce tonal inventory of the High tone in monosyllables, and maps the syllabic interrelations between the monosyllabic and disyllabic tonal triplets.

The chapter also discusses how Sylheti developed a much simpler phonemic inventory and syllabic structure while evolving as a language, standing out as a distinct member of its language family. We present the New Indo-Aryan (NIA) (ISO - 639-2 / 5) forms to represent the reflexes of Sylheti's diachronic phonemes and words. These forms have retained the manner of articulation distinctions and the obstruent feature of the sounds, which underwent complete deletion in Sylheti. Earliest studies on historical sound changes have shown that the unit subject to historical change is not the word but the phoneme (Bloomfield, 1933, p. 351). In this dissertation, we explore the phonemic sound changes and the ensuing tonogenesis in Sylheti. Instead of using a single language to represent the diachronic forms, we rely on New Indo-Aryan (NIA) words as synchronic cognates of the hypothesized diachronic forms. We employ the diacritic * to denote these NIA words, which are treated as the diachronic counterparts of the words under scrutiny. These words have been obtained from online dictionaries (from digital libraries of South Asia) such as *A comparative dictionary of Indo-Aryan languages* (Turner, 1962); *Learners' Hindi-English dictionary* (Bahri, 1989), a Hindi dictionary; and Bengali dictionaries: *Samsada Bangala uccarana abhidhana* (Bhattacarya, 1970), and *Samsad Bengali-English* (Biswas, 1970). The oldest forms of Indo-Aryan languages and their historical forms correspond to the NIA forms. We thus present Sylheti words as possible historical reconstructions of their corresponding historical NIA words (retrieved from well-known dictionaries, also available online).

Apart from its distinct prosodic structure, robust differences in the lexicon, and morpho-syntactic structure, Sylheti also has a noticeably reduced inventory of phonemes compared to its cognate languages. For example, the inventory of phonemes in Bengali consists of twenty-eight consonants, four semivowels, and fourteen vowels. Additionally, there are seven cardinal consonants and one cardinal vowel present only in certain styles of speaking (Ferguson & Chowdhury, 1960). Previous studies on Sylheti's phonemic inventory (Chalmers and Miah, 1996; Gope and Mahanta, 2015; Gope, 2018; Goswami, 2016) show that Sylheti has a reduced phonemic inventory compared to its cognate languages like Bengali, Assamese, or Hindi. The studies report that the language underwent a uniform reduction in its consonantal inventory due to lenition and the loss of some manner features among the obstruent class, and suggest that Sylheti's vowel space has been restructured as well.

Our study on syllable structure in this chapter contributes to our understanding of the permissible onsets and coda. We analyse the sonority scale across syllable boundaries to understand the role of onset and coda positions in tonogenesis, which plays a significant role in the three-way tonal contrast in the language discussed in detail in Chapters 3 and 4. In contrast to previous studies, we discuss phonological changes or syllabic repair strategies in the language in terms of diachronic changes rather than the sounds being present in their underlying forms. We argue that the language underwent significant sound changes and phonological processes, leading to a reduced phonemic inventory and simplified syllabic structure. In addition to the diachronic phonological processes that led to the simplified syllabic structure in the language, we also present a brief analysis of the synchronic phonology of the segmental processes, which also play a role in defining the phonological domain of prosodic words in later chapters (Chapters 5 and 6).

Our data elicitation for the phonemic inventory was based on standard data collection methods and obtained from the Sylheti-speaking community of the Barak Valley of Assam, India. The phonemic inventory deviates only in a few minor details (discussed in section 2.1.3) when compared with previous studies on Sylheti (Gope, 2015; Gope, 2018), conducted on Sylheti spoken in the Dharmanagar district of North Tripura, India. This chapter presents a set of five vowels and 17 consonants in Sylheti, which are acoustically and phonemically distinct from each other, resembling the previous studies on the Sylheti phonemic inventory with a few allophonic differences. The structure of this chapter is as follows: section 2.1 aims to familiarize the reader with the Sylheti sound system by providing the phonemic inventory of the language. Section 2.2 discusses the segmental sound change by studying the diachronic reflexes of their synchronic forms. The section analyses the diachronic instability of the inherent four-way laryngeal contrast leading to tonogenesis in the language and briefly discusses the synchronic segmental processes in the language. Section 2.3 analyses the syllable structure and phonotactic constraints in Sylheti. It further investigates the gemination structure in the language and discusses the minimal weight requirement in Sylheti disyllables. Section 2.4 discusses studies on the syllable structure and simplification processes Sylheti adopted from a diachronic aspect. Section 2.5 presents a summary of the chapter.

2.1. The phonemic inventory of Sylheti

Previous studies on Sylheti phonology (Chalmers and Miah 1996; Gope 2016; Goswami 2016) report a reduced phonemic inventory in Sylheti compared to that of the Indo-Aryan language family from which it descends. Sylheti's reduced consonantal and vowel inventory has been discussed in detail in the following subsections.

2.1.1. The vowel inventory

Most Indo-Aryan languages exhibit length contrast for vowels; however, length contrast has been neutralized in some Indo-Aryan languages like Bengali, Assamese, Oriya, Rajbanshi, and Maithili, which are cognate to Sylheti (Pandey, 2010). Similar to some of its closest cognate languages, vowel length is not phonemic in Sylheti either; there is an absence of contrastive short or long vowels. The phonemic contrast between oral and nasal vowels is exhibited in most Indo-Aryan languages, such as Hindi and Maithili (Jha, 1986; Pandey, 2010). This contrast is also exhibited in Eastern Indo-Aryan languages that are genetically closer to Sylheti, like Bengali (Ferguson & Chowdhury, 1960) and Assamese (Mahanta, 2012). Both these languages exhibit contrastive nasal counterparts for the oral vowels for the back vowels only. The vowel inventory of Sylheti includes only five oral vowels and completely lacks nasal vowels; the language possesses a simplified vowel inventory with no duration and nasal contrast, unlike most Indo-Aryan languages. We have conducted an elementary acoustic study on Sylheti vowels to evaluate the language's vowel space, which has been demonstrated in subsections 2.1.1.1 and 2.1.1.2.

2.1.1.1 Methodology

Five contrastive words with target vowels were recorded from three native speakers (2 female, 1 male) of Sylheti residing in Silchar, a town in the Barak Valley of Assam, India. The speakers use Sylheti in their everyday speech at home and are bilingual, fluent in both in Bengali and Hindi. The sentences containing the target words were recorded in a quiet room using a Tascam DR 100 recorder with a Shure head-worn microphone attached. The words carrying the target vowel were recorded in the cVc structure in a carrier sentence of SOV order. The sentence was uttered in the following frame:

ami   X   xɔi-si
1st p   X   say-perf 1p
I said X

X is the target word. The target words have an underlying lexical Mid-tone (Table 2.1). Table 2.1 lists all the contrastive minimal pairs for the vowels (with the same underlying tone).

Vowel Space	**Front**	**Back**
High	i sesame t̪il	u pick up t̪ul
Mid-open	ɛ oil t̪ɛl	ɔ below t̪ɔl
Low		a palm t̪al

Table 2.1. Sylheti vowels with contrastive minimal pairs

The vowel formants’ F1, F2, and F3 values were extracted and plotted using the *"Vowels"* package (Kendall & Thomas, 2018) in R studio (4.2.1) to analyze the vowel space in Sylheti. To determine the vowel space, the non-normalized mean of the vowel formant values for each vowel was computed as one set of means across all speakers and iterations[3]. The *"vowelplot"* function was then used to plot the vowels in F1~F2 space. The means were computed and plotted separately for each speaker[4] in the second mode.

[3] means<- compute.means(my_vowels, separate=TRUE)

[4] means <- compute.means(my_vowels)

2.1.1.2 Results

Each word in the table was recorded in three iterations from each speaker (5*3 = 15 tokens each speaker) within the '*I x said*' SOV declarative sentence frame, where '*x*' represents the target word. Figure 2.1 depicts the mean formant values for F1 and F2 for each vowel on a two-dimensional chart.

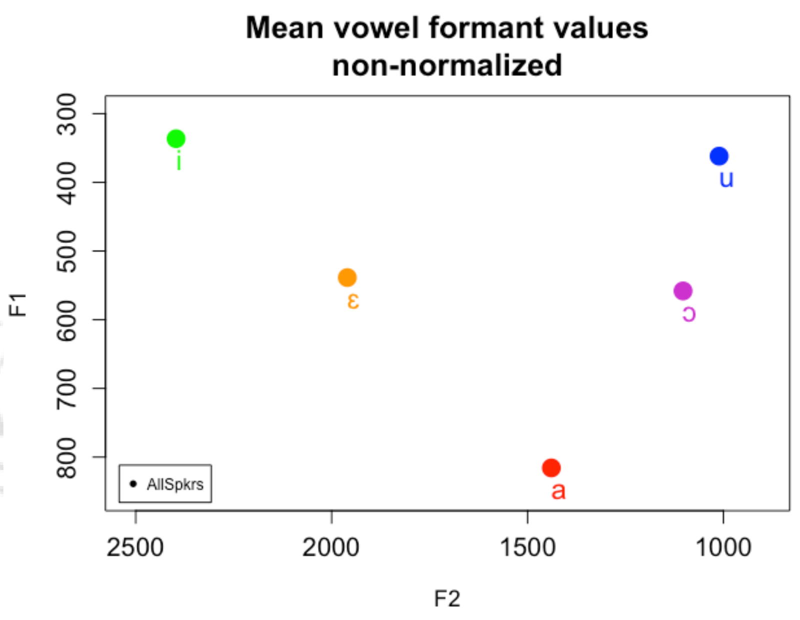


Figure 2.1. Vowel space in Sylheti

Figure 2.2 plots the vowel space of three native Sylheti speakers separately, extracted from the minimal pairs presented in table 2.1.

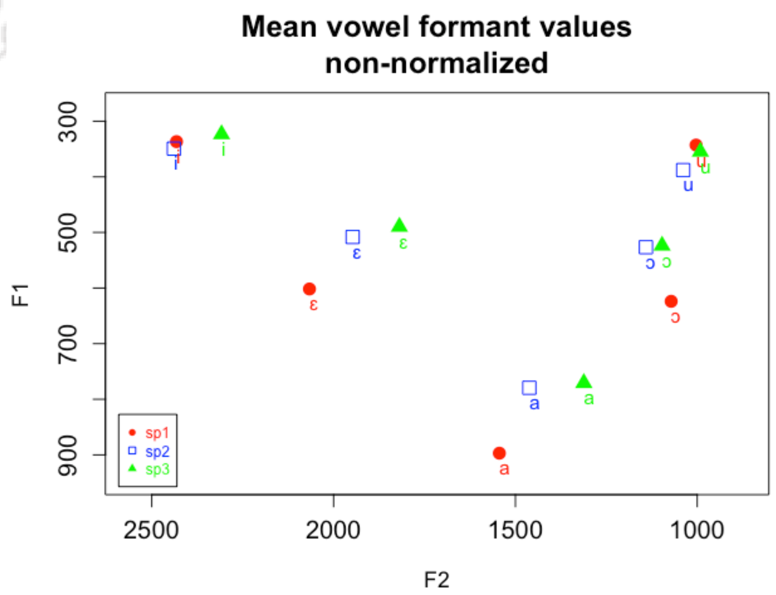


Figure 2.2. Speaker-wise mean of vowel space in Sylheti

The vowel plots demonstrated in Figure 2.1, and Figure 2.2 are represented in the vowel chart for Sylheti in Figure 2.3.

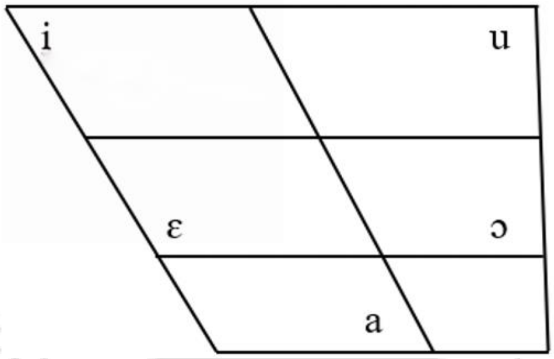


Figure 2.3. The vowel chart for Sylheti

The trapezium illustrates the shape of the tongue. The frontness/backness and openness/closeness of vowels are visually explicit with their relative positions. Sylheti exhibits peripheral high front and back vowels /i, u/ followed by peripheral front and back mid vowels /ɛ, ɔ/, followed by the low vowel /a/. The observation of the vowel chart in Figure 2.3 demonstrates the significant reduction of the vowel space of Sylheti compared to its cognate NIA languages, as discussed earlier in this subsection.

2.1.2 Diphthongs

The definition of a diphthong has been a subject of debate. Acoustically, it can be defined as a vowel involving a change in its formant values (Aguilar 1999; Lindau, Norlin, and Svantesson 1990), while phonologically, a diphthong is characterized by two vocoids within the same syllable nucleus (Anderson 1985; Odden 2005). Although there are languages with extensive diphthong inventories, languages where the number of branching nuclei is the square of the number of simple nuclei are very rare; no language has all the diphthongs that one could get by arbitrarily pairing all the vowels of the language (Lindau, Norlin, & Svantesson, 1985). Sonority dispersion is a significant factor in this phenomenon, as diphthongs tend to avoid a combination of two vowels with similar sonority (Miret 1998). As a result, /ai/ is preferred over /ia/ and /ou/ over /uo/; vowel sonority adheres to a hierarchy predictable from height and centrality (Gordon 2006; Kenstowicz 1997), as shown in figure 2.4.

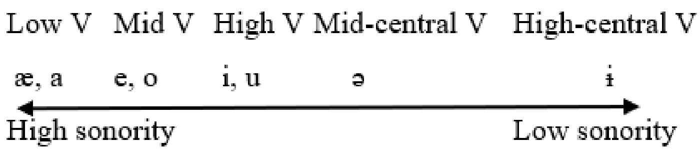


Figure 2.4 Vowel sonority scale

That the falling sonority is typical in most of the world's languages is well reflected in the inventory of Sylheti diphthongs. Diphthongs in Sylheti are mostly falling diphthongs and are only three in number. These can be called the root diphthongs in Sylheti, as presented in Table 2.2.

Diphthong	Word	Gloss
ɔi	mɔ̀i	*'ladder'*
ai	mài	*'mother/little girl'*
ui	t̪úi	*'you'*

Table 2.2. Sylheti root diphthongs ai, ui and ɔi

The branching nucleus in Sylheti seems to follow a falling sonority scale in all three root diphthongs, and each diphthong falling towards the cardinal high vowel, the least sonorous vowel according to the sonority scale in Figure 2.4. For example, the diphthong /ai/ falls from the most sonorous low vowel /a/ towards the least sonorous high vowel /i/. There are derived diphthongs in Sylheti, which are also triggered by verbal inflections and should not thus be confused with the root vowels. These derived diphthongs, too, seem to follow the sonority sequencing as in words in (1):

1. Derived diphthongs: xa+i *'eat+1P Pres'*, xɔ+is *'tell+Fut 2P'*, sa+ɔ *'ask for+2P'*.

2.2 Sound change and the consonantal system of Sylheti

Studies on the cross-linguistic tendencies of consonant lenition and fortition, such as Honeybone (2008) and Bybee and Easterday (2019), report that weakening is more prevalent than strengthening in languages. Consonantal sounds are more likely to undergo lenition than fortition across languages. In addition to the simplified vowel space, the consonantal inventory of Sylheti also underwent lenition throughout generations of speakers. The traces of diachronic phonemes that have undergone lenition are evident in the synchronic phonemic inventories of the New Indo-Aryan (NIA) group of languages from which Sylheti descends. The sound changes that significantly reduced the language's consonantal inventory were deaffrication and spirantization of obstruents.

Previous acoustic and phonological studies (Gope and Mahanta 2015; Goswami 2016) on Sylheti have demonstrated that most diachronic obstruents in the language underwent uniform lenition. Gope and Mahanta (2015) conducted an acoustic study on the phonemes in Sylheti and showed that affricates such as *tʃ lenited to /s/, resulting in words such as *tʃal changed to /sal / *'roof'*. The voiced counterpart of the affricate *ʤ lenited to /z/ as in the word for spicy /zál/ << *dzal *'net'*. The voiceless velar stop was reduced from */k/ to /x/ as in the word for *'drain'*, [xāl] << *kal, but the voiced velar /g/ remained unchanged. In another study, Goswami (2016) conducted a descriptive study on the language and concluded that the language underwent a transition from obstruents to fricatives as in /xɔsu/ << *kotʃu' *taro root'* and in /bazar/ << *baʤar' *market'*.

Gope (2016) considered Standard Colloquial Bengali (SCB) as the underlying form of Sylheti words in his study, as SCB still retains the four-way laryngeal contrast. His work has shown that the language underwent uniform de-aspiration of the obstruents. Aspirated obstruent like *b^{h} underwent de-aspiration to /b/ as in [bálá] << *b^{h}ala *'good'*. Another sound change reported by (Goswami 2016) is the total deletion of the glottal /h/ in the language. It is evident from these lenition processes that the reduced consonantal inventory of Sylheti has a complete absence of the feature [+spread glottis]. These changes led the diachronic four-way laryngeal contrast to a two-way contrast, i.e., voicing contrast, resulting in a reduced consonantal inventory in the language with only 17 consonants (Table 2.3)[5].

	Bilabial		Inter-dental		Alveolar		Palato-Alveolar		Retroflex		Velar	
Plosive		b	t̪	d̪	(t)	(d)			ʈ	ɖ		g
Nasal		m				n						ŋ
Tap or Flap						r				(ɽ)		
Fricative	ɸ				s		ʃ				x	
Affricate						ʤ						
Lateral						l						

Table 2.3 Sylheti Consonants

[5] The consonants in the parentheses represent their allophonic status in the language.

All the consonants occur word-initially in Sylheti except for the velar nasal /ŋ/, the retroflex trill /ɽ/, and the palato-alveolar fricative /ʃ/. Table 2.4 lists all the minimally and near minimally contrastive words for all 17 consonants in Sylheti.

Word Initial	Gloss	Word final	Gloss
/pɔr/	read	/ɖɔŋ/	joke
/xɔr/	do	/sɔɽ/	slap
/ɖɔr/	fright	/d̪ɔʃ/	ten
/mɔr/	die	/ɸɔɽ/	read
/gɔr/	house		
/lɔr/	move		
/bɔr/	pressure		
/d̪ɔr/	hold		
/ʥɔr/	fever		
/hɔr/	get off		
/t̪ɔr/	your		
/nɔl/	tap		
/sɔl/	walk		
/rɔŋ/	colour		
/ʈɔx/	sour		

Table 2.4 Minimally contrastive words in Sylheti

2.2.1 Diachronic spirantization in Sylheti

Most of the diachronic obstruents in Sylheti underwent lenition and changed to their homorganic fricatives. The synchronic form of these obstruents can be found in the NIA words, as explained earlier in this chapter. This process enriched the consonantal system of Sylheti with fricatives and lesser obstruents compared to its cognate languages. As can be observed in Table 2.4, the inventory of the language consists of the bilabial voiceless fricative /ɸ/, voiceless alveolar fricative /s/, palato-alveolar fricative /ʃ/ and the voiceless velar fricative /x/. The only deviation we found from the previous study (Gope and Mahanta 2015; Goswami 2016) is the presence of the affricate /ʥ/, which Gope claims to have fricativized to /z/ in the variety in which the study was conducted. This difference could be attributed to the regional variance of Sylheti.

2. *Spirantization of obstruents in Sylheti:*

   i) ɸān << *pan *'betel-leaf'*

   ii) sānā << *tʃɘna: *'cottage cheese'*

   iii) xāl << *kal *'bad-time'*

   iv) xɔ̄lā << *kela: *'banana'*

   v) sāɽ << *tʃaɽ *'earthen pieces'*

Spirantization did not spread to all obstruents; the voiced velar stop /g/ did not lose occlusion such as in the word /ga:s/ << *ga:tʃʰ *'tree'*; as mentioned above, the voiced affricate /ʥ/ was also found to retain its occlusion in our study such as in the word /ʥal/ << * ʥal 'net'. Sylheti synchronic consonantal inventory consists mostly of fricatives, which makes it stand out compared to its cognate group of languages. The velar fricatives /x/ is present in cognate NIA languages like Hindi, Sindhi, Urdu, and Dogri; they have a two-way voicing contrast [x: ɣ] in all these languages except for Dogri (Pandey, 2010). While Assamese (Mahanta, 2012) consonantal inventory contains the alveolar fricatives /s,z/, the velar fricative /x/, and the glottal fricative /h/, SCB has palatal /ʃ/, dental/alveolar /s̄/ or alveolar /s/ and glottal /h/ (Chatterji, 1921; Fergus & Chowdhury, 1960; Kar & Truckenbrodt, 2019); both these languages exhibit an allophonic bilabial voiced fricative [β]. The voiceless bilabial fricative /ɸ/ as a phoneme is unique to Sylheti; allophonic realization of stop as fricatives has been reported in intervocalic environments (Kar & Truckenbrodt, 2019; Khan, 2010).

2.2.2 Diachronic loss of the laryngeal feature [+spread glottis] in Sylheti

Gope's (2016) work significantly advanced our understanding of sound change in the Sylheti language, with a particular focus on the role of voiced aspirates. His study used an acoustic analysis of Voice Onset Time (VOT). In a detailed investigation, Gope examined the Voice Onset Time (VOT) of diachronically aspirated and unaspirated stops (he considers the diachronic forms or the NIA words as the underlying forms of the words under study), an area previously unexplored in Sylheti phonetics. His results indicated no significant interaction between individual pairs of these stops. He claims that these voiced stops lack active aspiration contrast and only differ in terms of place of articulation (Table 2.5).

Sylheti Word	Underlying form	Gloss	Sylheti Word	Underlying form	Gloss
ga	ga	body	ga	g^{h}a	wound
bat̪	bat̪	arthritis	bat̪	b^{h}at̪	rice
ɖax	ɖax	roaring of cloud	ɖax	ɖ^{h}ax	drum
ban	ban	tie	ban	b^{h}an	pretend
bari	bari	home	bari	b^{h}ari	heavy
ɖala	ɖala	tray	ɖala	ɖ^{h}ala	pour

Table 2.5 Synchronic Homophonous Pairs in Sylheti Showing Aspiration Contrast Loss (Adapted from Gope, 2016)

Table 2.5, as shown above, provides an overview of the synchronic homophonous pairs from Gope's 2016 study. With a careful observation of the examples, it becomes evident that voiced aspirates in Indo Aryan languages typically correspond to unaspirated voiced consonants in Sylheti. This mapping can be observed in three word pairs from the provided table. For example, the Sylheti word 'ga', meaning 'wound', originated from 'g^{h}a', displaying a loss of aspiration. Similarly, 'bat̪' (rice) came from 'b^{h}at̪', and 'ɖax' (drum) from 'ɖ^{h}ax', both depicting the same aspiration loss. A key insight of Gope's research was the impact of the systematic loss of voiced aspirates on the pitch of adjacent vowels, suggesting the emergence of new tonal patterns in Sylheti. Deepening the exploration, Gope scrutinised the interplay between diachronically unaspirated and aspirated stops. The results were rather enlightening. The absence of a significant interaction between individual pairs of these stops highlighted a typical path in tonogenesis where the loss of certain phonetic contrasts gives rise to new tonal contrasts to preserve lexical distinctions. Gope & Mahanta (2014) and Gope (2016) establish that the diachronic voiced aspirates correspond to a lexical high tone, and the diachronic unaspirated voiced stops map to low tone; this will be discussed in detail in Chapter 3.

Gope's exploration of Sylheti phonetics led him to the significant conclusion that the loss of aspiration wasn't confined to voiced stops alone but also seeped into voiceless stops. Additionally, studies focused on Sylheti phonemes (Gope and Mahanta 2015; Goswami 2016; McCarthy et al. 2013) have shown that there was a uniform merger of the [-spread glottis] and [+spread glottis] consonants in Sylheti which led to the reduction in its consonantal inventory. Gope claims that this merger triggered tonogenesis in the language (Gope and Mahanta 2014; Gope 2016), as shown in 3.

3. *Aspiration merger that triggered tonogenesis (Gope, 2016):*

i. /g^hail/ > gáil *'beater'*

ii. /gail/ > gài̖l *'scolding'*

iii. /b^hala/ > bálá *'good'*

iv. /bala/ > bàlà *'bangle'*

Our study in this chapter focuses on the loss of aspiration in Sylheti, a feature prominently noted in both onset and coda positions. This uniform phonetic change forms the cornerstone of our investigation, prompting a detailed examination of the language's shifting phonological landscape. The forthcoming sections seek to investigate these intricate changes further, potentially illuminating undiscovered aspects of Sylheti tonogenesis, thereby contributing to the broader discourse on language evolution and change.

2.2.2.1 The uniform loss of the [+spread glottis] feature in Sylheti

It is cross-linguistically attested that the laryngeal configuration can be exploited to distinguish or contrast between sounds (Halle & Stevens, 1971; Ladefoged, 1972; 1973; Lombardi, 1991; Iverson & Salmons, 1995). Studies like Halle & Stevens (1971) and Ladefoged (1972; 1973) have suggested that only two variables can describe laryngeal contrast to distinguish between aspiration, tonal phenomena, and all the glottal stricture and Voice Onset Time phenomena. These variables are based on the degree of stiffness of the vocal cords and the degree of constriction of the glottis and are characterized in terms of two binary oppositions : [±stiff], [± slack]; and [± spread], [± constricted]; conventionally, neither [+stiff, +slack] nor [+spread, +constricted] can co-occur (Halle & Stevens, 1971; Iverson & Salmons, 1995). The degree of constriction of the glottis defines the features [spread glottis] and [constricted glottis], which are ends of the same continuum; the physiological state of the glottis is spread open [spread glottis], the feature responsible for aspiration; and is narrowed in [constricted glottis], the feature responsible for glottalization or phonation with a creaky voice (Ladefoged & Maddieson, 1996, pp. 55-7). Ridouane, Clements, & Khatiwada (2011) provided a language-independent phonetic definition of the feature [spread glottis] and showed that an articulatory description of this feature in terms of a single common glottal configuration or gesture would be insufficient to account for the full range of speech sounds characterized by this feature. The [stiff] or [slack] features are referred to as the glottal stricture of the glottis. Voicing in obstruents is considered to be a side-effect of the vocal folds being slack enough and the stiffening of the vocal cord. This configuration of the glottis is also used to represent tone contrast in vowels (Kingston, 2011). A stop would be pronounced without voicing when specified for [slack] vocal folds and this state of the glottis would also lower f0 on the following vowel while a stop specified for [stiff] glottis would be pronounced with voicing and would also raise the f0 on the following vowel. We have used only the privative units [spread glottis] and [voice] to represent the laryngeal gestures of the Indo-Aryan languages in our subsequent discussions (the crux of the discussion is represented in Table 2.6).

The Indo-Aryan languages are characterized by unique rich four-way laryngeal contrast featured in two dimensions by the two-by-two matrix of [spread glottis] and [voice] features (Ohala & Ohala, 1972). The unique characteristic of these languages is the voiced aspirated feature which is defined by both [spread glottis] and [voice] features (Halle and Stevens, 1971; Dutta, 2007; Lombardi, 1994). What further complicates the inherent laryngeal system of these languages is that the voiced aspirates represent an independent mode of phonation and have often identified the voiced aspirated consonants with a breathy voice or a murmured release, also characterized by the [+slack] feature (Dixit, 1987; Halle and Stevens, 1971; Ladefoged & Maddieson, 1996; Ladefoged, 1973). We have however, concentrated on diachronic aspiration contrast - the primary factor involved in tonogenesis of Sylheti, and have saved the scope of diachronic phonation contrast for future studies, which might have played a secondary role in tonogenesis in the language (Gope, 2021).

Most New Indo-Aryan (NIA) languages, such as Bengali, Assamese, Nepali, and Hindi, still retain this contrast (Cho et al., 2019; Dixit, 1989; Dutta, 2007; Lisker & Abramson, 1964; Mikuteit & Reetz, 2007). The four-way obstruent contrast in the NIA languages is articulated at five places of articulation that may vary across languages within the language family: bilabial, dental, alveolar, retroflex, and velar, as represented in Table 2.6:

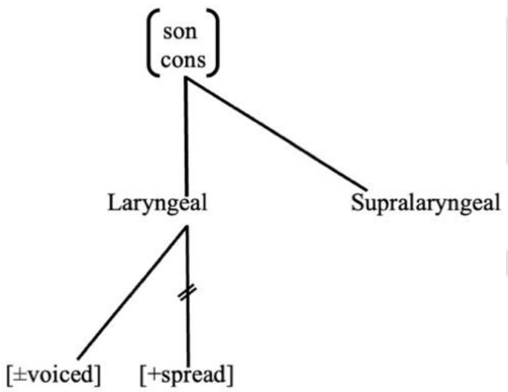
		Laryngeal Features			
		-voiced	+spread,-voiced	+voiced	+spread, +voiced
Place Features	Labial	p	pʰ	b	bʱ
	Dental	t̪	t̪ʰ	d̪	d̪ʱ
	Alveolar	t	tʰ	d	dʱ
	Retroflex	ʈ	ʈʰ	ɖ	ɖʱ
	Velar	k	kʰ	g	gʱ
	Palato-Alveolar	tʃ	tʃʰ	ʥ	ʥʱ
	Glottal				ɦ

Table 2.6. Four-way laryngeal contrast predominant in New Indo-Aryan languages

The diachronic loss of aspiration from the phonemic inventory of Sylheti played a crucial role in restructuring the language's phonology. This sound change resulted in the instability of the inherent four-way laryngeal contrast leaving [voice] as the only feature to mark laryngeal contrast; for example, the series of [tʃ, ʥ]: [tʃʰ, ʥʰ] was reduced to /s/: /z/(ʥ) as in *tʃal >> sāl *'roof'*: *ʥal >> zàl/ʥàl *'net'*; *tʃʰal >> sàl *'skin'*: *ʥʰal >> zál/ ʥál *'spicy'*. The instability of the inherent rich laryngeal system of the language with an inherent [spread glottis] contrast subsequently triggered tonogenesis, which reshaped the phonology of the language and placed it among a few rare Indo-Aryan languages like Punjabi (Evans et al., 2018; Gill & Gleason, 1972) and Pahari (Khan, 2017; Khan et al., 2020) which use tone to express lexical contrast. (Gope and Mahanta, 2014; Gope, 2016).

Laryngeal features such as [spread glottis] or [constricted glottis] are used in laryngeal phonology as privative or binary units, which is also an essential aspect of feature geometry. Feature geometry assumes the hierarchical organization of segments, and the features [spread], [constricted], and [voice] are subsumed under the laryngeal node (Clements, 1985: p. 233; Lombardi, 1991). Although this chapter does not follow any particular model throughout, we have used a partial feature tree (Clements, 1985; Sagey, 1986; 1987; Yip, 1989) to demonstrate how the individual laryngeal feature node was diachronically delinked from a segment leaving the rest of the feature nodes in the laryngeal tree as well as the supralaryngeal tree unaffected, as demonstrated below in 4 below for a diagrammatic representation :

4. *Diachronic delinking of the [+spread glottis] node*:



The partial tree (the supralaryngeal node is not expanded here as our discussion is limited to the laryngeal node) in 4 shows that it was only the [+spread glottis] node, which delinked from its feature tree, leaving the [voice] node intact, and the change was independent of the supralaryngeal node of the root. The onsets in the old forms of *tʃal >> sāl *'roof'*: *tʃʰal >> sàl *'skin'* share all the Place and Manner features except [spread glottis] which are responsible for aspiration, and this feature node was delinked from the Laryngeal node leading to identical segments in the onset position and subsequently to homophonous words, reinterpreted as tonal pairs. Pitch variations have been established to have a physiological association with glottal configurations, especially glottal width and constriction of the larynx (Ladefoged, 1973). Since spirantization is independent of the laryngeal node, there can be no association between the spirantization and tone, which is why this subsection and the following one avoid any discussion on the diachronic spirantization in tonal pairs such as *tʃal >> sāl *'roof'*: *tʃʰal >> sàl *'skin'*.

2.2.2.2 Loss of [+spread glottis] feature and tonogenesis

Laryngeal phonology characterizes the plain voiceless stop as marked by the absence of any feature, and sound change is constrained by principles of markedness (Cohn 2022; Honeybone 2005; Hyman 1975); it is unnatural for the [-voice] series /p, t, k/ to turn into the [+ series /b, d, g/ in a language. The feature [+spread glottis] is universally unmarked (Honeybone, 2005), and it is, therefore, natural for a language that marks aspiration contrast to neutralize [+spread glottis] first. Evidence in support of this phonological universal is also attested across Indo-Aryan languages. Tonogenesis in Punjabi triggered by the loss of aspiration has captured the attention of linguists for years (Evans and Kulkarni, 2018; Gill and Gleason, 1969; Haudricourt, 1972), recent studies on Pahari (Khan, 2017; Khan, Xu, and Sohail, 2020) also show that it was the instability of the inherent four-way laryngeal contrast which triggered tonogenesis in the language. Ongoing sound changes in the Northwestern group of Indo-Aryan languages, primarily spoken in Pakistan, such as Jangli, Kalasha, and Shina, also demonstrate that the languages have either neutralized or are on the verge of neutralizing aspiration contrast future (Hussain & Mielke, 2020; Hussain, 2021; Hussain, 2022).

We have used the synchronic cognate words of the NIA languages to reconstruct the diachronic reflexes of Sylheti phonemes, as discussed in the introductory part of this chapter. Our analysis of the historical forms of Sylheti phonemes obtained from NIA cognates shows that the loss of [spread glottis] feature, specifically aspiration, was lost in all syllabic positions in both monosyllabic and disyllabic words as shown in Table 2.7:

Sylheti Word	**NIA**	**Gloss**	**Sylheti Word**	**NIA**	**Gloss**
ɖáx	ɖʰapp	body	ɖàx	ɖakk	call
ɖ̪ɛxá	ɖ̪ekʰa	meet	ɖ̪ɛ̀xà	ɖagga	*young bull*
xàl	kʰal	skin	xāl	kal	*bad time*

Sylheti Word	NIA	Gloss	Sylheti Word	NIA	Gloss
sìkà	tʃʰikkja	*sling rope*	sīkā	tʃīkka	*muskrat*
ɸíʈá	piʈʰa	pie	ɸīʈā	piʈa	*beating*
súl	tʃʰol	peel	sùl	tʃʰul	*peel*
xáʈ	kaʈʰ	*valuable wood*	xàʈ	kʰaʈ	*ground-stool*
ɸáxá	pãnkʰa	*wing*	ɸāxā	paka	*ripe*

Table 2.7 Loss of aspiration in Sylheti in different syllabic positions leading to tonogenesis

The loss of aspiration was uniform in the language for both voiceless and voiced consonants, as observed in the dataset in Table 2.7. The verb /ɖáx/'*cover*' underwent a loss of aspiration from the voiced retroflex obstruent *ɖʰ >> /ɖ/ in the onset position. The loss of aspiration from the coda position can be observed in the word for *'valuable wood'*/xáʈ/; the historical aspirated voiceless alveolar coda merges with its unaspirated counterpart *ʈʰ >> /ʈ/. The loss of aspiration from the word medial position can be observed in the word for *'wing'* /ɸáxá/; the aspirated voiceless velar stop in *pãnkʰa changes to *k and further undergoes spirantization to /x/: *kʰ >> /x/. De-aspiration of these consonants in most of these words subsequently led to homophones which further triggered tonogenesis in the language, for example, the tonal pair *tʃīka >> sīkā *'muskrat'* and *tʃʰikkja >> sìkà *'sling rope'*. It is noteworthy that the loss of aspiration led to either lexical High or Low tones as shown in 5; diachronic unaspirated onsets or codas mapped to a default Mid tone.

A further interesting observation of the sound change in the coda of the monosyllabic words demonstrated in the dataset in 6 shows the traces of diachronic aspirated sonorants in the language. We investigated deeper into the merger of [-spread glottis] and [+spread glottis] in the coda position in Sylheti for the first time, presenting a wider picture of the diachronic laryngeal merger in the language. A different aspect of the laryngeal merger can be observed in the diachronically contrastive series in 6:

6. *The merger of aspiration contrast in both onset and coda positions:*

i. *tʃaɽ >> sāɽ *'earthen pieces'*:
ii. *tʃʰoɽ >> sàr *'let go'*
iii. *tʃaɽʰi >> sáɽ *'vessel'*
iv. *ʥar >> ʥàr/zar *'to digest'*
v. *ʥʰar >> ʥár/zar *'to dust'*

The tonogenetic association of the diachronically aspirated coda in monosyllables with the medial consonant in disyllables suggest that the coda was resyllabified as the onset of the second syllable in disyllabic structures. For example, the word for *'ride'*/sɔ́ɽ/ in 7 (i) and *'wicker stool'* /múɽá/ in 7 (iv) are cognate with the NIA forms *tʃəɽʰ and *moɽʰa: respectively,

7. *Loss of [spread glottis] feature in sonorant codas:*

i.	/sɔ́ɽ/ << *tʃɔɽʱ	*'ride'*
ii.	/ɸɔ́ɽ/ << *pɔɽʱ	*'read'*
iii.	/búɽá/ << *buɽʱa	*'old'*
iv.	/múɽá/ << *moɽʱa: '*wicker stool'*	

The existence of High-Mid tone pairs like /sɔ́ɽ/ *'ride'* and /sɔ̄ɽ/*'slap'* in the language (explained in Chapter 3) demonstrate a two-way laryngeal contrast for the retroflex trill [ɽ: ɽʰ]. The traces of this diachronic contrast show that the loss of [spread glottis] in Sylheti had also spread to aspirated sonorant codas, one of the salient features of NIA languages. The two-way laryngeal contrast for sonorants is evident in the NIA group of languages like Hindi, Bhojpuri, Magahi, and Lamani (Ohala, 1983; Ohala, 1983; Ohala & Ohala, 1992; Pandey, 2010; Shukla, 1981) which have been lost in Bengali and Assamese. As sonorants are inherently voiced, they lack distinctive [voice] (Cho, 1991; Lombardi, 1991), and thus the laryngeal contrasts in sonorant consonants is reduced to only two-way contrast: modal ø and [spread]; sonorants exhibit this contrast only in the coda or in the word medial positions in most of these languages. The laryngeal contrast exhibited by some of the NIA languages (Ohala & Ohala, 1992; Pandey, 2010; Shukla, 1981) has been represented in 8:

8. *Two-way laryngeal contrast in NIA sonorants:*

   [n, ɽ, l]: [nʰ, ɽʰ, lʰ]
   [+voice]: [-voice, +spread glottis]

The diachronic deletion of aspiration from the coda position is an inherent feature of the Eastern Indo-Aryan languages. This phonotactic constraint on coda aspiration is also attested in Sylheti's cognate languages; aspiration is banned from the coda position in Bangla (Kar & Truckenbrodt, 2019) and tends to undergo de-aspiration in non-initial positions in Assamese (Mahanta, 2012).

2.2.3. Loss of the glottal fricative

Most of the NIA languages like Hindi, Kashmiri, Punjabi, and Gujarati exhibit a one-way spread glottal contrast for the fricative /ɦ/ (Cardona, 1965, p. 29; Maddieson, 1984); it is considered as a member of a special class of laryngeal to be classified with the glottal /ʔ/ (Maddieson, 1984). The laryngeal features inherent to voiced aspirates have also been found to correlate to the old Indo-Aryan guttural *ɦ (Dutta, 2007). This distinctive phonetic feature has undergone a process of neutralization in Sylheti. Understanding this transition in the language's phonetic structure will provide invaluable insights into the dynamic evolution of the Sylheti language, revealing the role of phonetic changes in driving broader phonological transformations.

The deletion of the [+spread glottis] feature from the phonemic inventory of Sylheti extended beyond the de-aspiration of consonants and led to the complete deletion of the diachronic [+voice, +spread] glottal fricative *ɦ. This deletion has also been reported by (Goswami 2016) in her study. Table 2.8 shows a total deletion of the glottal fricative consonant (*ɦ) in Sylheti.

Sylheti Word	NIA	Gloss
ɔild̪a	ɦɔlud̪	*yellow*
im	ɦim	*snow*
aʃ	ɦã:ʃ	*duck*
atti	ɦa:t^hi	*elephant*
at̪a	ɦat̪a:	*ladle*
iŋʃa	ɦimsa:	*envy*

Table 2.8. Loss of the glottal fricative [ɦ] in Sylheti

The words in Table 2.8 show that the diachronic forms of Sylheti words underwent complete deletion of *ɦ. The NIA column represents the diachronic reflexes of the glottal fricative *ɦ in Sylheti, which is still retained in its cognate NIA languages. The deletion of the *ɦ in Sylheti was a part of the deletion of the [+spread glottis] feature from the language.

This process is similar to the trajectory observed in several other tonal languages such as Punjabi and Pahari. This neutralization, or loss of the guttural fricative, appears to have been a key trigger in the process of tonogenesis in these languages, leading to the development of tonal contrasts. We propose that the uniform loss of aspiration from obstruents and sonorants in the language subsequently led to the deletion of the voiced fricative *ɦ and subsequent to the tonogenesis triggered by the merger of aspiration contrast, the deletion of the voiced guttural also triggered tonogenesis in the language. Cross-linguistic evidence of the voiced guttural triggering tonogenesis in Indo-Aryan languages in also attested in Punjabi and Pahari Bhatia (1975). Tonogenesis triggered by word initial voiced aspirates and voiced *ɦ had unpredictable tonal mapping which was later phonologized in the language and the sounds underwent subsequent deletion in the final stage of tonogenesis in the languages. This shift typically led to a higher pitch, thus establishing a phonetic link between the breathiness of the former consonant and the high pitch of the following vowel (Bailey, 1970; Manrique, 2010), while the deaspiration of voiced stops mapped to a low tone (Ohala, 1983). However, the loss of voiced aspirates, once a distinct feature in Punjabi, led to the emergence of a low tone (Bhatia, 1975). As these aspirated voiced stops disappeared, they left a phonetic void that was filled by a shift to a low tonal register for the associated words.

Unlike the tonal trajectory in Punjabi, the correlation between the laryngeal gestures of both diachronically voiced aspirates and the guttural fricative in Sylheti mapped to a high tone. This can be observed after a closed scrutiny of the synchronic words in the language which underwent the deletion of *ɦ onsets. We propose that this deletion led to a rise in pitch for words with *ɦ onsets, and their homophonous vowel-initial words remained unmarked for tone (or received the Mid tone: to be discussed in detail in chapter 4). The existence of tonal pairs such as *ɦa:r >> /ár/ '*necklace'* and *a:r >> /ar/'*and'*; *a:t̪a: >> /at̪a/ *'custard apple'* and *ɦa:t̪a: >> /át̪á/'*ladle'* point towards the fact that the loss of spread glottal fricative also led to a two-way tonal contrast (discussed in Chapter 4).

However, since our data for this phenomenon is scarce, a detailed study on this aspect of Sylheti tonogenesis remains beyond the scope of this dissertation, and this phenomenon leaves to be explored in future research[6]. These intriguing transformations and the coexistence of these tonal pairs point towards the possibility of the loss of the glottal fricative having played a significant role in the development of Sylheti's tonal system. However, a comprehensive understanding of this complex phonetic phenomenon necessitates a more in-depth investigation. The exploration of the potential correlation between the loss of the glottal fricative and tonogenesis in Sylheti presents a compelling avenue for future linguistic research. Establishing this link could provide valuable insights into the intricate mechanisms driving phonetic changes and the consequent evolution of language.

[6] Which is why we have not marked the words which underwent [ɦ]deletion, with tonal values in Table 2.8.

The reconstruction of the synchronic tonal realization of Sylheti words thus demonstrates a diachronic consonantal inventory with the following laryngeal contrast as shown in 9:

9. *Summary of the diachronic four-way laryngeal contrast in Sylheti:*

[p, t̪, ʈ, k, tʃ]:	[pʰ, t̪ʰ, ʈʰ, kʰ, tʃʰ]:	[b, d̪, ɖ, g, ʥ, ɽ]:	[bʰ, d̪ʰ, ɖʰ, gʰ, ʥʰ, ɽʰ, ɦ]
[-voice]:	[-voice, +spread glottis]:	[+voice]:	[+ voice + spread glottis]

Unlike spirantization, the loss of the entire [+spread glottis] cluster (both [-voice, +spread glottis] and [+voice, +spread glottis]) was uniform which subsequently led to the reanalysis of the laryngeal feature as phonemic tone in the language which is central to this dissertation and will be discussed in detail in Chapter 3 and Chapter 4.

2.2.4 Synchronic consonantal processes

Although Sylheti retains the dental and retroflex consonants of the NIA languages, they have been observed to follow conditional alteration to their alveolar counterpart for some speakers in the intervocalic environment in the Barak Valley Sylheti. *Some* of the speakers tend to realize the retroflex sounds, i.e., /ʈ/, /ɖ/ and /ɽ/ as the alveolars [t], [d], and [r] in this region. For example, the retroflex [ʈ] in the word for *'sour'*, /ʈɔx/ will retain its form but will alter into the alveolar /t/ in the word for '*thorn'*, /xaʈa/. It is noteworthy that the alveolar stops [t] and [d] are not found to be phonemic in the language. We again deviate here from a previous study on Sylheti (Mahanta and Gope, 2018) which claims that /t/ and /d/ are alveolar phonemes in the language. An early survey of Sylheti by Chalmers and Miah (1996) reported the shift of the retroflex phonemes into alveolars within the language. This shift is, however, not consistent for the speakers of Barak Valley Sylheti, which is why this is not discussed in the allophonic section. Gope and Mahanta (2014) also report that while the Tripura Sylheti retains the retroflex stops, it lacks the retroflex trill. A study on Sylheti-English bilinguals in Cardiff (Mayr et al., 2021) also claims that the second and third-generation bilingual speakers of Sylheti are dedentalizing the stops, for example, the dental stop /t̪/ is altering into alveolar [t].

2.2.4.1 Phonological rules and allophonic occurrences

Sylheti shows positional restrictions on the distribution of the voiceless velar fricative /x/ and the voiceless palato-alveolar sibilant in the onset position (Goswami 2016). The language also posits restriction on the distribution of the bilabial fricative /ɸ/ in a syllable-medial environment. Some of these restrictions result from phonological processes like debuccalization and assimilation, which will be discussed briefly in this section.

Progressive assimilation of two heterogenous sounds is widespread in languages; among assimilatory processes, place assimilation is more commonly attested than manner assimilation (Ohala, 1990). One of the assimilation processes discussed in this subsection is progressive manner assimilation in Sylheti words. This assimilation occurs when the appearance of the voiceless bilabial fricative /ɸ/ is constrained to surface as a fricative, i.e. when preceded by the bilabial nasal /m/ in Sylheti words. The manner of articulation of the bilabial nasal spreads to the following consonant in such consonant clusters. This cluster is permitted in the medial position of a lexical word only. The assimilation of the voiceless bilabial fricative into the voiceless bilabial plosive, when followed by the bilabial nasal, is thus an assimilation of manner, i.e., the manner [+cont] assimilates to [-cont] when followed by a homorganic nasal [-cont], as in /lampa/'*tall'* in 10.

10. *Environment of the voiceless bilabial stop:*

sampa	'a variety of banana'
ʃompɔrko	'relationship'
lampa	'tall'

The bilabial nasal on the boundary of the preceding word changes the bilabial fricative of the onset of the following word, which is individually realized only as the bilabial fricative between words within one phonological domain (discussed in Chapter 6). Assimilation leading to fortition is also applicable when the voiceless velar fricative is followed by either the voiceless velar plosive or the voiced velar plosives across word boundaries (discussed in Chapter 6).
Fortition often occurs in prosodically strong positions and is cross-linguistically attested to be conditioned by high or front vowels or domain-initial positions, among other factors (Bybee & Easterday, 2019). Fricatives in Sylheti undergo environmental fortition conditioned by following high vowels and by geminated structure. The voiceless velar fricative /x/ undergoes fortition when followed by high vowels /i/ and /u/ and surfaces as its homorganic obstruent [k] and is realized as /x/ elsewhere (11).

11. *Onset distribution of /x/:*

/xāl/	bad time
/xɛ̄l/	play
/xɔ̄l/	tap
[kūl]	dynasty

[kīl] punch

The voiceless velar, bilabial, and alveolar fricatives also undergo fortition or strengthening in intervocalic geminate structures, which will be discussed in the sub-section on Gemination in Sylheti (2.2.3).

The palato-alveolar fricative /ʃ/ loses its oral constriction and retains a glottal articulation in the onset position, also known as debuccalization (McCarthy 1988). /ʃ/ surfaces as its debuccalized allophone [h] in complementary distribution; /ʃ/ and [h] are thus in complementary distribution in the language. /ʃ/ occurs word-medially and word-finally, whereas [h] occurs in the onset position (12).

12. *Onset distribution of /ʃ/:*

[hɔr] move aside
[hasa] true
/xɔʃa/ astringent taste
/ɖuʃ/ hit with head

Almost all other consonant sounds are permissible at the onsets and coda position of Sylheti syllables.

2.3 Sylheti syllable structure

Sylheti restricts the occurrences of certain consonant sounds in certain syllabic positions. Sonorant consonants, for example, are not syllabic in the language and thus occur as onset or coda; only vowels are allowed to occur as the nucleus of the syllable, for instance, in the /xan/'*ear*'; only/a/ can occur as the nucleus. The retroflex [ɽ] is prohibited at the word-initial position and may appear in the word-final or intervocalic position.

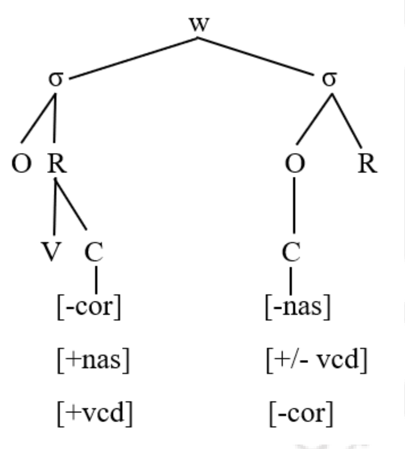
The phonemes strictly prohibited in the onset of a syllable in Sylheti are the nasal velar [ŋ], which is allowed only at the coda position (13). Eden (2018) reports in her analysis of the Camden Sylheti dataset by implementing a mathematical model that /ŋ/ is always followed by its homorganic stop /g/ in intervocalic environments. A syllable may end with a velar nasal in Sylheti if a homorganic stop onset follows it. The nasal velar [ŋ] occurs only in the coda position in the language and therefore is followed by the homorganic stop [g], i.e., the voiced velar stop occurs as the onset of the following syllable. Our data in 13 demonstrates the occurrence of the velar nasal in Sylheti:

13. *Distribution of the velar nasal in Sylheti :*

/fuŋ.ga/	*'illegitimate child'*
/baŋ.ga/	*'broken'*
/luŋ.gi/	*'garment'*
/ʈɛŋ.gra/	*'a fish'*
/lɛŋ.gra/	*'lame'*
/baŋ/	*'break (verb)'*
/gaŋ/	*'river'*

As shown in the dataset, the word /fuŋ.ga/'*illegitimate child'* has two syllables where the velar nasal is followed by a homorganic voiced velar stop, which also shares the same laryngeal feature with the nasal velar stop. A similar rule applies to the words for *broken* /baŋ.ga/ or for /luŋ.gi/'*garment'*. However, in words like /baŋ/ '*break (verb)'*, the velar nasal is allowed to occur individually as it occurs in the coda position. The onset distribution of the velar nasal has been demonstrated in 14:

14. *Onset distribution of /ŋ/:*



This phenomenon is also attested in Sylheti's cognate language Hindi; Ohala (1999) claims that the nasal velar never occurs individually or without being followed by its homorganic stop /g/.

2.3.1 Possible Syllable Structures

The theory used in the analysis of the Sylheti syllable structure is the Generative CV-Phonology Model of the syllable (e.g., Clements and Keyser, 1983). A clear picture of the possible non-derived syllable structures in Sylheti is given in 15.

15.	CV	xɔ	*say*
	CVV	xɔi	*puffed rice*

CVC	lik	*louse*
CV.CVC	ɖi.ʈan	*idiom*
CV.CV.CV	ɸu.ʈa.ni	*arrogance*
V.CV	ɔ.nɔ	*here*
CVC.CV	ɸuŋ.ga	*bastard*
V.CV	a.ʈu	*knee*

The syllable structure presented here suggests that Sylheti syllables strictly prohibit consonant clusters. Sylheti does not have tautosyllabic clusters of its own (Eden 2018; Eden 2020; Gope, Goswami, and Sanyal 2021). The language uses repair strategies to avoid tautosyllabic clusters in its diachronic forms and borrowed words which we will discuss in the section. The inventory of the voiced and sonorant codas is very high in proportion to the voiceless stop codas. Examples shown in 16 show that Sylheti favours open syllables, and a substantial percentage of syllables in the language are of CVC or CVCV shape.

2.3.2 The Law of Syllable Contact in Sylheti

The Syllable Contact Law (SCL) makes two distinct claims about the coda consonant α and the onset consonant β in a syllable contact pair: α.β. First, a pair is better if the sonority of the consonant α is greater than the sonority of the consonant β (Murray and Vennemann 1983; Vennemann 1988). Second, the greater this sonority drop from α to β, the more preferred the syllable contact pair will be. Some languages restrict coda-onset sequences, requiring a syllable-final consonant to be equally or more sonorant than the following onset (Clements, 1990). There is a cross-linguistic preference for syllable contacts with a falling sonority slope (Vennemann & Murray, 1983) and (Vennemann, 1988).

We have used Jespersen's (1904) sonority hierarchy, and to illustrate the application, we have assumed the sonority scale that (Clements 1990) posits in the sonority index (16).

16. *The sonority index:*

Vowels (V) 5
Glides (G) 4
Liquids (L) 3
Nasals (N) 2
Obstruents (O) 1

The syllable contact scale entails that the less marked the onset and the adjacent coda, the more harmonic the relation between them. Several different coda/onset combinations can be equally harmonic: for example, [ɸɔn.t̪i] and [ɸuŋ.ga] have the same sonority drop of 1, as the distances /n/-/t̪/ and /ŋ/-/g/ are the same on the sonority scale (Table 2.9).

Sylheti Word	Sonority slope	Gloss
bɔʈ.la	+2	*fat man*
ɸɛt̪.ni	+1	*witch*
ɸɔn.t̪i	-1	*great-grandchild*
ʃut.ki	0	*dried fish*
bus.ka	0	*baggage*
ɸuŋ.ga	-1	*bastard*

Table 2.9. Sonority slope in Sylheti

As can be observed in Table 2.9, Sylheti does not allow an extensive sonority slope (only -2 or +2) across syllable boundaries as vowel/liquids to obstruent ungrammatical. Our analysis shows that Sylheti underwent syllable simplification of liquid-obstruent or liquid-nasal contact across boundaries. This can be attributed to the Law of Syllable contact, which restricts a high drop in sonority across syllable boundaries. Syllable contacts which are marked according to SCL, sound alterations such as omission, assimilation, vowel epenthesis, and metathesis, are applied as repair strategies to produce more unmarked syllable contacts. Sylheti uses gemination as a repair strategy to avoid the sonority slope of liquid-obstruent, liquid-nasal, or vowel-obstruent clusters, which will be discussed in Section 2.3.3.

2.3.3 Gemination in Sylheti

The primary correlate for geminates is usually longer than singleton, which is expected to reflect in their consonant duration (Ladd and Scobbie 2003; Ridouane 2010). Long consonants or geminates have been studied in tautomorphemic or heteromorphemic environments (Mohanan & Mohanan, 1984) in the literature of geminate consonants (Hayes 1986; Kenstowicz 1982; Lahiri and Hankamer 1988). Our study of Sylheti geminates limited to tautomorphemic lexical geminates only. Geminates are restricted to the intervocalic position in Sylheti, which is the most common position in world languages for geminate consonants (Dmitrieva, 2012). This can be observed in /sat̪t̪i/'*umbrella'* or in /gul.la/'*round/ball'* in 17.

17. sat̪.t̪i *umbrella*

d̪ub.ba	*grass*
ɸal.la	*weighing stone*
gul.la	*round/ball*
at̪.t̪i	*elephant'*

The majority of geminates in Sylheti is limited to obstruents, nasals, and laterals and occur only intervocalically; the only fricatives allowed in geminate structures are the palato-alveolar voiceless fricative [ʃ]. Rhotic geminates are not attested in non-derived words in the language. Sylheti favors VC-CV syllabification for geminates. The first half of the geminate is syllabified as the coda of the first syllable and the second half as the onset of the second syllable. Sylheti thus syllabifies geminates in a coda-onset configuration as shown in (18):

18. *Syllabification of Sylheti Geminates*

This structure of intervocalic geminates is inherent to Sylheti and its cognate languages like Hindi. In an experimental study on Hindi syllabification structure, Ohala (1999) reports that the majority of native speakers perceive VC-CV structures for intervocalic geminates.

2.3.3.1 Gemination and fricative fortition

Geminate structures in Sylheti impose a phonological requirement of altering the fricatives into their homorganic obstruents (allophones). There are cross-linguistic evidences of place of articulation preferences for geminates (Thurgood, 1993). Studies (Taylor, 1985) have shown that some languages prefer obstruent geminates over fricative gemination. Some languages might also require modifying lenition processes (Kirchner, 2000) or strengthening the geminate consonant. This phenomenon of fricative fortition geminate structures has also been reported in Sylheti in a recent study by Prasad (2021), who shows that the voiceless velar fricative undergoes fortition not only when it precedes a high vowel but also when it is in geminate structure. She claims that gemination being a strong syllabic structure, requires the fricative to alter to its obstruent counterpart. We concur with Prasad (2021) and also claim that gemination is used as a repair strategy to avoid rhotic-obstruent clusters and that the geminated fricative fortition is not limited only to the voiceless velar fricative /x/ > [k] in Sylheti; it alters the voiceless bilabial fricative to its homorganic stop /ɸ/ > [p] and the alveolar fricative /s/ to its homorganic affricate /s/ > [tʃ]. This restriction on fricative gemination is also attested in its cognate NIA languages, such as Hindi (Mishra & Bali, 2011). Fricative fortition in Sylheti is demonstrated in Table 2.10. This rule leads to the occurrence of the intervocalic alveolar sibilant to surface as its affricate allophone in a geminate structure, as observed in the table for /xitʃ.tʃa/ << [xissa] *'tale'*.

Sylheti Word	Underlying form	NIA	Gloss
kitʃ.tʃa	xissa	kissa	*yellow*
lɔik.kɔ	lɔixxɔ	ləkʃja	*snow*
bɔk.ka	bɔxxa	bʰokka	*hole/shallow*
suk.ka	suxxa	tʃɔkʰa	*sharp*
baitʃ.tʃa	baissa	bətʃtʃa:	*child*
sappa	saɸɸa	tʃʰappa	*seal*
lappa	laɸɸa	lapʰ	*jump (verb)*
t̪ippannɔ	t̪iɸɸannɔ	t̪irpan	*fifty-three*

Table 2.10. Phonological alteration of fricatives to obstruents in Sylheti geminates

The Sylheti words presented in the table are the surface structure forms in which the geminate fricatives undergo fortition to avoid fricative gemination. The underlying forms are demonstrated with the fricative phonemes of the language. Thus /baitʃ.tʃa/ is the surface form of the word [baissa:] *'child'*. A similar restriction can be observed against the surfacing of the bilabial fricative; in Table 2.10, for example, [laɸɸa] *'jump (verb)'* is the base verb form or the imperative form for the word *'jump'*; the noun form of the same word is /laɸ/'a jump'; the bilabial fricative surfaces as bilabial obstruent when in a geminate structure in this case.

2.4 Discussion: Studies on cluster simplification in Sylheti

A previous study on Sylheti syllabic structure (Gope, Goswami and Sanyal 2021) reports that Sylheti adopts repair strategies such as rhotic syncope as in proʃ.no > ɸɔʃ.nɔ *'question'*, rhotic-vowel metathesis as in kri.mi > kir.mi *'tapeworm'*, vowel anaptyxis as in slɛt > sɛ.lɛʈ '*slate*' and gemination as in borrowed words to avoid consonant clusters. Eden (2020) in her study on Camden Sylheti, compares the present data with Sanskrit and reports that the language adapted metathesis diachronically as in ⟨krimi⟩ → [kiɽa] to repair clusters in their original[7] forms. She

[7] Eden assumes the Old Indo Aryan forms as the original form of Sylheti words in her study.

reports anaptyxis as in bread > [bɛrɛɖ] and prothesis as in [ɪspid] *'speed'* as active repair strategies in borrowed words as well. We argue that Sylheti also adapted phonological repair strategies to avoid consonant clusters while developing as a language in its diachronic words. Gemination of two heterogenic consonant clusters as a strategy to repair unattested syllable contact is a very commonly attested form of assimilation in languages of the world (Ohala, 1990; Seo, 2011). A previous study (Goswami 2021) shows that Sylheti uses gemination to avoid sonority rise across syllables; liquid and obstruent contact across syllable boundaries is repaired by deleting the liquid, and only the obstruent sound undergoes gemination in this process. Old forms of Sylheti words with the rhotic-fricative coda-onset cluster underwent fricative gemination to obey the law of syllable contact as in /bɔʃʃa/ >> *vərʃɑ' *monsoon'*. The obstruent-rhotic sequence in a coda-onset environment underwent a similar phonological process as can be seen in /ϕit̪t̪i/ >> *pit̪rija *'paternal'***.** The preference for obstruent gemination over liquids is attested in many languages (Dmitrieva 2012; Taylor, 1985). Sylheti clearly marks rhotic consonant clusters. In words like /mit̪.t̪u/ >> *mrit̪ju *'death'* and /d̪ɔibbɔ/ >> *d̪ravja *'substance'*, onset clusters with rising sonority from nasal to rhotic and obstruent to rhotic were deleted. The sonorant rise across syllable boundaries in these words from obstruent to glide also underwent gemination of the obstruents as glide sounds are absent in the language's phonemic inventory. The preference for obstruent gemination over liquids could be attributed to the fact that in the process of cluster simplification, languages tend to retain the least sonorous member of the consonant cluster (Pater and Barlow 2003).

2.5 Conclusion

This chapter illustrates how Sylheti developed its unique phonemic inventory for vowels and consonants during its development as a language. Our acoustic analysis of the vowel space confirms that the language has only five and lacks close-mid vowels. A close observation of the consonants shows that the language underwent a complete deletion of the [+spread glottis] feature for all the consonants in all positions. We conclude that spirantization occurred simultaneously with deaspiration in the language but played no role in tonogenesis. It was the uniform delinking of the [+spread glottis] laryngeal gesture which was reinterpreted and phonologized as tone. The language lacks tautosyllabic consonant clusters. Consonant clusters are allowed only intervocalically in Sylheti, but a few clusters are constrained on the onset-coda boundary. Sylheti gemination follows a coda-onset configuration to avoid clusters in geminates as well. The most attested syllable contact is a sonority distance of -2 to +2 in the language. Phonotactic constraints and syllabification strategies in the language are inherent in its cognate languages, for example, rules for onset restrictions on /ŋ/, aspiration deletion from the coda position, constraints on fricative gemination, and geminate syllabification. Most of the repair strategies used in diachronic forms are not active in present-day Sylheti. As reported in previous studies, borrowed forms undergo repair in the language. Gemination, rhotic-syncope, and epenthesis are some of the repair strategies in Sylheti adapted while developing as a language for simplification of liquid-obstruent contact across syllables. These clusters might be traced back to the old form of the words reflected by the NIA words or might be a result of the language's development. The upcoming chapters discuss tonogenesis resulting from the deletion of the [+spread glottis] feature in Sylheti in detail and discuss how the phonotactic constraints and syllable structures played a role in the evolution of the language as a tonal one.

Chapter 3

Tonogenesis and Tones in Sylheti

Introduction

This chapter studies Sylheti as a tonal language and investigates the nature of tonogenesis in Sylheti that arose from the loss of aspirated consonants (Gope, 2016). These consonants still retain their aspiration contrast in their cognate languages, such as Bengali, Assamese, and Hindi. As discussed in Chapter 2, we have used the synchronic cognate words from these genetically related languages to present the diachronic form of the words under study and to understand the tonogenetic factors involved in the development of Sylheti as a tonal language. We discuss the monosyllabic tonal pairs and triplets in this chapter and propose that the instability of the four-way laryngeal contrast in both onsets and coda positions triggered a three-way tonal contrast in Sylheti. We have used linear mixed effect models of f0 and duration to examine the acoustic correlates of tone contrast in the language. Unlike the previous versions of our study on tonogenesis on the three-way tonal contrast in Sylheti, which appeared in Raychoudhury & Mahanta (2020) and Raychoudhury & Mahanta (2022), this chapter and Chapter 4 present a broader and typological aspect of the phonology and phonetics of the three-way tonal contrast in Sylheti. A part of the statistical analysis presented in section 3.3 has appeared in Raychoudhury & Mahanta (2020) and Raychoudhury & Mahanta (2022), additionally, we have presented the study of both raw and standardized pitch contrast to understand the direct output and for a prerequisite for the perception test conducted in Chapter 4. The structure of this chapter is as follows. 3.1 aims to introduce the tonogenesis of Sylheti. The section further divides itself to summarize the previous studies done on Sylheti tonogenesis. 3.2 introduces and analyses the phonological three-way tonal contrast in Sylheti. Section 3.3 divides itself into a detailed acoustic analysis of the production test done on three tones in monosyllables and analyses the results. 3.4 discusses the results and concludes the tonal contrast in Sylheti from a typological perspective.

3.1 An overview of tonogenesis in Sylheti

The development of tone or tonogenesis (Matisoff, 1970; 1973) is established in many languages as a phenomenon, that reveals the usual patterns of sound change. It is one of the most common sound changes that has occurred in many genetically unrelated languages as well (Ohala, Hombert, & Ewan G, 1979). Tones may start as redundant phonetic features of the conditioning sounds that contain these f0 features. The f0 perturbations of these conditioning sounds are reinterpreted in a tonal language, which subsequently leads to the assignment of contrastive tones in the language (Matisoff, 1973). The conditioning sounds might often be lost or reduced from the phonemic inventory of a tonal language, and the f0 features finally replace the primary contrastive feature. Tonogenesis may give rise to tonal contrast in previously non-tonal languages or multiplies its tonal inventory (Haudricourt, 1954; Hyman, 1978; Hombert, 1978; Thurgood, 2002). Studies done with the objective of understanding the mechanisms of tonogenesis have shown that the seeds of tonogenesis are extractable from speakers of non-tonal languages (Ohala, Hombert, & Ewan G, 1979). These changes can often be reconstructed to their old forms by analyzing diachronic linguistic data of a language over different periods or by analyzing synchronic data from cognate languages, which still retain the phonemic contrast, the loss of which triggered tonogenesis in the language under study (Haudricourt, 1971; Karlgren, 1966; Kingston, 2005; Matisoff, 1973). Reconstructing diachronic forms from synchronic studies can help us understand how factors such as vowel height, aspiration, phonation type, etc., can affect the fundamental frequency (f0) of a vowel. For example, Vietnamese, a part of the Mon-Khmer family, exhibits an elaborated tonal system. Historically, Vietnamese consonants were divided into two categories: clear or non-glottalized (voiceless and unaspirated), and heavy or glottalized (voiced or aspirated). The clear consonants evolved to have high or mid-level tones, while the heavy consonants have a low tone, with further splits due to the final segments (Kirby, 2011). This phonetic conditioning from the initial and final consonants was a primary driving force behind the complex six-tone system found in modern Vietnamese.

We saw in Chapter 2, how Sylheti tonogenesis was a subsequent process of the breakdown of its diachronic four-way laryngeal contrast inherent to the Indo - Aryan languages to a two-way contrast (Gope & Mahanta, 2014; Gope, 2016). This breakdown of the four-way contrast underwent several phonological stages to be finally compensated by tone contrast in the language. Hyman (1976; 2013) proposes three stages of a universal phonetic tendency to become phonological, and one of the well-documented outcomes of phonologization is the development of linguistic tone. The seeds of these phonetic universals are often observable cross-linguistically (Hombert, 1974; 1975; Lea, 1973). An example is the phonologization of intrinsic f0 perturbations of diachronically aspirated voiced obstruents of Sylheti that played a significant role in the tonogenesis in the language. This intrinsic effect of the aspirated voiced obstruents is exaggerated in stage II and these features are actually used as cues. An interesting cross-linguistic evidence of this stage is observable in the ongoing sound changes in the north-western group of Indo-Aryan languages such as Jangli, Kalasha, and Shina, which are spoken primarily in Pakistan. Studies on these languages (Hussain & Mielke, 2020; Hussain, 2021; Hussain, 2022) demonstrate that they depend largely on phonation and f0 cues to contrast between various laryngeal categories and places of articulation and they have either neutralized or are on the verge of neutralizing aspiration contrast. This suggests that these languages may be either phonation or tonal contrast in the near future. Sylheti and its cognate tonal languages like Punjabi and Pahari demonstrate stage III, where the original contrast is lost, and now the f0 perturbation is used to identify a phonological contrast; tone is thus phonemic at this stage. The phonologization of this intrinsic feature of voiced aspirates is well-attested in Indo-Aryan languages like Punjabi and Pahari. Despite differing analyses, different studies on Punjabi tones (Evans and Kulkarni, 2018; Gill and Gleason, 1969; Haudricourt, 1972) conclude that Punjabi tones arose from the merger of breathy voiced consonants with both unaspirated voiced and voiceless consonants. Recent acoustic studies on Pahari also show that tonogenesis was triggered by the loss of contrast between aspirated voiced stops, unaspirated voiced stops, and voiceless stops (Khan, 2017; Khan, Xu, and Sohail, 2020).

The upcoming section provides a background on tonogenesis in Sylheti and how tone emerged from an atonal stage in the language. In the subsequent sections and in the next chapter (Chapter 4), we investigate tonogenesis in Sylheti conditioned by the loss of laryngeal contrast on both syllable-initial and syllable-final consonants for the first time and present a revised hypothesis of tonogenesis in Sylheti where the presence of contrastive tone is well established. This dissertation pays particular attention to the three-way tonal contrast that has emerged from the diachronic merger of aspirated and unaspirated voiceless and onsets and codas. It analyses the full-fledged, four-way laryngeal contrast in the diachronic origin of Sylheti, as well as their synchronic realization as lexical tones. As described in Chapter 2, evidence of the diachronic existence of [+spread glottis] feature in Sylheti words can now only be found in the synchronic forms in its cognate languages and most of the Indo-Aryan languages spoken in the Indian subcontinent; some are still found in the written form of Sylheti. We have thus used the NIA words to represent the old forms of Sylheti minimal pairs and triplets which have retained the [+spread glottis] feature or the obstruent feature. We use these words to represent the diachronic reflexes of the words in the dissertation. For instance, the word for wood appears as /kaʈ^h/ in all the aforementioned dictionaries; whereas the cognate word for *'let go'* is found as /tʃ^{h}aʈ/ in the Bengali dictionary (Bhattacarya, 2003) and /tʃ^{h}oṛ/ in the Hindi dictionary

(Bahri,1989) and in Turner (1962); the cognate word for '*buck goat*' can be found in Bhattacarya (2003) as /pãʈ^{h}a/ and in Turner (1962) as /paʈʈ^{h}a/.

3.1.1 Background: Sylheti tonogenesis

The very first account of Sylheti tonogenesis was provided by Gope and Mahanta (2014), who found that vowels after underlying (or historical) aspirated consonants are produced with a higher pitch and have been phonologized as the lexical High tone. The study was followed by Gope's very well-received dissertation (2016), which gave a phonetic and phonological insight into how Sylheti – a genetically non-tonal language, developed a two-way lexical tone contrast as a consequence of the merger of aspirated and unaspirated voiced obstruent onsets. Gope established that it was the merger of aspirated and unaspirated voiced obstruent consonants which triggered tonogenesis in the language. He had considered the synchronic data from Bengali, or more precisely, Standard Colloquial Bengali (SCB) to represent the underlying form of Sylheti words in his study as the SCB phonemic inventory retains the four-way laryngeal contrast of Indo-Aryan languages.

Gope (2016) presents a detailed acoustic study of the vowel and consonantal inventory of the language. He compares the language's consonantal inventory with that of SCB which exhibits a rich laryngeal contrast with ten aspirated stops and their unaspirated counterparts and demonstrates that Sylheti's consonantal inventory consists majorly of fricatives and exhibits the complete absence of aspirated obstruents. The dissertation establishes that the loss of [+spread glottis] feature from the language triggered tonogenesis in the language. The study statistically confirms the tonal contrast in Sylheti. Encompassing 24 monosyllabic words, accounted for CV, CVV, and CVC syllable structures, the study solidified the existence of a high tone following the loss of a historic breathy voice contrast [+spread glottis]. This change is believed to serve as a replacement mechanism ensuring distinctive lexical meanings among homophonous words, following the phonological process of lenition and the loss of [+spread glottis]. This two-way contrast is demonstrated by the tonal pairs in Table 3.1 below.

Sylheti Word	Underlying form	Gloss	Sylheti Word	Underlying form	Gloss
gà	ga	body	gá	g^{h}a	wound
bàt̪	bat̪	arthritis	bát̪	b^{h}at̪	rice
ɖàx	ɖax	roaring of cloud	ɖáx	ɖ^{h}ax	drum
bàn	ban	tie	bán	b^{h}an	pretend

Table 3.1 Tonal mapping in Sylheti words following loss of voiced aspirates (adapted from Gope, 2016)

The tonal pairs in the table adapted from Gope (2016) demonstrate that the historical voiced aspirated onset such as in the word for *'drum'*, led to a lexical High tone in Sylheti, /ɖáx/ << *ɖ^{h}ak. The historical onset with voiced unaspirated feature in the word for *'call'*, thus led to a contrastive Low tone, /ɖàx/ << *ɖak as demonstrated in Figure 3.1[8].

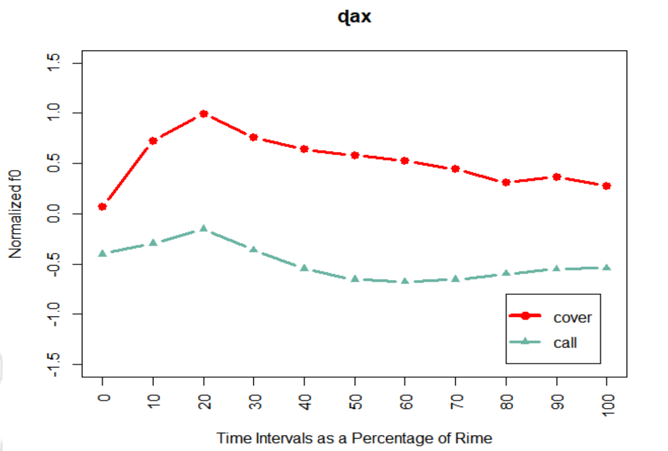


Figure 3.1: Normalized f0 interval contour for the High-Mid contrast for the tone pair /ɖáx/ 'cover' and /ɖàx/ 'call'.

Gope (2016) concluded that the loss of breathiness, indicated by [+spread glottis], prominently impacts only the pitch, while the duration and intensity metrics of the vowels enduring unaltered. This observation provides a solid foundation for our upcoming examination, which will further probe the effects of aspiration loss on voiceless stops in Sylheti. shows that pitch is the only acoustic correlate affecting tone in the language. He conducted a systematic perception test which showed that the rhyme of a syllable must contain f0 fluctuation of at least 37.32 Hz pitch which should be continued at least till 60% of the rhyme to be perceived as different or contrastive word by the speakers. Gope (2016) predicts the existence of a third tone and claims that tonogenesis in Sylheti extended beyond minimally contrastive lexical pairs and that there was a spread through the lexicon of Sylheti.

In the forthcoming sections, we will delve into how a comprehensive exploration of the four-way contrast inherent to the New Indo-Aryan languages elucidates the correlation between Sylheti's tonal system and the deletion of the [+spread glottis] feature. This investigation promises to shed light on the intricacies of the tonal evolution in Sylheti. Shifting our attention towards voiceless obstruents, we have chosen not to concentrate on the voiced aspirates within

[8] The line graph is a result from our experiment on words with voiced onsets; our results resemble that of Gope (2016) for the voiced onsets.

this particular study. Our findings pertaining to voiced aspirates align with those presented by Gope (2016), offering a similar perspective on the loss of breathiness and its implications (as demonstrated in Figure 3.1). Hence, this study intends to deepen the understanding of Sylheti's tonogenesis through an emphasis on the less explored domain of voiceless obstruents.

3.1.1.1 Phonation and tonogenesis

Tone is often found to be accompanied by voice quality differences such as a breathy vs. creaky or lax vs. tense voice (Lee, 1983). Gope and Mahanta (2016) claimed that phonation also played a role in Sylheti tonogenesis. The authors argue that along with the consonant's historical feature, the vowel qualities of the syllables carrying the tone also possess phonation qualities, which are associated with tone assignment in the language. The vowels associated with High tone are in a continuum of modal to creakiness. In contrast, the vowels associated with low tones seem to be modal in nature, justifying the association of High tone to vowel with property of creakiness. Gope (2016) postulates that the loss of breathiness property was lost in Sylheti and subsequently the higher airflow initially required for producing breathy voiced stops was directed towards the adjacent vowel, largely due to the hypo-correction tendency of native speakers resulting in High tone. He claims that due to hypo-correction, the words voiceless onsets follow the similar tone assignment to minimally contrastive words, i.e., /xál/ << *k^{h}al receives a High tone and /xàl/<< *kal receives a Low tone. The study shows that breathy voiced consonants is compensated in the neighbouring vowels, resulting in a low tone. A recent development in this aspect of tonogenesis in Sylheti (Gope, 2021) proposes a statistical model to predict phonation contrasts between contrastive tones; Gope demonstrates that the breathy phonation, once associated with High tone are in the continuum of modal to tense phonation now, which can be attributed to hypo-correction. On the other hand, the significantly higher (and positive) spectral balance and tilt values associated with the vowels carrying low tones confirm that these vowels are in the continuum of breathy to lax phonation. As discussed in Chapter 2, our study emphasizes primarily on the three-way tone contrast conditioned by the merger of the [+spread glottis, -voice] and [-spread glottis, -voice] features; the role of phonation in this aspect of tonogenesis in Sylheti remains to be explored in future studies.

3.2 The hypothesis of the three-way tonal contrast in Sylheti

This chapter is central to the dissertation and seeks to analyse a three-way tonal system in Sylheti subsequent to the breakdown of the aspiration contrast from consonants in both the onset and coda positions with empirical evidence with special emphasis on voiceless obstruents for the first time. The emergence of tonal variation arising from voiceless aspiration is not a common occurrence. Voiceless aspirated stops typically exhibit a wider glottal opening, a characteristic that might alter the basic frequency of a subsequent vowel. This relationship, as posited by Hombert et al. (1979), has been observed in several languages where such a glottal configuration leads to an alteration in the pitch of the ensuing vowel, thereby contributing to tonogenesis.

We hypothesize that if the merger of aspirated and unaspirated onsets played a significant role in the emergence of a two-way tonal contrast in the language, as established in the previous studies, then the merger of aspiration contrast in the coda position is also correlated to the language's tonal phenomenon. The interaction between the breakdown of consonantal contrast and tone has been studied for years to understand the mechanism of tonogenesis (Hombert, 1978; Haudricourt, 1954; Kingston, 2005; 2011; Matisoff, 1973; Yip, 2002). Our discussion on the distinctive features of the laryngeal node in Chapter 2 stipulates that, alongside voicing and aspiration, the glottal configuration can also contribute to variations in the fundamental frequency (f0) which defines the tonal phenomena (Ladefoged, 1973). Maran (1973) posits a raised larynx for a voiceless obstruent and a lower larynx for a voiced obstruent. Halle and Stevens (1971) propose that both following and preceding consonants would perturb f0 on the vowel, but the perturbation for the postvocalic consonant is not documented to be the same (Ohala, 1973). Studies on the physiology of tone (Ohala, 1973; Ohala, Hombert, & Ewan G, 1979) suggest that the aerodynamics of vocal folds while producing voiceless stop tends to raise the pitch on the following vowel followed by a fall while the voiced stop tends to lower the f0. However, the f0 perturbations of aspirated stops are found to be relatively complex (Hyman, 2013). While voiceless aspirated stops are documented to raise the f0, voiced aspirated stops, also referred to as breathy voiced stops, are known to depress f0 (Ohala, 1973). In the case of postvocalic consonants, the most widely attested phenomenon across languages is the correlation of the rising tone to a glottal coda, mostly attested in glottal stop ending syllables in languages such as Lahu and Vietnamese (Ohala, Hombert, & Ewan G, 1979). It has been established that unlike the preconceived notion, the loss of voiced aspirates led to a High tone (Gope, 2016). In this chapter, we explore the complex f0 perturbations attested across languages (Hyman, 2013). Our study demonstrates that the f0 perturbation induced by voiceless aspirated onsets may also lower the pitch of the following vowels which stands in opposition to the pattern attested across languages. Our study expands to the correlation between tone and f0 perturbation of postvocalic obstruent and argues that the High tone can also be mapped to the diachronic merger of aspiration contrast on the coda position in a language.

Previous studies on Sylheti tonogenesis focused on how the loss of aspiration from voiced onsets led to a two-way tonal contrast in Sylheti. We found that the loss of aspiration on the coda position triggered a three-way tonal contrast in Sylheti. As opposed to the loss of aspiration from voiced onsets, which resulted in a lexical High tone (Gope & Mahanta, 2014), the loss of aspiration from voiceless onsets led to a lexical Low tone. The factors responsible for tonogenesis of the three-way tonal contrast namely for the Low, High, and Mid tones are different than those identified in the previous studies on Sylheti tonogenesis (Gope, 2016). as opposed to the loss of aspiration from voiced onsets which mapped to a lexical High tone, the loss of aspiration from voiceless onsets mapped to a lexical Low tone. Contra Gope (2016), we found that the voiceless aspirated onsets led to a lexical Low tone and subsequently, the voiceless unaspirated onsets led to a lexical Mid tone. We thus found that the diachronic merger of aspirated and unaspirated onsets and codas resulted in a three - way tonal contrast in Sylheti. This can be demonstrated with the tonal triplets in Table 3.2.[9] Being segmentally identical, the lexical contrast between these minimal triplets can now only be found at the tonal level. For example, the historical voiceless aspirated onset in *kʰaʈ, the word for '*floor - stool'*, maps to a lexical Low tone in the first triplet, /xàʈ/ << *kʰaʈ. The historical voiceless unaspirated onset in *kat, the word for '*cut'*, maps to a contrastive Mid tone, /xāʈ/ << *kaʈ. The historical voiceless aspirated coda in *katʰ, the word for '*valuable wood'*, maps to the lexical High tone, /xáʈ/ << *kaʈʰ. The historical merger of voiceless aspirated and voiceless unaspirated onsets thus results in a Mid - Low lexical tone contrast on the following vowel. The merger of the aspirated and unaspirated codas further maps to a lexical High tone on the preceding vowel leading to a three-way tonal contrast in the language.

NIA	High	Gloss	NIA	Mid	Gloss	NIA	Low	Gloss
*kaʈʰ	xáʈ	valuable wood	*kaʈ	xāʈ	cut	*kʰat	xàʈ	floor-stool
*tʃaʈʰi	sáʈ	vessel	*tʃaʈ	sāʈ	earthen pieces	*tʃʰoʈ	sàʈ	let go
*pəʈʰ	ɸɔ́ʈ	read	*poʈ	ɸɔ̄ʈ	fall			
			*koi	xɔ̄i	a fish	*kʰoi	xɔ̀i	puffed rice

[9] The asterisk preceding the NIA words indicate the diachronic/proto forms of the Sylheti words under study.

Table 3.2. Sylheti tonal triplets with voiceless onsets

The tonal pairs and triplets in the above table demonstrate that syllabic position also had a significant role in evolution of the language's tonal system. As can be observed, tonogenesis triggered by the merger of aspirated and unaspirated consonants was not restricted to voiceless obstruent consonants and that historical aspiration in sonorant codas also mapped to the lexical High tone. The existence of aspirated sonorants in the synchronic NIA languages is evident in most of the Indo-Aryan languages (Ohala & Ohala, 1992). The realization of this feature is, however, constrained in the synchronic form of some of these languages such as Assamese (Mahanta, Assamese, 2012) and Bengali (Kar & Truckenbrodt, 2019). That the loss of this feature also had a role in tonogenesis in the language can be demonstrated by the existence of the minimal triplets such as /sáɽ/ << *tʃaɽʰi *'iron vessel'*, /sāɽ/ << *tʃaɽ *'earthen pot'* and /sàɽ/ << *tʃʰoɽ *'let go'* in Table 3.2. The merger of */tʃ/ and */tʃʰ/ onsets led to Mid and Low tone contrast in words for *'(broken) earthen pieces'* and *'leave'* respectively; the loss of aspiration from the tap retroflex in the coda position of the word for *'(iron) vessel'* led to a High tone here as well[10]. This contrast is well demonstrated in the PRAAT pictures for the three lexical tones recorded from the same speaker, in the carrier sentence: 'I x said', x being the target word. The PRAAT picture in Figure 3.2 for the carrier sentence : ámí sáɽ xɔ̄i-si *'I said vessel'*, demonstrates the lexical High tone for the word, /sáɽ/ << *tʃaɽʰi *'(iron) vessel'* in the medial position.

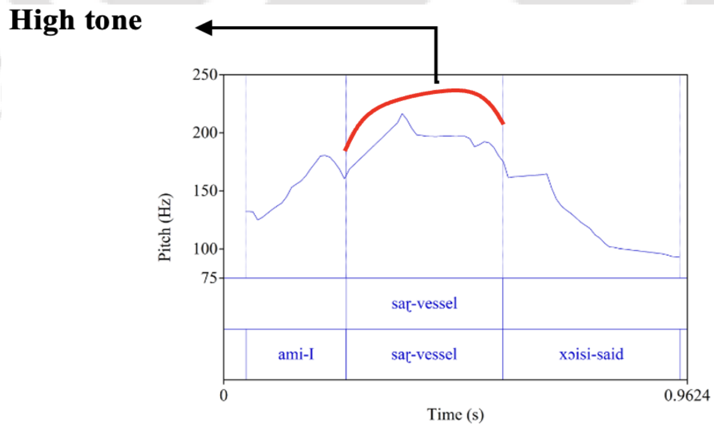


Figure 3.2. PRAAT picture for the lexical High tone in sentential context:
ámí sáɽ xɔ̄i-si *'I said (iron)* ***vessel****'*
Speaker: Male; Age:26

[10] We could not map any of the lexical tones to a diachronic word which had aspiration in both onset and coda positions. This aspect of tonogenetic thus conflict remains beyond the scope of this dissertation.

The contrast between the lexical High tone and Mid tone is well demonstrated in the word /sāɽ/ << *tʃaɽ *'(broken) earthen pieces'*, as can be observed in the PRAAT picture for the carrier sentence : ámí sáɽ xɔ̄i-si/ *'I said (broken) earthen pieces'*, in Figure 3.3, recorded from the same speaker.

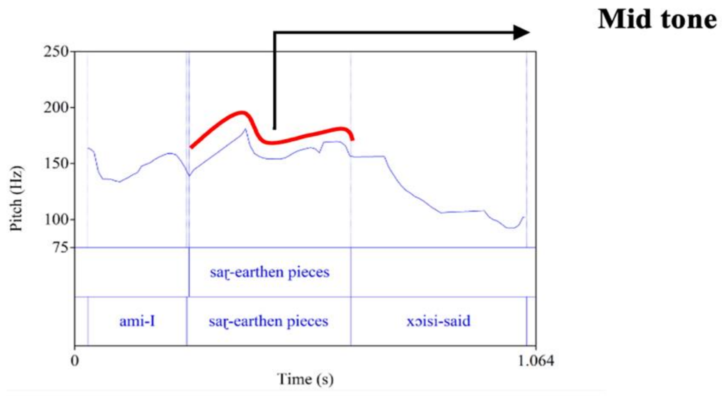


Figure 3.3. PRAAT picture for the lexical High tone in the carrier sentence:
ámí sāɽ xɔ̄i-si *'I said (broken)* ***earthen pieces****'*
Speaker: Male; Age:26

A careful observation of the pitch track in Figure 3.4 for the word /sàɽ/ << *tʃʰoɽ *'leave'*, with an underlying Low tone, in the carrier sentence: ámí sàɽ xɔ̄i-si *'I said* ***let go****'* demonstrates a clear High-Mid-Low lexical tone contrast in Sylheti.

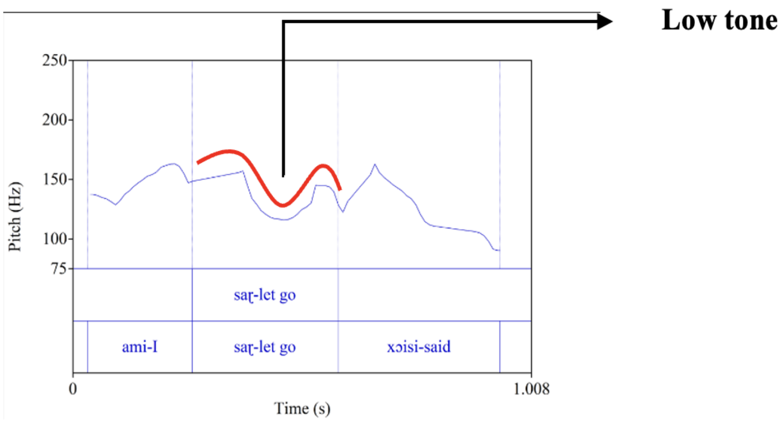


Figure 3.4. PRAAT picture for the lexical High tone in sentential context:
ámí sàɽ xɔ̄i-si *'I said* ***let go****'*
Speaker: Male; Age:26

Thus, the merger of aspirated and unaspirated sonorant consonants played a role in Sylheti tonogenesis as well. Sylheti has a richer inventory of tonal pairs as compared to that of minimal triplets. High-Mid tonal pairs resulted from the merger of aspirated and unaspirated codas as in the tonal pair, /ɸɔ́ɽ/ << *pəɽʰ *'read'* and ɸɔ̄ɽ << *poɽ *'fall'*. The Mid-Low tonal pairs resulted from the merger of aspirated and unaspirated onsets as in the tonal pair /xɔ̄i/ << *koi *'a fish'* and /xɔ̀i/ << *kʰoi *'puffed-rice'*.

There is a cross-linguistic tendency in the Indo-Aryan languages for f0 following voiceless aspirated consonants to be produced with a low f0 of the following vowel significantly more than the vowel following voiceless unaspirated stops (Dutta, 2007). We argue here that this inherited low f0 affects the vowel after the onset, which subsequently triggered tonogenesis in the language. Further, the merger of historical unaspirated and aspirated codas affected the f0 of the preceding vowel and resulted in the contrastive High-Mid lexical tone contrast. The emergence of the High tone resulting from the loss of aspiration in coda consonants is an important part of the evolution of Sylheti tonogenesis. It is plausible that the lexical Mid tone is the default tone which is mapped to words with no diachronic aspiration on both onset and coda positions; this aspect of tonogenesis in the language will be discussed in detail in Chapter 4.

A phonetically plausible explanation for the conditioning of high pitch preceding final and medial aspirates could be the aerodynamic properties inherent to aspirated consonants. Aspiration usually necessitates extended Voice Onset Time (VOT), thereby requiring a larger air volume to be expelled from the lungs. This heightened subglottal pressure potentially raises the fundamental frequency, or pitch, of the preceding vowel (Hombert, Ohala, & Ewan, 1979). Moreover, the strain on vocal folds during aspirated consonant production may also contribute to a higher pitch (Lisker & Abramson, 1964). This leads us to the hypothesis that the physical act of aspiration could have phonologized into a tonal contrast.

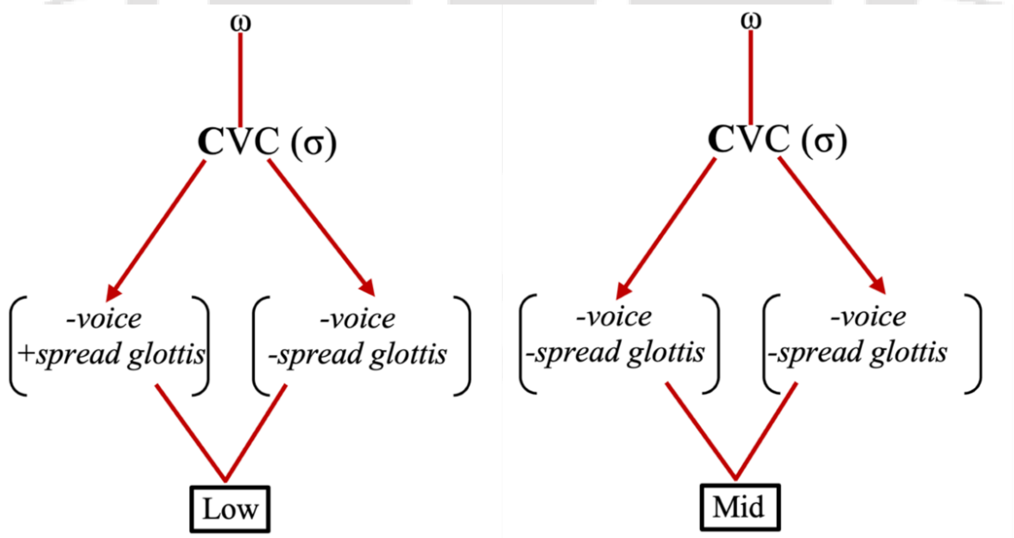
We argue that the mapping of the diachronic [+spread glottis] feature of the coda to the lexical High tone was a consequence of the reinterpretation of the lexical tone assignment and tonogenesis in Sylheti to maintain the lexical contrast. This tonogenetic environment is reanalysed as word medial consonant in a disyllabic environment, leading to the three-way tonal contrast in disyllables which we discuss in the next chapter.

Sylheti has a sparse distribution of the High tone in monosyllables which was conditioned by the reinterpretation of the diachronic [+spread glottis] coda. This is attributed to the fact that coda consonants tend to have certain restrictions in many languages (Hyman, 2012). Cognate languages of Sylheti, like Bangla (Kar and Truckenbrodt, 2019) and Assamese (Mahanta, 2012) constraint the phonetic realization of aspiration in coda position. This postulation is elaborated by the adequate presence of minimal pairs and triplets for the High tone in disyllabic structures (which we present in Chapter 4).

3.2.1 Representation of tone and tonogenesis

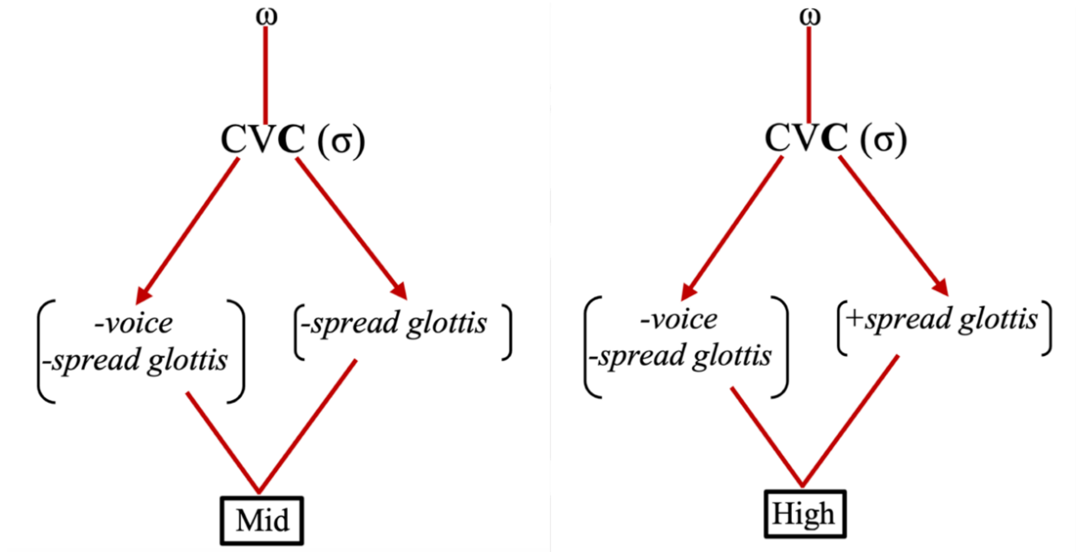
The autosegmental theory of tone proposed by (Goldsmith, 1976) dealt with certain problems of tonal representation which was left unaddressed by generative phonology. The theory represents tone on an autonomous tier, associated with but independent from the segmental tier, which solved the issue of representing the addition and deletion of association lines and phonological features in the segmental and tonal tiers. We follow the convention of autosegmental phonology (Leben, 1973; Goldsmith, 1976) to represent tone in this dissertation, especially in Chapter 4, to represent the tonal association across syllables in Sylheti words; this approach is also used to represent the tonal alignment across morphemic boundaries in prosodic words of the language (Chapter 5 and Chapter 6); we also attempt to analyze the tonal alignment at utterance level in the language in Chapter 7. We also represent the diachronic merger of laryngeal contrasts on onset and coda positions and their association to lexical tone in Sylheti with an autonomous tier for tone in 1:

1. *Representation of how the merger of aspirated and unaspirated onsets possibly triggered tonogenesis in Sylheti:*



The merger of the [-voice, +spread glottis] and [-voice, -spread glottis onsets are represented in 1, where the aspiration contrast is lost on the onset position, and the falling f0 is used to identify a phonological contrast with the default Mid tone; being segmentally identical, it is now distinguished by the Mid-Low contrast. Tone thus becomes phonemic at this stage. Tone retains a constant pitch in Sylheti and continues across syllables thus representing a level tone with many to one association of the segmental tier to the tonal tier, which will be discussed in detail in Chapter 4. The merger of the [-voice, -spread glottis] and [+spread glottis] codas are represented in 2.

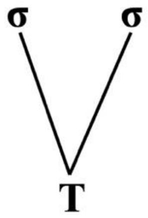
2. *Representation of how the merger of aspirated and unaspirated codas possibly triggered tonogenesis in Sylheti::*



Diachronic words with a [-voice, -spread glottis] onset and [-spread glottis] coda associates to the default Mid tone and the words with a [-voice, -spread glottis] onset and a [+spread glottis] coda associates to the synchronic High tone as represented in 2. This merger thus results in a Mid-High contrast. This two-fold merger resulted in tonal triplets in the language like /sáɽ/ << *tʃaɽ^{h}i 'iron vessel', /sāɽ/ << *tʃaɽ 'broken earthen pieces', and /sàɽ/ << *tʃ^{h}aɽ 'let go'; /xáɽ/ << *kaɽ^{h} 'valuable wood', /xāɽ/ << *kaɽ 'cut', and /xàɽ/ << *k^{h}at 'ground stool'.

After the f0 perturbation of the prevocalic and postvocalic consonants were reanalysed as phonological tone in the language, the tone of the syllable was reinterpreted as the tone of the word. We expand our study into tonogenesis in Sylheti and propose that the pitch of the tone extends across syllables thus demonstrating a many to association between the segmental and tonal tier (Gussenhoven, 2004, p. 29) as represented in as shown in 3:

3. Multiple association between tone and syllable:



We explore this aspect of Sylheti tonogenesis in the upcoming chapter (Chapter 4), emphasising on the empirical evidence based on production and perception analysis of lexical tones in disyllabic words in the language.

3.3 Acoustic study of three-way tone contrast

In this section, we seek empirical evidence in our hypothesis that the instability of the four-way laryngeal contrast did not just map to High and Low tones based on the historical aspiration of the onset. Both voicing and syllabic positions of the consonants led to a three-way tonal contrast in Sylheti. We have avoided the redundancy of describing the tone assignment by voiced onsets, as our results reconfirmed the previous study on Sylheti tonogenesis. The words selected for this study have their diachronic laryngeal values preserved in the cognate NIA languages.

We present a production analysis of the acoustic correlates of the three-way tonal pattern in Sylheti and address the different tonal patterns conditioned by the loss of aspiration from both onsets and coda positions in the language. The analysis is based on a production experiment on monosyllabic tonal pairs and triplets in Sylheti. The dataset we used for the study has been presented in Table 3.2 which presents a wider picture of the Sylheti tonogenetic pattern and shows that voicing and aspiration resulted in different tonal patterns in the language. We present the effect of tone on pitch and duration and its role in the three-way tonal contrast.

3.3.1 Methodology: Data Collection & Recording

This dataset was prepared with the help of 7 native speakers of Sylheti language residing in the Barak Valley in the southern region of Assam state in India. Two of the speakers belonged to the age group 50-55: one male and one female; five of the speakers belonged to the 20-26 age groups: one male and four females. The data was recorded in multiple sessions. All the speakers were bilinguals in Bengali and Sylheti and had their primary education in either Bengali or English languages. The sentences with target words were displayed on a screen written in Bengali (as the speakers use Bengali script in general) along with the meaning of each word English and they were instructed to read the sentence in Sylheti. Each target word had 3 repetitions and the words were recorded within the medial position of same carrier sentences for all words with x being the target word; carrier declarative sentences of the SOV order were uttered as:

ami X xɔi-si

1st p X say-perf 1p

I said X

Since it is well established that only laryngeal features created f0 perturbation leading to the emergence of tones in Sylheti, we have selected words which have the laryngeal values preserved in the cognate (NIA) languages without any lexical tone. The dataset we used contains 30 words, consisting of 12 minimal pairs and 2 minimal triplets of CVC pattern with three iterations each (Table 3.2).

NIA	High	Gloss	NIA	Mid	Gloss	NIA	Low	Gloss
*kaʈʰ	xáʈ	valuable wood	*kaʈ	xāʈ	cut	*kʰaʈ	xàʈ	floor stool
*tʃaɽʰi	sáɽ	vessel	*tʃaɽ	sāɽ	earthen pieces	*tʃʰoɽ	sàɽ	let go
*piʈʰ	ɸíʈ	beat	*piʈ	ɸīʈ	back			
*tʃəɽʰ	sɔ́ɽ	ride	*tʃoɽ	sɔ̄ɽ	slap			
*pəɽʰ	ɸɔ́ɽ	read	*poɽ	ɸɔ̄ɽ	fall			
			*kal	xāl	bad time	*kʰal	xàl	skin
			*pal	ɸāl	animal (collective)	*pʰal	ɸàl	a jump (noun)
			*pan	ɸān	betel leaf	-	ɸàn	yam leaf
			*tʃul	sūl	hair	*tʃʰol	sùl	peel
			*koi	xɔ̄i	a fish	*kʰoi	xɔ̀i	puffed rice
			*t̪al	t̪āl	palm	*t̪ʰal	t̪àl	plate
			*kua	xūa	well	*kʰua	xùa	fog
			*kul	xūl	dynasty	*kʰul	xùl	a musical instrument
			*kal	xāl	bad time	*kʰal	xàl	drain

Table 3.2. Sylheti monosyllabic tonal pairs and triplets with voiceless onsets

We used TASCAM DR-100 digital recorder for recording at sampling frequency of 44.1 KHz and 32 bits resolution attached to a Shure head worn microphone.

3.3.2 Analysis of acoustic correlates

Each sound file was segmented and annotated on PRAAT and the f0 (in Hz) values from temporal midpoint of the rime and the f0 direction from the onset to offset of rime and duration values of the vowel of each target syllable starting from the onset until the offset of voicing of the rime were extracted with the help of a PRAAT script. The script measured the pitch contour at every 10% of the rime of each syllable. A contrastive tone does not have a fixed F0. There are variations from speaker to speaker depending on factors such as gender and age and for the same speaker depending on the mood and whether the word occurs at the start or the end of the utterance, and so on. One speakers' f0 range for low tone, for example, might thus be high tone for another speaker's range. It thus cannot be identified in isolation by pitch alone. To overcome this, pitch normalization is required to achieve a pitch difference between the tones irrespective of individual and intonational differences.

3.3.2.1 Pitch

We first analysed f0 movement by z-score normalization of the f0. The z-score value indicates the distance of the raw score from the mean. A value above the mean would indicate a positive z-score and a negative if the value lies below the mean. It allows the comparison of scores on different kinds of variables by standardizing the distribution and hence is also known as a standard score. Since f0 is best perceived in vowels and sonorants (Xu & Wang, Pitch targets and their realization: Evidence from Mandarin Chinese, 2001) it is attested in many tonal languages that the syllable rime is the only domain of tone (Gordon M. , 2001). We have thus analyzed the f0 of the rime of each target syllable at 11 consecutive points (10 intervals) starting from the onset until the offset (of rime), i.e., startpitch to endpitch (0%-100%), each interval representing 10% of the total length of the pitch – track was normalized using the z-score standardization. Each data point was transformed into a corresponding z-score via the z-score metric. The normalized f0 value (z) was calculated as the difference between the raw f0 in Hertz (F) and the mean f0 of each subject in Hertz (μ), divided by the standard deviation of the overall f0 of the same speaker (σ).

$(z = (F - \mu)/\sigma)$.

The averages of the intervals of normalized f0 values for tonal pairs and triplets were plotted to see the pitch contrast throughout the rime of the words.

We built a linear mixed effects model – lme4 (Bates et al., 2015) for f0 (Hz) from the temporal midpoint of the rhyme of each target word to analyze the direct representation of phonetic contrast between the lexical tones in pitch; we did not perform any transformations (z-scale) on this. The f0 of Vowel at Midpoint was designated as the dependent variable and the Tone was the independent variable for monosyllables. As random effects, we had intercepts for speakers and words, as well as by-speaker and by-word random slopes for the effect of tone.

```
Monosyllable.model = lme4::lmer(f0VowelMid ~ Tone + (1+Tone|Speaker)
+ (1+Tone|Word), data = Monosyllables)
```

Although care was taken to minimize external effects between recordings, it cannot be totally negated which is why the data was standardized for our next model to investigate a statistically accurate difference between the three tones. Pitch normalization was used on f0 from the temporal midpoint of the target words as the data was recorded from a sample of both male and female speakers of different age groups. Z-score normalized f0 of Vowel at Midpoint was designated as the dependent variable in this model, random factors remained unchanged.

```
Monosyllable.model = lme4::lmer(Normalizedf0VowelMid ~ Tone +
(1+Tone|Speaker) + (1+Tone|Word), data = Monosyllables)
```

Both random intercept and random slope have been considered in both the models to avoid any statistical significance retained by chance (Barr et al, 2013). We considered random intercepts as well as random slopes to prevent type-I errors (Barr et al, 2013; Bates et al, 2015) as random slope model allows the explanatory variable to have a different effect for each group. While as it allows each group line to have a different slope meaning that the explanatory variable can have a different slope for each group.

We probed further into the difference between the tones in terms of f0 direction. Ten linear mixed effects model were then built to study f0 movement of the tonal words under study. Normalized f0 values of ten interval points (10% through 100%) were entered as the dependent variable; the independent variables and the random factors remained unchanged in this model as well. An example of the 10 models is given below (for f0 from 0-10%):

```
Tone.model_Int10 <- lme4::lmer(f0Normalized ~ Tone + (1 + Tone|Word)
+ (1 + Tone|Speaker), data = subset(Monosyllables, Intervals ==
"Int10"), REML = FALSE.
```

3.3.2.2 Duration

Studies on the acoustic correlates of tone have shown that duration has an inverse relationship with the tone, i.e., the High tone will have the shortest duration among the three syllables under study (Gill & Gleason, 1969; Khan, Xu and Sohail 2020; Xu 1997). We also measured the raw values of duration (in milliseconds) for each target syllable to analyze the possibility of acoustic multidimensionality of tone in the language. A model for duration contrast between the tones was built for monosyllables, changing the dependent variable to duration, and keeping the independent variables and random factors the same as the pitch models.

```
Duration.model= lme4::lmer(Duration ~ Tone + (1+Tone|Speaker) +
(1=Tone|Word), data = Monosyllables)
```

Random intercept and random slope were considered for all these models. ANOVA tests were run for all the models which compared the full model and a null model with likelihood ratio tests (Akiva et al., 1986). The statistical significance of all the ANOVA tests was examined with an alpha level of 0.05.

3.3.3 Results

A careful observation of the line graphs from figure 3.5 – figure 3.12 representing the f0 movements shows that the words with diachronic aspiration on the onset position map to a low tonal contour, the words with unaspirated onset or coda map to a medial tonal contour and words with diachronically aspirated coda map to high tonal contour. The y-axis in the pitch plots in Figure 3.5 represents the normalized pitch and the x-axis represents the time - interval at eleven consecutive points of the vowel. The figure plots the f0 difference for the minimal triplet for the High, Mid and Low contrast, /xáʈ/ << *kaʈʰ 'valuable wood', /xāʈ/ << *kaʈ 'cut', and /xàʈ/ << * kʰaʈ 'ground-stool'.

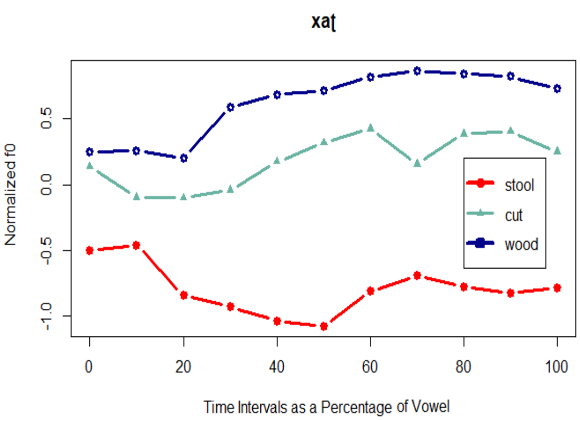


Figure 3.5: Normalized f0 interval contrast for the High - Mid - Low contrast for the tone triplet /xáʈ/ 'valuable wood' /xāʈ/ 'cut' and /xàʈ/ 'ground-stool'.

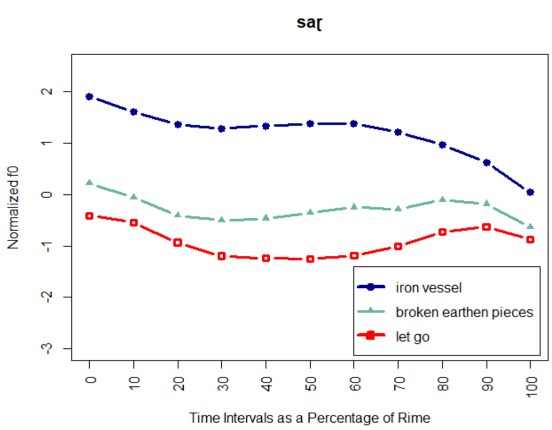


Figure 3.6: Normalized f0 interval contrast for the High - Mid - Low contrast for the tone triplet /sáɽ/ 'iron vessel' /sāɽ/ 'broken earthen pieces' and /sàɽ/ 'let go'.

Figure 3.6 plots the f0 difference for the minimal triplet /sáɽ/ << *tʃaɽʰi 'iron vessel', /sāɽ/ << *tʃaɽ 'broken earthen pieces', and /sàɽ/ << *tʃʰaɽ 'let go' throughout the rime. It is evident in both the tonal triplets that the loss of aspiration from the coda position led to the lexical High tone in Sylheti and the merger of aspirated and unaspirated voiceless consonants led to the Mid-Low lexical tone contrast.

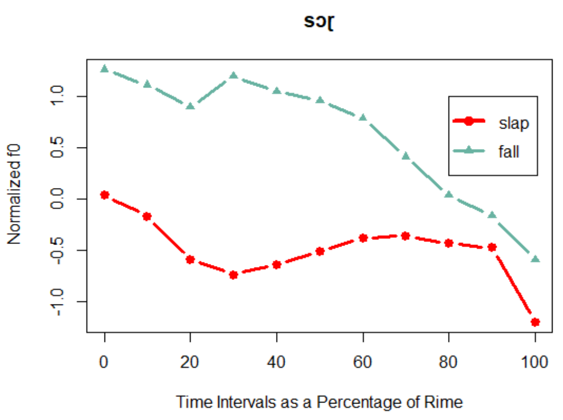


Figure 3.7: Normalized f0 interval contrast for the High-Mid contrast for the tone pair /sɔ́ɽ/ 'ride' and /sɔ̄ɽ/ 'slap'.

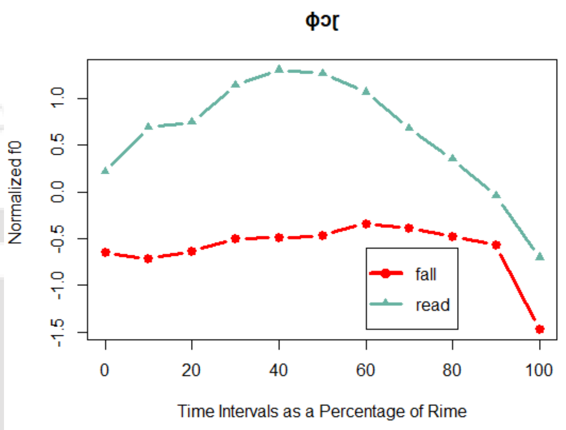


Figure 3.8: Normalized f0 interval contrast for the High-Mid contrast for the tone pair /ɸɔ́ɽ/ 'read' and /ɸɔ̄ɽ/ 'fall'.

The y-axis in the pitch plots in Figures 3.7 and 3.8 represent the normalized pitch and the x-axis represents the time - interval at eleven consecutive points of the rime for High-Mid tone pairs resulted by the merger of aspirated and unaspirated codas. The graph in figure 3.7 shows the clear difference between the f0 of High-Mid tonal pair for the minimal pair /sɔ́ɽ/ << *tʃəɽ 'ride' and /sɔ̄ɽ/ << *tʃoɽ 'slap'. Figure 3.8 plots the minimal pair /ɸɔ́ɽ/ << *pəɽʰ 'read' and /ɸɔ̄ɽ/ << *poɽ 'fall' which show similar f0 difference between High and Mid tones throughout the rime.

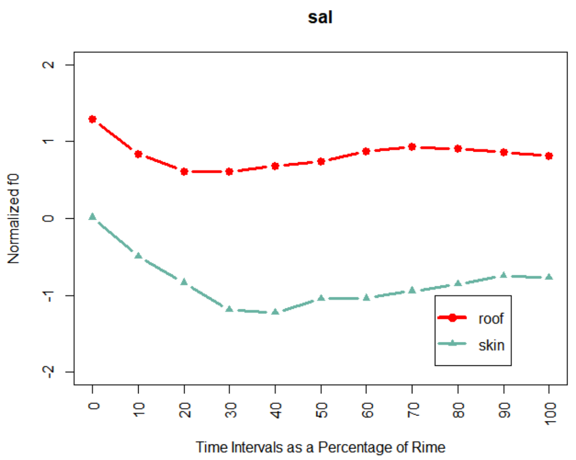


Figure 3.9: Normalized f0 interval contrast for the Mid - Low contrast for the tone pair /sāl/ ‘roof’ and /sàl/ ‘skin’.

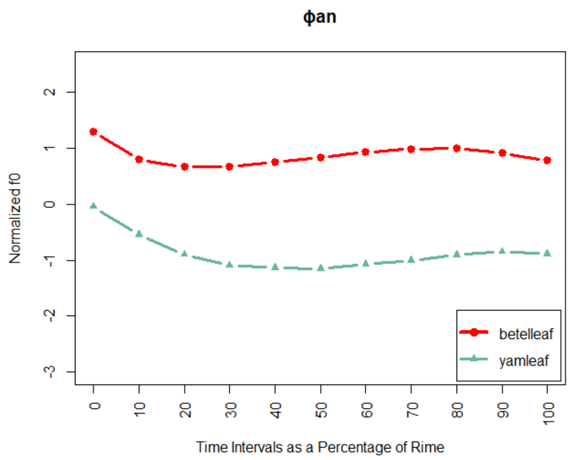


Figure 3.10: Normalized f0 interval contrast for the Mid - Low contrast for the tone pair /ɸān/ ‘betel-leaf’ and /ɸàn/ ‘yam-leaf’.

Figure 3.9 and Figure 3.10 plot the f0 directions for the Mid-Low minimal pairs resulted from the merger of aspirated and unaspirated voiceless onsets. Figure 3.9 plots the minimal pair /sāl/ << *tʃal ‘roof’ and /sàl/ << *tʃ^{h}al ‘skin’ demonstrating the f0 difference between Mid-Low tones throughout the rime. A similar pattern can be noticed for the Mid-Low tonal pair in Figure 3.10 for ɸān << *pan ‘betel-leaf’ and ɸàn << *p^{h}an ‘yam-leaf’.

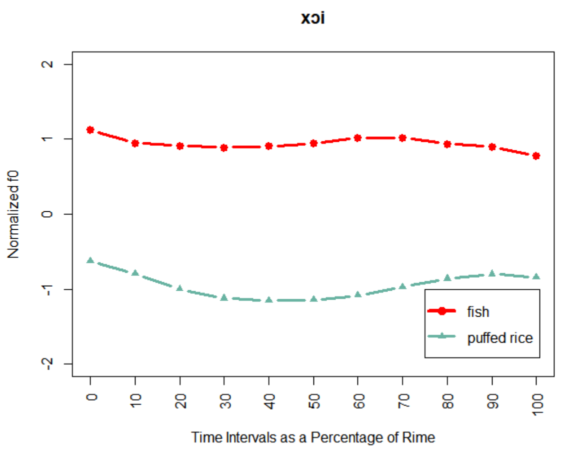


Figure 3.11: Normalized f0 interval contrast for the Mid - Low contrast for the tone pair /xɔ̄i/ ‘fish’ and /xɔ̀i/ ‘puffed rice’.

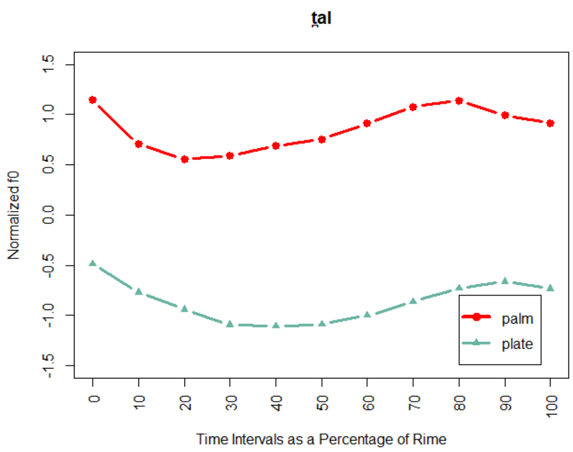


Figure 3.12: Normalized f0 interval contrast for the Mid - Low contrast for the tone pair /t̪āl/ ‘palm’ and /tàl/ ‘skin’.

Similar patterns can be observed for the f0 directions of Mid-Low minimal pairs resulted from the merger of aspirated and unaspirated voiceless onsets in figure 3.11, /xɔ̄i/ << *koi ‘fish’ and /xɔ̀i/ << *k^{h}oi ‘puffed rice’ and in in figure 3.12, /t̪āl/ << *t̪al ‘palm’ and /t̪àl/ << *t̪^{h}al ‘plate’.

3.3.3.1 Statistical significance

The fixed effects results for vowel mid f0 in Table 3.3 shows the distinction between the f0 of the intercept which represents the Mid and the Low tone. The intercept was about 222.301 Hz which represents the Mid tone. The low tone was lower by about 52.475 Hz than the Mid tone and the High tone is higher by only about 5 Hz; the t value for the High tone shows that there is a lack of significant contrast between the Mid and High tones. Tone thus affected pitch ($\chi2$ (1) = 9.4948, DF = 1, p = 0.002061).

	Fixed Effects	Estimate	Std. Error	t value
Mid Vowel f0	Intercept	222.301	20.219	10.995
(Normalized)	High Tone	5.793	19.438	0.298
	Low Tone	-52.475	12.443	-4.217

Table 3.3. Fixed effects for mid vowel f0 contrast between High, Mid and Low tones for monosyllables

In the boxplot in Figure 3.13, the y axis plots pitch in Hz and the x axis plots the tones under study. The boxplot demonstrates the distinction between the median values of the direct f0 (non-normalized and without the speaker and item variations); it plots the effect of mid vowel f0 on tone and shows the contrast between the High and Mid and High and Low tones. A phonetic overlap between the High and Mid tones is evident here.

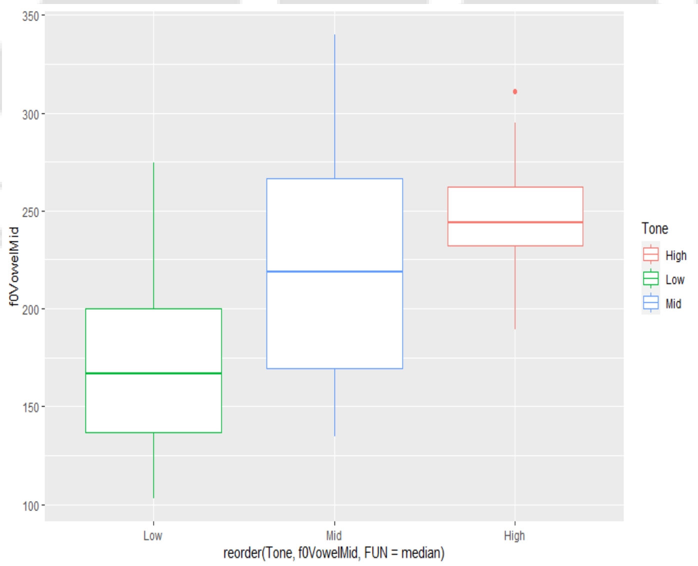


Figure 3.13. Boxplot of mid vowel f0 contrast between High, Mid and Low tones

The fixed effects results for z-score normalized vowel mid f0 in Table 3.4 shows a clear distinction between the Mid tone and the Low tone. The t-value for the High tone shows that there is a lack of significant contrast between the Mid and High tones here as well. The intercept was about 0.62496 which represents the Mid tone. Tone thus affected pitch ($\chi 2$ (1) = 14.857, DF = 1, P value = .000116).

	Fixed Effects	Estimate	Std. Error	t value
Mid Vowel f0	Intercept	0.6477	0.1751	3.698
(Normalized)	High Tone	0.1429	0.2207	0.648
	Low Tone	-1.2028	0.2676	-4.495

Table 3.4. Fixed effects for normalized mid vowel f0 contrast between High, Mid and Low tones for monosyllables

There was a phonetic overlap between the Mid tone and the High tone. This could be attributed probably due to the lack of tokens for the High tone. This can be visualized in the boxplot in Figure 3.14, the y-axis plots pitch in Hz and the x-axis plots the three tones.

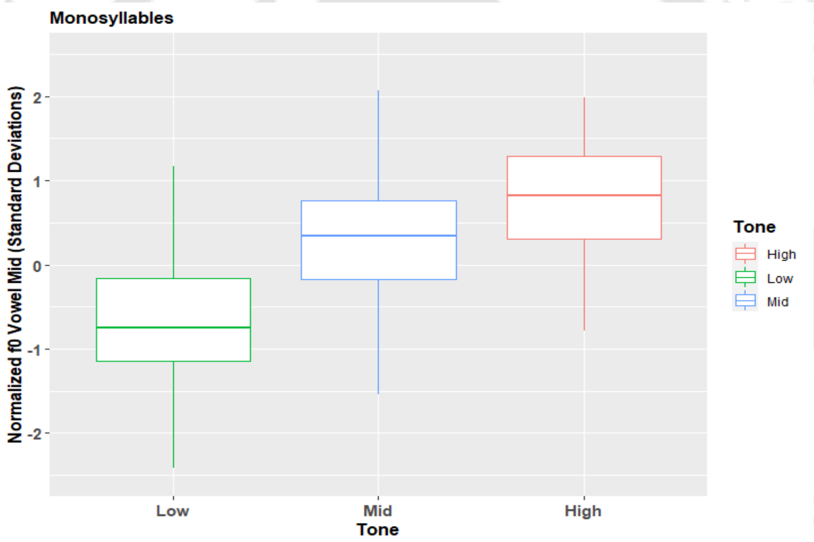


Figure 3.14 Boxplot of normalized mid vowel f0 contrast between High, Mid and Low tones

The sample size for the High tone probably acted as a deterrent here. The scope of this experiment was thus scarce for a significant study of three-way tone contrast for monosyllables. The significance of the difference between the Mid and Low tones and the lack of significant difference between High and Mid tones can be visualized in Figure 3.15 which plots the results of the mixed effects. The y - axis in the figure shows the degree of significance of the difference of the Low and High tones with the Mid tone which is the intercept (as shown in Table 3.4).

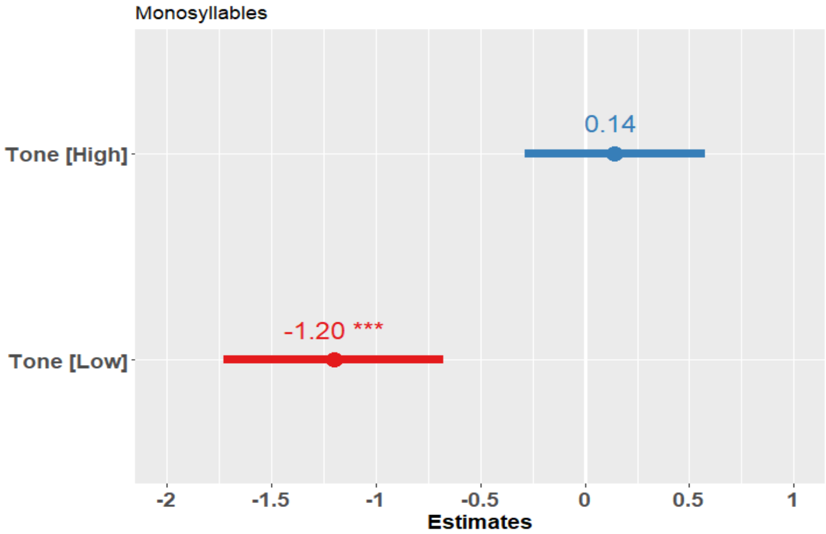


Figure 3.15 Estimates (Fixed Effects) plot for contrast between High, Mid and Low tones for monosyllables

The asterisks on the value for Low tone in the figure indicate the high significance level.[11] The difference between the three tones is visualized in the boxplot below (Figure 2) showing the significance of difference between the Mid and Low tones and the overlap between the High and Mid tones. The predictions for random slope model has been plotted in figure 3.16.

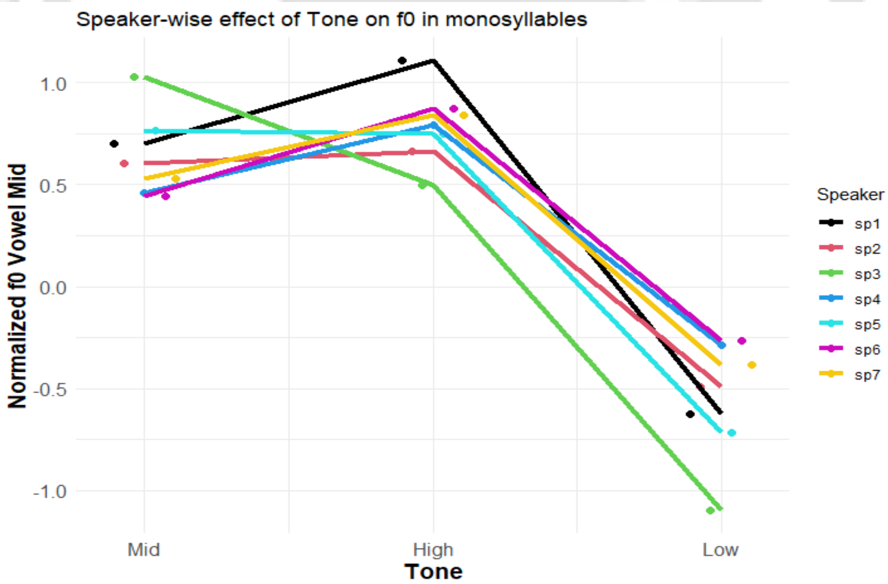


Figure 3.16. Predictions for the speaker-wise slope of the effect of Tone on pitch in monosyllables.

The predictions for the random slope model for vowel mid f0 show that the slope between Mid tone and High tone is positive for some speakers while for others, the slope between Mid tone

[11] The asterisks following the values in the figure show the level of their statistical significance. '***' 0.001 '**' 0.01 '*' 0.05.

and High tone is zero or negative. There is clearly an interspeaker variability for the three tones in monosyllables. There is, however, a clear distinction between High and Low tones for all the speakers.

Our ANOVA results for f0 direction of the ten interval points show that tone is affecting pitch for each of the intervals (Interval 10 : $\chi 2$ (1) = 5.0669, DF = 1, p = .024387; interval 20 : $\chi 2$ (1) = 11.876, DF = 1, p = .000569; interval 30 : $\chi 2$ (1) = 16.826, DF = 1, p = .000041; interval 40 : $\chi 2$ (1) = 18.082, DF = 1, p = .000021; interval 50 : $\chi 2$ (1) = 16.575, DF = 1, p = .000047; interval 60 : $\chi 2$ (1) = 16.197, DF = 1, p = .000057; interval 70 : $\chi 2$ (1) = 15.835, DF = 1, p = .000069; interval 80 : $\chi 2$ (1) = 26.894, DF = 1, p = <.00001; interval 90 : $\chi 2$ (1) = 14.405, DF = 1, p = .000147; interval 100 : $\chi 2$ (1) = 23.98, DF = 1, p = <.00001). However, the High tone has a phonetic overlap with both the Mid and Low tones which can be observed in the t-values in Table 3.5.

Interval	**Fixed Effects**	**Estimate**	**Std. Error**	**t value**
Interval 10	Intercept	0.40757	0.19691	2.07
	High Tone	0.01086	0.35566	0.031
	Low Tone	-0.89706	0.22944	-3.91
Interval 20	Intercept	0.38775	0.19404	1.998
	High Tone	0.09456	0.3434	0.275
	Low Tone	-1.04429	0.23202	-4.501
Interval 30	Intercept	0.415	0.1876	2.212
	High Tone	0.2025	0.3461	0.585
	Low Tone	-1.2038	0.2202	-5.467
Interval 40	Intercept	0.4396	0.1766	2.49
	High Tone	0.1603	0.3394	0.472
	Low Tone	-1.2879	0.2101	-6.131
Interval 50	Intercept	0.4575	0.1707	2.68
	High Tone	0.1601	0.3364	0.476
	Low Tone	-1.3145	0.2131	-6.169
Interval 60	Intercept	0.4941	0.1695	2.915
	High Tone	0.1372	0.3275	0.419
	Low Tone	-1.3331	0.2165	-6.158

Interval	Fixed Effects	Estimate	Std. Error	t value
Interval 70	Intercept	0.51836	0.17096	3.032
	High Tone	0.09841	0.33019	0.298
	Low Tone	-1.30772	0.22225	-5.884
Interval 80	Intercept	0.52222	0.16375	3.189
	High Tone	0.03617	0.32985	0.11
	Low Tone	-1.24067	0.22179	-5.594
Interval 90	Intercept	0.46058	0.17648	2.61
	High Tone	0.07038	0.34554	0.204
	Low Tone	-1.11528	0.22443	-4.969
Interval 100	Intercept	0.3945	0.163	2.421
	High Tone	0.2021	0.3497	0.578
	Low Tone	-1.0319	0.2118	-4.871

Table 3.5 Fixed effects of normalized f0 interval contrast between the three tones for Monosyllables

The boxplot in Figure 3.17 shows the statistical contrast for normalized pitch between the High, Mid, and Low tones for monosyllables. An overlap between the High and Mid and High and Low tones is clearly visible in these f0 intervals; the overlap between the High and Low tones is suggestive of the lack of sample size for the High tone.

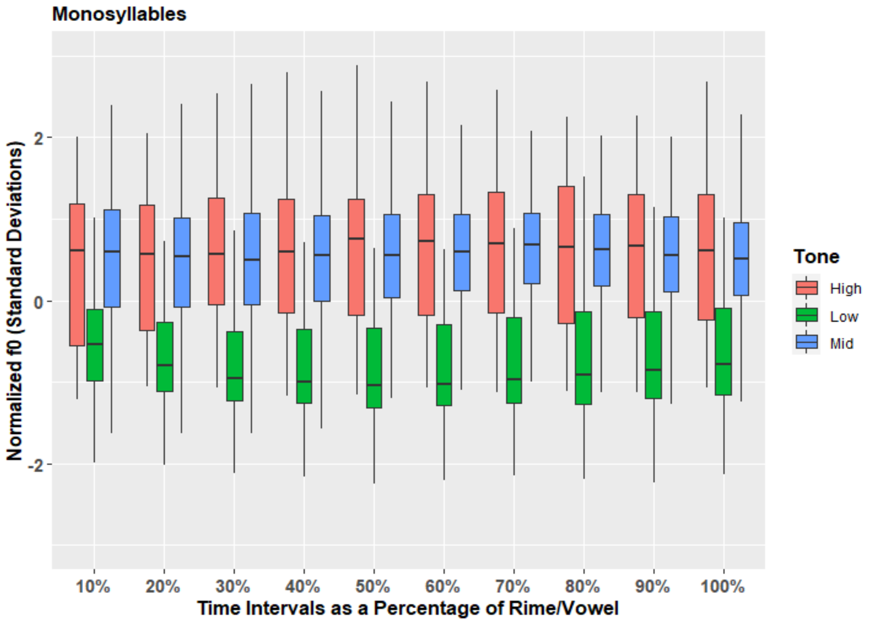


Figure 3.17. Boxplot of normalized f0 intervals for the High, Mid and Low contrast for monosyllables

We did not find a significant difference for duration between the tones ($\chi2$ (1) = 3.4126, DF = 2, p = .181536). The Intercept was about 231.75 milliseconds which represents the Mid tone ; the High tone was lengthened by about 50.46 milliseconds than the Mid tone and the Low tone was negligibly shorter by only about 9.22 milliseconds than the Mid tone as shown in Table 6.

	Fixed Effects	Estimate	Std. Error	t value
	Intercept	231.75	11.10	20.871
Duration	High Tone	50.46	27.61	1.828
	Low Tone	-9.22	15.14	-0.609

Table 3.6. Fixed effects for duration contrast between High, Mid and Low tones for monosyllables

Although the duration is lengthened for the High tone, it cannot be considered as a cue for tonal contrast as the t value minimally deviates from the mean. For a clearer perspective on the duration contrast between the lexical tones, we further conducted a test for disyllables in the study.

3.4 Discussion and Conclusion

Our analysis establishes our hypothesis that the merger of historical voiceless aspirated and unaspirated voiceless onsets resulted in the Mid-Low lexical tone contrast in Sylheti. It is evident that the language has a contrast between the High, Mid, and Low tones in the monosyllabic words. However, the lack of statistically significant results for f0 and duration leads to the conclusion that perhaps there are other cues distinguished. As stated in section 3.1.1, Gope and Mahanta (2016) showed that the High tone is associated with marginal creakiness whereas the Low tone seemed modal. Although the previous study did not find a conclusive relationship between phonation and tone for all the speakers, a detailed analysis of the monosyllables on the tonogenesis of Sylheti with emphasis on voice quality and prosodic factors like, rhythm and stress may lead to further understanding of the fine-grained tonal system in Sylheti. The existence of significant contrast for the three tones in disyllables (chapter 4) also suggests that among other factors, the lack of significant contrast in monosyllables is a result of the very small sample size for High tones.

Our results contributes to the typological aspect of tonogenesis. Our discussion on the interaction between tone and consonant showed how tonogenesis is the outcome of the reanalysis of f0 perturbations induced by the prevocalic or postvocalic consonants. These perturbations are primarily the correlated to the physiological configuration of the larynx and are generally widely attested across languages. However the previous study on the tonogenetic patterns of Sylheti demonstrates that the association of breathy stops is not limited to a low tone, as Gope (2016) shows that in contrast to the tonogenetic patterns associated with Punjabi breathy stops diachronic aspirated voiced stops in Sylheti rather mapped to the lexical High tone. Our analysis in this chapter demonstrates that tonogenesis triggered by diachronic aspirated voiceless obstruents rather associated to a Low tone which differs from the crosslinguistic evidence of a rise in pitch induced by the aspirated voiceless stops. This difference can also be attributed to the complicated laryngeal system of the Indo-Aryan languages; Gope (2021) shows that the vowels following diachronic voiced obstruents exhibit a breathy feature. Dutta (2007; 2014) shows that voiced aspirated stops in Hindi are produced with an independent phonation mode, and a breathy release of the voiced aspirated stop spreads distinctively throughout the duration of the following vowel. Segmental studies on Gujrati, another Indo-Aryan language, have shown the breathiness in voiced aspirated stops is realized on the following vowel (Pandit, 1957; Fischer-Jørgensen, 1967; Khan, 2012). The unique feature of the association of breathy phonation with voiced aspirates of NIA lnaguges (Ohala & Ohala, 1972) could be attributed as a marked feature which led the native speakers of Sylheti to reinterpret the association of the f0 perturbation induced by breathy obstruents to the marked High tone. The association of the diachronic aspirated voiceless aspirates could be rather associated with the inherent low f0 perturbations induced by the sound in NIA languages as discussed earlier in this chapter.

It may be noteworthy to consider the potential variability in the production of the mid tone. Upon closer scrutiny of our findings, a noticeable trend emerges: when contrasted with a high tone, the mid tone exhibits a considerably lower pitch compared to when it contrasts only with a low tone. This pattern may hint at a certain degree of ambiguity in the mid tone's status, contingent on the number of occurring contrasts. The normalized f0 intervals representing the contrast for the lexical tones in section 3.3.3 seem to substantiate this possibility. The lack of a significant finding for the monosyllables could possibly be linked to the substantial variability of mid tones. This might lead us to posit that they are not necessarily 'mid' but rather tonally unmarked, suggesting a contrast of High, Unmarked, and Low (H-Ø-L) instead. This discussion highlights the phonological universality of the Mid tone as the default tone. which will be explored in Chapter 4 which presents a wider picture of the typological aspect of Sylheti tonogenesis.

Chapter 4

The three-way tonal contrast in Sylheti: Disyllables

General Introduction: Typology of tone languages

Tonal languages differ in terms of the number of tonal contrasts which syllables may support (Clark 1983; Hyman 1988). While some languages only support a constant pitch height, some also support a changing pitch height such as a rising or a falling tone. Languages like Halkomelem (Upriver) for example, can have only contrastive level tones (Galloway, 1991):

a. q^{w}á:l (High tone) *'mosquito'*
b. q^{w}à:l (Low tone) *'to speak'*

There are languages in which some tones appear to be contours and may span over syllables but may be phonologically level (Yip, 2002). In contour tone languages pitch change may have a contrastive function within a syllable (Zhang, 2002) as in languages like Kuki-Thaadow, where contrastive contours are present in the minimal permissible tone bearing unit (Hyman 2007):

a. sâa (Falling tone) *'animal'*
b. sǎa (Rising tone) *'hot'*

The major difference between tone languages is in tone-bearing units which can be defined as individual landing sites to which the tones anchor (Hyman & Leben, 2017). Tone systems can vary primarily in terms of the number of contrasts in tone height and in their choice of tone-bearing unit (Clark, 1983; Hyman, 1978; Hyman & Leben, 2020). Matisoff (1973) observes that a major feature of truly tonal language is that these languages are mostly monosyllabic in nature and thus syllable is the tone-bearing unit in these languages. The chapter thus expands our investigation into the tonogenesis of three-way tonal contrast in Sylheti disyllables to attain a wider picture of the typological aspect of tonogenesis in the language for the first time. It analyzes the tone-bearing unit, or more precisely the landing site of tone in Sylheti by investigating the behavior of tone in its disyllabic words. As we had established in the previous chapter, Sylheti has a phonological contrast of three level tones in monosyllables. We seek empirical evidence for the minimal tone-bearing unit in this chapter by studying the behavior of tone in disyllables. The chapter establishes that Sylheti disyllables exhibit three lexical tones and that the tones vary individually in their behavior of pitch in their second syllables. Pitch serves as the significant acoustic correlate of tone in disyllables as well. We analyze the phonological contrast between the High, Mid, and Low tones in Sylheti disyllables from a tonogenetic perspective and seek empirical evidence for phonological contrast between the three tones in disyllables which resulted from the instability of the four-way laryngeal contrast. We establish that, the diachronic forms of the consonants and their syllabic positions also had a role in disyllables which resulted in the three-way tone contrast in Sylheti.

We have used the synchronic cognate NIA words in this chapter as well to present the reflexes of the diachronic aspirated forms of the words under study. We argue in this chapter that the diachronic merger of aspirated and unaspirated onsets led to a Mid-Low tone contrast in Sylheti disyllables whereas the merger of aspirated and unaspirated medial consonants led to the High and Mid tone contrast in the language, subsequently resulting in minimal tone triplets like /xúʈá/ *'room'*, /xūʈā/ *'crooked stick'* and /xùʈà/ *'taunt'*. We study both production and perception to investigate the tonal distribution in Sylheti disyllables with a special focus on the production test. As stated in chapter 3, we have avoided the redundancy of analyzing words with voiced onsets and have probed only into words that have voiceless onsets in disyllables as well.

The structure of the chapter is as follows: 4.1 describes the three-way tonal system of Sylheti with attention to the tonogenetic factors in Sylheti disyllables. The section further divides itself into a detailed acoustic analysis of the production test done on three tones in disyllables and analyses the results to summarize the tonal characteristics and tone assignment in Sylheti disyllables. 4.2 presents an elementary analysis of our perception test in Sylheti disyllables and discusses the results. 4.3 discusses both the production and perception results and concludes with the possibility of the presence of a neutral tone in Sylheti.

4.1 Three-way contrast in disyllables: the tonogenesis

It has been established in the previous chapter that the historical aspirated voiceless onsets resulted in a lexical Low tone, and the historical aspirated coda led to a lexical High tone in Sylheti. When we expanded our studies to disyllables, we found that, while the emergence of Low-Mid contrast resulted from the merger of diachronic aspirated and unaspirated voiceless onsets, tonogenesis of the High tone in monosyllabic and disyllabic words has different syllabic origins in the language. In the case of monosyllables, the High tone emerged from the merger of aspirated and unaspirated codas as in the tone pair, /ɸɔ́ʈ/ << *pɔʈ^h *'read'* and ɸɔ̄ʈ << *poʈ *'fall'*; whereas in disyllables, the same tone emerged from the merger of aspirated and unaspirated medial consonants as shown in the tone pair, /ɸúʈ̪í/ << *pũʈ̪^{h}i *'manuscript'* and /ɸūʈ̪ī/ << *pũʈ̪i *'bead'* in Table 4.1. The merger of initial and medial consonants thus subsequently led to minimal triplets in disyllables as well as in the triplet /ɸáʈá/ << *paʈʈ^{h}a *'buck goat'*; /ɸāʈā/ << *paʈʈa *'grindstone'*; /ɸàʈà/ << *pʰɘʈa *'crack'*. It can be observed that the historical voiceless obstruent onsets led to a lexical Low tone, for example, in /ɸàʈà/ << *pʰɘʈa *'crack'*; historical unaspirated voiceless onsets led to a lexical Mid tone as in /ɸāʈā/ << *paʈʈa *'grindstone'*; the High tone was conditioned by the historical aspirated word medial consonant rather than the coda as in medial consonant, and led to the lexical High tone as in the disyllabic word, /ɸáʈá/ << *paʈʈʰa *'buck goat'* (Table 4.1).

NIA	High	Gloss	NIA	Mid	Gloss	NIA	Low	Gloss
*paʈʈʰa	ɸáʈá	buck goat	*paʈʈa	ɸāʈā	grindstone	*pʰɘʈa	ɸàʈà	crack
*koʃʈʰa	xúʈá	room	*kuʈa	xūʈā	crooked stick	*kʰuʈʈa	xùʈà	taunt
*pũʈʰi	ɸúʈí	manuscript	*pũʈi	ɸūʈī	bead			
			*tʃaʈʈa	sāʈā	earthen	*tʃʰiʈ	sàʈà	eccentricity
*kaʃʈʰa	xáʈí	small stick				*kʰãnʈi	xàʈì	pure

Table 4.1 Disyllabic tonal triplets in Sylheti

We hypothesize that, the aspirated coda which conditioned the lexical High tone in monosyllables was re-analyzed in disyllables and thus, it was the diachronic aspirated medial consonant that conditioned the High tone in these words. This chapter thus contributes to our understanding of the prosodic typology of Sylheti. Our analysis for the three-way tone contrast is Sylheti presents more explicit acoustic results in disyllabic words, than that in monosyllabic words as the language has a large distribution of minimal pairs and triplets for the High tone in disyllabic structures (Table 4.2). A plausible explanation for this could be that in open syllabic structures, the phonetic realization of aspiration was not constrained. In the next section, we seek to conduct an acoustic analysis for the three-way tone contrast in Sylheti disyllables. We explicitly aim to seek empirical evidence for our hypothesis that when in the word-initial position, the loss of diachronic aspiration from voiceless obstruents conditioned a Low tone, and in the word-medial position, the loss of diachronic aspiration conditioned a High tone in disyllables.

4.1.1 Acoustic analysis of production test

This section presents a production analysis of the acoustic correlates of the three-way tonal pattern in Sylheti disyllables. We analyze the contrastive tones conditioned by the diachronic aspiration from both initial and medial positions in disyllables. The analysis is based on a production experiment on disyllabic tonal pairs and triplets in Sylheti. The dataset we used for the study has been presented in Table 4.2 which presents an explicit pattern of the three-way tonal contrast in Sylheti, with a significant inventory as compared to that of monosyllables. We present the effect of tone on pitch and duration and its role in the three-way tonal contrast.

4.1.1.1 Methodology: Data Collection and Recording

We have considered a set of controlled phonetic experiments for this study which investigated a production analysis for a set of Sylheti disyllabic words for the three-way tonal contrast. This dataset was prepared with the help of 7 native speakers of Sylheti residing in the Barak Valley in the southern region of Assam state in India. Two of the speakers belonged to the age group of 50-55: one male and one female; five of the speakers belonged to the 20-26 age group: one male and four females. All the speakers were bilinguals in Bengali and Sylheti and had their primary education in either Bengali or English languages. The sentences with target words were displayed on a screen written in Bengali (as the speakers use Bengali script in general), along with the meaning of each word in English, and they were instructed to read the sentence in Sylheti. Each target word had 3 repetitions and the words were recorded within the medial position of the same carrier sentences for all words with x being the target word; carrier declarative sentences of the SOV order were uttered as:

ami   X   xɔi-si
1st p   X   say-perf 1p
I said X

We have selected words that have the laryngeal values preserved in the cognate NIA languages, from the online dictionaries mentioned in the previous chapter (Bahri,1989; Bhattacarya, 2003; Biswas, 1970; Turner, 1962) without any lexical tone. The dataset we used contains 58 words, consisting of 4 minimal triplets, 2 near minimal triplets, and 20 minimal pairs of CVCV syllabic patterns in three iterations each as shown in Table 4.2.

NIA	High	Gloss	NIA	Mid	Gloss	NIA	Low	Gloss
*paʈʈʰa:	ɸáʈá	buck goat	*paʈʈa	ɸāʈā	grindstone	*pʰəʈa:	ɸàʈà	crack
*koʃʈʰa	xúʈá	room	*kuʈa	xūʈā	crooked stick	*kʰuʈʈa	xùʈà	taunt
*pãnkʰa	ɸáxá	wing	*pəka:	ɸāxā	ripe	*pʰãka:	ɸàxà	empty
*tʃiʈʈʰa	síʈá	list	*tʃikʈə	sīʈā	crude sticky jaggery	*tʃʰiʈa	sìʈà	droplets
*kãʈ̪ʰa:	xáʈ̪á	blanket	*kãʈ̪a	xāʈ̪ā	thorn	*kʰaʈ̪a	xàʈ̪à	copy
*piʈ̪ʰa:	ɸíʈ̪á	sweet pie	*piʈ̪a:	ɸīʈ̪ā	beating	*pʰiʈ̪a:	ɸìʈ̪à	ribbon
*pũʈ̪ʰi	ɸúʈ̪í	manuscript	*pũʈ̪i	ɸūʈ̪ī	bead			
*pãnʈʰi	ɸaʈi	nanny goat	*pa:ʈi	ɸaʈi	mat			
*tʃulʰa	súlá	stove				-	sùlà	scrubber
*kaʃʈʰa	xáʈí	small stick				*kʰãnʈi	xàʈi	pure
*pãnkʰi	ɸákí	bird				*pʰãms	ɸàkì	knot
—	xúɸá	misfortune				*kʰõpa	xùɸà	hair bun
			*kela:	xɔ̄lā	banana	*kʰola	xɔ̀là	stream bed
			*tʃaɽai	sɔ̄ɽā	sparrow	*tʃʰoɽa	sɔ̀ɽà	stream
			*ʈaka:	ʈɛ̄xā	money	*ʈʰeka	ʈɛ̀xà	contract
			*ʈoɽa	ʈūɽā	bunch of flower	*ʈʰoɽa:	ʈùɽà	little
			*tʃaʈʈa	sāʈā	earthen candle	*tʃʰiʈ	sàʈà	eccentricity
			*tʃaurja	sūrī	theft	*tʃʰuri	sùrì	knife
			*ka:ɳi	xānī	blind of one eye (FEM)	*kʰa:na:	xànì	food
			*tʃəna:	sānā	chickpea	*tʃʰa:na:	sànà	cottage cheese
			*kətʃtʃa	xāsā	raw	*kʰãtʃa	xàsà	cage

NIA	High	Gloss	NIA	Mid	Gloss	NIA	Low	Gloss
			*qəbra	xɔ̄bɔ̄r	grave	*k^həbər	xɔ̀bɔ̀r	news
			*ka:li:	xālī	ink	*k^ha:li:	xàlì	empty
			*kotʃuri	water	*phena	ɸɛ̀nà	foam	*kotʃuri
			pa:na:	ɸɛ̄nā	Hyacinth			
			*tʃikka	sīkā	muskrat	*$tʃ^h$ikkja	sìkà	sling rope

Table 4.2. Sylheti disyllabic tonal pairs and triplets with voiceless onsets

We used TASCAM DR-100 digital recorder for recording at a sampling frequency of 44.1 KHz and 32 bits resolution attached to a Shure head-worn microphone.

4.1.1.2 Analysis

Each sound file was segmented and annotated on PRAAT and the f0 and duration values of the vowel of each target syllable starting from the onset until the offset of voicing of the rime were extracted with the help of a PRAAT script. We first analyzed the f0 movement by z-score normalization of the f0. A z-score value describes the position of a raw score, in terms of its distance from the mean. A value above the mean would indicate a positive z-score value and a negative if the value lies below the mean. It allows the comparison of scores on different kinds of variables by standardizing the distribution and hence is also known as a standard score. Since f0 is best perceived in vowels and sonorants (Xu & Wang, 2001), it is attested in many tonal languages that the syllable rime is the only domain of tone (Gordon, 2001). We have thus analyzed the f0 of the rime of each target syllable at 11 consecutive points (10 intervals) starting from the onset until the offset (of rime), i.e., startpitch to endpitch (0%-100%), each interval representing 10% of the total length of the pitch-track was normalized using the z-score standardization. Each data point was transformed into a corresponding z-score via the z-score metric. The normalized f0 value (z) was calculated as the difference between the raw f0 in Hertz (F) and the mean f0 of each subject in Hertz (μ), divided by the standard deviation of the overall f0 of the same speaker (σ).

$(z = (F- \mu)/\sigma)$.

The averages of the intervals of normalized f0 values for tonal pairs and triplets were plotted (for all the 7 speakers) to see the pitch contrast throughout the rime of the words.

We analysed the raw output of f0 at the temporal mid-point of each target syllable of the disyllabic words under study. A linear mixed effects model – lme4 (Bates et al., 2015) was built for pitch. As we seek to investigate into the tonal targets in disyllables, we built a mixed effects model for disyllables as well, where Tone and Syllable (with interaction term) were measured as independent variables. The f0 of Vowel at Midpoint was designated as the dependent variable. As random effects, we had intercepts for speakers and words, as well as by-speaker and by-word random slopes for the effect of tone.

```
Disyllable.model= lme4:: lmer(f0vowelmid ~ Tone*Syllable +
(1+Tone|Speaker) + (1+Tone|Word), data = Disyllables).
```

Our next model analysed the z-score normalized f0 (Hz) from the temporal midpoint of the vowel/rime of each target syllable to probe into the phonetic contrast between the lexical tones in terms of pitch. Z-score normalized f0 of Vowel at midpoint was designated as the dependent variable in this model, random factors remained unchanged.

```
Disyllable.model= lme4:: lmer(Normalizedf0VowelMid ~ Tone*Syllable +
(1+Tone|Speaker) + (1+Tone|Word), data = Disyllables).
```

Both random intercept and random slope have been considered in both the models for disyllables as well.

Ten linear mixed effects model were then built to study f0 movement for disyllabic words under study. Normalized f0 values of ten interval points (10% through 100%) were entered as the dependent variable; the independent variables and the random factors remained unchanged.

```
Tone.model_Int10 <- lme4::lmer(f0Normalized ~ Tone + (1 + Tone|Word)
+ (1 + Tone|Speaker), data = subset(Disyllables, Intervals ==
"Int10"), REML = FALSE).
```

A model for duration contrast between the tones was built. Duration and Syllable (with interaction term) was designated as the dependent variable; the independent variables and random factors were the same as the pitch models.

```
Duration.model= lme4::lmer(Duration ~ Tone*Syllable + (1+Tone|Speaker)
+ (1=Tone|Word), data = Disyllables)
```

ANOVA tests were run for all the models which compared the full model and a null model with likelihood ratio tests (Akiva et al., 1986). The statistical significance of all the ANOVA tests was examined with an alpha level of 0.05.

4.1.1.3 Results

A careful observation of the line graphs representing the f0 movements shows, that the words with diachronic aspiration on the onset position map to a low tonal contour, the words with unaspirated onset or coda map to a medial tonal contour, and words with diachronically aspirated coda map to high tonal contour. The y-axis in the pitch plots in figures 4.1 – figure 4.10 represents the normalized pitch and the x-axis represents the time - interval at eleven consecutive points of the vowel. The normalized interval pitch contours of disyllables, showed a clear pitch variation for the three tones as plotted in Figures 4.1 and 4.2.

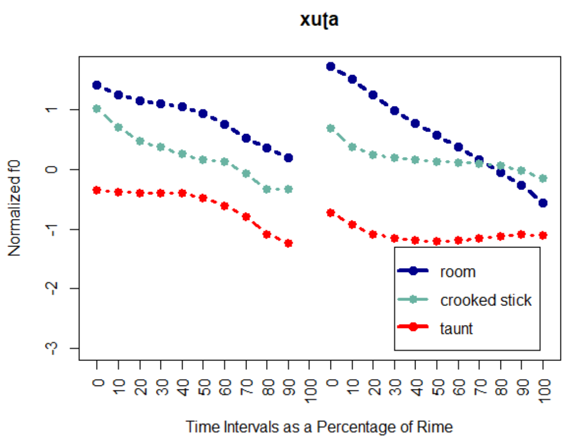


Figure 4.1: Normalized f0 interval contrast for the High -Mid -Low contrast for the tone triplet /xúʈá/ 'room' /xūʈā/ 'crooked-stick' and /xùʈà/ 'taunt'.

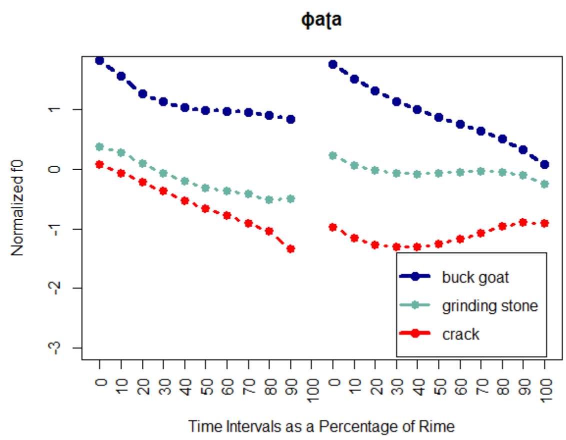


Figure 4.2: Normalized f0 interval contrast for the High -Mid -Low contrast for the tone triplet /ɸáʈá/ 'buck-goat', /ɸāʈā/ 'grindstone' and /ɸàʈà/ 'crack'

Figure 4.1 plots the f0 interval contours for the minimal triplet for Low, Mid, and High tones in [xùʈà] << *kʰuʈʈa '*taunt*', [xūʈā] << *kuʈa '*crooked stick*', and [xúʈá] << *koʃʈʰa '*room*'. A similar pitch contrast is plotted in Figure 4.2 for the minimal triplet, [ɸàʈà] << *pʰɘʈa '*crack*', [ɸāʈā] << *paʈʈa '*grinding stone*' and [ɸáʈá] << *paʈʈʰa '*buck goat*'.

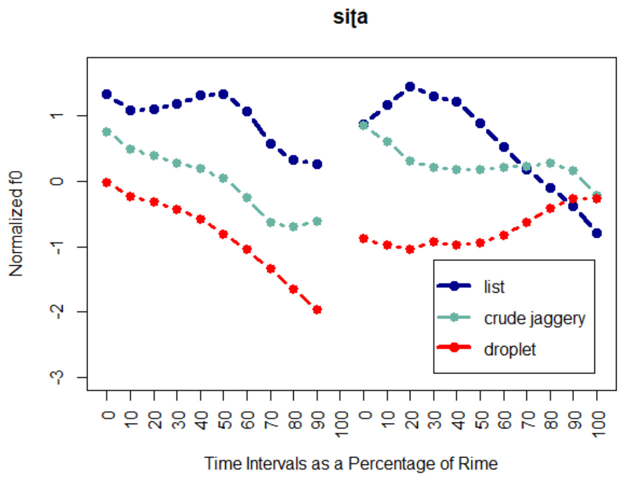


Figure 4.3: Normalized f0 interval contrast for the High -Mid - Low contrast for the tone triplet /síʈá/ 'list', /sīʈā/ 'crude jaggery' and /sìʈà/ 'droplet'

Figure 4.3 plots normalized f0 interval contrast for the High -Mid - Low contrast for the tone triplet, [síʈá] *'list'*, [sīʈā] *'crude jaggery'*, and [sìʈà] *'droplet'*.

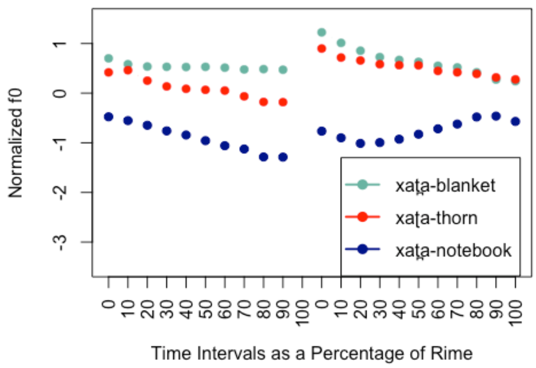


Figure 4.4: Normalized f0 interval contrast for the High -Mid - Low contrast for the near minimal triplet /xáʈ̪á/ 'blanket' /xāʈ̪ā/ 'thorn' and /xàʈ̪à/ 'copy'

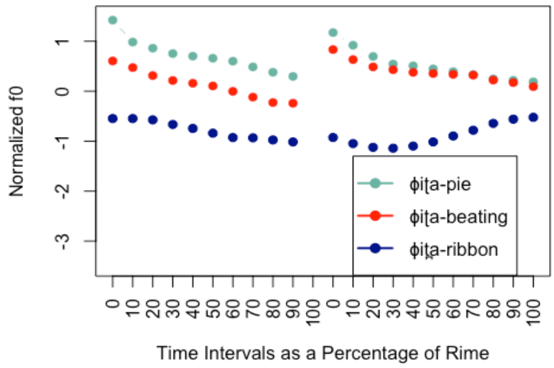


Figure 4.5: Normalized f0 interval contrast for the High -Mid - Low contrast for the tone triplet /ɸìʈ̪à/ 'sweet pie' /ɸīʈā/ 'beating' and /ɸìʈ̪à/ 'ribbon'

A significant difference was found between the High, Mid and Low tones for the near minimal triplets as well. A careful observation of the line graphs for the near minimal triplet, /xàʈ̪à/ << *kʰaʈ̪a: *'copy'*, /xāʈā/ << *kãʈa *'thorn'* and /xáʈ̪á/ << *kãʈ̪ʰa: *'blanket'* in figure 4.4 shows that there a clear difference between the words in terms of f0 direction. This difference can also be observed for the near minimal triplet, /ɸìʈ̪à/ << *pʰiʈ̪a: *'ribbon'*, /ɸīʈā/ << *piʈa: *'thorn'* and /ɸíʈá/ << *piʈʰa: *'sweet pie'* in figure 4.5.

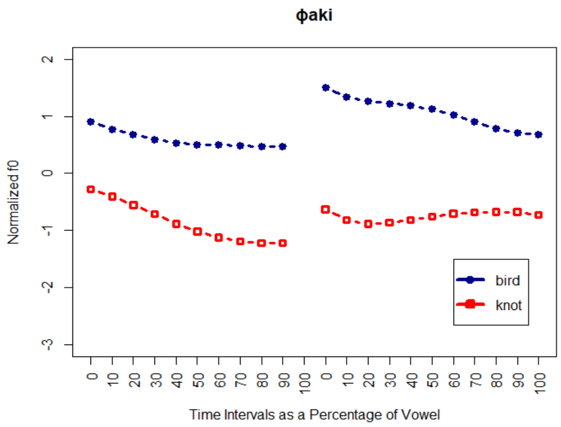


Figure 4.6: Normalized f0 interval contrast for the High and Low contrast for /ϕáxí/ ‘bird’ and /ϕàxì/ ‘knot’

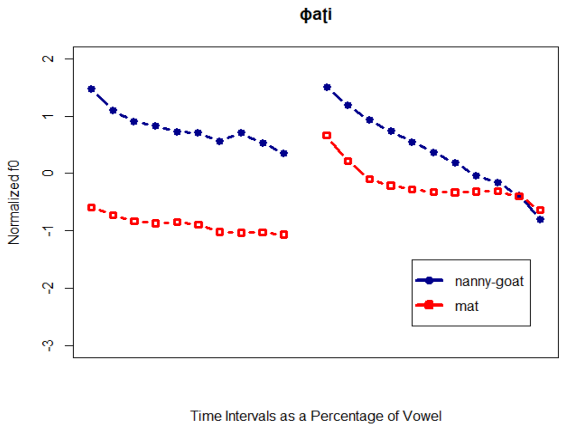


Figure 4.7: Normalized f0 interval contrast for the High -Mid contrast for the tone pair /ϕáʈí/ << *paʈhi ‘nanny-goat’ and ϕāʈī << *paʈi ‘mat’

The High and Low tone contrast is represented by the line graph in /ϕáxí/ << *pak^{h}i *‘bird’* and /ϕàxì/ << *p^{h}aki *‘knot’* in figure 4.6. The difference between f0 interval points for the High and Mid tones can be observed in figure 4.7 for the tone pair, /ϕáʈí/ << *paʈ^{h}i *‘nanny-goat’* and ϕāʈī << *paʈi *‘mat’*.

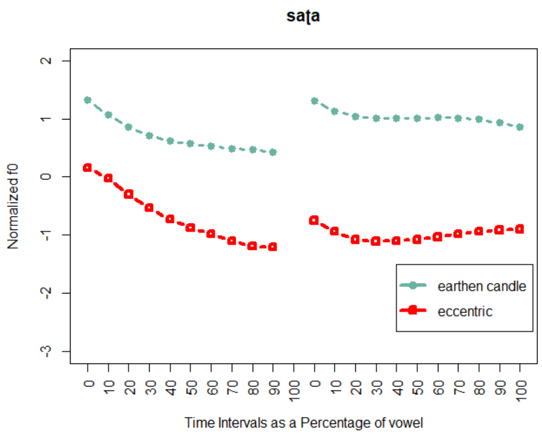


Figure 4.8: Normalized f0 interval contrast for the High -Mid - Low contrast for the tone pair /sāʈā/ ‘earthen candle’ and /sàʈà/ ‘eccentric’

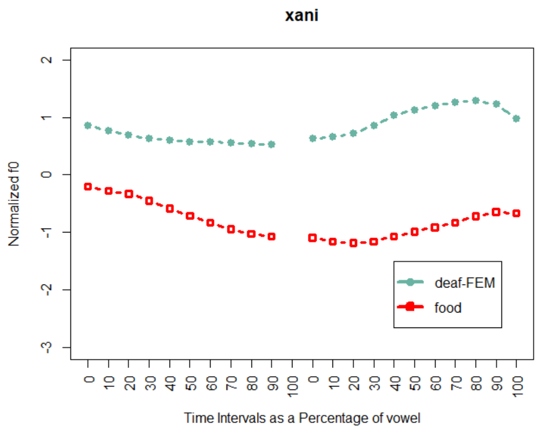


Figure 4.9: Normalized f0 interval contrast for the High -Mid - Low contrast for the tone pair /xānī/ ‘deaf-FEM’ and /xànì/ ‘food’

The Mid and Low tone contrast is represented by the line graph in, /sāʈā/ ‘earthen candle’ and /sàʈà/ ‘eccentric’in figure 4.8. Similarly, the difference between f0 interval points for High and Mid tones can be seen in figure 4.9 for the tone pair, /ϕáʈí/ << *paʈ^{h}i ‘nanny-goat’ and /ϕāʈī/ << *paʈi ‘mat’.

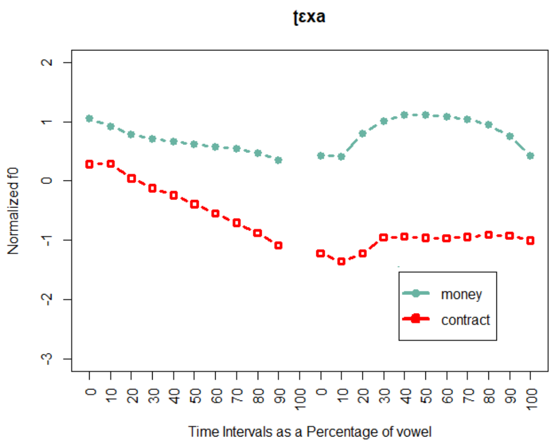


Figure 4.10: Normalized f0 interval contrast for the Mid-Low contrast for the tone pair /ţɛ̄xā/ 'money' and /ţɛ̀xà/ 'contract'

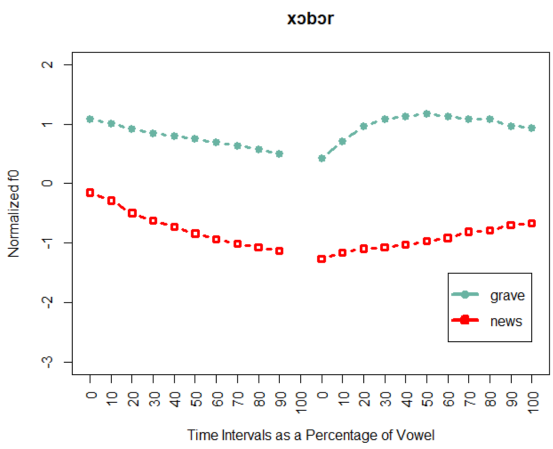


Figure 4.11: Normalized f0 interval contrast for the Mid – Low contrast for the tone pair /xɔ̄bɔ̄r/ 'grave' and /xɔ̀bɔ̀r/ 'news'

Similarly, the difference between the Mid and Low tones is clearly visible for the tone pairs /ţɛ̄xā/ 'money' and /ţɛ̀xà/ 'contract' plotted in Figure 4.10. Figure 4.11 plots /xɔ̄bɔ̄r/ 'grave' and /xɔ̀bɔ̀r/ *'news'*. Tone thus affected pitch for both the syllables at each of the interval points.

4.1.1.3.1 Statistical significance

The fixed effects result in Table 3.3 for the vowel mid-f0 raw values show a significant difference for both the High and Low tones. The intercept represents the Mid tone in the first syllable. The intercept was about 215.947 Hz (Mid tone); the Low tone was lower by about 35.071 Hz than the Mid tone and the High tone is higher by about 40.926 Hz than the Mid tone; the t values for the High and Low tones show significant difference with the Mid tone. Tone thus clearly affected pitch ($\chi2$ (1) = 87.683, DF = 2, P value < .00001).

	Fixed Effects	Estimate	Std. Error	t value
	Intercept	215.947	20.364	10.605
	High Tone	40.926	8.998	4.548
Mid Vowel f0	Low Tone	-35.071	10.944	-3.205
	2nd Syllable	8.024	1.554	5.164
	2nd Syllable: High Tone	-19.425	2.828	-6.869
	2nd Syllable: Low Tone	-18.365	2.246	-8.177

Table 4.3. Fixed effects for mid vowel f0 contrast between High, Mid and Low tones for monosyllables

The boxplot in Figure 4.12 demonstrates the distinction between the median values of the direct f0 (non-normalized and without the speaker and item variations). The y axis here plots pitch in

Hz and the x-axis plots the tones under study. The boxplot shows the effect of mid vowel f0 on tone and plots the clear contrast between the High - Mid - Low tones.

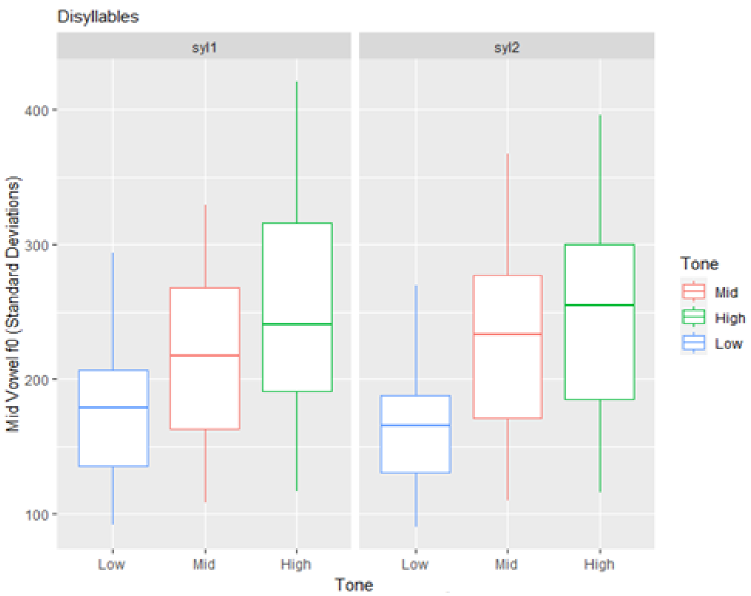


Figure 4.12. Boxplot of non-normalized mid vowel f0 values for the High, Mid and Low contrast for disyllables

Fixed effects results in Table 4.3 and the boxplot in Figure 4.12 demonstrate that the High and Low tones have significant fall in their second syllables; a fall of about 19.425 Hz for the High tone and about -18.365 Hz for the Low tone from their first syllables. The Mid tone, however, has a rise of about 8.024 Hz.

The High, Mid and Low tones in disyllables showed a clear difference for z-score normalized f0. As shown in Table 4.4, the intercept was about 0.22484 which represents the Mid Tone in the first syllable. Both the High and Low tones show a significant difference with the Mid tone. Tone thus clearly affected pitch ($\chi 2$ (1) = 131.98, DF = 4, P value < .00001).

	Fixed Effects	Estimate	Std. Error	t value
Mid Vowel f0 (Normalized)	Intercept	0.22484	0.05832	3.855
	High Tone	1.08820	0.14574	7.467
	Low Tone	-1.12067	0.09553	-11.73
	2^{nd} Syllable	0.22634	0.03434	6.591
	2^{nd} Syllable: High Tone	-0.53313	0.06199	-8.601
	2^{nd} Syllable: Low Tone	-0.41259	0.05020	-8.220

Table 4.4. Fixed effects for normalized mid vowel f0 contrast between the High, Mid and Low tones for disyllables.

The boxplot in Figure 4.13 demonstrates that f0 for the High tone is significantly higher than the Mid tone and goes significantly lower for the Low tone for disyllabic words.

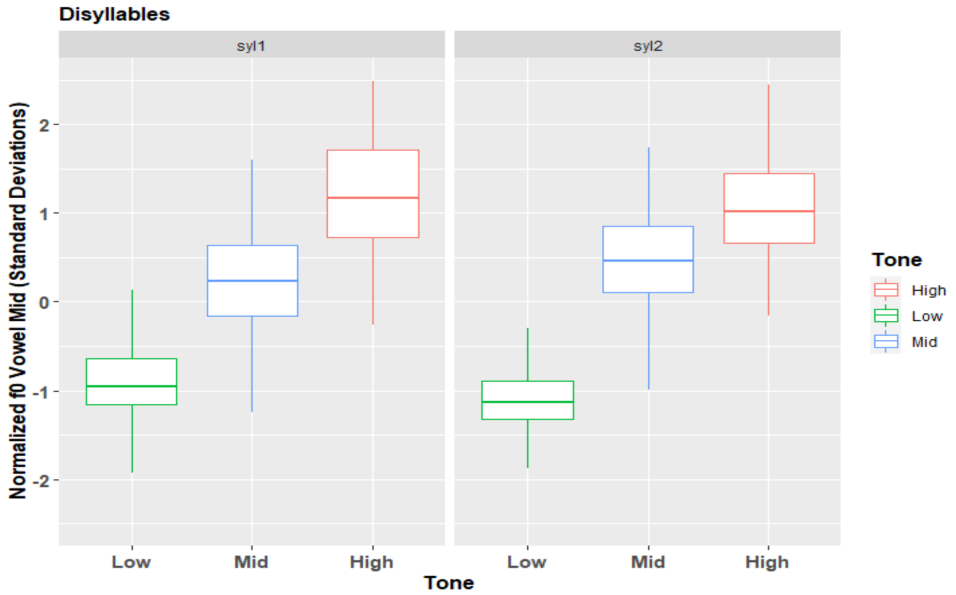


Figure 4.13. Boxplot of normalized mid vowel f0 values for the High, Mid and Low contrast for disyllables

As expected, the fixed effects results for normalized f0 also showed that the second syllable is significantly lower for the High and Low tones whereas, it has a significant rise for the Mid tone. This can be visualized in Figure 4.14 which plots the results of the mixed effects showing the degree of significance of difference with the intercept.

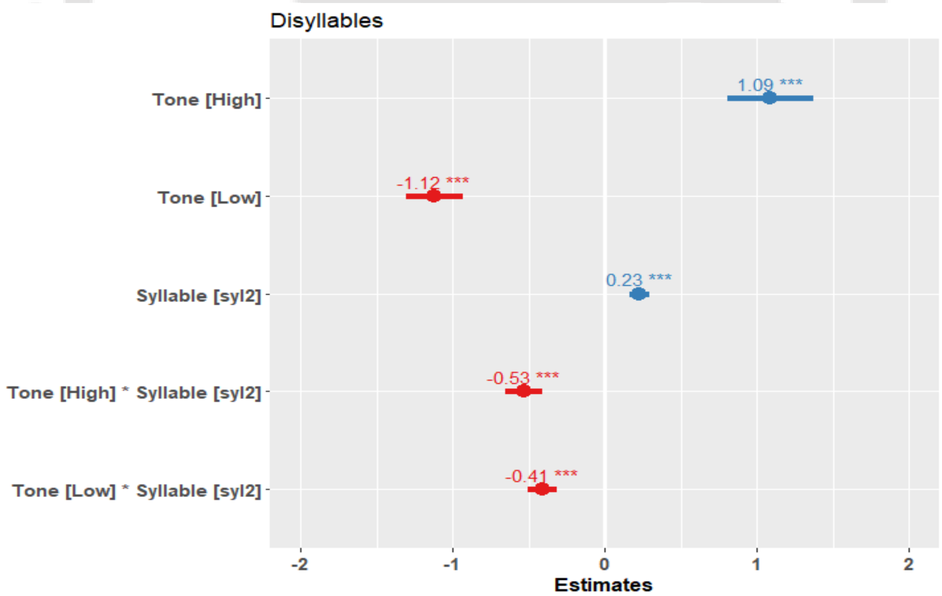


Figure 4.14. Estimates (Fixed Effects) plot for contrast between High, Mid and Low tones for disyllables

The predictions for the random slope model show that interspeaker variability is minimal for the three tones in disyllables. The slope between Mid and High tones is positive whereas the slope between High and Low tone is negative for all the speakers as can be seen in Figure 4.15.

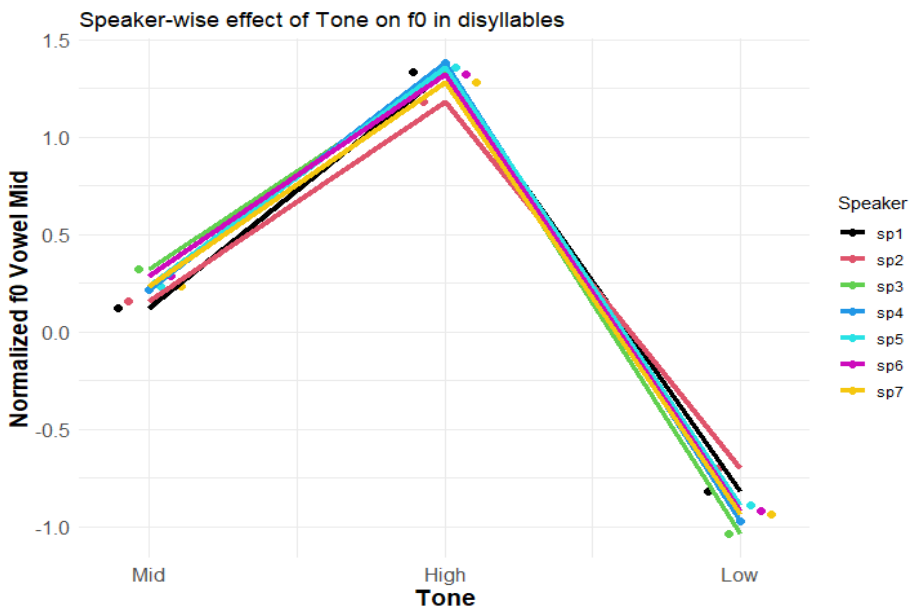


Figure 4.15 Predictions for the speaker-wise slope of the effect of Tone on pitch in disyllables

Significant contrast was found between the High, Mid and Low tones for the fixed effects and ANOVA results for f0 directions of both the syllables of the disyllabic words for all ten interval points showed a clear significance of difference as can be seen in Table 4.5 for the first Syllable.

Interval	Fixed Effects	Estimate	Std. Error	t value	Chi-Sq	Df	P Value
Interval 10	Intercept	0.54561	0.07325	7.449			
	High Tone	0.90458	0.20602	4.391	17.014	1	.000037
	Low Tone	-0.85158	0.15796	-5.391			
Interval 20	Intercept	0.40182	0.06505	6.177			
	High Tone	0.95797	0.20512	4.670	17.497	1	.000029
	Low Tone	-0.81449	0.14983	-5.436			
Interval 30	Intercept	0.30088	0.06288	4.785			
	High Tone	0.95865	0.20636	4.645	8.6051	1	.003352
	Low Tone	-0.81680	0.14902	-5.481			
Interval 40	Intercept	0.23875	0.06205	3.848			
	High Tone	0.95423	0.21004	4.543	18.559	1	.000016
	Low Tone	-0.84587	0.14985	-5.645			
Interval 50	Intercept	0.17978	0.06356	2.828			
	High Tone	0.95850	0.20112	4.766	18.595	1	.000016
	Low Tone	-0.87533	0.14939	-5.859			

Interval	Fixed Effects	Estimate	Std. Error	t value	Chi-Sq	Df	P Value
Interval 60	Intercept	0.11750	0.06446	1.823			
	High Tone	0.93856	0.18887	4.969	19.215	1	.000012
	Low Tone	-0.89898	0.14715	-6.109			
Interval 70	Intercept	0.05503	0.06590	0.835			
	High Tone	0.90413	0.17839	5.068	19.273	1	.000011
	Low Tone	-0.92003	0.14622	-6.292			
Interval 80	Intercept	-0.00597	0.07034	-0.085			
	High Tone	0.96409	0.17660	5.459	26.894	1	<.00001
	Low Tone	-0.94118	0.14017	-6.715			
Interval 90	Intercept	-0.04224	0.07147	-0.591			
	High Tone	0.82451	0.20964	3.933	20.941	1	<.00001
	Low Tone	-0.97899	0.12821	-7.636			
Interval 100	Intercept	-0.05345	0.07053	-0.758			
	High Tone	0.83607	0.20896	4.001	22.627	1	<.00001
	Low Tone	-1.03045	0.11852	-8.694			

Table 4.5 Fixed effects of normalized f0 interval contrast between the three tones for first syllable

Table 4.6 shows the fixed effects and ANOVA results for all the ten interval points for the second syllable.

Interval	Fixed Effects	Estimate	Std. Error	t value	Chi-Sq	Df	P Value
Interval 10	Intercept	0.38626	0.07964	4.850			
	High Tone	0.98351	0.23944	4.108	27.416	1	.000037
	Low Tone	-1.36955	0.13871	-9.874			
Interval 20	Intercept	0.38572	0.06502	5.933			
	High Tone	0.88610	0.20690	4.283	26.152	1	.000029
	Low Tone	-1.35932	0.13982	-9.722			
Interval 30	Intercept	0.3913	0.0524	7.468			
	High Tone	0.7848	0.1657	4.737	25.338	1	.003352
	Low Tone	-1.3534	0.1425	-9.495			
Interval 40	Intercept	0.39452	0.04742	7.737			

Interval	Fixed Effects	Estimate	Std. Error	t value	Chi-Sq	Df	P Value
	High Tone	0.63345	0.14848	3.276	23.934	1	.000016
	Low Tone	-1.34360	0.14642	-8.896			
Interval 50	Intercept	0.40367	0.05217	2.828			
	High Tone	0.45290	0.13827	4.766	23.738	1	.000016
	Low Tone	-1.33896	0.15051	-5.859			
Interval 60	Intercept	0.41503	0.05278	7.864			
	High Tone	0.27450	0.13695	2.004	23.288	1	.000012
	Low Tone	-1.31613	0.15376	-8.560			
Interval 70	Intercept	0.41452	0.05511	7.522			
	High Tone	0.11043	0.1418	0.779	21.773	1	.000011
	Low Tone	-1.25830	0.1507	-8.352			
Interval 80	Intercept	0.26509	0.0861	3.079			
	High Tone	0.11837	0.0979	1.209	18.334	1	<.00001
	Low Tone	-1.06568	0.1644	-6.482			
Interval 90	Intercept	0.1207	0.1558	0.775			
	High Tone	0.1794	0.1313	1.367	12.312	1	<.00001
	Low Tone	-0.8993	0.2029	-4.431			
Interval 100	Intercept	-0.08418	0.1837	-0.458			
	High Tone	0.23961	0.1368	1.752	9.8738	1	<.00001
	Low Tone	-0.73748	0.2021	-3.649			

Table 4.6 Fixed effects of normalized f0 interval contrast between the three tones for second syllable

Tone thus affected pitch for both the syllables at each of the interval points. The boxplots in Figures 4.16 and 4.17 plot the f0 for all the ten interval points for the High, Mid, and Low tones for the first and second syllables, respectively.

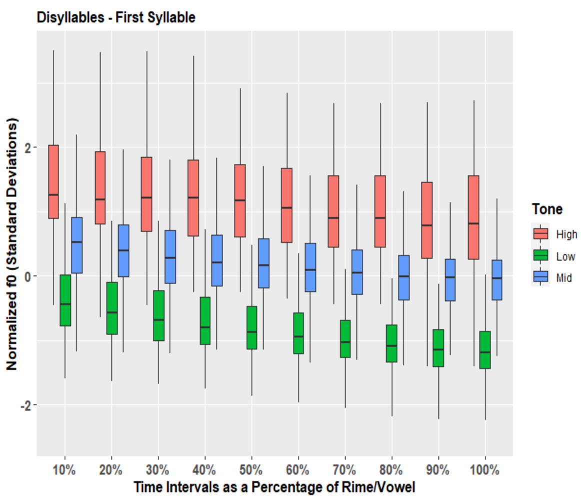


Figure 4.16. Boxplot of normalized f0 intervals for the High, Mid and Low contrast for First Syllable.

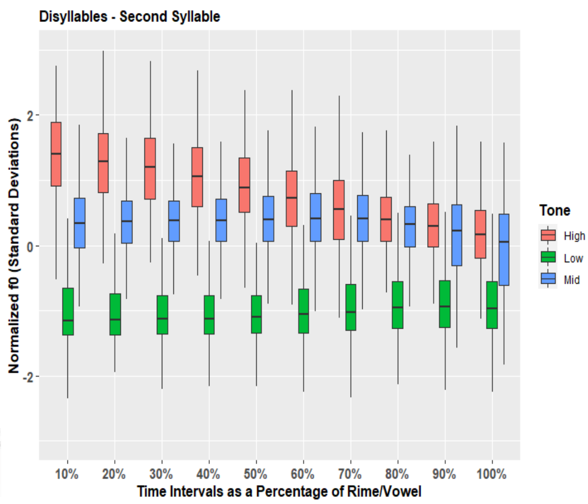


Figure 4.17. Boxplot of normalized f0 intervals for the High, Mid and Low contrast for Second Syllable.

The analysis for the effect of tone on duration did not provide us with unambiguous results for disyllables either. As shown in Table 4.7, the statistical difference for duration was found to be significant between the lexical tones and syllables, ($\chi 2$ (1) = 6.3841, DF = 1, p = .011515). The intercept was of 92.338 milliseconds which represents the Mid tone in the first syllable.

	Fixed Effects	Estimate	Std. Error	t value
Duration	Intercept	92.34	3.851	23.98
	High Tone	9.664	1.890	1.890
	Low Tone	-12.12	4.080	-2.970
	2^{nd} Syllable	44.37	1.720	25.79
	2^{nd} Syllable: High Tone	-39.59	3.104	-12.75
	2^{nd} Syllable: Low Tone	6.616	2.514	2.632

Table 4.7. Fixed effects for duration contrast for High, Mid and Low tones for disyllables

The High tone is longer by only about 9.664 milliseconds than the Mid tone and the Low tone is shorter than the Mid tone by about 12.12 milliseconds. A clear duration difference is seen only between the first and second syllables of the High tone (t value = -12.75) and the Mid tone (t value = 25.79). Duration for the second syllable of the Mid tone is lengthened by about 44.365 milliseconds than the first syllable whereas, the second syllable of the High tone is shortened by about 39.59 milliseconds.

4.2 Perception of tones in Sylheti

For distinct tones to be perceived, the signal must contain difference in f0 (in height or contour) between tones, and these must in turn be large enough to be perceptible as pitch differences. For example, in languages like Mandarin, relative duration up to the turning point of the f0 contour may be the critical cue for native speakers to distinguish Tones 2 and 3 in isolation (Moore & Jongman, 1997). Cross-linguistic studies on tone perception like Gandour, et al (2000) have argued that the direction and slope of pitch change are intrinsic to the perception of tone contrasts as listeners judge similarities between tones based on shape and slope rather than the height of the endpoints. A previous study on tonal perception in Sylheti (Gope & Mahanta, 2014), used categorical perception and hypothesized that stimulus with less discrimination might be perceived as the token belonging to the same category. Since the previous study by the same author (Gope, 2016) did not find duration as an acoustic correlate of tone either, the perception study only used f0 fluctuations in the perception study. The study showed that native speakers can identify pitch fluctuation as tonal variation up to the first 60% of the pitch contour in monosyllabic tonal words. The range of difference in f0 must be continued (at least) till 60% of the total rhyme/voiced part of the target syllable) to be able to be perceived as different words.

4.2.1 Perception of Tone in Disyllabic words

In our analysis of tone production, we focused on the phonetic features of Sylheti tones and found that the fundamental frequency (F0) contour played a crucial role in distinguishing the tonal categories. Other acoustic characteristics did not exhibit significant co-variation with changes in F0, highlighting the primary importance of pitch cues in tone recognition. Building upon these findings, our perception test involved manipulating the pitch of disyllabic words to further investigate the impact of pitch fluctuations on tonal perception.

The manipulation of our stimuli's pitch range fluctuations was based on the results obtained from the production test, which focused on the three-way tonal contrast in disyllabic words. To analyze the perception aspect, we developed a dedicated tool that enabled us to automate the data collection process and obtain precise response outputs. Our primary objective in creating this tool was not to measure the response time of the speakers but rather to create a realistic perception scenario without the need for sound replay.

The perception test aimed to investigate whether speakers relied on syllabic information to recognize the lexical tones, considering their varying positions within the syllables. Additionally, we aimed to explore whether the same target stimulus would be identified as a different tone when its frequency was manipulated to be higher or lower. By conducting this perception test, we aimed to gain insights into the role of syllabic information in tonal recognition and assess the impact of manipulated pitch frequencies on tone perception. The utilization of our automated tool provided a robust platform to gather accurate data and analyze the responses systematically.

Overall, our goal was to examine the influence of syllabic position and pitch manipulation on tone perception, and our perception test, facilitated by the specially designed tool, allowed us to investigate these factors effectively.

4.2.1.1 Methodology

An elementary perception test was conducted on an HP laptop to examine the relationship between lexical tone production and perception in Sylheti for disyllabic words in the present study. Since our production results showed that different syllabic positions resulted in the three tones, we wanted to see if the perception of those tones is limited to the environment of their origin, i.e., the Mid and Low tones might be realized on the first syllable only while the High syllable might be perceived on the second syllable. The purpose of the test was to determine whether native speakers of Sylheti are able to perceive the tonal contrast among the three tones observed in our analysis of Sylheti disyllabic words. The test was conducted separately for each speaker and their response was recorded on a very elementary tool built on C# for this test.

4.2.1.2 Participants

Ten native speakers of Sylheti participated in this study. 4 male participants belonged to the age-group 35 – 45 years of age and the 6 female participants belonged to 2 age groups: 3 female participants belonged to the 20 -30 age group and the other 3 belonged to the 35-40 age group. The eligibility of the participants was decided on the fact that they have been using this Sylheti in everyday conversation at home. All participants were also decided on the basis that they had used or are using English as one of their official or educational language. All participants selected had healthy hearing abilities and knew at least the minimal requirements for operating computer.

4.2.1.2.1 Stimuli

A dataset of 10 disyllabic tonal words (3 High tone words, 3 Low tone words and 4 Mid tone words) were recorded for this test from a one male and one female native speaker in an "I x said" context in three iterations and the best of the three for each word was selected for the test. A lexical pitch direction identification test was conducted with each participant. The disyllabic words were manipulated for one syllable per stimuli. Therefore, each tonal word was subjected to five different stimuli, each varying in pitch direction. The words were synthesized syllabically on PRAAT to mimic their contrastive tone's counterpart. This can be explained with the PRAAT pictures in Figures 4.18, 4.19 and 4.20. Figure 4.18 represents a Sylheti disyllabic word with an inherent Mid tone.

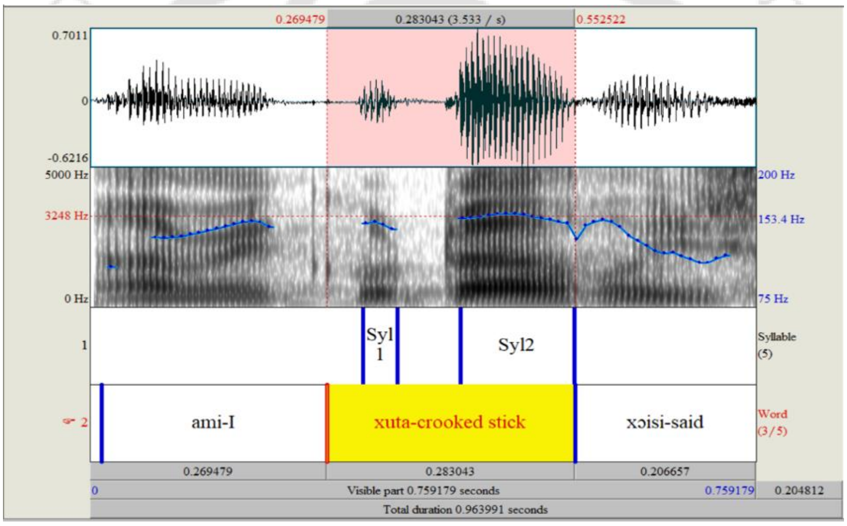


Figure 4.18 Baseline pitch of a Mid tone disyllabic word

Stimulus 1: The basic disyllabic word (in the carrier context) as recorded from the native speaker (Figure 4.18).

Stimulus 2: The mid tone disyllabic words for example, the word kūtā *'stick'* were resynthesized on PRAAT to a higher pitch into their High tone counterpart (kútá '*room*') only for the first syllable BY 40 Hz and published as one stimulus (Figure 4.19).

Stimulus 3: The mid tone disyllabic words, for example, the word kūtā 'stick' were resynthesized on PRAAT only for the second syllable to a higher pitch by 40 Hz into their High tone counterpart and published as another stimulus (Figure 4.20).

Stimulus 4: The pitch was manipulated on PRAAT lowering the pitch level by 35 Hz to match the pitch contour of its Low tone counterpart (for example to kùtà *'taunting'*) only for the 1st syllable (Figure 4.21).

Stimulus 5: The pitch was manipulated on PRAAT lowering the pitch level by 35 Hz to match the pitch contour of its Low tone counterpart (for example to kùtà *'taunting'*) only for the 2nd syllable (Figure 4.22).

Stimulus 6: A sixth stimulus was added which was not different from the 1st stimulus. The first stimulus was copied to see if the accuracy for the non-manipulated word was similar to that of the first one.

The identical stimuli were played twice (stimulus 1 and stimulus 6) to measure the speaker's perceptual consistency. The resynthesized sound files for each tone were published as an input for the test. So, each tonally contrastive word had 6 stimuli, making a set of 60 stimuli to be identified by the native speakers.

The stimuli were played were arranged in a random manner so that one stimulus is not followed by its resynthesized or tonally contrastive stimuli. This was done to make sure that the listener should not be able to predict the next stimuli and be mentally prepared for an influencing the response for the next one.

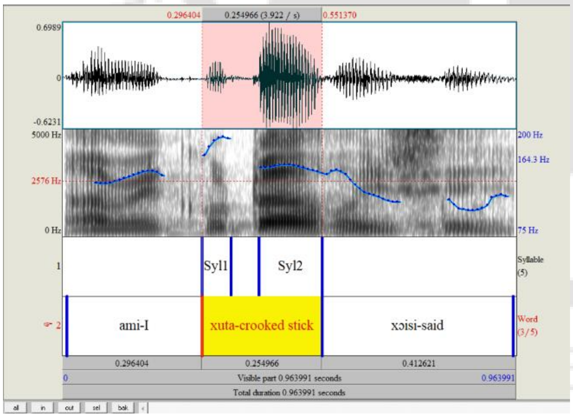


Figure 4.19 Resynthesized with higher pitch for 1st syllable

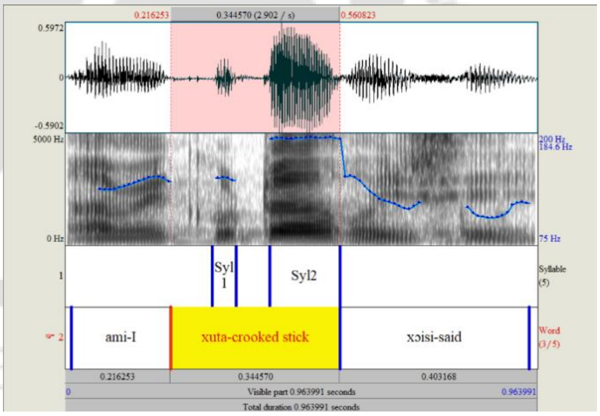


Figure 4.20 Resynthesized with higher pitch for 2nd syllable

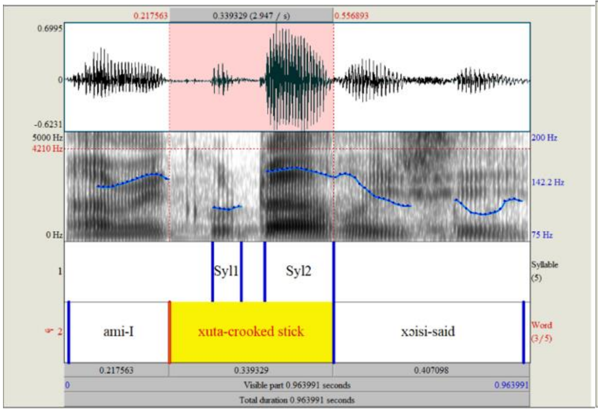


Figure 4.21 Resynthesized with lower pitch for 1st syllable

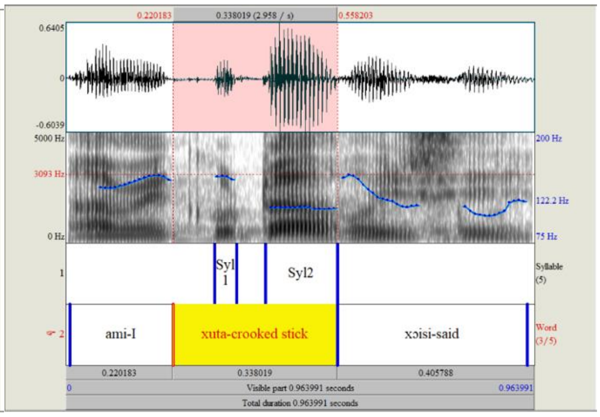


Figure 4.22 Resynthesized with lower pitch for 2nd syllable

The High and Low tone tokens were also employed to examine the impact of pitch manipulations on participants' perception of all three tones in specific syllables.

High Tone Manipulation: The stimuli for the High tone manipulation condition included:

1. Stimulus 1: The original disyllabic word recorded from the native speaker.
2. Stimulus 2: The first syllable of the mid tone disyllabic words resynthesized with a higher pitch by 40 Hz to represent the High tone counterpart.
3. Stimulus 3: The second syllable of the mid tone disyllabic words resynthesized with a higher pitch by 40 Hz to represent the High tone counterpart.
4. Stimulus 6: A replication of Stimulus 1 without any manipulation, serving as a control.

Low Tone Manipulation: The stimuli for the Low tone manipulation condition included:

1. Stimulus 1: The original recording of the disyllabic word.
2. Stimulus 4: The pitch of the first syllable lowered by 35 Hz to match the pitch contour of the Low tone counterpart.
3. Stimulus 5: The pitch of the second syllable lowered by 35 Hz to match the pitch contour of the Low tone counterpart.
4. Stimulus 6: A replication of Stimulus 1 without any manipulation, used as a baseline control.

4.2.1.2.2 Design

Lexical tone perception across disyllables was tested in 10 adult native speakers of Sylheti. Lexical tone recognition was measured for three tonal patterns: High Tone, Mid Tone and Low Tone 3. An elementary tool was built on C# to capture the responses and the time elapsed in between the sound played and the response entered. Each speaker was taken to a separate room and given a laptop with the tool ready to take the test on the screen. The speaker was given a Sennheiser PC 3 headphone to listen to the sounds to be played on the tool. On being pressed on the *Begin Analysis* button, the stimuli sounds were automatically picked up from a specified folder and were played in sequence. Three possible responses were indicated for the sound played on the screen from which the listener had to select one. The possible responses assigned to each stimulus were the meaning of the sound in English along with the meanings of their tonal counterparts as shown in Figure 4.23:

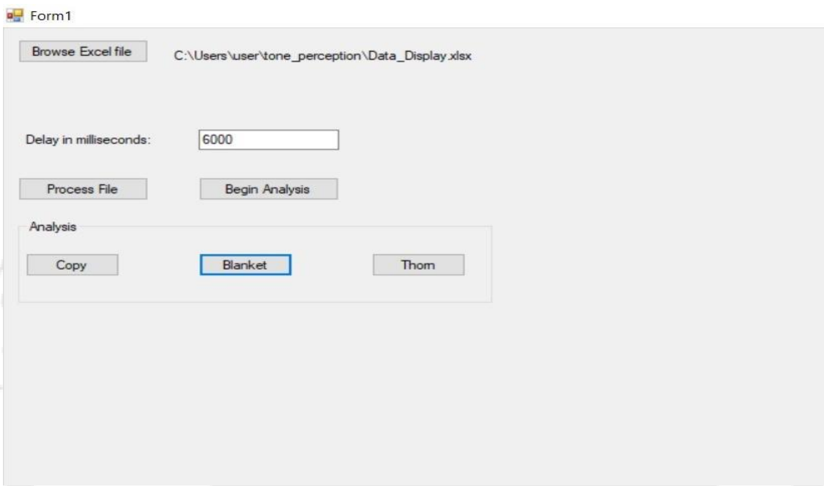


Figure 4.23. Perception response recorder tool

The possible response for a two-way contrastive pair had two meanings displayed on the screen and the third option was displayed as NA. The responses had to be given by the listeners by clicking on the option he/she found to be the correct meaning for the stimulus. In case of confusion about the meaning of the stimulus, the listener was asked to leave the response unattended. A fixed interval of 6000 ms was specified for each stimulus which transitioned to the next stimulus after the response was given. If the response was not given within the time limit, the stimuli automatically transitioned to the next sound recording this response as NIL. The Output for each user’s entry was captured in a .log file with the time taken for each response, which was converted to an excel sheet as shown in Figure 4.24.

Output	Option_selected	Played	Selected	Time diff in millise	Time diff in seconds
Sound 1 played at: 17:33:50.333	Option 2 selected. Time: 17:33:56.347	17:33:50.333	17:33:56.347	6014	6.014
Option 2 selected. Time: 17:33:56.347					
Sound 2 played at: 17:33:57.283	Option 2 selected. Time: 17:34:03.313	17:33:57.283	17:34:03.313	6030	6.03
Option 2 selected. Time: 17:34:03.313					
Sound 3 played at: 17:34:04.177	Option 2 selected. Time: 17:34:10.200	17:34:04.177	17:34:10.200	6023	6.023
Option 2 selected. Time: 17:34:10.200					
Sound 4 played at: 17:34:11.043	Option 2 selected. Time: 17:34:17.055	17:34:11.043	17:34:17.055	6012	6.012
Option 2 selected. Time: 17:34:17.055					
Sound 5 played at: 17:34:17.900	Option 1 selected. Time: 17:34:23.916	17:34:17.900	17:34:23.916	6016	6.016
Option 1 selected. Time: 17:34:23.916					
Sound 6 played at: 17:34:24.783	Option 2 selected. Time: 17:34:30.799	17:34:24.783	17:34:30.799	6016	6.016
Option 2 selected. Time: 17:34:30.799					
Sound 7 played at: 17:34:31.680	Option 1 selected. Time: 17:34:37.693	17:34:31.680	17:34:37.693	6013	6.013
Option 1 selected. Time: 17:34:37.693					
Sound 8 played at: 17:34:38.495	Option 2 selected. Time: 17:34:44.504	17:34:38.495	17:34:44.504	6009	6.009
Option 2 selected. Time: 17:34:44.504					

Figure 4.24. Sample of the output results for a speaker in Tabular format for the perception test

The response showed us that a few sounds were left un-responded to within the given time and that most of the responses were given within the time limit of 6 seconds. The output was analysed further to see that accuracy of tone perception by the native speakers.

4.2.2 Statistical Analysis

This study focused only on disyllabic words and the purpose of the experiment was to investigate the perception accuracy of different tones in relation to syllable manipulation. Our results for the accuracy perception accuracy among the low, mid, and high tones for the disyllabic words without any pitch manipulation showed no difference in perception accuracy across stimuli. Further, we sought to examine whether there would be any variations in perception accuracy after manipulating the pitch of the stimuli. Interestingly, our results indicated a significant difference in perception accuracy for the low and high tones when subjected to pitch manipulation and thus these results were analysed using an analysis of variance (ANOVA) to examine the effects of tone and syllable on perception accuracy. The analysis was conducted using the R programming language, specifically utilizing the package 'stats' for performing the ANOVA test and 'ggplot2' for visualizing the results.

The perception test data was collected, and a data frame was created in R to organize the data. The data frame included columns for the tone (Low, Mid, High), the syllable (syl1, syl2), and the correctness of the response (0 or 1).

The analysis employed a one-way ANOVA test, which is a statistical method used to assess the differences between multiple groups. In this case, it examined the effect of the variable "syllable" on perception accuracy for each tone category. The ANOVA model included both random and fixed variables. The random variables were "Speaker" and "Word," which accounted for individual variation in perception accuracy across different speakers and words. The fixed variable was "Syllable," which represented the syllables (syl1 and syl2) manipulated for pitch.

The analysis calculated a 95% confidence interval for the mean differences between the perception accuracy of different syllables within each tone category.

4.2.2.1 Results and discussion

Our findings corroborate the significance of pitch cues in distinguishing the tonal categories of disyllabic words, as supported by our earlier results on pitch production. To further investigate, we calculated the accuracies for both the 1st and 6th stimuli under the non-manipulated condition. This analysis aimed to determine if the recognition accuracy remained consistent across different iterations of the stimulus.

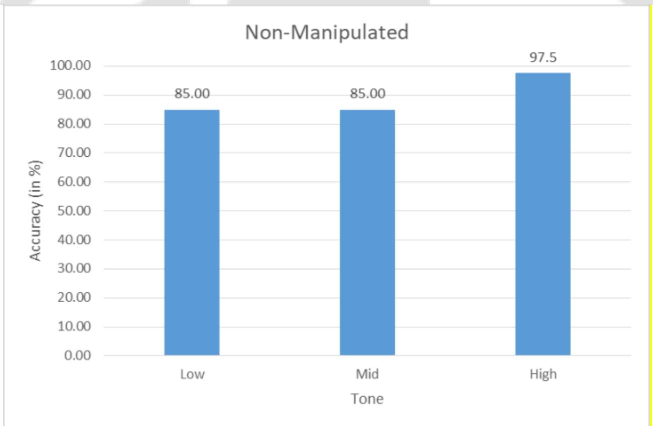


Figure 4.25. Overall accuracy (in %) for pitch identification for non-manipulated tonal words

Our analysis revealed that there were no significant differences in perception accuracy among these three tonal categories. This finding is illustrated in Figure 4.25, where the perception accuracy for the low, mid, and high tones is depicted as similar across the board.

Interestingly, for the disyllabic words manipulated for pitch, we observed a remarkable difference in pitch fluctuation between the first and second syllables, particularly for the High and Low tones. The manipulation of pitch resulted in a significantly higher fluctuation in the pitch of the disyllabic words, primarily attributed to the variations in the second syllable. The perception test results indicate the significant influence of tone and syllable on the accuracy of pitch perception. The statistical analysis revealed a significant effect of tone on perception accuracy, as indicated by the F-value and associated p-values. Table 4.8 presents the results of the ANOVA conducted to examine the effect of syllable position on tone recognition accuracy across three tonal categories: Low, Mid, and High.

Tone		Df	Sum Sq	Mean Sq	F Value	Pr(>F)
Low	Syllable	1	3.50	3.500	16.72	9.49e-05
	Residuals	89	18.63	0.209		
Mid	Syllable	1	0.00	0.00251	0.013	0.909
	Residuals	189	36.43	0.19273		
High	Syllable	1	5.158	5.158	25.51	1.35e-06
	Residuals	140	28.307	0.202		

Table 4.8 Analysis of Variance (ANOVA) Results for Tonal Categories by Syllable

For the Low tone, the factor Syllable was found to be significant ($F(1, 89) = 16.72$, $p < 0.001$). The Sum of Squares (SS) for the Low tone was 3.50, and the Mean Square (MS) was 3.500. This indicates that there is a significant difference in perception accuracy between the two syllables for the Low tone (Figure 4.26). The residuals, representing the unexplained variation, had an SS of 18.63.

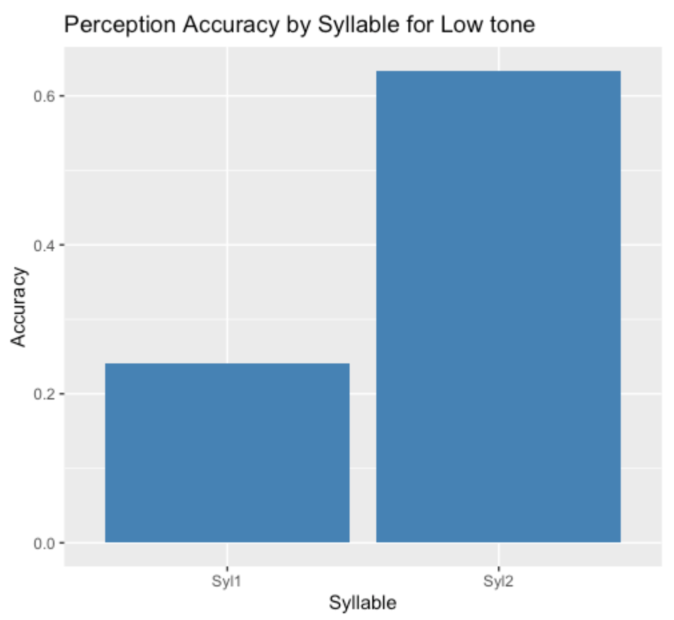


Figure 4.26 Perception accuracy for manipulated stimulus for the Low tone

For the Mid tone, the factor Syllable was not found to be significant ($F(1, 189) = 0.013$, $p = 0.909$). The SS for the Mid tone was 0.00, with a very small MS of 0.00251. This suggests that there is no significant difference in perception accuracy between the two syllables for the Mid tone (Figure 4.27). The residuals had an SS of 36.43.

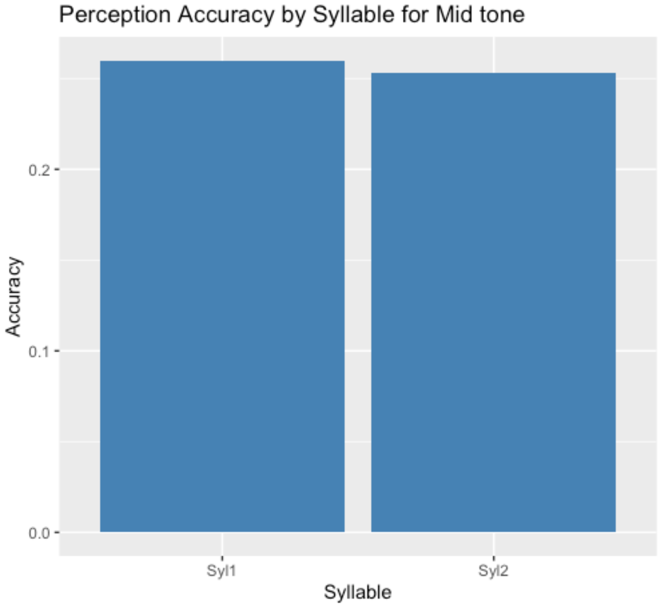


Figure 4.27 Perception accuracy for manipulated stimulus for the Mid tone

For the High tone, the factor Syllable was found to be highly significant ($F(1, 140) = 25.51$, $p < 0.001$). The SS for the High tone was 5.158, and the MS was 5.158. This indicates a significant difference in perception accuracy between the two syllables for the High tone (Figure 4.28). The residuals had an SS of 28.307.

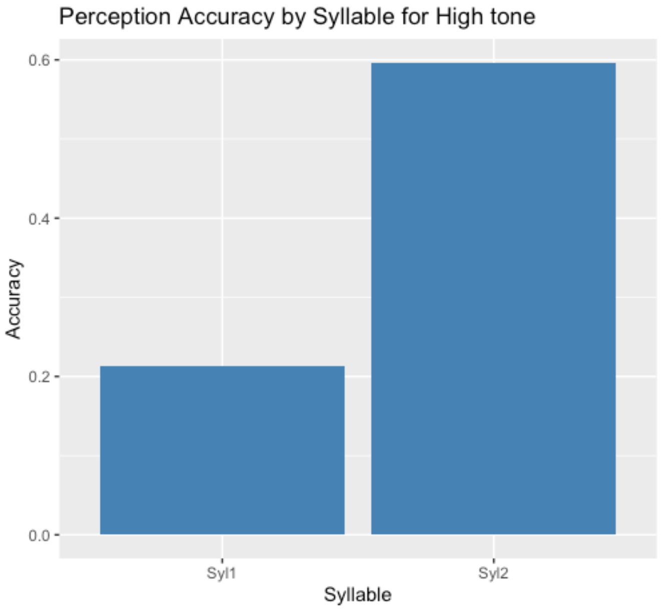


Figure 4.28 Perception accuracy for manipulated stimulus for the High tone

Overall, these findings suggest that the perception accuracy varies significantly depending on the tone and syllable combination. Specifically, there are significant differences in perception accuracy between syllables for the Low and High tones, while there is no significant difference for the Mid tone. These results support the hypothesis that the manipulation of syllables affects perception accuracy differently depending on the tone.

The recognition patterns of pitch fluctuations for the High tone (Figure 4.28) closely resemble those of the Low tone (Figure 4.26), suggesting similar perception characteristics. In contrast, the perception of pitch fluctuations for the Mid tone (Figure 4.27) appears to be evenly distributed across both syllables for most speakers. This observation aligns with the unique rising nature of the Mid tone, as identified in the production study discussed in section 4.1. Consequently, the distinct perceptual features of the Mid tone contribute to its discrete recognition patterns. Overall, our findings indicate that the average perception of pitch cues for disyllabic tonal words in Sylheti primarily relies on the second syllable.

4.3 Conclusion and discussion

Our production and perception tests (with a focus on the production test) conclude that, Sylheti has three level lexical tones namely the High, Mid, and Low tones in disyllables. It is evident from our production and perception analysis of the tonal system of Sylheti disyllables, that the language has three lexical tones named, High, Mid, and Low. Our results for Mid vowel showed that the Mid vowel is significantly lower than the High tone and significantly higher than the Low tone for both raw and normalized f0. The f0 direction for all the interval points showed a clear significance for both the syllables as well. We can also see stability in the three-way tone contrast for all the seven speakers; the slope between the High and Mid tone is positive and the slope from the Mid to Low tone is negative for all 7 speakers. We retain our proposal in chapter 3 that the phonetic cues in voiceless onsets that are inherent to NIA languages, triggered tonogenesis in the language. The High tone was conditioned from the loss of aspiration in the medial consonant in disyllables which we argue to be the reanalysis of the diachronically aspirated coda which initially mapped to the lexical High tone in monosyllables. Our results for duration as an acoustic correlate of tone showed that there are statistically significant differences between the tones for duration, but they are for a very short duration which possibly is perceptually negligible as a cue for tonal contrast between the three tones. The difference in duration is also concentrated in the second syllable and thus does not render an overall difference to be perceived as a significant acoustic correlate of tone in the language. It is a known fact among acoustic studies on tone that duration has an inverse relationship with tone, i.e., the High tone will have the shortest duration among the three syllables under study (Gill & Gleason, 1969; Khan, Xu and Sohail 2020; Xu 1997). We, however, could not find a conclusive result as these differences existed only in the second syllable and the Low tone was found to have a shorter duration than both the High and Mid tones. It is thus conclusive from our experiment on monosyllables in chapter 3 and disyllables in this chapter and the previous studies on Sylheti tones (Gope and Mahanta 2014; Gope 2016) that f0 is the only acoustic correlate in Sylheti; duration as a correlate does not give us an unambiguous result.

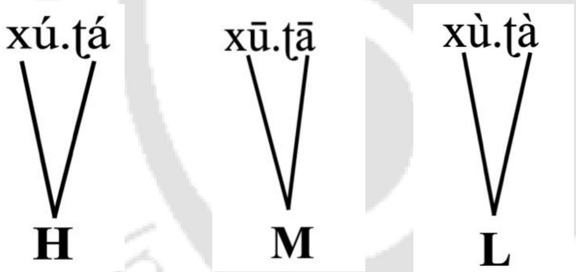
A careful observation of our results shows a difference in the behaviour of f0 direction, and duration for each of the lexical tones in disyllables which can be attributed to their individual characteristic. While the High tone seems to exhibit falling and shortening effects on pitch and on duration of the second syllable, the Mid tone seems to exhibit both rising and lengthening effects on pitch and duration for the second syllable. The rising tendency of the Mid tone towards the second syllable is visible in the minimal triplets and pairs presented in figures 4.1 to 4.5; we can see a merging of the f0 contour for the High and Mid tones, as the High tone has a falling tendency as opposed to that of the Mid tone. This tendency is statistically observable in the boxplots in figures 4.16 and 4.17 as well. The Low tone, however, has a significantly falling effect on the pitch of the second syllable which does not correlate with its duration characteristics. The difference in the behaviour of tone in their first and second syllable, is rather on the whole word than on individual syllables and thus, cannot be considered as contrastive contours. The rises and falls in the tones are possibly thus individual characteristics of each lexical tone, as contour would generally be present on the lowest permissible tone bearing unit, which is evident across many tonal languages of the world (Gordon, 2001). Though there is a cross-linguistic tendency of tones to involve (significant) movement, those movements may just be apparent if they are not present in the basic tonemic unit (Pike 1948; Xu and Wang 2001). We can thus concur with Gope (2016) that syllable cannot be the TBU in Sylheti.

We concur with Gope (2016) here as well, that pitch is the only significant correlate and cue for tone contrast in the language. The pitch fluctuations must be 35 Hz lower and 40 Hz higher than the Mid tone to be perceived as different words by the speakers. It is by default the second syllable of the word, which is perceived as the cue for the distinction. The results confirm that f0 is contrastive for the tones that we have identified. Native speakers were able to easily identify the tones in the first syllable itself. We conclude that, Sylheti has lexical distinction based on f0 of the tonal words only.

4.3.1 The Tone Bearing Unit (TBU) in Sylheti

The well-formedness constraint proposed in the autosegmental theory of tone (Goldsmith, 1976, p. 48) states that, each tone should be associated with one vowel and all vowels should be associated with at least one tone and that, association lines do not cross. An issue that arises in this theory, is the representation of tone contrast per syllable, and how tones distribute themselves over a word. Our analysis shows that, the tone's pitch continues on an adjacent tone and is perceived as the property of the word as a whole. We can thus infer that word is the TBU in Sylheti and represent the relation between the tonal and the segmental tier as a many to one association of tone as described in Chapter 3. To explain the tonogenesis in disyllables and the TBU in Sylheti, we call the instance we used in the introductory part of this chapter: the diachronic [-voice, +spread glottis] onset in *k^{h}uʈʈa, the word for *'taunt'* , maps to the lexical Low tone; /xùʈà/ << *k^{h}uʈʈa; the diachronic [-voice, -spread glottis] onset in *kuʈa, the word for *'grinding stone'* maps to the contrastive Mid tone, xūʈā << *kuʈa and the diachronic [-voice, +spread glottis] medial consonant in *koʃʈ^{h}a, the word for *'room'* mapped to the lexical High tone, xúʈá << *koʃʈ^{h}a. The tonal assignment in this triplet is demonstrated in 1:

1. Tone bearing unit in Sylheti



It is possible, that the reanalysis of the tonal inventory led to the spreading/linking of the tone to the adjacent syllable in the language classifying it among word-tone languages like Shanghai (Zhu, 2006) and Tibetan (Duanmu, 1992).

While initially considering the word as the Tone Bearing Unit (TBU) in the language, it becomes apparent that the tonal structure exhibits a dynamic and expansive nature when examining affixed forms and compounds. These words often show a dissociation from the TBU and instead link to the prosodic tones LHL or HL. This observation suggests a more intricate and adaptable tone structure in which tones can extend beyond individual words and interact with larger prosodic units. Therefore, it is crucial to further investigate the tonal patterns in compound words and complex words to gain a comprehensive understanding of the language's phonologically expansive tone system. This sets our motivation for the forthcoming chapters (Chapter 5 and 6) of our study.

4.3.2 Residual tonogenetic aspects

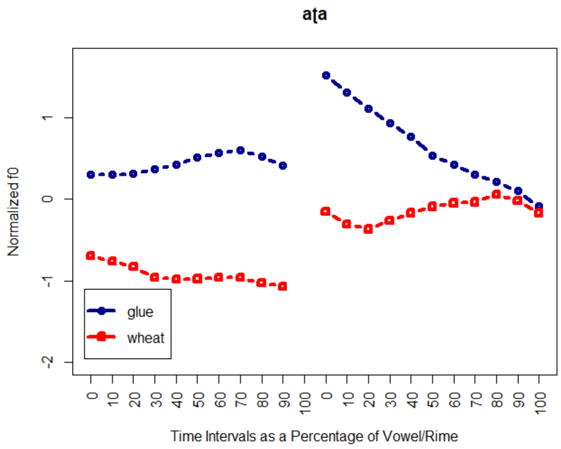
Interestingly, it was also observed, that there are minimal pairs or triplets in Sylheti with sonorant or vowel onsets where the medial consonants have diachronic aspiration contrast[12]. We propose that, such words which had diachronically aspirated medial consonants associate with the lexical High tone for instance in, áɽá << *aɽʰa *'glue'* in Table 4.8 and words with diachronically unaspirated medial consonant associate with the lexical Mid tone as in āɽā << *aɽa *'wheat'*.

NIA	High	Gloss	NIA	Mid	Gloss
*aɽʰa	áɽá	glue	*aɽa	āɽā	wheat
*moɽʰa:	múɽá	wicker stool	*moɽ	mūɽā	a twist
*d̪ekʰa	d̪ɛ́xá	meeting	*ɖagga	ɖɛ̄xā	young male cow
*a:tʃʰa:ɽ	ásáɽ	tossing	*atʃa:r	āsāɽ	pickle

Table 4.9 Disyllabic tonal pairs with non-obstruent onsets in Sylheti

We found a clear contrast for Mean f0 and f0 movement for such minimal pairs, as plotted in Figure 4.31, áɽá << *aɽʰa *'glue'* and āɽā << *aɽa *'wheat'*. Figure 4.32 plots the tonal pair múɽá << *moɽʰa 'wicker stool' and mūɽā << *moɽ *'a twist'*. Figure 4.33 plots the near minimal pair d̪ɛ́xá << *d̪ekʰa *'meeting'* and ɖɛ̄xā << *ɖagga *'young male cow'*.

[12] Based on our observations and findings in this study, a hypothesis can be proposed regarding the existence of a clear contrast in Mean f0 and f0 movement for the minimal pairs examined. However, it is important to note that our study does not confirm or consider the relationship between vowel-initials and low tones. These findings serve as a foundation for future research, which should delve deeper into this aspect to provide a more comprehensive understanding.



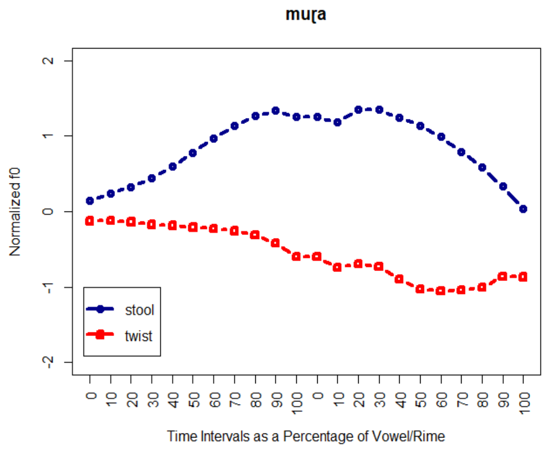


Figure.4.31 f0 direction for the minimal pair áʈá '*glue*' and āʈā '*wheat*'

Figure.4.32 f0 direction for the minimal pair múʈá '*wicker stool*' and mūʈā '*a twist*'

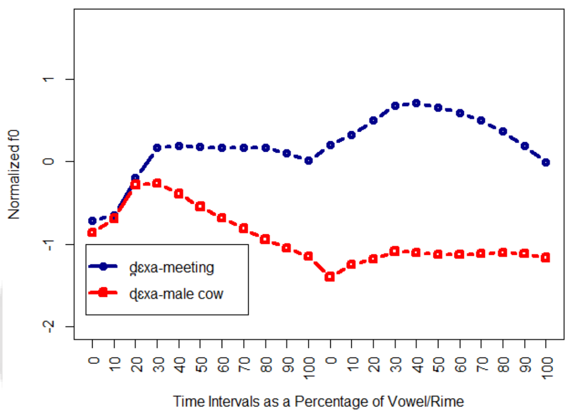


Figure.4.33 f0 direction for the near minimal pair ɖéxá '*meeting*' and *ɖēxā* '*young male cow*'

The results reported for the tonogenetic aspects of tonal pairs and triplets in Sylheti in this chapter suggest that these words exhibit a High-Mid tonal contrast. As is evident that these words cannot have a three-way contrast as these either have initial vowels or sonorant onsets; diachronically aspirated sonorant onsets do not occur in NIA languages. Halle and Stevens (1971) propose that both Mid tone and sonorants are [-stiff, -slack] and thus unlike obstruents which have tonal affinities, sonorant consonants readily accept any tone; it is thus plausible that the word with sonorant onsets and diachronic unaspirated medial consonant associates to the default Mid tone in tonal pairs such as múʈá << *moʈ^{h}a 'wicker stool' and mūʈā << *moʈ '*a twist*'.

4.3.3 Mid tone as the Neutral tone

It is noteworthy, that the tonogenetic origin and the varied behavior of the Mid tone lead the analysis toward another possible direction. Based on the findings from our production experiments in chapters 3 and 4, it is evident that the emergence of tone in Sylheti can be attributed to words that historically lacked aspirated sounds. We saw in chapter 3, that the Mid tone is lower by only about 5 Hz than the High tone whereas, in disyllables, the Mid tone is lower by about 19.42 Hz than the High tone. One way of looking at this variation in the Mid tone is the neutral tone in Sylheti which varies with the degree of contrast in monosyllables and disyllables. It could be attributed to the fact, that words with unaspirated onsets or codas were reinterpreted as the neutral tone. Studies such as, Pulleyblank (1986) argue that the Mid tone is the default tone by virtue of the universal status of the default rules. The three-way tone contrast is possibly a High-Ø-Low contrast. It is a possibility, that the reanalysis of the tonal inventory of Sylheti has also led to the assignment of the neutral tone or the Mid tone to words that have no tonogenetic base.

The observed variability of the Mid tone in both monosyllabic and disyllabic words further support the phonological motivation proposed in this study. The fact that the Mid tone exhibits different pitch patterns depending on the presence or absence of tonogenetic bases suggests that it plays a crucial role in maintaining tonal contrasts and preserving lexical distinctions. This variability highlights the flexibility and adaptability of the Mid tone as a neutral or default tone, allowing it to accommodate various phonological contexts and contribute to the tonogenetic aspects of the tonal system. The coexistence of distinct pitch patterns for the Mid tone in monosyllabic and disyllabic words provides additional evidence for its phonological significance and strengthens the notion that it serves as a pivotal element in the overall tonal inventory of Sylheti. Here, our findings deviate from the earlier findings of Gope (2016) and suggest that, in Sylheti, it is the Mid tone rather than the Low tone that serves as the foundational tonal category. We hypothesize that words lacking a tonogenetic base are associated with a lexical Mid tone, indicating a tonal unmarked status. This hypothesis aligns with the substantial variability observed in Mid tones and suggests a contrastive tonal system comprising High, Unmarked, and Low tones (H-Ø-L). Further research investigating the basic or neutral tone in Sylheti holds promise for a more comprehensive understanding of its tonal inventory and may provide insights into the tonogenetic aspects of tonal pairs.

Chapter 5

Tonal Polarity in Sylheti words

Introduction

The chapter is primarily an investigation on tonal polarity in Sylheti complex morphemes. We analyze the phonotactic rules of complex nominal and verbal morphemes along with their tonal alignment patterns across morpho-syntactic boundaries and propose that complex morphemes act as one prosodic domain in the language. The chapter studies complex morphemes with special attention to nominal stems in Sylheti as they exhibit phonological well-formedness better than other classes of words (Smith, 1999). The most striking feature found in these words is tonal polarity exhibited by the LH and HL tone contours. In this regard, we concur with Mahanta and Gope (2018), but unlike the previous study, we discuss both inflectional and derivational stems vis-à-vis all the three lexical tones, /High-ø-Low/ established in this dissertation and show that tonal polarity is demonstrated only by the High and Low tones; the default tone, i.e., the Mid tone is immune to polarity.

This chapter is divided into the following sections: Section 5.1 discusses the background on tonal polarity in Sylheti and gives a picture of tonal polarity present in the language. Section 5.2 provides a comprehensive examination of the phonological structure and tonal polarity in inflectional stems of Sylheti, encompassing both complex nominal words. Within this section, a detailed analysis of the pitch tracks of these complex nominal words is presented. In Section 5.3, the focus shifts to the analysis of tonal polarity in derived noun stems of Sylheti, accompanied by a concise analysis of the pitch tracks of these stems. Section 5.4 discusses tonal polarity in complex verb stems in Sylheti; the section further analyses the pitch tracks of the complex verb stems. Section 5.5 involves a phonological discussion of tonal polarity in complex stems in the language and Section 5.6 summarizes the chapter.

5.1 Tonal Polarity in Sylheti: Background

Tonal polarity requires a TBU- a morpheme in this study, to show an opposite tonal value to that adjacent to it (Schuh, 1978; Cahill, 2004). Tonal polarity has also been considered to be a result of OCP which requires two tones to assimilate or dissimilate (de Lacy, 2012; Kenstowicz, Nikiema, & Ourso, 1988). Assimilation may result in spreading - where the tone of the root spreads to the suffixes and prefixes. This coextensive relationship between assimilation and spreading allows for the extension of the tone throughout the entire word.

Dissimilation, on the other hand, requires the suffixes to bear a tone that is opposite to the neighbouring tone of the root. Tonal dissimilation and tonal polarity may appear similar at the surface level, but some studies (Cahill, 2004) have distinguished tonal polarity from dissimilation: in dissimilation the affected syllable has an identifiable underlying tone, whereas in polarization the affected syllable has no underlying tone (Newman, 1995). Polarity is fundamentally binary contrast between tone and the majority of research on tonal polarity has been conducted in the context of languages with two contrasting tones. Few studies (Chumbow, 1982; Meyase, 2021) however, indicate that this phenomenon can exist in languages with three or more tones as well. Literature on tonal polarity comes majorly from African languages like Margi (Hoffman, 1963; Pulleyblank, 1986), Bambara (Dwyer, 1976; Creissels & Grégoire, 1993), and Moore and Lama (Kenstowicz et al.,1988). Recent studies have shown that this feature is also predominant in Tibeto-Burman languages like Anál (Ozerov, 2018), Myebon Sumtu Chin (Watkins, 2013), Thadou (Hyman, 2007), Tinidiye (also known as Angami) (Meyase, 2021); tonal polarity has also been reported recently in Sylheti (Mahanta & Gope, 2018), one of the neighbouring Indo-Aryan language of the aforementioned Tibeto-Burman languages.

Complex morphemes in Sylheti exhibit a clear binary opposition between the High and Low tone values. Mahanta & Gope (2018) show that Sylheti suffixes receive an opposite tone of the underlying tone root to which they are attached. The binary opposition between the root and suffixes can be described as tonal polarity rather than OCP. Tonal polarity in Sylheti is a result of tonelessness of the suffixes and this phenomenon is clearly exhibited by the complex noun stems. For instance, the noun singular classifier /-ʈa/ or its plural form /-ʈain/ is inherently toneless and is rendered an opposite tone of the root to which it is attached. The word for *'ground-stool'*, /xàʈ/ for example, is specified for an underlying Low tone, and thus it assigns an opposite high tone to the classifier suffix /-ʈa/ which is basically toneless, thus the complex stem *'ground-stool-CL'* surfaces as the form /xàʈ-ʈá/, where the lexical tone of the root is intact and forms a LH tone contour with its suffix. In contrast, the word for *'valuable-wood'*, /xáʈ/ which has a lexical High tone, surfaces with a polar HL tone contour as the form /xáʈ-ʈà/ for the stem *'valuable-wood-CL'*. An important line of evidence supporting the concept of tonal polarity arises from the behaviour of the same plural suffix when attached to a root with the neutral Mid tone. In such cases, the resulting tone of the complex stem is remarkably level, as observed in examples like as in [ɸān-ʈā] *'betel leaf-CL'*. In the subsequent sections of this chapter, we will delve deeper into the intricacies of tonal polarity in Sylheti and explore its implications for our understanding of tonal phonology.

The chapter extensively studies complex nouns with disyllabic roots vis-à-vis all the three tones in this chapter and argue that nominal suffixes are inherently toneless and are assigned polar tones by the nominal roots to which they are attached, whereas the tonal alignment pattern in complex verb stems provides an argument in favour of dissimilation. It is well demonstrated in this chapter that noun roots in Sylheti do not change their underlying tonal specifications while interacting in complex stems.

5.2 Inflectional nominal stems in Sylheti

This section analyses nominal stems inflected for the plural, genitive, dative, and instrumental suffixes. These stems are categorized by the morphophonological form of the suffixes that attach to the nominal roots. Table 5.1 demonstrates nominal stems from all morphophonological classes. These stems surface with polar HL or LH tonal contour or with a level M and are sensitive morphophonologically.

Root	Gloss	Plural Classifier	Genitive	Plural Genitive	Accusative	Plural Accusative
búɽá	old man	búɽá-ìn	búɽà-r	búɽá-ín-t̪ɔ̀r	búɽá-rɛ̀	búɽá-ín-t̪ɔ́rɛ̀
búɽí	old woman	búɽì-n	búɽì-r	búɽí-n-t̪ɔ̀r	búɽí-rɛ̀	búɽí-n-t̪ɔ̀rɛ̀
bɔ̀in	sister	bɔ̀in-aín	bɔ̀in-ɔ́r	bɔ̀in-aìn-t̪ɔ́r	bɔ̀in-rɛ́	bɔ̀in-aín-t̪ɔ́rɛ́
ɸuā	boy	ɸuā-īn	ɸuā-r	ɸūa-īn-t̪ɔ̄r	ɸūa-rɛ̄	ɸūa-īn-t̪ɔ̄rɛ̄
ɸūɽī	girl	ɸūɽī-n	ɸūɽī-r	ɸūɽī-n-t̪ɔ̄r	ɸūɽī-rɛ̄	ɸūɽī-n-t̪ɔ̄rɛ̄
bɔ̀u	wife	bɔ̀u-aín	bɔ̀ú-r	bɔ̀u-aìn-t̪ɔ́r	bɔ̀u-rɛ́	bɔ̀u-aìn-t̪ɔ́rɛ́
bɛ̀ʈà	man	bɛ̀ʈà-ín	bɛ̀ʈá-r	bɛ̀ʈà-aìn-t̪ɔ́r	bɛ̀ʈà-rɛ́	bɛ̀ʈà-ìn-t̪ɔ́rɛ́
bɛ̀ʈì	woman	bɛ̀ʈí-n	bɛ̀ʈí-r	bɛ̀ʈì-n-t̪ɔ́r	bɛ̀ʈì-rɛ́	bɛ̀ʈì-n-t̪ɔ́rɛ́

Table 5.1. Nominal inflection and Tonal polarity in human/relational nominal complex stems

The forms of the inflectional suffixes belong to two different morphophonological categories: the first category of suffixes belong to human or relational nouns which includes the plural classifier, the dative suffix, and the genitive suffix. The second category of suffixes belong to non-human noun entities; this includes the plural classifier, the locative marker, and the instrumental marker. The plural classifier /-ain/ for instance, attaches directly to a human or relational nominal root while the inanimate root is always classified by /-ʈain/ in its plural form.

A common phonological process predominant across human or relational complex stems in Sylheti is vowel hiatus resolution. Vowel hiatus refers to a sequence of adjacent vowels belonging to separate syllables and the most common form of hiatus resolution in the languages of the world involves the elision of one of the two vowels in the sequence (Casall, 2012). That vowel hiatus is unattested in Sylheti is evident in the variants of the same plural classifier /-ain/ for different plural stems in Table 5.1; for example, the vowel [a] in the plural classifier undergoes elision when attached to vowel-ending root ending with the final vowel [a] in the word for '*old man-PL'* /búɽá-ìn/. Suffixes with an initial vowel sound usually always undergo phonological changes for both categories of suffixes

Similar process is demonstrable in plural stems where the root word ends in the vowel /i/ such as in the word for '*girl-PL*'/ɸūɽī-n/; the plural classifier /-ain/ undergoes elision of both /a/ and /i/ vowels. The classifier surfaces itself in root words ending in vowels other than /a/ and /i/ as can be observed in the word for *'wife-PL'* /bɔ̀u-áin/; similar can be observed in roots ending in consonants as in the word for *'sister-PL'* /bɔ̀in-áin/. The genitive marker /-ɔr/ loses its vowel when it is attached to a host with any vowel as in the word for *'man-GEN'* /bɛ̀ʈá-r/ and '*old man-GEN'* /búɽì-r/; the suffix /-ɔr/ surfaces only when attached to consonant ending roots such as in the stem *'sister-GEN'* /bɔ̀in-ɔ́r/. It is noteworthy that the dative suffix /-rɛ/does not change its form for any of the stems in the table; this leads us to infer that vowel hiatus is strictly unattested in the language which is why the suffixes undergo elision to resolve the conflict whereas, suffixes with a CV structure does not lead to any segmental conflict across morphemic boundaries. The plural genitive and plural dative forms are formed by infixing the plural classifier between the nominal host and the plural genitive suffix /t̪ɔr/ as in /ɸūa-īn-t̪ɔ̄r/ '*boy-PL-GEN'* or the plural dative suffix /t̪ɔrɛ/ such as in /ɸūa-īn-t̪ɔ̄rɛ̄/ *'boy-PL-DAT'*. Phonological rules in these complex stems occur over longer inflectional constructions as shown for the word *'sister'* /bɔ̀in-aìn-t̪ɔ́rɛ́/ *'sister-PL-ACC'*.

The plural classifier affixed to the non-human category of nominal hosts also undergoes vowel elision as shown in Table 5.2, where the inanimate nominal marker /-ʈa/ is infixed between the root and the plural classifier /-ain/ to classify the non-human. The plural classifier merges with its initial vowel /a/ with that of the inanimate marker and retains the same variant for all non-human entities such as in /ɸāt̪ā-ʈāin/ *'grinding stone-PL'* or /xáʈ-ʈaìn/ *'valuable wood-PL'*.

Root	Gloss	Plural Classifier	Instrumental
ɸāt̪ā	grinding stone	ɸāt̪ā-ʈāin	ɸāt̪ā-d̪iā
xàt̪à	copy	xàt̪à-ʈáin	xàt̪à-d̪iá
xát̪á	blanket	xát̪á-ʈàin	xát̪á-dià
xāʈā	thorn	xāʈā-ʈāin	xāʈā-diā
xáʈ	valuable wood	xáʈ-ʈàin	xáʈ-d̪ià
xàʈ	ground stool	xáʈ-ʈàin	xàʈ-d̪iá
ɸān	betel leaf	ɸān-ʈāin	ɸān-d̪iā
ɸàn	yam leaf	ɸàn-ʈáin	ɸàn-d̪iá
xáʈɔ̀l	jackfruit	xáʈɔ̀l-ʈàin	xáʈɔ̀l-d̪ià
sāʈā	earthen candle	sāʈā-ʈāin	sāʈā-d̪iā
sùlà	scrubber	sùlà-ʈáin	sùlà-d̪iá

Table 5.2 Non-human inflectional noun stems

As can be observed in the table, the instrumental suffix /-d̪iā/ surfaces with the same form through all nominal stems; the suffix undergoes glide insertion and thus always surfaces as /-d̪ija/. The suffix surfaces with a consonant ending root such as in /ɸān-d̪iā/ *'betel-leaf-INST'* as well as with a vowel ending root such as in /sùlà-d̪iá/ *'scrubber-INST'*.

5.2.1 Tonal polarity

As discussed above, Mahanta and Gope (2018) have shown that suffixes are toneless in Sylheti and tonal polarity enforces these suffixes to surface with an opposite tone than that of the root. In a similar vein, our dataset in Table 5.1 and Table 5.2 analyses the tonal alignment across morphemes and shows that complex nominal stems posit a strict restriction against the occurrence of a LL or a HH contour. Consider the word for '*sister-PL'* in Table 5.1, the root [bɔ̀in] is prespecified for a lexical Low tone in this stem, which surfaces itself and instantiates an opposite high tone on the plural suffix /-ain/, forming an LH contour in the form /bɔ̀in-áin/ 'sister-PL'. This structure of nominal stems is consistent in constructions with an underlying High tone as in the form for the word *'old woman-PL'*, /búʈì-n/; the root with an underlying Low tone enforces an opposite high tone on the toneless plural suffix to form a HL contour. A careful observation of the tonal alignment in stems such as, /búʈì-n/ *'old woman-PL'* suggests that tonal polarity the dataset for plural genitive and plural accusative columns in Table 5.1, leads us to observe that tonal polarity is peripheral in Sylheti; in a complex structure of noun and its suffix, the rightmost TBU surfaces with a polar tone of that in the root. If the complex stem contains more than one suffix, the opposite tone always lodges itself at the rightmost suffix of the domain of a complex stem such as in the form for the word *'old woman-PL-GEN'* [bɔ̀in-aìn-t̪ɔ́r]; the low tone of the LH tone contour aligns to the root [bɔ̀in] *'sister'* and the plural infix /-ain/; the rightmost suffix, i.e., the plural genitive suffix [-t̪ɔr] surfaces with the polar high tone. We may observe that in words like '*woman-GEN'* /bɛ̀ʈí-r/ or *'old woman-PL'* /búʈì-n/, the polarized tone is always realized on the final TBU of the root; this tonal alignment pattern is observed for roots ending in /i/.

Of particular divergence here is the behavior of the neutral tone or the Mid tone as can be seen in [ɸuā-īn] *'boy-PL'* and [ɸūʈī-n] *'girl-PL'*; the Mid tone does not work in the same predictable ways. The same plural classifier in both these stems surfaces with a level tone when affixed to a root with the neutral tone. This tonal alignment may be observed for the complex stem for '*boy-GEN*', [ɸuā-r]; the tone of the root word [ɸuā] *'boy'* remains unchanged and spreads over to the genitive suffix [-r]. Tonal polarity is thus exhibited by High and Low tones only and the Mid tone, which is immune to polarity, spreads over to the toneless suffix.

The Instrumental suffix /-d̪ia/ for inanimate nominal stems behaves in the same way and exhibits polarity for the root noun with either High or Low lexical tones. Consider the word [xáʈɔ́l-d̪ià] '*jackfruit-INST'* in Table 5.2 where the underlying High tone surfaces as itself and enforces a low tone on the instrumental suffix thus forming thus forming a LH tone contour. In contrast, the underlying Low tone of the root in the form [sùlà-d̪iá] *'scrubber-INST'* enforces a high tone on the same instrumental suffix, thus forming a HL tone contour. The neutral tone of the root in the form for the complex word '*grindstone-INST'*, [sāʈā-diā] is immune to polarity and thus the stem surfaces with a level tone.

5.2.1.1 Analysis of the pitch tracks in inflectional nominal stems

Our observation of tonal polarity in inflectional nominal stems is demonstrated well in our analysis of the pitch tracks of the words elaborated in this subsection.

5.2.1.1.2 Methodology

A set of 20 inflectional stems and a set of 10 derivational stems was studied to probe into the prosodic structure. Data was collected from 4 native speakers (2 males, 2 females) of Sylheti. Two of the speakers belong to the 50 – 55 age group (age group 1): one male and one female; two of the speakers belong to the 26 – 28 age group (age group 2): one male and one female. The material with target words were displayed on a screen as well as on a sheet of paper along with the meaning of each word written. The words were recorded in a controlled environment of SOV order. Each target word had 2 tokens and the words were recorded in sentential contexts with x being the target word within declarative sentence frame of the SOV order were uttered as:

ami X xɔi-si

1st p X say-perf 1p

I said *X*.

Each sound file was segmented and annotated on PRAAT and the time-normalized f0 values of the vowel of each target syllable starting from the onset till the offset of voicing of the rime were extracted with the help of the script [Prosody Pro] (Xu, 2013). The script extracted 10 time points (time-normalized) for each syllable and the averages of the intervals of time-normalized f0 values for the complex words were plotted to observe the pitch contour throughout the words. The forthcoming subsection (5.2.1.1.3) discusses the tonal alignment in inflectional stems; derivational complex stems are discussed in the subsection 5.3.1.

5.2.1.1.3 Results and discussion

We plotted the pitch contours of the complex words online graphs to observe the tonal alignment across morphemes; each syllable is represented by ten separate time points in these pitch tracks. A careful observation of the pitch tracks shows that both inflectional and derivational complex words in Sylheti surface with either LH or HL tone contour and a level M tone. The fine-grained F0 alignment differences do not affect meaning or representation and are instead considered to arise from differences in phonetic implementation rather than phonological representation. On analysing the tonal patterns, it is observed that when the root of a word carries a high tone, the high tone is realized on the second syllable. Conversely, when the root has a low tone, an interesting rising tone is observed on the first syllable of the suffix. This observation suggests a clear correlation between the tonal properties of the root and the resulting tonal contours in the derived word. The consistent realization of the H tone on the second syllable and the rising tone on the first syllable of the suffix highlights the role of tonal interactions and provides insights into the phonological processes at play in this language.

A careful observation of the pitch tracks for the complex nominal stems suggest that the suffixes are inherently toneless in Sylheti. Consider the form [xàt̪à-t̪áin] *'notebook'-PL'* in Figure 5.1: the underlying Low tone of the root noun imposes a high tone on the plural suffix

/-ʈain/. The disyllabic root surfaces with its underlying low tone on both the syllables in [xàʈ̪à] *'notebook'* and the plural root rises to form a LH contour.

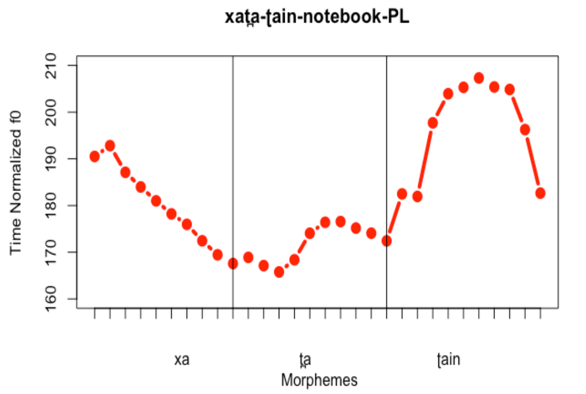


Figure 5.1 Pitch contour for the word /xaʈ̪a̠-ʈáin/ *'notebook-PL'*. Speakers = 4, N = 8
Note: The Low tone of /xaʈ̪a̠/ surfaces with a falling contour to about 170 Hz and /-ʈáin/ surfaces with a rising tone to about 210 Hz

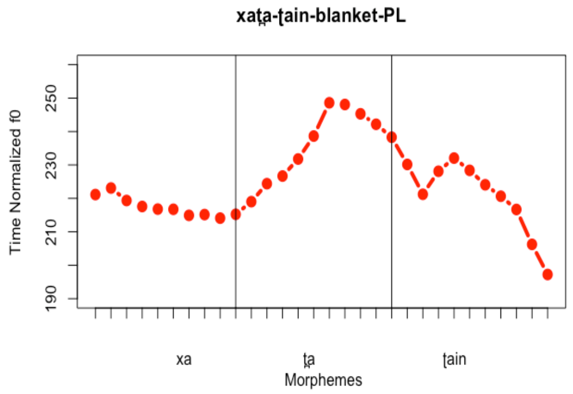


Figure 5.2 Pitch contour for the word /xáʈ̪á-ʈàin/ *'blanket-PL'*. Speakers = 4, N = 8
Note: The High tone of /xáʈ̪á/ surfaces with a rising contour to about 250 Hz and /-ʈàin/ surfaces with a falling tone to about 190 Hz

The same suffix is assigned a low tone by its root in the word [xáʈ̪á-ʈ̪àin]; this can be observed in Figure 5.2. The underlying High tone of the root noun /xáʈ̪á/ *'blanket'* imposes a low tone on the plural suffix /ʈain/ forming a HL contour. It can be observed in Figures 5.1 and 5.2 that the complex noun stems with the same plural suffix surface with the polar LH and HL contours. In contrast to the forms [xa̠ʈ̪a̠-ʈáin] *'notebook-PL'* and [xáʈ̪á-ʈàin] *'blanket-PL'*, we may observe that the same plural suffix surfaces with the tone of its host pre-specified for an underlying Mid tone.

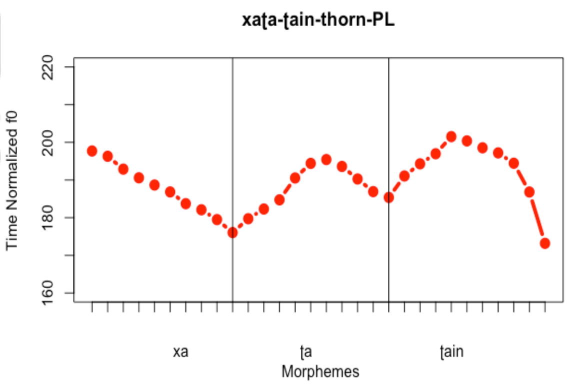


Figure 5.3 Pitch contour for the word [xāʈ̪ā-ʈāin] *'thorn-PL'*. Speakers = 4, N = 8
Note: The Mid tone of /xāʈ̪ā/ surfaces with a level pitch of about 200 Hz which continues to the suffix /-ʈāin/

It is thus represented by the plural forms of the near minimal triplets /xáʈ̪á/ *'blanket'*, /xāʈ̪ā/ *'thorn'*, and /xàʈ̪à/ *'notebook book'* that the tone of the plural suffix /-ʈain/ relies on the

underlying tone. The complex stems with a root pre-specified for either a High or a Low tone prohibit the occurrence of LL or HH sequences, resulting in the polar contours LH and HL.
It is thus demonstrable by the plural forms of the near minimal triplet that the tone of the plural suffix /-ʈain/ depends on the underlying tone. It is also demonstrable that are exhibited by complex stems with a root pre-specified for either a High or a Low tone and these tones prohibit the occurrence of LL or HH sequences which results in the polar contours LH and HL. We may also observe the non-polar behavior of the Mid tone for the form [ɸān-ʈāin] *'betel-leaf-PL'* in Figure 5.4. The monosyllabic root noun /ɸān/ *'betel-leaf'* surfaces with the neutral Mid tone which is immune to polarity, and the plural suffix /-ʈain/ thus also remains unspecified for a tone, resulting in a level tone.

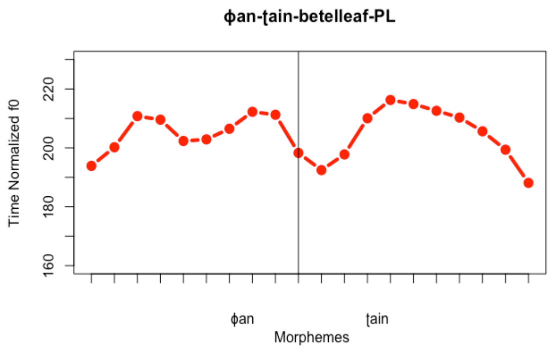


Figure 5.4 Pitch contour for the word [ɸān-ʈāin] *'betel-leaf-PL'*. Speakers = 4, N = 8

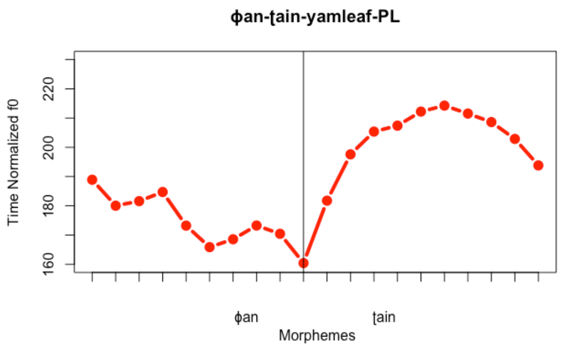
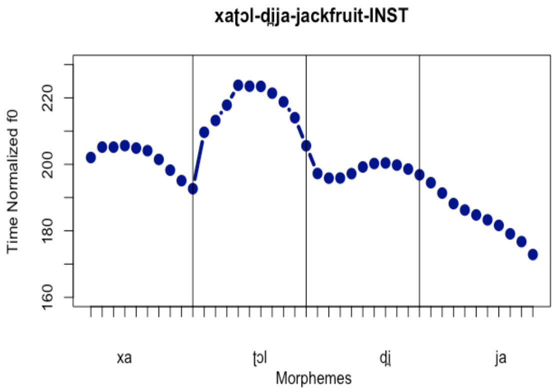


Figure 5.5 Pitch contour for the word [ɸàn-ʈáin] *'yam-leaf-PL'*. Speakers = 4, N = 8

The same suffix is assigned a high tone by its monosyllabic host pre-specified for an underlying Low tone thus forming a LH contour as can be observed in Figure 5.5, for the form [ɸàn-ʈāin] *'yam leaf-PL'*.

We observe the polarity for the instrumental suffix /-d̪ia/. We have used the suffix's phonetic form [-d̪ija] in our analysis of the pitch tracks of complex nominal stems to better understand the tonal alignment across syllables. As can be observed in Figure 5.6, the instrumental suffix [-d̪ija] surfaces with a low tone when it is affixed to the root prespecified for a lexical High tone, /xáʈɔ́l/ *'jackfruit'* and thus the form [xáʈɔ́l-d̪ìja] surfaces with a HL tone contour.



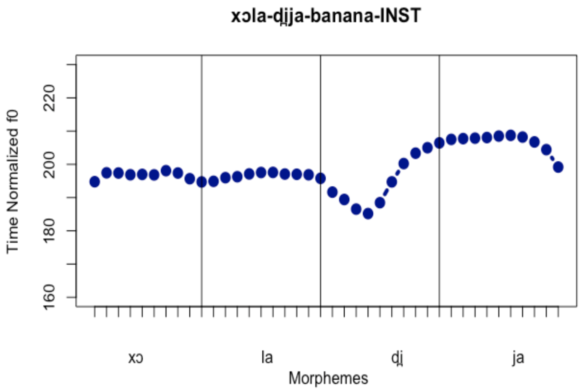
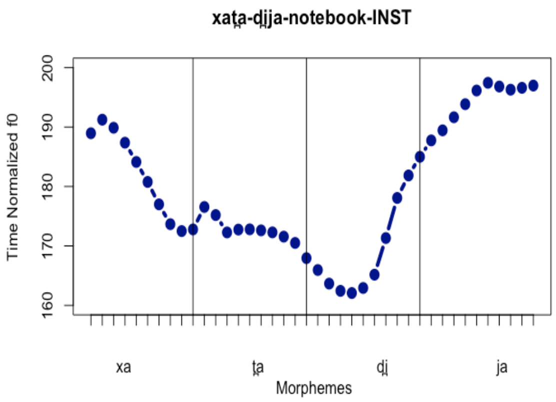


Figure 5.6 Pitch contour for the word [xáʈɔ́l- d̪ìjà] '*jackfruit-INST'. Speakers = 4, N = 8*

Figure 5.7 Pitch contour for the word [xɔ̄lā- d̪ījā] *'banana-INST'. Speakers = 4, N = 8*

The same suffix surfaces with a Mid tone, when affixed to its host /xɔ̄lā/ *'banana'* as can be observed in the form [xɔ̄lā-d̪ījā] Figure 5.7. The polar LH tone contour is observed for the same instrumental suffix when attached to its host /xàʈ̪à/ *'notebook',* pre-specified with an underlying Low tone; this can be observed in Figure 5.8 for the form [xàʈ̪à-díjá] *'notebook-INST'.*



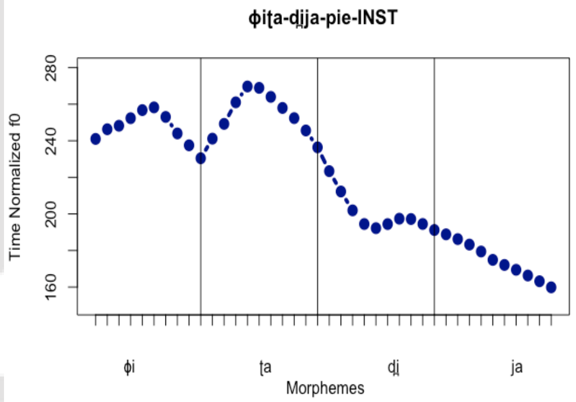


Figure 5.8 Pitch contour for the word [xàʈ̪à-d̪íjá] *notebook-INST'. Speakers = 4, N = 8*

Figure 5.9 Pitch contour for the word [ɸíʈá-d̪ìjà] *'pie-INST'. Speakers = 4, N = 8*

As it can be observed in Figure 5.8, the root noun surfaces with the lexical Low tone and the suffix /-dija/ is assigned an opposite high tone thus forming the LH tone contour. The tonelessness of the instrumental suffix is also demonstrable in the form [ɸíʈá-d̪ìjà] *'pie-INST'* in Figure 5.9. As can be observed in the figure, the lexical High tone of the root [ɸíʈá] *'pie'* surfaces itself, enforcing an opposite low tone on the suffix /-d̪ija/ and thus forming the HL contour.

We observed tonal polarity in human/relational nominal stems as well. Consider the form [bɛ̀ʈà-ìn-ʈ̪ɔ́rɛ́] *'man-PL-GEN'* in Figure 5.10: the rightmost suffix, i.e., the plural accusative suffix /-ʈ̪ɔrɛ/ surfaces with a high tone when attached to the plural stem [bɛ̀ʈà-ín] *'man-PL'*. It is observable that tonal polarity is exhibited by the rightmost suffix, whereas the plural infix here surfaces with the underlying Low tone of the root noun /bɛ̀ʈà/; the nominal stem [bɛ̀ʈà-ìn-ʈ̪ɔ́rɛ́] thus surfaces with a LH contour.

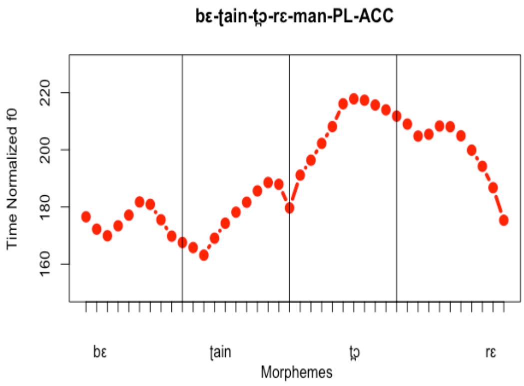


Figure 5.10 Pitch contour for the word [bɛ̀ʈà-ìn-ʈ̪ɔ́rɛ́] *'man-PL-ACC', Speakers = 4, N = 8*

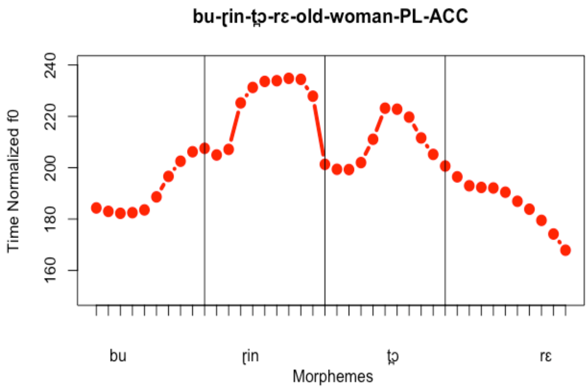


Figure 5.11 Pitch contour for the word [búɽínʈ̪ɔ̀rɛ̀] *'old-women-GEN' Speakers = 4, N = 8*

The same genitive plural suffix, /-ʈ̪ɔrɛ/ surfaces with a low tone in the stem [búɽí-n-ʈ̪ɔ̀rɛ̀] *'old woman-PL-GEN'* in Figure 5.11. As can be observed in the figure, the plural infix /-n/ surfaces with the underlying High tone of the root noun [búɽí] *'old woman'*; /-ʈ̪ɔrɛ/ surfaces with an opposite low tone thus forming the HL contour.

5.3 Derived noun stems

The bound morphemes in derived forms are like lexical morphemes in that they may belong to a syntactic category such as Noun, Verb or Adjective. These affixes thus belong to the syntactic category of the complex words of which they form a part (Booij, 2005). Most of the derived stems in this section are either derived abstract nouns or adjectives as shown in Table 5.3.

Root verbs	Derived form	Gloss	Derived Meaning
xām	xām-lā	work – Adj-Mas	worker
ɸɛ̄ʈ	ɸɛ̄ʈ-lā	stomach – Adj-Mas	big bellied (man)
xà	xà-úrá	eat – NOM-Mas	eater
ɸɛ̄nd̪ā	ɸɛ̄nd̪ā-ūrī	weep – NOM-Fem	weeper
gɔ́r	gɔ́r-ùa	home – Adj	homely
ɸɔ́t̪	ɸɔ́t̪-ùa	road-Adj	homeless/stray
ɸūx	ɸūx-ɽā	worm-Adj	infested
ɸàt̪rà	ɸàt̪rà-mí	buffoon – NOM	facetiousness
ɸūŋʈā	ɸūŋʈā-mī	comedian-NOM	buffoonery
sùsrà	sùsrà-mí	fraud-NOM	deceitfulness
sūr	sūr-amī	thief-NOM	theft
gàìndʑà	gàìndʑ-urí	cannabis-Adj	cannabis-addict

Table 5.3 Derivational noun stems

It is observable from the dataset in Table 5.3 that the derivational suffixes in Sylheti are bound by phonotactic constraints for each morphophonological category. The adjectival suffix /-la/ for example, only attaches to consonant-ending noun roots as in [xām-lā] *'work-Adj'* and [ɸɛ̄ʈ-lā] *'stomach-Adj',* whereas the adjectival suffix /-ura/ or /-uri/[13] attaches to vowel-ending verb roots as in /xà-úra/ *'eat – NOM'* and [ɸɛ̄nd̪ā-ūrī] *'weep–NOM'*. The form [-ami] of the nominalizer suffix also undergoes vowel elision when it attaches to adjectives or noun roots to derive abstract nouns, for example, when it is affixed to roots ending in the vowel /a/ as in [ɸàt̪rà-mí] *'buffoon – NOM'* and retains its basic form [-ami] when attached to roots ending in consonants as in [sūr-amī] *'thief-Nom'*.

5.3.1 Tonal polarity in derived stems: discussion of analysis of pitch tracks

Our observation of the derived nominal stems suggests that tonal polarity is also inherent across derivative nominal stems. Consider the stem [ɸɔ́t̪-ùa] *'work-NOM'*; the root noun [ɸɔ́t̪] *'road'* has an underlying High tone, and it imposes an opposite low tone on the toneless nominalizer morpheme /-ua/, thus forming a HL contour as can be observed in Figure 5.12.

[13] Nouns ending in vowel /i/ is specified for feminine gender whereas /a/ is for masculine gender in Sylheti.

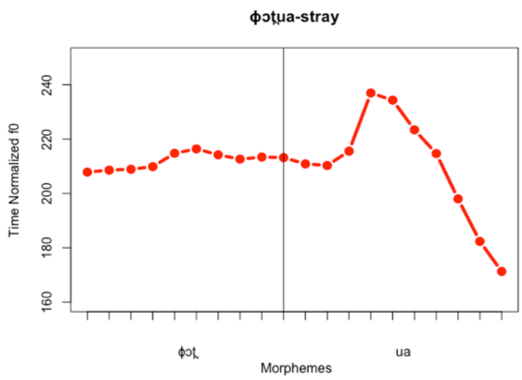


Figure 5.12 Pitch contour for the word [ɸɔ́ʈùa] *'stray'. Speakers = 4, N = 8*

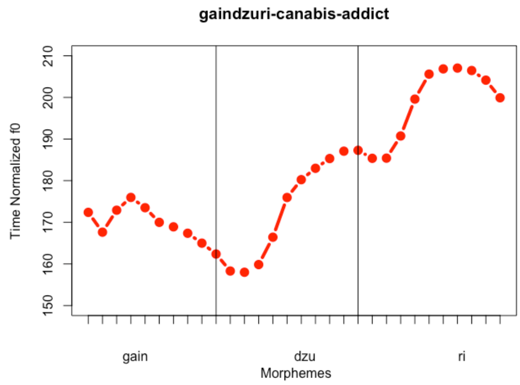


Figure 5.13 Pitch contour for the word [gaìnʣurí] 'cannabis addict'. *Speakers = 4, N = 8*

A polar LH contour can be observed in Figure 5.13 for the derived stem [gaìnʣ-urí] *'cannabis addict'*. The root /gàinʣà/ prespecified for a lexical Low tone, imposes a high tone on the adjectival suffix /-uri/. Similar LH tone contour is exhibited by the complex stem [xaù-rá] *'eater'* as can be observed in Figure 5.14. The underlying Low tone of the root /xà/ *'eat'* imposes an opposite high tone on the nominalizer suffix /-ura/.

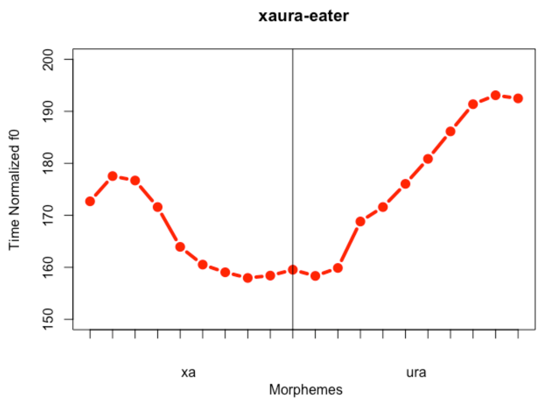


Figure 5.14 Pitch contour for the plural word [xà-urá] *'eater'. Speakers = 4, N = 8*

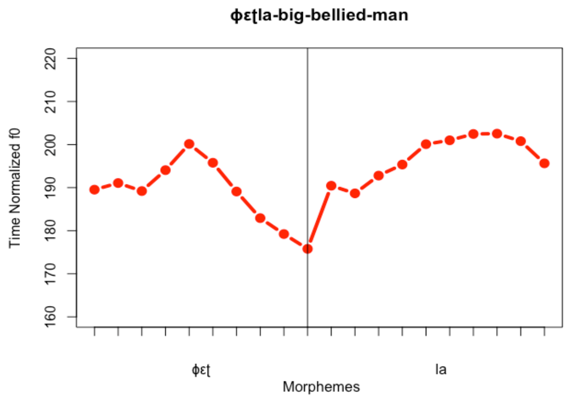


Figure 5.15 Pitch contour for the plural word [ɸɛ̄ʈlā] *'big-bellied-man'. Speakers = 4, N = 8*

The root [ɸɛ̄ʈ] *'stomach'* in Figure 5.15 with a neutral tone can be observed to surface with a level tone along with the adjectival suffix [-la], thus the complex stem [ɸɛ̄ʈlā] *'big-bellied man'* surfaces with a level M tone across morphemes.

5.4 A brief analysis of complex verb stems

The pattern of tonal polarity exhibited by nominal complex stems has been argued to be contradicted by verbs in the study conducted by Mahanta and Gope (2018). The study shows that verbal suffixes with prespecified tones impose their opposite tonal value on verbal stems, thereby inducing a change in the tone of the root. The authors argue that verbal suffixes have a dominant high tone such that it induces the root to change its tone to a value that is opposite to its own. Most of the verbal suffixes are claimed to be prespecified for a high tone which might enforce a verb with a lexical High tone to surface as a low tone.

This section investigates complex verb stems vis-à-vis all the three lexical tones and their alignment across morphemes in these words. Our study on the tonal behaviour of verb stems involved verb suffixes belonging to two different aspectual classes: the perfective class and the habitual suffix which belongs to the perfective class. Unlike the previous studies, our analysis shows that the tonal behaviour of the verbal suffixes may differ according to their aspectual class; both the imperfective (habitual) and perfective suffixes inflect for person as shown in the dataset in Table 5.4.

Root	**Gloss**	**Habitual suffix**			**Perfective suffix**		
		1P	2P	3P	1P	2P	3P
ɸāt̪	spread	ɸàt̪-í	ɸàt̪-ɔ́	ɸàt̪-ɛ́	ɸát̪-sí	ɸát̪-sɔ́	ɸát̪-sɛ́
xāʈ	cut	xàʈ-í	xàʈ-ɔ́	xàʈ-ɛ́	xáʈ-sí	xáʈ-sɔ́	xáʈ-sɛ́
xàʈ	toil	xàʈ-í	xàʈ-ɔ́	xàʈ-ɛ́	xàʈ-sì	xàʈ-sɔ̀	xàʈ-sɛ̀
sìr	tear	sìr-í	sìr-ɔ́	sìr-ɛ́	sìr-sì	sìr-sɔ̀	sìr-sɛ̀
bɔ́r	fill	bɔ̀r-í	bɔ̀r-ɔ́	bɔ̀r-ɛ́	bɔ́r-sí	bɔ́r-sɔ́	bɔ́r-sɛ́
gúr	spin	gùr-í	gùr-ɔ́	gùr-ɛ́	gúr-sí	gúr-sɔ́	gúr-sɛ́

Table 5.4 Verb stems

The basic phonological skeleton of the morpheme for the habitual suffix is /-V/ which alters with the person inflection. The inflection for the first person is marked by the morpheme /-í/ as in the word for the complex stem [ɸàt̪-í] *'spread-HAB-1P'* in the table; inflection for the second person is marked by the morpheme /-ɔ́/ as in the complex stem [xàʈ-ɔ́] *'toil-HAB-2P'*; inflection for the third person is marked by the suffix /-ɛ́/ as in the complex stem [bɔ̀r-ɛ́] *'fill-HAB-3P'*.

The columns for the perfective suffix in Table 5.4 shows the inflections for person and the tonal specifications of the perfective verb stems. The perfective suffix is marked by the basic suffix /-sV/. The inflection for the first person is marked by the morpheme /-sí/ as in the word for the complex stem [ɸát̪-sí] *'spread-PERF-1P'* in the table; inflection for the second person is marked by the morpheme [-sɔ́] as in the complex stem [xàʈ-sɔ̀] *'toil-PERF-2P';* inflection for the third person is marked by the suffix /-sɛ́/ as in the complex stem [bɔ́r-sɛ́] *'fill-PERF-3P'*. One notable pattern observed for the perfective stems is that the tone of the root predominates over other factors, except in cases where the root is unspecified or carries the neutral tone. This will be discussed in detail in 5.4.1.

5.4.1 Tonal polarity in complex verb stems

A careful observation of the dataset for the habitual aspect in Table 5.3 demonstrates that unlike the nominal suffixes, the completive suffix is prespecified for high tone which is evident from the uniformity of its tonal value across different verbs irrespective of their underlying tone. The underlying lexical tone of the verbal hosts do not condition any alteration in the tonal specification for the suffix. We concur with Mahanta and Gope (2018) on this and show that unlike nominal suffixes, verbal suffixes are prespecified for a dominant high tone in a complex verb stem and these suffixes tend to alter the tone of the root. Additionally, our analysis argues that the habitual verb stems always surface with a LH tone contour whereas the tonal patterns in verb stems inflected for the perfective aspect behave differently. Consider the form of the habitual verb stem [ɸàt̪-í] *'spread-HAB-1P'* in Table 5.3: the root verb /ɸāt̪/ *'spread'* has a neutral tone but when followed by a suffix prespecified for a high tone, it surfaces as a low tone; the suffix always surfaces with its underlying high tone, thus forming a LH tone contour. This tone contour is uniform across person inflections of the habitual stems. This can be demonstrated by the person inflections for the same verb; consider the second person inflection, [ɸàt̪-ɔ́] *'spread-HAB-2P'* and the third person inflection, [ɸàt̪-ɛ́] *'spread-HAB-3P'*. As can be observed in these stems, the habitual suffix inflected for second person, i.e., the form /-ɔ́/ and third person, i.e., the form /ɛ́/ enforce the root /ɸāt̪/ *'spread'* to surface as a low tone, thus forming the LH tone contour. The tonal conflict between the root and its suffix with an underlying high tone can also be observed in the verb stem [gùr-í] *'spin-HAB-1P'*. The root verb /gúr/ *'spin'* is underlyingly specified for a lexical High tone which is enforced to surface as a low tone by the habitual suffix prespecified for a high tone /-í/, thus forming the LH tone contour. It is noteworthy that we do not observe a polar HL tone contour in habitual verb stems. Habitual verb stems behave differently for stems with lexical Low tone specified for the root which is demonstrated by the verb stems specified for the root. Consider the stem [xàʈ-ɛ́] *'toil-HAB-3P'*; the root /xàʈ/ surfaces with its underlying Low tone and the habitual suffix /-ɛ́/ is observed to surface with its underlying high tone. This pattern is also observed for the verb stem [sìr-ɛ́] *'tear-HAB-3P'* which suggests that an underlying LH undergoes no change.

The perfective verb stems however exhibit HH and LL tone sequences at the surface level. Consider the form [xáʈ-sɛ́] *'cut-PERF-3P'*: unlike the habitual verb stems, the root /xāʈ/ *'cut'* specified for a lexical Mid tone, surfaces as a high tone and the perfective suffix /-sɛ́/ which is also surfaces with its underlying high tone in the perfective stem. As demonstrated in the table, the second and third-person inflections exhibit a similar pattern for tonal alignment across the perfective aspect form of verb stems as well.

As can be observed in the table, the perfective suffix, prespecified for a high tone, surfaces with its underlying tone but it does so without enforcing an opposite tonal value on its host, such as in the stem, [gúr-sɔ́] *'spin-PERF-2P'*. Similar phenomenon is observed for the Mid tone: for instance, the verb root and the perfective suffix surface with their underlying tones in the stem [ɸát̪-sɔ́] *'spread-PERF-2P'*. Similarly, roots with lexical Low tone also surfaces with its underlying tone but the suffix prespecified with high tone surfaces with a low tone as can be observed in the stem [xàt-sì] *'toil-PERF-1P'* in the table. The tonal alignment across verb stems in Sylheti will be discussed in detail in the subsection 5.4.2.

5.4.2 Analysis of the pitch tracks in complex verb stems

We analyse the difference between the tonal alignment patterns across verb stems based on their aspectual inflections. Our analysis shows a clear difference in the tonal behaviours of habitual and completive aspects which are discussed below. Unlike the habitual suffix, the perfective suffix always raises the pitch range of its host with an underlying Mid or High tone. This tonal behavior varies for the lexical Low tone; the lexical Low tone surfaces itself in the perfective verb stem and the prespecified high tone of the suffix alters to a low tone, thus forming a level L tone in such constructions.

The methodology for this analysis was kept unchanged as that for nominal stems. Pitch tracks for both the perfective and imperfective aspects were plotted next to each other for each of the verb stems to observe the difference in tonal behaviour between the two classes of verb stems.

5.4.2.1 Results and discussion

A careful observation of the pitch tracks for the complex verb stems suggests that unlike the nominal suffixes the verbal suffixes are prespecified with a high tone. The suffixes exhibit a dominance and enforces the root to change its underlying tone. As a result, we observe a persistent LH surface contour for the habitual aspect. Consider the form [gùr-í] *'spin-HAB-1P'* where the verb /gúr/ *'spin'* inflected for the first person, habitual aspect in Figure 5.15. The underlying high tone of the suffix /-í/ surfaces itself, enforcing the root /gúr/ *'spin'* to surface with a low tone, thus forming a LH tone contour.

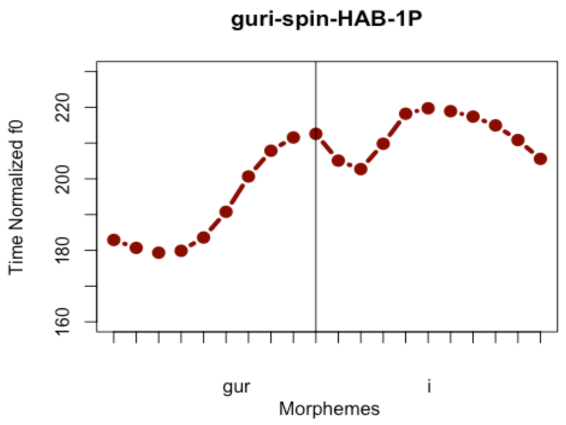


Figure 5.16 Pitch contour for the verb stem [gùr-í] *'spin-HAB-1P'. Speakers = 4, N = 8.* **Note:** /gúr/ surfaces with a much lower pitch range than the suffix /-i/ which surfaces with a high pitch of about 215 Hz.

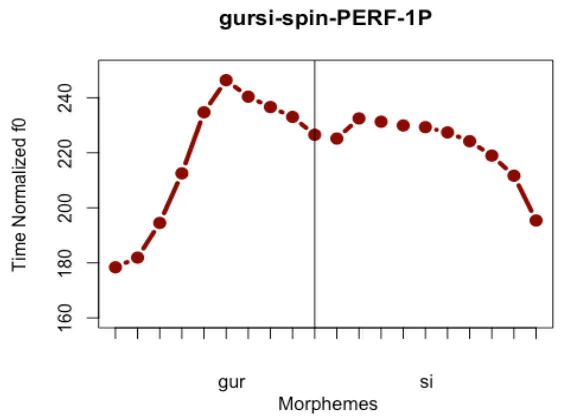


Figure 5.17 Pitch contour for the verb stem [gúr-sí] *'spin-PERF-1P'. Speakers = 4, N = 8.* **Note:** /gúr/ surfaces as a high tone with a pitch range of about 245 HZ which is much higher than the suffix /-í/ in Figure 5.15 and the suffix /-sí/ also surfaces as its underlying high tone.

As can be observed in Figure 5.16, the same verb inflected for the first person, perfective aspect, surfaces with its underlying High tone and the perfective suffix prespecified for a high tone also surfaces with its underlying tone.

The tonal structure of the verb /ɸāt̪/ 'spread' inflected for the first person, habitual aspect resembles that of the verb stem [gùr-í] *'spin-HAB*-1P'. The Mid tone of the root is also enforced to surface with an opposite low tone by the suffix which always surfaces with its underlying high tone. The form [ɸàt̪-í] *'spread-HAB-1P'* plotted in Figure 5.18 suggests that the underlying Mid tone of the root verb surfaces as a low tone when followed by the habitual suffix prespecified for a high tone, thus forming the LH tonal contour. This tonal alteration is enforced by the suffix prespecified for high tone to impose the inherent polarity in the language. The perfective suffix is observed to raise the pitch range of the root verb and the stem surfaces with an overall rising tone.

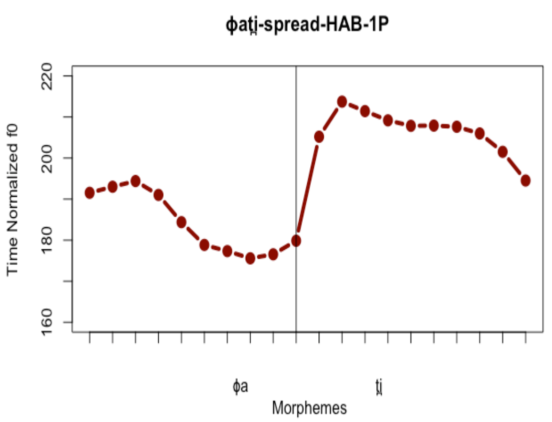


Figure 5.18 Pitch contour for the verb stem [ɸàt̪-í] *'spread-HAB-1P'. Speakers = 4, N = 8.*
Note: The low tone surfaced for the verb root /ɸāt̪/ has a much lower pitch range of about 190-180 Hz than the root with underlying high tone in Figure 5.15; the difference between lexical high and mid tones can be observed in these forms.

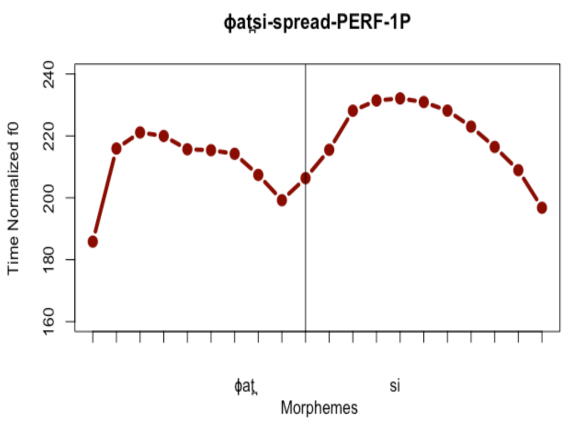


Figure 5.19 Pitch contour for the verb stem [ɸát̪-sí] *'spread-PERF-1P'. Speakers = 4, N = 8.*
Note: *An overall rise in the pitch range for the verb stem can be observed; the pitch* for the verb root /ɸāt̪/ *is about 220 Hz, much higher than the habitual form of the verb in Figure 5.17.*

The suffix [-sí] for the perfective aspect prespecified with a high tone tends to rise the tone of its host which is demonstrable in Figure 5.18 in the form [ɸáṯ-sí] *'spread-PERF-1P'*. The verb root /ɸāṯ/ with the underlying neutral tone surfaces as a high tone when followed by the perfective suffix prespecified for a high tone.

The difference between the tonal behavior of the perfective and imperfective aspects of verb in Sylheti is uniform across person inflections. Consider the form [bɔ̀r-ɔ́] *'fill-HAB-2P'* for where the root verb is inflected for the second person and habitual aspect. The root verb, /bɔ́r/ *'fill'* has an underlying High tone which is enforced to surface as a low tone by the habitual suffix /-ɔ/, prespecified for a high tone forming a LH contour as can be observed in Figure 5.19. Figure 5.20 demonstrates the uniformity of the high tone across morphemic boundaries in the perfective form of the verb /bɔ́r/ *'fill'*, [bɔ́r-sɔ́] *'fill-PERF-2P'*, inflected for the second person.

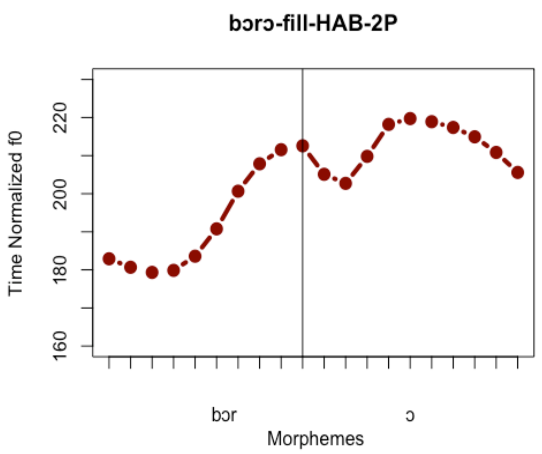


Figure 5.20 Pitch contour for the verb stem [bɔ̀r-ɔ́] *'fill-HAB-2P'. Speakers = 4, N = 8.*

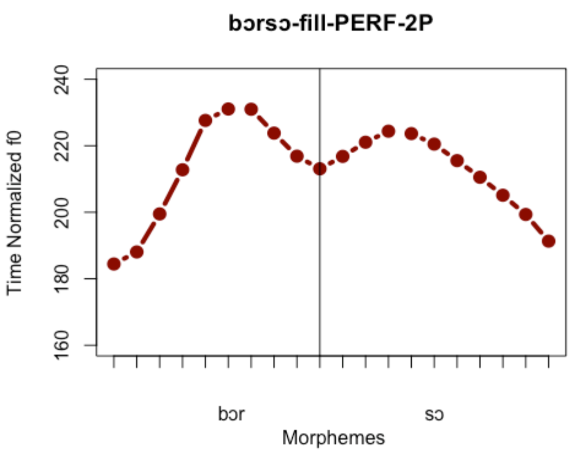


Figure 5.21 Pitch contour for the verb stem [bɔ́r-sɔ́] *'fill-PERF-2P'. Speakers = 4, N = 8.*

A difference in the behavior of the verb stems can be observed in forms with a lexical Low tone specified for the root verb as can be observed in Figure 22 and 23. The verb root /xàʈ/ *'toil'* prespecified for a lexical Low tone surfaces itself in the form [xàʈ-ɛ́] *'toil-HAB-3P'*; the habitual suffix prespecified for a high tone also surfaces itself in this form. It is thus demonstrable that the habitual suffix does not alter the tone of the root as its underlying tonal value is opposite to that of the suffix. As the stem surfaces with a LH tone contour, no tonal alteration is observed in verb stems with a lexical Low tone specified for the root.

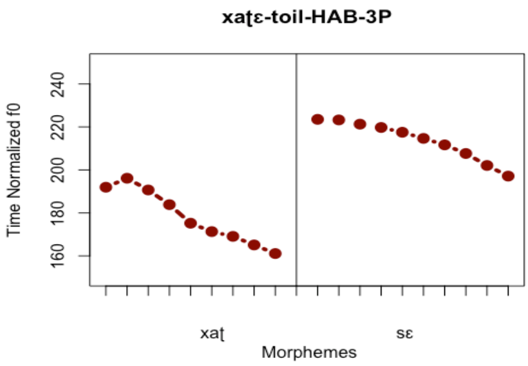


Figure 5.22 Pitch contour for the verb stem [xa̖ʈ-ɛ́] *'toil-HAB-3P'*
Speakers = 4, N = 8

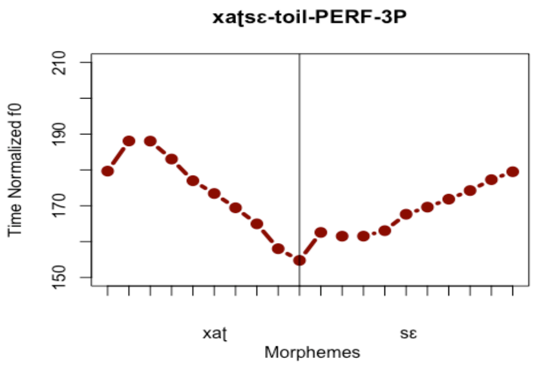


Figure 5.23 Pitch contour for the verb stem [xa̖ʈ-sɛ̀] *'toil-PERF-3P'*
Speakers = 4, N = 8

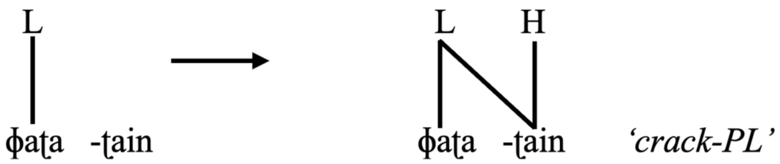
The same verb also surfaces with a Low tone when it hosts the perfective marker suffix such as in the stem [xàʈ-sɛ̀] *'toil-PERF-3P'*. It is noteworthy that the perfective suffix /-sɛ́/ prespecified for a lexical high tone surfaces as a low tone when affixed to a root prespecified for a lexical Low tone. The lexical Low tone of the roots in Sylheti verb stems have been observed to always surface itself unlike the lexical Mid and High tones which are altered depending on the aspectual class of the verbal suffix.

5.5 Discussions: Tonal Polarity in Sylheti complex stems

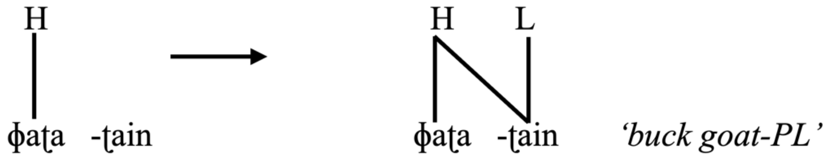
Our analysis of complex stems in Sylheti demonstrates that nominal stems clearly exhibit tonal polarity. Our analysis shows that nominal suffixes inherently lack their own tonal specifications and the same suffix may surface with three different tones, depending on the lexical tonal specification of the root to which it is attached. The tonelessness of the suffixes proves that the root and suffix are dominated by single tonal node leading a nominal root to form a prosodic domain along with its suffix. The possible autosegmental representation of tonal alignment of complex nominal stems in Sylheti can thus be summarised using the instance of plural classifier suffix /-ʈain/ attached to the tonal triplet /ɸáʈá/ '*buck-goat'*, /ɸāʈā/ *'grind-stone'* and /ɸa̖ʈa̖/ *'crack'*. This suffix has been used in to represent all nominal suffixes analyzed in the study. We have adopted the autosegmental notations used by Cahill (2004) to summarise the possible underlying and surface representations of how tonal polarity is achieved in Sylheti nominal complex stems:

1. *Autosegmental representation of tonal polarity in nominal complex stems :*

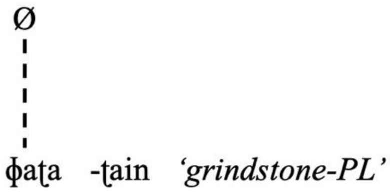
a)



b)



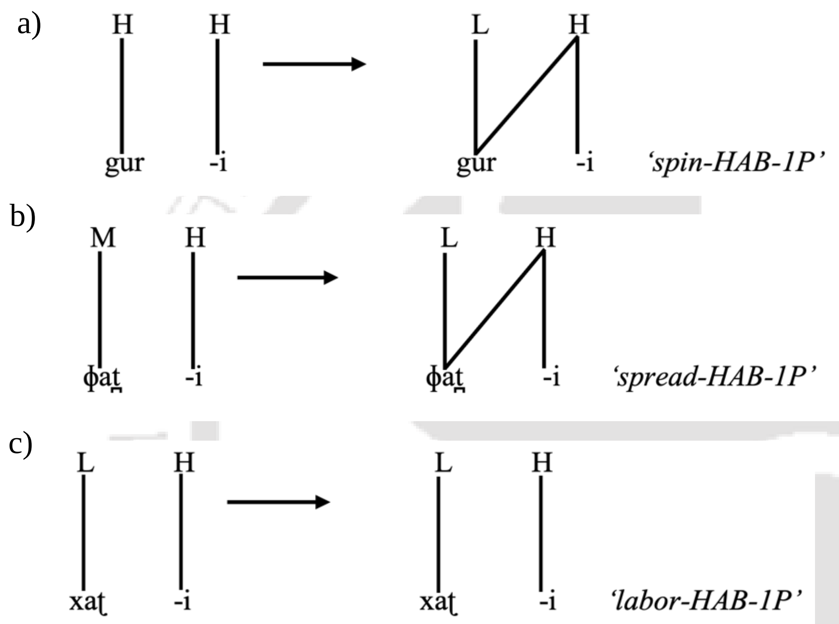
c)



The tonelessness of the suffixes is well demonstrated in these representations. /ɸáʈá/ '*buck-goat'* in 1 (a) is prespecified for a lexical High tone and the plural suffix /-ʈain/ is not prespecified for any tone. The root and suffix are dominated by a single tonal node and the tonal node assigns an opposite tonal value of the root to the suffix to meet the surface HL tonal contour. The same suffix is assigned a high tone by the tonal node resulting in a LH contour when attached to a root prespecified for a lexical Low tone as represented in 1 (b) /ɸàʈà/ *'crack'*. The representation in 1 (c) demonstrates how the root with the neutral tone or the Mid tone, such as /ɸāʈā/ *'grind-stone'* is immune to polarity and the suffix without tone remains unspecified. The failure to exhibit tonal polarity thus does not seem to correlate to the morphophonological category of suffixes, it rather correlates to the phonological characteristics of the individual lexical tones in the language. We argue that only the marked tones trigger polarity resulting in either LH or HL tonal contours whereas the Mid tone, which is the neutral tone, is immune to polarity. Our observation of the alignment of tonal contours in Sylheti nominal stems also confirm to the observation by Archangeli & Pulleyblank (1994) that "polarity effects occur at the edges of a domain", which is demonstrated by forms such as, [bɛʈà-ìn-t̪ɔ́rɛ́] '*men-PL-DAT'*.

In contrast, our analysis of the tonal behavior of complex verbal stems suggests that unlike nominal suffixes, verbal suffixes in Sylheti are not toneless; both the perfective and imperfective verbal suffixes in the language are rather prespecified with a high tone. The tonal behavior of the verb stems varies across aspectual classifications of verbs. As observed in both the imperfective and the perfective aspects, the high tone in the suffix always surfaces itself. The underlying H of the verbal suffix enforces the root to change its underlying tone and surface with an opposite tonal value of the suffix i.e., a L. The representations in 2 summarise the possible underlying and surface representations of tonal polarity in Sylheti verb stems. As this underlying structure of verb stems is consistent across all three person inflections, it has been represented by the first-person inflection for the verbs [gúr] *'spin'*, [ɸāt̪] *'spread'*, and /xàʈ/ *'labor'* representing the lexical High, Mid and Low tones respectively in 4.

2. *Autosegmental representation of tonal polarity in habitual verb stems:*



As can be observed in 2, the imperfective verb stem always surfaces with a LH tone contour for verbs across all the three person inflections in Sylheti. It is demonstrable that the underlying high tone of the habitual suffix [-í] exhibits dominance in the stem and enforces the lexical High tone of the root [gúr] *'spin'* in 1 (a) the lexical Mid tone of the root [ɸāt̪] *'spread'* in 1 (b) to surface as low tone. Hence, both these stems surface as LH contour as the forms /gùr-í/ *'spin-1P'* and /ɸàt̪-í/ *'spread-1P'*. We can observe in 1 (c) that verb stems with underlying LH structure do not undergo any change and thus the habitual verb stem in which the verb root [xàʈ] *'labor'* is prespecified with a lexical Low tone and habitual suffix surface with their underlying tone as the form /xàʈ-í/ *'labor-1P'*.

The tonal alteration pattern in verb stems suggest that the suffix specified for a high tone enforces the preceding root to surface with a tonal value opposite to it; this provides an argument in favor of tonal dissimilation which is the result of Obligatory Contour Principle

(OCP) where the affix is presumed to have an underlying tone and prohibits the occurrence of the sequence of two or more L tones or two or more H tones. However, the alteration of the lexical Mid tone to a low tone suggests that this alteration rather instantiates to meet the tonal requirement of the habitual verb stems with a LH tone contour. Given its neutral nature, the Mid tone effortlessly conforms to the surface structure of habitual verb stems. The perfective verb stems however, do not exhibit a pattern for polar tonal contour unlike the habitual verb stems. Tonal patterns across aspectual categories of verb stems needs to be explored in future with larger dataset for complex verb stems.

5.6 Summary and Conclusion

The larger picture of tonal polarity is consistent with the claim that the polarity rules are generally limited to specific morphemes or lexical categories in most of the languages (Anderson, 1974; Schuh, 1978). In Kɔnni for example, tone polarity is restricted to the Noun Class I plural morpheme. Polarity may not be the same for all tones in a language, while the High and extra High tones trigger complete assimilation of tone onto the following suffix in Tinyidie (Meyase, 2021), the Mid tone triggers an extra high tone in the suffix and the Low tone triggers a high tone in the suffix. In Sylheti, tonal polarity is head based in nominal stems; suffixes are inherently toneless, and polarity or tone assignment is governed by the root noun. Tonal polarity is exhibited by LH or HL tone contour which is dependent on the phonological properties of the individual lexical tones in nominal stems. It is evident that polarity is enforced by the lexical High and Low tones of the root noun while the default Mid tone is immune to polarity.

In habitual verb stems, the surface LH is achieved in two different ways: the suffix prespecified for a high tone triggers an opposite low tone in the roots when the root has an underlying High or Mid tone; the suffix and root remain unchanged for tone where the root is specified for a lexical Low tone underlyingly. In perfective stems, however, our dataset was scarce to arrive at a conclusion about the tonal rules. The common structure found for both the aspectual classes of complex verb stems was that the suffix always surfaces with its underlying high tone, which triggers certain rules as demonstrated above, to meet the tonal requirements of verb stems in the language. Our study concurs with Mahanta and Gope (2018) that the verbal paradigm shows a marked pattern of aggressive dominance to enforce polarity in Sylheti but we also diverge here by arguing that the surface tonal structure in the verbal paradigm is dependent upon the aspectual classification of the stem and the LH contour predominant in habitual verb stems is a result of tonal dissimilation imposed by the underlying high tone of the suffix. A detailed study of the complex verb stems would further reveal the nuances of the class of suffixes which exhibit a different behavior such as the perfective suffix. Our study concurs with Mahanta and Gope (2018) that Sylheti prosody abides by the Noun faithfulness constraint (Smith, 1999) where nouns demonstrate a phonologically privileged status; nouns have been specifically shown to exhibit a greater well-formedness of tonal polarity than other words in Sylheti.

The predominance of tonal polarity and tonal alignment patterns and phonotactic constraints and phonological rules across morphological boundaries within complex words in Sylheti concludes that suffixes form one prosodic domain with their roots in the language. Prosodic boundaries have been used as an infallible criterion for the delimiting the prosodic word boundaries in a variety of languages (Revithiadou, 2011; Hannahs, 1991,1995a,1995b; Kang, 1992; Peperkamp, 1997; Kleinhenz, 1998; Hall & Kleinhenz, 1999; Vigário, 1999, 2003). It is possible that the domain of prosodic word is the domain of phonological rules and tonal polarity in Sylheti, and tonal polarity is always peripheral as it occurs at the edge of the domain of prosodic word. It would be an interesting prospect for a future study on how the morphosyntactic chunks in a complex word are mapped into one prosodic word in the language and how tonal structure of these words play an important role in defining the domain of a prosodic word in Sylheti.

Chapter 6

Tonal melody in Sylheti Compound Words

General Introduction: Compounds

The traditional demarcation between morphologically complex words and compounds is that complex words are formed by affixation to the root morpheme and compounds are generally formed by attaching two content words (Booij, 2005). Compounding is one of the most productive word formation processes that creates new entities from existing ones. Prosodic structures of compounds have been claimed to behave differently in different languages as opposed to a fixed left stress pattern in nominal compound structures (Chomsky and Halle, 1968). In English, compound stress (e.g., bláck board vs. black bóard) appears to provide a clear distinction between compounds and Adjective + Noun (A + N) syntactic phrases (Booij, 1983; Booij, 2005). Compound stress has also been found to resemble word stress in languages like Finnish where lexical stress is contrastive; studies like Virkkunen et.al, (2018) among others show that Finnish compounds as a phonological unit always have primary stress on the first syllable as lexical words in the language have a fixed stress on the first syllables. In Bengali however, the first syllable receives the default stress, and this pattern extends to compound words (Hayes & Lahiri, 1991) as well; compounds have their strongest stress on their initial syllables in the language but there may also be a weaker/inaudible stress on the initial syllable of the second member. Studies like Mohanan (1982) show that prosodic co – compounding structure also exists in Malayalam where both members of the compounds receive accent or intonational LH.

This chapter investigates the phonology of Sylheti compound words and analyzes how the combination of two or more content words in sequence prespecified for lexical tone are mapped into one compound stem in a tone language. It studies the prosodic structure of compound stems in the language and shows that just like complex morphemes, compound words form one prosodic domain in the language and that a compound stem is the domain for phonological rules and tonal alignment across word boundaries. We analyze both nominal and verb compound stems and the interaction of lexical tones within their prosodic domains when they surface in proximity to each other. It is important to mention here that most of the verb compounds we analyse here (Section 6.2.2) were infinitive forms of verbs that had a nominal connotation, whereas the nominal compounds considered in the study primarily include words that have achieved the status of nominal stems in the language. The chapter focuses on the uniform tonal melody predominant only in nominal compound stems and seeks empirical evidence for the acoustic correlates of this uniform structure. We have mostly analyzed words that are specified for lexical tone or have a tonogenetic base (see Appendix A) as per our analysis on tone in Chapters 3 and 4. This chapter is divided into the following sections: Section 6.1 discusses nominal compounds in Sylheti. The section divides itself into a phonological discussion of the domain of compound stems in Sylheti as a domain of phonological processes and tonal alignment and discusses their prosodic and grammatical structures. The section further divides into a detailed acoustic analysis of nominal compound stems. Section 6.2 discusses the structure of verb compounds in Sylheti; the section divides itself into an analysis of verb compounds as the domain of tonal alignment and discusses the phonology of the tonal polarity with the help of a brief analysis of the pitch tracks of the stems. Section 6.3 delves into a phonological discussion of the tonal melody and the predominant tonal polarity in compound stems and concludes the chapter.

6.1 Nominal Compounds

Compounds in Sylheti are composed of two word like element and the head of the compound, the element which typically determines the lexical category of the compound, is usually the last element of a compound; the composition is usually : modifier + head and head + head. While compound verbs only occur in copulative structure in their infinitive forms, nominal compounds fall into both categories. These words are also sensitive to morphonology and always surface with a LHL or HL tone contour.

6.1.1 Compound stem as the domain of tonal alignment

Our study focuses primarily on quadrisyllabic nominal compounds to understand the tonal alignment and their phonetic realization on each syllable. Compounds exhibit a variety of semantic relations in Sylheti such as the endocentric compound /ɖúk-là/ *'drum-NOM'* + /bɛ̀ʈà/ *'man'* [ɖùklábɛ̀ʈà] *'drummer*' in Table 6.1 which contains a semantic head within itself or the exocentric compound /bɔ̀sʈ̪à/ '*sack'* + /ɸɔ̄sā/ '*rotten'* > [bɔ̀sʈ̪áɸɔ̀sà] *'old news'* which lacks a head and loses the meaning of its constituents after the compound formation. An instance of high productivity of compounding in Sylheti can be observed in the compound /ɖùklábɛ̀ʈà/ *'drummer*' which is composed of one derived stem and one underived root.

Nominal compounds with two root nouns can be observed in the exocentric compound /bɔ̀stà/ '*sack'* + /ɸɔ̄sā/ '*rotten'* > [bɔ̀sʈ̪áɸɔ̀sà] '*old news'* which lack a grammatical head and lose the meaning of their constituents after the compound formation. Head and head compound structure can be observed in copulative compounds in the table such as the compound [gàd̪á-gùɽà] *'transportation'* in the table which is a combination of the words for *'donkey'*, /gád̪á/ and *'horse'* /gúɽá/.

First Noun	Gloss	Second Noun	Gloss	Compound	Gloss
bɔ̀stà	*sack*	ɸɔ̄sā	*rotten*	bɔ̀st̪áɸɔ̀sà	*old news*
bàʃì	*stale*	bìjà	*wedding*	bàʃíbìjà	*a wedding ritual*
ɖúk-la	*drummer*	bɛ̀tà	*man*	ɖùklábɛ̀tà	*drummer (man)*
ɸūɽā	*burnt*	xɔ̄ɸāl	*forehead*	ɸùɽáxɔ̀ɸàl	*bad - luck*
xānā	*punctured*	xɔ̄lʃī	*urn*	xànáxɔ̀lʃì	*punctured-urn*
gád̪á	*donkey*	gúɽá	*horse*	gàd̪á - gùɽà	*transportation*
xāʈ-ā	*cut-NOM*	sìrà	*scratch*	xàʈá-sìrà	*injuries*

Table 6.1 Right-headed nominal compounds in Sylheti

A careful observation of the underlying tones and surface tonal alignment of the compounds in the table shows that it is always the second syllable of the first word that receives the rising tone; the following word as a whole receives a falling low tone and remains unmarked for surface tone. An interesting aspect that emerged from the analysis is that this structure is uniform for all compounds presented in the table with the underlying tonal combination of High + Mid, High + Low, Low + Low, Mid + Mid, Mid + Low, and Low + Mid and High + High. Thus, all the constructions presented in Table 6.1, irrespective of their underlying tonal specification and their grammatical heads, exhibit a uniform LHL surface tone contour.

The PRAAT picture in Figure 6.1 demonstrates how the leftmost word in a compound stem is marked by rising tone, i.e., by a LH tone contour. The compound presented in the figure is a nominal compound that is comprised of two nouns with an underlying High tone in the first word and an underlying Low tone in the second word: /ɖúkla/ + [bɛ̀ʈà] > ɖùklábɛ̀ʈà *'drummer (man)'*. There is a rising LH pattern that rises from the first syllable to the second syllable; the second word in the compound is rather subservient to the first word and receives a falling tone, thus the compound /ɖùklábɛ̀ʈà/ *'drummer'* surfaces with a LHL tone contour. The lexical High tone is clearly suppressed in the first syllable to meet the LH tone contour inherent to nominal compounds.

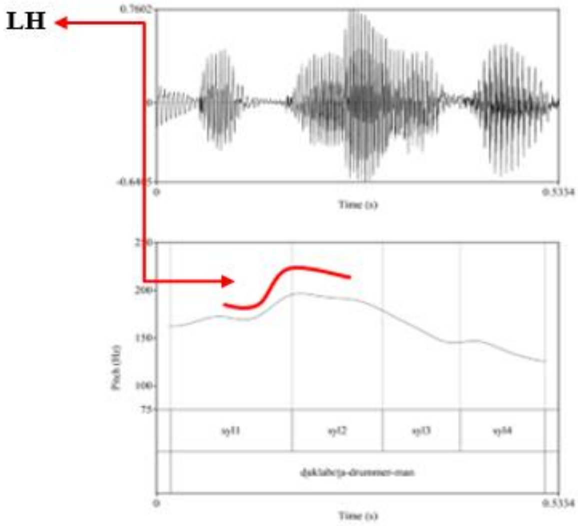


Figure 6.1 ɖúklá *'dummer'*+ bɛ̀ʈà *'man'* > ɖuklábɛʈà *'drummer (male)'*

This tonal structure is consistent for compounds with all underlying tonal combinations. Consider the compound in Figure 6.2 which is composed of two nouns, [bàʃì] *'stale'* and [bìja̖] *'wedding'* with the same underlying tonal specification, i.e., the Low tone. This compound marks the leftmost word with a LH contour followed by a falling L, thus surfacing with a LHL tone contour in the form /bàʃíbìjà/ *'a wedding ritual'*. As can be observed in the figure, the two words in the nominal compound do not surface with their underlying Low tone or with the rising pitch in both the words. Nominal compounds thus clearly act as one prosodic unit in Sylheti which is realized by a uniform LHL tone contour and the second word is always subservient to the initial word; the surface structure of the compound stems in nominal compound stems.

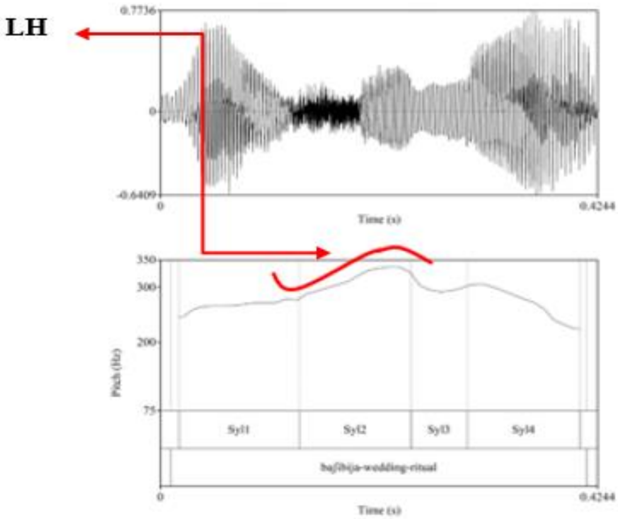


Figure 6.2 bàʃì *'stale'* + bìjà *'wedding'* > bàʃíbìjà *'wedding ritual'*
Speaker: Female; Age: 26

The LHL tonal contour, however, is controlled by the lexical High tone in the final position when the preceding underlying tone is a Low or Mid tone. Compounds with an underlying High tone (High-final compounds, henceforth) always surface with the final High tone, enforcing the preceding word to surface with a low tone on both the syllables, thus forming a polar LH tonal contour. This structure surfaces in compounds with a combination of Low + High underlying tones such as, in the compound /xùsi̇̀d̪ɔ́rá/ *'kidnapper'* in Table 6.2 and with an underlying combination of Mid + High lexical tones as in the compound /sìt̪àbáʥá]/ *'fried flattened rice'*.

First Noun	Gloss	Second Noun	Gloss	Compound	Gloss
xùsì	*child*	d̪ɔ́r-a	*catcher*	xùsìd̪ɔ́rá	*kidnapper*
sīt̪ā	*flattened rice*	báʥá	*fry*	sìt̪àbáʥá	*fried flattened rice*
mūt̪ī	*head*	gɔ́ntɔ́	*curry*	mùt̪ìgɔ́ntɔ́	*a curry made of fish head*
xùlà	*open*	ɸít̪á	*pie*	xùlàɸít̪á	*pancake*

Table 6.2 High-final nominal compounds in Sylheti

An expected pattern that can be observed by the analysis of the High final compounds is that, similar to the LHL tonal melody, the surfacing of the final High is uniform for all compounds with a tonal combination of underlying Low + High tones such as in the compound /xùsìd̪ɔ́rá/ '*kidnapper*', and the combination of underlying Mid + High lexical tones such as in the compound /sìt̪àbáʥá/ '*fried flattened rice'*. This pattern is also uniform across different morphological classification of the High final compounds. The second word in the compound /xùsìd̪ɔ́rà/ '*kidnapper*', for example, is a derived stem [dɔ́r-a] '*catch-NOM*', but unlike the tonal pattern of complex morphemes observed in Chapter 5, the suffix surfaces with the tone of its host in a compound structure and thus the form /xùsìd̪ɔ́rá/ '*kidnapper*' receives a uniform H on the fourth syllable at the surface level.

Our analysis shows that, an ubiquitous LHL tone contour of Sylheti compounds is borne by trisyllabic compounds. The data for trisyllabic compounds consists mostly of one pattern where the first word was monosyllabic, and the second word was disyllabic as shown in Table 6.3. The analysis of these compounds clearly demonstrates that the H tone always aligns to the leftmost word of the compound regardless of the syllabic structure of the word. The rising tone is borne by the first word whereas both the syllables in the second word receive the falling tone as in the compound [xɔ̄m] *'less'* + [ɸɔ̄iʃī] *'money-NOM'* > /xɔ́mpɔ̀iʃì/ *'cheap'*, where both the words have an underlying Mid tone but are realized as a rising tone on the first word and a falling L on the second word on both of its syllables.

First Noun	Gloss	Second Noun	Gloss	Compound	Gloss
ām	*mango*	ɸāt̪ā	*leaf*	ámpàt̪à	*mango-leaf*
xɔ̄m	*less*	ɸɔ̄iʃ-i	*money-NOM*	xɔ́mpɔ̀iʃì	*cheap*
d̪āt̪	*tooth*	ɸūk-ɽa	*insect-ADJ*	d̪át̪ɸùkɽà	*person with infested teeth*
bɔ̄i	*book*	xàt̪à	*copy*	bɔ́i- xàt̪à	*book & copy*

Table 6.3 Right-headed trisyllabic compounds in Sylheti

Based on the observed tonal alignment of the compounds listed in Table 6.3, it is stipulated that compound stems act as one prosodic domain in Sylheti and the first word of the domain is marked with a rising tone. Considering the limited data, further research is needed to analyse the tonal alignment of trisyllabic compounds. As this is a primary attempt at understanding tonal alignment in Sylheti compound stems, we have focused principally on the phonological domain of quadrisyllabic compounds two root words for a better understanding of the syllabic alignment of tones which is elaborated in the subsection 6.1.3.

6.1.2 Compounds as the domain of phonological rules

Other than f0 cues, inter-word segmental processes also confirm the status of compound stems as a phonological domain. The most common phonological process that undergoes in compounds is the fortition of fricatives as shown in Table 6.4.

First Noun	Gloss	Second Noun	Gloss	Compound	Gloss
ām	*mango*	ɸāt̪ā	*leaf*	ámpàt̪à	*mango-leaf*
ɸās	*five*	sɔ̄kkɔ̄r-i	*go round-NOM*	ɸátʃtʃɔ̀kkɔ̀rì	*playful person*
ɸāx	*cooking*	gɔ́r	*room*	ɸákgɔ̀r	*kitchen*
xɔ̄m	*less*	ɸɔ̄iʃī	*money-NOM*	xɔ́mpɔ̀iʃì	*cheap*

Table 6.4 Compound internal segmental processes in Sylheti

As discussed in Chapter 2, fricative fortition occurs under two phonological environments: in an intervocalic geminate structure and when preceded by a homorganic [-cont] sound. We observed both these processes in compound stems. As we can observe in the table, [ɸas] ‘*five’* [sɔ̄kkɔ̄r-i] ‘*go round-NOM’* > /ɸatʃtʃɔkkɔri/ *‘playful person’*, the alveolar fricative /s/ in the coda position of the first word and in the onset position of the second word create a geminate structure. The segmental rule of fricative fortition in a geminate structure in lexical words applies across word boundaries here within a compound stem: the alveolar fricative thus surfaces as its homorganic allophone affricate [tʃ] as discussed in Chapter 2 (section 2.3.3.1).

The manner assimilation of the voiceless bilabial fricative /ɸ/ to a preceding homorganic [-cont] nasal changes the sound to its homorganic [-cont] allophone /p/, which occurs within a lexical word boundary as discussed in section 2.1.3.1.1, is also evident here; the assimilation of [+cont] sound to [-cont] occurs across word boundaries within the phonological domain of compounds like /ampat̪a/ *'mango-leaf'* and /xɔmpɔiʃi/ *'cheap'*. The underlying bilabial fricative /ɸ/ in the onset position of the second word in both the compounds assimilates to [p] when preceded by bilabial nasal /m/ in the preceding coda. This kind of assimilation and other segmental processes apply within a compound or phonological domain in a sentential frame as in 3:

3. [[tái]PP [ámpat̀a]PP [t̪ul-bɔ]PP]
   she mango-leaf lift-FUT-2P
   'She will lift the mango leaf'

This process however is blocked across for the same sequence of sounds across phonological phrases as shown in 4:

4. [[tái]PP [ām]PP [ɸāt̪-ɔ]PP [lɔ̄i-ā]PP [xài-bɔ́]PP]IP
   she mango plate-LOC take-PERF eat-FUT-2P
   'She will eat the mango from her plate'

As can be observed, /m/ and /ɸ/ occur in contact across phrasal boundaries for the words *'mango'* and *'plate'* but assimilation of [+cont] to [-cont] is blocked here.

Similar phenomenon is noticed for the voiceless velar fricative /x/ when it is followed by a viced velar stop /g/ across word boundaries in a compound stem as in the compound [ɸakgɔr] *'kitchen'*; the [+cont] /x/ assimilates to its [-cont] homorganic voiced velar stop and surfaces as its homorganic voiceless velar stop here. This assimilation is also blocked across phrasal boundaries as shown in 5:

5. [[gas-ɔr]PP [am]PP [t̪ɔx]PP [kintu]PP [ɸɔsa]PP [naj]PP]IP
   tree-GEN mango sour but rotten NEG
   '(The) tree's mangoes are sour but not rotten'

/x/ and /k/ occur in contact across phrasal boundaries for the words *'sour'* and '*but'* and thus the gemination of [k] is blocked here.

6.1.3 An acoustic analysis of prosodic pattern in nominal compounds

In this section, we analyse a production experiment to establish the pitch patterns across syllables. We have considered two different sets of compounds for this analysis: the first set comprised the compounds which exhibited the ubiquitous LHL tone contour and the next set consisted of the High-final compound stems. We have considered f0 and duration of the target compound stems to analyze the acoustic correlates of the tonal alignment in these words. As stated earlier in this chapter, we have only considered the compounds which are a combination of two disyllabic words. Since our dataset for trisyllabic compounds was scarce, we have not considered trisyllabic compounds in our statistical analysis to control any statistical bias.

6.1.3.1 Methodology and Analysis

Data was collected from 8 native speakers (3 males, 5 females) of Sylheti for 22 compounds. Four of the speakers belong to the 50 – 55 age group (age group 1): two males and one female; four of the speakers belong to the 20 – 28 age group (age group 2): one male, and four females. We have considered only the compounds where both words have a disyllabic structure (Table 6.5) to analyse the acoustic correlates of the tonal structure. This dataset model had 13 nominal compounds conforming to the LHL tonal structure and a set of 5 High-final nominal compounds were analysed next.

First Noun	Gloss	Second Noun	Gloss	Compound	Gloss
ɸūɽ-a	burn-NOM	xɔ̄ɸāl	forehead	ɸùɽáxɔ̀ɸàl	bad - luck
bɔ̀stà	sack	ɸɔ̄sā	rotten	bɔ̀st̪áɸɔ̀sà	old news
bàʃì	stale	bìjà	wedding	bàʃíbìjà	a wedding ritual
ɖúk-lá	drum-NOM-Mas	bɛ̀tà	man	ɖùklábɛ̀tà	drummer (man)
xáʈɔ́l	jackfruit	bìsì	seeds	xàʈɔ́lbìsì	jackfruit seeds
xát̪á	blanket	ʃilaì	stitch	xàt̪áʃìlaì	blanket-patterned stitch
xānā	punctured	xɔ̄lʃī	urn	xànáxɔ̀lʃì	punctured-urn
t̪ālū	crown of head	sùlà	peeled	t̪àlúsùlà	bald
xāmlī	worker(FEM)	bɛ̀ʈì	woman	xàmlíbɛ̀ʈì	working-woman
gád̪á	donkey	gúɽá	horse	gàd̪á - gùɽà	donkey & horse

First Noun	Gloss	Second Noun	Gloss	Compound	Gloss
xāʈ-ā	cuts-INF	sìrà	scratches	xàʈá - sìrà	cuts and scratches
bàʃɔ̀n	utensils	ala	vendor	bàshɔ́nàlà	utensil-vendor
gàɽì	vehicle	gùɽà	RED	gàɽí - gùɽà	vehicles
xùsì	child	ɖɔ́rá	catcher	xùsìɖɔ́rá	kidnapper
sīɽā	flattened rice	bádʑá	fry	sìɽàbádʑá	fried flattened rice
mūɽī	head	gɔ́ntɔ́	curry	mùɽìgɔ́ntɔ́	a curry made of fish head
xùlà	open	ɸítá	pie	xùlàɸítá	pancake
bɛ̄ʈā	man	múk-a	face-NOM	bɛ̀ʈàmúká	manly-faced

Table 6.5. Sylheti nominal compounds used in the study

The material with target stops were displayed on a screen as well as on a sheet of paper along with the meaning of each word written. 22 nominal compounds were recorded in a controlled environment of SOV order. Each target compound had 3 tokens and the words were recorded in sentential contexts with x being the target compound within declarative sentence frame of the SOV order were uttered as:

ami X xɔi-si

1st P X say-perf 1p

I said X.

Each sound file was segmented and annotated on PRAAT and the time-normalized f0 values of the vowel of each target syllable starting from the onset till the offset of voicing of the rime were extracted with the help of the script [Prosody Pro] (Xu, 2013). The script extracted 10 time points (time-normalized) for each syllable and the averages of the intervals of time-normalized f0 values for the compound words were plotted to observe the pitch contour throughout the words.

A linear mixed model was built with values extracted using the script Prosody Pro for 13 nominal compounds with the LHL surface tone structure. Another linear mixed model included compounds of Mid + High and Low + High tonal combinations for 5 nominal compounds. The time normalized f0 values for the target syllables were plotted to demonstrate the pitch curve of the compounds.

Four different linear mixed-effects models – lme4 (Bates et al., 2015) were built for the Mean f0[14], Maxf0[15], Minf0[16], and Duration[17] of the compounds extracted with help of the same script were attributed as the dependent variables respectively and Syllable was assigned as the independent variable for all the models. The random factors included the speaker and the item (compound). To test for significant effects, ANOVA tests were run for both models next which compared the full model and a null model with likelihood ratio tests (Ben-Akiva & Swait, 1986) to know the significance of the difference. The statistical significance of all the ANOVA tests was examined with an alpha level of 0.05.

6.1.3.2 LHL melody demonstrated by the pitch tracks of compound stems

Our analysis of the pitch patterns across syllables showed that prosodic words with the same underlying tonal specification in a compound structure always surface with a rising tone contour in the first word followed by a prolonged fall in the final word. It is always the second syllable of the first word which receives the rise from the first syllable.

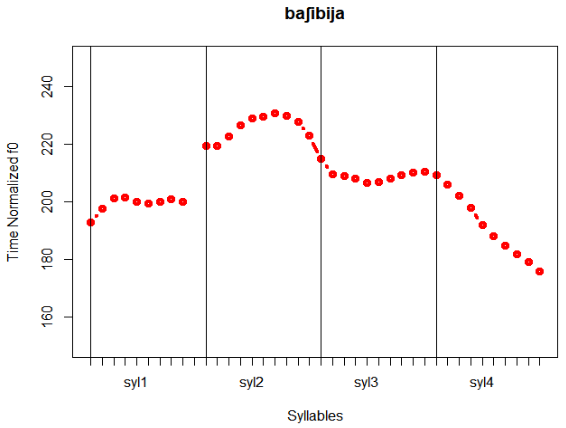


Figure 6.3. Normalized f0 for the L+L compound, /bàʃì/ + /bìjà/ = [bàʃíbìjà]

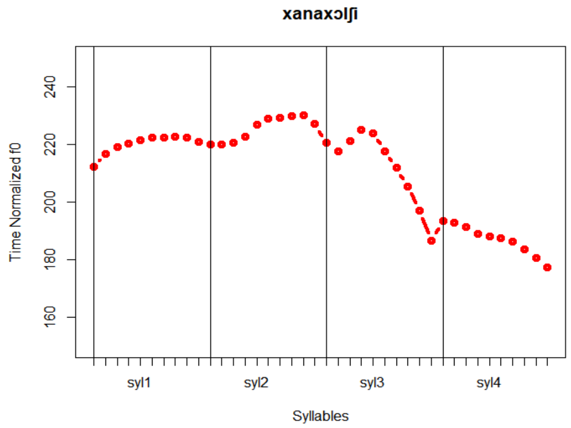


Figure 6.4. Normalized f0 for the M+M compound, /xānā/ + /xɔ̄lʃī/ = /xànáxɔ̀lʃì/

A careful observation of the pitch tracks in Figure 6.3 and Figure 6.4 shows that compounds with similar underlying tonal combination for both words surface with a LH contour in the first

[14] Compound.model_Meanf0 <- lme4::lmer(f0 ~ Syllable + (1 + Syllable|Speaker) + (1 + Syllable|Item), data = subset(Compound_Data, f0Type == "Meanf0"), REML = FALSE).
[15] Compound.model_Maxf0 <- lme4::lmer(f0 ~ Syllable + (1 + Syllable|Speaker) + (1 + Syllable|Item), data = subset(Compound_Data, f0Type == "Maxf0"), REML = FALSE).
[16] Compound.model_Minf0 <- lme4::lmer(f0 ~ Syllable + (1 + Syllable|Speaker) + (1 + Syllable|Item), data = subset(Compound_Data, f0Type == "Minf0"), REML = FALSE).
[17] Compound.model_Duration <- lme4::lmer(f0 ~ Syllable + (1 + Syllable|Speaker) + (1 + Syllable|Item), REML = FALSE).

word and a fall in the final word thus forming an LHL structure. Figure 6.3 plots the compound /bàʃíbìjà/ *'wedding ritual'* which is comprised of an underlying Low + Low lexical tone combination. A similar LHL pattern is surfaced for the compound /xànáxɔ̀lʃî/ *'punctured urn'* which is composed of underlying Mid + Mid tone combinations in Figure 6.4. The time normalized pitch contours for all eight speakers in both the figures demonstrate the LHL tonal alignment pattern in Sylheti; there is a rise in the second syllable from the first syllable and a significant fall in the second word irrespective of the different underlying tonal specification of the compounds. The initial rise and the subsequent fall are borne by both underlying Low + Low and Mid + Mid lexical tone combinations.

We can clearly infer from the pitch contour in in the compound /ɖùklábɛ̀ʈà/ *'drummer'* that the first word is marked by a rising tone followed by a falling pitch contour plotted in Figure 6.5; the compound has an underlying lexical tone combination of High and Low tones.

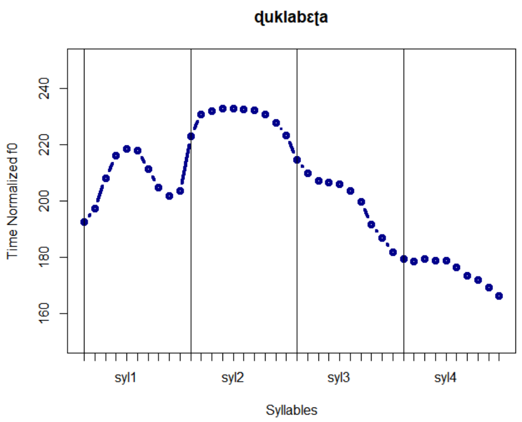


Figure 6.5. Normalized f0 for the H+L compound /ɖúklá/ + /bɛ̀ʈà/ = [ɖùklábɛ̀ʈà] *'drummer'*

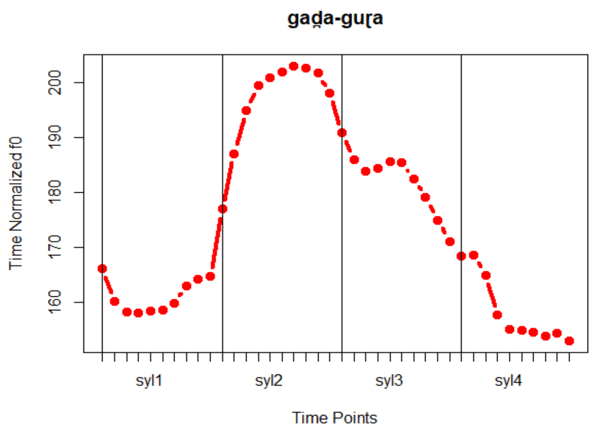


Figure 6.6. Normalized f0 for the H+H compound /gáɖá/ + /gúʈá/ = [gàɖá- gùʈà] *'transportation'*

The uniform LHL tonal structure is also borne by underlying High + High tone combination. The compound [gàɖá- gùʈà] *'transportation'* is a copulative compound in Sylheti which receives the rising tone on the second syllable in the first word and is followed by a fall in the second word as can be observed in Figure 6.6.

Our close analysis of the lexical tonal combinations of High + Mid, Mid + Low, and Low + Mid broaden our understanding of the ubiquitous tonal structure of Sylheti compounds. The tonal combination of Mid and High tone or Low and High tone in the aforementioned order, however, always surfaces with a falling tone on the initial syllable opposite to this structure.

The underlying High tone surfaces with a rising tone and is realized on the second syllable when it occurs in the initial word. It surfaces with a falling pitch when it occurs in the final word and is preceded by either a Low or a Mid tone; it is realized on both the syllables of the second word. However, the former pattern is found to be uniform for all other tonal combinations except a High final compound, i.e., Low + Low, Mid + Mid, Low + Mid, Mid + Low, High + Low, and finally High + High combinations as well.

Our results for High-final compounds conform to our observation that compound structures with underlying lexical High tone on the final word always surface with a high tone and the preceding word surfaces with a low tone. The surfacing of the H tone on the final word is an exception to the common tonal pattern of compound words in Sylheti.

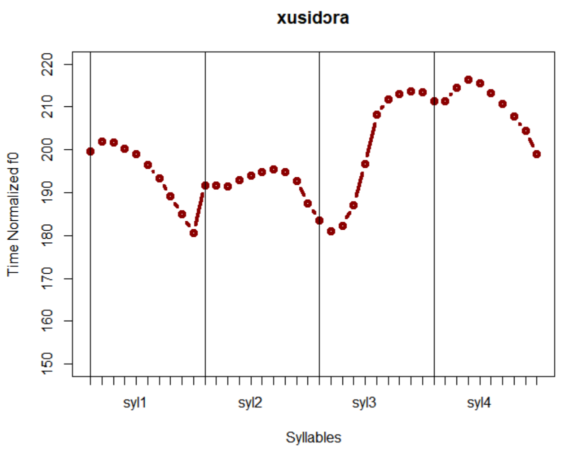


Figure 6.7. Normalized f0 for the L+H compound /xu̍si̍/ + /d̪ɔ́rá/ = [xu̍si̍d̪ɔ́rá] *‘kidnapper’*

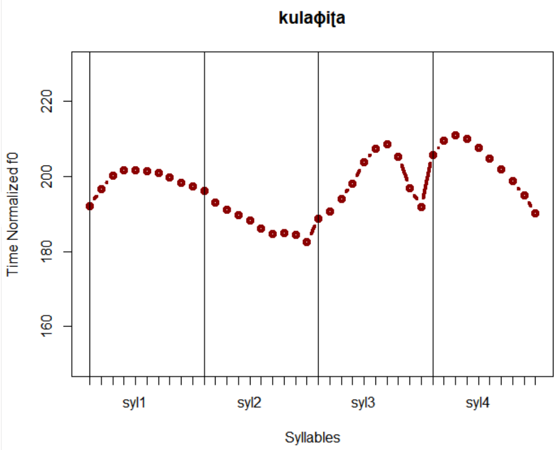


Figure 6.8. Normalized f0 for the L+H compound /xùlà/ + /ɸíʈá/ = [xula̍ɸíʈá] *‘pancake’*

The pitch contours for the final H in such structures suggest that the lexical tone conflicts with the LHL prosodic structure of Sylheti compounds. Consider the compound [xu̍si̍d̪ɔ́rá] *‘kidnapper’* in Figure 6.7; the structure demonstrates a visible rise in the third syllable and continues on the final syllable for these compounds. The rise is clearly visible in the third syllable for these compounds as can be observed in the form [xu̍la̍ɸíʈá] *‘pancake’* plotted in Figure 6.8 which has an underlying combination of lexical Low + High tones. The underlying High tone clearly surfaces on the third syllable for both these compounds.

6.1.3.2.1 Statistical significance

Our results for the first set of compounds showed significant rise in the second syllable and a very significant fall for the final syllable in terms of Mean f0 ($\chi2$ (1) = 9.9509, DF = 2, P value

= .006905**), Max f0 ($\chi 2$ (1) = 9.951, DF = 2, P value = 0.006905**) and Min f0 ($\chi 2$ (1) = 12.874, DF = 2, P value = 0.001601**).

	Fixed Effects	Estimate	Std. Error	t value
Mean f0	Intercept	209.093	20.498	10.200
	2nd Syllable	10.913	3.484	3.132
	3rd Syllable	-4.196	4.483	-0.936
	4th Syllable	-25.446	7.511	-3.388
Max f0	Intercept	218.102	21.717	10.043
	2nd Syllable	12.705	3.777	3.363
	3rd Syllable	-0.316	3.886	-0.081
	4th Syllable	-22.058	7.257	-3.040
Min f0	Intercept	197.134	18.961	10.397
	2nd Syllable	9.954	3.345	2.976
	3rd Syllable	-8.750	6.294	-1.390
	4th Syllable	-28.176	7.225	-3.900

Table 6.6 Fixed effects model for the LHL tone contour in nominal compounds in terms of Pitch (Hz)

As shown in Table 6.6, our results for Meanf0, Maxf0, and Minf0 for the first set of compounds showed a significant rise in the second syllable and a steep fall in the fourth syllable. The overall difference between the syllables was highly significant for Meanf0 ($\chi 2$ (1) = 10.363, DF = 2, P value = 0.005619**) as plotted in Figure 6.9. The speaker-wise slope for these compounds in Figure 6.10 confirms the f0 pattern across all 8 speakers.

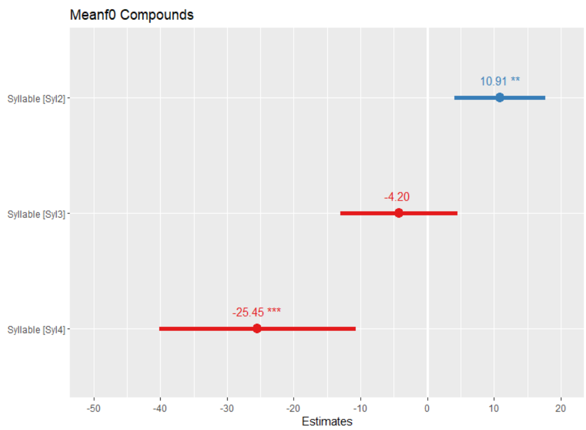


Figure 6.9. SJ plot for fixed effects (Mean f0 for LHL tone contour in compounds)

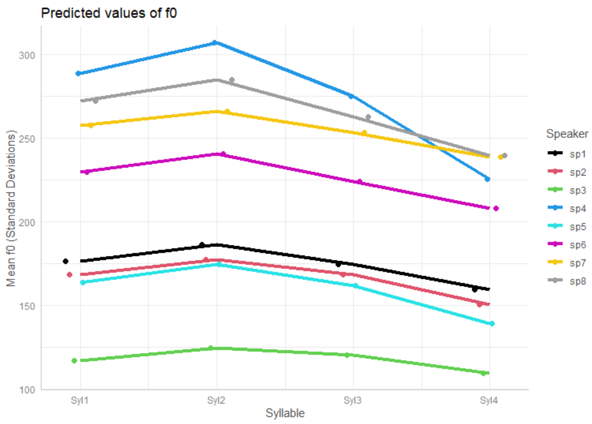


Figure 6.10. Speaker-wise slope for the LHL tone contour in compounds for Mean f0

The overall difference between the syllables for Maxf0 was highly significant as well (χ2 (1) = 9.951, DF = 2, P value = 0.006905**) as plotted in Figure 6.11. The speaker-wise slope for these compounds in Figure 6.12 conform to the f0 pattern across the speakers.

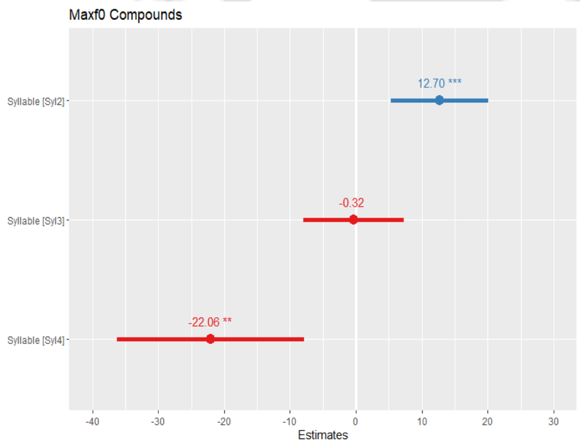


Figure 6.11. SJ plot for fixed effects (Max f0 for LHL tone contour in compounds)

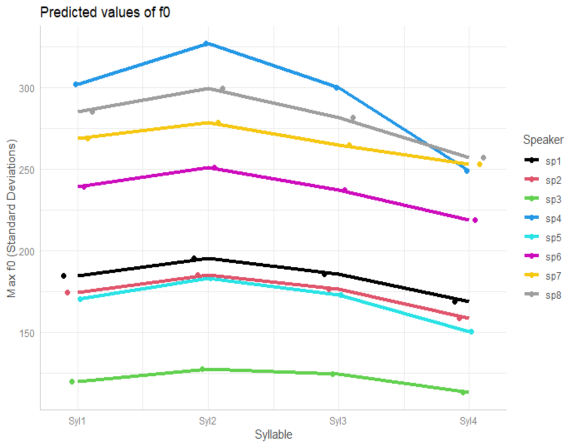


Figure 6.12. Speaker-wise slope for the LHL tone contour in compounds for Max f0 (Hz)

The overall difference between the syllables for Minf0 was equally significant (χ2 (1) = 12.874, DF = 2, P value = 0.001601**) as plotted in Figure 6.13. The speaker-wise slope for these compounds in Figure 6.14 conform to the LHL f0 contour across the speakers.

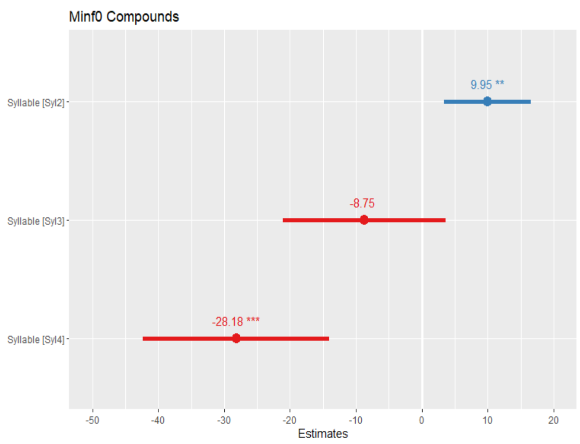


Figure 6.13. SJ plot for fixed effects (Min f0 for the LHL compounds)

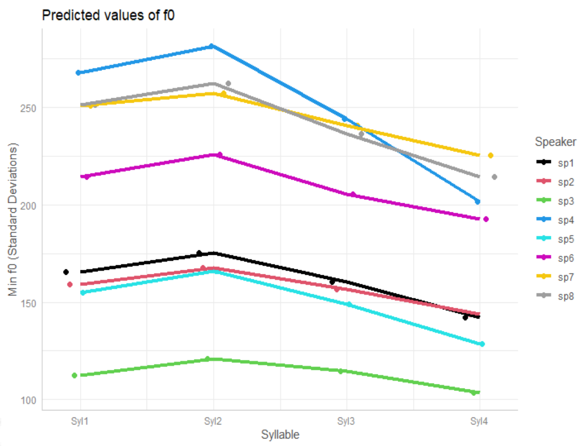


Figure 6.14. Speaker-wise slope for the LHL compounds for Min f0 (Hz)

The SJ plots in Figures, 6.9, 6.11 and 6.13 plot the estimates of fixed effects results for Mean f0, Min f0, and Max f0 respectively between the four syllables for the LHL tone pattern in compounds; the asterisks on the value for syllables in the figures indicate the high significance level.[18] We did not find any significant difference between the syllables in terms of duration ($\chi 2$ (1) = 2.1854, DF = 2, P value = 0.33531) as shown in Table 6.7. The final syllable was however noticeably longer by about 14.054 milliseconds than all other syllables. This phenomenon can be phonologically interpreted as a clear instance of final lengthening

	Fixed Effects	Estimate	Std. Error	t value
	Intercept	107.486	5.787	18.572
Duration	2nd Syllable	5.951	11.927	0.499
	3rd Syllable	-7.640	9.656	-0.791
	4th Syllable	14.054	10.054	1.398

Table 6.7 Fixed effects model for nominal compounds in terms of Duration

Our results for the High-final compounds show that the pitch falls for the second syllable and the third syllable rises significantly, as can be seen in Table 6.8. However, we did not find a significant difference in terms of pitch.

	Fixed Effects	Estimate	Std. Error	t value
	Intercept	192.128	15.934	12.058

[18] The asterisks following the values in the figure show the level of their statistical significance. '***' 0.001 '**' 0.01 '*' 0.05.

	Fixed Effects	Estimate	Std. Error	t value
	2nd Syllable	-6.624	4.018	-1.648
Mean f0	3rd Syllable	5.670	4.004	1.416
	4th Syllable	4.267	4.805	0.888
	Intercept	180.728	14.852	12.169
	2nd Syllable	-4.767	3.873	-1.231
Min f0	3rd Syllable	-1.167	4.379	-0.267
	4th Syllable	-1.439	4.790	-0.300
	Intercept	199.256	16.759	11.889
	2nd Syllable	-5.781	4.303	-1.344
Max f0	3rd Syllable	11.516	4.318	2.667
	4th Syllable	8.016	4.875	1.645

Table 6.8 Fixed effects model for High final nominal compounds in terms of Pitch

As shown in the table, our results for mean f0 for compounds that had an underlying High tone in the second word showed a rise in the third syllable although it was not statistically significant ($\chi 2$ (1) = 2.7998, DF = 2, P value = 0.246622); the SJ plot in Figure 6.15. The intercept is about 192.128 Hz which represents the first syllable; there was a fall of 6.624 Hz in the second syllable which is clearly different from the previous set of compounds analysed. There was a rise of about 5.670 Hz in the third syllable. Our results for min f0 showed a rise in the third syllable as shown in Table 6.8, although it was not statistically significant ($\chi 2$ (1) = 0, DF = 2, P value = 1); the SJ plot in Figure 6.16. The intercept is about 180.728 Hz which represents the first syllable. The results for max f0 showed a significant rise in the third syllable, although the overall difference between the syllables was not statistically significant ($\chi 2$ (1) = 5.2062, DF = 2, P value = 0.07405). The intercept was about 199.256 Hz which represents the first syllable; there was a fall of 5.781 Hz in the second syllable and a rise of about 11.516 Hz in the third syllable (SJ plot in Figure 6.17).

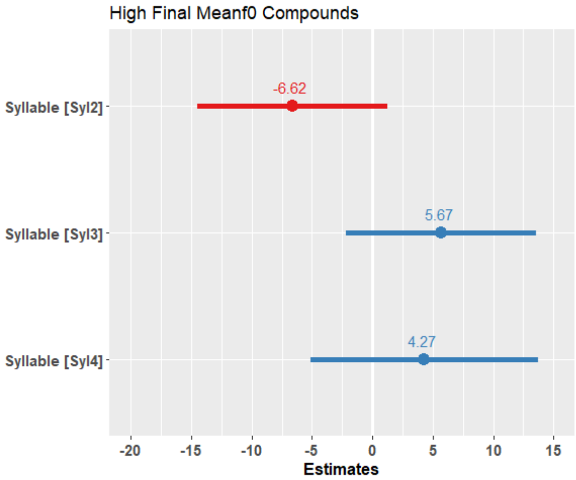


Figure 6.15. SJ plot for fixed effects (Max f0 for High final compounds)

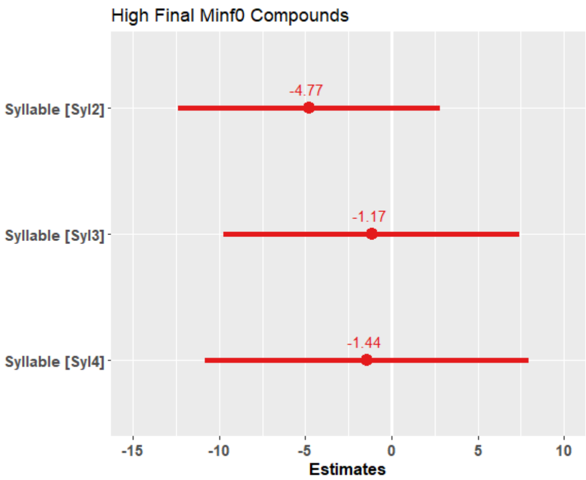


Figure 6.16. SJ plot for fixed effects (Min f0 for High final compounds)

The SJ plots in Figures 6.15, 6.16, and 6.17 plot the estimates of fixed effects results for Mean f0, Min f0, and Max f0 respectively between the four syllables in High final compounds.

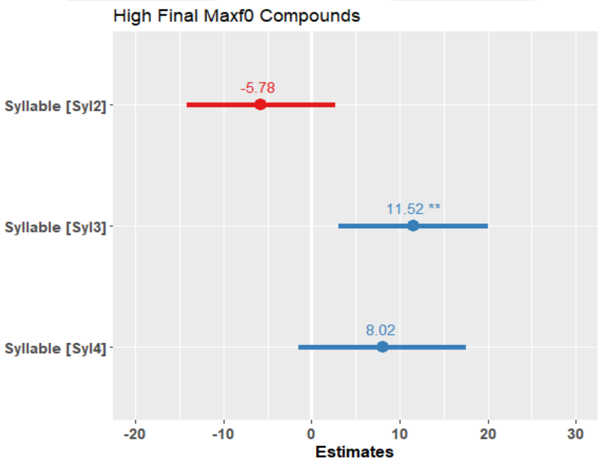


Figure 6.17. SJ plot for fixed effects (Max f0 for High final compounds)

As shown in Table 6.9, our results for the duration for compounds that had underlying High tone in the second word showed a significant lengthening of the third syllable by 44.88 milliseconds.

	Fixed Effects	Estimate	Std. Error	t value
	Intercept	87.881	14.553	6.039
Duration	2^{nd} Syllable	23.787	19.626	1.212
	3^{rd} Syllable	44.880	7.557	5.939

Fixed Effects	Estimate	Std. Error	t value
4th Syllable	23.408	20.356	1.150

Table 6.9 Fixed effects model for High final nominal compounds in terms of Duration

The overall difference between the syllables was highly significant ($\chi 2$ (1) = 13.09, DF = 2, P value = 0.001437 **). The intercept is about 87.881 milliseconds which represents the first syllable as plotted in Figure 6.18.

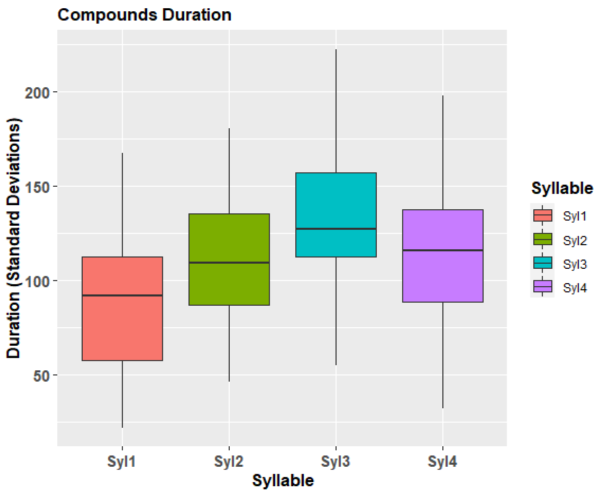


Figure 6.18. Boxplot of raw duration contrast between syllable for High final compounds

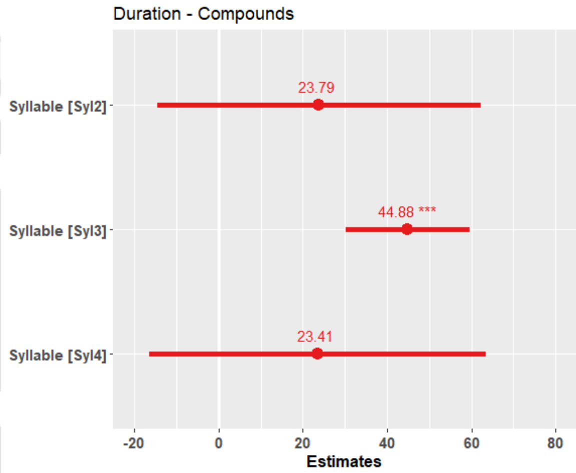


Figure 6.19. SJ plot of duration contrast between syllable for High final compounds

The SJ plots in Figure 6.19 plot the estimates of fixed effects results for duration between the four syllables in High final compounds which shows that the third syllable is significantly longer.

6.2 A brief analysis of Verb Compounds

Compound verbs in Sylheti occur in copulative structure in their infinitive forms for the tonal combinations High + Low, High + High, Mid + Low, Mid + High, Low + Mid as shown in 6:

6. *Verb compounds in Sylheti*

a) úʈ-a *'get-up-INF'* + bɔ̀-a *'sit-INF'* > úʈá – bɔ̀a *'activities'*

b) lɛ́x-a *'write-INF'* + ɸɔ́ɽ-a *'read-INF'* > lɛ́xá - ɸɔ̀ɽà *'studies'*

c) sɔ̄l-a *'walk-INF'* + ɸìr-a *'return-INF'* > sɔ́lá - ɸìrà *'movement'*

d) māʤ-a *'scrub-INF'* + gɔ́ʃ-a *'scratch-INF'* > màʤà - gɔ́ʃá *'cleaning'*

e) xà-wa *'eat-INF'* + ɸɔ̄r-a *'wear-INF'* > xàwà - ɸɔ́rá *'necessities'*

Verb compounds in Sylheti are generally constructed in infinitive forms and the verbs have a connotational meaning. As can be observed in the compound in 6 (e), the compound of the verbs /xa̖w-a/ *'eat-INF'* and /ɸɔ̄r-a/ *'wear-INF'* is used to refer to a connotation of *'necessities'* rather than being used as to refer to a combination of two activities. Similarly, the compound of the verbs *'stand-INF'* and *'sit-INF'* in 6 (a) rather refers to general activities than to a literal compound of both the activities.

6.2.1 Compound verbs as the domain of tonal polarity

A careful observation of verb compounds in (6) demonstrates that tonal interactions influence each other at the domain of compound stems but this class of compounds in Sylheti does not exhibit a predominant pattern or tonal melody. Tonal interaction between words in a verbal compound stem exhibits clear tonal polarity which is also suggestive of a result of OCP as observed for complex verb stems in Chapter 5. The same infinitive verb [gɔ́ʃ-a] *'scratch-INF'* with an underlying High tone surfaces with a HL tone contour when preceded by a verb with an underlying Mid tone as in [mād͡ʑ-a] *'scrub-INF'* + [gɔ́ʃ-a] *'scratch-INF'* > /ma̖d͡ʑa̖ - gɔ́ʃá/ *'cleaning'*; it surfaces with a HH tone when followed by a Mid tone as in [gɔ́ʃ-a] *'scratch-INF'* + [ɸīʃ-a] *'grind-INF'* > /gɔ́ʃá - ɸi̖ʃa̖/ *'mediocre'*. The underlying Mid tone always surfaces with a polar LL tone when preceding or following a word with underlying High tone in both these compounds. The underlying Mid tone also surfaces with a H tone when it interacts with a preceding Low tone as in the verb compound, [sɔ̄l-a] *'walk-INF'* + [ɸi̖r-a] *'return-INF'* > /sɔ́lá - ɸi̖ra̖/ *'movement'*; the word for *'return-INF'* receives a falling L tone, thus forming a HL tone contour. The difference in the tonal behavior of the lexical Mid tone in compound stems with different underlying tonal combination demonstrate that polarity is predominant in verb compounds. There is always a tonal conflict between two lexical tones in these compounds which results in a surface structure of either a HL or a polar LH structure.

We find evidence of the predominant LHL melody of nominal compounds in the compound [lɛ́x-a] *'write-INF'* + [ɸɔ́ɽ-a] *'read-INF'*, /lɛ̀xá - ɸɔ̀ɽa̖/ *'studies'* where both the words in the compound have an underlying High tone. The rising LH tone is realized on the leftmost word and the final word receives a polar L tone. However, this phenomenon needs to be analyzed in detail with a larger corpus for compound verbs to confirm to the presence of the predominant LHL melody in this class of compounds as well.

6.2.2 A brief analysis of the pitch tracks of verb compounds

We analysed the difference between the behaviour of tone across verb compounds. Our analysis shows that tonal interaction between words in a verbal compound stem exhibits clear tonal polarity. The methodology for this analysis was kept unchanged as that for nominal compounds. The script extracted 10-time points (time-normalized) for each syllable and the average of the intervals of time-normalized f0 values for the compound stems were plotted to observe the pitch contour throughout the words.

6.2.2.1 Results and discussions

The word for *'scratch-INF'* [gɔ́ʃ-a] with an underlying High tone surfaces with a rising tone followed by a falling tone in the compound /mà̀ʣà̀ - gɔ́ʃá/ *'cleaning'*, preceded by a low pitch as can be observed in Figure 6.20 and with level high pitch in the compound /gɔ́ʃá - ɸȉʃà/ *'mediocre'* followed by a falling pitch as can be observed in Figure 6.21.

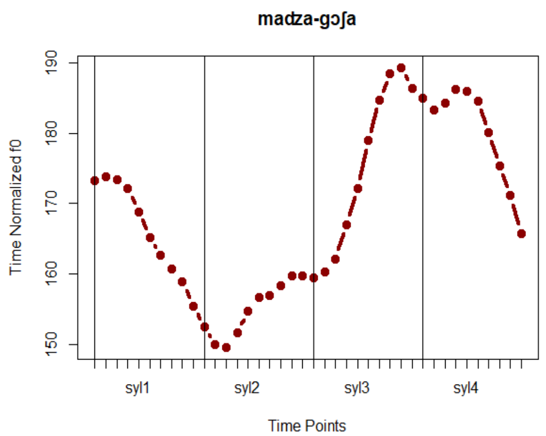


Figure 6.20. Pitch contour for the M + H compound /māʣā/ + /gɔ́ʃá/ = [mà̀ʣà̀ - gɔ́ʃá] *'cleaning'*

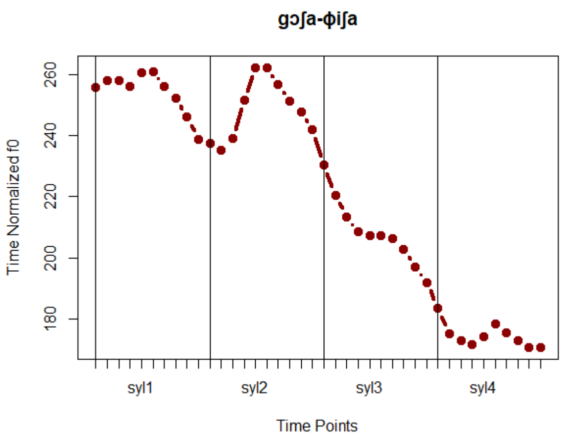
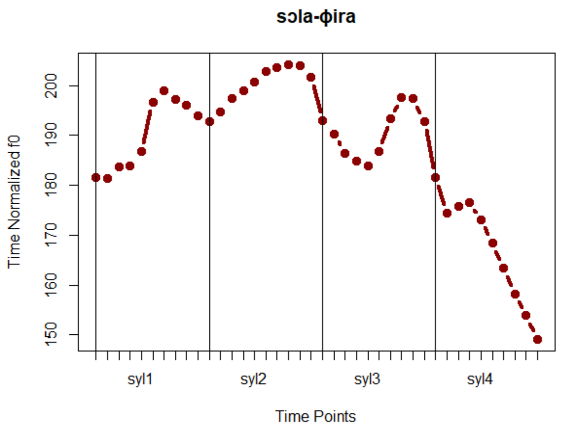


Figure 6.21. Pitch contour for the H + M compound /gɔ́ʃá/ + /ɸīʃā/ = [gɔ́ʃá - ɸȉʃà] *'mediocre'*

The polar behavior of tone in these stems is also demonstrable by in the verbal compound, [sɔ́lá - ɸȉrà] *'movement'*; the word for *'to return'* receives a falling pitch as can be observed in Figure 6.22: the underlying Mid tone for the stem /sɔ̄lā/ *'to walk'* surfaces with a level high pitch followed by falling pitch contour for the stem /ɸȉrà/ *'to return'*. It is noteworthy that the infinitive suffix /-a/~/-wa/ receives the tone of the verb which suggests that unlike complex verb stems, suffixes of verbs in compound stems do not exhibit polarity.



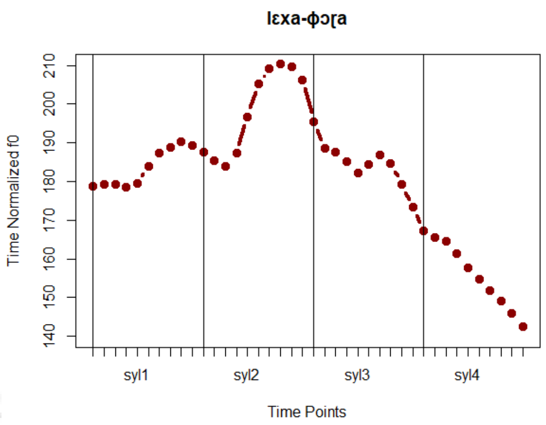


Figure 6.22. Pitch contour for the M + L compound /sɔ̄lā/ + /ɸìrà/ = [sɔ́lá - ɸìrà] *'movement'*

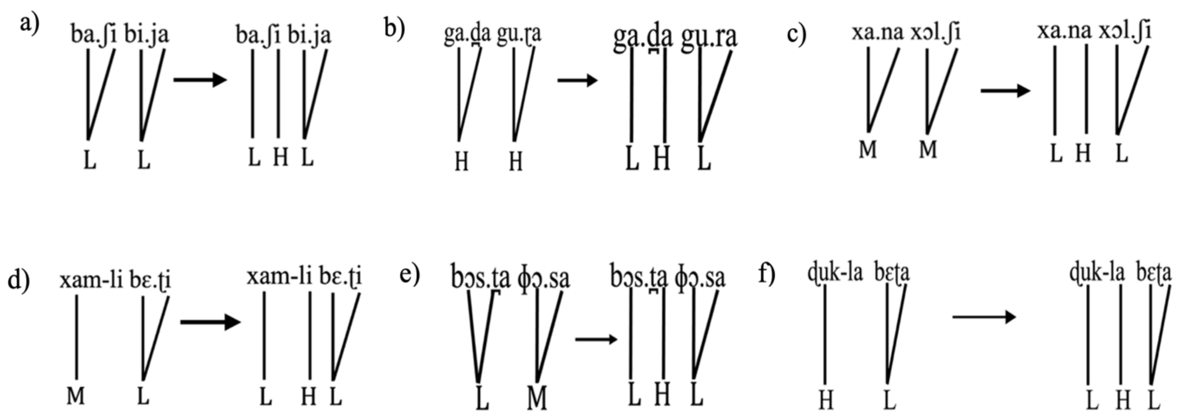
Figure 6.23. Pitch contour for the H + H compound /lɛ́xá/ + /ɸɔ́rá/ = [lɛ́xá-ɸɔ́rá] *'studies'*

The existence of the predominant LHL melody can only be seen in verbs with the same underlying lexical tones as in the compound [lɛ́xá-ɸɔ́rá] *'studies'* plotted in Figure 6.23.; the first syllable receives the low tone and the H is realized on the second syllable in the word /lɛ́xá/ *'to write'* and the following word, /ɸɔ́rá/ *'to study'* in the compound receives an L, thus forming an LHL structure for this compound. The underlying lexical High tone for both the words in this compound surfaces with only one dominant tone in the first word which is realized by a rising tone contour on the second syllable. However, unlike the nominal compounds, the LHL pattern is not predominant in verb compounds.

6.3 Discussion and summary: Tonal melody and polarity in Sylheti compounds

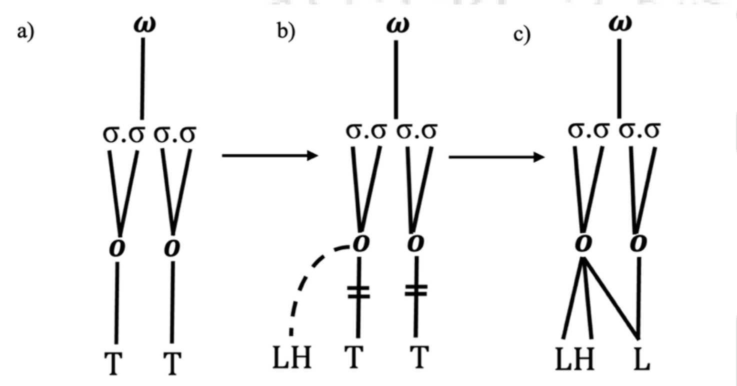
Our analysis suggests that the domain of nominal compounds acts as one phonological domain, marked by the LHL tonal melody. Our analysis of the acoustic correlates for this tonal pattern shows a significant rise in pitch from the first to the second syllable followed by a significant fall. Although we did not find a significant difference between syllables for duration, the fourth syllable, i.e., the final syllable showed a lengthening which might not be perceptible. This LHL structure is uniform and occurs across compound stems with a combination of different underlying tonal specification. The possible representation of the underlying and surface tonal alignment in nominal compounds is demonstrated in 7:

7. *Tonal alignment of LHL melody in Sylheti compounds* :



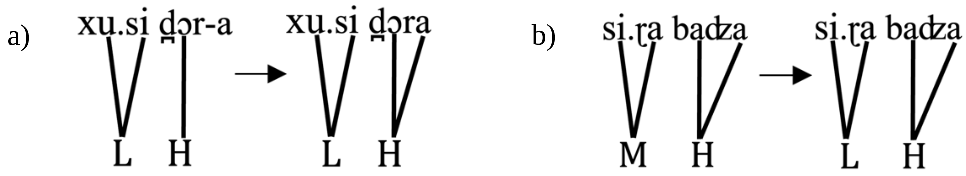
Compound stems represented in 7(a), 7(b) and 7(c) demonstrate that the combination of words with same underlying tonal specification always surface with the LHL tone contour. The form /bàʃíbìjà/ *'a wedding ritual'* in 1(a) demonstrates that the sequence of underlying L and L tones which surfaces with a LH, thus the leftmost word [bàʃi] surfaces as the form /bàʃí/, and the word [bìjà] surfaces with a falling tone as the form /bìjà/. Similarly, 7(b) demonstrates that in the compound /gàḍá- gùṛà/ *'transportation'* with the underlying sequence of two High tones, the second High tone is lost in the surface level and the first High tone surfaces with a rising tone on the second syllable. The combination of words two underlying Mid tones surface with a rising tone on the second syllable as can be observed in the representation in 7(c) for /xanaxɔlʃi/ *'punctured urn'*; the low tone aligns to the first syllable of the leftmost word and the second syllable aligns to the H of the compound stem followed by a falling tone on the second word of the stem. The representations in 7(d) for /xàmlíbɛ̀ṭì/ *'worker-FEM'* with underlying tonal combination of the High and Low tones and in 7(f) /ḍùklábɛ̀ṭà/ *'drummer-M'* with an underlying tonal combination of the Low and Mid tones, demonstrate that the derivational suffix /-la/~/-li/ *'NOM'* unspecified for an underlying tone, also align to the surface LHL tone contour of compounds in Sylheti. These findings thus add substantially to our understanding of the difference between the prosody of complex morphemes and compounds in the language. The compound stem /bɔ̀sṭáɸɔ̀sà/ *'old news'* in 7(e) demonstrates that the underlying tonal combination of the Low and Mid tones also surface as the LHL tone contour. So far it is evident that the LH melody aligns with the first word in the compound stem and the L tone always aligns to the rightmost word; this tonal contour cannot be linked to the underlying tonal specification of the words in the stems: the words in compound stems delink from their lexical tone and map to the tone of the phonological domain of a compound. It is also conclusive that the inherent tonal polarity of complex morphemes observed in Chapter 5, is predominant in the domain of compound stem as well. Words with the same underlying tonal specifications are not allowed to surface in a sequence and thus, the inherent polarity of phonological word in Sylheti leads to a LHL tone contour. The autosegmental representation 8(a) and 8(b) demonstrates how the tonal node delinks from the lexical tone and associates to the rising tone inherent to the compound stems; 8(c) represents the assignment of the polar falling tone to the adjacent word, thus finally surfacing as the LHL tone contour. We adapt Yip's (2002) tonal node representation to accommodate the contour tone LH in our autosegmental representations of the tone of Sylheti compound stems.

8. *Autosegmental representation of LHL melody assignment in nominal compounds:*



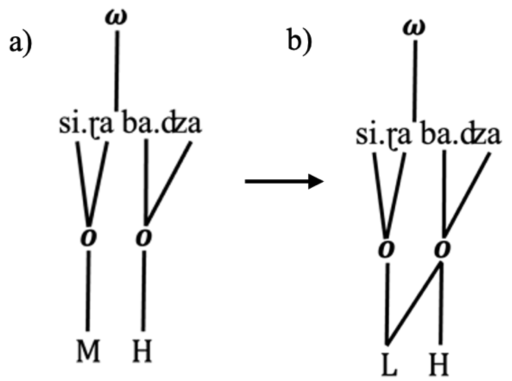
Our results for the High-final compounds clearly showed a rise in the pitch contour for the third syllable, although the results were not statistically significant. The first word receives a low tone on both the syllables and a rise in the third syllable followed which continued for the fourth syllable; we found a significant high-pitch excursion for the third and fourth syllables. An interesting result that emerged from the statistical analyses is that the duration results were different for the two models in the study. These results show a significant relationship between the rise in pitch and the lengthening in duration for the third syllable in High-final compounds. Although the acoustic tests revealed a weak correlation between pitch and duration, one aspect that was conclusive of the analysis was that this set of nominal compounds share the LH tone contour. The possible representation of the underlying and surface representations of this tonal pattern is demonstrated in 9:

9. *Final High tone alignment in Sylheti compounds:*



It is conclusive from the representation in 9(a) for the compound /xùsìd̪ɔ́rá/ *'kidnapper'* that the sequence of underlying Low + High tones surface themselves, thus violating the LHL tone contour of compound stems in the language. The representation for the compound /sìràbádʑá/ *'fried flattened rice'* in 9(b) shows that the underlying Mid tone is enforced to surface as a low tone when it precedes the High tone in a compound stem. Thus, polarity is imposed only on a Mid tone when followed by an underlying High tone which can be summarized in 10:

10. *Autosegmental representation of the of the process of LH tone contour alignment in High-final compounds:*



10(a) demonstrates the underlying representation of the compound stem intact with its underlying tones and 10(b) represents the assignment of an opposite low tone by the final High tone in the stem. The lexical High tone triggers dissimilation of a preceding Mid tone, thus forming the LH tone contour.

It is evident that the underlying lexical tones influence each other and surface with polar tonal values in Sylheti. Our analysis of the nominal compound stems and observation of the tonal behavior of verb stems provide substantial argument in favor of a predominant tonal polarity that requires an initial tone to be followed by an opposite tone (Duanmu, 1999). The existence of a polar LHL melody demonstrates the existence of a prosodic structure which marks the tonal domain of compound stems in Sylheti; there are clear exceptions to this rule controlled by the lexical High tone. However, the inherent polarity does not exhibit any exception; this phenomenon is also attested in verb compounds in the language. The surfacing of HL or LH tone contour clearly demonstrates tonal polarity. However, unlike complex nominal words, tonal polarity in compound stems argues in favor of dissimilation as the adjacent tones enforce opposite tonal values on each other. However, the emergence of the LHL surface structure in verb compounds with an underlying combination of two same tones indicates towards the possibility of it being the canonical structure of compounds stems which is well-exhibited by nouns as has also been observed for nominal complex stems.

This tonal melody also provides a plausible argument in favor of the existence of a prominence relation in Sylheti compound words. It is plausible that the leftmost word is marked for prominence by the rising (LH) tone whereas the rightmost word remains unmarked and thus receives a falling tone. Hyman (2009) claims that pitch accent languages, which are classified as a sub-category of tone languages, choose between tone and stress; nouns in Cherokee for instance are specified for three distinctive lexical tones, however, words unspecified for lexical tones may coexist with an optional L*H accent that may exist as demarcation of feet (Johnson, 2005). Studies such as Clements & Goldsmith (1984); Matisoff (1973) and Ratliff (2015) show that the assignment of accent or prominence in compounds is a step toward the loss of tones in a tone language. This structure has also been proposed for other tonal languages like the Bantu languages (Goldsmith & John, 1984; Kenstowicz, 1987). Haya, for instance, shows one prominent syllable in each noun stem (Hyman & Byarushengo, 1984); Zulu nouns have a different tonal melody or accent assignment according to the category of noun stems (Laughren, 1984); whereas Tonga uses a single basic tone melody across categories, along with its tolerance of a tonal rule sensitive to lexical category (Goldsmith, 1984). As Sylheti exhibits characteristics of a language which is yet at a certain tonogenetic stage where not all words are marked for tone, relation with prominence needs to be explored in future studies with special attention on verbal compound stems.

Chapter 7

Intonation in Sylheti: A Preliminary Account

General Introduction: Intonation

While pitch is a property of words in tonal languages, it is exploited as a carrier of linguistic information at the post-lexical level in all natural languages. Intonational systems may associate pitch patterns and syntactic or prosodic boundaries and carry discourse meanings simultaneously. Pitch manipulation for intonational purposes may vary across languages; for example, yes/no questions end with a rising contour in English, but in Hungarian and Chickasaw, yes/no questions end with a fall (Gussenhoven, 2004; Ladd, 2008). Similarly, languages may differ in manipulating pitch for marking prominence – languages like English associate word-level prominence with a specific syllable, while languages like French, Bengali, and Korean associate prominence with the phrasal level (Gordon, 2014; Jun, 1993; Jun & Fougeron, 1995; Jun & Fougeron, 2000; Khan, 2008; Van der Hulst, 2011). This chapter investigates the post-lexical prosodic structure in Sylheti and claims that the language behaves as a pitch accent language above the lexical level. The chapter is a preliminary attempt to demonstrate the basic intonational structure of Sylheti, a tonal language that uses pitch to contrast lexical meanings. Both tonal and non-tonal languages are known to have f0-based intonation, and even densely tonal languages exhibit intonational boundary tones (Gussenhoven, 2004). We seek to analyze the prosodic organization of a tone language based on f0 contour and phrase internal segmental processes following the intonational framework adopted by Liberman (1975); Bruce (1977); Pierrehumbert (1980); Beckman & Pierrehumbert (1986); Beckman & Pierrehumbert (1988) and Hayes & Lahiri (1991). The interaction between tone and intonation may differ across languages; for example, specific Oto-pamean languages of Mexico, lexical tone contrast is restricted to pre-final syllables, reserving intonational contrast at the final syllables (Hyman & Kemmonye, 2011). Boro, a Tibeto-Burman tonal language spoken in North-Eastern India, preserves the underlying specification of all its sequences of lexical tones except the ones occurring at the edges of Intonational Phrases (IP) and allows post-lexical tones to influence the right edge of lexical specification (Das, 2017). We show that Sylheti reserves the nuclear position for lexical contrast and marks intonational contrast at the boundaries. Although it is evident that Sylheti attests to the properties of a tonal language, our analysis shows that the language has the characteristics of a pitch accent language at the post lexical level.

We adopt the Autosegmental metrical approach to intonational phonology, which proposes a hierarchically organized prosodic structure (Bruce, 1977; Liberman, 1975; Pierrehumbert, 1980; Beckman & Pierrehumbert, 1986; Beckman & Pierrehumbert, 1988). Pierrehumbert and Beckman (1988) added a phrasal domain below the Intermediate Phrase (IP), i.e., the accentual phrase (hereafter AP) while describing the prosodic hierarchy of Japanese. Pitch accent is particularly central to this theory and proposes that pitch associates with the phonologically prominent syllable; pitch contours have been defined as a series of low and high tone: they could be pitch accents, marking the main syllable or marking the edges of a prosodic unit. We assume this model and seek to investigate the peculiarities and similarities of the intonational pattern of this language as it is surrounded by tonal languages, and the native speakers of this language are primarily bilingual and use its cognate non-tonal language, Bengali, at schools and formal contexts.

This chapter demonstrates that, the intonational structure of the language resembles that of Bengali (Khan, 2008) to a certain extent and is an example of how intonational patterns can behave independently of its lexical system. It contributes to our understanding of how a tone language in the non-final stage of its evolution, like Sylheti, may behave like a pitch-accent language, a subtype of tone languages (Hyman, 2009) at the post-lexical level. Our analysis of complex morphemes has shown so far that the language is not densely marked for tones and toneless syllables sometimes acquire tone from words lexically specified for tone and interaction between words lexically specified for tones exhibits tonal dissimilation. It is thus inferred that unlike pure tone languages, not all lexical words are prespecified for tone like the nominal suffixes (as concluded in Chapter 5). Thus, we left words with no apparent tonogenetic base, unmarked for lexical tone and analysed their behaviour in the intonational structure. This chapter is a preliminary attempt to understand the intonational structure of Sylheti, a tonal language with SOV basic word order. It compares its structure mostly with its cognate non-tonal languages of the Indo-Aryan language family. We seek to investigate the peculiarities and similarities of the intonational pattern of this language as it is surrounded by tonal languages and the native speakers of this language are mostly bilingual and use its cognate non-tonal language, Bengali, at schools and formal contexts.

This chapter is divided into the following sections: Section 7.1 discusses the basic intonation structure in Sylheti and presents the hypothesis for the chapter; subsection 7.2 investigates the pitch tracks of the intonation contours of basic declarative sentences of Sylheti compounds and the section further discusses the intonational structure of topicalized and interrogative utterances briefly. Section 7.3 concludes the chapter.

7.1 Intonation in Sylheti

Pure tone languages, particularly the East Asian languages, have been attested to avoid conflict between intonation and lexical tone; these languages often use different mechanisms, such as the insertion of sentence-final segmental particles such as in Vietnamese and Mandarin (Yip, 2002, p. 271). African languages like Hausa use particles but have also been reported to use intonation (Inkelas, 1988). However, the interaction between intonation and lexical tone has also been observed to result in lexical tone alternations in pure tone languages like Taiwanese (Peng, 1997). For example, the utterance final intonational H alters the Mid-level tone to a rising tone and raises the f0 of the lexical High tone. The boundary between the intonational patterns of tonal and non-tonal languages is not this straightforward, and both can share each other's features to some extent. One example is the usage of prosodic phrasing by tonal languages for focus marking, which is also observable in non-tonal languages like Bengali (Yip, 2002, p. 268).

Sylheti seems to deploy prosodic phrasing and resembles the phrasing system of NIA languages (Féry, 2010; Hock, 2016; Khan, 2016; Patil et al., 2008). Both individual studies on the intonation of NIA languages like Bengali (Hayes & Lahiri, 1991; Khan, 2008; 2014); Hindi (Patil, et al., 2008); Assamese (Twaha & Mahanta, 2016; Twaha, 2017) and Tamil (Keane, 2014) and as a group of languages (Féry, 2010; Hock, 2016; Khan, 2016) have shown that, these languages exhibit phrasal prosody for phonological words; the L*H melody that is the most ubiquitous structure in the intonational system of these languages, is also demonstrated by Sylheti for some of its Phonological Phrases (PP). This tonal structure is observed mainly on the leftmost syllable of the PP in these languages and may shift to the second syllable in some of the languages depending on their weight sensitivity constraints like Bengali (Hayes & Lahiri, 1991) and Assamese (Mahanta, 2001; 2012).

Our preliminary analysis of the intonational contours[19] in the upcoming subsections demonstrates that, the ubiquitous rising pitch in the NIA languages is not applicable in Sylheti in all contexts as lexical tones are dominant in certain positions in the language. We propose that, the LH contour is restricted in a language like Sylheti which has tonogenetic properties

[19] Building on the ubiquitous phrasal structure of the NIA languages, we have marked each stem as phonological words.

unlike majority of NIA languages which have been proposed to share an intonational structure (Khan, 2016).

7.1.1 Tonal alignment in Sylheti IPs

This subsection discusses the tonal alignment that Sylheti uses to convey intonational or pragmatic meanings. The language preserves lexical tone in the nuclear position and associates the pre-nuclear PP with the L*H which can be observed in the NIA languages. However, we observe a falling tone followed by the L*H; the L*HL pattern is observed to surface frequently in most of the utterances. The rightmost boundary of the IPs receives a lowering; however, this lowering does not appear to influence the lexical tone for most of the constructions. NPs or VPs usually form one tonal domain marked by L*H or L*HL. The language retains lexically contrastive tones in the nuclear positions and lodges the intonational tone on the rightmost boundary. We found a consistent rising tone on the left edge of the intonational boundaries as can be observed in the intonational contours[20] for the sentences in Figure 7.1 and Figure 7.2, recorded from the same female speaker, 26 of age.

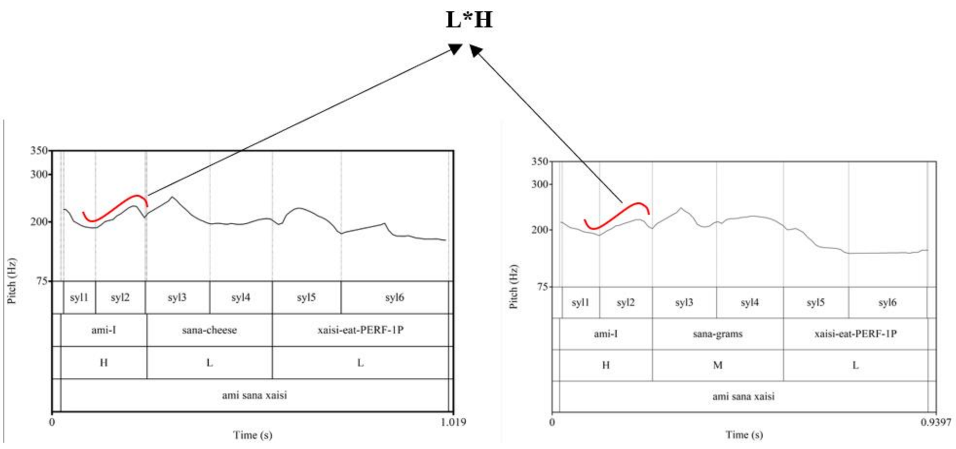


Figure 7.1. Intonational contour for the sentence:
[[**ámí**]$_{PP}$ [sa̍na̍]$_{PP}$ [xa̍i-si]$_{PP}$]$_{IP}$
I cheese eat-PERF-1P
I ate cheese

Figure 7.2. Intonational contour for the sentence:
[[**ámí**]$_{PP}$ [sānā]$_{PP}$ [xa̍i-si]$_{PP}$]$_{IP}$
I grams eat-PERF-1P
I ate grams

The intonational contours for the sentences in plotted in Figure 7.3 and Figure 7.4, recorded from the same Female speaker, 56 of age demonstrates that the lexical tone always surfaces at the nuclear position. The difference between the underlying High and Low lexical tones for the tonal pair /bɛ́ɽá/ *'lamb'* and /bɛ̀ɽà/ *'fence'* can be clearly observed as marked in the PRAAT

[20] The words in bold indicate that they are under focus.

pictures in Figure 7.3 and Figure 7.4. We observed an initial rise in words with an underlying Low tone as well which is analyzed later in the chapter.

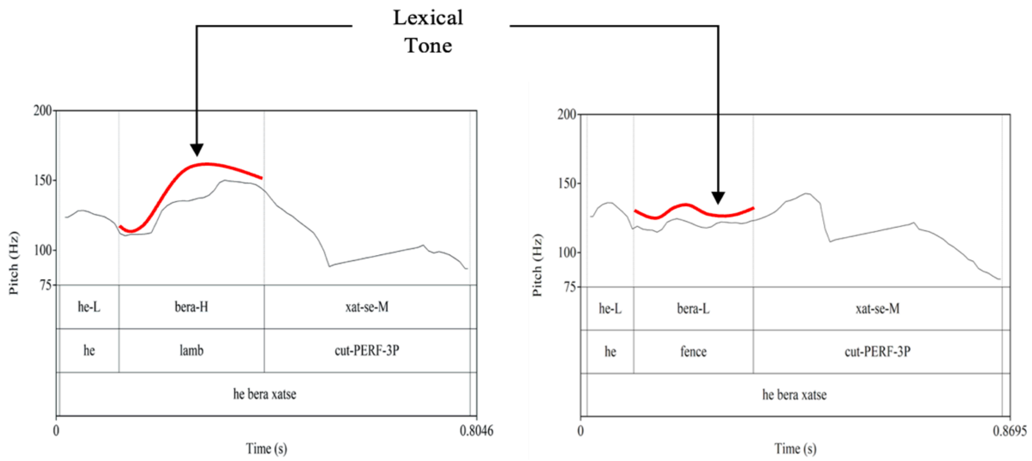


Figure 7.3. Intonational contour for the sentence:
[[hɛ̀]$_{PP}$ [**bɛ́ɽá**]$_{PP}$ [xāt-sɛ]$_{PP}$]$_{IP}$
he **lamb** cut-PERF-3P
he slaughtered the lamb

Figure 7.4. Intonational contour for the sentence:
[[hɛ̀]$_{PP}$ [**bɛ̀ɽà**]$_{PP}$ [xāt-sɛ]$_{PP}$]$_{IP}$
he **fence** cut-PERF-3P
he cut down the fence

The intonational contours for the sentences in plotted in Figure 7.3 and Figure 7.4, recorded from the same Male speaker, 26 of age demonstrates that the lexical tone always surfaces at the nuclear position. The difference between the underlying High and Low lexical tones for the tonal pair /bɛ́ɽá/ *'lamb'* and /bɛ̀ɽà/ *'fence'* can be clearly observed at the utterance level as marked in the PRAAT pictures in Figure 7.3 and Figure 7.4. The sentences recorded from the same speaker demonstrated in the PRAAT pictures in Figure 7.5 and Figure 7.6 give us an impression of clear differences in the final boundary tone of the two utterances, borne by the p-words [ɖáx] *'cover'* and [ɖàx] *'call'*. at the IP boundary in both utterances. The high tone of the perfective suffix also surfaces itself at the utterance level and is generally followed by a final fall.

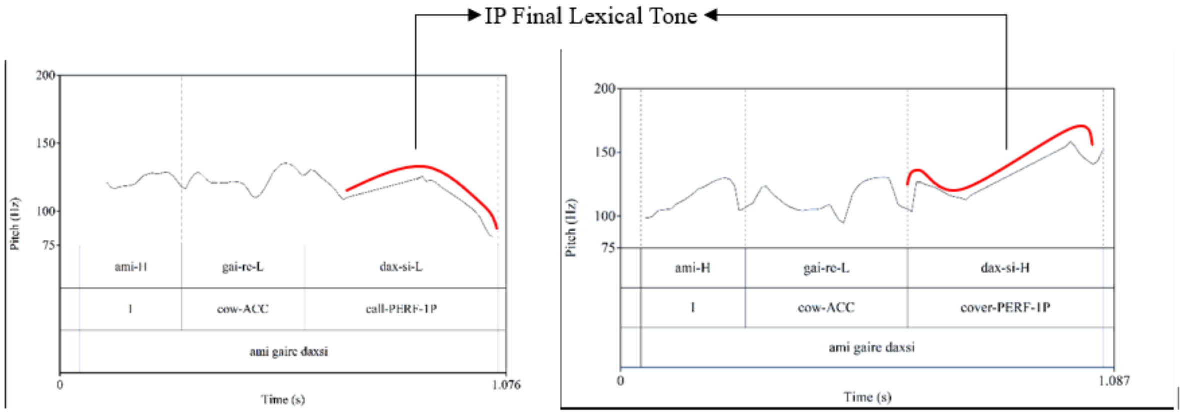


Figure 7.5. Intonational contour for the sentence:
[[ámí]$_{PP}$ [gài-rɛ]$_{PP}$ **[dàx-sí]**$_{PP}$]$_{IP}$
I cow-ACC **call-PERF-1P**
I called the cow

Figure 7.6. Intonational contour for the sentence:
[[ámí]$_{PP}$ [gài-rɛ]$_{PP}$ **[dáx-sí]**$_{PP}$]$_{IP}$
I cow-ACC **cover-PERF-1P**
I covered the cow

Another interesting observation that emerged our analysis of the intonational contours in Sylheti was that tonal polarity inherent to Sylheti complex words, surfaces at the intonational level as can be observed for the form /gài-rέ/ *'cow-ACC'*; the underlying Low tone of the word for *'cow'*, [gài] surfaces itself at the intonational level, imposing an opposite high tone on the toneless accusative suffix [rɛ]. It is important to mention that this is our first impression of the intonational structure of the language, and the lexical tone of the pronouns are not well explored yet. Although our observation of the pronoun /ami/ *'I'* exhibits a prespecified rising or high tone in citation forms as well as can be observed in the PRAAT pictures in Figure 7.7, Figure 7.8 and Figure 7.9 recorded from the same male speaker, 26 of age:

Figure 7.7. Intonational contour for the sentence:
[[ámí]$_{PP}$ [sáɽ]$_{PP}$ [xɔ̄i-si]$_{PP}$]$_{IP}$
I vessel say-PERF-1P
I said vessel

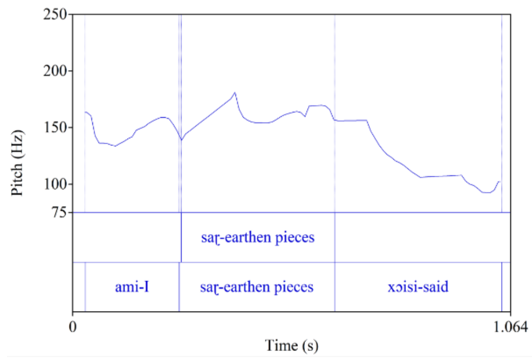


Figure 7.8. Intonational contour for the sentence:
[[ámí]$_{PP}$ [sāɽ]$_{PP}$ [xɔ̄i-si]$_{PP}$]$_{IP}$
I earthen-pieces eat-PERF-1P
I said earthen pieces

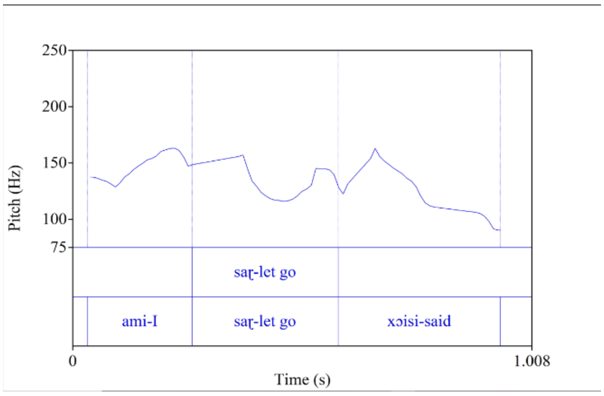


Figure 7.9. Intonational contour for the sentence:
[[ámí]$_{PP}$ [sàɽ]$_{PP}$ [xɔ̄i-si]$_{PP}$]$_{IP}$
I let go say-PERF-1P
I said let go

It is noteworthy that these sentences were recorded for our tone contrast data (Chapter 3) and despite the varying underlying tones of the following words, we observed a consistent rising pattern for the pronoun /ami/ *'I'*. The word for '*said'* which has an underlying Mid tone appears to be influenced by its preceding lexical tone. Sylheti also uses final boundary lowering to delimit the IP; the rightmost boundary surfaces as L%, LL%, or H*+L% for most of these sentences. We thus explored into different tonal combinations in the nuclear and final positions to analyse the tonal contrast that surfaces at the intonational level in the language.

As intonational contours are also tonally marked, the interaction of intonational contour with lexical tone can be observed in these figures. The initial L*H or L*HL pitch accent is realized on the leftmost or pre-nuclear p-word, we assume that this tonal structure surfaces for all tonal combinations, irrespective of the underlying tone of the leftmost p-word. The boundary tone exhibits a varied inventory and the canonical H*L% may not always be realized on the rightmost p-word; it could be realized on the penultimate or the final morpheme as well which we will explore in the following sections.

Of particular relevance is that, the PPs in the sentence represented in the PRAAT picture in Figure 7.10, demonstrate that the ergative case marker in [bàbà-έ]$_{PP}$ *'father-ERG'* and the dative marker in [raʤ-rέ]$_{PP}$ *'Radz (proper name)-ACC'* surface with an opposite H tone of its root, which clearly exhibits tonal polarity we observed for complex morphemes in Chapter 5. However, the underlying tone of the proper noun is left unmarked to arrive at a conclusion about the nature of the ergative suffix. This also suggests that the ergative marker in the language behaves in a similar manner as the plural and accusative suffixes.

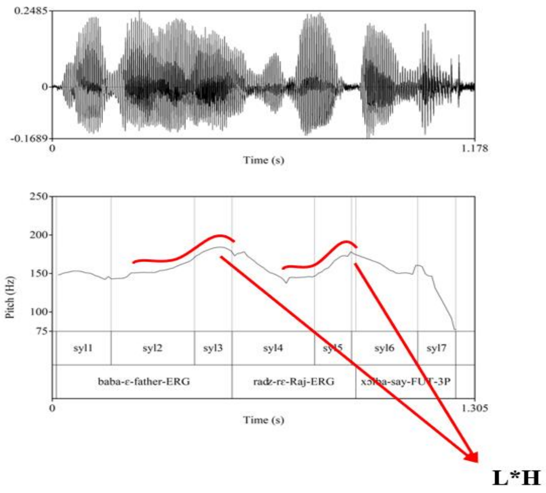


Figure 7.10 Intonation contour for the declarative sentence:
[[baba-ɛ]$_{PP}$ [raʥ-rɛ]$_{PP}$ [xɔ̄i-bā]$_{PP}$]$_{IP}$
father-ERG Raj-ACC say-FUT-3P

It is observable that the lexical tone and tonal forms of p-words in Sylheti always surface at the IP. The first syllable of phrases, however, may be marked with phonological prominence in constructions like this. The phrasing demonstrated in the rising pitch contours in each of the above phonological phrases the LH has a fall in these phrases which rises again for the next PP. We thus see variations in the common L*H pattern of the NIA languages, which is L*HL here. Constructions like this would reveal the structure but we are unable to use sentence with different case markers in the intonation section as we have not analyzed the lexical tonal or polarity aspects of proper nouns and case markers like ergative and dative yet.

7.1.2 An analysis of the normalized pitch tracks of IPs

Since our tokens for the sentences were limited for this study, we have analysed the time-normalized average of the sentences across all the 4 speakers only to study the basic intonational structure of the declarative sentences.

7.1.2.1 Methodology and analysis

The dataset was prepared with a variety of lexical tonal combinations to study the basic intonational structure of Sylheti. Our corpus consists of 25 declarative sentences, 25 topicalized sentences, and 12 wh-questions (see Appendix B). Speakers were asked to utter a declarative sentence followed by its topicalized sentence which was followed by the wh- question and yes-no questions version for the same sentence if available. The next declarative sentence was then recorded in the same order; thus, no 2 declarative sentences were recorded consecutively. The recorded sentences were segmented into .textgrid files in PRAAT. The pitch extracted for each sentence was interpolated and drawn as a PRAAT picture. We further extracted the time-normalized f0 values of each syllable for the declarative sentences only to investigate the basic intonational structure of the utterances. The values were extracted with the help of the script [Prosody Pro] (Xu, 2013) for each iteration of the 25 sentences (2 iterations 4 speakers). The script extracted 10 time points (time-normalized) for each syllable, and the averages of the intervals of time-normalized f0 values for the declarative sentences were plotted to observe the intonation contours.

7.1.2.2 Results and Discussion

Our analysis of the pitch tracks of the IPs showed that the p-words at the pre-nuclear positions associate with boundary tones. Sylheti retains the tone of lexically contrastive tones in the nuclear positions. Figure 7.11 plots the intonational contour for the sentence [[ámí]$_{PP}$ [sàǹà]$_{PP}$ [xàì-sí]$_{PP}$]$_{IP}$ *'I cheese eat-PERF-1P'* with an underlying combination of High + Low + Low tones, shows that the lexical Low tone for the word *'cheese'* surfaces with a fall here but the following verb at the rightmost boundary, which has an underlying Low tone, surfaces with a rising tone at the penultimate syllable. The rising in tone from the 1st syllable to the 2nd syllable followed by a fall, demonstrates the initial LHL tone contour. The lexical Low tone surfaces with its underlying tone in the medial position as can be observed in the 3rd and 4th syllables. In contrast, the lexical Low tone of the final verb, [xàì-sí] *'eat-PER-1P'*, delinks from its underlying tone and attaches to the IP boundary tone; it surfaces with a rising tone in the 5th syllable and is accompanied by a falling tone. The underlying high tone of the perfective suffix rather surfaces with a low tone which suggests that this fall is imposed by the boundary tone of the IP to meet the H*+L% tonal contour.

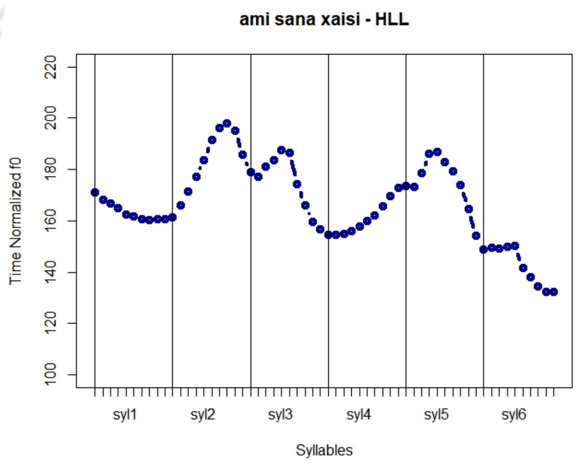


Figure 7.11 [[ámí]$_{PP}$ [sàǹà]$_{PP}$ [xàì-sí]$_{PP}$]$_{IP}$
I cheese eat-PERF-1P
I ate cheese

Figure 7.12 plots the intonational contour for the sentence [[àmì̀]PP [sānā]PP [xaì̀-sí]PP]IP *'I gram eat-PERF-1P'*, contrasts from Figure 7.11 at the nuclear medial position where /sàǹà/ *'cheese'* has been replaced with /sānā/ *'gram'*. The initial LHL can be observed on the 1st and 2nd syllables and the lexical Mid tone surfaces as a high tone which is clearly demonstrated on the 3rd and 4th syllables in the figure. The nuclear tone is followed by a falling tone on the final verb, [xài-sí] *'eat-PER-1P'* which can be interpreted as LL%. The lexical Low tone surfaces with a low tone here However, since the boundary tone is HL% for the same IP final p-word, it is possible that in the penultimate syllable, i.e., on the 5th syllable and is followed by the final L% of the IP.

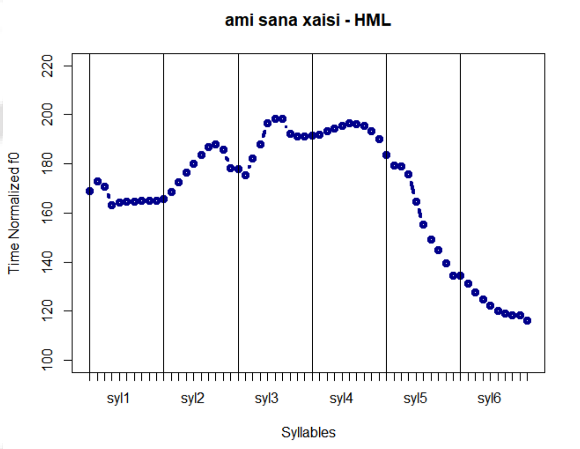


Figure 7.12 [[ámí]PP [sānā]PP [xaì̀-sí]PP]IP
I gram eat-PERF-1P
I ate cheese

Declination is quite apparent in the language as has been demonstrated in Figure 7.13 for the sentence [[ṯái]PP [gá]PP [ḏáx-sɛ̀]PP]IP *'she wound cover-PERF-1P'*. This declarative sentence has an underlying High tone for all the three words.

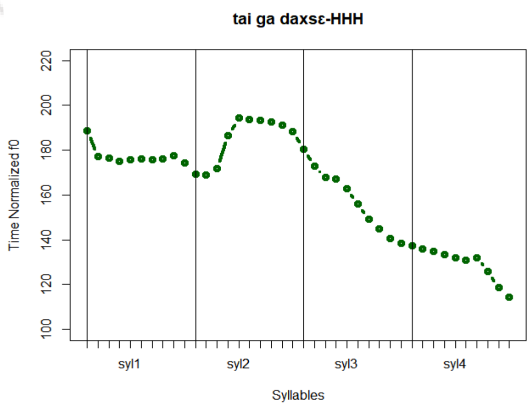


Figure 7.13 [[ṯái]PP [gá]PP [ḏáx-sɛ̀]PP]IP
she wound cover-PERF-3P
She covered her wound

The lexical High tone surfaces distinctively in the nuclear position and the lexical High tone of the pronoun does not surface in his IP. The lexical High tone is followed by a falling tone to meet the boundary L%. The lexical High tone surfaces with a low tone on the penultimate syllable, i.e., on the 3rd syllable and the fall is prolonged on the final syllable; this can be interpreted as a result of declination in the sentence triggered by the underlying sequence of High tones or tonal polarity imposed by the perfective suffix [sɛ́], which in turn surfaces with the final L% of the IP and its underlying high tone is suppressed in this process. The initial L*HL is evident in the similar sentence frame but with a lexical Low tone in the nuclear position, [[t̪ái]PP [gà]PP [ɖáx-sɛ́]PP]IP *'she body cover-PERF-1P'* in Figure 7.14. The underlying High tone at the IP final position also surfaces itself on the verb /ɖáx-sɛ̀/ *'cover-PERF-3P'* which suggests that, the lowering of the lexical High tone for the same word in Figure 7.13 is a result of declination. The IP boundary thus surfaces as H+L% as can be observed in the intonation contour for Figure 7.14. The final lowering is thus, evident in all the IPs discussed so far.

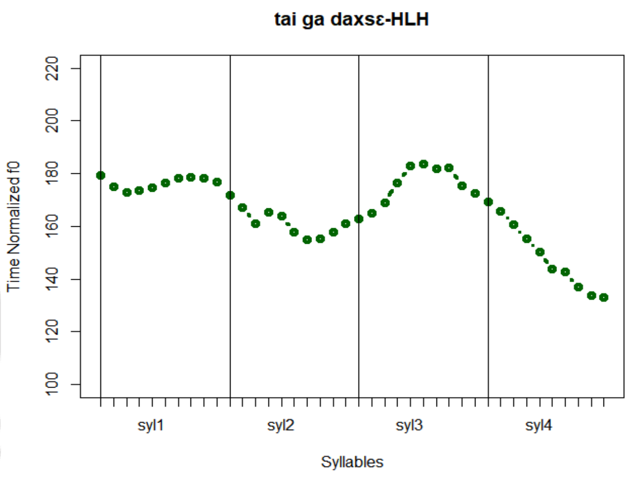


Figure 7.14 [[t̪ái]PP [gà]PP [ɖáx-sɛ̀]PP]IP
she body cover-PERF-3P
She covered her body

As discussed in the beginning of this section, the nominal and verbal stems are observed to always surface with their inherent tonal polarity. This phenomenon can also be observed in the intonational contour for the utterance, [[ámí]PP [gàì-rɛ́]PP [ɖáx-sì]PP]IP *'I covered the cow'* in Figure 7.15.

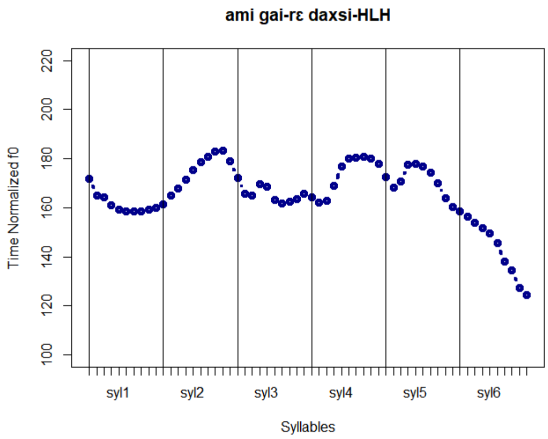


Figure 7.15 [[ámí]$_{PP}$ [gài-rɛ́]$_{PP}$ [ɖáx-sí]$_{PP}$]$_{IP}$
I cow-DAT cover-PERF-1P
I covered the cow

The lexical Low tone in nuclear position clearly surfaces itself in the 3rd syllable, followed by a polar high tone, forming a LH contour for the nominal stem *'cow-ACC'*. However, the verbal suffix [sí], which is prespecified for a high tone, surfaces with a low tone to meet the final lowering of the IP. The lexical High tone of the verb on the other hand, surfaces itself on the penultimate syllable of the utterance, thus forming the H+L% boundary tone for this IP as well.

The lexical Low tone in the penultimate position in the IP in Figure 7.16 also surfaces itself at the penultimate syllable and is followed by a rising tone in the final syllable for the sentence [[ámí]$_{PP}$ [gài-rɛ́]$_{PP}$ [ɖàx-sí]$_{PP}$]$_{IP}$ *' I cow-DAT cover-PERF-1P*. Similar to the IP in Figure 7.15, the nominal stem [gài-rɛ], surfaces with its inherent tonal polarity. It is thus, demonstrated in both these IPs, that the lexical tone contrast in word final position, which mostly comprises of a verb, preserves its underlying tone in the penultimate syllable.

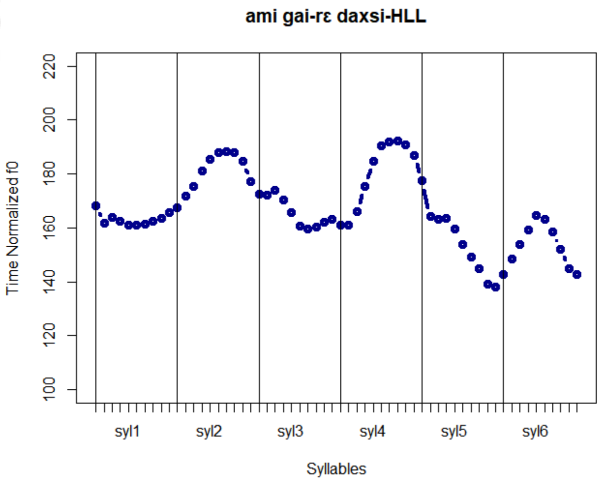


Figure 7.16 [[ámí]$_{PP}$ [gài-rɛ́]$_{PP}$ [ɖàx-sí]$_{PP}$]$_{IP}$
I cow-DAT call-PERF-1P
I called the cow

The initial L*HL accent for p-word at the leftmost position of the IP is also observed in the monosyllabic pronoun [hɛ̀] with an underlying low tone in Figure 7.17. In the IP [[hɛ̀]PP [sānā]PP [xɔ̄i-sil]PP]IP *'he gram say-PST'*, the lexical Mid tone can be observed to have surfaced as H*+H here as well, the IP final lexical Mid tone however surfaces with a falling tone. The sequence of underlying Mid tone thus, could be interpreted to have imposed a declination or this fall can also be interpreted as result of tonal polarity imposed by the past perfective suffix (unmarked for tone in this analysis), which enforces the lexical Mid tone to surface as a low tone as observed in Chapter 5.

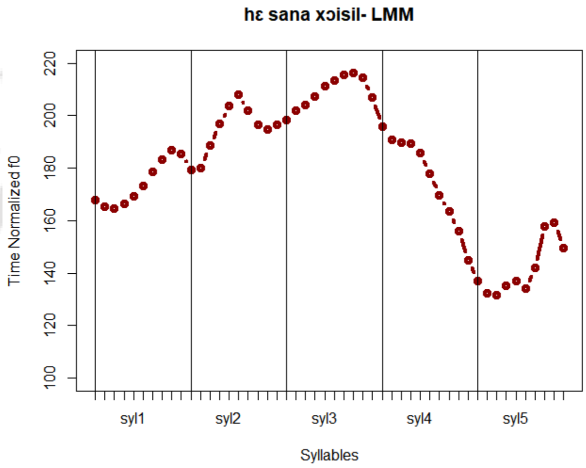


Figure 7.17 [[hɛ̀]PP [sānā]PP [xɔ̄i-síl]PP]IP
I gram say-PST PERF-3P
I said grams

Almost similar structure has been plotted in Figure 7.18 for the sentence [[hɛ̀]PP [sānā an-t̪ɛ]PP [xɔ̄i-sil]PP]IP *'he grams to bring-ASP say-PST'*; it can be observed that the word for *'gram'* /sānā/ does not surface with its lexical Mid tone in the medial position. The sentence has the past perfective suffix [-sil] unmarked for tone as this aspect of verbal suffixes yet remains to be explored, and the noun phrase [sānā an-t̪ɛ]PP has only the word for grams marked for the Mid tone where the word for the verb stem, *'to bring'* remains unmarked for tone. This PP appears to surface with the L*HL pitch accent; it is plausible that the rightmost edge of the PP is marked by the H on the 5th syllable. However, the tonal behaviour of the aspectual suffix [-tɛ] yet remains to be explored before arriving at this conclusion.

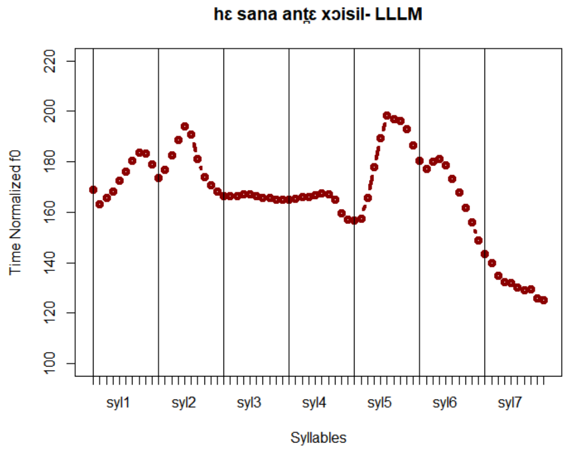


Figure 7.18 [[hɛ̀]$_{PP}$ [sānā an-ʈ̪ɛ]$_{PP}$ [xɔ̄ī-sīl]$_{PP}$]$_{IP}$
'he grams to bring-ASP say-PST PERF'
'he asked to bring grams'

Final lowering is evident here as well, the lexical Mid tone also surfaces with a low tone thus forming the L+L% contour on the IP final boundary.

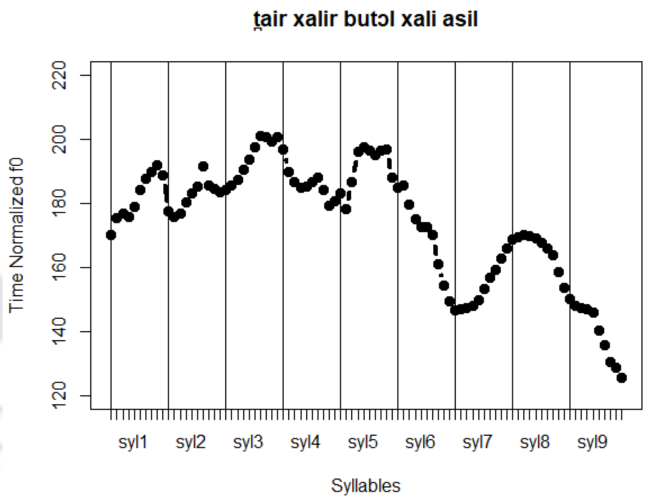


Figure 7.19 [[tai-r]$_{PP}$ [xālī-r]$_{PP}$ [buʈ̪ɔ̀l]$_{PP}$ [xàlì]$_{PP}$ [asil]$_{PP}$]$_{IP}$
she-GEN *ink-GEN bottle empty COP-PST*
her inkbottle was empty

The intonational contour for the complex declarative sentence [[tai-r]$_{PP}$ [xālī-r]$_{PP}$ [buʈ̪ɔ̀l]$_{PP}$ [xàlì]$_{PP}$ [asil]$_{PP}$]$_{IP}$ *'she-GEN ink-GEN bottle empty COP-PST'* is plotted in Figure 7.19. As can be observed in the figure, the initial L*HL surfaces for the leftmost p-word [tai-r]$_{PP}$ *'she-GEN'*; as the pronoun 'she' is prespecified for a high tone, the rise cannot be interpreted as tonal polarity imposed by the genitive suffix [-r]. This structure is however evident in the PP [buʈ̪ɔ̀l]$_{PP}$ *'bottle'* which surfaces with the rising tone on the 4th and 5th syllables. A careful observation of the phrasal contour for [bu̖ʈɔ̖l]PP *'bottle'* shows a significant fall, i.e., L*HL. The following lexical Low tone thus receives a steep fall for the word *'empty'*, [xàlì]. The IP final word does not have tonogenetic basis, and thus the final H+L% surfaces in this IP boundary.

7.2.3 Topicalized and question sentences

Topicalized sentences reflect the initial tonal contrast as plotted in Figure 7.20 for the topicalized sentence [[sa̖na̖]PP [xa̖isi̖]PP [ámí]PP]IP *'cheese eat-PERF-1P I'*.

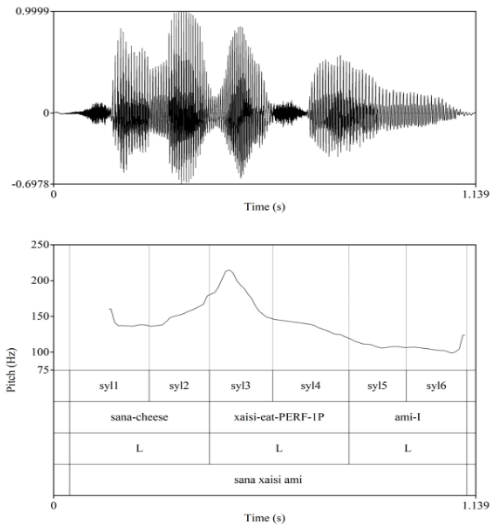


Figure 7.20 [[sa̖na̖]PP [xa̖i-si̖]PP [ámí]PP]IP
cheese eat-PERF I
It was cheese that I ate

The figure plots a topicalized sentence of the underlying Low tone on all the three words. The underlying lexical tone surfaces very notably in the initial position of the IP on the 1st and 2nd syllables and the following underlying Low tone receives a rising pitch, resetting the pitch for the final constituent to surface with its underlying Low tone. Thus, this IP clearly surfaces with all the underlying tones of its constituents.

The initial word in the IP in Figure 7.21 surfaces with its underlying Mid tone surfaces as a high tone with the H*+H structure in the intonational contour for the sentence in [[sānā]PP [xɔ̄isīl]PP [hɛ̀]PP]IP *'grams say-PST he'*. It is difficult to interpret the final lowering in both the IPs for the tropicalized sentences in Figure 7.20 and Figure 7.21 as both the IPs consist of a lexical Low tone in the final syllables.

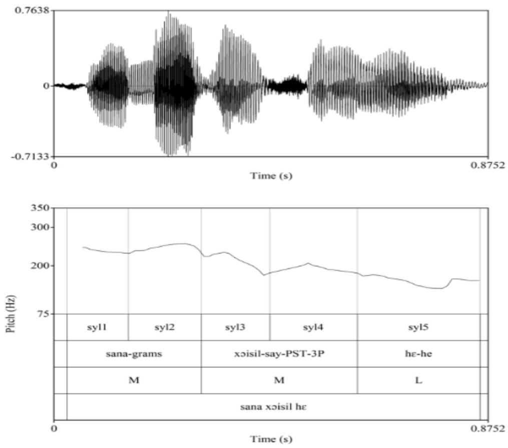


Figure 7.21 [[sānā]$_{PP}$ [xɔ̄i-sīl]$_{PP}$ [ámí]$_{PP}$]$_{IP}$
grams say-PERF-3P I
It was grams that I ate

The final lowering is however observable in the topicalized sentence in Figure 7.22 on the 4th and 5th syllables for the PP [ámí] *'I'*. The IP initial p-word [xɔ̀i]$_{PP}$ 'puffed-rice' surfaces with a rising pitch on the leftmost edge of the IP for the sentence [[xɔ̀i]$_{PP}$ [xaìmù]$_{PP}$ [ámí]$_{PP}$]$_{IP}$ *'puffed-rice eat-FUT-1P I'*, which remains to be explored for the initial LH.

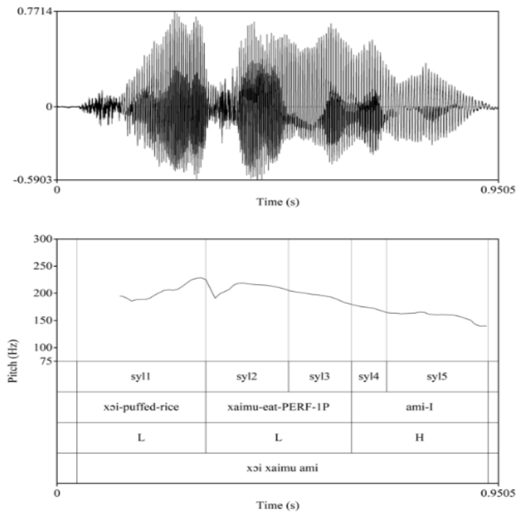


Figure 7.22 [[xɔ̀i]$_{PP}$ [xaì-mú]$_{PP}$ [ámí]$_{PP}$]$_{IP}$
puffed-rice eat-FUT-1P I
It is puffed-rice that I will eat

The initial p-word [xɔ̄i]$_{PP}$ *'fish'* surfaces with a rising pitch on the leftmost edge of the IP for the sentence [[xɔ̄i]$_{PP}$ [xaì-bɔ]$_{PP}$ [t̪ái]$_{PP}$]$_{IP}$ *'fish eat-FUT-3P she'* plotted in Figure 7.23.

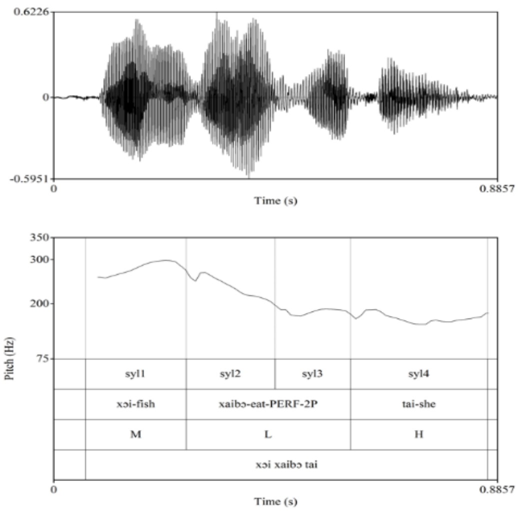
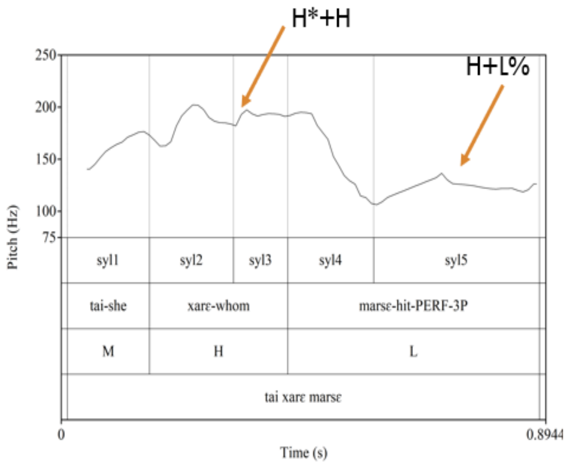


Figure 7.23. [[xɔ̄i]$_{PP}$ [xàì-bɔ́]$_{PP}$ [t̪ái]$_{PP}$]$_{IP}$
fish eat-FUT-3P she
It is fish that she will eat

The final L% is evident in this IP on the 4th syllable. The initial LH borne by the lexical Mid tone can be interpreted as the ubiquitous rising tone of Sylheti's cognate languages and at the same time can be interpreted as the surfacing of the Mid tone as the High tone at the utterance level. The contrast between the two lexical tones in Figure 7.22 and 7.23 in the initial position is clearly observed in both the sentences despite the rising pattern in both the words; the rest of the utterance receives a falling pitch in both the IPs. It is noteworthy that IP boundary appear as HL% in most of the topicalized sentences.

Wh-question words surface with H* +H phrasal structure on the nuclear position of Ip presented in Figure 7.24 for the sentence [[tái]$_{PP}$ [xárɛ́]$_{PP}$ [mar-sɛ]$_{PP}$]$_{IP}$ *'she whom hit-PERF-3P?'*. Wh-question in Sylheti have an underlying High tone which surface in the intonational contour. This behaviour of the question constituents can also be observed in the intonational contour for the sentence [[túmí]$_{PP}$ [xɔ́i]$_{PP}$ [ʤà-iraɛ]$_{PP}$]$_{IP}$ *'you where go-PRES-PROG 2P?'* in Figure 7.25; the High tone surfaces as H* in this IP.



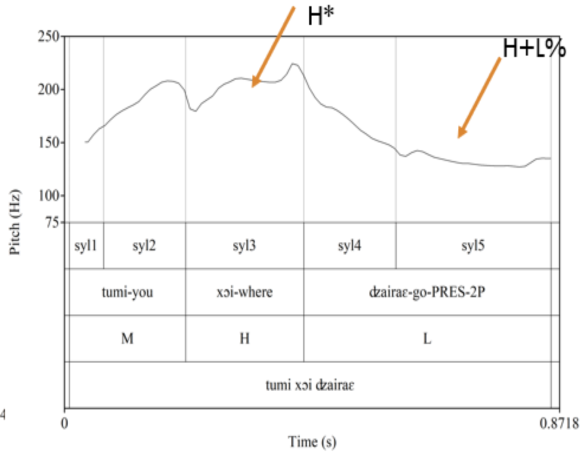


Figure 7.24. tái xárέ mar-sɛ
she whom hit-perf-3P
whom did she hit?

Figure 7.25. túmí xɔ́i ʥà-iraɛ
you where go-PRES-2P
where are you going?

7.3 Summary and Conclusion

It is attested cross-linguistically that pitch accent languages assign tones to stressed syllables but a tonal language may also deploy pitch accent to mark intonational melody (Yip, 2002, p. 276). Our observation of the intonational contours in section 7.2 suggests that the rising tones, i.e., L*H accent, which are common in South Asian languages are present in Sylheti but may not be a distinctive aspect of Sylheti intonation; they are mostly followed by a fall, thus forming L*HL. The rising tone surfaces at the word initial position except when there is a word lexically marked for the High tone in the leftmost PP, as demonstrated in Figure 7.9. Our impression of the intonation structure of the language is that Sylheti does exhibit the features of a pitch accent system, where the pitch height determines word contrast. The inventory of pre-nuclear intonation in Sylheti comprises L*H, L*HL and T* pitch accents, where T is the lexical tone. The initial L*HL is evident on most of the leftmost PP; the rise in the pitch contour is realized at the rightmost syllable of a word in the PP or on the rightmost word in a very few of the PPs such as [sānā an̪t̪ɛ]$_{PP}$ *'to bring grams'* in Figure 7.18. Lexical tones, and tonal polarity of complex stems is very evident in the nuclear positions and there are a very few constructions which neutralize the underlying tone of the constituents in this position. Lexical tone contrast is also observed in some of the utterance final VPs, where the penultimate syllable is preserved for the underlying tone of the verb root. This concludes that the language retains its tonal properties at the post lexical level. The presence of these intonational contours raises the possibility of the pre-nuclear constituents becoming dissociated from their lexical tone and becoming linked to the boundary tone, thereby initiating a discussion on this topic.

The final L% is consistent on almost all the utterances presented in this analysis which leads us to conclude the intonational system of Sylheti is clearly different than the basic intonational structure of Bengali (Hayes & Lahiri, 1991). Topicalized sentences provide a strong argument in favour of a system in the language which involves minimal conflicts at the intonational level.

Our data for lexical tone contrast in the final position of an IP, which comprises mainly of a verb, show that the lexical tone contrast is preserved in the penultimate syllable, reserving the last syllable for IP boundary which receives a falling tone, often marked by L%, H*L%, or LL%. We assume utterance final lowering is the skeleton of Sylheti intonation. We assume that the boundary tone can be achieved by H*+L%, LL% or L% and thus we assume that the skeleton of the utterance in Sylheti exhibits a default L%. The nuclear tone is preserved at the utterance level and the final falling pitch is usually attached to a morpheme or syllable and not on a PP. This association pattern of the boundary tone to a non-specific unit is also attested cross-linguistically (Gussenhoven, 2004). We conclude that the boundary tones almost always surface on the final boundary; the accentual aspect of the PPs on the nuclear positions, especially in a complex structure such as in Figure 7.19 in the language, remains to be explored further.

Chapter 8

Conclusion

This dissertation investigated the phonetics and phonology of tone and its interaction with component of grammar in Sylheti to provide a wide picture of the prosodic hierarchy of a tonal language which genetically belongs to a non-tonal language family and is geographically surrounded by numerous tonal languages. The primary aim of the dissertation was to probe into the phonology and phonetics of tonogenesis in the language, which defines its phonology and to provide a wide picture of the correlation between grammar and phonology in the language at the segmental and suprasegmental level. The phonological areas specifically investigated were:

- the phonemic inventory and phonological interactions at the segmental level in Sylheti.
- the lexical tone inventory by probing into the tonogenesis triggered by both onsets and coda positions in the language.
- the phonological domain of complex stems and its inherent tonal polarity: its exceptions and featural spreading.
- the tonal melody in compound words and their correlation with tonal polarity.
- the basic intonational structure of the language.

The following sections summarize the major findings in this study.

8.1 Phonology of Sylheti

This chapter examined the phonemic inventory of the language and established that in accordance with previous research on phonology done on different geographical locations of the Sylheti diaspora. It illustrates how Sylheti developed a very simplified phonemic inventory for both vowels and consonants in while developing as a language, and how this phenomenon correlates to the evolution of the language from its atonal stage to a tonal one. The simplified phonemic inventory of the language comprises of only 5 vowels and 17 consonants. The chapter confirms with acoustic analysis that the language has a simplified vowel inventory with only 5 vowels : /a/, /i/, /ɛ/, /ɔ/, and /u/.

The chapter proposes that the phonemes and words in New Indo Aryan (NIA) which can be traced in online dictionaries available online for the NIA words as these languages represent the reflexes of the diachronic forms of Sylheti words. A close observation of the consonants shows that the language underwent a complete deletion of the diachronic [+spread glottis] feature for all the consonants in all positions which triggered tonogenesis in the language. This loss was extended to the glottal fricative /h/ and this phenomenon might be associated with tonogenesis as well. It shows how the loss of aspiration as independent of spirantization of diachronic obstruents in the language. As claimed in the previous studies, the chapter confirms that the language lacks tautosyllabic consonant clusters. Consonant clusters are allowed only intervocalically in Sylheti, but a few clusters are constrained on the onset - coda boundary; the language underwent phonological processes to avoid unattested clusters in its diachronic forms. Sylheti gemination follows a coda-onset configuration to avoid clusters in geminates as well. The most attested syllable contact is a sonority distance of -2 to +2 in the language. Phonotactic constraints and syllabification strategies in the language are mostly inherent in its cognate languages, for example rules for onset restrictions on /ŋ/, gemination rules aspiration deletion from the coda position resembles the syllabification rules of the phoneme /ŋ/ and geminate syllabification; constraints on fricative gemination and geminate syllabification in Hindi (Ohala, 1999). Most of the repair strategies used in diachronic forms are not active in the present-day Sylheti which suggests these forms underwent repair strategies in the language. Gemination, rhotic-syncope and epenthesis are some of the repair strategies in Sylheti adapted while developing as language, for simplification of liquid- obstruent contact across syllables. These clusters might be traced back to the old form of the words reflected by the NIA words or might be a result of development of the words in the language as well.

8.2 Tonogenesis and tones in Sylheti

This chapter investigates the tonal inventory of Sylheti with special focus on monosyllabic words and shows that in addition to tonogenesis triggered by obstruent onsets, codas also had a role in the tonogenetic system of the language. The chapter presents a phonological analysis of tonogenesis in the language and presents an empirical evidence for the existence of a three-way tone contrast in Sylheti via analysing its acoustic correlates. It considers NIA words as the reflexes of Sylheti diachronic words and studies the words which have lost aspiration in onset and coda positions. The chapter primarily focuses on the acoustic experiments on the existence of three- way tonal contrast in Sylheti words and shows that the loss of aspiration contrast from both onset and coda positions triggered a three-way tonal contrast in the language. Although the chapter establishes the existence of the phonological High, Mid, and

Low tones, the lack of sufficient data for the High tone acts as a deterrent to a statistical significance of difference between the High and Mid tones. The chapter studies the acoustic correlates of the tonal triplets and pairs and shows that f0 is the only factor affecting tone and duration does not appear to be a significant correlate.

The chapter shows that the diachronic merger of aspirated and unaspirated onsets and codas resulted in a three - way tonal contrast in Sylheti. Being segmentally identical, the lexical contrast between these minimal triplets can now only be found at the tonal level. For example, the historical voiceless aspirated onset in *k^{h}aʈ, the word for ‘floor - stool’, maps to a lexical Low tone in the first triplet, /xàʈ/ << *k^{h}aʈ. The historical voiceless unaspirated onset in *kat, the word for ‘cut’, maps to a contrastive Mid tone, /xāʈ/ << *kaʈ. The historical voiceless aspirated coda in *kat^{h}, the word for ‘valuable wood’, maps to the lexical High tone, /xáʈ/ << *kaʈ^{h}. The historical merger of voiceless aspirated and voiceless unaspirated onsets thus results in a Mid - Low lexical tone contrast on the following vowel. The merger of aspirated and unaspirated codas further maps to a lexical High tone on the preceding vowel leading to a three – way tonal contrast in the language. We have also found that historical aspiration in sonorant codas also resulted in a High tone. The emergence of the High tone resulting from the loss of aspiration in coda consonants is an important part in the evolution of Sylheti tonogenesis. The analyses show that there is phonological evidence of the three-way tonal contrast in the language but the smaller sample size for the High tone in monosyllables acts as a deterrent in establishing a significant three- way contrast. We argue the underlying [+voice, +spread glottis] feature of coda was consequence of reinterpretation of the lexical tone assignment and tonogenesis in Sylheti to maintain the lexical contrast. This tonogenetic environment is reanalysed as word medial consonant in disyllabic environment, leading to the three-way tonal contrast in disyllables which we discuss in the next chapter. It is evident that the language has a contrast between the High, Mid and Low tones in the monosyllabic words. However, the lack of statistically significant result for f0 and duration also leads to the conclusion that perhaps there are other cues that distinguish these words. As Gope and Mahanta (2016) showed in their study, the High tone is associated with marginal creakiness whereas the Low tone seemed modal in nature. It is possible that the inherent sparse distribution of the aspirated coda in NIA languages, which led to the lexical High tone in Sylheti is a factor for the deterrent sample size for the lexical High tone. The chapter concludes with the proposal that a detailed analysis of prosodic factors and voice quality beyond monosyllables on the tonogenesis of Sylheti with emphasis on and like, rhythm and stress may lead to further understanding of the fine - grained nuances of the tonal system in Sylheti.

8.3 The three-way tonal contrast: Disyllables

This chapter studied the three-way tone contrast in Sylheti from a disyllabic perspective, examined based on the diachronic loss of aspiration in the onset and medial consonant. The chapter established that the diachronic forms of the consonants and their syllabic positions also had a role in disyllables which resulted in the three-way tonal contrast in Sylheti. We argue in this chapter that the diachronic merger of aspirated and unaspirated onsets led to a Mid-Low tonal contrast in Sylheti disyllables whereas the merger of aspirated and unaspirated medial consonant led to the High and Mid tonal contrast in the language, subsequently resulting in minimal tone triplets like, [síʈá] << *tʃiʈʈʰa *'list'*; [sīʈā] << *tʃikʈ̪ɔ *'sticky crude jaggery'*; [siʈ̀ à] << *tʃʰiʈa *'droplets'* or the triplet [xúʈá] << *koʃʈʰa *'room'*, [xūʈā] << *kuʈa *'crooked stick'* and [xùʈà] << *kʰuʈʈa *'taunt'*. The chapter showed, that the tonogenetic factors involved in disyllables are the same as those found in monosyllables. In disyllables, the same tone emerged from the merger of aspirated and unaspirated medial consonants as in the tonal pair, /ɸút̪í/ << *pũt̪ʰi *'manuscript'* and /ɸūt̪ī/ << *pũt̪i *'bead'*. The merger of initial and medial consonants thus subsequently led to minimal triplets in disyllables, as well as in the triplet /ɸáʈá/ << *paʈʈʰa *'buck goat'*; /ɸāʈā/ << *paʈʈa 'grindstone'; /ɸàʈà/ << *pʰɘʈa *'crack'*. Has can be observed, the historical voiceless obstruent onsets led to a lexical Low tone for example in /ɸàʈà/ << *pʰɘʈa *'crack'* ; historical unaspirated voiceless onsets led to a lexical Mid tone as in /ɸāʈā/ << *paʈʈa *'grinding stone'*; the High tone was conditioned by the historical aspirated word medial consonant rather than the coda as in medial consonant led to the lexical High tone as in the disyllabic word /ɸáʈá/ << *paʈʈʰa *'buck goat'*. We can thus infer from our results that word is the TBU in Sylheti and represent the relation between the tonal and the segmental tier as a many to one association of tone.

We studied both production and perception to investigate into the tonal distribution in Sylheti disyllables with special focus on production test. This chapter is primarily based on acoustic experiments and establishes a three-way contrast in Sylheti disyllabic words that is statistically significant. It is evident from our phonological and production analysis on the tonal system of Sylheti disyllables of a CV.CV syllabic patterns, that the language has three lexical tones named, High, Mid and Low. Our results for Mid vowel showed that the Mid vowel is significantly lower than the High tone and significantly higher than the Low tone for both raw and normalized f0. This chapter also shows that f0 is the major correlate of tone and duration does not show a very significant correlation to tone. The acoustic results suggest that f0 is equally contrastive across syllables both in production and perception. The perception test results show that the speakers have a preference to the second syllable to mark contrast between the tones for the High and Low tones generally. The chapter also establishes a difference in behaviour between the individual characteristics of the Mid tone as compared to the High and Low tones from both production and perception perspectives. The chapter concludes with the discussion that words which had diachronically aspirated medial consonants, associate with the lexical High tone and words with diachronically unaspirated medial consonant associate with the lexical Mid tone. It argues that, unlike proposed in Gope (2016), it is the Mid tone rather than the Low tone, which is the base or neutral tone in Sylheti. The tonal behaviour of the Mid tone at the domain of complex stems and compounds analysed in Chapters 5 and 6, further strengthen this observation.

8.4 Tonal Polarity in Sylheti words

This chapter primarily studied complex nominal stems in Sylheti. It discusses the inflectional and derivational suffixes and their categories in the language. The chapters concludes that Sylheti nominal stems clearly exhibit tonal polarity and provide empirical evidence in favour of the presence of tonal polarity rather than tonal dissimilation, which is the result of OCP. Our analysis shows that nominal suffixes inherently lack their own tonal specifications and the same suffix may surface with three different tones, depending on the lexical tonal specification of the root to which it is attached. The default tone, i.e., the Mid tone is immune to polarity and thus unlike the polar High and Low tone, is unable to impose a polar tone to its toneless suffix. The stems with roots which have a underlying High or a Low tone, always surfaces with either a LH or a HL tone contour. Our analysis of the pitch tracks of the complex words confirms to this divergent behaviour of the Mid tone from that of the High and Low tones. The tonelessness of the suffixes proves that the root and suffix are dominated by single tonal node leading a nominal root to form a prosodic domain along with its suffix. We argue that tonal polarity is rather dependent on the feature of the lexical tone than on the grammatical class of the suffixes. The chapter conducts a brief study on complex verb stems and concludes that, tonal alteration patterns and suggest that the suffixes are prespecified for a high tone. The high tone of the suffix enforces the root to change its underlying tone and surface as a low tone, thus forming the LH contour. This pattern is, however, consistent for the habitual verb stems; the underlying low tone does not undergo any alteration as it meets the surface requirement of the LH structure. The change from the lexical Mid tone to a low tone indicates that this modification is implemented to fulfill the tonal demand of the habitual verb stems with a LH tone contour, thereby highlighting the neutral characteristics of the Mid tone. The perfective verb stems however, do not exhibit a pattern for polar tonal contour unlike the habitual verb stems and rather seems to raise the tone of the root to which it is attached.

8.5 Tonal melody in Sylheti compound words

This chapter analysed compound stems in Sylheti as well and demonstrated that compound stems form one phonological domain in Sylheti. It shows that the phonotactic constraints and inherent polarity of the language are also implemented on compound stems as one phonological domain. It investigates into both verb compound stems and nominal compound stems and analyses the interaction of lexical tones when they surface in proximity to each other. The chapter probed into different verbal and nominal compounds and analysed the fundamental difference in their prosodic behaviour. It is important to mention here that most of the verb compounds analysed in this chapter, were infinitive forms of verbs which had a nominal connotation, whereas the nominal compounds considered in the study primarily involves words which have achieved the status of nominal stems in the language. The chapter focuses on the uniform tone melody predominant only in nominal compound stems and seeks empirical evidence for acoustic correlates of this uniform structure. We have mostly analysed words which are specified for lexical tone or have tonogenetic base as per our analysis on tone. The chapter also presents a detailed acoustic analysis of the nominal compound stems and shows that LHL tonal melody is uniform across all the compound words and is consistent across speakers.

Our analysis suggests that the domain of nominal compounds acts as one phonological domain, marked by the LHL tonal melody. Our analysis of the acoustic correlates for this tonal pattern shows a significant rise in pitch from the first to the second syllable followed by a significant fall. This LHL structure is uniform and occurs across compound stems with a combination of different underlying tonal specification. It is evident that the underlying lexical tones influence each other and surface with polar tonal values in Sylheti. The chapter analyses the underlying tonal rules leading to the surface LHL structure of the words. Compound verbs, however, exhibit the polar LH or HL tone contours and the behavior of the Mid tone in this structure also confirms to its status of being the default tone in the language. Our analysis of the nominal compound stems and observation of the tonal behavior of verb stems provide substantial argument in favor of a predominant tonal polarity in Sylheti that requires an initial tone to be followed by an opposite tone. It concludes with the discussion that the LHL tone contour might be interpreted as the prosodic marker of the phonological domain of compounds in the language.

8.6 Intonation in Sylheti: a preliminary account

The chapter demonstrates the basic intonational structure of Sylheti, a tonal language which uses pitch to contrast lexical meanings. It presents a preliminary attempt to study the intonational structure of Sylheti. This chapter investigated into the post lexical prosodic structure in Sylheti and claim that the language behaves as a pitch accent language above the lexical level. Our analysis shows that Sylheti exhibits a phrasal structure like that of its cognate languages, and phonological phrase is the basic unit in the intonational system of the language. This basic unit of intonation emerges mostly in ditransitive and complex sentences and almost consistently on the leftmost boundary of an IP. The rising tones, i.e., L*H accent, which are common in South Asian languages are present in Sylheti but may not be a distinctive aspect of Sylheti intonation. The rising tones mostly surface at the word initial position and may also be suppressed by a following lexical High tone. The inventory of pre-nuclear intonation in Sylheti comprises L*H, L*HL and T* pitch accents, where T is the lexical tone. The final lowering is consistent for almost all the sentences and the IP final word, which comprises mainly of a verb, preserves its lexical tone in the penultimate syllable, reserving the last syllable for IP boundary which is often marked by L%, H*L%, or LL%. The nuclear tone is preserved at the utterance level and the final falling pitch is usually attached to a morpheme or syllable and not on a PP. Our analysis of the topicalized sentences suggest that there is minimal interaction between tone and intonation; there is an apparent IP lowering for all the topicalized utterances but the lexical tone of the topicalized words, always surface itself. The chapter concludes with the remark, that the lexical Mid tone exhibits a difference in its behaviour in these structures as well and always surface as a H tone, thus the intonational system allows the words specified for lexical tones to srface with a H or a L tone only.

8.7. Implication and scope for future studies

We conclude that the tonogenetic origin and the varied behaviour of the Mid tone leads the analysis towards another possible direction. It is confirmed from our production experiments in chapter 3 and chapter 4 that the tone had emerged from words which diachronically had no aspirated sounds or tonogenetic role. Our results for monosyllables showed that the Mid tone is lower by only about 5 Hz than the High tone whereas, in disyllables the Mid tone is lower by about 19.42 Hz than the High tone. This variation in the behaviour of the Mid tone is the neutral tone in Sylheti which varies with the degree of contrast in monosyllables and disyllables. The difference in the individual characteristics of the Mid tone in disyllables exhibited in both our production and perception analyses strengthen this observation. We also found that in complex morphemes, it is only the High and Low tones that impose opposite tonal values on the adjacent toneless suffixes whereas, the (proposed) neutral Mid tone spreads over to its suffix. As we concluded from our analysis on compound words, the High tone does not surface with the canonical LHL tonal contour of compounds in the language when preceded by a Mid and Low tone, but a Mid tone preceded by a Low tone adheres to the LHL melody of the compound stems. High and Low tones exhibit rigidity in complex and compound stems and the Mid tone may change its behaviour form depending on the context of stems. They mould to the LHL melody which defines the domain of the compound stems or stay immune to tonal polarity. In case of verb stems, the Mid tone may surface as a Low tone when adjacent to a High tone in one prosodic domain and may also surface as a High tone when adjacent ot a Low tone. We propose that this phenomenon can be attributed to the fact that words with unaspirated onsets or codas were reinterpreted as the neutral tone. Furthermore, tonal alignment rules for prosodic stems may vary between complex words and compound words in the language. While the root noun always surfaces with its underlying lexical tone in complex words enforcing tonal polarity or spread onto the adjacent toneless suffix, it does not surface with all tonal combination in compound words. The prosodic structure and phonological rules inherent to compound words conclude that content words with prespecified lexical tones in compound structures surface with a canonical LHL melody.

This phenomenon is attested in tonal languages with an optional accentual feature as well, where a uniform accentual pattern may be exhibited by only one grammatical category (Goldsmith, 1984). Tonelessness of adjacent morphemes have also been analyzed as one of the major factors leading to the reanalysis of tone as accent, which could be one of the possibilities of Sylheti prosodic stems (Clements & Goldsmith 1984). However, lexical tones are overridden by accent which causes the root to lose its tone, which is not the case in Sylheti complex morphemes; we witness this behaviour of nominal compound words in the language which is analysed in the next chapter. Furthermore, tonelessness of suffixes cannot always classify a densely or sparsely tone language: the Tibeto-Burman languages for instance, are unquestionably purely tone languages but languages like Meithei, Mende, and Hakha Lai demonstrate that not every syllable or morpheme need to have a phonological tone (Hyman, 2011).

These conclusions contributes to our understanding that Sylheti exhibits the features of a tonal language where the words lexically marked for tones do not always surface themselves. There are evidence of toneless syllables and suffixes in the language which suggests that the language is in of its non-final stages of tonogenesis. The phonological domain of compounds is something that can be explored in future to analyse the possibility of a prosodic structure in the stems which supresses the lexical tone of the words. Another aspect of the conclusion which remains to explored in future is our impression of the intonation structure of the language. It is inferred that Sylheti does exhibit the features of a pitch accent system, which needs to be probed in detail. The accentual and prominence relation aspect of the prosodic system in the language thus remains to explored along with the underlying tonal specifications for words which have no tonogenetic base in the language to achieve a wider perspective into its lexical and post lexical tonal inventory.

<u>APPENDIX A</u>: <u>Sylheti Word List</u>

Table A1 : Sylheti monosyllables

Word	***Gloss***	**Word**	***Gloss***	**Word**	***Gloss***
xāʈ	*cut*	ɸɔ́ɽ	*read*	gàŋ	*river*
sāɽ	*earthen pieces*	xáʈ	*valuable wood*	sàd̪	*roof*
ɸīʈ	*back*	sáɽ	*vessel*		
sɔ̄ɽ	*slap*	ɸíʈ	*back*	ʥàr	*tolerate*
ɸɔ̄ɽ	*fall*	sɔ́ɽ	*ride*	ɖàx	*call*
xāl	*bad time*	ɸɔ́t̪	*road*		
ɸāl	*animal (collective)*	láɸ	*jump*	xà	*eat*
ɸān	*betel leaf*	máɸ	*jump*	sìr	*tear*
sūl	*hair*	báŋ	*break*	xàʈ	*toil*
xɔ̄i	*a fish*	ɖúʃ	*hit with head*	d̪àt̪	*tooth*
t̪āl	*palm*	gúʃ	*bribe*	bɔ̀i	*book*
xūa	*well*	ʥár	*shake*	sàn	*scatter*
xūl	*dynasty*	ɖáx	*cover*	gàs	*tree*
xāl	*bad time*			ʥɔr	*fever*
ɸɛ̄ʈ	*stomach*	gúr	*spin*	gùl	*liquid mixture*
sūr	*thief*	ʥɔ́ɽ	*storm*	bɔ̀r	*blessing*
xām	*work*	gúl	*round*	ɖɔ̀r	*fear*
ɸūx	*worm*			xàʈ	*floor stool*
ɸāt̪	*spread*	bɔ́r	*fill*	sàɽ	*let go*
xān	*ear*	bɔ́ɽ	*intestine*	ɸàʈ	*burst*

ɸūʈ	*burn*	d̪ɔ́r	*hold/catch*	xàl	*skin*
xɔ̄m	*less*	gɔ́r	*house*	ɸàl	*a jump*
mādʑ	*scrub*	d̪έx	*see*		*(noun)*
sɔ̄l	*move*	sɔ́ux	*eye*	ɸàn	*yam leaf*
ɸɔ̄r	*wear*	lέx	*write*	sùl	*peel*
xɔ̄	*say*	úʈ	*get up*	xɔ̀i	*puffed rice*
ʈiɸ	*press*	múx	*mouth*	t̪àl	*plate*
t̪āl	*palm*	gá	*wound*	xùa	*fog*
ɸuā	*boy*			xùl	*a musical instrument*
ʈɔ̄x	*sour*			xàl	*drain/skin*
xɔ̄r	*do*			bɔ̀in	*sister*
ɸīʈ	*beat*			bɔ̀u	*wife*
bɔ̀i	*book*			xàm	*envelope*
ām	*mango*			gàs	*tree*
t̪ul	*lift*			gà	body
t̪il	*sesame*			gài	cow
ɸāx	*cooking*				
ɸās	*five*				
ɸɔ̄s	*rot*				
sā	*ask*				
ɸā	*get*				

Table A2: Sylheti Disyllables

Word	*Gloss*	Word	*Gloss*	Word	*Gloss*
ɸāʈā	*grindstone*	ɸáʈá	*buck goat*	ɸàʈà	*crack*
xūʈā	*crooked stick*	xúʈá	*room*	xùʈà	*taunt*
ɸāxā	*ripe*	ɸáxá	*wing*	ɸàxà	*empty*
sīʈā	*crude sticky jaggery*	síʈá	*list*	sìʈà	*droplets*
xāʈā	*thorn*	xát̪á	*blanket*	xàt̪à	*copy*
ɸīʈā	*beating*	ɸíʈá	*sweet pie*	ɸìt̪à	*ribbon*
ɸūt̪ī	*bead*	ɸút̪í	*manuscript*	sùlà	*scrubber*
ɸaʈi	*mat*	ɸáʈí	*nanny goat*	xàʈì	*pure*
xɔ̄lā	*banana*	súlá	*stove*	ɸàkì	*knot*
sɔ̄ɽā	*sparrow*	xáʈí	*small stick*	xùɸà	*hair bun*
ʈɛ̄xā	*money*	ɸákí	*bird*	xɔ̀là	*stream bed*
t̪ūɽā	*bunch of flower*	xúɸá	*misfortune*	sɔ̀ɽà	*stream*
sāʈā	*earthen candle*	xáʈɔ́l	*jackfruit*	ʈɛ̀xà	*contract*
sūrī	*theft*	búɽá	*old man*	t̪ùɽà	*little*
xānī	*blind of one eye (FEM)*	búɽí	*old woman*	sàʈà	*eccentricity*
sānā	*chickpea raw*			sùrì	*knife*
xāsā	*raw*	gɔ́ntɔ́	*curry*	xànì	*food*
xɔ̄bɔ̄r	*grave*	gád̪á	*donkey*	sànà	*cottage cheese*
xālī	*ink*	gúɽá	*horse*	xàsà	*cage*
ɸɛ̄nā	*water Hyacinth*	d̪ɛ́xá	*to meet*	xɔ̀bɔ̀r	*news*
sīkā	*muskrat*	múɽá	*wicker stool*	xàlì	*empty*
ɸūɽī	*girl*	bɛ́ɽá	*lamb*	ɸɛ̀nà	*foam*
ɸɛ̄nd̪ā	*weep*	xɔ́gá	*throat*	sìkà	*sling rope*

ɸūŋʈā	*comedian*	bɔ́xá	*naive*	gài̇nʤà	*cannabis*
ɸāʈ̪ā	*leaf*			ɸàʈ̪rà	*buffoon*
sɔ̄kkɔ̄r	*go round*			bɛ̀ʈà	*man*
ɸɔ̄iʃā	*money*			bɛ̀ʈì	*woman*
xɔ̄ɸāl	*forehead*				
xɔ̄lʃī	*urn*			xùlà	*open*
ɸɔ̄sā	*rotten*			gùɽà	*horse*
xānā	*punctured*			sìrà	*scratch*
ʈ̪ālū	*crown of head*			bìjà	*wedding*
sīɽā	*flattened rice*			bɛ̀tà	*man*
xɔ̄ɸāl	*forehead*			bìsì	*seeds*
ɸūɽā	*burnt*			ʃìlaì	*stitch*
mūɽī	*head*			gùɽà	*dust*
xālā	*black*			ɖɛ̀xà	*young bull*
ʈ̪ālā	*lock*			mùɽà	*twist*
sɔ̄gā	*stupid*			bɔ̀stà	*sack*
				bàʃì	*stale*
				bìjà	*wedding*
				bàʃɔ̀n	*utensils*
				bɛ̀ɽà	*fence*
				xali	

APPENDIX B: Sylheti Sentence list

Appendix B1: Declarative Sentences

1. ámí sànà xài-sí — HLL
   I cheese eat-PERF-1P

   a. *I ate cheese*

2. ámí sānā xài-sí — HML
   I grams eat-PERF-1P
   I ate grams

3. tái gà dáx-sɛ́ — HLH
   she body cover-PERF-3P

   she covered her body

4. tái gá dáx-sɛ́ — HHH
   she wound cover-PERF-3P

   she covered her body wound

5. ámí gài-rɛ́ dàx-sí — HLL
   I cow-DAT call-PERF-1P

   I called the cow

6. ámí gài-rɛ́ dáx-sí — HLH
   I cow-DAT cover-PERF-1P

   I called the cow

7. tái xɔ̀i xài-bɔ — HLL
   I puffed-rice eat-FUT-3P

   I will eat fish

8. ámí xɔ̄i xài-mu — HML
   I fish eat-FUT-1P

   I will eat fish

9. hɛ̀ bɛ̀ɽà xāt-sɛ́ — LLM
   he fence cut-PERF-3P

   he cut down the fence

10. hɛ̀ bɛ́ɽá xāt-sɛ́ LHM
he lamb cut-PERF-3P

he slaughtered the lamb

11. tái ɛ̄x-ʈā xām ɸāi-sɛ́ HMMM
she one-CL work get-PERF-3P

she got a job

12. tái ɛ̄x-ʈā xàm ɸāi-sɛ́ HMLM
she one-CL envelope get-PERF-3P

she found an envelope

13. hɛ̀ bɛ́ɽá xɛ̀dà-ite gì-ja bɛɽà báŋg-sɛ́ LHLLLH
he lamb chase-ASP go-PERF fence break-PERF-3P
he broke the fence while chasing the lamb

14. hɛ̀ xátá sìr-sɛ̀ LHL
he blanket tear-PERF-3P
he tore the blanket

Appendix B2: Topicalized Sentences

1. sànà xài-si ámí LLH
cheese eat-PERF-1P I

it was cheese that I ate

2. sānā xài-si ámí MLH
grams eat-PERF-1P I
it was grams that I ate.

3. gà dáx-sɛ́ ʈ̪ái LHH
body cover-PERF-3P she

it was her body that she covered

4. gá dáx-sɛ́ ʈ̪ái HHH
wound cover-PERF-3P she
it was her wound that she covered

5. xɔ́i xài-bɔ ʈ̪ái LLH
fish eat-FUT-3P she

it's fish that she will eat

6. xɔ̀i puffed-rice | xài-mu eat-FUT-1P | ámí I | LLH

it's puffed-rice that I will eat

7. bɛ̀ʈà xāi-sɛ́ hɛ̀ | LML
fence eat-PERF-3P he
it was the fence that he cut down.

8. bɛ́ʈá xāt-sɛ́ hɛ̀ | HML
lamb cut-PERF-3P he
it was a lamb that he slaughtered.

9. ɛ̄x-ʈā xām ɸāi-sɛ́ tái | MMMH
one-CL work get-PERF-3P she
it was a job that she found

10. ɛ̄x-ʈā xàm ɸāi-sɛ́ tái | LLMH
one-CL envelope get-PERF-3P she

It was an envelope that she found

Appendix B3: Wh-Questions

1. hɛ̀ xítá sìʈ-sɛ | LHL

he what tear-PERF-3P
what did she tear?

2. tái xárɛ́ dàx-sɛ | HHL

she whom call-PERF-3P
whom did she call?

3. hɛ̀ xɔ́i ʥà-it̪ɔ | LHL
he where go-ASP-3P
what will he go?

4. hɛ̀ xɔ́bɛ́ ʥà-it̪ɔ | LHL
he when go-ASP-3P
when is he supposed go?

5. tái xárɛ́ màr-sɛ́ | HMM
she whom call-PERF-3P
whom did she hit?

6. túmí xɔ́i ʥà-iraɛ | HHL
you where go-PRES-2P
where are you going?

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