TONE AND INTONATION IN BORO

BY

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A

DISSERTATION

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DECLARATION

This is to certify that the dissertation entitled “Tone and Intonation in Boro", 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 Dr. 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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This is to certify that the dissertation entitled "Tone and Intonation in Boro" submitted by Mr. Kalyan Das (Registration Number: 11614113), a research scholar in the Department of Humanities and Social Sciences, Indian Institute of Technology Guwahati, for the award of the degree of Doctor of Philosophy in Linguistics, is a record of an original research work carried out by him 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 needed 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 Mili, Maina, Nirjor and Maa...Thank you for your support, love and understanding.

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Abstract

Intonation refers to tunes which exist separate from the linguistic text (Hayes and Lahiri, 1991) and play important roles in the phonology of a language in terms of signaling sentence level pragmatic meanings, such as sentence type and focus (Ladd, 1996). These tunes can function as melodic morphemes (Pierrehumbert, 2001). Variation in fundamental frequency (f_0) provides the phonetic foundation for these linguistically significant aspects of languages. The same phonetic cue is employed in tone languages for melodic variations which result in change in meaning of lexical items or which function as grammatical categories, such as tense, aspect or case (Yip, 2002). Since the phonetic correlate for tone and intonation is variation in f_0, the study of intonation in a tone language provides the opportunity to evaluate the extent to which intonational features influence tonal features or to examine whether tonal features resist intonational influence. This dissertation evaluates this relationship between tonal and intonational pitch variations in connection with Boro, a two-tone language spoken in the north-east part of India. A production experiment is presented to show that alignment of lexical tones in Boro follows a minimal disyllabic Prosodic Word (PrWd) domain. Lexical tones surface right aligned within this domain adhering to the processes of tone shift, tone spreading and tone deletion.

A detailed examination of pitch contours of sentences of various lengths and types is presented to show that initial and final boundary tones, downstepping, declination and phrasing constitute the post-lexical component of a tone language like Boro. It is shown that utterances in Boro can be grouped into three levels of prosodic units: PrWd, immediate phrase (ip) and Intonational Phrase (IP). Acoustic evidence has also been presented to show that the left edges of IPs in Boro are marked by an L%H% tone. While IP medial lexical tones surface with their characteristic f_0 trends, IP final lexical tones coexist with the right edge boundary tones. Acoustic results have shown that both the lexical and a monotonal boundary tones align to the rhyme of the IP final syllable. A scaling difference also surfaces for the f_0 target for the boundary tone depending on the two contrastive tones preceding it. Bitonal boundary tones may sometimes

obliterate the f_0 specification for the final lexical tones. It is also shown that right edge boundary tones for IPs can have a global effect in addition to local impact in terms of alignment. Although IP medial lexical items in Boro do not surface with any intonational tunes aligned to them except with their characteristic pitch trends, the intonation of Assamese spoken by Boro speakers shows that the second language (L2) participants could phonetically realize the typical Assamese L^*H_P contour (Twaha and Mahanta, 2016) marking each of the phonological phrases.

This dissertation has also explored in detail the prosody of focus marking in Boro. Results have shown that ex-situ focus in Boro is expressed by ip boundary insertion. Focus marking with emphatic particles associates an H* pitch accent to the particle itself and the pitch register of the whole IP is raised. Register of the whole IP is lowered for contrastive and corrective focus. Based on these results, it is also argued that focus prosody in Boro necessitates a relook at the prosody-focus correlation. These features of the prosody of focus in Boro are not replicated in the intonation of Assamese produced by Boro speakers. Compression of duration of all the syllables is found to be the dominant phonetic cue for both L2 Assamese corrective and narrow focus marking.

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Contents

List of Abbreviations and Symbols

Acc/A	Accusative Case
AM	Autosegmental Metrical
ATR	Advanced Tongue Root
CF/$_{contfoc}$	Contrastive Focus
CrF	Corrective Focus
Dat	Dative Case
Det/D	Determiner
Emp	Emphatic Particle
$_{foc/f}$	Focus
f_0	Fundamental Frequency
f	Focus tone
Fm/F	Female
Fut	Future tense
Gen	Genitive Case
h	High Register Tone
H	High Tone
Hab	Habitual
hz	Hertz
Imp	Imperative
ip	Intermediate Phrase
IP/$_{\iota}$	Intonational Phrase
l	Low Register Tone
L	Low Tone
L1	First Language
L2	Second Language
Loc	Locative Case

M	z-score normalized meanf_0 value
Max	Maximum
maxf_0	Maximum f_0
Min	Minimum
MF	Morphological Focus
Neg	Negative Marker
NF	Narrow Focus
Nom/N	Nominative Case
o	Object
OCP	Obligatory Contour Principle
msec.	Millisecond
NP	Noun Phrase
p-phrase/$_P$	Phonological Phrase
PFC	Post Focus Compression
Poss/Po	Possessive Case
Prf/P	Perfective Aspect
Prog	Progressive Aspect
Prsnt	Present tense
PrWd	Prosodic Word
Pst	Past tense
QPart	Question Particle
s	Subject
Sub	Subjunctive mood
TBU	Tone Bearing Unit
V	Vowel
Verb/V	Verbal Inflection
VP	Verb Phrase
!	Downstepped Tone
↓	Downstepping
*	Pitch accent
T-	intermediate phrase boundary tone

T%	Intonation phrase boundary tone
(T)	Optional Tone
u	Utterance
WF/$_{widfoc}$	Wide Focus
XP/YP	Maximal Projection
3rd	Third person

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Chapter 1

Introduction

1.0 General Introduction

The delicate pitch variations that human beings can produce are employed in languages in two distinct and linguistically significant ways. Changes in the pitch of the voice of the speaker may result in *lexical pitch variation* or it may be looked at as *intonational pitch modification*. Both these variations are phonologically represented as tones, like High and Low, which form a string of elements running parallel to the string of vowels and consonants (Gussenhoven, 2004) in the autosegmental approach to the analysis of tones (Leben 1973; Goldsmith 1976). The phonetic source of both these two types of variations is the rate of closing and opening action of the vibrating vocal folds. The *variation in the rate of vibration of the vocal cords is exploited to distinguish words* in those languages which are referred to as 'tone languages.' In all languages of the world, vowel height and consonantal place of articulation are central to conveying the meanings of words. Variation in pitch of the voice is also used to distinguish meaning in the tone languages of the world. By some estimates as much as 60-70 per cent of the world's languages are tonal (Yip, 2002). These languages are categorized as 'tone languages' for employing pitch variation or for exploiting fundamental frequency (henceforth f_0) value in changing the meaning of the words. Word-level distinctions can be quite rich in tone systems, which contrast up to five pitch levels (Maddieson, 1978) and with contour tones the number of contrasts may go up to eight or more (Bateman 1990; Gussenhoven 2004).

Tonal features can enter the phonology of a language not only from its lexical tone. Tonal phonology accepts not only input at the lexical level, but also at the level of the utterance (Yip, 2002). In other words, *pitch variation can also be used contrastively by languages for the expression of discourse level meaning* and for marking phrases (Gussenhoven, 2004). Thus, intonation provides a further meaning and also f_0 variation to the utterances which are independent of the meanings of the words already invested with word-level pitch height. Given this fact that *the phonetic correlate f_0 is the same for tone and intonation*, the study of intonation in a tone language gives us a privileged vantage point for exploring the extent to which lies the possibility of factoring out the intonational rules to f_0 contours (Clements, 1990). It allows us to see how a language, which exploits f_0 mainly for the purpose of lexical and grammatical contrasts, succeeds in encoding the functions often expressed by means of intonation in non-tonal languages (Hyman and Monaka, 2011). The *existence of both lexical and intonational tones* in tone languages may result in considerable manipulation of word-level tone by the postlexical phonology. In such a language, word level inputs can be modified by the introduction of additional pitch features like the phonological phrase final boundary tone.

Hyman and Monaka (2011) use the term ‘submission’ to describe this phenomenon of the intonational tones invading and overriding lexical tones. They also discuss two other ways in which languages resolve the complication of the occurrence of intonational tones alongside lexical ones: ‘accommodation and avoidance’. ‘Accommodation’ or ‘peaceful coexistence’ refers to the process of dividing the utterance string in such a way that lexical tones and intonational tones contrast in separate locations. ‘Avoidance’ refers to the situation in which intonation is minimized or there is minimal tolerance of intonation in the tone system. Given the universal nature of the presence of intonation in languages, its presence in tone languages and the resulting utterance-level f_0 modulation have been the point of focus of many studies. Yip (2002) is of the opinion that this presence of intonation in tone languages (a) may move up or down the entire pitch register, (b) it may widen or narrow the pitch range, (c) it may insert boundary tones at domain edges, or (d) it may apply downstep within some prosodic domain. A similar view is propounded by Gussenhoven (2004: 27): “Interactions between lexical and intonational tones are common in tone languages, where initial or final boundary tones may affect the values of adjacent lexical tones. Processes that refer indiscriminately to lexical and intonational tones strongly support the position that these tones form a single phonological string”. The intonational tones get associated to the text by following some rules of the intonational phonology of the language and this may result in modification of the lexical tonal properties of the text.

Boro, being a member of the Tibeto-Burman family of languages, has been described as a two tone language by various studies during the past few decades (Sarmah, 2004). The intonational properties of the language are yet to be studied in an extensive manner and *the* *objective of the present study is to look into the ways the tone-intonation interaction* is accomplished in this language. An overview of the studies on tone and intonation in tone languages of the world would certainly provide ample opportunity to understand the ways such an interaction is looked at by the present theories of intonational phonology. The sections below try to delineate this.

1.1 Tone in Languages

Tone refers to the phenomenon which changes meaning of words because of a change in the pitch of the word. Those languages which use this property of pitch change as a way of indicating differences among words are called tone languages. Hyman (2001) provides the most plausible definition of a tone language: “a language with tone is one in which an indication of pitch enters into the lexical realization of at least some morphemes” (Hyman, 2001). Literatures on tone suggest that most of the languages using tonal contrast are to be found mainly in three areas of the world: Africa, East and South-East Asia and the Pacific, and the Americas.

The acoustic correlate for tone is f_0 and *differences in tone are perceived as a difference in pitch of the voic*e. This difference in the pitch of the voice is caused by variation in the rate of vibration of the vocal cords. This rate of vibration of the vocal cords or the frequency of their vibration is measured in hertz (henceforth hz) as each cycle of the vibration of vocal folds is counted as one hertz. As the human voice is capable of manifesting various ranges of pitch variation, there can be various levels of contrasting tones in tone languages. Many tone languages have a binary level contrast for tone. A three way contrast occurs in Yoruba, a four way contrast in Mambila and a five way contrast in Bencnon (Gussenhoven, 2004). A tone language with two contrastive pitch heights is described as a two tone language. A three contrastive pitch height can be found in the example in (1) from Nupe (Hyman and Schuh, 1974):

(1) Low: [bà]’to count’
Mid: [bā] ‘to cut’
High: [bá]’to be sure’

Sometimes tonal modifications have to shoulder the responsibility of carrying so much of meaning contrast that only *level tones* or the raising/lowering the pitch of the voice to a certain height does not suffice the purpose. Such requirements make tone languages take recourse of *contour tones*. Level tones require that the pitch of the voice is raised or lowered to a certain level, rather than a rise and a fall in pitch (Yip, 2002). Contour tones involve a change in the pitch of the voice. This may be simple rises or falls, or tones which first rise and then fall or first fall and then rise (Yip, 2002). Pike (1948) has termed these two types of tone languages as 'register tone languages' and 'contour tone languages' respectively. True contour tones seem to be added to tonal inventories only in languages with large number of tonal contrasts. Two-tone languages, for example, usually contrast two level tones, rather than a rise and fall (Yip, 2002). It is generally found that languages showing contour tone contrasts already have the feature of level tone contrasts. Some tone languages do have the presence of both level tones and contour tones, and together they present a number of tonal contrasts in the language. In Cantonese, for example, the syllable [yau] can be pronounced with one of six different pitches, and has six different meanings, as shown in (2):

(2)	*[yau] in Cantonese*	
	high level	'worry'
	high rising	'paint (noun)'
	mid level	'thin'
	low level	'again'
	very low level	'oil'
	low rising	'have' (Yip, 2002)

Tone languages also may vary depending on the number of positions in which a tone contrast can be made. Voorhoeve (1973) uses the term nonrestricted tone language for those languages in which tones are assigned to individual syllable on a relatively free basis and without regard to the tone pattern throughout the entire word or morpheme (Hyman and Schuh, 1974). Though 'nonrestricted' tone languages are relatively rare, most tone languages are found to be 'restricted' in the sense that tones in these languages are not freely assigned to syllables, but tonal distribution takes place in terms of 'word melodies.' Thus, as reported in Mende, a falling contour is realized as a falling tone on monosyllabic words, as a high tone followed by a low tone on disyllabic words, and as a high tone followed by a mid tone followed by a low tone on trisyllabic words (Hyman and Schuh, 1974).

The foundation for the phonology of distribution of tones in tone languages is provided by Goldsmith's (1976) argument for Autosegmental Phonology. Following Leben (1973), Goldsmith (1976) provides evidence of tones existing on a separate tier from the rest of the representation or tones existing as autonomous segments. The unit in the segmental structure to which tones associate is called the 'Tone Bearing Unit' Or TBU. Lexical tones are assumed to be part of the underlying representation of morphemes (Pulleyblank, 1986) and it is realized on the surface if it is associated with a TBU. Surface tonal association is influenced by morphological operations and such associations are subject to conditions of well-formedness (Pulleyblank, 1986). *Association of tone to TBU* is derived by well-formedness conditions and conventions of associations like tone deletion or vowel deletion etc. (Pulleyblank, 1986). Hyman and Schuh (1974) have found downstep, downdrift, spreading, absorption, simplification, low-rising as some of the phonological processes that regulate the distribution of tones across TBUs in tone languages. Example of lexical *tone migrating* from the verb root to the right edge can be found in Digo (Yip 2002; Goldsmith 1990). This kind of tonal shift may also be to the penultimate syllable as in Chizigula (Kenstowicz and Kisserberth, 1990). *Tone spreading* to the right is also a natural process (Hyman and Schuh, 1974). Sometimes tone spreading is local, taking in just one extra syllable, and sometimes it is unbounded, covering any number of available target syllables (Yip, 2002). The analysis of tone distribution presented in this dissertation will show how tonal phonology of Boro also adheres to processes like tone spreading, tone shift or tone migration, tone deletion and alignment to the right edge. *Alignment refers to association of tonally significant f_0 rise or fall to a particular syllable. Tone shift or tone migration refers to deletion of original association line and insertion of a new association line. Deletion refers to the process of deleting an association line. Spreading refers to one-to-many association* (YIP, 2002). Results presented in Chapter 2 will show how the surface realization of lexical tones in Boro is controlled by these processes occurring within the structure of Prosodic Words (PrWd).

1.2 Intonation in Languages

Intonation contours can be usually analyzed as tunes, that is, as formal entities separate from the linguistic text. The tunes reside in an 'intonational lexicon' and convey intonational meanings (Hayes and Lahiri, 1991). Ladd (2008) gives a useful working definition when he refers to intonation as the use of "suprasegmental phonetic features to convey postlexical[1] or

[1] The term post-lexical is used by Ladd (2008) to refer to linguistic feature that applies to phrases or utterances as a whole. This can be contrasted with features like stress, accent and tone which serve to distinguish words from one another.

sentence-level pragmatic meanings in a linguistically structured way" (Ladd, 2008: 4). While it is widely known that pitch can be part of a word's lexical entry in many, if not most, of the world's language (i. e. tone languages like Mandarin or Dhosa), intonation is only concerned with the postlexical use of pitch, both in languages with lexically-defined pitch (e.g. Xhosa, Japanese) and those without (e.g. English, Arabic) (Khan, 2008). Although it has been noticed in the study of languages that a person's pitch can rise and fall due to non-linguistic factors such as emotional state and social aspirations, intonation tries to describe linguistically significant use of pitch such as in marking questions or statements or for marking a focused constituent. To highlight the linguistically distinctive nature of intonation from its non-linguistic implementation and from its relatedness to paralinguistics, Gussenhoven (2004) presents an analysis of intonation in terms of the three design features of arbitrariness, discreteness and duality identified by Hockett (1958, 1960) as being true for human language. Ladd (1998) also distinguishes linguistic intonation from paralinguistic features by describing that intonational features are organized in terms of categorically distinct entities like low tone or boundary rise instead of gradient physical parameters like tempo or loudness. By including in his definition words like 'sentence-level or postlexical', Ladd (2008) makes it clear that intonation conveys meanings that apply to phrases or utterances as a whole, such as sentence type or speech act, or focus and information structure. In addition to variances in pitch, most current analyses of intonation also covers a wide variety of non-tonal prosodic phenomena including prominence of words in a phrase and grouping of words and phrases.

Studies on intonation as a linguistically significant phenomenon has developed over the last few decades, a fact which has been made obvious by Ladd (2008) himself when he says that the actual collocation *intonational phonology* has become more common only after the publication of the first edition of his book. This book gives an overview of the approaches to studying intonation in the late 1970s. The Autosegmental-Metrical model of intonation came into currency following the monumental works on intonation by Pierrehumbert (1980), Beckman and Pierrehumbert (1986), and Pierrehumbert and Beckman (1988) which highlight recent developments in the area of intonational phonology. Much of the *earlier work on intonation focused on finding the acoustic cues to intonational phenomena like finality, continuation, interrogation, and also emotional states like anger, surprise and boredom*. Delattre (1963) and Lieberman (1967) have made some of these kinds of studies. Some other studies were undertaken for describing *intonation for practical ends like improving the pronunciation of foreign speakers or as part of the general development of phonemic theory*. According to Ladd (1998), this approach is represented by the work of the American structuralist school. Many description of intonation in the British tradition (e. g. O' Conner and Arnold (1973)) and the description of Dutch by 't Hart, Collier, and Cohen (1990) had the implicit view that tones and segmental phonemes formed separate tiers (Gussenhoven, 2004). Selkirk's (1978) idea that *speech reflects phonological representation consisting of hierarchically organized constituents* included Intonational Phrase (henceforth IP) as one of the constituents. This kind of division of utterance into an intonationally defined constituent provided more focus to the importance of studying the phonology of intonation. It is Pierrehumbert's (1980) thesis that marked the beginning of a new period in intonational research by presenting a model which separated the phonological representation from its phonetic implementation (Gussenhoven, 2002).

Recent approaches to the study of intonational phonology, having been influenced by Pierrehumbert (1980), Beckman and Pierrehumbert (1986), and Pierrehumbert and Beckman (1988), almost unequivocally regard *a pitch contour of an utterance as a string of pitch targets*. While previous descriptions of English (e. g Trager and Smith, 1951) described four or more contrastive levels of pitch, transcribed with numbers representing their relative height, this inventory was reduced to only two opposing tonal targets in Pierrehumbert's (1980) analysis of English: High (H) and Low (L)[2] . It is assumed that *each tone is lined to a syllable which is either metrically strong or marks the boundary of a prosodic unit*. The second important theoretical assumption was that tonally unspecified syllables get their surface tone by phonetic interpolation between two adjacent tonal targets. The intonational tones which get associated to the most prominent positions in the utterance are **pitch accents**. *Pitch accents get associated to those TBUs in the utterance which have the property of being accented.* Pitch accents can be monotonal or bitonal, and in the case of a bitonal pitch accent one of the tones, T*, associates

[2] Although H and L tones refer to linguistically significant pitch movements in both tone and intonation, in intonational phonology they are marked as pitch accent and boundary tones, and in tonal phonology they distinguish lexical items or serves as morphological units. Section 4.3 discusses the boundary H and L tones in Boro and 5.4 highlights H* pitch accent used for focus marking with emphatic particles. In non-tonal languages, pitch accents assist in identifying prosodic units by aligning to the most-prominent position within these domains. Boro does not employ pitch accents for this purpose. Rather, right alignment of lexical tones takes over the function of pitch accent as pitch demarcates boundary of prosodic units in a way not seen in non-tonal languages.

with the accented TBU with the leading or trailing tone remaining unassociated (Gussenhoven, 2004). Exact realization of leading or trailing tone is context dependent.

A second variety of tone that is talked about in intonational phonology is **boundary tone**. *Boundaries of prosodic units can also be marked either by a monotonal tone or by a bitonal tone*. These are edge marking tones which are associated to the edges of prosodic units like IP, intermediate phrase (henceforth ip) or phonological phrase (henceforth p-phrase) (Hayes and Lahiri, 1991). Boundary tones (Pierrehumbert, 1980) are distinguished from other tones by their distribution. These tones only occur on the edgemost syllable of a domain, such as the last syllable of an IP. Thus they differ from lexical tones in having a phrasal distribution and function to distinguish sentence types (Myers, 2004). Boundary tones also undergo difference in phonetic implementation compared to the other types of tone. In Hungarian a right edge boundary tone H% marking questions had a higher f_0 value in the same position than a H* marking focus (Gosy and Terken, 1994). Boundary tones often have strong effect on the f_0 scaling of other tones in the utterance (Myers, 2004). Chichewa questions end in a final rise and statements in final fall (Myers, 1996). The f_0 values of lexical high tones in Chichewa are markedly higher in questions than in statements (Myers, 1996). f_0 peaks are higher in questions than in statements in languages as diverse as Swedish (Garding, 1979), Russian (Svetozarova, 1975), Mandarin (Ho 1977; Shih 1987), Vietnamese (Nguyen and Boulakia, 1999), Kikuyu (Clements, 1981), Jita (Downing, 1995) and Hausa (Inkelas and Leben, 1990). Another important point has emerged in the discussion of boundary tones in tone languages. Boundary tones can sometimes migrate away from the edge of a prosodic unit, as shown by Hyman (1990) for Luganda super-high tones and by Gussenhoven (2000) for Dutch phrasal tones.

Boundary tones can also determine the f_0 pattern at the left edges of prosodic constituents. Higher f_0 target at the beginning of an utterance in non-tonal languages has been grammaticalized by proposing an H% initial boundary tone in English (Pierrehumbert, 1980). H% left edge boundary tone initiates the pitch contour of the reading of the title of a story which is subsequently read in full (Gussenhoven, 2004). In Georgian, a particular kind of question intonation begins with an initial H_ι (Bush, 1999). French opposes H_ι to L_ι in IP initial position, although H_ι occurring initially is rare (Post 2000; Gussenhoven 2004). Still the initial H_ι could trigger downstepping of the following H*. Complex boundary tones consisting of a tone sequence can also occur at the left edge of prosodic units. The LHLH string marking accentual phrase is Seoul Korean is reduced to just an initial LH if the accentual phrase consists of three syllables (Jun 1993, 1998). Accentual phrases in Northern Bizkalan Basque are characterized by an initial pitch rise due to a sequence of LH tones where the target of L occurs on the first syllable and the H aligns to the second syllable (Gussenhoven, 2004). This is similar to what Pierrehumbert and Beckman (1988) proposes for Tokyo Japanese: the final L boundary tone of an accentual phrase surfaces on the next accentual phrase beginning with an H target. This results in an initial rise for the following accentual phrase and this rise is attributed to the sequence of LH initial boundary tone. In Northern Bizkalan Basque the realization of the LH initial boundary sequence depends on the availability of syllables. Neither of the initial L or H boundary tones surfaces when the first syllable is occupied by H*. In instances of H* surfacing on the second syllable, only the L boundary tone of the LH sequence surfaces (Gussenhoven, 2004). In Tokyo Japanese, if the first syllable is accented, the accent preempts the association of either L or H of the initial LH boundary tone. When the accent aligns to the second syllable, the L associates with the first mora and the H with the second mora, if it is available (Pierrehumbert and Beckman, 1988).

"Ladd (1998) coined the term Autosegmental-Metrical model" (Gussenhoven, 2004: 123) to refer to the fact that study of intonation in this model proposes *separate tiers for segments and tones*, and also that these tiers are ordered hierarchically in prosodic constituents as presented by Selkirk (1978). In other words, an intonationally defined prosodic unit is hierarchically organized, and obeys the Strict Layer Hypothesis (Selkirk 1984, 1986). A prosodic unit of a given level of the hierarchy is composed of one or more units of the immediately lower prosodic unit, and each unit is exhaustively contained in the superordinate unit of which it is a part (Selkirk, 2002). Among the prosodic constituents presented by Selkirk (1978), the most relevant ones for the study of intonation are IP, p-phrase, PrWd. However, in the revised theory of Beckman and Pierrehumbert (1986) an additional intonationally defined constituent was introduced, the ip, ranked immediately below the IP (Gussenhoven, 2004). The pitch accent (T*) gets associated with an accented syllable in a prosodic constituent mentioned above. Such syllables, a subset of the stressed syllable, are assumed to be marked with a feature 'accent', which means that they require a pitch accent (Gussenhoven, 2004). When the intonational tones appear at the edges of prosodic constituents, like IP, they are called boundary tones.

The pitch contour or 'tune', made up of the pitch accents and boundary tones, are represented on a tier separated from the segments, or 'text' (Hayes and Lahiri, 1991). The 'tune tier' is aligned to the 'text tier' at accented syllables or at phrase edges, at the post lexical stage of derivation. Although a phonological description of the distribution of pitch accents and boundary tones in the tune forms part of intonational analysis, a complete analysis of an intonational system will comprise of its phonetics, phonology, morphology, as well as its other interfaces with semantics and syntax. In principle, the IP wide contour could be a single morpheme, or any single tone or sequence of tones contained within the IP could be a morpheme (Gussenhoven, 2004). The central idea of this view is that elements of intonation have morpheme-like meaning (Ladd, 1998). This view contrasts the earlier assumptions that quite specific meanings, such as interrogation, anger, and incompleteness, are conveyed by rather general phonetic properties.

Although studies on intonational phonology assume that the tonal targets are aligned to designated parts of the segmental string, the Autosegmental-Metrical model holds the idea that the string of tones contains lexical and intonational tones. Impetus to such a view is drawn from Bruce (1977), who isolated the contribution of the lexical tones of Stockhom Swedish from that of the intonational tones, representing them as a string of pitch levels that were timed with the stresses and phrase ends. The integration of lexical and intonational tones played an important role in the description of Japanese in the work by Pierrehumbert and Beckman (1986), and later in that of Norwegian, varieties of Basque and Dutch dialects (Gussenhoven, 2002). An outline of the way the coexistence of these two types of tones is analyzed in the literature is given in the next section.

1.3 Tone and Intonation

Since f_0 is used for both tone and intonation, the critical question often asked is *how much of intonational features are allowed in tone languages*. Some of the earlier studies focusing on this sought to keep these two aspects of the use of the pitch of human voice as two different entities. Thus some linguists (e.g. Abercrombie 1967; Bae 1998; Roca and Johnson 1999) classified world's languages into tonal and intonational categories. Based on the assumption that the function of speech prosody is predominantly either of one kind or the other, the languages of the world are divided into either of the two classes - *tone language* or *intonation language* (Abercrombie, 1967). Later studies have argued for non-existence of these two absolute categories. It is argued that tone and intonation do not constitute appropriate classificatory criteria for human languages as they are neither phonetic nor phonological cognates (Atoye, 1989). Tench (1996) regards classification of human languages into tone and intonation categories as complete misunderstanding about the nature of intonation. The author's view is that *all languages, tonal or non-tonal, use pitch variation for intonational purpose* in their utterance and discourse. Tench (1996) also argues that the exploitation of pitch for lexical purposes pre-empts any extensive use of pitch for intonational purpose. Thus tone languages put intonation to a limited use. In other words, tone languages will have some form of structural intonation (Gussenhoven, 2004). Studies on tone and intonation like Cruttenden (1997), Yip (2002) and Ladd (2008) throw some amount of light on the possible range of phonetic modifications for intonational influence on tone languages. It is accepted that *tonal languages can make use of pitch register raising or lowering, downdrift (downstep), expansion or narrowing of pitch range, modification of the tone at the right edge* (Cruttenden 1997; Yip 2002; Ladd 2008).

Assuming that a language with the least number of tones will exhibit more phrasal level f_0 influence than a language with more tones, a simple (two-tone) tone language may point us towards the directions in which f_0 differences can have an impact on the tonal system of the language. *Pitch range modification* is one of the results of intonational interference on the realization of lexical tone. According to Myers (1996), the f_0 values of lexical high tones in a two tone language like Chichewa remain higher in questions by an average of 75 hz than in statements. In addition to this, the second of two lexical H tones in questions show much higher value than its appearance in a statement with a similar condition. Ma et al. (2006), have found that intonation in Cantonese affects the f_0 pattern of tones across positions. In questions, all the tones are produced with higher f_0 level and rising f_0 contour was found at the final positions of the questions. Lee (2004) also has shown that in Cantonese, the f_0 level of tones at the sentence final positions increase when the direction of the f_0 movement of intonation and tone are the same. When the direction of f_0 movement of intonation and tone do not coincide, the f_0 value of the tone is neutralized, as when the f_0 contour of a falling tone is truncated at the end of a rising intonation. The use of the prosodic means of modification of the overall contour shape to signify certain intonational meaning has also been attested in tone languages. The raising of the overall pitch register is reported in Hausa questions (Inkelas and Leben, 1990)

Intonation makes its presence felt in African tone languages in the form of *downdrift* (Downing and Rialland, 2017) as in Igbo (Liberman et al, 1993), Dschang Bamileke (Bird, 1994), Yoruba (Laniran and Clements, 2003), Chichewa (Myers, 1996) and Dagara (Rialland and Some, 2011). A related phenomenon in the study of intonation is that of *downstep*. Downstep is generally defined as compression of the pitch range as a consequence of some phonological regularity (Grice, D'Imperio, Savino and Avesani, 2005). It can be looked at in terms of interval calculation in mathematical terms (Lieberman and Pierrehumbert 1984; Pierrehumbert and Beckman 1988; Prieto et al. 1996; Laniran and Clements 2003, Laniran 1992). It refers to the phenomenon of pitch drop in the context of phonological and morphological motivation. A downstepped H tone is realized at a lower pitch than a preceding H tone if L tone intervenes (Gussenhoven, 2004). In addition to this kind of *automatic downstepping*, lowering of pitch height may also result from a sequence of H tones without the presence of any intervening tone, a phenomenon known as *non-automatic downstepping*, which is downstep of spontaneous type (Gussenhoven, 2004). A sequence of H tones may not also show any effect of downstepping as the case found to be in Yoruba (Fajobi, 2005) and Dschang (Hombert, 1974). A related phenomenon is that of *declination*. The term declination describes a gradual pitch lowering phenomenon over the course of an utterance (Cohen and 't Hart, 1968). Thus the domain of declination is the whole IP. The effect of declination is quite evident in sentences comprising of sequences of identical tones (Gussenhoven, 2004). The three languages with a two-way tonal contrast, Chumburung, Hausa and Shona show declination for sentences with only H tones[3]. Sentences containing only L tones decline to a greater degree than H tones in Chumburung. Mambila shows no declination (Genzel, 2013). Laniran and Clements (2003) conclude that there is very little declination in Yoruba. It is only present in all-L sentences, where we also see considerable final lowering (Gussenhoven, 2004).

Boundary tones also sometimes influence the surface realization of lexical tones. Gussenhoven and Vliet (1999) show that in the Dutch dialect of Venlo, interaction between lexical tones and the sequences of boundary tones, Declarative L and Interrogative LH, results in distinct tonal modification. IP final Declarative L causes lowering of lexical H tone. Interrogative $L_i H_u$ causes the lexical L tone to assimilate with the IP final L tone. In Akan, high

[3] A sequence of High tones in Boro also undergoes pitch drop. Section 3.3.1 describes this as phonetic downstepping.

pitch register tones are associated with the left edge of an IP and low pitch register with the right edge (Kugler, 2017). Also sentence final H tones drop to a low pitch level. All these tone languages show some amount of f_0 modification to express intonation.

Another strategy employed by some tone languages for post lexical purposes is the *insertion of a prosodic boundary* before, or in the vicinity of the focused constituent (Hartmann, 2008). Section 1.4 will present a brief sketch of the way the intonation of focus marking is related to formation of prosodic units. Recent studies on Akan (Genzel, 2013; Kugler, 2017), Chichewa and Tumbuka (Downing, 2017) have revealed more about the nature of intonational interference in tone languages. These studies have tried to approach the target languages from the point of view of Autosegmental Metrical framework.

1.4 Focus and Prosody in Tone Languages

Focus refers to the phenomenon of information packaging which reflects the speaker's beliefs about how the information fits the hearer's knowledge store (Vallduvi, 1992). Depending on the nature of the highlighted parts of an expression in illocutionary give-and-take, focus is usually divided into two main categories: *broad focus* and *narrow focus*. The main point of distinction between these two types of foci is the size of the significant part of the sentence or the size of the 'focused constituent' (Gussenhoven, 2004). Broad focus is identified by Ladd (1980) as the 'expression wide focus', where *the whole sentence bears salience* (Büring 2012; Gussenhoven 1983; Schmerling 1976). If a sentence is uttered in an out-of-the-blue context (Ladd, 1980), it can be considered as receiving broad or wide focus. An answer to a very general question like "what happened?" functions as a neutral statement and receives broad or wide focus (Ladd 1980; Büring 1997; Krifka 2007). *Any focus constituent which is smaller than the whole expression is described as having narrow focus*. According to Ladd (1980), 'normal stress' leaves the focus broad or unspecified and 'contrastive stress' narrows the possible range of foci to a particular constituent or small set of constituents. Narrow focus is usually related to individual words and refers to contrastive information that distinguishes itself within a set of contextually given alternatives that may occur in the same position in spontaneous speech (Drubig and Schaffar, 2001; Lehiste, 1970). Depending on the nature of the discourse level information*, focus can be classified as presentational, contrastive and corrective*. Presentational focus is the most common type of focus which refers to the information content of the answer to a question. Zubizarreta (1998) equates *presentational focus* in a statement with that part of the statement which is given as a new information for answering a wh-question. In instances of a sentence highlighting *new information*, it may also contain the old information as *given information* (Allerton 1978; Baumann 2006). Zubizarreta (1998) further distinguishes between *new information* (presentational focus) and *contrastive focus*. According to Zubizarreta (1998), contrastive focus negates the value assigned to a variable in the context statement (as indicated by the implicit or explicit negative tag associated with contrastive focus), and at the same time, it introduces an alternative value for such a variable. Similar observation is also made by Krifka (2007). Since contrastive focus negates a previous proposition, it is sometimes referred to as *corrective focus* as in Gussenhoven (2004).

Languages use various kinds of linguistic devices to express information packaging. It may be expressed in the syntax, by reserving a structural position for the focused constituent, like the end of the sentence or the position before the verb; or by using focus particles, which are placed in some structural positions before or after the focused constituent (Gussenhoven, 2004). Investigations into the ways languages express focus prominence has shown that *prosody also conveys discourse level information* as can be found in the discussion of focus by Gussenhoven (1983). Other studies have also provided evidence for the way prosodic structure can convey discourse level information (Ladd 1980; Watson 2010). *Duration, f_0 and intensity have been the three acoustic cues commonly related to information structure* (Cruttenden 1997; Jun 2005). In an intonational language like English, an important means for making a particular word more prominent than surrounding words is by investing longer duration, changes in f_0 movement and greater intensity (Eady and Cooper 1986; Eady, Cooper, Kloouda, Mueller and Lotts 1986). The three acoustic properties mentioned above are related to prominence marking in German also (Féry and Kügler, 2008).

It is generally assumed that tone languages do not use pitch variation to the same extent as intonation languages do for marking a focused constituent, since lexical tones already use some of the f_0 space in tone languages (Cruttenden, 1986). Given that pitch variation and lexical tones have the same acoustic and articulatory properties (both are produced by pitch modulations within the same pitch range), the complete obliteration of lexical tones by an intonation pattern is avoided. Still, some intonation effects of focus can be observed in tone languages as well. Various studies have attempted to unravel the significant phonological role that intonation plays in tone languages for the purpose of focus marking. Xu (1999) presents an analysis of the effects of focus marking in Mandarin Chinese, a language with four contrastive tones. The study reports that a *non-final focus substantially expands the pitch range, particularly the upper end, of the words under focus. Focus also has its effect on post-focus words* as it is found that focus suppresses the pitch range of these words. Pitch expansion is much smaller on the final focused word. Kugler and Genzel (2012) present the results of a production experiment investigating the tonal and durational means of encoding new information focus in Akan, a tone language with contrast between low tone and high tone. The study shows how in Akan *increasing prosodic prominence is related to a gradual decrease in pitch height of the target words*. It is also noticed that tonal lowering is accompanied by a decrease of duration of the word under focus. Xu, Chen and Wang (2012), while investigating the production of focus in Taiwanese, Taiwan Mandarin and Beijing Mandarin, notice *the presence of on focus raising of* f_0*, increase in intensity and duration* for all speaker groups. The study also finds that the speakers of Beijing Mandarin employs two additional means of focus marking: post-focus lowering of f_0 and intensity. *Pitch expansion of the focused constituent* is also attested in Hausa (Laben, Inkelas and Cobler, 1989). It is reported that high raising occurs on focused constituents in the left periphery of the clause, a position for subject focus and ex-situ non-subject focus. Ouyang and Kaiser (2013) investigate the prosodic cues for corrective focus and new information focus in Mandarin Chinese and find that *correction yields lengthening,* f_0 *expansion and intensity range expansion* of the target words. On the other hand, new information triggers only lengthening and f_0 range expansion. Karlsson, Svantesson and House (2012) find that the intonation correlates of focus marking in Kammu is prosodic increasing of the pitch range of the boundary tone of the phrase under focus. As Kammu has two dialects, a tonal variety and the other one a non-tonal variety, the difference in pitch range is found to be less in the tonal variety than the f_0 changes on non-tonal variety for the purpose of focus marking.

The acoustic bedrock for information structure discussed above has been theoretically formalized as **Stress-Focus** constraint (Selkirk 1984, 1995; Truckenbrodt 1995) demanding *focus to be maximally prominent* (prosodically) (Selkirk 2004; Szendröi 2003; Truckenbrodt 2005; Samek-Lodovici 2005, Büring 2010). Stress is understood as highest metrical prominence on the IP level usually corresponding to the use of a nuclear pitch accent on the focus-marked element in intonation languages like English (Ladd 1998; Cohan 2000). *The pitch accent is a prominence lending tonal morpheme which aligns to the syllable bearing the primary stress*

(Selkirk 1984, 1995). It is the feature of a pitch change involving a local maximum or minimum which signals that the syllable with which it is associated is prominent in the utterance (Ladd, 1998, 2008). Fry's (1955, 1958) works were the harbinger of this notion of f_0 playing the most important role in perceived prominence. Bolinger (1958) reinterpreted this by proposing the concept of pitch accent as the actual prominence in an utterance. Pierrehumbert (1980) later reinvented the concept of pitch accent as a distinct phonological phenomenon related to the intonation pattern of an utterance. The presence of pitch accent is agreed to assign salience or contrast independently of the shape of the overall phrasal melody (Pierrehumbert and Hirschberg 1990). *In addition to the f_0 maximum or minimum, increase in duration of the segments of the accented syllable has also been related to pitch accents* in languages like English and Dutch (Beckman and Edwards 1990; Cambier-Langeveld and Turk 1999; Cambier-Langeveld 2000). Most intonational languages use the H*L falling tone as a pitch accent to mark focus (Hartmann, 2008). When a pitch accent aligns to the constituent receiving focus, the following material can be sometimes 'deaccented' (Ladd 1980, 1998). The post focus contour is deaccented because there are no more accented targets following focus (Richter and Mehlhorn 2006; Hartmann, 2008).

Another strategy employed by some tone languages for focus marking is related to prosodic phrase structure. This refers to the *insertion of a prosodic boundary before, or in the vicinity of the focused constituent* (Hartmann, 2008). The relationship between focus and phonological phrasing is well known in Japanese (Poser, 1984), Hausa (Inkelas, 1988), Korean (Chao, 1990), Modern Greek (Condoravdi, 1990), and Shanghai Chinese (Selkirk and Shen, 1990). Kanerva (1990) describes how *narrow focus within the verb phrase in Chichewa results in an increase in the number of p-phrases*. When the verb only is placed under narrow focus, a phonological boundary forms after the verb in the verb phrase. The entire verb phrase forms one p-phrase when the whole VP is focused. Downing (2006) describes the focus marking strategy in Chitumbuka and highlights how *prosodic phrasing marked by lengthening of the penultimate syllable of the focused constituent* lends prominence to a constituent. Downing (2008) demonstrates how in Chichewa, Chitumbuka and Durban Julu phonological rephrasing functions as the prosodic correlate of focus. Thus, analyzing the tonal system of a language without taking into account the intonational structure may result in incomplete understanding of the data (Gussenhoven, 2012).

Focus prosody of Boro, presented in chapter 5, generates great interest for the typology of intonation since it employs neither phonological rephrasing nor sentence stress for its focus prosody. Boro exploits both register raising and register lowering for discourse salience. Corrective and contrastive focus marking is prosodically executed by a register l (low) tone, and focus marking with emphatic particles results in a register h (high) tone associated to the whole IP. Although the emphatic particles can surface with local f_0 feature, raising of register is a more prevalent means for focus marking with such particles. The theoretical implication for these results is for the issue of typology of focus prosody, cross-linguistically.

1.5 Boro

Boro is one of the major Tibeto-Burman languages predominantly spoken in many parts of the Brahmaputra Valley of Assam and also in some parts of West Bengal. The language is also known as **Bodo**, a term used by Hodgson (1847) mentioned in one of the earliest descriptions of the language found in The Linguistic Survey of India (1903)[4]. DeLancey (1987) uses both the terms Boro and Bodo to describe this language. The influential Bodo Sahitya Sabha (Bodo Literary Society) has advocated the use of *both Boro and Bodo* to name the language. Many recent studies on the language like Burton-Page (1955), Bhat (1968), Bhattacharya (1977), Joseph and Burling (2001, 2006), Basumatary (2005), Boro (2007) and DeLancey (2010, 2011) have described the language as Boro. It is in line with these studies that the term Boro is used in this dissertation. The language has been described as *vulnerably endangered* by UNESCO Atlas of the World's Languages in Danger 2010, occupying the lowest level in a scale comprising of the levels: definitely endangered, severely endangered, critically endangered and extinct in ascending order. The major portion of the Boro community is found in the districts of Dhubri, Goalpara, Kokrajhar, Chirang, Bagsa, Odalguri, Kamrup and Darrang (Basumatary, 2005). The number of Boro speakers in Assam in 2001 census was 1,296,162[5].

Racially the Boro people belong to the Mangloid stock of the Indo-Mangloid or Indo-Tibetan groups (Bhattacharya, 1977) and, in features and appearance they approximate closely to the Mangolian type (Brahma, 2012). *Bathou,* the supreme God among the Boros, forms an important aspect of their culture. "They observe various ceremonies and festivals in relation to birth, wedding, death and agriculture. The *Boisagu* or the springtime festival is famous for community

[4] Grierson, G. A. edited Linguistic Survey of India. Vol III Part II, 1903, pp. 1-17.
[5]Source: http://www.censusindia.gov.in , retrieved on May 10, 2013.

singing, dancing and consuming rice-beer accompanied with feasts. The weaving of cotton and endi (eri) cloth with fine embroidery is the special craftsmanship of the womenfolk. They follow some interesting methods and processes in respect of fishing and hunting. The use of magic, witchcraft and hymns in different ceremonies is remarkable. The article of food include rice, vegetables, fish and meat gathered from tortoises, crabs, fowls, deer and pigs. The preparation of rice-beer with special condiment as ingredients is an interesting technique essential in their domestic life (Bhattacharya, 1977: 17).

Boro has three major regional dialects which are known as the Western Boro dialect, the Eastern Boro Dialect and the Southern Boro Dialect (Basumatary, 2005). According to Basumatary (2005) the *Western Boro variety spoken in the districts of Kokrajhar, Dhubri and Chirang is recognized as the standard form of Boro*. The Eastern Boro dialect is spoken in the districts of Bagsa, Kamrup and Odalguri. The Boro spoken in the Krishnai, Agia, Dudhnoi areas of Goalpara district is known as the Southern variety of Boro. These dialect groups are divided based on variations which are found chiefly in the phonological, lexical and partially in morphological levels (Basumatary, 2005). As the Western variety of Boro is considered to be the standard variety, data for the present study has been collected from Bashbari and Debitola area of the Parbatjhora sub-division of Kokrajhar district and also from Bhatipara village near Kokrajhar. Most of the Boro writers used Bengali and Assamese script during the pre 1974-75 years. During 1974-75 an agreement was adopted by the Central Government of India and the Bodo Sahitya Sabha, where it was decided that Devanagari would be used as the standard script for this language (Basumatary, 2005).

Most of the places where the western and eastern varieties of Boro are spoken form part of the Bodoland Territorial Administrative area, consisting of Kokrajhar, Bagsa, Chirang and Udalguri districts of Assam. These districts came into existence with the formation of the Bodoland Territorial Council (BTC) in 2003. The accord for the creation of BTC was signed by the central Government of India, the government of the state of Assam and the Bodo Liberation Tigers under the provision of the Sixth Schedule of the Constitution. The districts under BTC witnessed *large scale violence* involving indigenous Bodos, Santhals (a non-Bodo tribe) and Muslims at several intervals beginning with 1993, even before the formation of the BTC (Saikia, 2011). Large scale violence occurred in the area in 1994 and this resulted in *displacement of many indigenous Bodo and also Muslim population* living in Kokrajhar, Bongaigaon and Barpeta districts (Nath, 2003). Insurgency also aggravated the situation with the formation of The Bodo Liberation Tigers and the National Democratic Front of Bodoland around 1996 (Nath 2003; Saikia 2011). Violence and rioting revisited the area, especially the Kokrajhar district, in 1996 when large number of *Santhals were killed living in lower Assam* (Bhattacharya, 2005). The year 2012 saw another spree of violence and arson which resulted in the deaths of more than 80 people and destruction of property. *Almost half a million people from mainly Bodo and Muslim communities from nearly 400 villages were forced to stay in refugee camps* for an extended period (Barooah, 2013). The three Bodo villages from where data was collected for this dissertation were also severely caught in the clashes in 2012.

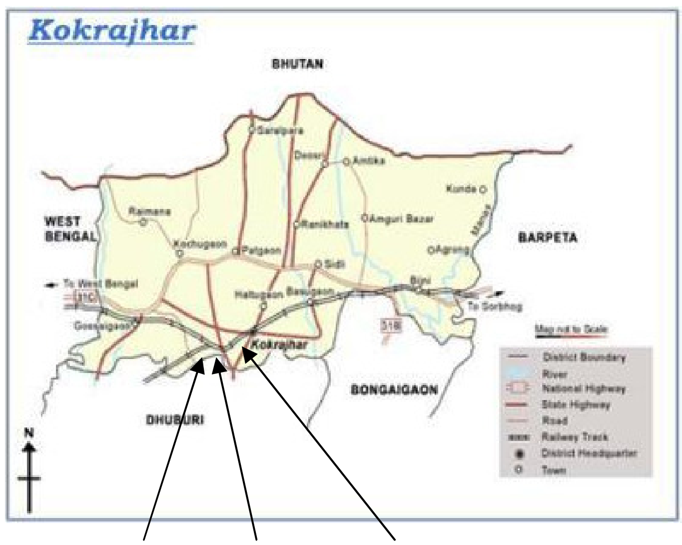


Figure 1.1: **Location of Bashbari, Kazigaon and Bhatipara villages in Kokrajhar district**.[6]

Figure 1.1 shows the locations of Bashbari, Kazigaon and Bhatipara villages near Kokrajhar. These places, bordering the Kokrajhar district of BTAD and Dhubri district, remained tense for many months and this forced us to visit the area for several rounds of data collection process. Journey to the villages shown by arrow marks in Figure 1.1 often required a reconnaissance of the prevailing security situation since several kilometers of dense forest had to be covered to reach these places. On several occasions *the data collection process was stopped midway*. Sometimes the villages remained *inaccessible due to strikes* called by various local organizations. All these factors forced us to *modify our initial plan to continue with the same number of participants for all the experiments* described in this dissertation. A speaker from Bashbari village also had to undergo *gallbladder operation*. This speaker participated in the

[6]Source: http://www.thehindu.com, retrieved on August 3, 2013.

experiments for contrastive and corrective focus and *post-operation he withdrew from the experiments* which were conducted later.

Section 1.7 presents a sketch of the way the tone system in Boro have been analyzed over the last few decades. The other aspects of the language have also been studied extensively. The *phonology* of the language is described by studies like Burton-Page (1955) and Joseph and Burling (2006); while Bhattacharya (1977), Boro (2001), Brahma (2012) give accounts of the *structure of the language focusing on phonology, morphology and sentence structure.* Basumatary (2005) focuses on phonology, morphology and vocabulary. The *vocabulary* of the language has been looked into in details by studies like Bhat (1968) and Bhattacharya (1977). The *grammar* of the language has been subjected to thorough investigation by some recent studies like DeLancey (2010, 2011, 2015) and Boro (2016).

The phonetic inventory of Boro consists of *six pure vowels*, *eight diphthongs* and *sixteen consonants* (Brahma, 2012). The inventory of pure vowels in Boro is presented in Table 1.1.

	Front	Central	Back
Close	i		ɯ u
Mid	e		ɔ
Open		a	

Table 1.1: **Vowel inventory in Boro**

All of the vowels occur in all the three positions in words. The eight diphthongs in the phonetic inventory of Boro are /ai/, /ɔi/, /ui/, /ɯi/, /iu/, /ao/, /eu/ and /ɯo/. Another special phonological feature of Boro is its lexical tones. Section 1.7 presents a brief sketch of the tonal phonology of the language. Boro follows the Subject + Object + Verb word order for sentence construction. This is illustrated in (3)

(3) bí-ɯ daodɯí zá-dɯŋ-mɯn
he-Nom egg eat-Prf-Pst
He ate egg.

1.6 Morphology of Boro

Boro roots and/or bases are inflected *for considerably good number of grammatical categories* such as tense, aspect, mood, gender, case, degree, negation, causation, passive voice etc (Brahma, 2012). Since most of the words in the language are monosyllabic, the rich morphology of the language is often put into execution for day to day purposes. *Categorical* *prefixes and classifiers* provide two examples of the way most of the polysyllabic words are derived in Boro. Inflection for tense, aspect, mood, gender, case etc are added to these words. Chapter 2 of this dissertation looks at distribution of tones in Boro in the context of various affixation processes. The exposition presented in chapter 2 is not an exhaustive one. The chapter has attempted to only provide a rudimentary exposition of Boro morphology.

Categorical *prefixes* are added to a similar set of nouns which have something in common among them. A prefix like dao- 'bird' precedes the names of birds like daok^{h}a 'crow', daosri 'house maina', daot^{h}u 'dove' and the prefix na- 'fish' precedes the names of fishes like nat^{h}ur 'prawn' and nasrai 'smooth snake headed fish' (Brahma, 2012). Categorical prefixes like 'dao' and 'na' can also occur as free morphemes in Boro. A few bound morphemes also function as categorical prefixes in Boro. For example the prefix 't^{h}ai' occurs before the names of many fruits and vegetables like t^{h}aizou 'mango', t^{h}alir 'banana' and t^{h}aibeŋ 'cucumber'. The classifier 'a-' occurs before the names of body parts like at^{h}in 'foot', ak^{h}ai 'hand' and asi 'finger/toe'.

Classifiers are added to numerals which describe nouns. For example, the numeral se 'one' is preceded by the classifier 'dɯi -' when it refers to one egg as in dɯise daodɯi 'one egg'. But se 'one' is preceded by the classifier 'sa-' when it precedes mansi 'person' as in sase mansi 'one person.'

Since Boro is a tone language (see section 1.7), an examination of the distribution process of lexical tones vis-à-vis various word formation processes is expected to show how morphological processes result in phonological alternation. The analysis presented in this dissertation mostly looks at monosyllabic and some disyllabic words. This is because there are very few nonderived polysyllabic words in Boro (as discussed in this section). Chapter 2 discusses how lexical tones surface when affixes are added to these monosyllabic or disyllabic words. Chapter 3, on the other hand, examines the pitch contours of such derived words when they occur in sentential contexts.

1.7 Tones in Boro

Tones occur in most of the Tibeto-Burman languages (Basumatary, 2005) and Boro is no exception to this. Inspite of there being differences in opinion regarding the number of tones in the language, most researchers agree that Boro is a tone language (Weidert, 1987). Boro uses lexical H and L tones with the L sometimes seen as a default Mid tone (Sarmah, 2004). These tones can be employed to distinguish lexical meaning of Boro words as in (4) below (Sarmah, 2004):

(4a) [gáo] ‘tear or split’

(4b) [gào] ‘shoot by arrow or gun’

The tone bearing unit (TBU) in Boro is the syllable and the tonal organization is such that in disyllabic words only one TBU can bear the lexically distinct tone. The rightmost TBU is the location for hosting the lexical tone in disyllabic words.

Burling (1959), in his description of Proto-Boro, expresses the lack of too many tonal distinctions in Boro compared to many of the other Tibeto-Burman languages which have elaborate tone system consisting of as many as four tones. This study presents evidence for the existence of *two tones in Boro*: high and low. Joseph and Burling (2001) reiterate the view expressed in Burling (1959) and come to the conclusion that *Boro has a two-tone system*. In addition to this, Joseph and Burling (2001) also mention about the presence of the phenomenon of tone spreading in Boro towards the right in which a suffix is pronounced with a high pitch when it is attached to a word ending in a glottal stop.

There have been differences in opinion regarding the number of tones in Boro. Bhattacharya (1977), while presenting a descriptive account of Boro, claims that the language has a four tone system described as /1,2,3,0/. The first three tones can be hosted by different positions and the fourth tone /0/ is presented as a neutral tone which is dependent on either the preceding or the following syllable with one of the /1,2,3/ tones. Bhattacharya (1977) describes tone 1 as having a level or rising pitch pattern, tone 2 as having a level contour in word medial position and falling before pause, and tone 3 as having a low falling pitch pattern.

Joseph and Burling (2006), while presenting a description of the comparative phonology of the Boro-Garo languages, reiterate Joseph and Burling (2001) by describing a two-tone system for Boro. They found no evidence for the four tones claimed by Bhattacharya (1977). Although this study focused mainly on tone pattern in monosyllabic words, it is also claimed that in Boro disyllabic words can have only one of the two tone patterns, whether a high tone or a low tone, with no distinction made in the syllable position of the tone (Joseph and Burling, 2006). Sarmah (2004) presents further evidence to show that Boro has two tones: H and L.

1.8 Intonation in Boro

The intonation pattern of Boro has not been the subject of any research barring a few minor comments on the overall contour patterns by Bhattacharya (1977) and Joseph and Burling

(2006). Bhattacharya (1977) observes that the tonal contour of Boro syllables before pause or terminal juncture are of different types and this is related to the kind of pragmatic meaning the stretch of utterance expresses. Joseph and Burling (2006) notice the existence of other tonal patterns in Boro in addition to lexical pitch and suggest that these variations may result from interference from question intonation and emphasis, which can significantly modify the underlying tone. Mahanta, Das and Gope (2016) give a detailed account of narrow presentational focus marking in Boro with and without the presence of morphological focus markers. This study has found that narrow focus in Boro is prosodically marked by compression of the post focus part of some of the sentences they examined. On the other hand, focus with the help of morphological focus markers is expressed by an H* pitch accent which aligns to the focus markers themselves. At the same time this H* of the focus markers lowers the pitch of nearby H tones resulting in anticipatory downstepping.

1.9 Hypotheses

Taking into consideration all the aspects of tone and intonation in languages discussed in the preceding sections, the following research hypotheses were designed to be tested during the course of this dissertation.

a. Tone to TBU association in Boro differs between its underlying and surface representation.
b. Boro, being a tone language, puts intonation to a limited use.
c. Boro is different from other densely tone specified languages. Thus prosodic factors play a more substantial role at the post lexical level. This influences scaling and alignment of lexical tones relative to the TBUs.
d. Semantic-pragmatic factors such as focus may also be affected by prosodic factors in a tone language like Boro where each and every syllable is not marked for lexical tone.

1.10 Research Objectives

A general survey presented above has indicated that change in pitch can have influence on both tonal and intonational aspects of languages. Since Boro employs lexical tone for distinguishing meanings of words, the language provides yet another opportunity for an extensive investigation on the amount of intonational modification that a tone language tolerates. As discussed in 1.8, the intonation of Boro is yet to be studied extensively. An attempt in this direction would surely reveal more about the interaction between tone and intonation in languages. In view of this insight and the list of hypotheses presented in 1.9, this dissertation has made an attempt to explore the following research objectives:

1. The first aim of this dissertation is to investigate *the correlation between the underlying lexical tones and their surface association* to TBUs in Boro. It has been already mentioned in section 1.7 that the rightmost syllable is the location for hosting lexical tones in Boro (Sarmah, 2004). This study subjects this alignment rule to several processes of prefixation and suffixation. The objective behind this endeavour has been to examine whether any specific phonological factor influences the surface tonal association in Boro. The results are presented in Chapter 2.
2. The second objective of this dissertation is to present an *analysis of the intonational phonology of Boro* following the Autosegmental Metrical (AM) model. Sections 1.3 and 1.4 have discussed the ways intonational modifications contribute to the final shaping of the pitch contour of an utterance. Although modifications by boundary tones have been attested in a few tone languages like Chichewa (Myers, 1996), any presence of pitch accent in such languages is yet to be reported. The question arises whether a two tone language like Boro makes use of pitch accent for intonational purposes. This dissertation explores this question and tries to examine whether the language presents phonetic evidence for the presence of such a prosodic feature. It also attempts to explore the nature of boundary tones and their contribution in the pitch contour of an utterance. The results are presented in Chapter 3
3. The AM model of study of intonation looks at the pitch contours of utterances as composed of prosodic units which have unique tonal characteristics. The third objective of this study is to examine whether intonation phonology of *Boro identifies multiple layers of prosodic units* and, if so, what are their tonal characteristics. In pursuing this question, the study hopes to enumerate the intonational tones in Boro. The results are presented in Chapter 3 and 4.
4. Another objective of this dissertation is to investigate the *prosody of focus marking* in Boro. The objective is to look into the prosodic cues implemented to signal various kinds of information structure like focus marking with emphatic particles, ex-situ focus, contrastive focus (Zubizarreta, 1998) and corrective focus (Gussenhoven, 2004) in Boro.

Chapter 5 attempts to evaluate the global or local effects of f_0 realization implemented for focus marking in Boro.

5. Finally, the dissertation focuses on the *intonation of Assamese produced by the native speakers of Boro*. Since Assamese does not use lexical tones as an integral part of its phonology, the speakers of a tone language like Boro might show a tendency to transfer the features of the first language (L1) to the second language (L2). Chapter 6 examines whether the intonation of Assamese spoken by Boro speakers follow the intonational rules of their L1 or that of L2.

Studies on interaction between tone and intonation have already acquainted us with the prosodic means employed for intonational interference in tone languages. The results presented in this dissertation try to highlight the course that the underlying tonal specifications go through on their way to surface realizations in the pitch contours of Boro utterances.

1.11 Layout of the Dissertation

The chapters of this dissertation are organized in the following manner:

- Chapter 1: *Introduction*- This chapter highlights the *theoretical motivation* for studying the intonational features of a tone language like Boro. The discussion in this chapter starts with an overview of the theoretical aspects of tone. It also highlights the role intonation plays in tone languages and their possible interaction. It is shown that strategies employed for focus marking provide important insights regarding the extent to which intonation is allowed to modify surface pitch contours of lexical tones in languages. Subsequently this chapter discusses the *hypotheses* and the *research objectives* designed to evaluate them. At the end, an outline of the chapters and their arrangement in the dissertation is presented.
- Chapter 2: *Tone in Boro*- This chapter examines the distribution of lexical tones in Boro vis-à-vis word formation processes. It also examines underlying tonal nature of the prefixes and suffixes in Boro. Results of a production experiment show that *tonal alignment in Boro can be explained by proposing a prosodic domain for tone shift, tone spreading and tone deletion*. Depending on the abilities of the affixes to alter the tonal specifications of the stems, this chapter categorizes them as dominant and recessive.

- Chapter 3: *Intonational Phonology of Boro-* This chapter proposes a *description of the intonational phonology of Boro* following the tradition of the Autosegmental-Metrical (AM) Model. It shows how initial boundary tone, downstepping, declination and phrasing constitute the post-lexical component of a tone language like Boro. It is shown that utterances in Boro can be grouped into three levels of prosodic units. These prosodic units can be identified as Prosodic Word (PrWd), intermediate phrase (ip) and Intonational Phrase (IP). Based on the distribution of lexical tones described in chapter 2, it is proposed that *PrWd domain in Boro is minimally disyllabic*. Evidence is also presented to argue that the PrWd structure in Boro is applied recursively (Peperkamp, 1997). Acoustic evidence has also been presented to show that the left edges of IPs in Boro are marked by an L%H% tone. Based on evidence from f_0 contours, this chapter concludes that suspension of downstepping provides the phonetic cue for ip boundary marking in Boro.
- Chapter 4: *Tonal Inventory in Boro-* This chapter describes the full *inventory of the post lexical tones in Boro* occurring at the right edges of IPs. Examination of pitch contours of various sentence types such as statements, wh-questions, yes/no questions etc. has shown that some sentence types in Boro are marked by monotonal boundary tones like L% or H%, and some other sentence types end with bitonal boundary tones like LH% or HL%. The chapter also looks in detail the *interaction between the final lexical tones in IPs in Boro and the right edge boundary tones*. Acoustic results have shown that both the lexical specification and a monotonal intonational tone align to the rhyme of the IP final syllable. A scaling difference also surfaces for the f_0 target for the boundary tone depending on the two contrastive tones preceding it. Bitonal boundary tones may sometimes obliterate the f_0 specification for the lexical tones. Only in the instances of recursive PrWd domains, the lexical tone is allowed to align to the penultimate syllable while the bitonal boundary tone aligns to the rhyme of the IP final syllable. This chapter also shows that right edge boundary tones for IPs can have a global effect in addition to local impact in terms of alignment. It is shown that an IP final intonational tone can also result in global raising of pitch contours in Boro.
- Chapter 5: *Focus in Boro-* This chapter highlights the prosodic means employed for *ex-situ focus, focus with emphatic particles, contrastive focus and corrective focus.*

Results presented in this chapter show that ex-situ focus in Boro is expressed by ip boundary marking. Focus marking with emphatic particles results in two distinct prosodic modifications. An H* pitch accent is associated to the particle itself and the *pitch register of the whole IP is raised*. The H* pitch accent does not associate to the final occurrences of the emphatic particles. Final occurrences of the emphatic particles result only in register raising. The chapter also looks at the prosody of contrastive focus and corrective focus in the language and it is shown that such meanings are expressed by compression of the duration of the focused words. A second prosodic means used for contrastive and corrective focus is the phonological feature of *lowering the register of the IPs*. Based on these results, this chapter concludes that Boro uses register change as an important aspect of its intonation. It is also argued that focus prosody in Boro necessitates a relook at the prosody-focus correlation since in Boro focused constituents do not surface with maximum prosodic prominence.

- Chapter 6*: Intonation of L2 Assamese-* This chapter presents an analysis of the intonation of L2 Assamese produced by Boro speakers. Results presented show that L1 Boro *tonal distinctions are not transferred to L2 Assamese* when semantically equivalent words are used. Based on evaluation of f_0 contours, it is shown that L2 participants could phonetically realize the typical L1 Assamese L^*H_P contour (Twaha and Mahanta, 2016) marking each of the p-phrases. It is also shown that Boro L2 speakers of Assamese show greater amount of accuracy in realizing the L^*fH_P for wh-question than using this pitch accent for corrective focus marking. Examination of pitch contours also shows that L2 Assamese speakers do not maintain any consistency in producing the L*H pitch accent for narrow focus marking used in L1 Assamese. Instead, compression of duration of all the syllables is shown to be the dominant phonetic cue for both L2 Assamese corrective and narrow focus marking.
- Chapter 7: *Conclusion-* This final chapter of the dissertation presents a *summary* of the findings. In addition to this, *the scope of future work* is also highlighted in this chapter.

xxxxxxxxxxxxxxxxxxxxxx

Chapter 2

Tone in Boro

2.0 Introduction

Distribution of lexical tones is an important aspect of the description of tonal phonology of a particular language (Yip, 2002). The autosegmental nature (Leben 1973; Goldsmith 1976) of tones provides the theoretical foundation for tonal association to a segment other than the source segments. Morphology often bears witness to this kind of tonal processes. Boro provides an example of it. The nature of *interaction between tone and morphology* in Boro has been dwelt upon in some details by Bhattacharya (1977), Weidert (1987) and Joseph and Burling (2001). Bhattacharya (1977) has mentioned that the high tone is lowered to the next lower tone, and a low tone is raised to the immediate higher tone in a condition where it is associated with a suffix. In other words, whenever a suffix is added, the root is assigned a mid tone (Bhattacharya, 1977). Weidert (1987) has shown that the high tone of the root is assigned to a toneless suffix after affixation. Sarmah (2004) has described that Boro has toneless TBUs (some of the suffixes in the language) which receive the tonal specification of the stem when they are added to monosyllabic roots. This kind of disyllabic derived words in Boro conform to the tonal pattern of disyllabic non-derived words where the rightmost TBU is specified with a tone (Sarmah, 2004). In addition to this, the study by Sarmah (2004) provides evidence for the presence of suffixes in Boro with underlyingly specified tone. The study finds that the causative suffix '-ho' in Boro is underlyingly specified for a low tone and it retains its tonal specification after affixation to a root. This process however does not change the tonal specification of the stem and thus the process of '-ho' affixation leads to the morpho-phonologically complex word with the presence of lexical tones on both the stem and the suffix. This chapter tries to enumerate the details of *tone and morphology interaction in relation to various word formation processes allowed in Boro. The objective of the present chapter is also to evaluate the underlying tonal nature of the prefixes and suffixes* that participate in the following morphological processes in Boro:

a) Tense-Aspect affixation
b) Number affixation.
c) Case marking affixation
d) Negative affixation
e) Adjective forming affixation
f) Causative verb forming affixation

In addition to investigating the tonal nature of the affixes, this chapter also aims at elucidating the nature of *tonal alignment in Boro in connection with the inflectional and derivational processes* mentioned above. Results presented will show that *tones in Boro surface right aligned to a minimum disyllabic domain following the phonological processes of deletion, shifting, spreading and alignment* (see section 1.1). Tone shift and tone deletion work within this domain and contribute to tone-to-TBU association. Tone association to a third syllable may sometimes result from spreading. Section 2.1 presents a detailed account of the methodology adopted for this study. Section 2.2 enumerates the findings and presents a detailed account of the way f_0 specifications for the lexical tones align to TBUs in the post-affixation stage. Section 2.3 summarizes the findings in the form of three important aspects of tone alignment in Boro vis-à-vis affixation. It takes stock of the way the tonal status of the affix and its characteristics as a prefix or suffix interact with the phonetics of tone alignment in Boro. This is followed by conclusion in Section 2.4.

2.1 Methodology

The process of data collection for the experiment in this chapter has been controlled with the aim of understanding the pattern of lexical tones in Boro and how these underlying tones interact with various prefixes or suffixes. The pitch pattern relative to the rhyme in a syllable in time is considered to be the indicator of the underlying tone of the word or affix under consideration. Since Boro has two lexical tones: High and Low, it was thought to be important to evaluate the interaction of these lexical tones with various affixes used in the language. With this in mind, the data collection process for the present experiment aimed at exploring the following three factors:

i. The nature of the lexical tones in Boro
ii. Whether lexical tones undergo any change post affixation.
iii. Whether affixes contribute any lexical tone post affixation.

With this in view, the native speakers of Boro were asked to pronounce the target words placing them in the blank position of the sentence frame given below so that their tonal specification can be acoustically established:

àŋ	__________________	bùŋ-dɯŋ-mɯn
I		say-Prf-Pst
I	__________________	said.

2.1.1 Materials

The experiment presented in this chapter has tried to arrive at results which exhibit a pattern of interaction of tone and morphology in *six categories of affixation* allowed in Boro. Each category of affixation in Boro is executed by several lexical variants. With this in mind, a data set consisting of various words and their inflected/derived forms have been used in this experiment. It has been already mentioned in section 1.6 that *most of the Boro words are derived forms* with affixes added to either monosyllabic or disyllabic bases (Bhattacharya, 1977). From this perspective, the affixes considered for this experiment do not constitute an exhaustive list. Rather, they were given more priority than the others for this experiment due to their productive nature as far as affixation in Boro is concerned. A survey of Boro word lists (Bhattacharya 1977; Basumatary 2005) and descriptions of Boro morphology (Bhattacharya 1977; Basumatary 2005; Brahma 2012) have provided the impetus for including the affixes in Table 2.1 in this experiment.

Affixation	Tone	Words	Prefixes	Suffixes
Tense-Aspect	High	t^{h}aŋ ‘go’		-ɯ, -gɯn, -gou, -bai, -dɯŋ, -dɯŋmɯn
	Low	lɯŋ ‘drink’		
Case Inflection	High	dao ‘bird’, nɯŋ ‘you’, bibari ‘Bibari’, nɔ ‘home’, hat^{h}ai ‘market’		-a, -k^{h}ou,-ao, -nɯ, -ni, -niao, -dʒɯŋ
	Low	dɯi ‘water’, aŋ ‘I’, sɯmdɯn ‘Samdan’, rua ‘axe’, bar ‘wind’, maozi ‘cat’, din ‘day’, bɯrma ‘goat’, hazɯ ‘hill’, enzor ‘rat’, seŋra ‘boy’, gɯzoɯ ‘high’		
Plural Inflection	High	nɯŋ ‘you’, nɯŋt^{h}aŋ ‘you(Hon)’, nɔ ‘home’, ada ‘elder-brother’, alasi ‘guest’, laisri ‘Laisri’		‘-p^{h}ɯr’ ‘-mɯn’ ‘-sɯr’
	Low	got^{h}o ‘child’		
Negative Affixation	High	t^{h}aŋ ‘go’		‘-a’ ‘-ak^{h}ɯi’ ‘-lia’
	Low	p^{h}ɯi ‘come’, lɯŋ ‘drink’		
Adjective Forming Affixation	High	za ‘eat’, suŋ ‘short’, hai ‘shorten’, p^{h}e ‘intoxicate’, bɯhɯi ‘flow’, sɯrzi ‘create’, dɯmɯi ‘become cloudy’, lao ‘lengthen’, mao ‘do’, p^{h}ur ‘whiten’, zi ‘to tear’, zen ‘to lose’, bai ‘break’, lir ‘weigh’, t^{h}ɯŋ ‘straighten’, duŋ ‘to heat’, ruŋ ‘loosen’, zɯŋ ‘to be light’, gɯ ‘be pure’	gV-	‘-k^{h}or’ ‘-dɔ’ ‘-dɯb’ ‘-braŋ’ ‘-brɯm’ ‘-lu’ ‘-deŋ’ ‘-t^{h}i’
	Low	lɯŋ ‘drink’, si ‘to wet’, ham ‘become good’, su ‘become cold’, sɯm ‘blacken’, rɯm ‘ripe’, k^{h}ɯi ‘sour’, t^{h}ao ‘to make tasty’, seo ‘to rot’, t^{h}aŋ ‘to be alive’, t^{h}ɯi ‘to die’.		
Causative verb forming affixation	High	go ‘escape’, gab ‘cry’, zɯb ‘finish’, zam ‘old’, gi ‘fear’, buŋ ‘speak’, p^{h}ɯt^{h}ai ‘belief’, ruŋ ‘mild/soft’, ga ‘separate’, zi ‘to tear’, zo ‘sit’, suŋ ‘short’, ran ‘dry’.	bV- p^{h}V- sV-	‘-hɯ’
	Low	t^{h}ab ‘fasten’, ham ‘become good’, mao ‘do’, mɯsa ‘dance’, k^{h}am ‘fire’, geo ‘open’ .		

Table 2.1: **Speech material for the experiment.** The third column presents the stems, and the fourth and fifth column presents the list of affixes which are added to the stems in the respective row.

2.1.2 Participants and Recording

Five male speakers of Boro were asked to produce the words mentioned in 2.1.1 The speakers produced the words embedded in the sentence frame in 2.1. The participants were between 22-28 years of age and they were born and raised in their native villages where the recording was conducted. All of them were from the same socio-economic background. The *experiment was carried out in quiet locations* at Bhatipara, Kazigaon and Bashbari villages. One speaker was from Bashbari village. One of the participants was from Kazigaon village in Parbatjhora sub-division of Kokrajhar district and the other three speakers were residents of Bhatipara village situated near the border between Bilashipara subdivision in Dhubri District and Kokrajhar District. All the speakers were graduates and they had elementary knowledge of Assamese. None of the speakers had any previous record of hearing or listening impairment. Each speaker was paid a small fee for his participation in the production experiment. According to Basumatary (2005), the Western Boro variety spoken in the districts of Kokrajhar, Dhubri and Chirang is recognized as the standard form of Boro language. From this viewpoint, the data collected for the present experiment can be described as the standard variety of Boro.

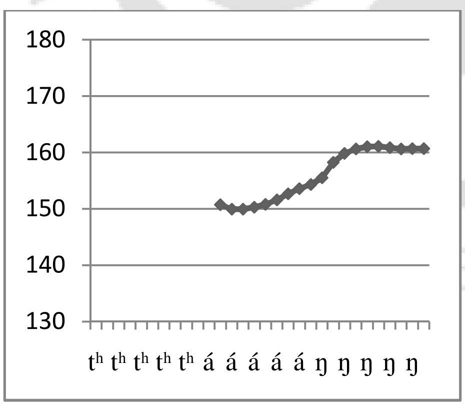
The speakers produced *6 iterations* of each word in the data set embedded in the sentence pattern mentioned above with sufficient pause in between. The *first iteration was not taken into account*. The subjects were asked to read the sentences aloud written in the Devanagiri script. The speakers were explicitly told the meaning intended by the words they were about to pronounce. A unidirectional head-worn microphone connected with Edirol Roland R-09HR via xlr jack was used for the recordings. The recordings were digitized at a sampling frequency of 44.1 kHz and 32 bit resolution. The process of recording continued for several days due to noise disturbance caused by strong winds.

2.1.3 Data Analysis

Each iteration of the individual words was first extracted and saved as a separate wave file using the speech analysis software- Praat 5.3.04_win32 (Boersma and Weenink, 2012). Individual sound files of the words were further segmented into the phoneme level and Praat TextGrid files were created for each word. Segmentation was based on spectrograms, zoomed waveforms, in addition to the aural verification of the sound files. The segmented files were processed with a Praat Script [ProsodyPro] (Xu, 2013) for obtaining measurements of f_0. This script provides various measurements of individual wave files such as time-normalized f_0 where the f_0 in each interval is divided into the same number of points (default = 10), and thus the points 1-10 belong to the first interval and the points 11-20 to the second interval and so on. The script also provides values for meanf_0, maxf_0, minf_0, duration and so on. The averaged normalized f_0 values of all the iterations of each word (**5 speaker x 5 iterations = 25**) were plotted as line graphs in order to observe the difference between the pitch contours of the words before and after affixation. Further details are provided in the following sections where the results are presented mostly as observations of the pitch contours.

2.2 Results

The existence of lexical tones in Boro has been previously discussed by many studies starting from Burling (1959) to Bramha and Sarmah (2012). Bramha and Sarmah (2012) have argued that the high tone in Boro is realized by rising contour and the low tones display a falling contour. One of the objectives of the present study has been to examine the *nature of pitch contours with which tonal minimal pairs are pronounced*. Figure 2.1 presents the time normalized pitch contours of the word [tʰaŋ] which expresses contrastive meaning depending on the tone with which it is pronounced. The pitch contour for **tʰáŋ** 'go' in Figure 2.1 (left panel) surfaces with a rising pitch and that of **tʰàŋ** 'to live' (right panel) with a falling pitch. In Figure 2.1 and in rest of the Figures in this chapter, 10 f_0 points for each segment is shown. The y-axis of the Figures in this chapter presents time normalized pitch values in hertz.



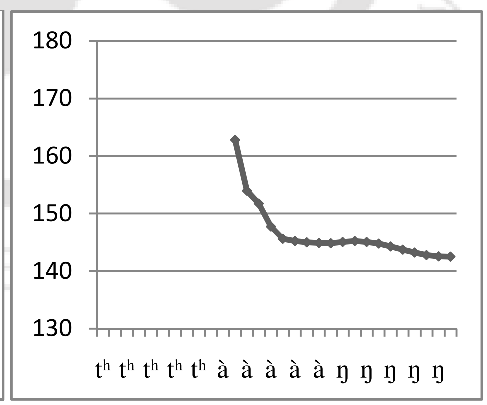


Figure 2.1: **Pitch contours for tonal minimal pairs in Boro**. The panel on the left presents the time normalized pitch contour for **tʰáŋ** 'go' and the panel on the right presents the time normalized pitch contour for **tʰàŋ** 'to live' (n=25)

The other tonal minimal pairs that this study has examined are given in Table 2.2. The lexical words in Table 2.2 also surface with *rising pitch contour when high tones associate to* *them and they show falling pitch contour when they are spoken with low lexical tones*. However, pitch contours for some other words revealed that *the low tone in Boro sometimes surfaces with low level pitch even when the rhyme is bimoraic*. The pitch contours of **lɯ̀ŋ** 'drink' in Figure 2.2 and **dɯì** 'water' in Figure 2.4 show that the low tone in Boro is sometimes pronounced with a low level pitch.

High Tone	Low Tone
baí 'break'	baì 'buy'
daó 'bird'	daò 'travel'
gaó 'halves'	gaò 'shoot'
hɯ́ɯ 'hasten'	hɯ̀ɯ 'give'
saó 'roast'	saò 'curse'

Table 2.2: **Tonal minimal pairs in Boro.**

Examination of the pitch contours of the stems in Table 2.1 (after affixation) has not only provided crucial information regarding alignment, it has also shown that *Boro affixes can be best described in terms of dominance relationship*. The primary meaning of the term dominance in linguistics is connected with the domination of one element or some elements compared with any other element in opposition. Grade (1976) has introduced dominance to accentology as a term for the accentual power of suffixes (Grade 1976; Stundzia 2011). The explanation of this phenomenon treats dominance as an accentual property of derivational affixes, which neutralizes the accentual properties of base stems, and therefore the placement of stress in derivatives is predetermined exclusively by dominant suffixes. The term 'dominance' has been used by Kiparsky (1982c, 1984a), to describe affixes which idiosyncratically cause the deletion of structure, usually tone or stress, from the base they attach to, often but not necessarily substituting a new pattern in place of the deleted material. 'Recessive' affixes do not cause such deletion (Inkelas, 1998). Inkelas (1998) presents two cases of dominant affixes, one from Vedic Sanskrit (Kiparsky 1982c, 1984b) and the other one from Hausa. It is shown that the recessive (or tone-integrating) affixes in Hausa add their underlying tone melody to the tone melody of the base to which they attach, whereas dominant affixes replace the tone of the base by their own melody. The examples in (1) from Inkelas (1998) elaborate this.

(1) Recessive Affix:

ba- goober	+	-ii	bagoobirii
L L H		H	L L HH
From-Gabir + ethonym			'a Gabir man'

Dominant Affix:

ba-katsina	+	-ee	bakatsinee
L L HL		HL	H HH L
From-Katsina ethonym			'a Katsina man'

It can be seen that the addition of the recessive suffix *–ii* does not change the tonal pattern of the stem in bagoobirii 'a Gabir man', while the dominant suffix *–ee* brings about a change in the tonal pattern of the stem ba-katsina 'from-Katsina'. Withgott and Halvorsen (1988) have reported about a similar phenomenon in Norwegian, a tone accent language. While describing the East Norwegian Accent, the study presents evidence to show that the neutral affixes do not influence the tonal property of the words. The tone inducing affixes in Norwegian has been divided into two categories: weakly dominant affixes which contribute tone to a non-derived base and strongly dominant affixes which can impose tone on both non-derived and derived forms. "An example such as ^{H}utferdsel 'outgoing traffic' illustrates that the tone provided by the class of weakly dominant affixes can be overwritten by subsequent affixation. ^{H}utferdsel is formed from ^{L}ferdsel 'traffic' (from the stem ferd- 'travel'). Prefixation of ut- overrides the L tone supplied by the weakly dominant inner suffix –sel. ut- exemplifies the second category of tone inducing affixes—strongly dominant affixes—which determine tone even if the base form is derived" (Withgott and Halvorsen, 1988). In short, the weakly dominant affixes are able to dominate over the tone of the stem and strongly dominant affixes dominate over the tone of everything. The distinction between the dominant affixes and recessive affixes is unpredictable from their phonological makeup. As a result, the impact by the dominant affix is a paradigm example of morphologically conditioned phonology (Inkelas, 1998). Inkelas and Zoll (2007) also report that dominant affixes delete an H tone from the base of affixation and recessive affixes leave a base H tone in place in Japanese, a pitch accent language. While presenting an analysis of data taken from Poser (1984), it is shown that the adjective forming suffix *–ppó* and the 'indigene' suffix *–kko* are dominant, causing deletion of H tone (if any) from the base of affixation. On the other hand the conditional suffix *–tára* and the past tense suffix *–ta* are recessive, both preserve base accent, if any. *Affixes in Boro can also be divided into the categories of dominant and recessive* following the nature of interaction they display with the stems they attach with. Some of the affixes in Boro change the lexical specification of the roots, and thus they may be described as *dominant***.** Some other affixes do not change the lexical specification of the stems. These affixes surface with the lexical tones of the stems if they themselves are unspecified for any lexical tone. Some affixes with their own lexical specification surface with it and at the same time allow the stem to preserve its tone. These affixes may also be described as *recessive*. *Distribution of lexical tones post affixation provides cues for classifying the affixes into dominant or recessive categories*. The sections below discuss this.

2.2.1 Tone Shift to right edge

Tone shift is an important characteristic of tones (Yip, 2002) (see section 1.1). This section highlights the ways the *tonal phonology of Boro permits tone shift to influence distribution of lexical tones*. Evaluation of pitch contours of disyllabic derived words has shown that lexical tones in Boro shift to the right edge in such words. Both prefixation and suffixation lead to this rightward shift. Sometimes, alignment to the right edge results in deletion of the lexical tone of the rightmost element. When the rightmost element is not specified with any tone, lexical specification only aligns to the right edge. Alignment to the right edge also provides the phonetic cue for identifying the lexical specification of the leftmost TBU. The sections below illustrate this.

2.2.2 Suffixation and tone shift

Suffixation invariably leads to the lexical tones of the stems aligning to the TBU at the right edge. This happens irrespective of the suffix having its lexical specification or not. *Tense and aspect suffixes present an instance of such tonal migration*. In Boro tense and aspect are expressed by attaching six different suffixes to verbal roots. These suffixes are -ɯ (Present Habitual), -gɯn (Future), -gou (Immediate Future), -bai (Present Perfective), -dɯŋ (Present Progressive), and -dɯŋmɯn (Past). In this study, the pattern of occurrence of the tense-aspect suffixes with roots of high tone and low tone types was investigated. The aim was to find out possible tonal changes as a result of affixation. Results have shown that *none of the tense-aspect suffixes in Boro are specified with their own lexical tone*. Figure 2.2 presents an instance of the occurrence of the habitual present marking suffix -ɯ with a high tone and a low tone word.

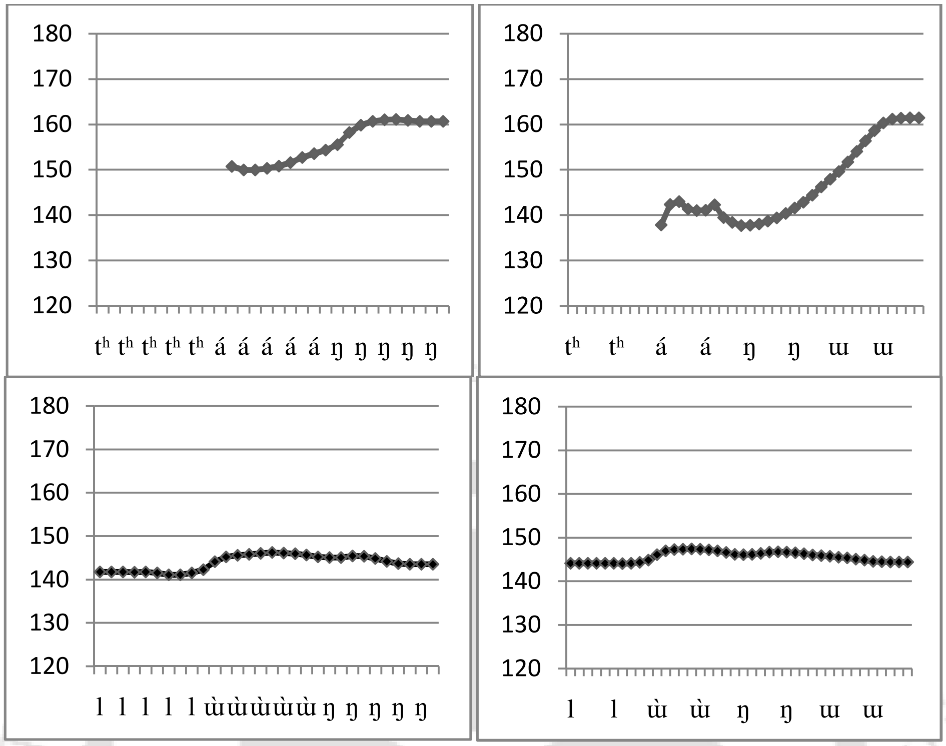


Figure 2.2: **Tense-aspect suffix and tone shift.** The upper panels show tʰáŋ 'go' with and without the habitual present marking suffix -ɯ. The lower panels present the f_0 contour for lɯ̀ŋ 'drink' with the same suffix. These are time normalized pitch contours for 25 iterations of each of the words (5 repetitions x 5 speakers).

It can be seen in Figure 2.2 that the underlying high tone of the verb **tʰáŋ** 'go' shifts to the habitual present marking suffix in **tʰaŋɯ́** 'go-Prsnt-Hab'. A similar pattern is noticed for the low lexical tone for **lɯ̀ŋ** 'drink' and its habitual inflectional form **lɯŋɯ̀** 'drink-Prsnt-Hab'. This pattern of distribution of tone results also when the other tense-aspect suffixes are added to stems. Table 2.3 shows that the tense-aspect suffixes in Boro do not possess any inherent tonal specification. Rather they surface with the tone of the root verb following the pattern of *right-alignment of lexical tone in Boro derived disyllabic words*. Since the *tense aspect suffixes do not alter the tonal specification of the stems, they can be described as recessive* affixes.

tʰáŋ 'go'	lɯ̀ŋ 'drink'
tʰaŋgɯ́n 'go-Fut'	lɯŋgɯ̀n 'drink-Fut'
tʰaŋgoú 'go-Fut'	lɯŋgoù 'drink-Fut'
tʰaŋdɯ́ŋ 'go-PrsntProg'	lɯŋdɯ̀ŋ 'drink-PrsntProg'
tʰaŋbaí 'go-PrsntPrf'	lɯŋbaì 'drink-PrsntPrf'

Table 2.3: **Tense aspect suffixes and tone shift.** The H tone of tʰáŋ 'go' in the left column and the L tone of lɯ̀ŋ 'drink' in the right column shift to the suffix.

Tone shift affects disyllabic derived words also when the negative marking suffixes are added to verbs. Verbs are inflected for negative forms in Boro by adding the negative suffix '-a'. In addition to this, '-lia' and '-akʰɯi' are used as extended forms of the negative suffix '-a', particularly in cases where negation has to occur with the tense marker. The suffix '-lia' marks negative in the future. The suffix '-akʰɯi' refers to negative in the perfective aspect. Tonal distribution, following the addition of the latter two negative markers, would be discussed in section 2.2.5. This is because their addition results in trisyllabic derived words. Since this section has focused on disyllabic derived words and their tonal alternation, only suffixation by '-a' is discussed here. Figure 2.3 presents the pitch contour for the words **tʰáŋ** 'go' and **pʰɯì** 'come' occurring with this *negative marking suffix*.

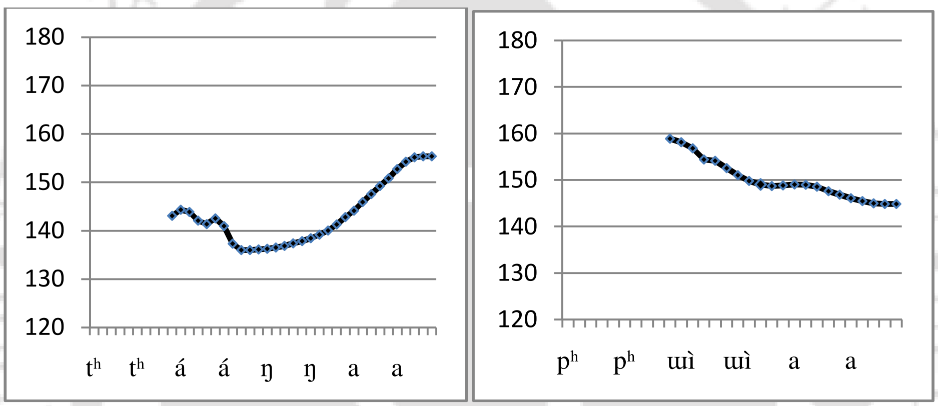


Figure 2.3: **Negative suffix and tone shift.** Averaged time normalized pitch contour for the verbs tʰáŋ 'go' and pʰɯì 'come' occurring with the negative marker '-a' (n=25)

It can be seen from the pitch contours presented in Figure 2.3 that the high tone of the verb tʰáŋ 'go' surfaces in the form of a rising f_0 pattern aligned to the negative marker itself. The low tone of the verb pʰɯì 'come' makes the negative marking suffix surface with a falling f_0 pattern. Section 2.2.5 will show that the other two negative markers '-lia' and '-akʰɯi' cause tone shift to the second syllable and spreading to the third syllable when these suffixes are added to monosyllabic stems. *Since none of the negative marking affixes bring about any change in the tone of the stems, they can also be grouped into the recessive category.*

Similar to the tense-aspect and negative marking suffixes, *case marking suffixes also cause the lexical tone to align to the right edge* when they are added to monosyllabic stems. Cases are marked in Boro by adding various suffixes. Figure 2.4 presents the pitch contours for two monosyllabic nouns dɯì 'water' and daó 'bird' occurring with the nominative case marker '-a'.

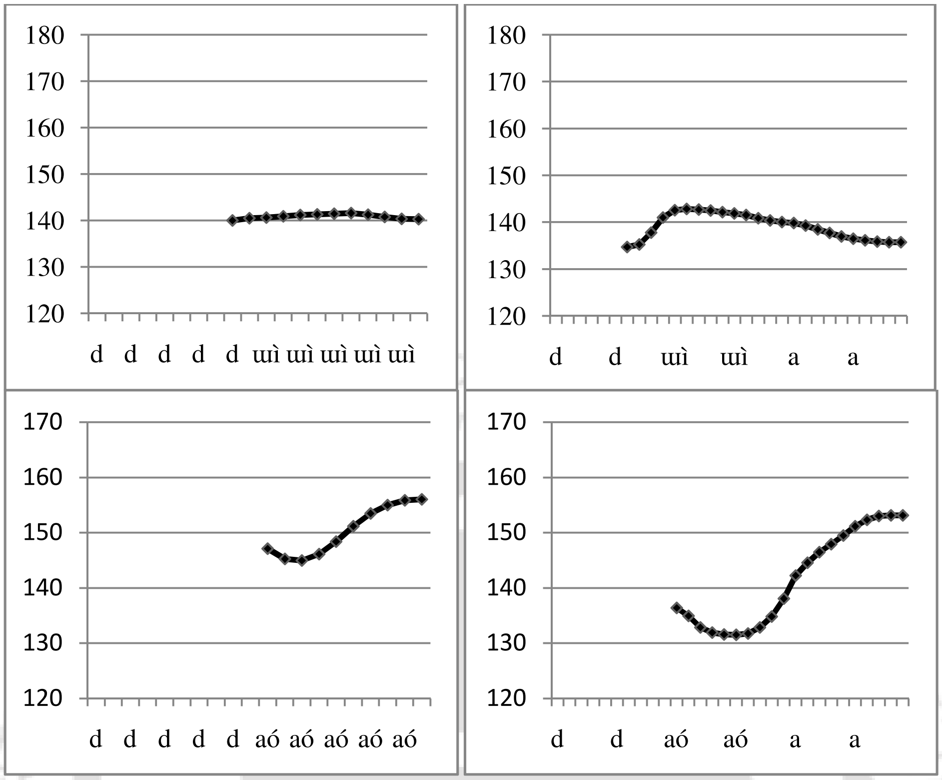


Figure 2.4: **Case inflection and tone shift.** The upper panels show dɯì 'water' with and without the nominative marking suffix -a. The lower panels present the f_0 contour for daó 'bird' with the same suffix. These are time normalized pitch contours for 25 iterations of each of the words (5 repetitions x 5 speakers). The y-axis presents normalized f_0 in hz.

It can be seen in Figure 2.4 that the underlying high tone of the noun **daó** 'bird' shifts to the nominative case marking suffix in **daoá** 'bird-Nom'. A similar pattern is noticed for the low lexical tone for **dɯì** 'water' and its nominative case inflectional form **dɯià** 'water-Nom'. This shows that the process of tone shift to the right edge of disyllabic derived words is a robust phenomenon in the tonal phonology of Boro[7]. Plural marking suffixes like '-p^hɯr' '-sɯr' and '-mɯn' also highlight the ubiquitous nature of this pattern of tonal alignment in the language. Even derivational suffixes like adjective forming ones adhere to this.

The adjective forming suffixes that this study has evaluated for their effect on the tonal pattern of the derived words are '-k^hor' '-dɔ' '-dɯb' '-braŋ' '-brɯm' '-lu' '-deŋ' '-t^hi'. They are

[7] Section 2.2.4 will show that some of the case marking affixes posses their own lexical specification. The lexical specification of the nominative, accusative and genitive case markers surface only when they are preceded by a disyllabic stem. At the same time, the tone of the stems also surface in such words. While occurring with a monosyllabic stems, these suffixes emulate the distribution of the tense-aspect suffixes discussed in 2.2.2 and they surface with the lexical tone of the root aligned to the right edge. Since the lexical specification of these three case markers does not modify the tonal patterns of the stems, they can be classified into the recessive category of affixes in Boro.

added to different lexical items and most of them do not occur with both the high tone and low tone root types. Only two among them, ‘-kʰor’ and ‘-lu’ can occur after roots of both the two lexical tone types in Boro. Figure 2.5 presents the pitch contour of the adjectives formed as a result of adding ‘-kʰor’ to the verbal roots of both the high and low tone types.

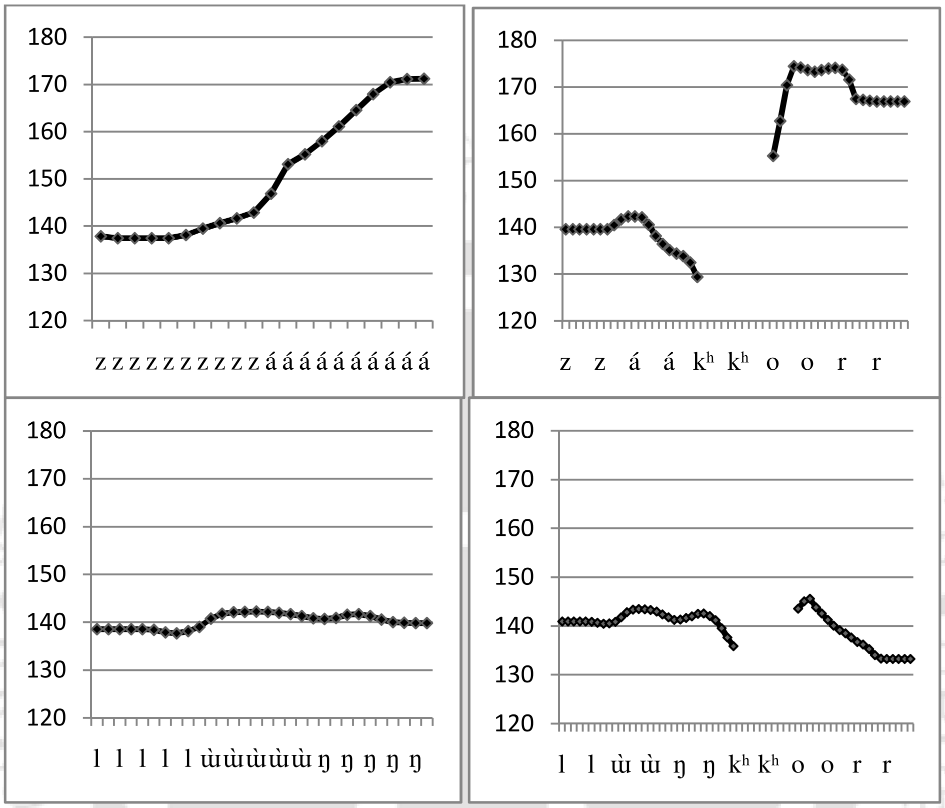


Figure 2.5: **Adjectival suffix and tone shift.** Averaged time normalized f_0 contour for the verb zá ‘eat’ and the adjective zakʰór ‘gluttonous’ in the upper panels and lɯ̀ŋ ‘drink’ and the adjective lɯŋkʰòr ‘drunkard’ in the lower panels. (n=25)

It can be seen in Figure 2.5 that the suffix ‘-kʰor’ surfaces with the underlying tonal specification of the verb roots. In the case of the adjective **zakʰór** ‘gluttonous’, the raising f_0 pattern of **zá** ‘eat’ aligns to the second syllable. The verb **lɯ̀ŋ** ‘drink’ is specified for low tone and consequently **lɯŋkʰòr** ‘drunkard’ surfaces with the low tone aligned to the suffix. *Pitch contours of other disyllabic derived words with either an inflectional suffix or derivational one have shown that tone in Boro obligatorily shifts to the second TBU in such words.*

2.2.3 Prefixation and Tone shift

Tone shift shapes the pitch contour of a disyllabic derived word even when it results from a sequence of a prefix and a stem. Two processes of prefixation and the resultant tonal alignment have been examined in the experiment described here: derivation of adjectives and of causative verbs. Adjectives in Boro can be formed from verbs be prefixing the syllable 'gV' where '**V**' *copies the vowel of the stem.* This process of adjective formation has revealed an interesting aspect of the way tonal distribution interacts with morphological process in Boro. The prefix 'gV' can occur with both high tone and low tone root types. A careful examination of the tonal pattern of the adjectives after affixation has shown that the roots always surface with a low specification irrespective of its tonal character before prefixation. In Figure 2.6 the prefix occurs with two verbs: **haí** 'shorten' and **hàm** 'become good'. It can be seen that a low tone surfaces on the root after affixation in both **gahaì** 'low' and **gahàm** 'good'.

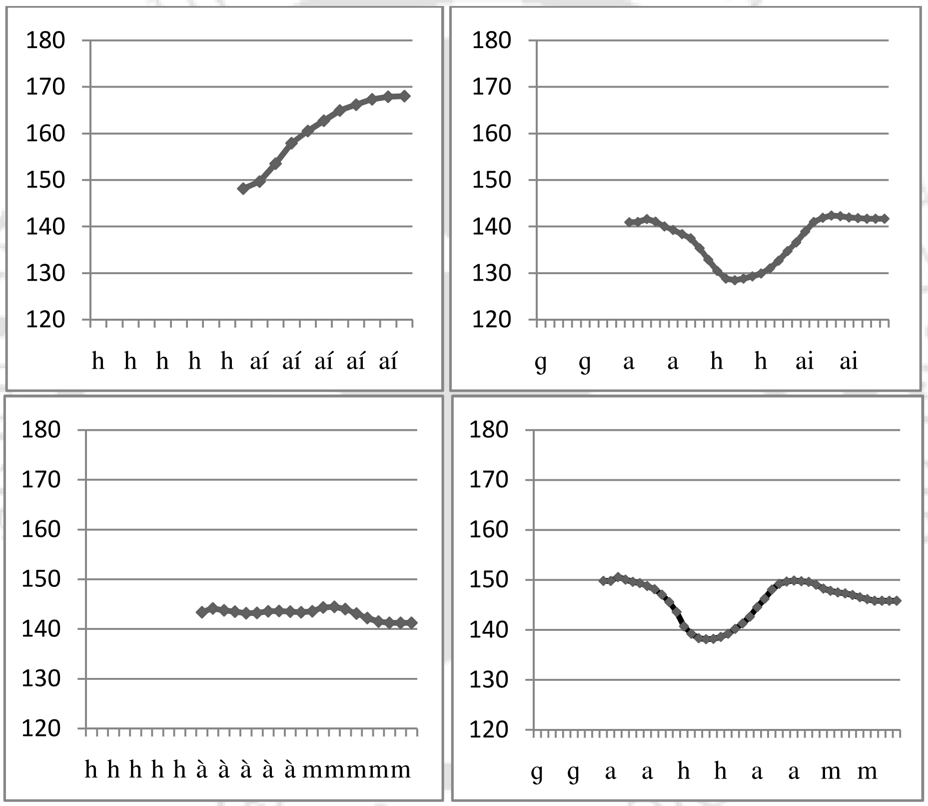


Figure 2.6: **Adjectival prefix and tone shift.** Averaged time normalized pitch contour for the adjective gahaì 'low' derived from haí 'shorten' and for the adjective gahàm 'good' derived from the verb hàm 'become good'. (n=25)

Verb	Adjective
pʰúr ‘whiten’	gupʰùr ‘white’
sú ‘become cold’	gusù ‘cold’
zí ‘to tear’	gizì ‘torn’
sì ‘to soak’	gisì ‘wet’
zén ‘lose’	gezèn ‘loser’
hàm ‘become good’	gahàm ‘good’

Table 2.4: **Derived adjectives post-prefixation.** Adjectives derived from verbs where the low tone of the prefix shifts to the right edge resulting in deletion of the lexical tones of the stems.

Pitch contours of other adjectives formed by this kind of affixation has revealed the same pattern of the root surfacing with a low specification. Table 2.4 presents a list of derived adjectives and their tonal pattern that has been investigated in this study.

The surface alignment of low tone to the right edge of all the derived adjectives in Table 2.4 can be explained by assuming that the adjective forming prefix ‘gV’ in Boro is inherently specified with low tone and when it precedes a root, *the low specification of the prefix shifts to right edge*. This results in *deletion of the lexical tone of the stem*. For this, these prefixes can be classified into *dominant group of affixes in Boro*.

Causative verbs in Boro can be formed by prefixes of three types: bV-, pʰV-, sV- where the *vowel of the prefix copies the vowel of the root*. Sarmah (2004) has presented a detailed account of the tone pattern of the causative prefixation in Goalparia dialect of Boro. It is shown that the causative prefixes do not have inherent tonal specification and they get a default mid tone when they are affixed to a stem. The data for the discussion in this chapter, collected from the Kokrajhar area, has revealed some new patterns of tonal distribution following causative prefixation. It is found that causative verb formation by prefixation in Boro follows the pattern of adjective formation. Prefixation by bV-, pʰV-, sV- results in a change of the tonal specification of the root. Irrespective of the tonal specification of the root before the causative prefix is added, a low tone surfaces on the root after causative formation. Figure 2.7 presents the pitch contours for the causative verbs **bekʰeò** ‘to make something open’ and **pʰɯzɯ̀b** ‘to make finish’ derived from the verbs **geò** ‘open’ and **zɯ́b** ‘finish’ respectively.

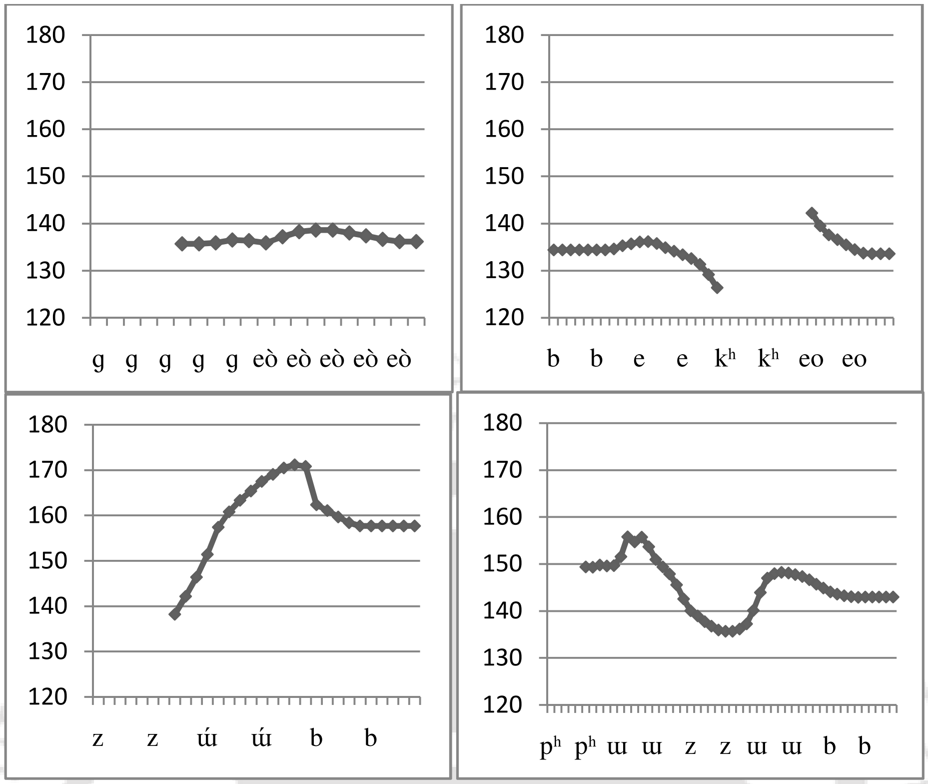


Figure 2.7: **Causative prefix and tone shift.** Averaged time normalized pitch contour for the causative verbs bek^{h}eò 'to make something open' derived from the verbs geò 'open' and p^{h}ɯzɯ̀b 'to make finish' derived from zɯ́b 'finish'. (n=25)

It can be seen in Figure 2.7 that the lexical high tone of zɯ́b 'finish' changes to a low tone after the prefix is added to it. In bek^{h}eò 'to make something open', the low specification of the root geò 'open' is preserved even after affixation. The pattern of tonal distribution in Figure 2.7 is found to be similar to the one observed in adjective formation processes. Thus an explanation similar to the one for adjective forming prefixation can be proposed to account for the surface tone patterns in bek^{h}eò 'to make something open' and p^{h}ɯzɯ̀b 'to make finish'. We assume that the causative prefixes are also underlyingly specified with low tone and this *low specification shifts to the right edge after affixation following the pattern of right alignment of lexical tones in Boro.* This shift of the low tone to the rightmost syllable in the causative verb makes the high tone of the root change to a low tone. In comparison, the tonal specification of the low tone roots does not change but induces change on the previously specified tone on the right edge. This pattern of tonal distribution in the causative verbs is followed by all the instances of this kind derivation examined in this study. A list of such verbs and tonal distribution in them is provided in Table 2.5. Since the addition of the prefixes for the causative verb formation lead to a change of the tone of the stems, *these prefixes can be defined as dominant*.

Verb	Causative Verb
gáb‘cry’	sɯgàb ‘to make cry’
t^{h}àb ‘fasten’	sɯt^{h}àb ‘to cause to fasten’
zɯ́b ‘finish’	p^{h}ɯzɯ̀b ‘to make finish’
zàm ‘old’	p^{h}ɯzàm ‘to make old’
haí ‘shorten	p^{h}ahaì ‘to make low”
t^{h}ù ‘sleep’	p^{h}ut^{h}ù ‘to cause sleep’
zír ‘examine’	bizìr ‘to examine’
gó ‘escape’	bok^{h}ò ‘to make free’

Table 2.5: **Derived causative verbs post-prefixation.** Causative verbs derived from verbs where the lexical L of the prefix shifts to the right edge resulting in the delinking of the lexical specification of the stem.

Pitch contours of derived adjectives and causative verbs presented in this section show that *lexical tones of the prefixes also shift to the right edge when they form part of disyllabic derived words*.

2.2.4 Tone shift in disyllabic stems

Sections 2.2.2 and 2.2.3 have shown how tones align to the right edges in disyllabic derived words. However, *in trisyllabic derived words, the requirement of alignment to the right edge is fulfilled either by tone spreading to the third TBU or by blocking the migration of the lexical specification to the right edge*. This section discusses how tone shift to the third syllable is blocked in some instances in Boro. The nominative case marking suffix presents an example of this. Figure 2.4 shows how the nominative suffix ‘-a’ surfaces with the lexical tone of the stem when it forms part of a disyllabic derived word. When the same suffix is added to a disyllabic stem with low tone, it surfaces with a different pitch trend. *This provides clue to the fact that the nominative suffix* ‘-a’ *has its own lexical specification which surfaces only when it is added to a disyllabic stem.* The panel on the right in Figure 2.8 explains this.

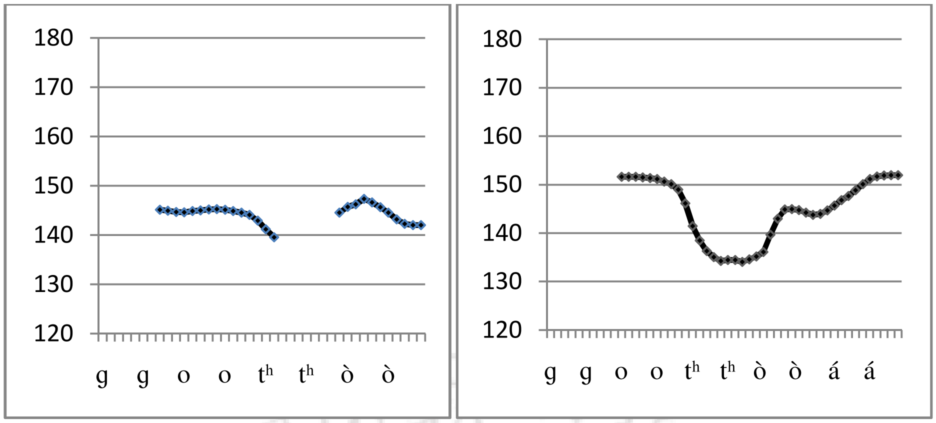


Figure 2.8: **Nominative inflection and absence of tone shift.** Time normalized pitch contours of got^{h}ò ‘child’ (left panel) and of got^{h}ò-á ‘child-Nom’ (right panel) (n=25). The rise in pitch during the nominative marker is because of its H lexical specification.

In Figure 2.4 the pitch drop continues till the end of **duià** ‘water-Nom’ because the low tone of the stem aligns to the right edge and the tone of the suffix is deleted. In **got^{h}ò-á** ‘child-Nom’, in the panel on the right of Figure 2.8, the lexical tone of the stem does not shift to the third syllable. Instead, the nominative suffix ‘-a’ in got^{h}ò-á ‘child-Nom’ surfaces with f_0 rise. Thus *tone alignment to the right edge is fulfilled by allowing the tone of the suffix to surface when it is added to a disyllabic stem.*

The genitive suffix also shows this kind of behaviour as far as its lexical tone is concerned. In Figure 2.9 (left panel) the genitive suffix follows a monosyllabic stem with low tone. Consequently, the derived disyllabic word surfaces with the low tone of the stem aligned to the right edge. In the panel on the right of the same Figure, the genitive suffix is preceded by a stem with high tone. As a result of the suffixation, *the high tone of the stem aligns to the suffix*.

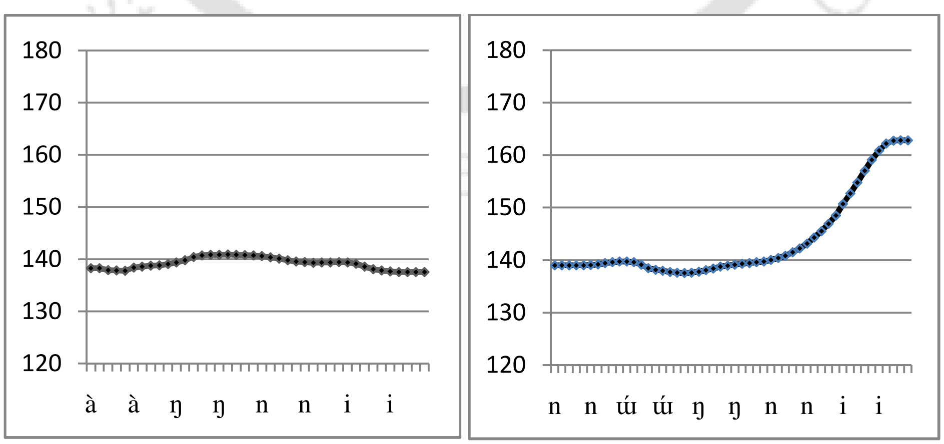


Figure 2.9: **Genitive inflection and tone shift.** Averaged time normalized pitch contour for the nouns aŋnì ‘I-Gen’ (left panel) and that of nɯŋní ‘you-Gen’ (right panel) (n=25). The genitive

suffix '-ni' surfaces with a rising contour in nɯŋní 'you-Gen' as the high tone of nɯ́ŋ 'you' moves to the right edge.

The high lexical specification of the genitive suffix is allowed to surface when the genitive marker is preceded by a disyllabic stem with low tone as in **bɯrmà** 'goat. The panel on the right of Figure 2.10 shows how the genitive suffix surfaces with a rising pitch.

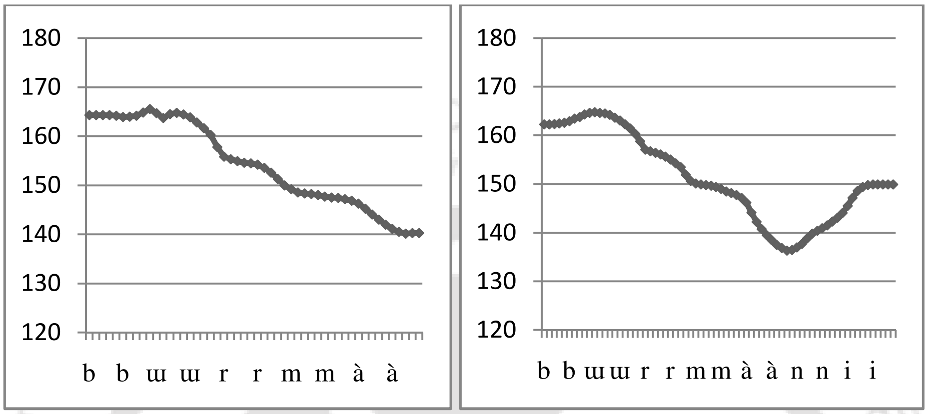


Figure 2.10: **Genitive inflection and absence of tone shift.** Averaged time normalized pitch contour for the nouns bɯrmà 'goat' (left panel) and of bɯrmàni 'goat-Gen' (right panel) (n=25). The lexical high specification of the genitive suffix '-ni' surfaces with a rising f_0 following the disyllabic stem bɯrmà 'goat'.

The pitch contour for **bɯrmàni** 'goat-Gen' surfaces with a fall aligning to the pitch points in time for the second syllable and this is followed by a rise as a result of the presence of the genitive marker. This rise extends till the end of the genitive marker. Due to this, the derived word surfaces with the low tone of the stem and the high tone of the genitive suffix. This provides yet another evidence of the way *Boro allows the tone of a suffix to surface when it is preceded by a disyllabic stem*. Results have shown that the accusative suffix in Boro also has its tone and its occurrence with a disyllabic stem provides evidence for it. Figure 2.12 shows it.

Figure 2.11 presents the pitch contours of words of high tone and low tone types occurring with the accusative case marker. As the stems in both the panels in Figure 2.11 are monosyllabic, the accusative case marker does not surface with its own lexical specification. Instead, the tone of the stem shifts to the right edge for boundary alignment.

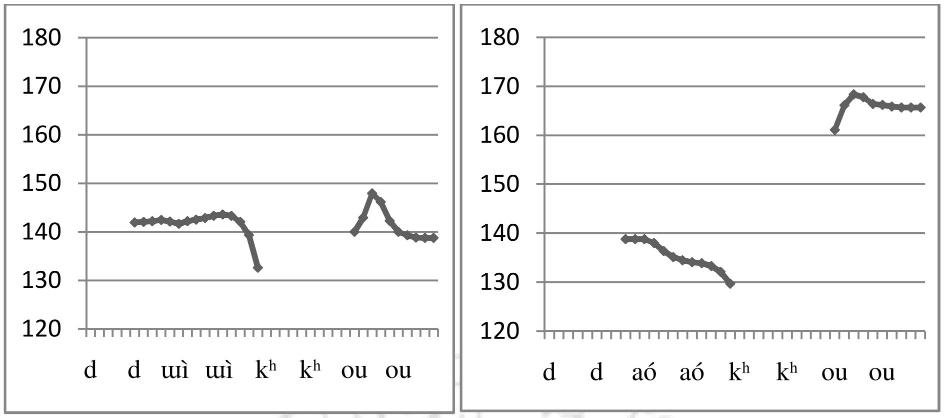


Figure 2.11: **Accusative inflection and tone shift.** Averaged time normalized pitch contour for the nouns dɯik^{h}où 'water-Acc' (left panel) and daok^{h}oú 'bird-Acc' (right panel) (n=25). The lexical specifications of both dɯì 'water' and daó 'bird' move to the right edge in both the panels.

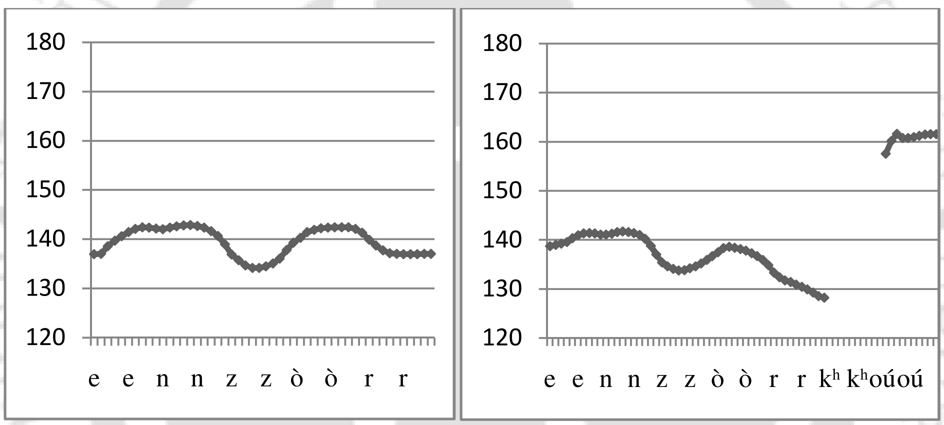


Figure 2.12: **Accusative inflection and absence of tone shift.** Time normalized pitch contours for the noun enzòr 'rat' with and without the accusative case marker -k^{h}oú. (n=20). The lexical high specification of the accusative case marker -k^{h}oú surfaces in the presence of the disyllabic stem enzòr 'rat'.

The *lexical specification of the accusative suffix surfaces only when it occurs with a disyllabic stem like* enzòr *'rat'*. The pitch contours presented in Figure 2.12 explain this. The panel on the right of Figure 2.12 shows how the low tone of the stem **enzòr** 'rat' is not allowed to shift rightward and the accusative suffix surfaces with a high tone in **enzòrk^{h}oú** 'rat-Acc'. This kind of interaction between tone of the three case markers in Boro and the stems they follow can be compared with the interaction between tense-aspect suffixes and the stems they follow. The tense-aspect suffixes surface with the lexical tone of the stem either due to tone shift or tone spreading[8]. The three case markers discussed till now succumb to the process of tone

[8] Tone spreading is discussed in section 2.2.5.

shift only when they follow monosyllabic stems. *When case markers follow disyllabic stems, the lexical tone is not allowed to spread rightward since the suffixes are specified with lexical tones.*

The adjective forming suffix '-lu' also highlights the difference in the way suffixes surface with their lexical tones depending on the length of the stems. It is found that the adjective forming suffix '-lu' has its own tonal specification. Figure 2.13 presents the pitch contours of the suffix '-lu' occurring with the verbs **sɯrzí** 'create' and **dɯmɯì** 'become cloudy'.

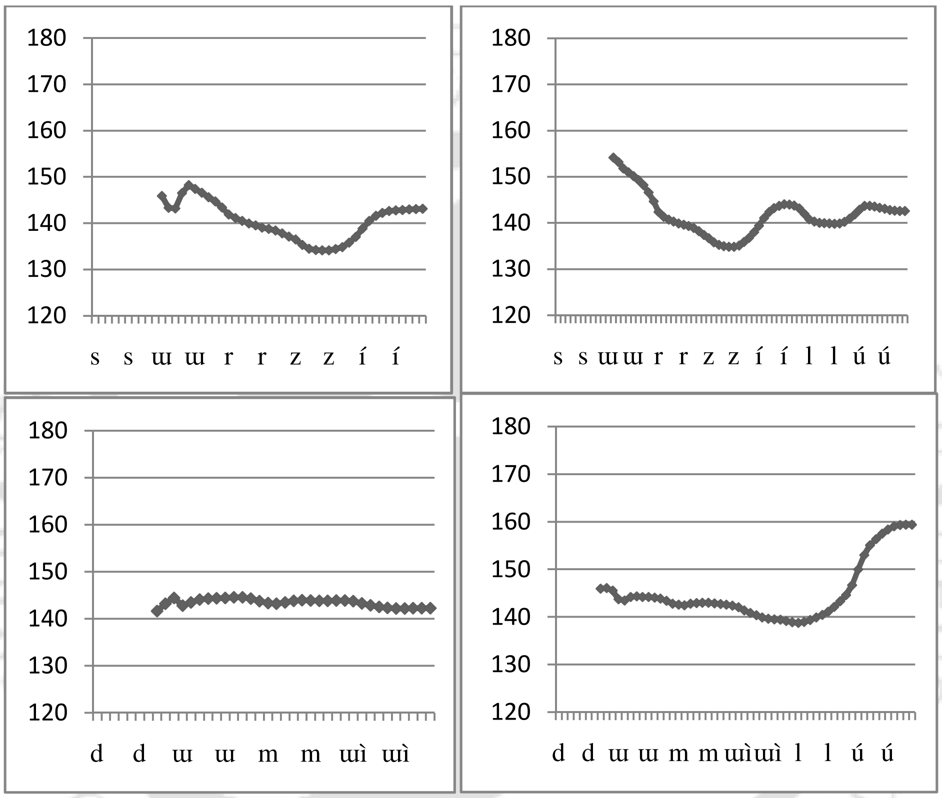


Figure 2.13: **Adjectival suffix and absence of tone shift.** Aggregated time normalized pitch contours for sɯrzí 'create' and sɯrzílú 'creative' in the upper panels and for dɯmɯì 'become cloudy' and dɯmɯìlú 'cloudy' in the lower panels. (n=25)

It can be seen in Figure 2.13 that the suffix is pronounced with a high and rising pitch even when it occurs with dɯmɯì 'become cloudy' having low lexical tone. Another important aspect of '-lu' suffixation is that the high tone on the second syllable of the root sɯrzí 'create' does not shift in the manner it migrates from the roots tʰáŋ 'go' and nɯ́ŋ 'you' to tʰaŋá 'go-Neg' and nɯŋsɯ́r 'you-plural' respectively. Thus, the lexical specification of the stems in Figure 2.13 do not change when the suffix '-lu' with high tone is added to them, which *makes a case for grouping this suffix also into the recessive category.*

This section has discussed the distribution of lexical tones in derived words where the stem consists of two syllables and a tone bearing suffix is added to it. Acoustic details show that *the tone of the disyllabic stem does not shift to a tone bearing suffix in Boro. Such trisyllabic derived words surface with the tones of both the stem and the suffix.*

2.2.5 Tone spreading to the right edge

Boro has several suffixes which do not have their own lexical specification. Trisyllabic words formed with the aid of these suffixes present another aspect of the tonal phonology of the language. The occurrence of a non tone bearing suffix at the right edge of such derived words results in spreading of the lexical tone of the stem to the final syllable. The lexical specification does not shift to the right edge as it does when such suffixes are added to monosyllabic stems. Instead, *the tone of the stem gets associated to the suffix following the principle of one-to-many association* (Yip, 2002). The derivation of **tʰaŋdɯ́ŋmɯ́n** 'go-Prf-Pst' and **lɯŋdɯ̀ŋmɯ̀n** 'drink-Prf-Pst' *not only present an instance of tone shifts but also of tone spreading*. It is noticed that the lexical specification does not shift to the third syllable when the suffix -mɯn is added. The *tone only spreads to the third syllable and thus both the ultimate and penultimate syllables surface with identical tones*. Figure 2.14 explains this.

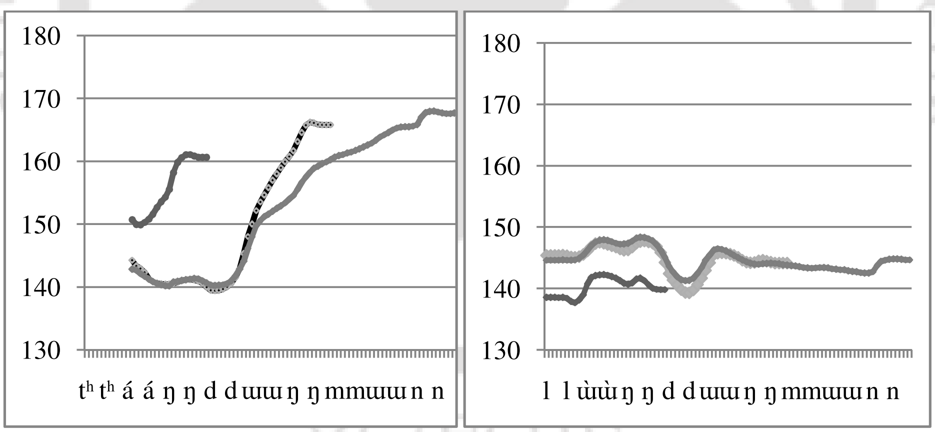


Figure 2.14: **Tense aspect suffixes and tone spreading.** Pitch contours of tʰáŋ 'go' and lɯ̀ŋ 'drink' with the suffixes '-dɯŋ' and '-mɯn' where the lexical tone spreads to the third syllable.

Tone spreading to the third syllable is also noticed when the case marking suffix '-ao' and the negative marking suffix '-akʰɯi' form part of trisyllabic derived words. Figure 2.15 presents the pitch contours of **gozoùaò** 'high-Loc' and **hatʰaíaó** 'house-Loc' where the locative case marker '-ao' occurs as the third syllable.

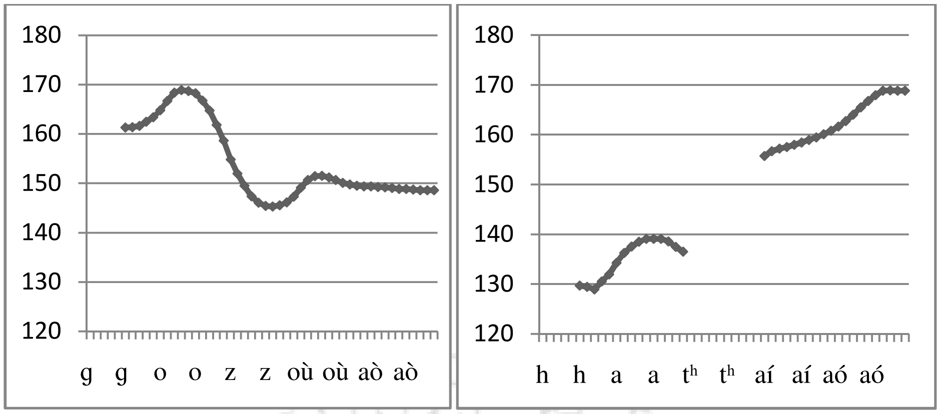


Figure 2.15: **Locative inflection and tone spreading.** Averaged time normalized pitch contour for the nouns gozoùaò 'high-Loc' and hatʰaíaó 'house-Loc' (n=25)

In the panel on the left of Figure 2.15 the low tone of gozoù 'high' spreads to the third syllable, the locative marking suffix. In the panel on the right of Figure 2.15, the continuous rise in the f_0 contour shows how the high tone of hatʰaí 'market' spreads to the locative marker. It has been already shown in Figure 2.8, 2.10 and 2.12 that some case marking suffixes in Boro possess their own lexical tones. Neither they change the tone of the stems, nor it is done by the non tone bearing case markers like '-ao' and '-nɯ'. Thus *these affixes can also be classified into the recessive category*. The pitch contours of the words **tʰaŋákʰɯí** 'go-Neg-Prf' and **pʰɯiàkʰɯì** 'come-Neg-Prf' are presented in Figure 2.16. It can be seen that for tʰaŋákʰɯí 'go-Neg-Prf' both the second and the third syllables surface with a rising f_0 contour. The contrastive pitch contour can be seen in the last two syllables of pʰɯiàkʰɯì 'come-Neg-Prf'.

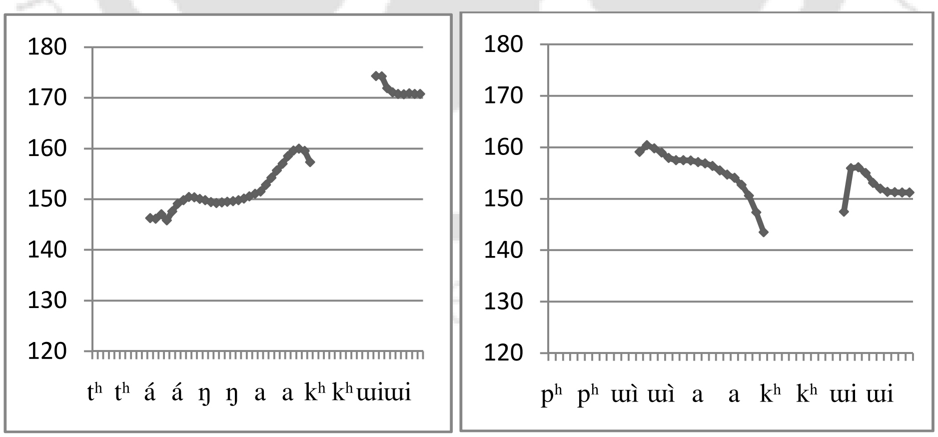


Figure 2.16: **Negative inflection and tone spreading.** Averaged time normalized pitch contours for the verbs tʰáŋ 'go' and pʰɯì 'come' occurring with the negative marker '-akʰɯi'. (n=25)

Acoustic evidence presented in this section shows that tone spreading occurs in Boro only in the context of trisyllabic words where the third syllable is a toneless suffix. *Lexical tone spreads* *from the second syllable to the third syllable following the phonological process of one-to-many association.*

2.2.6 Suffixation and no tone shift

Causative verb formation in Boro by adding the suffix '-hɯ' to the verbal roots reveals yet another interesting aspect of tonal distribution in Boro. It is found that *the causative suffix* '-hɯ' *is inherently specified with a low tone and it preserves its low tone even when it is added to a monosyllabic stem.* Figure 2.17 presents the pitch tracks for the causative verbs **maòhɯ̀** 'to cause an action' and **gíhɯ̀** 'to make frightened' derived from the verb **maò** 'do' and from the noun **gí** 'fear'.

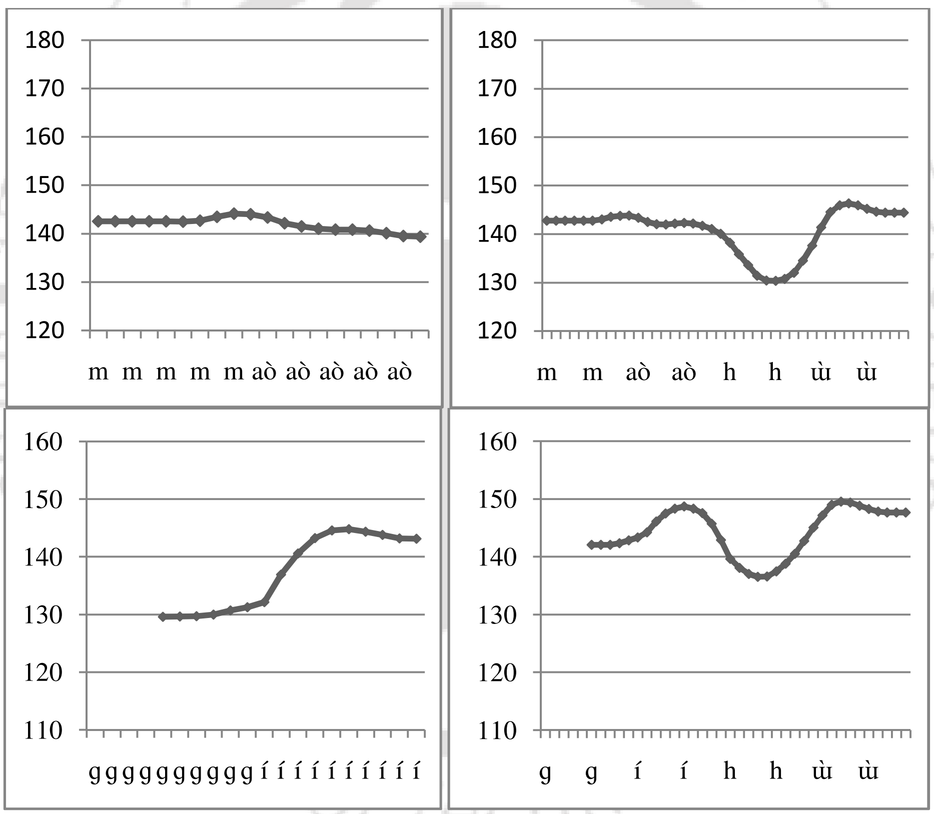


Figure 2.17: **Monosyllabic stem and absence of tone shift.** Averaged time normalized pitch contours for the causative verbs maòhɯ̀ 'to cause an action' and gíhɯ̀ 'to make frightened' derived from the verb maò 'do' and from the noun gí 'fear'. (n=25)

It can be seen in Figure 2.17 that the high tone of the root gí 'fear' is preserved even after the suffix '-hɯ' is added to it. The f_0 for the first syllable of gíhɯ́ 'to make frightened' does not surface as a low plateau. This suggests that the f_0 specification for the high tone does not shift to the second syllable. The f_0 trend of the verb maò 'do' does not change after the suffix is added.

'-hɯ' behaves in the same way when it occurs with disyllabic roots. Figure 2.18 presents the pitch contour of the causative suffix occurring with disyllabic roots. The causative suffix surfaces with its lexical tone after both **pʰɯtʰaí** 'belief' and **mɯsà** 'dance'. Since addition of the causative suffix does not change the tone of the stem, *it can also be defined as a recessive suffix in Boro*.

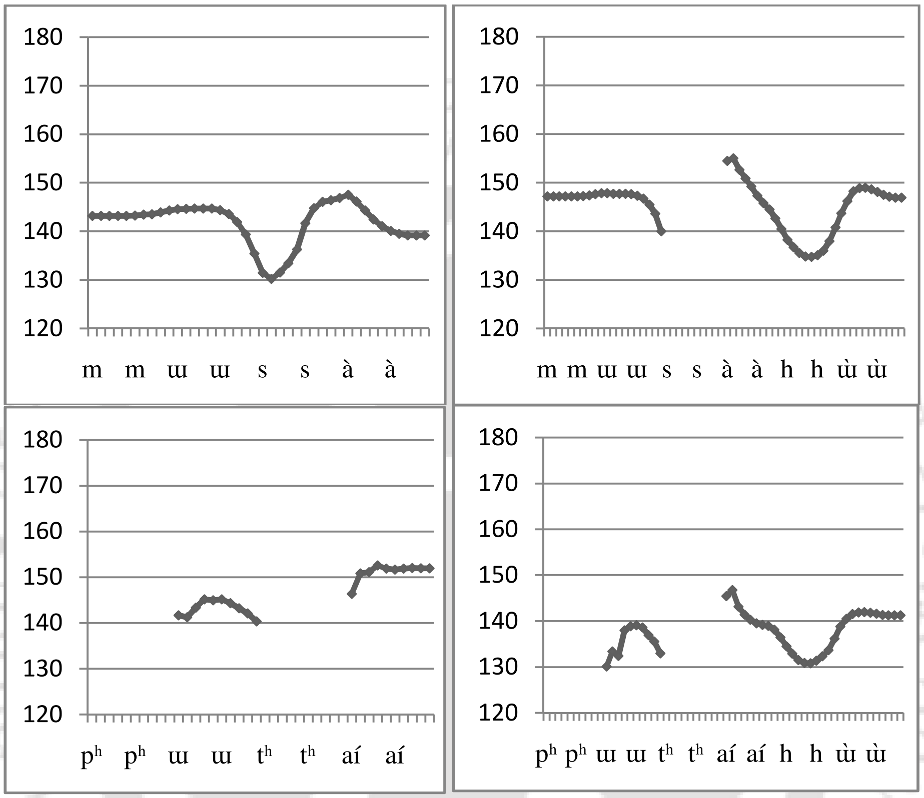


Figure 2.18: **Disyllabic stem and no tone shift.** Averaged time normalized pitch contour for the causative verbs mɯsàhɯ̀ 'to cause to dance' and pʰɯtʰaíhɯ̀ 'to make someone believe' derived from the verb mɯsà 'dance' and the noun pʰɯtʰaí 'belief'. (n=25)

This section has presented an exception to the already described pattern of tonal distribution within a disyllabic derived word. Based on acoustic evidence presented in sections 2.2.2 and 2.2.3 we argued that tones shift from the sponsoring TBU to align to the second one in derived disyllabic words. Results presented in this section show that the causative suffix '-hɯ̀' does not adhere to this alignment scheme. *Disyllabic derived words with the causative suffix* '-hɯ̀' *can surface with the tones of both the stem and that of the suffix associated to their sponsoring TBUs.*

2.3 Tone and Word-Formation in Boro

A detailed look at the distribution of lexical tones in Boro vis-à-vis various word formation processes has revealed the following important aspects of the tone system in the language.

Prefixes having their inherent tonal specification follow the pattern of right alignment of lexical tones. Due to this, the inherent tones of the prefixes shift to the right edge. This results in *delinking the tonal specification of the stem*. The processes of *adjective formation* presented in Figure 2.6 and that of *causative verb formation* presented in Figure 2.7 show how the lexical tones of the prefixes shift to the right edge.

Suffixes without any inherent tonal specification surface with the lexical tone of the stem as Boro words must have a lexical tone on the rightmost element. *Tone shifts to the suffix only when the suffix is added to a monosyllabic stem. When the suffix is preceded by a disyllabic stem, spreading fulfills the requirement of tonal association to the right edge*. In such a situation the tone only spreads from the second syllable to the third one and thus the resultant word surfaces with tone on both the second and the third syllables. Figure 2.19 repeats the pitch contour of hatʰaí-ao 'market-Loc' along with that of a disyllabic derived word nɔ́-ao 'house-Loc'. The mean f_0 of the vowel in nɔ́ 'home' (155.24 hz) is lowered (137.62 hz) when the locative marking suffix '–ao' is added to it and the suffix in nɔ-aó surfaces with a higher pitch (mean f_0 = 150.60 hz). Pitch target for the TBU in hatʰaí 'market' (mean f_0 = 168.96 hz) is not lowered in the same way when the same locative suffix is added to it. The mean f_0 of the second syllable in hatʰaí-aó 'market-Loc' is 158.76 hz compared to that of 165.906 hz for the third syllable. This *distinction between tone shift and tone spreading* depending on the syllable structure of the stem does not emerge in a prominent way when the stems have low tones.

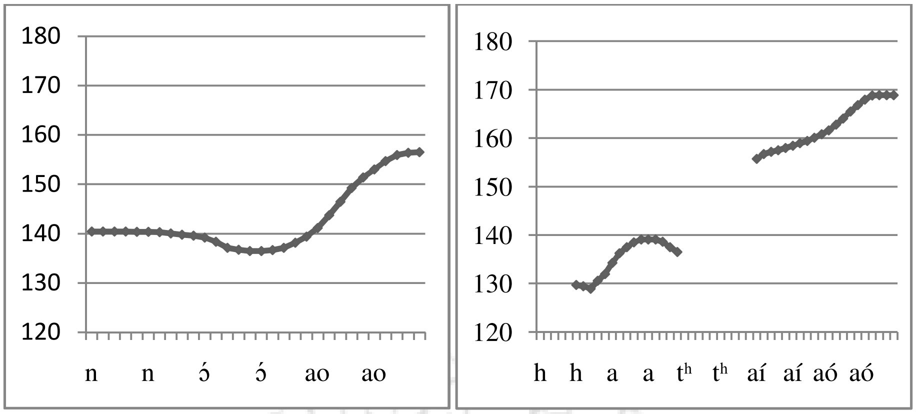


Figure 2.19: **Tone shift vs tone spreading.** Averaged time normalized pitch contours (n=25) in hertz for nɔ́-ao 'house-Loc' in the panel on the left and hat^{h}aí-ao 'market-Loc' in the panel on the right. 10 f_0 points for each phoneme are shown.

Suffixes having their inherent tonal specification behave differently as far as their association with monosyllabic and disyllabic stems is concerned. *The tone of the suffix is deleted when it occurs with a monosyllabic stem, and the tone of the stem shifts rightward and aligns to the right edge. The same is not deleted when it is preceded by a disyllabic stem and the resultant derived word surfaces with tones aligned to both the final and penultimate syllables*. A comparison between the pitch contours presented in Figure 2.4 and Figure 2.8 explains this. The causative '-hʉ̀' suffix does not follow this tonal alignment pattern. *The causative suffix '-hʉ̀' can surface with its tone even when it occurs with a monosyllabic stem. The resultant derived disyllabic words after the addition of this suffix surfaces with both the tones of the stem and that of the suffix.*

2.4 Conclusion

Tonal alignment in Boro vis-à-vis word formation processes reveals some important phonological properties of the language. It has been found that *Boro has some affixes which have their own tonal specifications*. Among these tone bearing affixes, *only the prefixes belong to the dominant class* as their addition changes the tonal specification of the stem. Although some suffixes have their lexical tones, their addition does not alter the tonal nature of the stems. Thus, *the status of an affix being recessive and its tonal status are not related in Boro*. This is similar to the data referred to by Inkelas and Zoll (2007) from Poser (1984) where it is described that the dominant or recessive status of a suffix is not related to its tonal character. Suffixes in Boro, irrespective of their tonal status, belong to the recessive category. Neither they always surface with their own tonal specification, nor with the lexical tone of the stem. Section 3.1 will relate tonal association in Boro derived words to a minimum disyllabic PrWd domain.

Non tone bearing suffixes surface with the tone of the stems. The way they get tonal association differs depending on whether they form part of the minimum disyllabic PrWd domain or recursive PrWd domain discussed in section 3.1. It has been already outlined in Chapter 1 how lexical tones can migrate from the verb root to the right edge in Digo (Yip 2002; Goldsmith, 1990). Bickmore (1996) and Bickmore and Doyle (1995) report that lexical tone can spread to the right in Chilungu verbal paradigms where an underlying H spreads rightward in an unbounded fashion, subject only to word-final extra-prosodicity. Nespor and Vogel (1986) describe that the prosodic word maybe of the same length or sometimes smaller than a syntactic terminal node, depending on language-particular definitions of the prosodic word domain. In Turkish and Sanskrit, the domain of prosodic word is reported to be smaller than a syntactic terminal node (Vigario, 2002). Other languages define the domain of prosodic words according to their phonological properties. Section 3.1 will argue that the minimum disyllabic PrWd domain in Boro may sometimes surface as smaller than a morphological word. Although at the level of PrWd lexical tones of both the stem and suffix can alter following the principle of PrWd formation, these tones undergo further modification when they surface at the level of phrase. Chapter 3 mainly focuses on this aspect of Boro tonal phonology.

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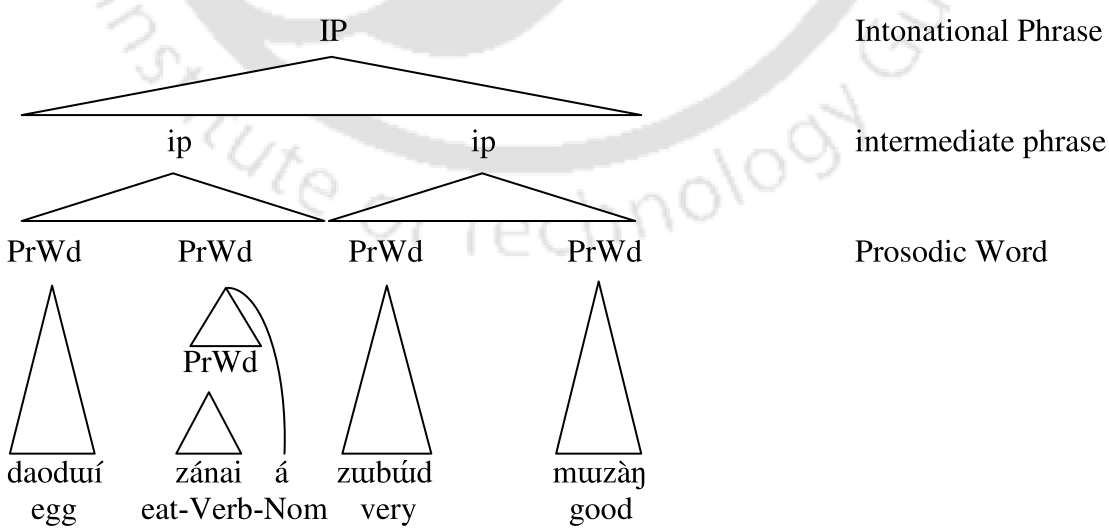
Chapter 3

Intonational Phonology of Boro

3.0 Introduction

The pitch contour of an utterance in a tone language can surface with both tonal and intonational f_0 features. Chapter 1 has already presented an outline of the studies which have focused on these two aspects of f_0 feature of utterances in tone languages. This chapter, taking cues from the f_0 trajectory of Boro sentences, provides further evidence to show that *languages use intonation inspite of having lexically distinctive tones*. Specially, the way tones in Boro behave when they occur at post-lexical stage will be investigated. The analysis presented here shows how *downstep and declination (see section 1.3) in Boro generate additional targets for the two lexical tones in the language*. The chapter also presents a detailed account of the way *context determines the surface f_0 pattern of the right aligned lexical tones in PrWd domains*. It is shown that *utterances in Boro can be grouped into prosodic units based on f_0 trends*. Three levels of prosodic units are identified in the form of PrWd, intermediate phrase (ip) and Intonational Phrase (IP). Figure 3.1 explains their hierarchical relationship.



To eat egg is very good.

Figure 3.1**: Hierarchical organization of the prosodic units in Boro**

The highest node in the hierarchy of the prosodic units in Boro is IP, which corresponds to a sentence. *The next node below IP is that of the ip.* An ip is motivated mainly by the intonational features of some of the sentences in Boro[9]. The phonology of PrWd formation, which constitutes the lowest level of prosodic unit, is elucidated in section 3.1. The tradition of intonational phonology developed by studies like Pierrehumbert (1980), Beckman and Pierrehumbert (1986), Pierrehumbert and Beckman (1988) is followed in this study also. Following the AM model of intonational phonology (see section 1.3) *this chapter shows how initial boundary tone, downstepping and phrasing constitute the post-lexical component of a tone language like Boro*. Section 3.2 presents a brief note on word stress in Boro. Section 3.3 describes the methodology adopted for the experiment and the kind of speech material considered in this chapter. Section 3.4 highlights the way lexical tones surface at the IP initial, medial and final positions. Section 3.5 describes the basic intonation patterns in Boro and shows how *downstepping and declination influence the lexical tones at the IP level*. Section 3.6 shows how *the left edge boundary tone influences initial lexical tones in IPs*. Section 3.7 presents a phonological account of intonation in Boro based on the nature of prosodic phrasing allowed in this tone language. Section 3.8 summarizes the findings.

3.1 Prosodic Word (PrWd) Formation

Pitch contours of the stems and inflected/derived forms listed in the data set presented in chapter 2 show that *Boro tones undergo tone shift, tone spreading and tone deletion* while they interact with word formation processes. *This section shows how distribution of lexical tones in Boro respects a minimum disyllabic PrWd domain*. It has been noticed that the lexical tone can shift from the initial position to the second syllable to align to the right edge of a derived word. But the lexical tone cannot shift from the second syllable to the next one irrespective of the word

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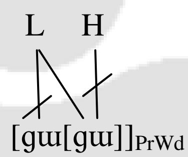
[9] Boro, with IP, ip and PrWd as part of its prosodic hierarchy, presents a unique case so far as the description of the intonational phonology of a tone language is concerned. Althought these three constituents form part of the intonational models of non-tonal languages, very often the phonological phrase (p-phrase) constitutes the next level of prosodic unit below ip as in Beckman and Pierrehumbert (1986). Sometimes an accentual phrase is identified as a prosodic domain below ip as in Japanese (Beckman and Pierrehumber, 1986) and French (Jun and Fougeron, 2000). The initial view of prosodic hierarchy (Selkirk 1978; Nespor and Vogel 1986) did not propose ip as one of the constituent units. It was mooted by the revised theory of Beckman and Pierrehumbert (1986). Although the size of ip as a constituent can be compared with that of p-phrase (Gussenhoven, 2004), it is an unsettled issue whether the ip and the p-phrase are the same thing (Hayes and Lahiri, 1991). A p-phrase is characterized by the presence of one or more pitch accents followed by a boundary tone (Hayes and Lahiri, 1991). An ip is marked by a boundary tone (Beckman and Pierrehumbert 1986) and it often functions as domains for phonological processes such as downstepping. This difference provided the theoretical impetus for proposing an ip domain in Boro in this dissertation.

having a disyllabic stem + suffix or a monosyllabic stem + suffix + suffix shape. The rightmost element in these kind of trisyllabic derived words get tonal association through tone spreading from the second syllable. This shows that the tonal phonology of Boro marks *the initial two syllables of a polysyllabic word* or *the whole of a disyllabic word as a phonological unit* and the *right edge of this unit should be obligatorily associated with a lexical tone*. It is also noticed from examples such as dɯià 'water-Nom' in Figure 2.4 that *derived disyllabic words can surface with only one tone*. This causes the deletion of the tone of the suffix and the tone of the stem shifts to the right edge. This kind of distribution of tone in Boro in relation to word formation processes can be explained by proposing *a prosodic domain* for the phenomena of tone shift, tone spreading and tone deletion. In addition to this, a further feature of *minimality condition can be invoked to explain why the disyllabic word frame has to be obligatorily associated with a lexical tone on its right edge*. The prosodic domain relevant here is that of the PrWd. This has been defined by many studies as the domain for the interaction between word formation and various phonological processes like stress shift, vowel mutation, consonant devoicing etc[10]. The interaction between lexical tone and morphological processes in Boro can be explained by proposing that the domain of PrWd in Boro controls the surface alignment of the underlying tonal specifications. Sarmah (2004) has already proposed such a domain for the occurrence of lexical tones in Boro in the post-affixation stages. The investigation by Sarmah (2004) proposed that the causative suffix –hɯ in Boro, having its own lexical specification, forms its own PrWd domain. The study also mentions that the plural suffix –mɯn allows tone copying within the domain of PrWd in Boro. Results presented in chapter 2 throw more light on the occurrence of lexical tones within the domain of PrWd in Boro and this can be taken as the starting point to propose the following few aspects of tonal phonology of Boro:

Prefixes in Boro, although they may have inherent tonal specification, do not form PrWd on their own. They become part of a PrWd consisting of the prefix and stem sequence. Lexical tones

[10] The PrWd is related to, but not necessarily isomorphic to, morphological word (McCarthy and Prince 1993a, 1993b; van der Hulst 1999). Wheeldon and Lahiri (2002) describe the PrWd as the minimal unit of phonological encoding. The domain of the PrWd in Serbian is diagnosed by the presence of pitch accent prominence (Zec, 2002) and it has been explained in terms of assigning primary stress in Greek (Nespor 1999; van der Hulst 1999). The motivation for PrWd as a phonological domain in SiSwati comes from long distance high tone shift. The rightmost high tone is SiSwati, as in other Nguni Bantu languages like Zulu, Xhosa and Ndebele generally, surfaces on the antepenultimate syllable of the word (Hall and Kleinhenz, 1999). Zsiga (1992) describes how the domain of a PrWd in Igbo is not coextensive with the syntactic word. This study explains how the two phonological phenomenon of ATR vowel harmony and vowel assimilation can only be explained in terms of the prosodic structure which can be described as PrWd.

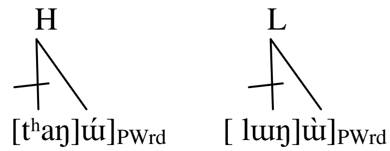
in such a PrWd has to fulfill the right alignment condition. This forces the *tone of the prefix to move to the right edge of the PrWd domain.* Since Boro does not allow the occurrence of contour tones, boundary alignment of the lexical tone within the PrWd domain results in (a) deletion of the lexical specification of the stem and (b) the tone of the prefix aligning to the right edge. Both *adjective forming and causative verb forming prefixes in Boro follow this*. This becomes evident in the process of derivation of **gɯgɯ̀** 'pure' from the verb **gɯ́** 'become pure'. The stem of this derived adjective is specified with high tone. But *after prefixation the specification of the stem changes to low*. This can be explained by assuming that the prefix gɯ̀- is underlying specified with low tone, and it combines with the stem into the same PrWd. In such a situation the right alignment requirement makes the underlying tone of the prefix move to the right. This alters the tonal specification of the stem gɯ́ 'become pure' to low. This process can be explained by the following association algorithm:



As the adjectival prefix in gɯgɯ̀ 'pure' becomes part of the same PrWd as the stem is, the lexical L of the prefix ultimately surfaces on the base, which is right aligned. There have been languages in which prefixes form their own PrWd[11]. The pattern of lexical tone distribution in Boro makes prefixes integral part of the PrWd of the stem. This case presents an instance where the PrWd in Boro matches with the morphosyntactic word. Boro reveals other possibilities discussed below which show that PrWds can also be smaller than morphosyntactic words.

Suffixes in Boro without tonal specification do not form their own PrWd. Rather they get attached to the PrWd of the stem. In such a situation they surface with lexical tone of the stem. The pitch contours presented in Figure 2.2 for the present habitual forms of verbs provide acoustic evidence for this. It is seen that in **tʰaŋɯ́** 'go-Prsnt-Hab' *the high tone on the suffix has shifted from the stem* and in **lɯŋɯ̀** 'drink-Prsnt-Hab' *the low tone has shifted to the suffix from the verb stem*. The association algorithm below explains the process of tone shift in tʰaŋɯ́ 'go-Prsnt-Hab' and lɯŋɯ̀ 'drink-Prsnt-Hab'.

[11] Inkelas (2014) reports that the highly prefixing Athapaskan verb is parsed into more than one PrWd. In Tahltan, for example, Alderete and Bob (2005) propose that verb stem forms a PrWd and the preceding span of prefixes another.



Disyllabic stems followed by toneless suffixes present a slightly different picture. Instances of tone distribution within a disyllabic stem + suffix domain show that the *PrWd domain in Boro is minimally disyllabic*. It is observed that the *f_0 signal for the tone does not shift from the stem to the suffix, when a toneless suffix is added to a disyllabic stem*. Figure 2.15 has shown this. Sarmah (2004) describes this phenomenon as an instance of tone copying. But evidence from other such disyllabic stems plus toneless suffixes in this investigation has revealed that *shifting of tone to the suffix or the tone spreading to the suffix crucially depends on the length of the stem*. This does not surface prominently in the case of low tone stems due to the low f_0 range of this tone and toneless syllables. But high tone spreading to a toneless suffix following a disyllabic stem has been observed for several stems and suffixes examined in this investigation. The correspondence between syllable length and prosodic word domain has been discussed in relation to other languages too[12]. Examination of disyllabic stem plus toneless suffixes in Boro also suggests that the *disyllabic stems, whether derived or non-derived, form a PrWd domain and the lexical tone is associated to the right edge of this domain. Due to this phonological necessity the tone does not shift further to the next syllable* in the way the tone shifts from the stem daó 'bird' to the suffix in Figure 2.4. The *addition of a suffix to the disyllabic PrWd domain constitutes the next level of PrWd and the lexical tone spreads to align to the right edge of this larger PrWd domain*. The disyllabic PrWd domain allows disyllabic stems to preserve their lexical tone even when a toneless suffix is added to them. The tone then spreads rightward in the next level of PrWd construction. In other words, *the PrWd structure in Boro is applied recursively* as has been defined by Peperkamp (1997). Thus, in the final derived form, the lexical tone surfaces both in the stem and in the suffix. The association algorithm for a suffixed form like hat^{h}aíaó 'market-Loc' is presented below:

[12] Zec (2002) observes that PrWd status in Serbian is diagnosed by pitch accent prominence and disyllabic function words are matched with PrWds, but those corresponding to a single syllable are not. Lehiste (2004) argues that in Serbo-croatian, Swedish and Estonian, contrastive tone requires for its manifestation a sequence of two syllables. Trommer (2008) reports that disyllabic adpositions in Hungarian form Phonological Words on their own.

H

[hat^{h}aí]$_{PrWd}$ aó]$_{PrWd}$

In instances *when tone bearing suffixes are added to disyllabic stems, they form recursive PrWd domains*. They can surface with their lexical tone when they constitute the recursive PrWd domain. The same suffixes become part of the minimal disyllabic PrWd domains when added to monosyllabic stems. In this situation they are not allowed to surface with their lexical specification. Figure 2.9 and Figure 2.10 have already presented the pitch contours of the genitive case marker '-ni' occurring with the monosyllabic stem àŋ 'I' and the disyllabic stem bɯrmà 'goat'. When the genitive marker occurs with the monosyllabic stem, it forms part of the minimal disyllabic PrWd domain. Since only one lexical tone can surface within this domain and this tone is aligned to the right edge, the lexical specification of the stem shifts to align to the suffix. Thus aŋnì 'I-Gen' surfaces with a low tone aligned to its right edge. In bɯrmà-ní 'goat-Gen' the suffix occurs outside the minimal disyllabic PrWd domain and forms part of the recursive PrWd domain. The low tone of the stem noun bɯrmà 'goat' does not spread to the right edge of the recursive PrWd domain since the high lexical specification of the genitive suffix aligns to the right edge of this recursive PrWd domain. The association algorithm for aŋnì 'I-Gen' and bɯrmà-ní 'goat-Gen' presented below explains how both the minimal PrWd and the recursive PrWd domains in Boro are marked with a lexical tone occurring on its right edge.

L   L   H

[[aŋ] nì]$_{PrWd}$ [[bɯrmà]$_{PrWd}$ ní]$_{PrWd}$

The causative suffix -hɯ̀ stands out as the *only tone bearing suffix in Boro which does not adhere to the pattern of tonal alignment described above.* Affixes forming different categories depending on their ability to form PrWd have been already described in the study of languages. The study by Booij (1984) highlights a similar distinction among affixes in Dutch. Booij (1984) describes the PrWd forming affixes as non-cohering and the affixes which cannot form PrWd are described as cohering affixes. Affixes in Boro having their tonal specification can also be distinguished based on their ability to form a PrWd. It is already described that prefixes with underlying specification cannot form PrWd in Boro. Suffixes with lexical tone can sometimes form a recursive PrWd domain with the stem. Only the causative suffix '-hɯ̀' shows the special property of preserving its lexical tone even when it forms part of the minimal disyllabic PrWd domain. Thus **gíhɯ̀** ‘to make frightened’ surfaces with the tones of the monosyllabic stem gí ‘fear’ and that of the suffix ‘-hɯ̀’. Sarmah (2004) proposed that the *causative suffix* ‘-hɯ̀’ *in Boro forms its own PrWd*. Examination of pitch contours of words involving this suffix presented in Figure 2.17 and 2.18 also reveals that the causative suffix ‘-hɯ̀’ forms a unit of its own type as far as tonal alignment is concerned. We propose that the suffix is marked as a PrWd in the lexicon itself, similar to the description of some Dutch suffixes by Nespor and Vogel (1986). It is because of this PrWd specification of the causative suffix it preserves its lexical tone even when it follows a monosyllabic stem. The association algorithm for the causative verb gíhɯ̀ ‘to make frightened’ is presented below:

$$\begin{array}{cc} \text{H} & \text{L} \\ | & | \\ [[\text{gí}] & [\text{hɯ̀}]_{\text{PrWd}}]_{\text{PrWd}} \end{array}$$

The discussion presented above shows that tones in Boro surface right aligned to PrWd domains. This section has foregrounded the following important aspects of the PrWd formation in Boro:

- The PrWd domain in Boro is minimally disyllabic and lexical tones surface right aligned to this domain.
- Recursive PrWd domain is formed when a third syllable is added to the minimal PrWd domain.
- Tones align to the right edge of minimal PrWd domain as a result of tone shift from the left edge.
- Tones can also align to the right edge of minimal PrWd domain following a joint effort by both tone shift and tone deletion.
- Tones align to the right edge of recursive PrWd domain either as a result of tone spreading from the second syllable or as a result of a tone bearing suffix forming the recursive PrWd domain.

3.2 Stress in Boro

Distribution of stress and its correlation to metrical foot structure may also be the motivational factors for PrWd formation (Hyman, 2006). For this, it was obligatory on the part of this investigation to examine whether stress plays some role in PrWd formation in Boro. A set of sixteen non-derived disyllabic words were looked at for this. Six among them contained the same vowel in both the syllables as in dabá 'knife', gibì 'earlier', lamà 'road', minì 'smile'. Another set of three words consisted of non-identical vowels in both the syllables as in bibù 'stomach', sesà 'hare' and $k^hok^há$ 'fishing device'. Rest of the words consisted of non-identical vowels and also different onset consonants in the two syllables as in dugà 'pride' and hazɯ̀ 'hill'. Five iterations of each of these words from five speakers formed the data series. Duration and intensity were calculated separately for the two syllables and the vowels in the target words. *Results did not reveal any consistent difference between the first and the second syllable in terms of duration or intensity*. It is known that tonal languages can sometimes use stress to mark prominence (Pankratz and Pike 1967; Bickmore 1995; de Lacy 2002). Stress is often assigned based on the correlation between prominence and metrical foot structure of a particular language (Selkirk, 1996). It is assigned to the first or the second one of the metrical units known as feet. In Boro, as discussed in 3.1, lexical tone obligatorily shifts to the right edge of a disyllabic domain. This tends to make it appear that the second syllable is specified for stress and for this the tone aligns to it. This hypothesis is obscured by the absence of any durational or intensity difference in the second syllable. Since the most obvious features of a stressed syllable in a tone language are length and intensity (Kidder, 2008), we don't have enough phonetic evidence in this line to suggest that there exists stress in Boro. It is for this reason we assume that *foot as a prosodic constituent cannot be motivated* for the prosodic hierarchy in Boro. In this context, distribution of lexical tones in disyllabic domains provides important information regarding PrWd formation in the language. Since *stress is negligible in Boro, PrWds rely on the contrastive pitch function of tone*.

3.3 Methodology

The study presented in this chapter is based on data collected from *4 male speakers* of Boro. The data set consisted of *140 scripted* sentences which included neutral statements, alternative questions and statements expressing narrow focus by the process of ex-situ focus marking allowed in Boro. The sentences differed from each other in a sequence of lexical tones as well as in length. Each of the participants produced 7 renditions of each of the sentences with sufficient amount of pause in between. The first and the last iterations were not taken into account. In this way a total number of *2800* (140 sentence x 4 speakers x 5 recordings) recorded sentences constituted the data series for this experiment.

3.3.1 Speech Material

The first set of data has examined how a sequence of similar tones surfaces in Boro. A number of sentences in this set of data consisted of a sequence of only high tones or low tones. A sequence of either three lexical tones or four lexical tones featured in these sentences. Within this group, 6 sentences consisted of only three lexical tones (3 each for low and high tones) aligned to the right edges of PrWds. The other 8 sentences, within this group, consisted of four lexical tones (4 each for low and high tones) aligned to the right edges of PrWds. (1) presents an example of a sequence of identical tones.

(1) Sequence of identical tones

bikʰunzɯ́-á daodɯí zá-dɯŋ-mɯn
mother-in-law-Nom egg eat-Prf-Pst
Mother-in-law bought egg.

The second set of data has looked at tone contrast in sentence initial, medial and final positions. The corpus for this data set included 40 sentences consisting of 20 pairs of related (near homophonous) constructions. These pairs of sentences differed from each other in only a high tone word occurring in place of a low tone word or vice versa. This is shown in (2). The substituted words with contrastive tones consisted of same number of syllables. In (2a) daodɯí 'egg' is substituted by bedòr 'meat' with the rest of the sentence remaining the same. In the other two examples, in (2b) zákʰor 'gluttonous' is substituted by lɯ̀ŋkʰor 'drukard' (sentence medial position) and in (2c) tʰáŋgɯn 'go-Fut' is replaced by pʰɯ̀igɯn 'come-Fut' (sentence final position). For each example, a phonetic notation is given followed by a morphological gloss and a translation.

(2) Tone contrast in sentence initial, medial and final positions

(a) daodɯí baìnaiá zɯbɯ́d mɯzàŋ
egg buy-Verb-Nom very good
To buy egg is very good.

bedòr baìnaiá zɯbɯ́d mɯzàŋ
meat buy-Verb-Nom very good
To buy meat is very good.

(b) bí-ɯ zákʰor zàbai
He-Nom gluttonous be-Prf
He has become gluttonous

bí-ɯ lɯ̀ŋkʰor zàbai
he-Nom drunkard be-Prf
He has become drunkard.

(c) bí-ɯ tʰáŋgɯn | bí-ɯ pʰɯìgɯn
He-Nom go-Fut | he-Nom come-Fut
He will go | He will come.

One of the objectives of this experiment was to examine whether the pitch contours of words change depending on their occurrence in phrase initial, medial and final positions. Sentences examining this constituted the third set of data. The final occurrence of the words was looked at placing them in alternative questions. This is because Boro follows Subject + Object + Verb word order and the final sentential slot is often occupied by the verb along with its inflections. Only alternative questions in Boro provide the context of the final occurrence of a non-verbal element. The pitch contour of the initial occurrence of the words daodɯí 'egg' and bedòr 'meat' in (2a) was compared with the medial and final occurrences of them in (3).

(3) Tone and sentential contexts

(a) bikʰunzɯ́-á daodɯí baì-dɯŋ-mɯn
mother-in-law-Nom egg buy-Prf-Pst
Mother-in-law bought egg.

bikʰunzɯ́-á bedòr baì-dɯŋ-mɯn
mother-in-law-Nom meat buy-Prf-Pst
Mother-in-law bought meat.

(b) nɯ́ŋ má baìgɯn, bedòr na daodɯí?
You what buy-Fut, meat or egg?
What will you buy? meat or egg?

nɯ́ŋ má baìgɯn, daodɯí na bedòr ?
You what buy-Fut, egg or meat?
What will you buy? egg or meat?

The fourth data set consisted of a series of 40 sentences with the same lexical items or sequence of lexical items occurring in sentence initial and medial positions. The objective for evaluating the pitch contours of such sentences was to examine how the same sequence of lexical tones in Boro surfaces depending on their sentential contexts. In the sentences in (4) the sequence of LH tones aligned to gizì zí 'torn clothes' occurs sentence initially and medially. Other combinations of lexical tones which formed part of such pairs of sentences are HL (e.g. nɯ́ŋnao zɯ̀o 'my ricebeer'), LL (e.g. àŋnao zɯ̀o 'my ricebeer') and HH (e.g. nɯ́ŋnao bɔ́n 'your firewood').

(4) Sequence of tones and sentential contexts

gizì zí gànnɯ nàŋa
torn cloth wear-Prsnt Neg
Don't wear torn cloth

bí-ɯ dinɯì gizì zí gàndɯŋ
he-Nom today torn cloth wear-Prf
He has worn torn cloth today.

The fifth set of data included sentences with embedded clauses and longer phrases in subject or object positions. Constituents of such varying lengths were used to investigate the nature of phrasing in Boro. This set of data consisted of 26 sentences. The last set of sentences in the data series presented instances of sentence internal constituents pre-posed to sentence initial position. Boro allows this kind of construction for ex-situ focus marking. The sentences in (5) present some of the instances of this.

(5) Tone and ex-situ focus marking

(a) bí-ɯ daodɯí baì-dɯŋ-mɯn
he-Nom egg buy-Pst-Prf
He bought egg

(b) daodɯí-kʰoú bí-ɯ baì-dɯŋ-mɯn
egg-Acc he-Nom buy-Pst-Prf
It is egg, he bought.

(c) bí-ɯ bibarí-nɯ tʰaizoú hɔ́r-dɯŋ
he-Nom Bibari-Dat mango give-Prf
He has given mango to Bibari.

(d) tʰaizoú-kʰoú bí-ɯ bibarí-nɯ hɔ́r-dɯ́ŋ
mango-Acc he-Nom Bibari-Dat give-Prf
It is mango, he has given to Bibari.

The experiment deliberately avoided conversational speech for a number of reasons including empirical shortcomings that might arise in the event that the test items of the required type are not obtained. The latter reason becomes clear when one takes into account the fact that sentences consisting of words with both lexical high and low tones cannot be built into the same conversation as these lexical items would mean different things. Another reason for avoiding conversational speech is to allow the participants enough time to produce the required intonational type. For these reasons this experiment opted for the elicitation method.

3.3.2 Participants and Recording

Four of the subjects who participated in the experiment in chapter 1 participated in this investigation as well. Each subject first sat with the experimenter and read the randomized list of scripted sentences to himself. After the subject was familiarized with the sentences, he read them individually into a unidirectional head worn microphone connected with Edirol Roland R-09HR via xlr jack. The recordings were digitized at a sampling frequency of 44.1 kHz and 32 bit resolution. The subject was allowed to re-record a sentence if he felt that it did not covey the intended meaning.

3.3.3 Data Analysis

The analysis of the recorded sentences was done following the same process as mentioned in 2.1.3. Individual sound files of the sentences were segmented into the syllable level and Praat TextGrid files were created. The segmented files were processed with a Praat Script [ProsodyPro] (Xu, 2013) for obtaining measurements of f_0 and duration. The averaged normalized f_0 values of all the iterations of each sentence (4 speaker x 5 iterations = 20) were plotted as line graph. Statistical tests were done in SPSS for evaluating whether the nature of difference in f_0 is statistically significant or not.

3.4 Results: Sentential position and lexical tones

An important aspect of tones surfacing in tone languages is the way context influences their f_0 trend. Tones produced in isolation can display pitch trends different from the way they are actually realized while occurring in the contexts of other tones. This section, based on examination of pitch contours of sentences like the ones mentioned in (2), shows that *tones in Boro preserve their lexical specifications only when they occur medially in IPs*. It has been found that the final occurrences of the lexical items result in modification of their f_0 trends by boundary tones. Chapter 4 enumerates in detail the interaction processes between the two lexical tones of Boro and the boundary tones occurring at the right edge of IPs. This section highlights the differences in the f_0 contours of lexical tones depending on their context of occurrence.

Figure 3.2 presents the time normalized pitch contours aggregated for 20 tokens (4 speakers x 5 repetitions) for a homophonous and ambiguous sentence. The only difference between the two sentences is the tone of the verb **baí** 'break' as opposed to that of **baì** 'buy'. In both the sentences the verbs are inflected with a verbal suffix –nai and a nominal case marker –á. High tones in Boro surface with a rising contour and low tones with a falling contour or low level contour (see Figure 1.1). It can be seen in Figure 3.2 that baí 'break' surfaces with a rising contour and the pitch continues to rise till the end of the nominative marker –á.

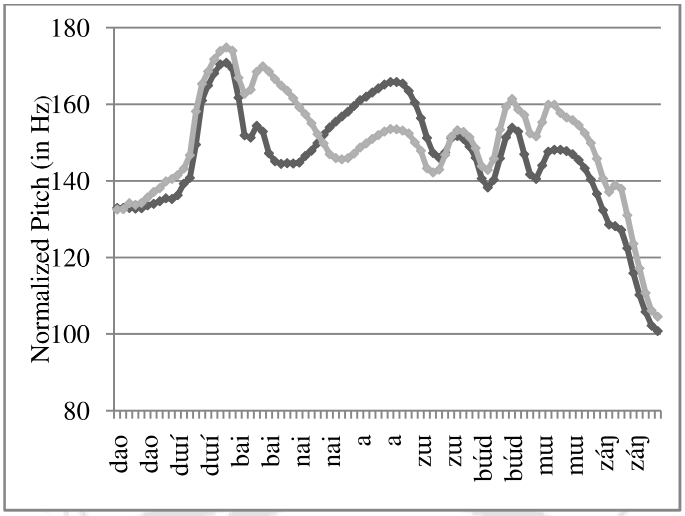


Figure 3.2: **Tone contrast in IP medial position.** Averaged normalized pitch contour of the following homophonous sentences (n=20)

daodɯí baínaiá zɯbɯ́d mɯzàŋ (dark line)	daodɯí baìnaiá zɯbɯ́d mɯzàŋ
egg break-Verb-Nom very good	egg buy-Verb-Nom very good
For egg to break is very good.	To buy egg is very good

The pitch trend for the inflected form of baì 'buy' shows a falling contour upto the verbal suffix –nai which surfaces with the lexical tones of the stems in both the sentences. This is because –nai forms part of the minimum disyllabic PrWd domain discussed in 3.1. The nominative suffix –á preserves its lexical specification even when it is preceded by a low tone aligned to –nai in baìnaiá 'buy-Verb-Nom'. The contrast between the pitch contours for **baínaiá** 'breaking' as opposed to that of **baìnaiá** 'buying' shows that *lexical tones in Boro preserve their lexical f_0 trends while occurring sentence medially.*

Contextual influence on lexical tone has been described in studies on Mandarin Chinese (Xu, 1997), Thai (Gandour et al, 1994) Yoruba (Laniran & Clements, 2003) and Cantonese (Wong, 2006). This section compares the surface realizations of the tones in Boro in IP initial, medial and final contexts. Results presented would show that *Boro words surface with pitch contours depending on the position they occupy in an IP*. Pitch contours of words with high tone and low tone show that both the height of the tone and the shape of the pitch fall or rise vary depending on its position in the IP. This can be seen in Figure 3.3.

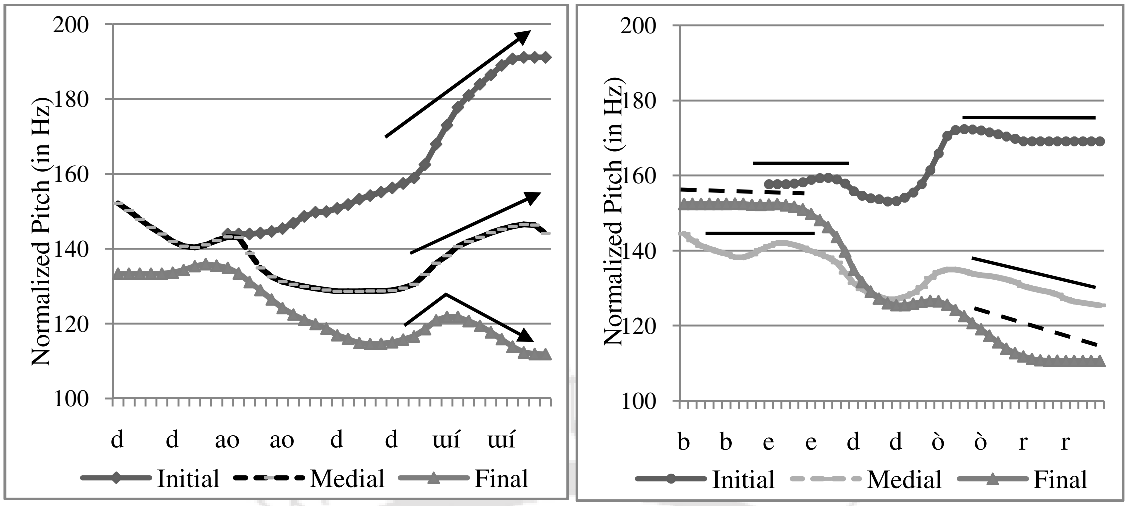


Figure 3.3: **Lexical tones in IP initial, medial and final contexts.** Averaged time normalized pitch contours of daodɯí 'egg' (left panel) and of bedòr 'meat' (right panel). The three contours in both the panels represent three IP contexts (n =20).

It can be seen in Figure 3.3 that *the pitch rise for the high tone on the second syllable of* daodɯí *'egg' is scaled lower when it occurs in IP final position*. The pitch contour surfaces only with a retracted peak compared to the scaling of the f_0 peaks for the other two occurrences of the word. The panel on the right of Figure 3.3 is quite important especially for the occurrence of lexical low tone in IP initial position. The initial occurrence of bedòr 'meat' can be compared with its medial and final occurrences as far as the shape of the pitch contour is concerned. The medial and final occurrences of bedòr 'meat' surface with a falling contour which is characteristic of Boro low tones occurring in isolation. The initial occurrence of the word results in a significant change of the pitch contour and the second syllable of bedòr 'meat' is scaled higher than the first syllable. The mean f_0 of the vowel of first syllable (158.49 hz, n=20) is lower than that of the second syllable (171.22 hz, n=20) of the phrasal initial occurrence of bedòr 'meat'. This shows that the IP initial low tone surfaces with a rising contour. Section 3.6 relates the scaling difference between the two syllables of the IP initial occurrence of bedòr 'meat' to an intonational left edge boundary tone. Acoustic evidence presented in this section reveals the following intonational aspects of pitch contours of Boro sentences:

- Tones preserve their lexical specifications only when they occur medially in IPs.
- IP initial L tones surface with a rising f_0 trend.
- IP final H tones surface with a retracted peak scaled lower than the pitch height for IP initial and medial occurrences of it.

3.5 Basic Intonation Patterns in Boro

Section 3.4 has shown that Boro lexical tones preserve their lexical specification at the IP level, except for low tone occurring initially and for high tone occurring IP finally. This necessitates a thorough look at the pitch contours of Boro words occurring at the left and right edges of IPs. Chapter 4 will discuss how surface pitch contours of lexical tones undergo modification in Boro when they occur at the right edges of IPs. Section 3.6 throws more light on lexical tones occurring on the left edge of IPs. This section discusses the way sequence of lexical tones surface in Boro IPs. The experiment in this chapter has compared the intonation patterns of sentences having various combinations of tones. It is found that *IPs in Boro surface with both downstepped tonal levels and with tonal targets undergoing declination*. This is discussed in the following sections.

3.5.1 Downstep in Boro

Section 1.3 has already presented an elaborate account of the way downstepping leads to intonational modification of tones. The intonation patterns in Boro IPs show that the language follows both the processes of downstepping and declination (as discussed in section 1.3) of f_0 targets for tones. In *sentences consisting of a sequence of high tones, each of the non-initial high targets is realized lower than the previous ones*. Figure 3.4 presents the time normalized pitch contour of the sentence núŋ-ni daodɯí-á haí-jao gɯlɯí-bai 'your egg has tumbled down'.

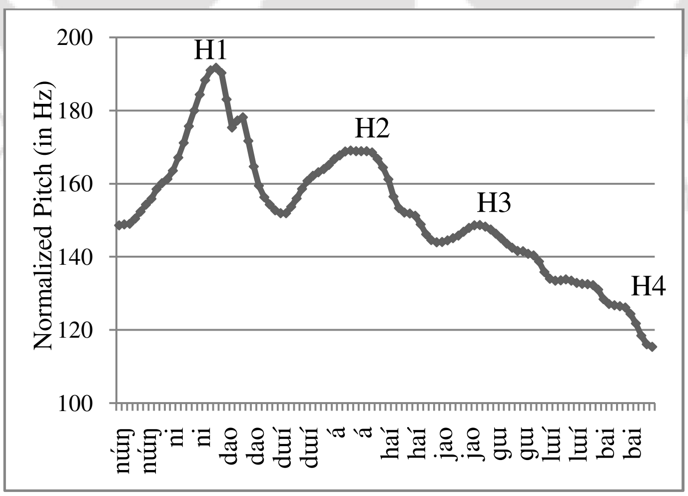


Figure 3.4: **Downstepping of non-initial H tones.** Time normalized pitch contour of an all H tone sentence núŋ-ni daodɯí-á haí-jao gɯlɯí-bai 'your egg has tumbled down' (n = 20).

The pitch contour presented in Figure 3.4 provides evidence for two interesting prosodic facts of Boro. The first one is that the second high tone (H2) surfaces lower than the first one (H1). Mean f_0 of H1 (181.85 hz) is higher than that of H2 (167.67 hz). The third H tone (H3) surfaces lower (146.83 hz) than that of H2. No low tone intervenes between the sequences of H tones in Figure 3.4, for the reason that in Boro polysyllabic words lexical tones do not align to the first syllable. The rising pitch contours for all the three non-final high tones are quite obvious in Figure 3.4. A second aspect of the prosody of Boro has been revealed by the word daodɯí-á 'egg-Nom'. The process of PrWd domain formation in Boro, discussed in section 3.1, would divide daodɯí-á into two PrWds. The schema presented in (6) summarizes it.

(6) [[daodɯí]$_{\text{PrWd}}$ á]$_{\text{PrWd}}$

Although both the ultimate and penultimate syllables in daodɯí-á 'egg-Nom' surface with high tone, the second high tone still surfaces higher than the first one. This shows that *downstepping in Boro cannot affect tonal scaling within the PrWd domain.*

Pitch contours of sentences with a sequence of low and high tones also surface with the high tone scaled lower compared to its pitch height in the context of another high tone preceding it. In Figure 3.5, pitch contours of sentences with an initial LH sequence is compared to that of an initial HH sequence with the second tone bearing lexical unit being the same.

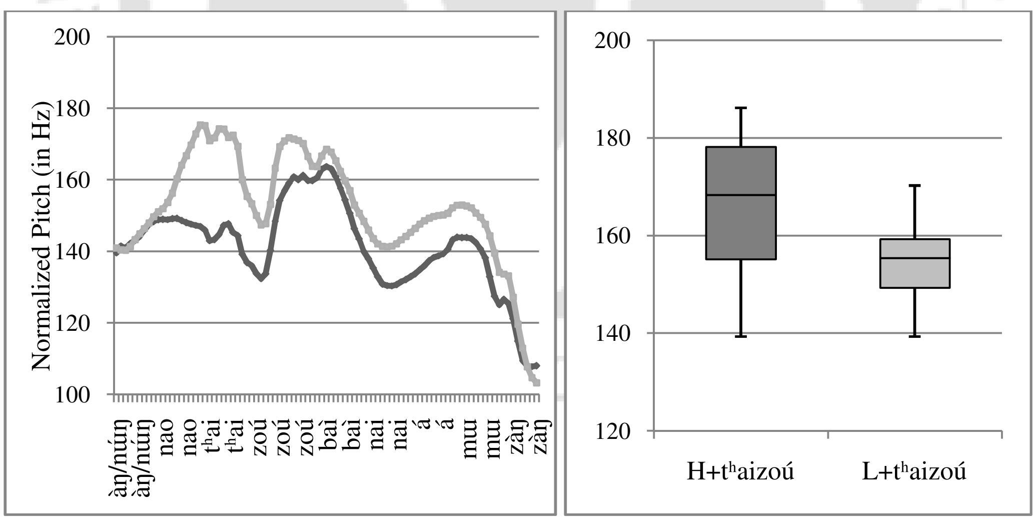


Figure 3.5: **Downstepping of H followed by L.** Averaged Normalized Pitch contour of the following near-homophonous sentences (n=20) (left panel). The panel on the right presents boxplot distribution of the Maxf_0 of the second syllable of tʰaizoú 'mango' in both these sentences. The boxplot provides information of the smallest observation, lower and upper quartile, median and largest observation for Maxf_0 for all the speakers.

nɯ́ŋ-nao tʰaizoú baì-nai-á mɯzàŋ (light line)
You-Loc mango buy-Verb-Nom good
It is good to buy mango at your place

àŋ-nao tʰaizoú baì-nai-á mɯzàŋ(dark line)
I-Loc mango buy-Verb-Nom good
It is good to buy mango at my place

Figure 3.5 compares the time normalized pitch contours of two sentences where tʰaizoú 'mango' occurs as the second constituent, and it is preceded by nɯ́ŋ-nao 'you-Poss' in one and by àŋ-nao 'I-Poss' in the other. The averaged f_0 maximum (Maxf_0) (n=20) of the second syllable of tʰaizoú 'mango' is found to be higher (163.21 hz) when it is preceded by nɯ́ŋ-nao 'you-Poss' as compared to the instance of it following àŋ-nao 'I-Poss' (155.42 hz). Two more intonational facts can be inferred from Figure 3.5. In a sentence with an LHHL sequence of lexical tones, the first peak aligns to the first H tone which is followed by a downstepped H before the pitch falls to the low boundary tone. Secondly the pitch register of the whole IP is lowered since it begins with an L tone. To understand this, the pitch contour for the HHHL sentence in the panel on the left of Figure 3.5 can be compared with that of the LHHL sentence in the same Figure.

In the study of intonation, the phenomenon of pitch drop has been often linguistically interpreted as downstep which results due to phonological or morphological influence. Pitch drop of the kind of non-initial tonal targets discussed in Figure 3.4 and 3.5 have been interpreted as non-automatic downstep and automatic downstep respectively in the study of intonational phonology (see section 1.3 for details). Although Boro H tones are scaled lower when they follow another high tone or a low tone, the investigation presented here could not relate this lowering phenomenon to any phonological or morphological factors. For lack of evidence, the lowering of high tones in Boro would be considered as only phonetic downstepping in the intonational phonology of Boro[13]. The lowering of pitch targets for high tones occurs in the following contexts:

- In a sequence of high tones, each of the non-initial high targets is realized lower than the previous ones.
- An initial L tone lowers the f_0 targets for the following H tones and this results in lowering the pitch register for the whole IP.

[13] Examination of the pitch contours and wave forms of the sentences with a sequence of H tones did not reveal any robust evidence to suggest phonological or morphological motivation for downstepping. For this, it is assumed here that downstepping is phonetic in Boro. If it is phonological then: HH > H↓H

3.5.2 L-raising in Boro

L raising results from a local carry-over effect of high tone on the following low tone (Laniran and Clements, 2003). The phenomenon of raising of L tone under the influence of H tones in the vicinity has been already attested in Thai (Gandour et al., 1994), Yoruba (Laniran and Clements, 2003) and Akan (Genzel, 2013). Visual examination of the pitch tracks of Boro sentences with initial HL tone sequence has revealed that Boro L tones are raised when they are preceded by H tones. The panel on the left of Figure 3.6 presents averaged time normalized pitch contours of two sentences differing in the initial tone.

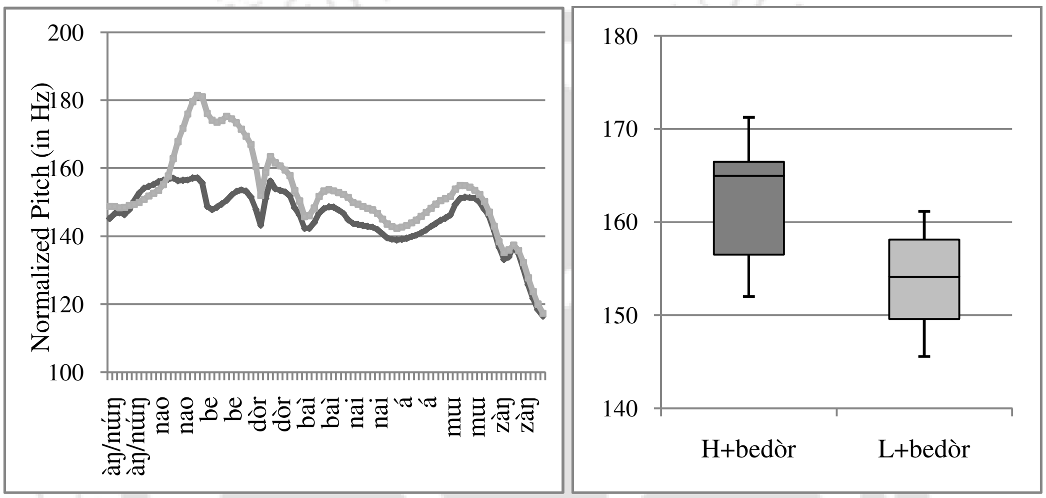


Figure 3.6: **Raising of L following H tone.** Averaged time normalized pitch contours of the following near-homophonous sentences (n=20) (left panel). The panel on the right presents boxplot distribution of the Meanf_0 of the second syllable of bedòr 'meat' in both these sentences. The boxplot provides information of the smallest observation, lower and upper quartile, median and largest observation for Meanf_0 for all the speakers.

nɯ́ŋ-nao bedòr baì-nai-á mɯzàŋ (light line)	àŋ-nao bedòr baì-nai-á mɯzàŋ (dark line)
You-Loc meat buy-Verb-Nom good	I-Loc meat buy-Verb-Nom good
It is good to buy meat at your place	It is good to buy meat at my place

The Meanf_0 of the second syllable of bedòr 'meat' (in Figure 3.6) aggregated for all the speakers (n=20) is found to be more (157.15 hz) when the word is preceded by nɯ́ŋ-nao 'you-Loc'. This can be compared to the aggregated Meanf_0 of the second syllable of bedòr 'meat' (n=20) (150.46) when the word is preceded by àŋ-nao 'I-Loc'. The pitch contours presented in Figure 3.6 also show how a sequence of LLHL tones surfaces at the IP level in Boro. It can be seen that a late high tone in Boro may surface with a lower pitch than an early L. The late H in the LLHL tone sequence is downstepped following the pattern of phonetic lowering discussed in

Section 3.5.1. *These results show that low tones in Boro undergo raising when they are preceded by H tones.*

3.5.3 Declination in Boro

It has been already shown in Figure 3.4 that all-H tone sentences in Boro result in phonetic lowering, interpreted here as phonetic downstepping, of non-initial H tones. The all-L sentences in Boro do not show similar amount of pitch drop in the non-initial tones as is the case found to be in all-H sentences. Figure 3.7 presents averaged time normalized pitch contour of a sentence with a sequence of L tones.

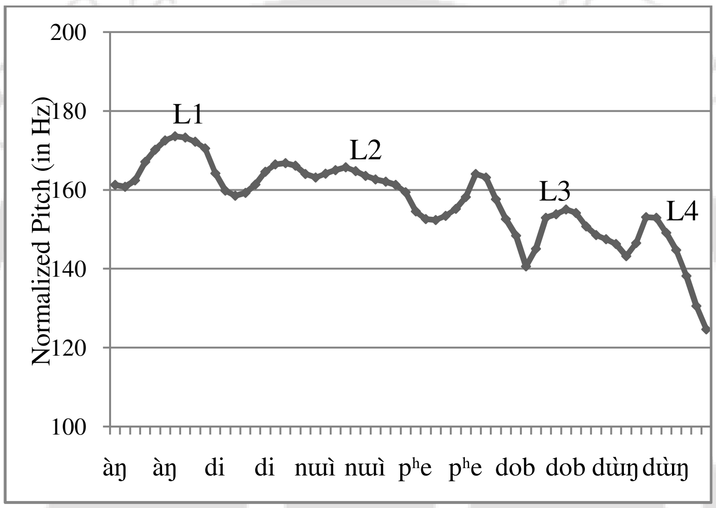


Figure 3.7: **Pitch drop in IP with LLLL tone sequence.** Averaged time normalized pitch contour of àŋ dinɯì pʰedòb dùŋ ‘I have got slightly drunk today’ (n=20).

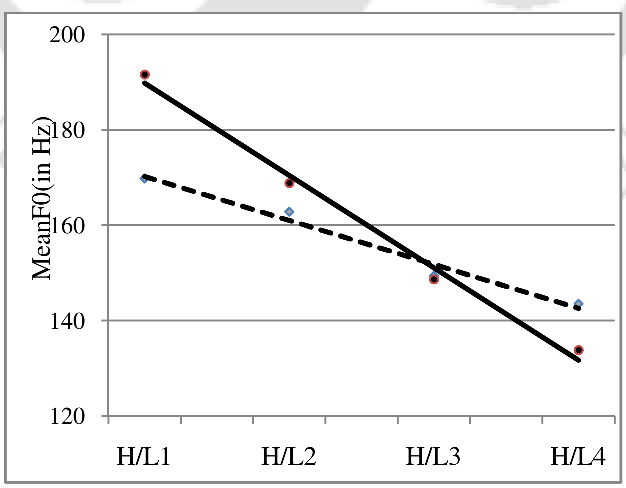


Figure 3.8: **Comparison of pitch drop in IPs with HHHH and LLLL sequence.** Pitch drop in the non-initial H tones in nɯ́ŋ-ni daodɯí-á haí-jao gɯlɯí-bai ‘your egg has tumbled down’ (Figure 3.4) and non-initial L tones in àŋ dinɯì pʰedòb dùŋ ‘I have got slightly drunk today’

(Figure 3.7). Mean of Maxf_0 for each H tone (n=20) and mean of Meanf_0 for each L tone (n=20) are shown connected by a trend line.

The lowering of the f_0 in the IP in Figure 3.7 shows that the pitch gradually drops to a low level towards the end before it finally undergoes a steep fall. Figure 3.8 presents the downward f_0 trajectory of the Maxf_0 for the H tones of the all-H sentence in Figure 3.4. This is compared with the downward slope of the Meanf_0 of the L tones of the all-L sentence in Figure 3.7.

It can be seen that for the all-H sentence, the f_0 falls from a higher peak to a lower f_0 target aligned to the final tone. The difference in f_0 fall for the all-H sentence is quite clear (the trend lines in Figure 3.8) compared to the f_0 slope for the all-L sentence. Table 3.1 compares the amount of f_0 drop for the non-initial tonal targets in both the all-H and all-L sentences. It can be seen that non-initial H tones in the all-H sentence undergo greater amount of pitch drop than non-initial L tones in the all-L sentence.

	High	Pitch Drop	Low	Pitch Drop
1	191.63		169.79	
2	168.89	22.74 (hz)	162.82	6.97 (hz)
3	148.65	20.24 (hz)	149.41	13.41(hz)
4	133.81	14.84 (hz)	143.49	5.92 (hz)

Table 3.1: **Pitch drop in HHHH and LLLL sequence.** Amount of f_0 drop in non-initial H and L tones for the trend lines presented in Figure 3.8.

It has been discussed previously that declination (see section 1.3) results in lesser amount of pitch drop and thus the lowering of pitch targets in Figure 3.7 can be interpreted as an instance of declination in Boro. Figure 3.7 presents an instance of final-lowering in Boro as the pitch contour drops to the lowest level towards the last part of the final syllable dɯ̀ŋ 'Prf'. The trend lines for downward pitch movement presented in Figure 3.8 provide evidence for two kinds of downtrends in Boro as far pitch drop is concerned. *A sequence of H tones undergoes phonetic downstepping and pitch targets for a sequence of L tones are lowered due to declination.*

3.6 Boundary modification at the left edge.

Section 3.4 has already given an account of the way the f_0 shapes of words with L tone vary when they occur in phrase initial position. *This section interprets the rising contour for IP initial L tones as a left edge boundary tone in Boro.* An instance of it can be seen in Figure 3.7, which presents the time normalized pitch contour of a sentence with àŋ 'I' occurring in IP initial position. It can be seen that the L tone word àŋ 'I' surfaces with an upward movement of the pitch followed by gradual drop of f_0 at the end of the coda consonant. The initial occurrences of the words with L tones in Boro are marked by this feature of a rise followed by a fall, although L tones in Boro manifest phonetically with falling f_0 movement in isolation. A detailed examination of the pitch contours of Boro sentences shows the robust nature of this initial contour in Boro as far as L tone is concerned. The surface realization of the lexical tones occurring at the right edge of phrases will be discussed in detail in Chapter 4.

A comparison between initial and non-initial occurrences of L tones, and between initial occurrences of H and L tones in Boro is quite important for understanding the nature of f_0 movement for IP initial tones. Figure 3.9 presents pitch tracks of IPs with H and L tones occurring in initial positions.

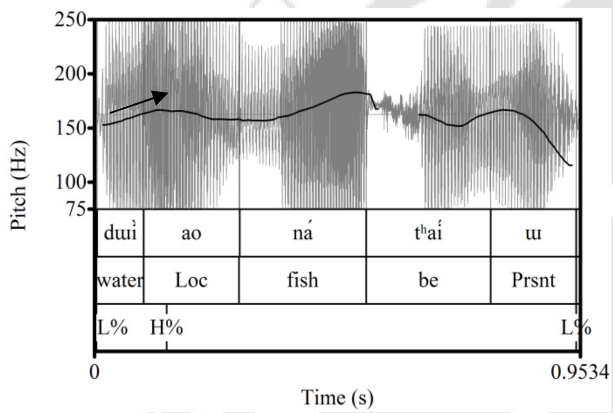


Figure 3.9: **Comparison between IP initial occurrences of L and H tones.** Pitch track of dɯì-ao ná tʰaíɯ 'Fish lives in water' in the panel on the left and of bí-ɯ nɔ́-ao tʰáŋ-ɯ 'he goes home' in the other panel.

It can be seen on the left panel of Figure 3.9 that the initial word dɯì-ao 'water-Loc' surfaces with a rise aligned to the middle of the second syllable followed by a fall to a low target at the end of the suffix. The IP initial H tone also surfaces with a rising contour. The panel on the right in Figure 3.9 presents the pitch contour of an IP with bí-ɯ 'he-Nom' occurring initially. The pitch for bí-ɯ 'he-Nom' rises to a peak aligned to the second syllable. This rise in f_0 follows the characteristic rising f_0 trend for H tone in Boro. Thus both the two contrastive lexical tones occurring IP initially in the two panels of Figure 3.9 surface with a rising pitch. But there can be seen a difference in the scaling of the high target. In the instance of bí-ɯ 'he-Nom' the f_0 reaches a higher target. The high target for the f_0 rise for dɯì-ao 'water-Loc' is scaled lower. Examination of pitch contours of other sentences in the data series with initial low tone has revealed a similar pattern of rise. It is also seen that the rise in f_0 affecting the initial L tone does not extend to the second L tone if there is one. The upper panel of Figure 3.10 presents the pitch track of an IP with a sequence of initial L tones in ɡudùŋ dɯì 'hot water'.

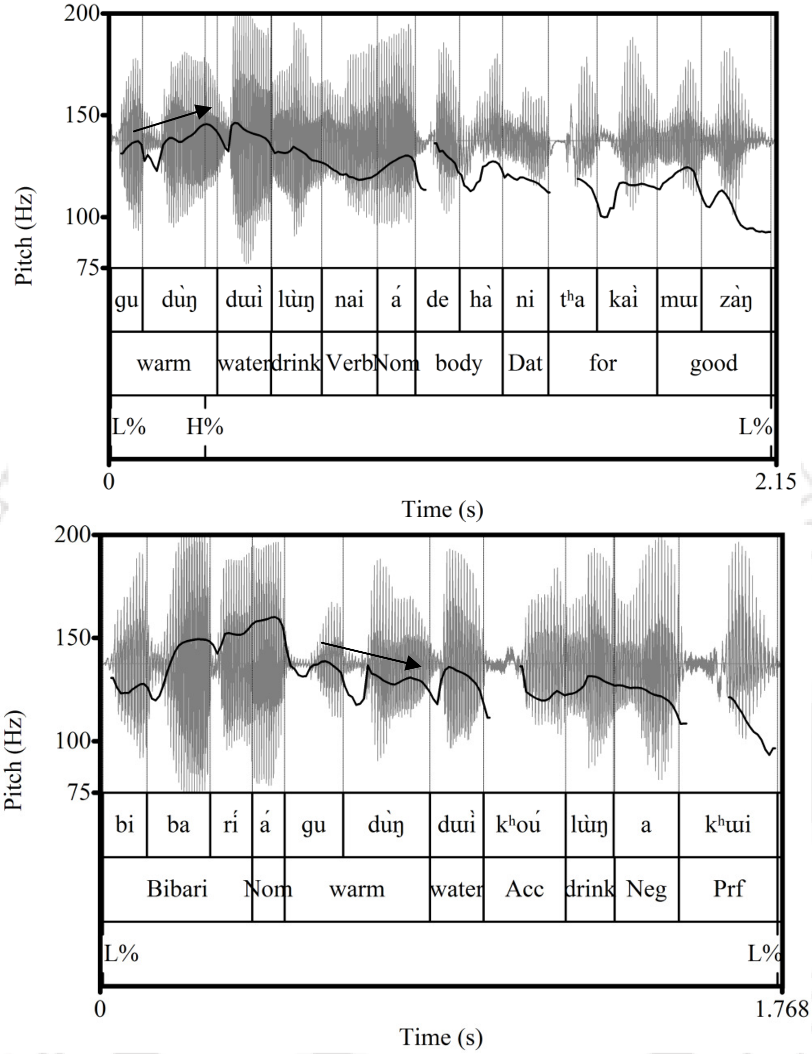


Figure 3.10: **IP initial and medial occurrence of LL tone sequence.** Pitch track of ɡudùŋ dɯì lùŋnaiá dehàní tʰakaì mɯzàŋ 'To have warm water is good for health' in the upper panel. The lower panel presents the pitch track of bibaríá ɡudùŋ dɯìkʰoú lùŋakʰɯi 'bibari does not drink warm water'. Both the pitch contours are produced by the same speaker.

It can be seen that the rise in f_0 aligns to the surface TBU in ɡudùŋ 'hot' (upper panel of Figure 3.10) and the second L tone aligned to dɯì 'water' surfaces with the characteristic falling contour for L tones. Thus, with an LL sequence of initial tones, the high target for the rising contour aligns to the first L tone. The f_0 trend of the initial sequence of LL tones in ɡudùŋ dɯì 'hot water' can be compared with that of its medial occurrence presented in the lower panel of Figure 3.10. In the medial occurrence, the sequence of LL tones surface with a continuous fall as can be seen for ɡudùŋ dɯì 'hot water' in the lower panel of Figure 3.10. This shows that irrespective of the initial constituent being monosyllabic (àŋ 'I') or disyllabic (gudùŋ 'hot') the L tone surfaces with a rising f_0 contour. In the case of a disyllabic constituent like gudùŋ 'hot', the high target for the rising f_0 trend aligns to the second syllable.

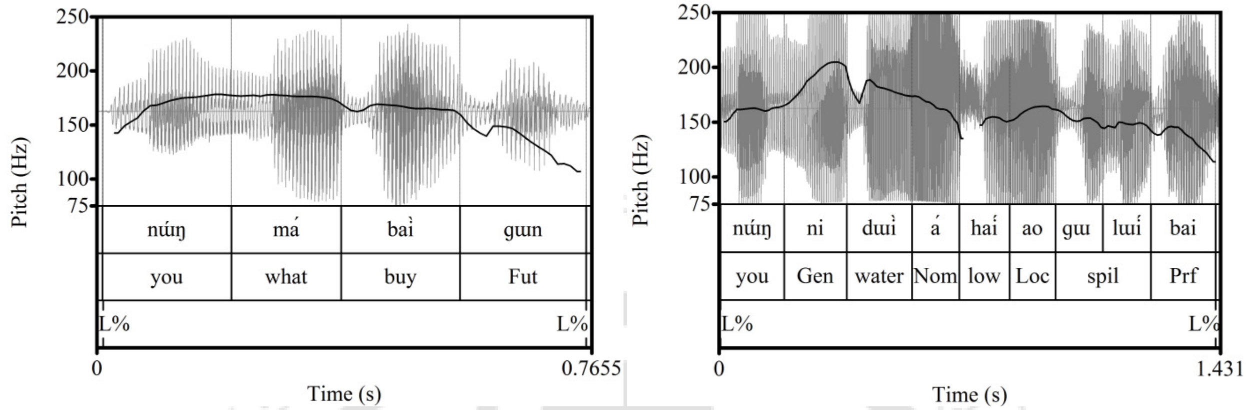


Figure 3.11: **IP initial H tone aligned to monosyllabic and disyllabic constituents.** Pitch track of núŋ má baìgɯn 'What will you buy?' (left panel) and of núŋní dɯìá haíao gɯlɯíbai 'your water has spilled over' (right panel) produced by the same speaker.

IP initial H tones in Boro also surface with a rising contour. The panel on the left of Figure 3.11 presents the pitch contour of a sentence with a monosyllabic word with H tone occurring initially. In the panel on the right of Figure 3.11, a disyllabic word with H tone occurs initially. It can be seen that both the monosyllabic núŋ 'you' and the disyllabic núŋní 'you-Poss' surface with a rise in f_0. The peak of the f_0 rise aligns to the second syllable in núŋní 'you-Poss' and to the final segment of the first syllable in núŋ 'you'. Another important aspect of the IP initial pitch rise is highlighted by the panel on the left on Figure 3.12.

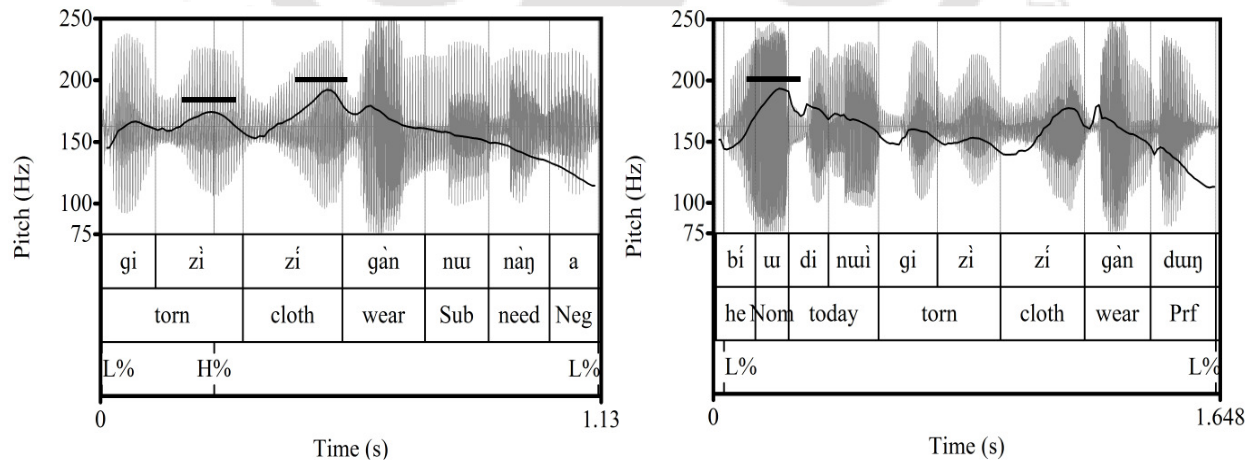


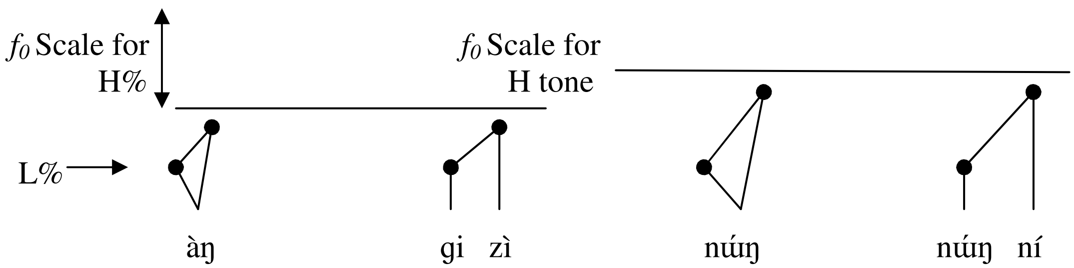
Figure 3.12: **IP initial and medial occurrences of LH tone sequence**. Pitch track of gizì zí gànnɯ nàŋa 'Don't wear torn cloth' (left panel) and bí-ɯ dinɯì gizì zí gàndɯŋ 'He has worn torn cloth today' (right panel) produced by the same speaker.

The panel on the left of Figure 3.12 presents the pitch contour of a sentence with an initial LH sequence. The initial L tone aligned to the second syllable of gizì 'torn' surfaces with a high target. A comparison between the pitch contours of the initial occurrence of gizì 'torn' and that of its medial occurrence presented in Figure 3.12 (right panel) shows it. It should be highlighted here that the high target for the f_0 rise for the IP initial L tone in gizì 'torn' is scaled lower than the high target for an IP initial H tone. The lines in Figure 3.12, and the rest of the discussion here, refer to f_0 heights aligned to a particular syllable. The lines marking f_0 heights in Figure 3.12 show that there exists a difference of scaling between the high target aligned to gizì 'torn' and that of the lexical H tone aligned to the second syllable of bí-ɯ 'he-Nom'.

We interpret the initial rising f_0 contour in Boro as an initial L%H% boundary tone. Section 1.2 has discussed how such a boundary tone influences the pitch contours in other languages[14]. In Boro, this tone interacts differently with the two lexical tones. It causes the IP initial L tone to surface with a rising contour. The pitch contour for àŋ 'I' in Figure 3.7 shows it. The f_0 height for the H% of the boundary L%H% is scaled lower than that of the high target for an IP initial H tone. The comparison between the pitch contours for dɯ̀i-ao 'water-Loc' and bí-ɯ 'he-Nom' in Figure 3.9 shows it. The H% of the boundary L%H% does not cause downstepping of the following lexical H tone. Although in Georgian the initial H_i could trigger downstepping of the following H*, in Boro the initial H% does not influence the following H tone. The sequence of boundary L%H% and lexical H tones aligned to gizì zí 'torn shirt' in Figure 3.12 shows it. The L% of L%H% aligns to the first syllable of gizì 'torn' and the H% surfaces aligned to the second syllable. Following this, the pitch is raised to an even higher target for the lexical H aligned to zí 'shirt'. The alignment schema presented in (7) shows how L%H% is squeezed when it is associated with a monosyllabic stem with L tone like àŋ 'I'. When the boundary L%H% associates with a disyllabic word with L tone, L% aligns to the first syllable and H% aligns to the second syllable. L%H% interacts with the initial H tone in such a way that the f_0 target for H% does not surface. This is irrespective of the number of syllables of the IP initial constituent with H tone. The alignment schema for nɯ́ŋ 'you' and nɯ́ŋní 'you-Poss', presented in (7), shows it.

[14] Left edge boundary tones are discussed in connection with IPs in English, French and Georgian. In Seoul Korean, Northern Bizkalan Basque, Tokyo Japanese the left edges of Accentual Phrases are marked by boundary tones.

(7) **Alignment of initial L%H% boundary tone**



The L%H% sequence does not spread to a second L tone following the one occurring on the left edge of the IP. The pitch contour for gudùŋ dɯì lùŋnaiá dehàní tʰakaì mɯzàŋ 'To have warm water is good for health' in Figure 3.10 shows it. The H target for the L%H% aligns to the second syllable of gudùŋ 'warm' and the next word dɯì 'water' surfaces with the characteristic falling f_0 trend for Boro L tones.

Results presented in this section show that the left edges of IPs in Boro are marked by an L%H% boundary tone. The alignment schema for this boundary tone can be summarized as:

- L%H% makes the initial L tone surface with a rising pitch contour.
- The H target for this L%H% does not surpass the anchoring segment of the initial L tone.
- An initial high tone preempts the occurrence of the H%, and only L% surfaces IP initially preceding H tone.
- Lexical high tone differs from the high target for initial L%H% in terms of scaling.
- The H target for L%H% does not cause downstepping of the following lexical H tone.

3.7 Prosodic phrasing in Boro

One of the important aspects of Autosegmental Metrical model of study of intonation is that of prosodic constituents to which intonational tones get associated (See section 1.3). A related notion is propounded by prosodic phonology which analyzed speech into hierarchically organized prosodic constituents (Selkirk 1978; Nespor and Vogel 1986; Hayes 1989). Although intonational models of many non-tonal languages have segmented intonational contours into various levels of prosodic constituents, such kind of description of tonal languages is quite limited. In an important book of its kind, Downing and Rialland (2017) in their account of intonation in African tone languages find evidence for smaller prosodic chunks in the form of p-phrases in Akan and Chimiini. The current description of Boro recognizes two layers of prosodic structure marked by intonational tone. The unit occupying the highest level in this hierarchy is the IP and a smaller prosodic unit can be identified in the form of ip.

Intermediate phrase (ip) as an intonationally defined constituent was introduced by Beckman and Pierrehumbert (1986) ranked below IP. The existence of an ip level of phrasing has been proposed for English (Beckman and Pierrehumbert, 1986), Italian (D'Imperio, 2002), Catalan (Feldhausen, 2008) and also for Cairene Arabic (Helmuth, 2007). Prieto (2009) defines the ip in Catalan in terms of the presence of a weaker disjuncture than that of IP. Khan (2008) describes the Bengali ip as a grouping of Accentual Phrases that form a tight syntactic unit, often corresponding to a small phrase and occasionally to a clause.

3.7.1 The ip as a prosodic domain in Boro: motivations

The ip in Boro is comprised sometimes of a clause or an adjectival phrase or in some other cases a pre-posed focused phrase. The evidence for the existence for the level of ip in Boro comes from the perspectives discussed in (i) and (ii).

(i) Weaker disjuncture marking edges of non-final constituents larger than PrWd and smaller than IP.

(ii) Suspension of lowering of pitch targets for non-initial H tones.

The first argument in favour of ip as a prosodic constituent comes from the kind of weaker disjuncture noticed in sentences containing two clauses. The tones marking the edges of such ips in Boro do not show the same magnitude of pitch range modification as found in the case of IP right edge tones. IPs in Boro are characterized by wider variety of right edge boundary marking tones (Chapter 4 discusses this) than that is found in the case of ips. It is to be noted here that only the non-final ips in Boro surface with their ip boundary tones. The boundary tones of the final ips get overridden by the IP final boundary tone. Figure 3.13 presents an instance of this.

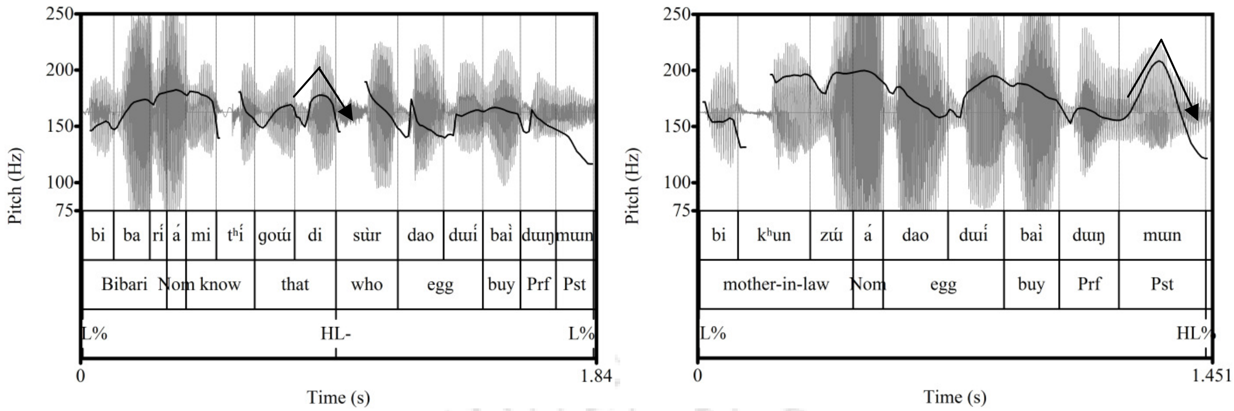


Figure 3.13: **Right edge ip boundary tone for non final ip.** The first clause [bibríá mitʰigoɯ́di] ‘Bibari knows that.’ surfaces with a falling boundary tone HL- in its right edge. This ip edge HL tone can be compared with the IP edge HL tone in the panel on the right presenting the pitch track of bikʰunzɯ́á daodɯí baìdɯŋmɯn? ‘Mother-in-law bought egg?’

The pitch contour for the sentence bibríá mitʰigoɯ́di sɯ̀r daodɯí baìdɯŋmɯn ‘Bibari knows who bought egg’ shows that the sentence consists of two ips forming an IP. The first ip, covering the first part of this complex sentence upto the complementizer *di* ‘that’, ends with an HL- ip boundary tone. The pitch contour presented in the panel on the left of Figure 3.13 shows how the *ip boundary tone is realized as a rise and fall in f_0 aligned to the ip final syllable*. It is also noteworthy here that the f_0 fall for HL- ip boundary tone is not realized in the same manner when the falling contour marks the edge of an IP. The panel on the right of Figure 3.13 presents the pitch contour of an IP with the boundary HL tone aligning to its right edge. A comparison between the pitch tracks shows that the HL boundary tone is realized differently depending on whether it aligns to the right edge of an ip or that of an IP. The boundary tone of the second ip gets influenced by the L% IP boundary tone in the panel on the left of Figure 3.13 and the f_0 falls to a low target.

The second argument in favour of the ip level in Boro is based on the nature of pitch curves of some utterances. Section 3.5.1 has already presented evidence to show that in an IP consisting of a sequence of H lexical tones, the non-initial ones undergo phonetic downstepping. It has been already shown in (6) that downstepping in Boro does not affect tonal scaling within PrWd and only the final H tone of the PrWd domain undergoes lowering. This prosodic requirement of each of the PrWd final H tones in a series of non-initial PrWds undergoing pitch drop is violated in Boro IPs beginning with a nominative clause. The final tone of the nominative clause does not affect the following H tone and the latter surfaces with a higher pitch target than the earlier one. Suspension of downstepping has been often interpreted as an evidence for marking a prosodic boundary in the study of intonation. Guessenhoven (2004), based on evidence from Poser (1984), Pierrehumbert and Beckman (1988) and Kubozono (1992), informs that in Tokyo Japanese the ip is the domain of downstep. The pitch contours presented in Figure 3.14 also show that downstepping is blocked after the nominative clauses due to a prosodic boundary.

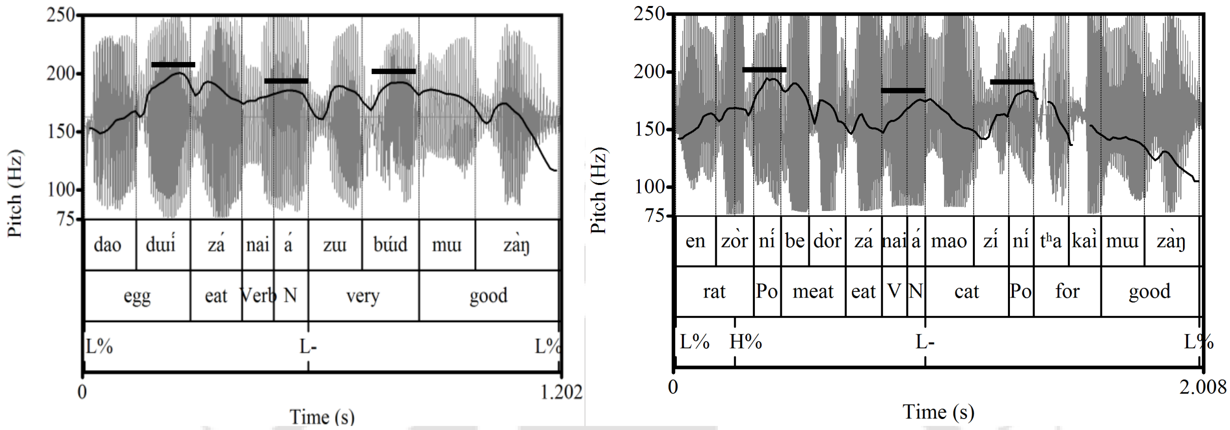


Figure 3.14: **Suspension of downstepping across ip boundary.** Pitch contour of daodɯí zánaiá zɯbɯ́d mɯzàŋ 'It is good to eat egg' (left panel) and of enzòrní bedòr zánaiá maozíní tʰakaì mɯzàŋ 'It is good for cat to eat rat meat' (right panel).

This prosodic constituent is larger than the already discussed PrWd domain in Boro. We identify this prosodic unit as an ip in the intonation phonology of Boro. In the panel on the left of Figure 3.14, the second H tone in the nominative clause daodɯí zánaiá 'to eat egg' undergoes downstepping. But the third H tone aligned to the adjective zɯbɯ́d 'very' surfaces higher than the preceding H tone. The mean of maximum f_0 (Maxf_0) of the final vowel in zánaiá 'to eat' is 169.67 hz (n = 20) compared to 175.10 hz of that of the final vowel in zɯbɯ́d 'very'. The ip boundary after the second H lexical tone blocks the downstepping of the third H lexical tone. The nominative clause in the panel on the right of Figure 3.14 also functions as a prosodic unit. The nominative clause in the panel on the right of Figure 3.14 ends with an H lexical tone and the next lexical H tone is not downstepped. The mean of maximum f_0 (Maxf_0) of the final vowel in zánaiá 'to eat' in the sentence enzòrní bedòr zánaiá maozíní tʰakaì mɯzàŋ 'It is good for cat to eat rat meat' is 158.19 hz (n = 20) compared to 168.81 hz of that of the final vowel in maozíní 'cat-Poss' in the same sentence. Figure 3.15 presents the comparison of Maxf_0 between two adjacent H lexical tones separated by ip boundaries. Based on the evidence presented above we assume that *suspension of downstepping in Boro functions as the prosodic cue for ips*.

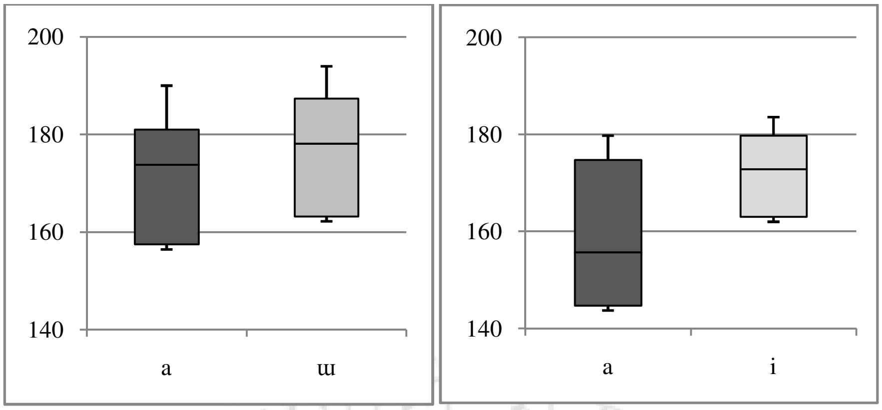


Figure 3.15: **Maxf_0 for adjacent H tones across ip boundary.** Comparison of maximum f_0 (Maxf_0) between the final vowels in zánaiá 'eat-Verb-Nom' (left panel) and that of the final vowel in zɯbɯ́d 'very' in daodɯí zánaiá zɯbɯ́d mɯzàŋ 'It is good to eat egg'. The panel on the right compares the Maxf_0 of the final vowel in zánaiá 'eat-Verb-Nom' and that of the final vowel in maozíní 'cat-Poss' in enzòrní bedòr zánaiá maozíní tʰakaì mɯzàŋ 'It is good for cat to eat rat meat'.

Fronted and other topicalized constituents are often set off by intonational markers, such as pause or a boundary tone (Frascarelli, 2000). Although the canonical word order in Boro is Subject + Object + Verb, it allows the object to be pre-posed to the initial position of a sentence for ex-situ focus marking. Noun phrases which are thus placed sentence initially for ex-situ object focus (Kugler and Genzel, 2012) also form ips in Boro. Figure 3.16 presents an instance of such kind of ex-situ focus marking where the object noun phrase daodɯí 'egg' occurs sentence initially.

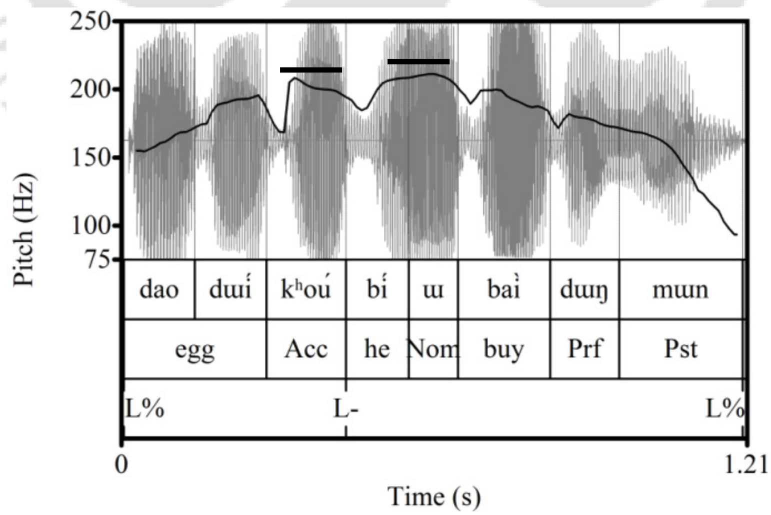


Figure 3.16: **Preposed object with ex-situ focus followed by ip boundary.** Pitch track of daodɯíkʰoú bíɯ baìdɯŋmɯn 'EGG he bought' where the object NP daodɯí 'egg' is pre-posed.

As can be seen in Figure 3.16, an H tone aligns to the last syllable of the focused constituent and it is followed by an L ip boundary tone. The evidence for the pre-posed object forming an ip again comes from the observed intonational phenomenon of downstepping in Boro. In Figure 3.16, with two lexical H tones in first two words of daodɯíkʰoú bíɯ baìdɯŋmɯn 'EGG he bought', the second H surfaces with higher f_0 target than the first one. This evidence also suggests that downstepping is not applied across ips in Boro. As the pre-posed constituent daodɯíkʰoú 'egg-Acc' is followed by an ip boundary, the following H tone in bíɯ 'he-Nom' is not downstepped. This suggests that *ip is the domain of downstepping in Boro*. Figure 3.17 presents another instance of an IP with a pre-posed object receiving ex-situ focus.

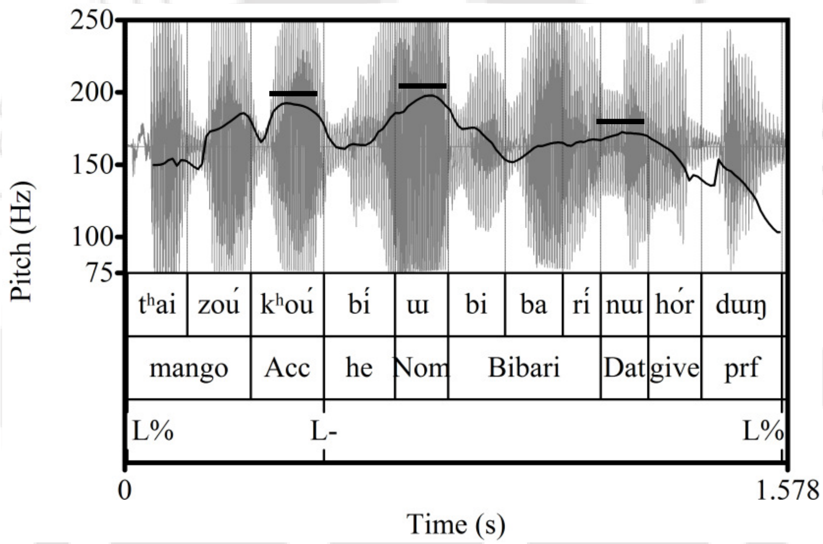


Figure 3.17: **ip boundary and suspension of downstepping.** Pitch track of tʰaizoúkʰoú bíɯ bibarínɯ hórdɯŋ 'Mango he gave to Bibari' where the direct object tʰaizoú 'mango' is pre-posed to the IP initial position.

The pitch contour presented in Figure 3.17 is of a sentence consisting of a direct and an indirect object with a di-transitive verb. The pitch contour in this Figure shows that the second H tone surfaces with a higher f_0 target than the first one negating any pitch drop for downstepping. The initial PrWd tʰaizoúkʰoú 'mango-Acc' is followed by an ip boundary. The second ip in Figure 3.17 follows the characteristic downstepping of non-initial H tones. The H tone in bibarínɯ 'Bibari-Dat' surfaces with a lower target than that of the ip initial H tone in bíɯ 'he-Nom'.

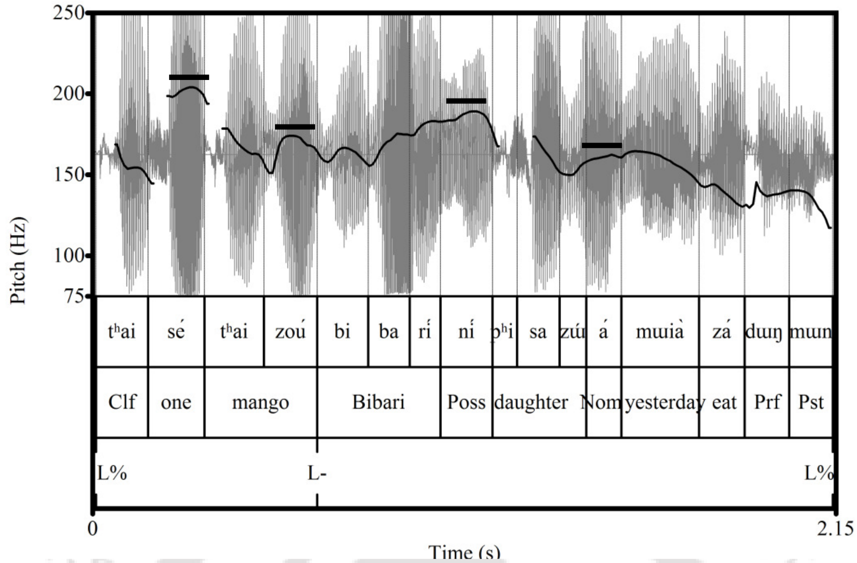


Figure 3.18: **ip boundary L- blocks downstepping of the following H tone.** Pitch track of t^{h}aisé t^{h}aizoú bibaríní p^{h}isazɯ́á mɯià zádɯŋmɯn 'One mango Bibari's daughter yesterday ate' with the object t^{h}aisé t^{h}aizoú 'one mango' receiving ex-situ focus.

Downstepping of non-initial H tones within ip domain can also be observed in pre-posed constituents containing more than one H lexical tone. Figure 3.18 presents the pitch contour of a longer sentence, with the subject and object containing more than one constituent. Both the constituents in the pre-posed object in Figure 3.18 t^{h}aisé t^{h}aizoú 'one mango' are specified with H tone and the second H tone undergoes pitch drop. The pitch again rises to a high target for the third H and the next H tone is again downstepped. The ip prosodic boundary after the pre-posed object t^{h}aisé t^{h}aizoú 'one mango' does not allow downstepping to spread to the next H tone in bibaríní 'Bibari-Poss'. However the second H tone in the second ip in Figure 3.18 undergoes downstepping. The right aligned H tone in p^{h}isazɯ́á 'daughter-Nom' surfaces lower than that of bibaríní 'Bibari-Poss'. This shows that *intonation in Boro marks certain prosodic units as the domain of downstepping. This study defines this as an ip domain in Boro based on the following prosodic aspects:*

- Non-initial H tones undergo downstepping within the ip domain.
- Pitch target for a non-initial H tone is not lowered if it is preceded by an ip boundary.
- Weak intonational juncture at the right edge also signals ip domain.

3.7.2 Intonational Phrase (IP)

The largest tonally-marked unit in the prosody of Boro is the IP. This unit often covers the entire sentence. The IP is marked by a major rise or a major final fall (Jun and Fougeron, 2000).

Pierrehumbert (1980) presents evidence to suggest that the right edge of the IP is marked by an H% or L% which aligns to the last syllable of the IP. This level is also marked by final lengthening and is optionally followed by a pause (Jun and Fougeron, 2000). In general, major phrase boundaries tend to be associated with longer pauses, greater and more complex tonal changes, and more final lengthening than minor boundaries (Prieto, 2009). The IP in Boro also exhibits some of these features. This section presents acoustic evidence to suggest that *IPs in Boro are marked by major rise or final fall, and also by pause* when two IPs constitute the highest level of prosodic hierarchy, which is described as Utterance by Selkirk (2009). The IP is the prosodic domain within which pitch range is specified, and thus at the start of each new IP, the speaker chooses a new range which is independent of the former specification. Figure 3.19 shows how a simple sentence like aŋ̀ pʰɯ̀i-gɯn 'I will come', with the subject NP and VP, forms an IP ending in a final fall.

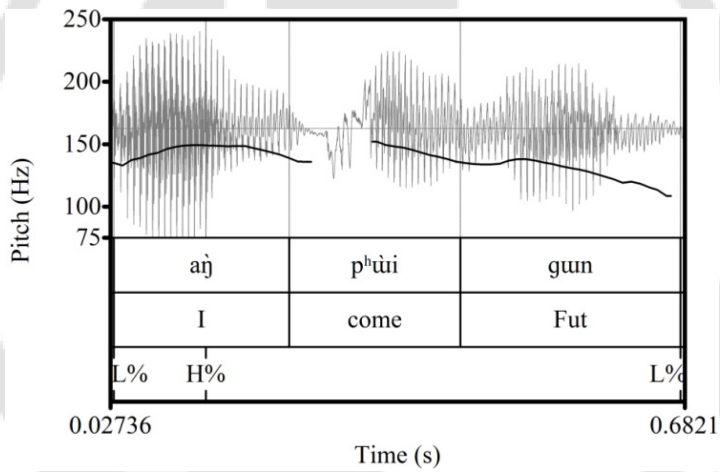


Figure 3.19: **Final fall and IP boundary.** Pitch contour for the IP aŋ̀ pʰɯ̀i-gɯn 'I will come' ending in f_0 minimum. The edge here is marked by the extreme drop in the f_0 in the final syllable.

The edge of the IPs in Boro is marked not only by major rise or fall in the f_0 pattern, the disjuncture can also be suggested by pause. Figure 3.20 presents the contour of an utterance with two IPs. *The edge of the first IP is not only marked by the major rise in f_0 contour, it is also suggested by the amount of pause before the second IP starts.*

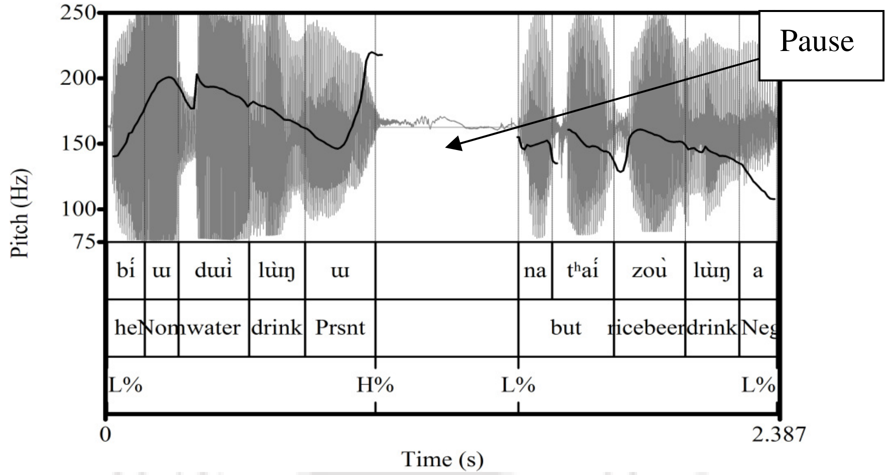


Figure 3.20: **Pause and major pitch movement, and IP boundary.** Pitch contour of the utterance bíɯ dɯì lùŋɯ natʰai zoù lùŋa ‘He drinks water but does not drink ricebeer’. The pause before *natʰai* ‘but’ separates the two IPs in the utterance.

Another evidence that supports the assumption for IP as a prosodic unit is the *lengthening of the final syllable of the phrase*. Figure 3.21 presents the pitch contour for the sentence bikʰunzɯ́á daodɯí baìdɯŋmɯn ‘Mother-in-law bought egg’

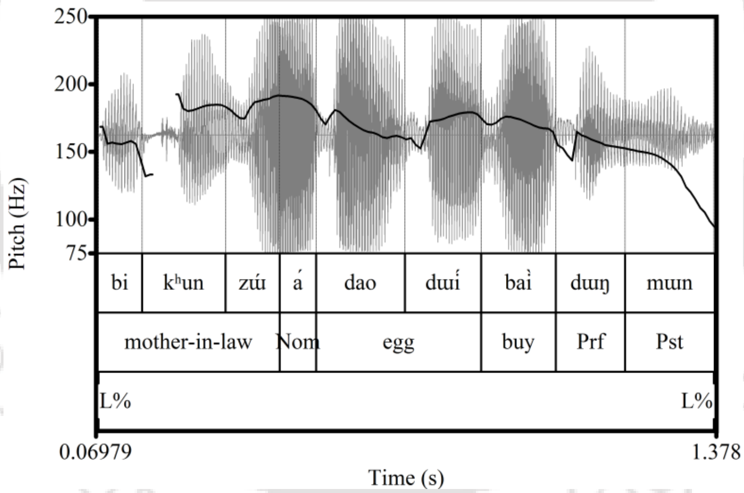


Figure 3.21: **Final lengthening and IP boundary.** The final syllable of IPs are longer than the preceding ones as is the case for -mɯn in the sentence bikʰunzɯ́á daodɯí baìdɯŋmɯn ‘Mother-in-law bought egg’

Average duration (n=20) of the last syllable of the sentence mɯn ‘Pst’ in Figure 3.21 is found to be higher (189.58 msec) than the preceding two syllables. The average duration for baì ‘buy’ is 157.53 msec. and for dɯŋ ‘Prf’ it is 146.15 msec. (n=20). Thus lengthening of the final syllable provides another phonetic cue for determining IP boundaries in Boro.

3.8 Conclusion

Although studies on intonation systems of the languages of the world have been growing over the years, the interaction between intonation and lexical tone is yet to be extensively pursued. Most studies on the properties of intonational interference in tone languages have taken into account two aspects. Some of the studies like Xu (1999), Kugler and Skopeteas (2006), Jannedy (2007), Karlsson, Svantesson and House (2012), and Kugler and Genzel (2012) have presented detailed account of the way information structure controls the surface realization of lexical tones. Other studies like Inkelas and Leben (1990), Mayers (1996), Gussenhoven and Vliet (1999), Lee (2004), Ma, et al. (2006), and Rialland (2007) have discussed how boundary intonational tones affect the lexical tones in utterances. Recent studies on Yoruba (Fajobi, 2005) Akan (Genzel 2013; Kugler 2017), Bemba (Kula and Hamann, 2017), Chichewa and Tumbuka (Downing, 2017) have revealed more about the nature of intonational interference in tone languages. This chapter has shown how a two tone language like Boro permits intonational modification of the lexical tones at the IP level. Acoustic evidence presented in this chapter has revealed the following features of the intonational phonology of Boro:

- Three levels of prosodic constituents can be identified in Boro: PrWd, ip and IP. PrWd is the domain for distribution of lexical tones. The ip in Boro functions as the domain of downstepping of H lexical tones. The highest level of prosodic constituency is the IP which is marked by both initial and final boundary tones. Boro does not make use of pitch accents to mark prominence within the prosodic units discussed above[15]. The hierarchical tree for prosodic constituents in Boro presented in Figure 3.1 captures this dimension of Boro intonational phonology.
- Left edges of IPs in Boro are marked by L%H% boundary tone which interacts differently with the two lexical tones. Both the targets for L%H% surface when an L tone occurs in IP initial position. In instances of an IP initial H tone, only the L target for L%H% precedes the high target for the lexical H tone.

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[15] Study of intonation in AM model uses pitch accent for marking phrasal prominence. Strings of words or morphemes are mapped onto prosodic units depending on the association of a pitch accent to each one of these domains.

- Lexical tones preserve their characteristic pitch trends when they occur medially in IPs. IP initial L tones and IP final H tones bear the mark of intonational modification in their surface realization.
- Lexical tones surface with additional tonal targets due to phonetic downstepping and declination. Downstepping affects a sequence of H tones and declination results in gradual fall in tonal targets for a sequence of L tones.

Boro presents a new perspective of the way intonation is allowed to play its role in tone languages. The description presented in this chapter has deliberately avoided looking into the way the final lexical tone interacts with the right edge IP boundary tone. The pitch contours presented in Figure 3.13 and 3.20 have already acquainted us with some of the possible ways in which the right edges of IPs can surface in Boro. Chapter 4 will show how Boro employs various right edge IP boundary tones for fulfilling various discourse requirements.

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Chapter 4

Tonal Inventory in Boro

4.0. Introduction

Intonational phonology describes the linguistically significant aspects of the pitch contours of utterances or sentences in a language. The contours or tunes comprise mainly of pitch accents and boundary tones in non-tonal languages (Hayes and Lahiri, 1991). Intonation does not play a similar role in tone languages (see 1.3 for details). Although both tone and intonation use variation in f_0 contours for linguistic purposes, complete obliteration of lexical tones by intonational pattern in tone languages is usually avoided (Yip, 2002). Chao (1968) compares lexical tone and intonation to ‘small ripples riding on larger waves’. Intonation affects the overall register, but the lexical tones retain their relative pitches and shapes and are mapped onto this registral ‘wave’ (Yip, 2002). It is for this reason that the more intonation contrasts a language has, the harder it is to maintain a system of lexical tone contrasts, and vice versa. It is for this reason that the process of introducing lexical tone to an intonation language will make the language respond most likely by reducing the number of intonation contours, and at the same time enhancing pitch contrasts by means of other phonetic parameters, like duration or vowel quality (Gussenhoven, 2004). Thus intonation is destined to play a limited role in lexical tone languages. This is observed by Kugler and Skopeteas (2006) in their analysis of Yucatec Maya, a Mayan language spoken in Yacatecan Peninsula. It is shown by Kugler and Skopeteas (2006) that neither topic nor focus is realized by intonational pitch accent, and intonational tones surface only at the phrasal edges in the form of boundary tones. Chapter 3 has already shown that tone languages do divide an utterance into smaller chunks to form phonologically significant prosodic units. In addition to this, linguistically significant pitch movement at the left edges of utterances also contributes to the surface structure of the pitch contours. These two aspects do not exhaust the possible post-lexical features of pitch movement and modulation in Boro. Boundary tones occurring at the right edges of IPs constitute another important aspect of the intonational contours in this language. *The objective of this chapter is to present an account of the tonal inventory in Boro consisting of the pitch contours for various types of utterances*. Boro, with its two lexical tones, provide further evidence of the fact that tone languages make very limited use of pitch accents, and intonation mostly bears its effect as boundary tones. Chapter 5 will present an account of the way an H* pitch accent surfaces aligned to the emphatic particles in Boro. The analysis presented in this chapter focuses mainly on *IP boundary tones and their interaction with the right most lexical tones in Boro*. It is shown that the language has a number of boundary pitch movements, each of which conveys a particular discourse meaning. Results show that Boro has *both monotonal and bitonal IP boundary tones which interact differently with the rightmost lexical tones depending on the composition of the IP final PrWds*. It has been already described in 3.7.1 that the ip in Boro ends with either an L- or HL- boundary tone. ip boundary tones in Boro do not show the same amount of pitch modification as shown by the IP boundary tones. This chapter presents acoustic evidence to argue that *monotonal boundary tones such as H% and L%, and bitonal boundary ones such as HL%, LH% and H(L)% occur at the right edges of IPs in Boro*. These IP final boundary tones are associated with various sentence types in the language like statements, questions, orders and exclamatory sentences.

Section 4.1 presents the methodology adopted in this chapter for data collection and data analysis. This section also describes the experiment. Section 4.2 enumerates the results for the way boundary tones surface for various sentence types. It is shown that *both the IP final monotonal boundary tones and the lexical tones of the IP final PrWds align to the rhyme of the rightmost syllable*. On the other hand, *IP final bitonal boundary tones sometimes override the lexical specifications*. Section 4.3 summarizes all the facts of the intonational phonology of Boro described in Chapter 3 and 4. Section 4.4 concludes this chapter.

4.1 Methodology

The data series for this experiment consisted of sentences evoking the contexts which the speakers face in everyday situations. The *sentences were of various types like declaratives, yes-no questions, wh-questions, requests, orders and vocatives.* The 4 speakers which participated in the experiment described in Chapter 3, were the subjects for the present experiment too. 5 iterations for each sentence by each of the speakers accumulated to 20 tokens for each of the sentence types considered for this experiment. A total number of **152 sentences** were used for this experiment. With **5 iterations** for each sentence by **4 speakers**, the total number of tokens accumulated to **3040** (152 x 5 x 4= 3040).

4.1.1 Materials

Out of the total number of 152 scripted sentences used for the present experiment, *the first data set consisted of 30 homophonous sentences*. Table 4.1 presents a glimpse of some of the sentences in this data set.

bí-ɯ he-Nom	bɯrmà 'goat'	zá(eat)/zà(be)-nɯ ‘to’	nagír-ɯ 'want-Prf
bí-ɯ he-Nom	bɯrmà 'goat'	zá(eat)/zà(be)-ɯ	
bí-ɯ he-Nom	t^háŋ ‘go’/t^hàŋ 'live' -a 'Neg'		
bí-ɯ he-Nom	t^háŋ ‘go’/t^hàŋ 'live'- dɯŋ 'Prf'		

Table 4.1: **Pairs of homophonous sentences used for the experiment**

The sequence of words in each row in Table 4.1 represents two homophonous sentences. Each of the sentences in Table 4.1 results in ambiguity since the meanings of the verbs ‘za’ and ‘t^haŋ’ change depending on the lexical tone associated to them. Sentences of this kind (differing in lexical tone of only one constituent PrWd) formed part of this data set. The participants were instructed well before recording as to the kind of meaning each rendition of the sentences was required to express. *Each of these 30 unambiguous sentences appeared in the pragmatic contexts of statement, yes/no question and incompleteness. In this way, the speech material for this data series amounted to a total number of 90 sentences (30 sentences x 3 contexts).* The homophonous sentences occurring in the three different discourse contexts provided ample opportunity to examine how pitch contours change in Boro while expressing pragmatic meanings. This also helped in factoring out the relationship between the two lexical tones in Boro and the intonational contours, while the sequence of PrWds remained the same.

The *second data set consisted of 24 sentences with the same sequence of PrWds*, but which expressed various types of meanings like surprise, incompleteness, yes/no questions with question particles. These meanings were elicited sometimes by punctuation marks or sometimes by placing particles, like ‘na’ or ‘nama’ for yes/no questions. The sentences were constructed in such a way that words with both H and L tones occur in object and verb positions. The sequence of PrWds in each of the rows in Table 4.2 constituted each of the sentences in this data set.

bikʰunzɯ́á ‘mother-in-law-Nom’	daodɯ́i ‘egg’	baìdɯŋmɯn ‘buy-Prf-Pst’
bikʰunzɯ́á ‘mother-in-law-Nom’	bedòr ‘meat’	baìdɯŋmɯn ‘buy-Prf-Pst’
bikʰunzɯ́á ‘mother-in-law-Nom’	daodɯ́i ‘egg’	zádɯŋ-mɯn ‘eat-Prf-Pst’
bikʰunzɯ́á ‘mother-in-law-Nom’	bedòr ‘meat’	zádɯŋ-mɯn ‘eat-Prf-Pst’

Table 4.2: **Sentences in the data series with identical sequence of PrWds**

The *four sentence frames* in Table 4.2 were placed in *six different semantic-pragmatic contexts*. Thus the total number of speech material in this data set accumulated to *24 sentences*. The rationale behind placing the same sentence in different contexts was to examine whether global characteristics of pitch contours for different contexts vary in Boro depending on boundary contours.

The aim of the third set of data was to examine the way tones surface when they align to IP final PrWds of various lengths (disyllabic/trisyllabic). The sentences in this data set were designed to examine the influence of various right edge boundary tones on the IP final lexical tone aligned to PrWds of different lengths (disyllabic/trisyllabic). Table 4.3 presents some of the sentences in this data set. A total number of *14 sentences featured in this data set*.

bí-ɯ he-Nom	zakʰór 'eater'	zà(be)-dɯŋ-mɯn
bí-ɯ he-Nom	daoduɯí 'egg'	zá (eat)-dɯŋ-mɯn
bí-ɯ he-Nom	zakʰór 'eater'	zà(be)-bai
bí-ɯ he-Nom	daoduɯí 'egg'	zá (eat)-bai
bí-ɯ he-Nom	dɯì 'water'	lɯŋ 'drink'-ɯ
bí-ɯ he-Nom	nɔ́-ao 'home-Loc'	tʰáŋ ‘go’-ɯ

Table 4.3. **Sentences for examining interaction between lexical and boundary tones**.

The fourth set of data for this experiment consisted of sentences with different sequence of PrWds expressing various meanings like (polite) request, vocative chant, wh-questions and alternative questions. Pitch contours of these sentences were examined to understand the prosodic means Boro adopts for various pragmatic purposes like asking a wh-question or calling someone or placing an order or request. The *speech material for this investigation comprised of 24 sentences*. Table 4.4 presents some of the sentences in this data series.

bikʰunzúá ‘mother-in-law-Nom’	má ‘what’	baìdɯŋmɯn? ‘buy-Prf-Pst’
bikʰunzúá ‘mother-in-law-Nom’	mábla 'when’	tʰáŋdɯŋmɯn? ‘go-Prf-Pst’
pʰɯ̀i ‘Come’		
tʰáŋ ‘Go’		
pʰɯ̀i-dɯ ‘come-polite’		
tʰáŋ- dɯ ‘go-polite’		

Table 4.4. **Wh-questions, requests, orders, vocative chants and incomplete utterances**.

4.1.2 Data elicitation

Data elicitation for this chapter involved several processes. Each of these processes was used for a particular sentence type.

Process I: Elicitation of questions

Questions were elicited by placing them in a context where the *question is followed by a negative answer* in which a new element is placed in the object position or the negative marker is removed from the verb in questions without any object. The question and answer pair presented in (1) explain this.

(1)	bí-ɯ dɯì lɯ̀ŋ-ɯ ? he-Nom water drink-Prsnt Does he drink water?	noŋá, bí-ɯ zoù lɯ̀ŋ-ɯ No, he-Nom ricebeer drink-Prsnt No, he drinks ricebeer
	bí-ɯ tʰáŋ-a ? he -Nom go-Neg Doesn’t he go?	noŋá, bí-ɯ tʰáŋ-ɯ No, he-Nom go-Prsnt No, he goes.

The participants were familiarized with the question-answer pairs like (1) before the recording so that each iteration of the questions would presuppose that the answer would be a negative one with a change of the object or the verbal inflection. The subjects recorded only the questions while they silently read the answers. This process was followed to *control the placement of focus in the yes/no questions*. Yes/no questions can bear both neutral and contrastive/narrow focus (King, 1997) and the prosody of such questions varies depending on the intended focus placement (D’Imperio, 2001). The yes/no questions considered for this experiment were put in the context in (1) to ensure that the object or the verb (in intransitive sentences) consistently bears the focus of the question. The context presented to the participants were considered important for maintaining consistency in the elicitation of the questions since studies have shown that context can determine whether a question receives narrow focus or wide focus (Romero and Han, 2002).

Process II: Incomplete utterances

Incomplete utterances were elicited by placing them as the *initial constituent of a sentence consisting of two coordinative clauses* joined by the conjunction nathai 'but'. The speakers were asked to pause for a brief moment after the first clause and this helped in eliciting the sense of incompleteness. The sentence frame presented in (2) illustrates this process of eliciting the sense of incompleteness.

(2) Subject + Object$_i$ + Verb [pause] nathai Object$_j$ + Verb
bí-ɯ dɯì lɯ̀ŋ-ɯ nathai zoù lɯ̀ŋ-a
he-Nom water drink-Prsnt but ricebeer drink-Neg
He drinks water, but does not drink ricebeer.

Process III: Statements

Statements were elicited by offering these sentences to the participants without any context. *Filler sentences consisting of non-related sets of PrWds were used to keep homophonous sentences at some amount of distance in the data set*. Such filler sentences were placed among homophonous sentences to minimize any carry over effect.

Process IV: Exclamatory sentences

Exclamatory sentences were also elicited by placing them in contexts where an exclamatory word *hare* 'surprise' and a small amount of pause preceded the sentences expressing surprise. The illocutionary context for the exclamatory sentences was provided by a clause expressing a contrast which brings in an object different from the one placed in the surprise expression itself. The example presented in (3) shows an instance of the whole context in which the surprise questions were placed.

(3) hare [pause] bikʰunzɯ́á daodɯ́i baìdɯŋmɯn! [pause] àŋ sáŋdɯŋmɯn bikʰunzɯ́a bedòr baìdɯŋmɯn
Surprise 'Mother-in-law bought egg!' I thought mother-in-law bought meat.

In the sentence frame given in (3) the object in the exclamatory sentence presents a contrast to the expectation of the speaker presented in the second clause. The focus here is on the object daodẃi 'egg' in contrast to bedòr 'meat'. The other exclamatory sentences used in this experiment were also placed in the same context. This was done to *control the prominence factor so that all the sentences expressing surprise received focus on the object*.

4.1.3 Data Analysis

Each iteration of the individual sentences was first extracted and saved as *separate wave files* using the speech analysis software- Praat 5.3.04_win32. Individual sound files of the sentences were further *segmented into the syllable level* and Praat TextGrid files were created for each of the sentences for acoustic analysis. The pitch contour of the individual sound files were generated as 'Praat picture file' for analyzing the intonational contours in Boro. The group of homophonous sentences in the data series differing only in the final lexical tone were examined for looking at the nature of interaction between the lexical and boundary tones in Boro. With this purpose, the *wave files of the last words of these sentences were saved as separate sound files* so as to observe the impact of intonation on the final lexical tones. These sound files were segmented at the phoneme level. The segmented files were processed with a Praat Script for obtaining measurements of f_0 of each interval. The script provided f_0 values for 11 equidistant points for each interval and this yielded time-normalized 11 f_0 points for each temporal domain. The *temporal domain or interval here refers to the domain between two boundaries* in the Praat segmentation windows. Time-normalization involves the process of calculation of pitch value at *11 points within two boundaries at every 10% gap*. Thus pitch value within a domain were calculated at startpitch point leading to 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% points and finally at the endpitch point. The Praat script was formulated in such a way that it also provided values for f_0 at middle point of each interval, and also meanf_0, maxf_0, minf_0, duration and so on. The *raw f_0 values* for the 11 points for each domain were *normalized* for speaker specific effects by using *z-score normalization* (Rose 1987, 1991). The z-score normalized f_0 values $p_z(n)$ were manually calculated by using the equation in (4).

(4) $$p_z(n) = \frac{p(n) - \mu}{\sigma}$$

In this equation, μ represents mean of f_0 for each point and σ stands for standard deviation and $p(n)$ is for f_0 value for each of the 11 points for each interval. Repeated measures style of analysis of variance (Anova) was conducted in SPSS with f_0 as dependent factor, speaker as random factor, and sentence type and tone as within subject factor. Further details are provided in the following sections where results showing f_0 trend and statistical analysis are presented.

4.2 Results

Chapter 3 has already described the way lexical tones surface in Boro at the IP level. Section 3.4 has given an account of the contextual variation of lexical tones in Boro. It has been shown that *IP medial lexical tones in Boro preserve their characteristic f_0 trends*. Pitch contours for the two homophonous sentences presented in the first row of Table 4.1 provide further evidence for this assumption. Figure 4.1 presents the averaged (n=20) z-score normalized pitch contour of the ambiguous homophonous sentence bí-ɯ bɯrmà **zá/zà**-nɯ nagír-ɯ 'He wants to eat/be goat'.

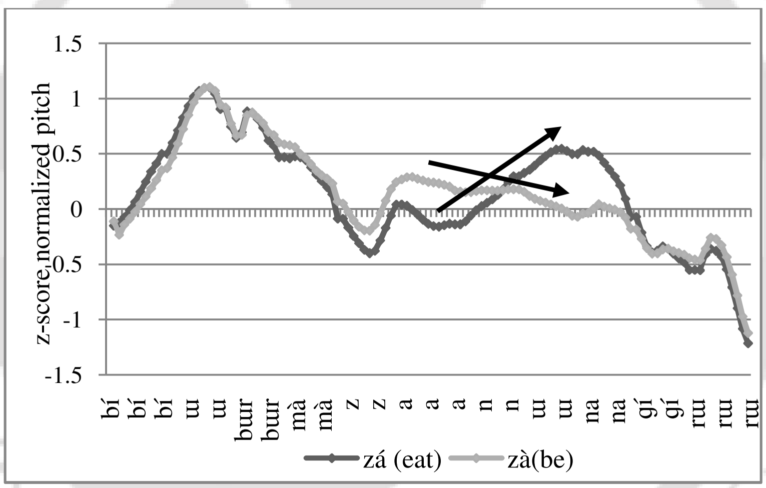


Figure 4.1: **IP medial occurrences of H and L tones.** *Averaged z-score normalized values for 11 points for each intervals (n=20) of* bí-ɯ bɯrmà zá/zà-nɯ nagír-ɯ *He wants to eat/be goat* extracted from all the speakers.

The ambiguity in the sentence results from the verbal stem 'za' which may mean either 'to eat' or 'to be' depending on whether it surfaces with H or L tone. The contours presented in Figure 4.1 show how the *pitch rises to a high target aligned to the final vowel of* -zanɯ *when it has H tone*. The *pitch falls to a low target aligned to its final vowel when it is specified with L tone*. In line with the argument presented in chapter 2, the lexical tones move to the second syllable in zá/zà-nɯ 'eat/be to'. A repeated measure Anova performed in SPSS has shown that the z-score normalized pitch values at the mid-point of the vowel ɯ in zá/zà-nɯ 'eat/be to' differ significantly in these two instances. The z-score normalized mean f_0 value (henceforth M) at mid-point for the vowel (n=20) in ‘eating’ is 0.48 hertz (hz) and it is 0.05 hz in ‘becoming’. There was a significant main effect of tone on mean f_0 at mid-point for the vowel $F(1, 3) = 273.77$, $p < 0.05$. No significant interaction was noticed, $F(4, 12) = 0.622$, $p = 0.121$. The two arrows in Figure 4.1 show that the f_0 movement at the beginning starts from a higher target in zà-nɯ ‘to be’ and it starts from a comparatively low target in zá-nɯ ‘to eat’. To be precise, the low target for the pitch rise for lexical H aligns to the start pitch point for the second syllable of zá-nɯ ‘to eat’, and the high target of the rise aligns to the 80% point for the vowel in -nɯ. The low target for the falling contour for lexical L tone aligns to the end pitch point of the second syllable zà-nɯ ‘to be’ and the high target for the fall aligns to the start pitch point for the vowel of the second syllable. Pitch contours presented in Figure 4.1 confirm our earlier claim in section 3.4 that *tones in Boro surface with their characteristic pitch trends occurring IP medially*. Although the rising f_0 trend for the H tone and the falling f_0 trend for the L tone continue till the word boundary, the IP final occurrences of such words reveal the nature of interaction between tone and boundary intonation. The intonational contours in Boro discussed in the following sections would throw more light on this.

4.2.1 Statements

Neutral statements in Boro are marked intonationally with L% boundary tone irrespective of the lexical tone of the utterance final word. *This section presents acoustic and statistical evidence to show how L% boundary tone for neutral statements interacts with the IP final tones in Boro.* Right alignment of the underlying lexical tone in derived words in Boro has already been discussed in Chapter 2. It is also shown in 4.2 that the f_0 fall for the lexical L tone starts from a higher target and the f_0 rise for the lexical H tone starts from a comparatively lower target. Although the boundary L% for statements in Boro causes both the lexical H and L to fall to the lowest pitch target, a comparison of the pitch contours of words with H and L tones followed by L% reveals that both the lexical and intonational tones align to the rhyme of the rightmost syllable. Figure 4.2 presents the aggregated z-score normalized pitch contours of only the final constituents in the sentences in (5)

(5)	bí-ɯ	tʰáŋ-a	bí-ɯ	tʰàŋ -a
	he-Nom	go-Neg	he-Nom	live-Neg
	he doesnot go		he doesnot escape	

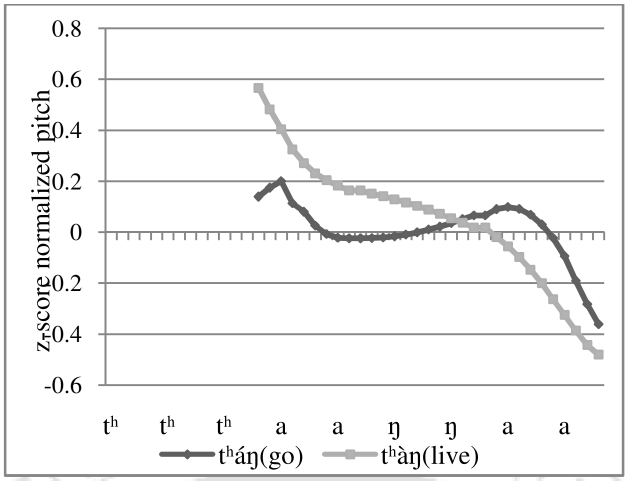


Figure 4.2: **Right edge H/L tones aligned to final open syllable followed by L%** *Averaged z-score normalized values for 11 points for each intervals (n=20)* of tʰaŋa ‘go-Neg/live-Neg’ occurring at the right edge of statements.

Pitch contours in Figure 4.2, for both tʰáŋ-a ‘go-Neg’ and tʰàŋ–a ‘live-Neg’, show that *statements in Boro end in an L%*. They also show that the fall starts from a higher f_0 target for the L tone, even when it occurs word finally. On the contrary, the pitch rises from a comparatively low target aligned to the start pitch f_0 point for the onset consonant of the second syllable of tʰáŋ-a ‘go-Neg’. Two additional f_0 events emerge. *The f_0 dips to a lower target when L% is preceded by an L lexical tone*. Secondly, the alignment of the pitch contour relative to the 11 f_0 points for the rhyme of tʰáŋ-a ‘go-Neg’ shows a rise extending till some part of -a when L% is preceded by H tone. This results in a *delayed fall of the pitch to the low target for the final L% when L% is preceded by H tone*. Also, examination of the pitch contours of the repetitions of the individual sound files showed that the *pitch falls sharply during the final syllable when L% is preceded by lexical L tone*. Z-score normalized pitch contours in Figure 4.2 elaborate this. To examine whether the delayed f_0 fall for lexical H and L% sequence bears an scaling effect on the rhyme of the final syllable, a repeated measure Anova test was performed comparing z-score normalized f_0 at the mid-points of the final vowels in tʰáŋa ‘go-Neg’ vs tʰàŋa 'live-Neg'. The meanf_0 at mid-point of the final vowel in tʰáŋa ‘go-Neg’ is found to be 0.02 hz and it is -0.20 hz for the same segment in tʰàŋa 'live-Neg', $F(1, 3) = 10.20$, $p < 0.05$ with no significant interaction , $F(4, 12) = 0.376$, $p = 0.82$. Similar alignment and scaling trends are noticed when L% is preceded by words having a coda consonant in the final syllable. Figure 4.3 presents the z-score normalized pitch contours of the final constituents in the sentences in (6).

(6) bí-ɯ tʰáŋ-dɯŋ bí-ɯ tʰàŋ-dɯŋ
he-Nom go-Prf he-Nom live-Prf
he has left he has survived

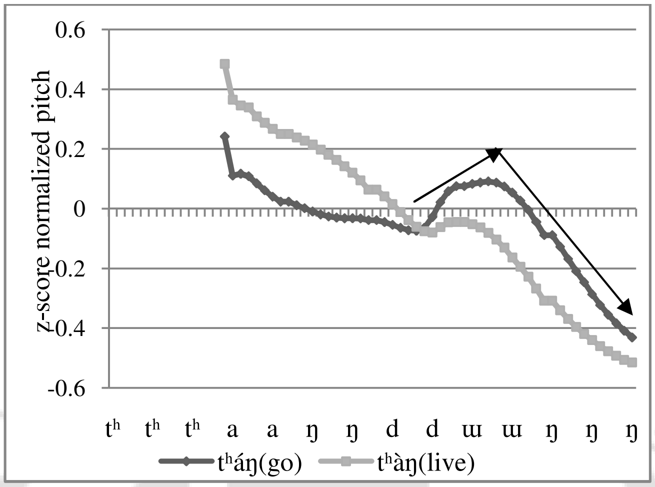


Figure 4.3: **Right edge H/L tones aligned to final closed syllable followed by L%.** *Averaged z-score normalized values for 11 points for each intervals (n=20)* of tʰaŋdɯŋ 'go-Prf / live-Prf' occurring as final constituents in statements.

The pitch contour of tʰáŋ-a 'go-Neg' in Figure 4.2 shows that the combination of lexical H and L% in Boro surfaces with a rise in f_0 followed by a fall aligned to the final vowel. The pitch contour for tʰáŋ-dɯŋ 'go-Prf' also surfaces with a similar f_0 trend when it is followed by L%. The only difference is that *the rise in f_0 and the subsequent fall align to the rhyme as a whole*. The arrow marks in Figure 4.3 show this. Figure 4.3 also replicates Figure 4.2 in the way the fall for the sequence of lexical L and L% surfaces. When the lexical H precedes L%, the pitch contour surfaces with a noticeable rise in f_0 aligned to the rhyme of the final syllable followed by a fall to low target for L%. The f_0 value at mid-point relative to time (at 50% point of the pitch span within two boundaries) of ɯ and ŋ is found to be higher when they surface with lexical H specification (0.07 hz vs -0.13 hz for ɯ and -0.28 hz vs -0.44 hz for ŋ, n = 20) compared to their occurrences in tʰàŋ-dɯŋ 'live-Prf'. Results of repeated measure Anova showed presence of significant difference between the f_0 at mid-point of the two segments in the above mentioned two contexts $F(1, 3) = 9.23$, $p < 0.05$ with no significant interaction $F(4, 12) = 1.25$, $p = 0.339$ for ɯ and $F(1, 3) = 32.148$, $p < 0.05$ with no significant interaction $F(4, 12) = 4.512$, $p = 0.06$ for ŋ. These results show that *f_0 remains higher during the rhyme of the final syllable when lexical H precedes L%*. This suggests that the underlying lexical H specification shows a different phonetic manifestation when H is followed by L%. This kind of two distinct f_0 trends do not surface in a noticeable way when lexical L is followed by L%. When the sequence of final lexical tone and boundary tone refers to contrastive targets, the pitch contour surfaces with two f_0 trends. Similar f_0 trend is noticed in the instance of a sequence of final L lexical tone and H% boundary tone. Section 4.2.2 throws some light on this. Results presented in this section provide important theoretical impetus as far as interaction between lexical and intonational tones and their alignment are concerned. In Somali, when the lexical H tone occurs phrase-finally in a statement, the H on the last syllable retracts to the penultimate syllable (Yip 2002; Banti 1988). The Otomi language Mazahua solves the problem of accommodating lexical and phrasal tones by placing them on entirely different syllables (Pike, 1975). Lexical tones align to non-final syllables and this leaves the final syllable as the domain for aligning phrasal tones. The prosody of Boro employs the following means to deal with the issue of alignment of the two lexical tones and L% for statements:

- Both the lexical and intonational tones can align to the rhyme of the final syllable.
- f_0 dips to a lower target for L% when L% is preceded by L tone.
- f_0 remains higher during the rhyme of the final syllable when lexical H precedes L%.
- A sequence of final H and L% results in delayed fall of the pitch to the low target.

4.2.2 Incomplete Utterances

Incompleteness in Boro is marked by H% boundary tone. *The discussion in this section highlights the surface realization of the two lexical tones in Boro when they are followed by H% for incomplete utterances*. Figure 4.4 presents the pitch contours for two incomplete sentences considered in the data series. The panel on the top presents the pitch track of an incomplete utterance ending with L tone (lexical tones in Boro derived words occur right aligned in PrWd domains). The pitch contour presented on the lower panel is of a tone sequence ending with H tone. Although the pitch contours in both the panels end with H%, there is a noticeable difference in the way the f_0 contours of the final constituents surface.

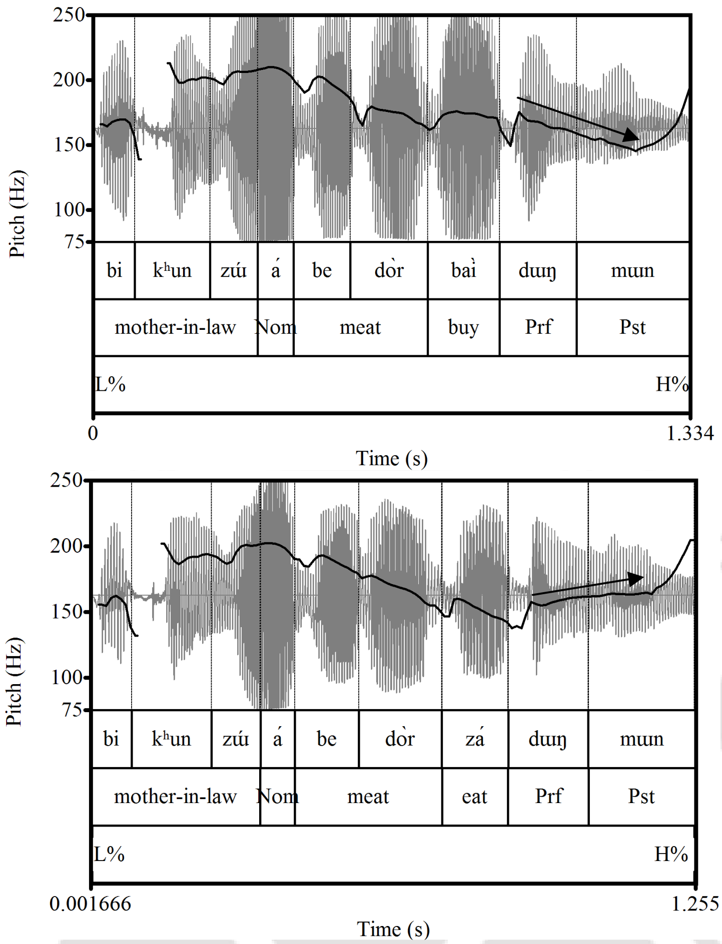


Figure 4.4: **Pitch contour for incomplete expressions.** The panel on the top presents the pitch track of the incomplete sentence bikʰunzɯ́á bedòr baìdɯŋmɯn……. 'Mother-in-law bough egg……' and that of the sentence bikʰunzɯ́á bedòr zádɯŋmɯn……. 'Mother-in-law ate egg……' in the other panel. Both the pitch contours end in H%.

It can be seen in the upper panel of Figure 4.4 that the final part of the pitch contour surfaces with a sharp rise in f_0 for H%. The boundary tone has aligned to the last syllable of baìdɯŋmɯn 'but-Prf-Pst'. The low target for the final lexical L tone has also aligned to the final syllable (shown by the arrow). No such dip in f_0 can be noticed in the pitch contour for the final syllable of zádɯŋmɯn 'eat-Prf-Pst' in the lower panel of Figure 4.4. Since the H tone in Boro surfaces with rising pitch aligned to the right edge of the PrWds, the pitch contour for zádɯŋmɯn 'eat-Prf-Pst' surfaces with a steady rise till some part of the final syllable (shown by the arrow) before rising steeply to a high target for the final H%. Interaction between homophonous words with the two contrastive tones in Boro and the H% marking incompleteness reveals some important aspects regarding (a) tonal alignment vis-à-vis lexical and boundary tones and (b) scaling of the boundary tone when it follows the two contrastive lexical tones.

Comparison of pitch contours of homophonous sentences in the data series with H and L tones preceding the H% for incompleteness has provided support to our earlier claim that *both the lexical and intonational tones align to the rhyme of the final syllable*. Figure 4.5 presents z-score normalized pitch contours of the final constituents of the sentences in (5) and (6) when they convey the meaning of incompleteness.

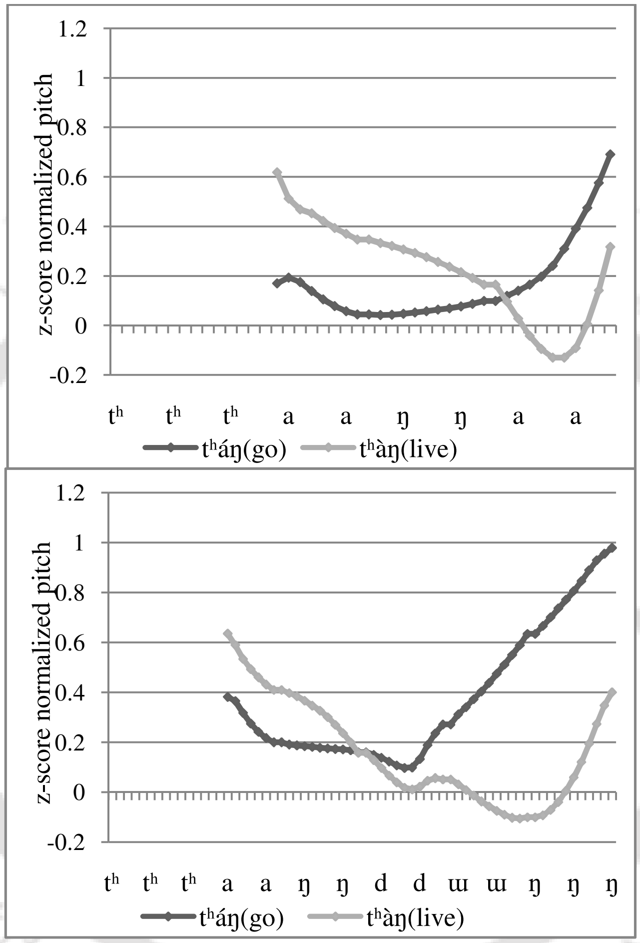


Figure 4.5: **Right edge H/L tones aligned to final syllable followed by H%.** Averaged z-score normalized values for 11 points for each intervals (n=20) of tʰaŋ-a 'go/live-Neg' (upper panel) and of tʰaŋ-duɯŋ go/live-Prf in (lower panel) occurring in sentences ending with H%.

The upper panel in Figure 4.5 shows that the lexical L of tʰàŋ–a 'live-Neg' interacts with H% in such a way that the f_0 dips to a low target for the lexical L and this is followed by a sharp rise to a high target for H%. Table 4.5 presents the f_0 points (see 4.1.3) in time to which the low target aligns when tʰàŋ–a 'live-Neg' precedes H% boundary tone. It presents the Minimum f_0 (Minf_0) points of all the iterations of tʰàŋ–a 'live-Neg' by all the participants. It can be seen that Minf_0 aligns to the 5th, 6th and 7th f_0 points of the final vowel.

S	tʰàŋa 'live-Neg'			tʰàŋdɯŋ 'live-Prf'		
	minf_0	Align	P	minf_0	Align	P
spu	0.03	a	5	-0.35	ŋ	2
spu	-0.10	a	6	-0.27	ɯ	9
spu	-0.21	a	6	-0.27	ɯ	11
spu	-0.14	a	7	-0.25	ɯ	10
spu	-0.10	a	6	-0.17	ɯ	8
sps	0.05	a	6	-0.19	ɯ	10
sps	0.17	a	6	-0.17	ɯ	10
sps	-0.10	a	6	-0.13	ɯ	9
sps	-0.05	a	6	-0.25	ɯ	10
sps	-0.16	a	7	-0.12	ɯ	11
spj	-0.4	a	6	-0.09	ŋ	2
spj	-0.36	a	7	-0.11	ŋ	3
spj	-0.33	a	7	-0.07	ŋ	2
spj	-0.43	a	7	-0.09	ŋ	3
spj	-0.39	a	7	-0.02	ŋ	2
spd	-0.26	a	7	0.08	ɯ	5
spd	-0.15	a	6	-0.6	ɯ	7
spd	0.18	a	6	-0.01	ɯ	2
spd	-0.01	a	6	-0.07	ɯ	3
spd	0.00	a	7	-0.08	ɯ	2

Table 4.5. **Low target for L tone preceding H%.** Minimum f_0 (minf_0) of the second syllables of tʰàŋa 'live-Neg' and tʰàŋdɯŋ 'live-Prf' and the f_0 points (P) of the segment (Align) it is aligned with. Values for all the iterations (5) by each speaker (S) are shown.

As the first point for this f_0 calculation has been defined as 'startpitch' point (see 4.1.3), the 5th, 6th and 7th points here refers to 40%, 50% and 60% in time of the whole f_0 span of the final vowel of tʰàŋ–a 'live-Neg'. The pitch then rises sharply till the 'endpitch' point for the final H%. Z-score normalized pitch contour for tʰáŋ-a 'go-Neg' shows that the pitch rises continuously during the final vowel. The end pitch point is scaled higher when H lexical tone precedes H% compared to the f_0 target for H% following L tone.

The lower panel of Figure 4.5 presents the pitch contour of the final constituents of the sentences in (6) when they end with H% expressing incompleteness. In the final occurrence of tʰàŋ–a 'live-Neg' (upper panel of Figure 4.5) followed by H%, Minf_0 aligns to 40% or 50% or 60% in time of the f_0 span of the final vowel. In the instance of tʰàŋdɯŋ 'live-Prf' followed by H%, the f_0 fall to a low target sometimes aligns to the end of the vowel in -dɯŋ 'Prf' and sometimes Minf_0 aligns to the beginning of the coda consonant. Subsequently it reaches a high target at the end of the coda. Table 4.5 shows the Minf_0 value of the rhyme of tʰàŋdɯŋ 'live-Prf'. It can be seen that for 14 iterations out of 20 the Minf_0 aligns to the vowel of the last syllable in tʰàŋdɯŋ 'live-Prf' and for 6 iterations the Minf_0 aligns to the final coda consonant. Thereafter, the f_0 rises sharply to a high target for the boundary H%. Thus two f_0 trends align to the pitch points in time of the rhyme of the final syllable and this suggests that both the lexical and intonational f_0 specifications remain anchored to the rhyme of the final syllable. Compared to this, the pitch shows a continuous rise through the rhyme of the last syllable when lexical H precedes H%. In this instance also *the f_0 target is scaled higher for H% compared to that of H% following lexical L.*

Lexical tones show difference in alignment when the boundary H% is preceded by a recursive PrWd domain. In the instances of disyllabic final words (minimal PrWd) occurring with H% boundary tone, both the lexical and intonational f_0 specifications remain anchored to the last syllable. Results have revealed that the lexical tone may also align to the penultimate syllable in addition to the final syllable when a trisyllabic word (recursive PrWd domain) occurs as the final constituent in an incomplete utterance. Figure 4.6 presents the pitch contours of the final constituents of the sentences in (7) expressing incompleteness.

(7) bí-ɯ zakʰór zà-dɯŋ-mɯn
he-Nom eater be-Prf-Pst
He became gluttonous

bí-ɯ daodɯí zá-dɯŋ-mɯn
he-Nom egg eat-Prf-Pst
He ate egg.

It can be seen in Figure 4.5 that the low target for the f_0 rise to H% has aligned to the beginning of the final syllable in tʰáŋ-dɯŋ 'go-Prf'. Similarly the fall to the Minf_0 in tʰàŋdɯŋ 'live-Prf' also has aligned to the beginning of the final syllable. Thus the pitch contours for tʰáŋ-dɯŋ 'go-Prf' and tʰàŋdɯŋ 'live-Prf' intersect at the end of the first syllable and then the f_0 starts its movement into two opposite directions corresponding to the two lexical tones. A comparison between the pitch contours of tʰàŋdɯŋ 'live-Prf' and tʰáŋ-dɯŋ 'go-Prf', versus that of zà-dɯŋ-mɯn 'be-Prf-Pst' and zá-dɯŋ-mɯn 'eat-Prf-Pst' shows that the f_0 trends of the first syllables of these IP final constituents surface in the same way. The f_0 features marking the two lexical tones, align only to the second syllable.

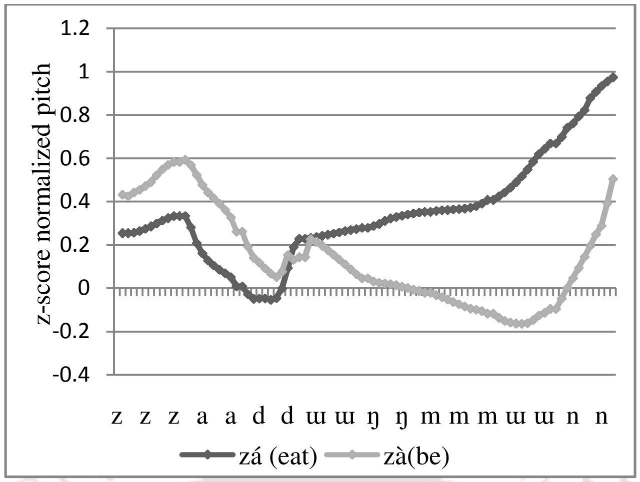


Figure 4.6: **IP final H/L tones aligned to minimum and recursive PrWd domains.** Averaged z-score normalized values for 11 points for each intervals (n=20) of zà-dɯŋ-mɯn 'be-Prf-Pst' and zá-dɯŋ-mɯn 'eat-Prf-Pst' when they occur as the final elements in an incomplete utterance.

One can see this distinction appear in the disyllabic sentence final words and in both the last two syllables in the trisyllabic sentence final words. Section 4.2.3 will present additional evidence for lexical tones aligning to both the second and third syllables in trisyllabic sentence final words. It will also be shown that lexical tones align only to the second syllable along with the intonational boundary tones when disyllabic words occur in IP final position. We will propose that a phonological factor rather than a case of phonetic interpolation influences this kind of difference in tonal alignment between disyllabic and trisyllabic IP final words. Section 3.1 has presented evidence to suggest that PrWd domain in Boro is minimally disyllabic. A suffix added to this minimal PrWd domain forms a recursive PrWd domain. In such a trisyllabic recursive PrWd domain, lexical tone aligns to the rightmost syllable by spreading from the second syllable. Due to this, both the second and the third syllables surface with the lexical tone aligned them. This phonological requirement associates the lexical tone to both the second and third syllables in trisyllabic IP final words.

The *H% boundary tone expressing incompleteness seems not to have any consistent effect on the global intonational pattern of the IPs in Boro*. Comparison of z-score normalized pitch contours of homophonous sentences with L% for statements and with H% for incompleteness does not reveal any consistent pattern for the 4 participants so far as the global pitch contours of the IPs are concerned. Figure 4.7 presents the pitch contours of the sentence bí-ɯ nɔ́-ao tʰáŋ-ɯ 'He goes home' with each of the panels showing the difference in averaged z-score normalized pitch contour between the occurrence of the sentence as a statement and an incomplete utterance. Each of the panels presents pitch contour for one of the 4 participants.

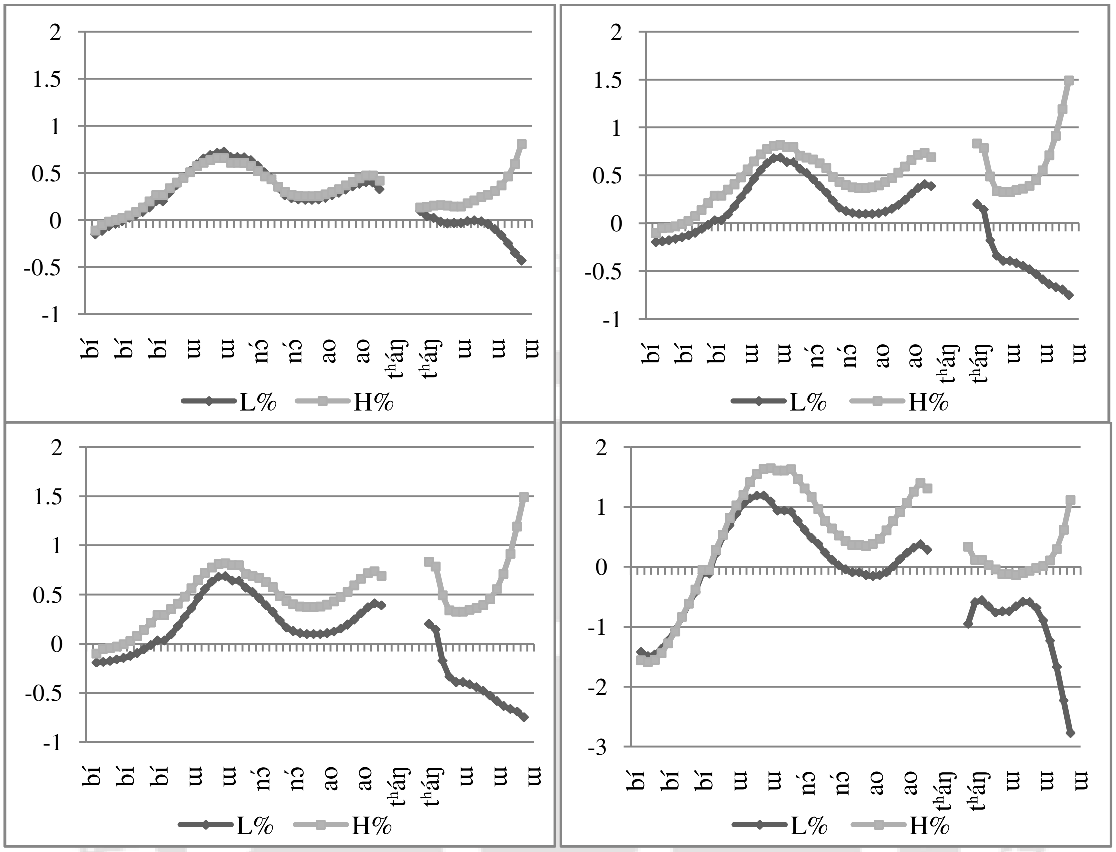


Figure 4.7: **L% and H% following HHH tone sequence.** Z-score normalized pitch contours aggregated for all the iterations by each of the participants for the sentence bí-ɯ nɔ́-ao tʰáŋ-ɯ 'He goes home' spoken as a statement and as an incomplete utterance.

Figure 4.8 presents the same comparison for the sentence bí-ɯ dɯì lùŋ-ɯ 'He drinks water'. It can be seen that for some speakers/sentences H% leads to overall raising of the register. However, there can also be seen other instances where H% has had only a local effect and it is manifested only with a sharp rise at the right edge. This is evident in both Figure 4.7 and Figure 4.8.

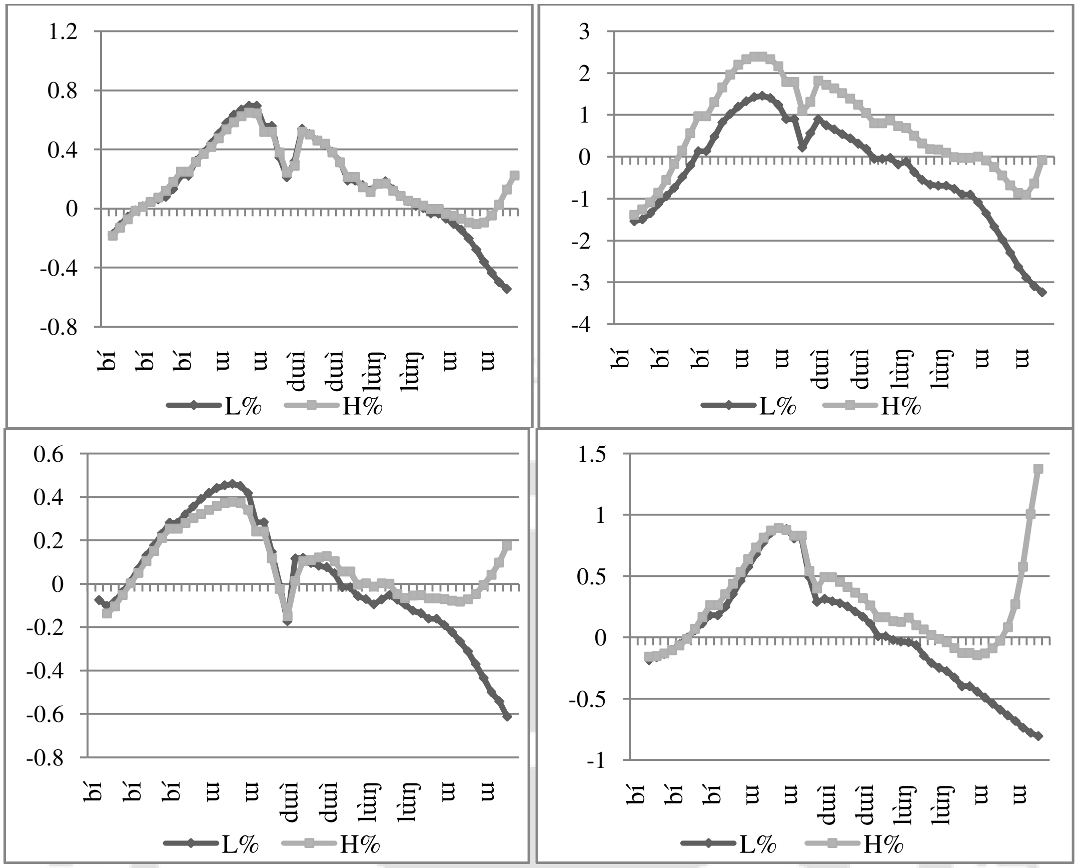


Figure 4.8: **Global effects of L% and H% on HLL tone sequence.** Z-score normalized pitch contours aggregated for all the iterations by each of the participants for the sentence bí-ɯ dɯì lɯ̀ŋ-ɯ 'He drinks water' spoken as a statement and as an incomplete utterance.

Sometimes, IP final rising intonational tones interact differently with the lexical tone occurring at the right edge. It may modify the lexical tone or it may also allow the lexical tone to coexist with it[16]. The H% boundary tone in Boro does not obliterate the pitch trend of the lexical tone preceding it. Results presented above show that the falling contour of the lexical L tone is not neutralized in Boro when it is followed by H% boundary tone expressing incompleteness. The prosodic aspect of the interaction between H% and the two lexical tones in Boro can be summarized as below:

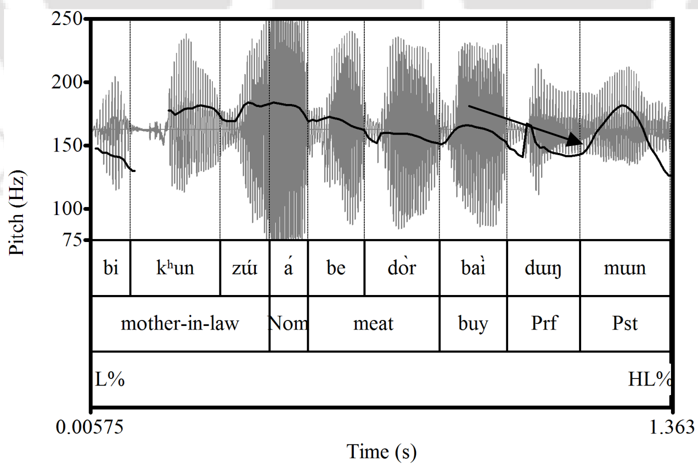
- H% for incompleteness does not have any global effect on the pitch contour of IPs.
- The high target for H% is scaled higher when H% is preceded by H tone.

[16] Thai questions are formed by adding a high tone at the end (Anawin, 1998) and when this tone occurs with a falling tone, the fall in neutralized and a level tone results. Chao (1968) notes that utterance final rising intonational tones are additive in Chinese, which are not allowed to replace the lexical tones. Thus in instances of the final rising intonational tone added to a final lexical fall, it produces a lengthened syllable on which a fall-rise sequence is realized.

- Pitch contour drops to a low target aligned to the rhyme of the final syllable when H% is preceded by L tone.
- Lexical tones align to both the minimum PrWd and recursive PrWd domains when a trisyllabic word occurs at the right edge of an IP marked by H% expressing incompleteness.

4.2.3 Yes/No questions (without question particle)

Questions in Boro expecting answers in the form of yes or no can be formed by adding the question particles ‘na’ or ‘nama’ at the right edge. Such questions can also be asked in the language without the addition of the question particle, based solely on intonational contours. Yes/No questions in Boro (without question particle) differ from statement in having a different boundary tone. *This section provides acoustic evidence to show that a falling pitch contour at the right edge marks yes/no questions (without question particle) in Boro*. This boundary tone is phonetically realized by a steep rise of the f_0 to a high target followed by a sharp fall to a low f_0 target. *This pitch transition can be defined as an HL% boundary tone*. Examination of the pitch contour of all the yes/no questions in the data set shows that the pitch rise to a high target and the subsequent fall to a low target align to the final syllable of the IP. This can be seen in Figure 4.9, where in both the panels, the f_0 targets for the rise and fall is visibly aligned to the IP final syllable -mɯn ‘Pst’.



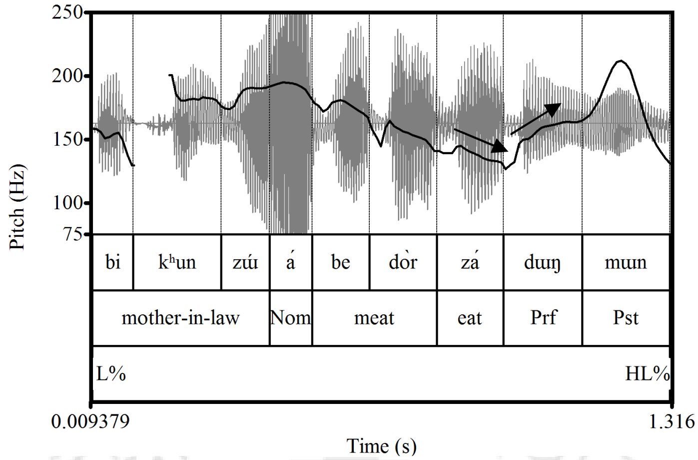


Figure 4.9: **Boundary tone for yes/no questions and final L/H tones.** The upper panel shows the pitch contour of bikʰunzúɯá bedòr baìdɯŋmɯn? 'Did mother-in-law buy meat?' where the boundary HL% is preceded by a sequence lexical HLL tones. The lower panel presents the same boundary HL% preceded by a sequence of HLH lexical tones in bikʰunzúɯá bedòr zádɯŋmɯn? 'Did mother-in-law eat meat?'

The f_0 trends of the penultimate syllables in both the panels in Figure 4.9 acquaint us with the alignment pattern of IP final lexical tones in the presence of a bitonal boundary tone like HL%. Section 4.2.2 has already shown how, in Boro, lexical tones can coexist with a monotonal boundary tone like H% expressing incompleteness. Figure 4.5 has shown how both the lexical and intonational tones can align to the rhyme of the final syllable. Figure 4.9 presents a slightly different picture where *the bitonal boundary tone leaves no room in the last syllable for the characteristic f_0 movement for the lexical tones*. Although f_0 trends do not show any rise or fall for lexical tones aligned to the IP final syllable in Figure 4.9, it seems the lexical tone is not totally obliterated by HL%. The pitch contours of the penultimate syllables in both the panels in Figure 4.9 show two different f_0 trends. The arrow mark in the upper panel in Figure 4.9 shows how the pitch surfaces with a downward trend aligned to the penultimate syllable. The penultimate syllable in the lower panel in Figure 4.9 surfaces with a rising contour as shown by the arrow mark. This difference in f_0 trend of the penultimate syllables may be attributed to the fact that the final lexical items in both these panels are specified with two different tones. Since zádɯŋmɯn 'eat-Prf-Pst' in the lower panel is lexically specified with a high tone, the f_0 specification of the high tone surfaces in the penultimate syllable with a rising contour. baìdɯŋmɯn 'buy-Prf-Pst' in the upper panel is lexically specified with a low tone and the f_0 specification of the low tone surfaces in the penultimate syllable with a falling contour. This presents yet another evidence of the way lexical tones can coexist with intonational tones in a tone language, albeit in two neighbouring syllables. The alignment expectation that the lexical specification would associate to the penultimate syllable when the bitonal HL% aligns to the IP final syllable is not fulfilled when a minimum disyllabic PrWd domain occupies the IP final position in HL% specified yes/no questions in Boro. Figure 4.10 presents more evidence for this.

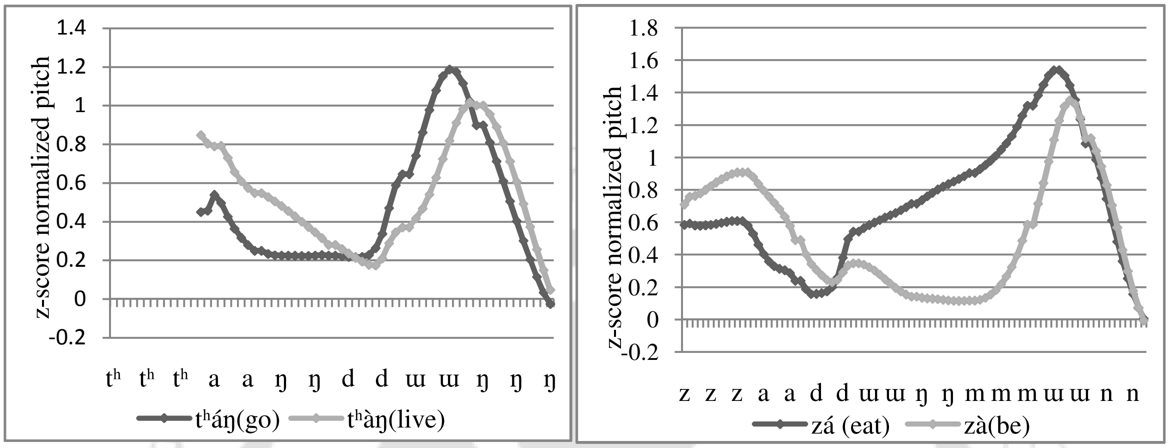


Figure 4.10: **Interaction between final L/H and HL%.** Averaged z-score normalized values for 11 points for each intervals (n=20) of tʰaŋ-dɯŋ *go/live-Prf* (left panel) and of za-dɯŋ-mɯn *eat/be-Prf-Pst* (right panel) when they occur as final constituents of yes/no questions.

The panel on the left in Figure 4.10 presents aggregated z-score normalized f_0 contour of tʰaŋ-dɯŋ *go/live-Prf* occurring at the right edge of yes/no questions (n=20). It can be seen that *the H and L targets for HL% align to the rhyme of the final syllable* -dɯŋ 'Prf'. Also, *there cannot be detected any residual f_0 trend marking the lexical tones* as there is absence of any gradual rise or fall aligned to the rhyme of the last syllable or of the penultimate syllable. Two additional f_0 facts emerge. The high f_0 target for HL% is scaled higher when it occurs at the edge of tʰáŋ-dɯŋ 'go-Prf'. Secondly, the high target for HL% is aligned earlier in time relative to the pitch points in tʰáŋ-dɯŋ 'go-Prf'. These two f_0 features of HL% can also be noticed in the other panel of Figure 4.10 which presents z-score normalized f_0 contours of the final occurrence of za-dɯŋ-mɯn 'eat/be-Prf-Pst' in yes/no questions. It can be seen that f_0 is raised to a higher target for HL% in zá-dɯŋ-mɯn 'eat-Prf-Pst' and the peak is aligned earlier. The f_0 values for each of the pitch points (from startpitch to endpitch) of the final syllables of all the iterations of tʰaŋ-dɯŋ 'go/live-Prf' and za-dɯŋ-mɯn 'eat/be-Prf-Pst' with H or L lexical tone were examined. Results showed that compared to a sequence of L tone and HL%, only in the instances of 14 iterations out of 20 for each word with a sequence of lexical H and boundary HL% the high target for HL% is aligned earlier with a gap of two f_0 points (20% of the pitch span). In the rest of the iterations the high targets align to the same f_0 points irrespective of HL% following L tone or H tone. This suggests that *early peak alignment for HL% occurring with lexical H does not emerge as a consistent pattern* for all the iterations.

The *scaling difference for the H target for HL% occurring with the two tones* presented a different picture. A repeated measure Anova measuring the scaling difference of the high target for HL% in instances of it occurring with H and L tones showed that the peak is realized higher with tʰáŋ-dɯŋ 'go-Prf' and zá-dɯŋ-mɯn 'eat-Prf-Pst'. The mean of maxf_0 of all the instances of HL% (n=40) in tʰáŋ-dɯŋ 'go-Prf' and zá-dɯŋ-mɯn 'eat-Prf-Pst' is 1.35 hz compared to 1.15hz for that of tʰàŋ-dɯŋ 'live-Prf' and zà-dɯŋ-mɯn 'be-Prf-Pst, $F(1, 3) = 22.76$, $p < 0.05$ with absence of any significant interaction, $F(9, 27) = 0.204$, $p = 0.992$.

A comparison between the two panels in Figure 4.10 reveals another important aspect of the way tone and intonation interact in Boro. It can be seen in the panel on the right of Figure 4.10 that the lexical H specification of zá-dɯŋ-mɯn 'eat-Prf-Pst' is not neutralized in the same way it is accomplished in the case of tʰáŋ-dɯŋ 'go-Prf' (left panel). The lexical H specification surfaces in the second syllable of zá-dɯŋ-mɯn 'eat-Prf-Pst' as the f_0 shows a rising trend aligned to this syllable. The second syllable of zà-dɯŋ-mɯn 'be-Prf-Pst' also surfaces with a falling contour in Figure 4.10. A repeated measure Anova was run to examine whether the value for f_0 at mid-point of the second syllable of zá-dɯŋ-mɯn 'eat-Prf-Pst' consistently differ from that of zà-dɯŋ-mɯn 'be-Prf-Pst'. Results showed that the meanf_0 for mid-point of the vowel of the second syllable zá-dɯŋ-mɯn 'eat-Prf-Pst' (n=20) is higher (0.59 hz) than that of zà-dɯŋ-mɯn 'be-Prf-Pst' (0.32 hz), $F(1, 3) = 12.83$, $p< 0.05$ with no significant interaction, $F(4, 12) =1.96$, $p = 0.16$. The rise in the second syllable of zá-dɯŋ-mɯn 'eat-Prf-Pst' is triggered by a phonological necessity rather than it is caused by phonetic interpolation to the next high target. The absence of a similar upward movement of the f_0 during the first syllable of tʰáŋ-dɯŋ 'go-Prf' in Figure 4.10 (left panel) can be cited as the reason for this assumption. Since a lexical tone has to align to the rightmost syllable in the minimal disyllabic PrWd domain in Boro, the second syllable of zá-dɯŋ-mɯn 'eat-Prf-Pst' also surfaces with H tone. As tʰáŋ-dɯŋ 'go-Prf' itself constitutes the minimal disyllabic PrWd domain, the rising f_0 contour for H tone has to associate to the second syllable following the rule of alignment to the rightmost TBU. Z-score normalized pitch contours of zá-dɯŋ-mɯn 'eat-Prf-Pst' expressing incompleteness with H% in Figure 4.6 also shows how the second syllable surfaces with a rising pitch. As explained above, a phonological requirement makes the second syllable of these words surface with lexical f_0 specification. The disyllabic word domain in Boro is obligatorily specified with a lexical tone at its right edge. Section 3.1 has already explained that the PrWd domain in Boro is minimally disyllabic and lexical tones align to the right of this domain. In the instances of a trisyllabic derived word occurring at the boundary of phrases like a yes/no question or incomplete utterance, the penultimate syllable provides a second domain for lexical tone association in addition to the final syllable. This suggests that the disyllabic word frame in Boro has to have a right aligned lexical specification at the phrasal level too. Thus, in Boro, *the features of PrWd domain remain relevant at the phrasal level. Tone is obligatorily assigned to the prosodic word domain and information structure requires that even semantic-pragmatic categories like question formation will also be encoded in this domain.*

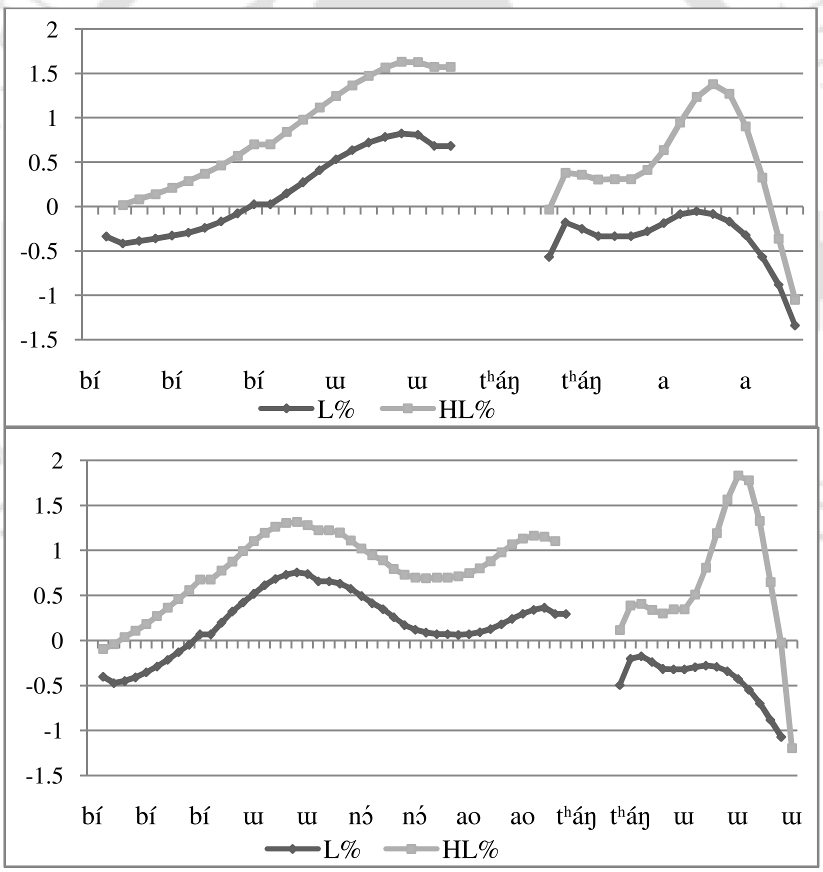


Figure 4.11: **Global raising and HL% for yes/no questions.** Averaged z-score normalized pitch contours (n=20) for bí-ɯ tʰáŋ-a 'He does not go' in the upper panel and bí-ɯ nɔ́-ao tʰáŋ-ɯ 'He goes home' in the lower panel. The dark lines present the pitch contours for statements and the light lines present the pitch contour for yes/no questions without question particle.

Section 4.2.2 has shown that the H% for incomplete utterances in Boro does not have any consistent global effect on the pitch contour of the IP. However, a comparison of the pitch contours of homophonous sentences with L% for statements and HL% for yes/no questions has revealed that *HL% boundary tone for yes/no questions raises the pitch register for the whole IP*. Figure 4.11 presents one such comparison. The upper panel of Figure 4.11 shows how the HL% boundary tone raises the pitch contour of the sentence bí-ɯ tʰáŋ-a? 'Doesn't he go?'. The lower panel of Figure 4.11 compares the pitch contours of a longer sentence and it can be seen that bí-ɯ nɔ́-ao tʰáŋ-ɯ 'Does he go home?' is pronounced with a higher pitch register compared to the instance when the same sentence is pronounced with L% boundary tone.

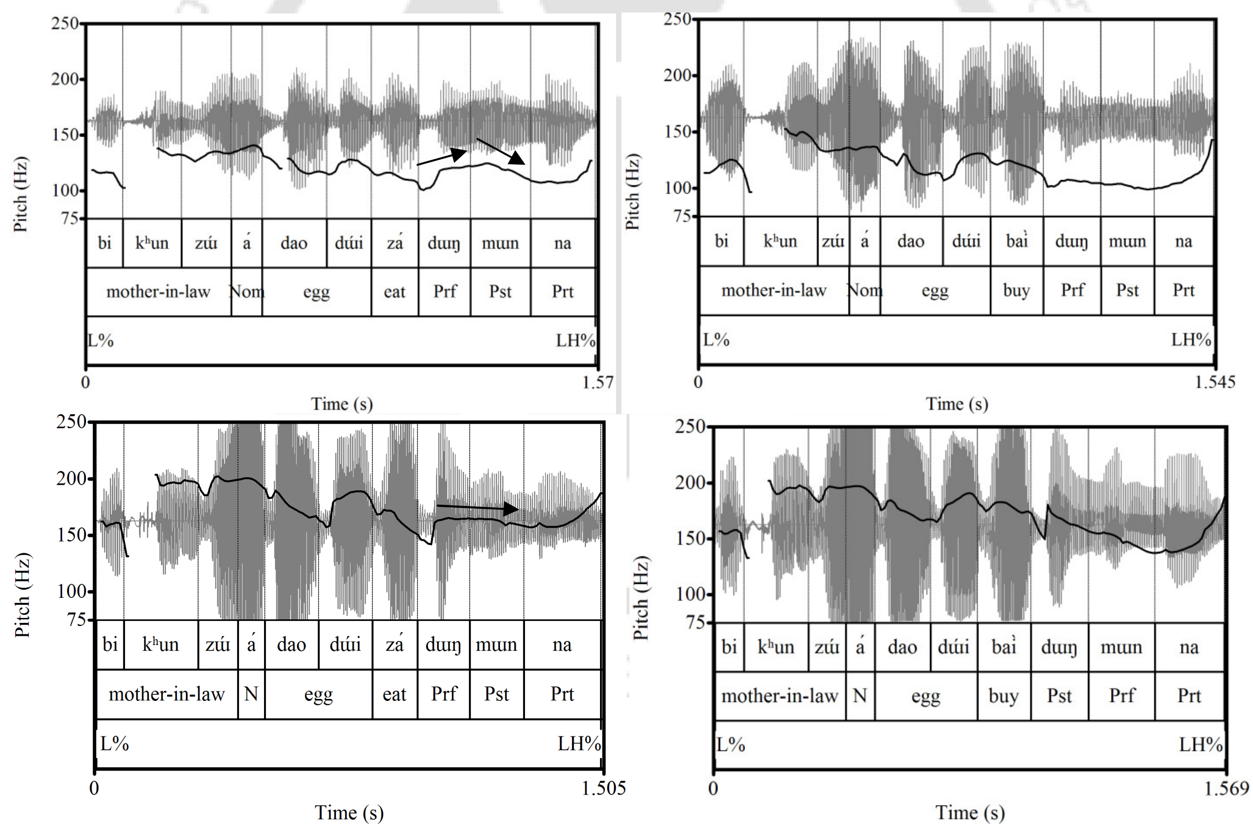
Questions without any syntactic or morphological markers present ample scope for studying the effect of intonation (Haan et al., 1997). Raising of pitch register as a prosodic means for interrogativity is attested in the study of intonation[17]. Rialland (2007) informs that final rising intonation for yes/no question can be found in many African tone languages and post-lexical HL melody is quite uncommon in these languages. Myers (1996) presents evidence to show that in Chichewa yes/no question is marked by H%. Yes/no questions can also end with an L% boundary tone as is the case in Chickasaw (Gussenhoven, 2004). Boro presents a different perspective since yes/no questions without morphological markers are intonationally marked by HL% boundary tone. Following are the prosodic features of such questions in Boro:

- Yes/no questions (without question markers) in Boro end with the bitonal HL% boundary tone.
- These questions are also marked by register raising for the whole IP.
- The H and L targets for HL% align to the IP final syllable.
- f_0 signal for the final syllable does not suggest any movement signifying H or L lexical tones when the HL% boundary tone aligns to the same syllable.
- Lexical tones can align to the penultimate syllable in trisyllabic words when the HL% boundary tone aligns to the IP ultimate syllable.
- The H target for HL% is scaled higher when the IP ends with H lexical tone.

[17] The intonational phenomenon of questions being uttered with a higher pitch register compared to declaratives have already been discussed by Inkelas and Leben (1990) in connection with Hausa where the raising effect is termed as Global raising. The global cue of raised pitch register appears to be a universal phonetic product of interrogativity (Gussenhoven, 2004). Berry and Aidoo (1975) and Dolphyne (1988) observe that yes/no question in Akan show a global f_0 effect which results in raising of both L and H tones to a higher register compared to their statement counterpart. This result is confirmed again by the study by Genzel (2013).

4.2.4 Yes/No questions (with question particle)

Interrogative sentences in Boro can also be formed with the addition of the interrogative particle ‘na’ after the main verb of the sentence. The experiment presented in this chapter included several yes/no questions with the question particle occurring with the last word specified with either lexical H or L tone. This section will show that irrespective of the underlying tone of the last word of the question, *yes/no questions with the particle ‘na’ end with LH% boundary tone.* Figure 4.12 presents the pitch contours of two yes/no questions differing in the IP final lexical tone. Each of these two yes/no questions ends with ‘-na’ particle. The panels in each row of Figure 4.12 compare the pitch contours for the two sentences produced by each of the participants. The panels on the left column present pitch contours with final lexical H tone and the panels on the right column present pitch contours for questions ending with lexical L tone.



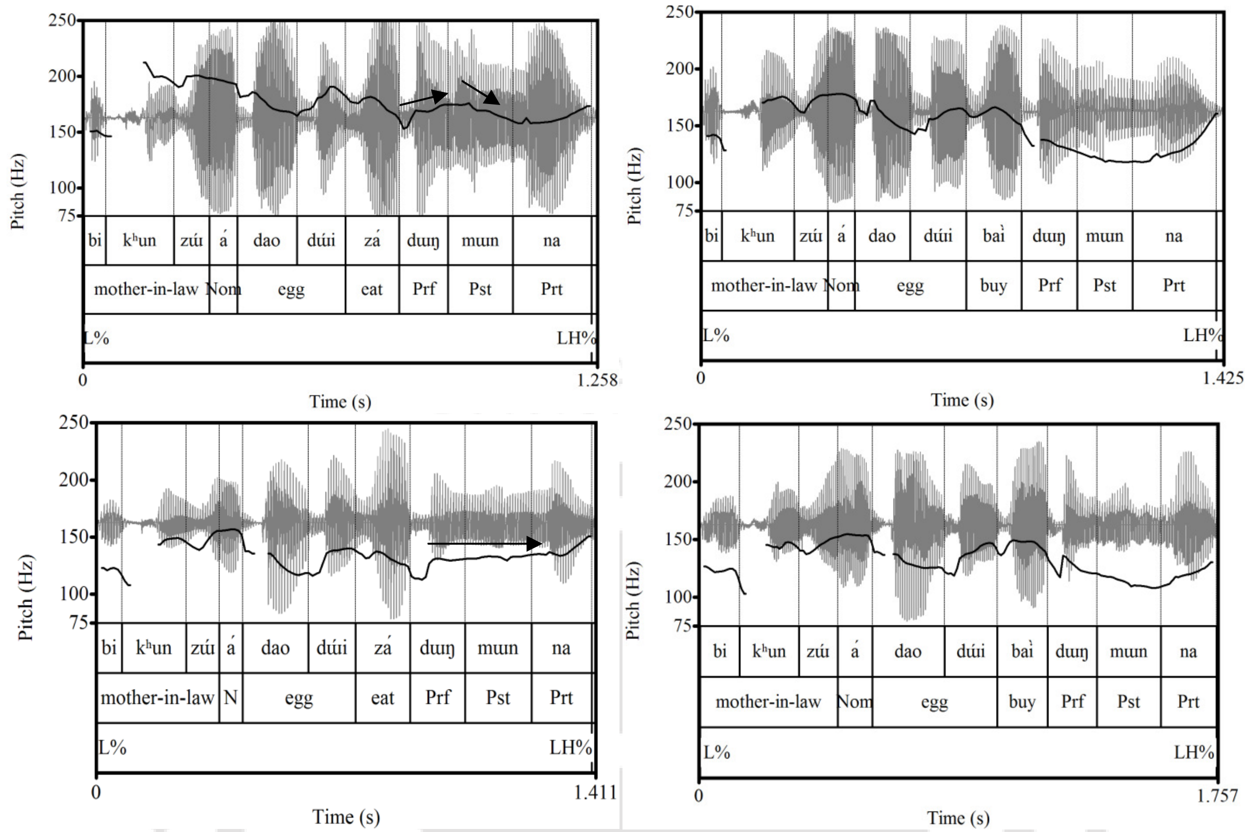


Figure 4.12: **Sequence of L/H tones and LH%.** The panels on the left column show how LH% aligns to the final syllable of bikʰunzɯ́á daodɯ́i záduɯŋmɯnna? 'Did mother-in-law eat egg?' and the panels on the right column show how LH% associates with the right edge of bikʰunzɯ́á daodɯ́i baìdɯŋmɯnna*?* 'Did mother-in-law buy egg?' ending with lexical L tone.

It can be seen in each of the panels on the right column of Figure 4.12 that f_0 *falls to a low target aligned to the question particle and subsequently it rises steeply to a high target*. Since baìdɯŋmɯnna 'buy-Prf-Pst-na' is specified with lexical L tone, it surfaces with a falling pitch contour. This fall is interrupted by a sharp rise aligned to the question particle itself. We assume that the final rise is the result of a LH% boundary tone and this LH% boundary tone is preceded by a lexical L tone aligned to the penultimate syllable of the questions ending with baìdɯŋmɯnna 'buy-Prf-Pst-na'. Thus the low f_0 target for the lexical tone in baìdɯŋmɯnna 'buy-Prf-Pst-na' is followed by another low target for LH%.

When the lexical L tone of the final word is substituted by an H tone, as in case of the verb stem like *zá* 'eat', the f_0 contour on the right edge surfaces only with a sharp rise. This can be seen in the pitch contours presented in the left column of Figure 4.12. It can be seen that the pitch points relative to time for záduɯŋmɯnna? 'eat-Prf-Pst-na' do not display any continuous rise in f_0 leading to the high target for LH%. Also the LH% boundary tone is scaled differently when it is preceded by lexical H tone. Since the final lexical H tone is followed by the LH% boundary tone, the high target for the lexical H and the low target for LH% influence each other. This results in two different pitch contours. The sequence of lexical H and boundary LH% surfaces with a high plateau followed by a sharp rise in the instances of pitch contours for two speakers (2nd and 4th row of Figure 4.12). For the other two speakers, the sequence surfaces as a fall to a low target followed by a sharp rise to a high target (1st and 3rd row of Figure 4.12). Pitch contours surface differently in the instances of the final lexical tone and the first element in LH% referring to similar and adjacent f_0 targets. The panels in the right column of Figure 4.12 show this. The low target for the L tone aligns to the penultimate syllable and another low target aligns to the question particle for LH%.

It can also be seen in Figure 4.12 that the question particle '-na' surfaces with a lengthened pitch in some instances compared to the preceding two syllables, although there is no coda consonant in the question particle. Gussenhoven (2004) gives examples from Central Franconian to show how increasing number of tonal targets, especially at the right edge, may result in lengthening of the pitch movement. Since the pitch movement during the question particle shown in Figure 4.12 has to align to two tonal target for LH%, it results in lengthening of the final syllable itself compared to the two closed syllables preceding it.

The yes/no question particle '-na' in Boro can also be followed by the question word 'ma' forming a '-nama' combination at the end of the questions. Analysis of the pitch tracks of these kind of questions has revealed that the right edge of these questions are marked by an LHL% boundary tone. The fall of the pitch at the edge of these questions is not as sharp as the one found in the case of yes/no questions (without question particle). The pitch contours presented in Figure 4.13 can be compared with that of Figure 4.9.

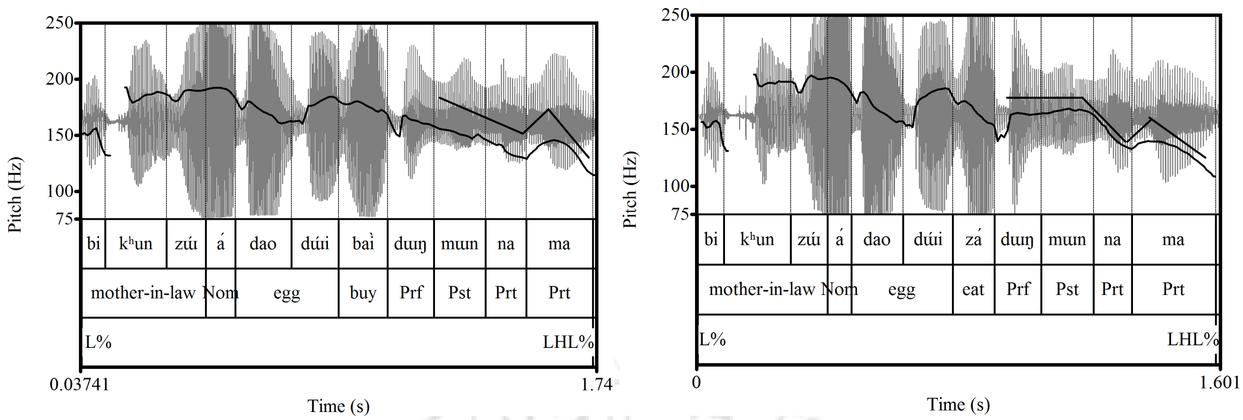


Figure 4.13: **Sequence of L/H tones and LHL%.** The pitch track on the left panel is of bikʰunzɯ́á daodɯ́i baìdɯŋmɯnnama? ‘Did mother-in-law buy egg?’ where the question particle ‘-nama’ surfaces with three f_0 targets. The panel on the right presents the pitch track of bikʰunzɯ́á daodɯ́i zádɯŋmɯnnama? ‘Did mother-in-law eat egg?’ where four f_0 targets surface for H LHL% final contour.

The boundary tone LHL% differs from HL% in the realization of the H target. The H target is scaled lower than what is found in the case of HL% boundary tone for yes/no questions (without question particle). The panel on the left in Figure 4.13 presents the pitch contour of one of the renditions of a question with ‘nama’ following baìdɯŋmɯn ‘buy-Prf-Pst’ bearing lexical L specification. Since the L lexical tone is immediately followed by the LHL% boundary tone, both the low targets (L tone and the initial L target for LHL%) surface as a continuous fall till the beginning of the final syllable ‘ma’.

The three targets of the LHL% boundary tone surface as a rising-falling pitch contour relative to the pitch points for the final syllable in the panel on the right in Figure 4.13. This Figure presents an instance where an H lexical tone precedes the final LHL%. The lexical H specification in zádɯŋmɯn ‘eat-Prf-Pst’ surfaces as a plateau aligned to the pitch points in time for the final two syllables of the word. Following this the f_0 dips to the initial low target of LHL%. Then the pitch rises to a high target before falling to the lowest f_0 level for the final L of LHL%. The trend lines for the pitch track show it. The three f_0 targets for LHL% scaled in a prominent way when LHL% is preceded by L lexical tone as in the panel on the left of Figure 4.13. In both the panels of Figure 4.13, the final syllable ‘ma’ surfaces with longer duration than the first constituent of the question particle ‘-nama’. This suggests that the last two tonal targets for LHL% align to the final syllable and due to two tonal targets aligning to it the last syllable ‘ma’ surfaces with lengthened pitch.

This section has discussed the intonational contours for yes/no questions in Boro marked by the question particles ‘ma’ and ‘nama.’ The alignment and scaling characteristics for the boundary contours for these two types of questions are summarized below.

- Yes/no questions (with question particles) in Boro are marked by LH% (for ‘na’ particle) and LHL% (for ‘nama’ particle) boundary tones.
- Both LH% and LHL% align to the questions particles.
- LH% and LHL% allow the lexical tone to align to the syllable preceding it.

4.2.5 Exclamations expressing surprise or disbelief

Surprise or disbelief in Boro is expressed by a particular boundary tone and without adding any morphological marker. The intonation contour which expresses surprise or disbelief in Boro is the same one used for incomplete sentences. *Acoustic characteristics of the sentences have shown that H% boundary tone is used for expressing surprise or disbelief in Boro. This boundary tone also affects the pitch contour of the IP by raising the register of the non-final lexical tones.* The H% for surprise or disbelief expressions follows the same pattern of alignment which is found in the case of incomplete sentences. Figure 4.14 presents pitch contours of sentences ending with L and H tones expressing surprise or disbelief.

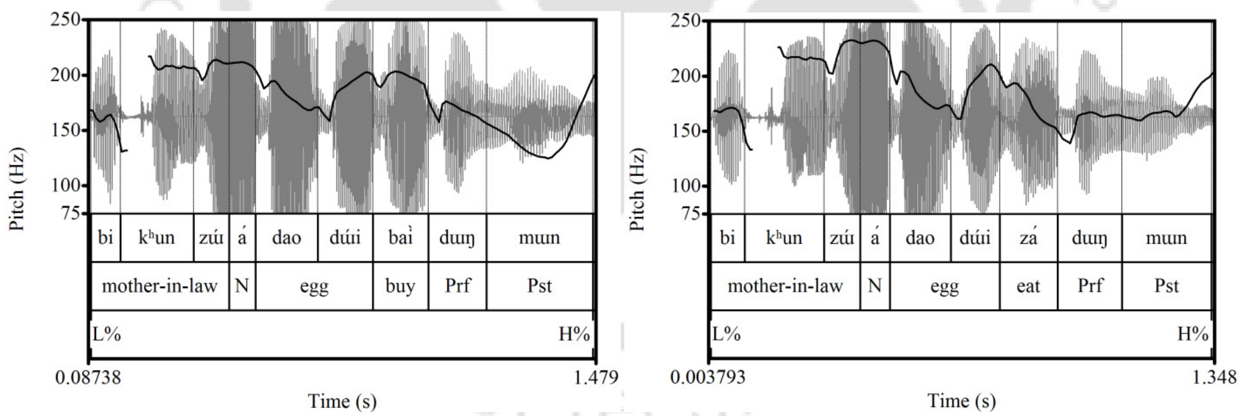


Figure 4.14: **Sequence of L/H tones and H% for surprise/disbelief.** The panel on the left presents the pitch contour of bik^{h}unzɯ́á daodɯ́i baìdɯŋmɯn! ‘Mother-in-law bought egg!’ and the panel on the right presents the pitch track of bik^{h}unzɯ́á daodɯ́i zádɯŋmɯn ‘Mother-in-law bought meat!’.

It can be seen in Figure 4.14 (left panel) that the f_0 dips to a low target before rising to a high one when the sentence ends with a lexical L tone. The f_0 falls to a low target for the IP final lexical L and then it rises to a high target for the final H%. This alignment schema is similar to what is found for incomplete sentences. *Both the final lexical and the intonational boundary* *tones align to the final syllable of surprise or disbelief expressions*. No such dip in f_0 is noticed when H% is preceded by lexical H specification. This can be seen in the other panel in Figure 4.14. The HH% final contour expressing surprise or disbelief surfaces with a plateau aligned to the pitch points in time for some part of the final syllable and this is followed by a steep rise to a high target. The last part of the contour in the panel on the right of Figure 4.14 is somewhat similar to the last part of the contour presented in the lower panel of Figure 4.4, where HH% expresses incompleteness. Since the right edges of Boro PrWds surface with a lexical specification, the contours presented in Figure 4.14 provide further evidence to suggest that both the lexical and intonational tones align to the IP final syllable in Boro.

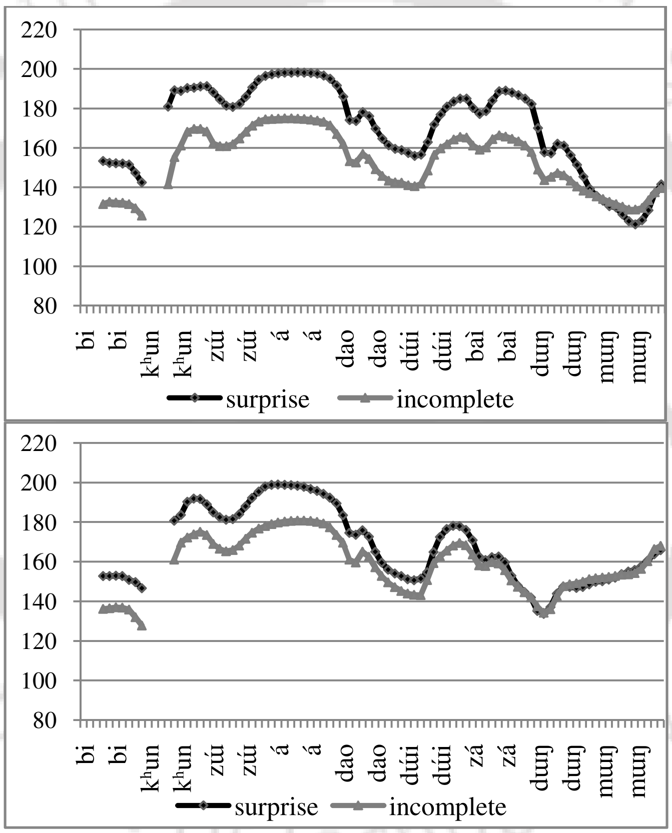


Figure 4.15: **H% for surprise/disbelief and non-final register raising.** The panel on the top presents the time normalized pitch contours of bikʰunzɯ́á daodɯ́i baìdɯŋmɯn 'Mother-in-law bought egg' expressing surprise (dark line) and incompleteness (light line), and the lower panel presents the pitch track of bikʰunzɯ́á daodɯ́i zádɯŋmɯn 'Mother-in-law bought meat' in the same two contexts.

Since both the incomplete sentences and sentences expressing surprise or disbelief in Boro are marked by H%, the averaged time-normalized pitch contours of two homophonous sentences differing only in the intended meaning were compared to examine whether H% influences the pitch contours of the two sentence types in different ways. *Results have shown that surprise or disbelief in Boro is expressed by raising the non-final lexical tones.* Figure 4.15 makes a comparison between two such pairs of sentences differing in the lexical tone of the final constituents.

The sentences in the two panels in Figure 4.15 differ in the lexical tone of the last PrWd. It can be seen in both the panels that the first two lexical tones are scaled higher when the sentences express the meaning of surprise or disbelief. However, the f_0 target for the final lexical tone and also for the boundary H% remain the same irrespective of the intended meaning of the sentence. The final part of the pitch contours of each pair of sentences in Figure 4.15 shows it. The raising of the f_0 targets in Figure 4.15 is quite different from what has been found in Figure 4.11. In the instances of yes/no questions without question particles, all the lexical tones surface with a higher register. But in surprise expressions, as shown in Figure 4.15, only the non-final lexical tones are scaled higher. *We assume an H% IP initial boundary tone for the register raising of non-final lexical tones*. This is similar to what Downing (1996) finds for questions in Jita[18]. In Boro, an incomplete utterance differs from a homophonous statement in employing a different boundary tone. An incomplete utterance ends with H% and a statement ends with L%. The non-final lexical tones in both these types of sentences are scaled in the same way. But lexical tones are not scaled in identical ways when H% occurs at the right edge of incomplete sentences and surprise expressions. Results presented for surprise or disbelief expressions in this section have revealed the following features of the prosody of such sentences:

- Surprise or disbelief is marked by H% aligned to the right edges of IPs in Boro.
- Compared to the pitch contours of incomplete utterances, non-final lexical tones are scaled higher when H% aligns to the right edges of sentences expressing surprise or disbelief.
- The raising effect can be phonologically interpreted as an initial high boundary tone, phonetically realized with a higher pitch register.
- The initial high boundary tone raises the register of only the non-final lexical tones.

[18] In Jita questions, the register is raised up to the penultimate syllable. This raising effect is phonologically interpreted as an initial High boundary tone (Downing, 1996).

4.2.6 Wh-question

Wh-questions are formed in Boro by placing the wh-words in-situ, that is, in the sentential position marked for the answer. The pitch contours for wh-questions in Boro is similar to those of the neutral statements. *Pitch contours for wh-questions have shown that such questions end with L% boundary tones.*

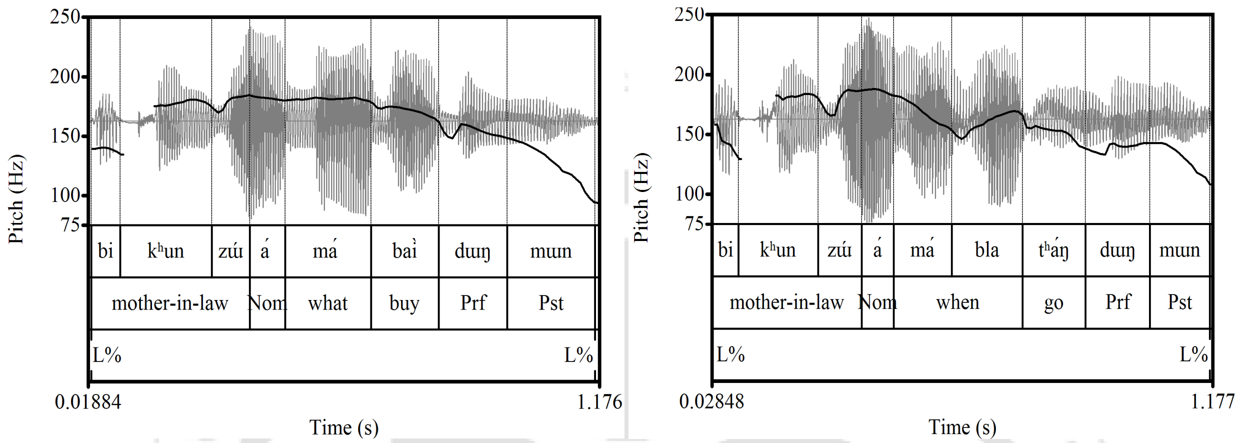


Figure 4.16: **wh-question and L%.** The panel on the left presents the pitch track for bikʰunzɯ́á má baìdɯŋmɯn? 'What did mother-in-law buy?' and the panel on the right presents the pitch contour of bikʰunzɯ́á mábla tʰáŋdɯŋmɯn? 'When did mother-in-law go?'

A survey of the questions with various wh-words in Boro has revealed that the sequence of citation tones are preserved respecting the prosody of tones occurring at IP edges of statements in Boro. Figure 4.16 presents the pitch contours for questions with two interrogative pronouns: má 'what' and mábla 'when'. It can be seen that the second H tone is realized with a lower f_0 target only when there are intervening syllables in between the two H lexical tones. The question with the interrogative pronoun má 'what' presents an instance where two adjacent H lexical tones occur. The first one has aligned to the right edge of the first PrWd and the second one has aligned to the interrogative pronoun itself. The two adjacent H tones surface as a high plateau. When there are intervening syllables between the right edge of the first PrWd and the right edge of the interrogative pronoun, the pitch contour does not surface with such a high plateau. This can be seen in the case of the mábla 'when' question. In the presence of the intervening syllable, the second H on mábla 'when' is realized as a downstepped H. Both these questions end in L%. The high plateau formed by the two adjacent H lexical tones in the má 'what' question suggests that the principle of OCP is violated in Boro, though an evaluation of more data would provide a clear insight into this. As far the right edge intonational tone is concerned, *wh-questions in Boro are marked by L% and this makes them intonationally similar to statements.*

4.2.7 Alternative questions

Alternative questions are a variety of yes/no questions and in Boro alternative questions are marked by the question particle ‘na’ occurring between the two alternatives presented to the addressee. In construction, such questions are similar to yes/no questions. The alternative questions in Boro can also be constructed in combination with wh-questions in the form of two answers and the addressee has to respond to one of them as the proper answer. Examples of these two types of alternative questions are: núŋ má baìgɯn? daodɯí na bedòr? ‘what will you buy? Egg or meat?’ and bibaría pʰɯ̀igɯn na tʰáŋgɯn ‘Bibari will come or go?’. This investigation contained 6 alternative questions including both the patterns mentioned above. The questions also included different sequence of lexical tones. They were also of different length which helped in evaluating the nature of pitch assignment in the presence of longer constituents as the two options presented in the question. Analysis of the pitch contours of these questions has revealed that *alternative questions in Boro are marked with L%, with the question particle ‘-na’ itself surfacing with a high f_0 target.* The high target can be interpreted as a lexical H tone with which the particle ‘-na’ surfaces. The pitch contours presented in Figure 4.17 show this.

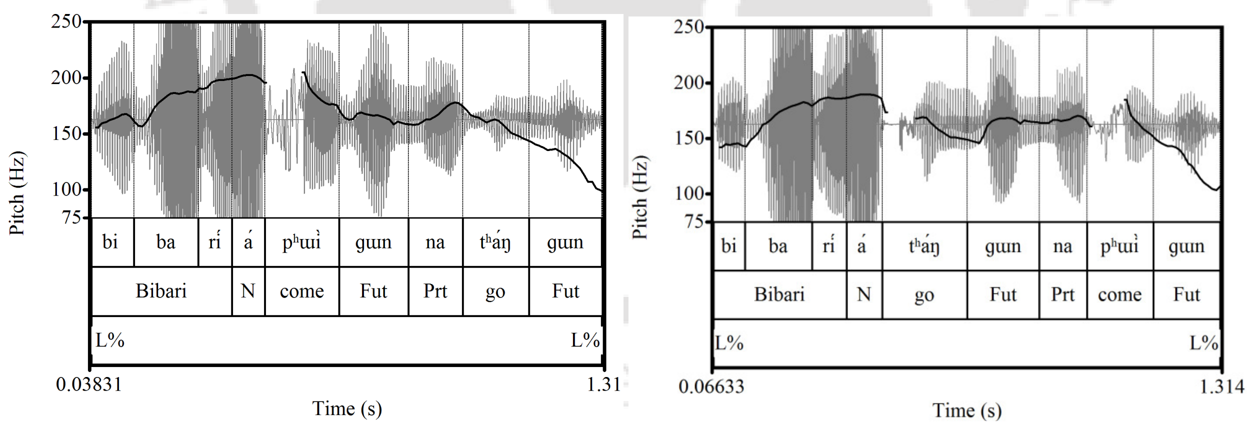


Figure 4.17: **Alternative question and L%.** In the sentence bibaríá pʰɯ̀igɯn na tʰáŋgɯn ‘Bibari will come or go?’ (left panel) the lexical H of ‘na’ surfaces with a rise. But in bibaríá tʰáŋgɯn na pʰɯ̀igɯn ‘Bibari will go or come (right panel) it surfaces as a plateau along with the H tone of the preceding verb.

In bibaríá pʰɯ̀igɯn na tʰáŋgɯn ‘Bibari will come or go?’ the particle ‘na’ surfaces with an H tone and then the pitch drops to a low target for L% boundary tone. This can be seen in the pitch contour in the left panel of Figure 4.17. This *combination of lexical H aligned to the particle ‘na’* *and final L% for alternative questions* can also be noticed in the pitch contour presented in the panel on the right in Figure 4.17.

4.2.8 Imperative sentences: Commands

Imperative utterance (being commands or requests) are interpreted as directive speech acts, i.e., as the speaker's attempt to get the hearer to perform the action described by the proposition. The illocutionary strength with which the speaker conveys this speech act can go from a strong command to a gentle request. In Boro, as in many other languages in the world, imperative utterances are usually structurally marked as verb-initial and also by the effect of the imperative mood. This section describes the intonation pattern employed in Boro for these types of utterances. *It presents acoustic evidence to suggest that strong commands in Boro are marked by HL% boundary tone and soft commands are marked by H%.* Figure 4.18 illustrates the typical pitch contour of Boro words used as strong commands.

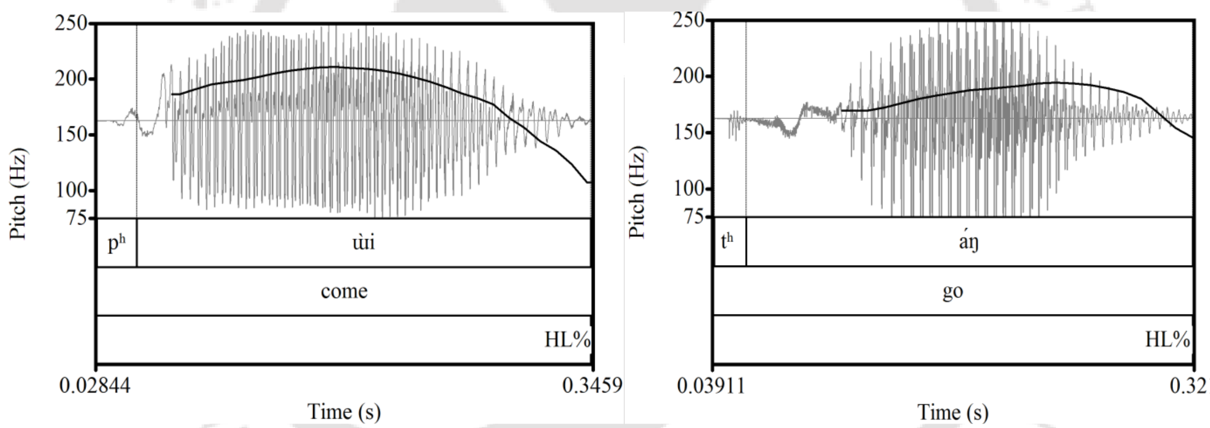


Figure 4.18: **Strong command and HL%.** Pitch tracks of strong commands expressed by the verb pʰɯ̀i 'Come' (left panel) and by the verb tʰáŋ 'Go' (right panel).

The panel on the left of Figure 4.18 presents the contour for a command associated to a verb with L tone. On the other panel of the same Figure, the contour gets associated to a verb with H tone. In both the panels the pitch rises to a high target aligned to pitch points in time for the vowel before falling to the lowest target at the end. *This falling contour for strong command in Boro can be interpreted as a HL% boundary tone.* Although strong commands expressed by the waveforms illustrated in Figure 4.18, soft commands expressed in Boro by employing a slightly different pitch contour. Figure 4.19 illustrates the pitch contour used in Boro for polite commands.

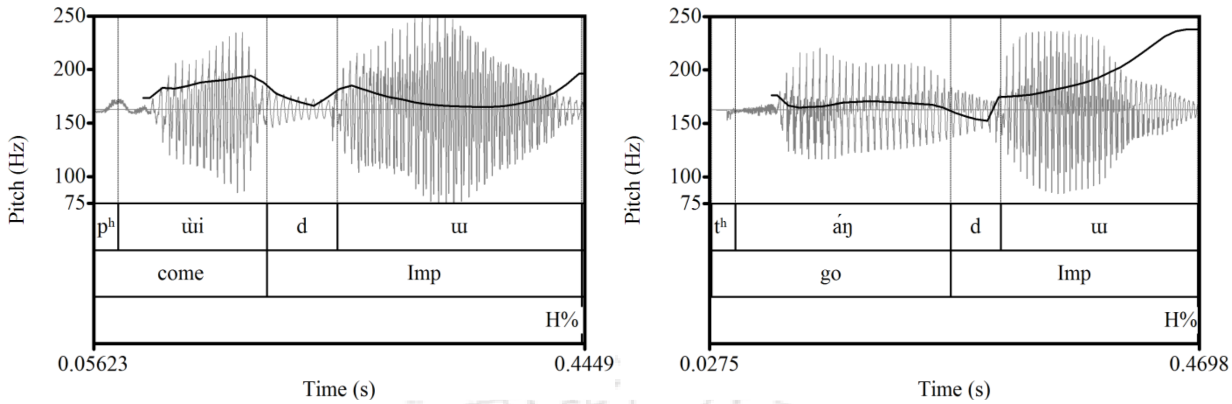


Figure 4.19: **Soft command and H%.** Pitch track of soft commands expressed by pʰɯ̀i-dɯ 'Come (polite)' (left panel) and by tʰáŋ-dɯ 'Go (polite)' (right panel).

Figure 4.19 shows that *soft command in Boro is marked by a final rise in f_0*. This H% boundary tone associates to pʰɯ̀i-dɯ 'Come (polite)' (left panel) and to tʰáŋ-dɯ 'Go (polite)' (right panel) following the alignment pattern for H% and H or L lexical tones discussed for incomplete utterances. Thus both the H% and the lexical tone align to the rhyme of the final syllable. Since more than one tonal target aligns to the rhyme of the final syllable, it is lengthened considerably. This can be seen in the pitch contour for pʰɯ̀i-dɯ 'Come (polite)'. The pitch is not lengthened in the same way during the final vowel in tʰáŋ-dɯ 'Go (polite)'. The difference may be due to the reason that in tʰáŋ-dɯ 'Go (polite)' the final lexical tone and the boundary H% refer to identical targets. When they refer to opposite f_0 targets, it results in lengthening of the pitch contour.

Soft command in Boro can also be expressed by adding the suffix '-nai' to the verb stems. Pitch contours for such commands also show that *H% boundary tone is used for soft commands of this type*. Figure 4.20 presents two instances of such commands. It can be seen in the panel on the left of Figure 4.20 that the final sequence of L lexical tone and H% surface with lengthened pitch compared to the sequence of H lexical tone and H% presented in the other panel of the same Figure.

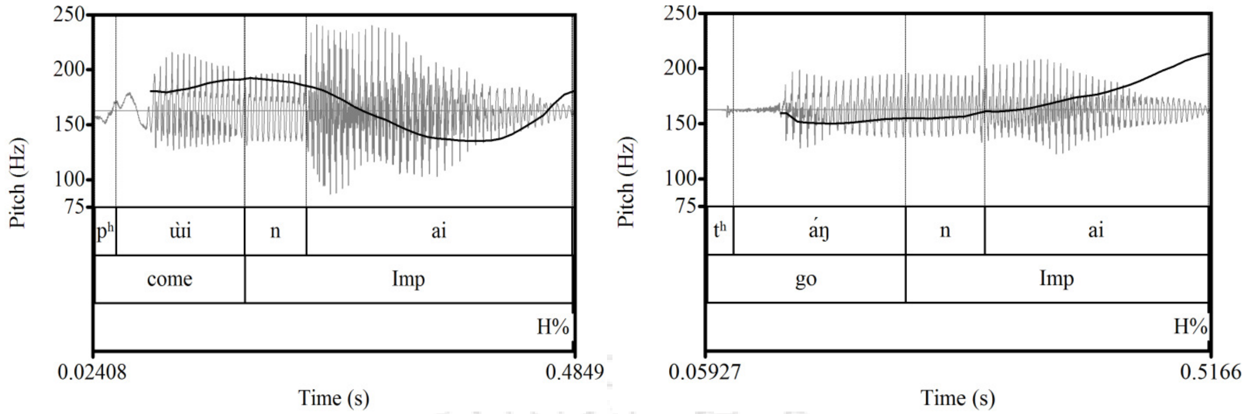


Figure 4.20: **Soft command and right edge alignment of L/H and H%.** Pitch tracks of polite requests expressed by pʰɯ̀i-nai 'Come (for a particular purpose)' (left panel) and by tʰáŋ-nai 'Go (for a particular purpose)' (right panel).

The observation on the pitch contours for commands in Boro discussed in this section has revealed the following prosodic properties of such expressions:

- HL% aligns to the right edge of strong commands.
- Soft commands are marked by H% aligned to the right edge.
- The final vowel surfaces with a lengthened pitch when the lexical and boundary tones refer to opposite f_0 targets.

4.2.9 Calling contour

The basic vocative use of the calling contour varies slightly from language to language[19]. *The calling contour in Boro is expressed by a gradual rise of the pitch to a high target aligned to the TBU at the right edge of the PrWd. Post this alignment, the pitch drops to a low target for one variety of calling contour and it surfaces as a truncated drop for the other variety of calling*

[19] The intonation pattern for calling contour is also known as 'vocative chant' or 'stylized fall', and this is first noticed and fully described for English (Varga, 2008). Ladd (1978) describes the calling intonation pattern as 'vocative chant'. Ladd (2008) describes that English and German vocative chants are marked by a H* which associates with the nucleus or most prominent lexically stressed syllable. This is followed by a !H and Leben (1976) and Haggo (1978) note that the location of this downstepped tone is sensitive to relative prominence, specifically the !H prefers to occur on the most prominent postnuclear syllable. However, in situations when the lexically stressed syllable is utterance final, it is in effect split up into two syllables, to provide a place or docking site for both H and the !H tone as in Jo – ohn in English and in Ja – an in German (Ladd, 2008). Varga (2008) describes that the Hungarian calling contour assumes a monotonal pitch accent H* followed by a downstepped H analysed as a phrase tone !H-. This is pronounced as H*!H-0% in utterance final positions where 0% is a zero boundary tone. In other words, in Hungarian, the H*…!H sequence goes to the last two syllables, irrespective of any prominence and a shortage of docking site is compensated by breaking the vowel in a monosyllabic word into two parts as in Pa…al (Varga, 2008).

contour. Pitch tracks of two names, bibarí ‘Bibari’ and sɯmdɯ̀n ‘Swmdwn’, pronounced with this intonation contour is presented in Figure 4.21.

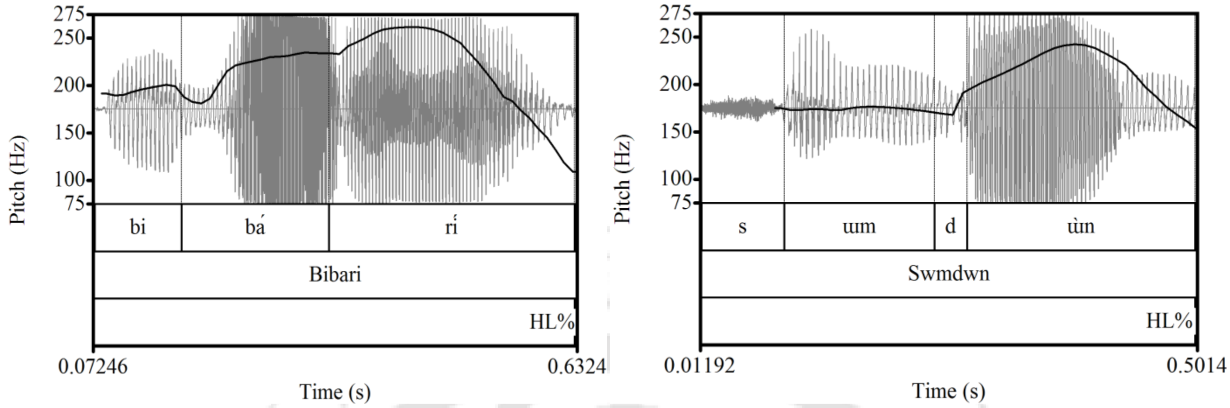


Figure 4.21: **Calling contour and HL%.** Pitch track for the proper nouns bibarí ‘Bibari’ (left panel) and sɯmdɯ̀n ‘Swmdwn’ (right panel) pronounced with the calling contours in Boro.

It can be seen in both the panels in Figure 4.21 that the high target aligns to the last syllable. This is followed by a sharp fall to a low target. A comparison between the two panels in Figure 4.21 shows that the high target for the HL% is scaled higher in bibarí ‘Bibari’ compared to what is found in the case of sɯmdɯ̀n ‘Swmdwn’.

A second variety of calling contour in Boro occurs in the renditions of the two proper nouns by the 3rd speaker. When pointed about this difference in the pronunciation, the speaker informed that this variety of intonation pattern is used to call somebody in close proximity as contrast to the other variety used for calling somebody at some distance. Figure 4.22 presents the pitch track of this variety of calling contour.

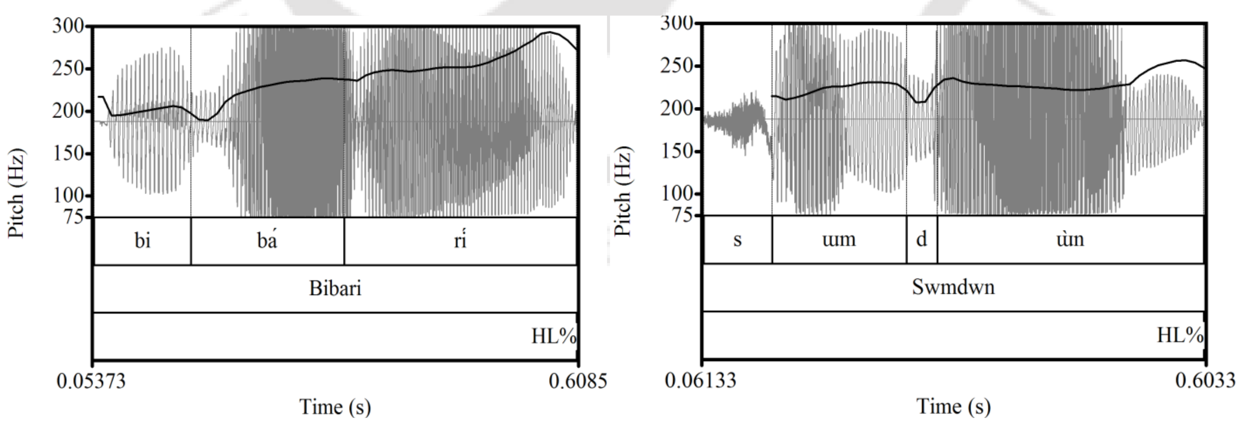


Figure 4.22: **Calling contour and H(L)%.** f_0 track for the proper noun bibarí ‘Bibari’ (left panel) and sɯmdɯ̀n ‘Swmdwn’ (right panel) produced with calling contour by the 3rd speaker .

It can be seen in Figure 4.22 that the pitch rises gradually to a high target aligned to the later part of the rhyme of the final syllable and this is followed by a truncated pitch drop, if one has to compare this one with the pitch pattern presented in Figure 4.21. Two crucial differences emerge between the pitch contours in Figure 4.21 and Figure 4.22. The pitch peak aligns to the earlier part of the pitch points in time of the rhyme in Figure 4.21. In contrast to this, the high target aligns to the later part of the rhyme of the final syllable in Figure 4.22. The boundary fall is to a low target in Figure 4.21 and the fall is truncated in Figure 4.22. Thus the pitch contour illustrated in Figure 4.22 can be described as a second variety of calling contour in Boro. *The intonation of the first variety of calling contour is marked by HL% aligned to the right edge. The other variety of calling contour is marked by a H(L)% where the final fall is truncated.*

4.3. Summary

Table 4.6 below summarizes the full inventory of postlexical tones in the intonational phonological model of Boro discussed till now. It has been discussed in Section 4.2 that lexical tones in Boro preserve their tonal pitch trends while occurring at IP medial positions. Section 3.6 has shown that IP initial lexical tones in Boro are influenced by the L%H% boundary tone. Evidence presented in this chapter shows that there is absence of any particular pitch movement in non-final positions which could be interpreted as pitch accent. Although, chapter 5 will present evidence to suggest that a particular type of pitch accent can surface in Boro for focus marking, pitch contours for various other sentence types have not displayed any pitch movement suggestive of pitch accent. Intonational contours discussed in this chapter show that Boro employs a host of boundary tones for expressing various types of meanings. Table 4.6 presents the inventory of intonational tones and Table 4.7 presents the contexts in which they occur.

Association	Target
ip boundary tones	L, HL,
IP boundary tone (left edge)	L%H%, H%
IP boundary tones (right edge)	L%, HL%, LH%, H%, LHL%, H(L)%

Table 4.6: **Full inventory of the intonational tones in Boro**

Tonal contour	Meaning
L%	Neutral and narrow focus statements, wh-questions and alternative questions.
HL%	Calling contour (Distant), Yes/no questions (without morphological marker), Strong commands
LH%	Yes/no questions (with '-na'),
LHL%	Yes/no questions (with '-nama')
H%	Soft commands, commands for a particular purpose, surprise or disbelief, incompleteness,
H(L)%	Calling contour (Near proximity)

Table 4.7: **Intonational contours in Boro and the meanings they express.**

4.4 Conclusion

Interaction between lexical and intonation tones are common in tone languages where initial or final boundary tones may affect the value of adjacent lexical tones (Gussenhoven, 2004). Tone languages do not generally have complex intonation system and thus European languages with lexical tone contrast, like Swedish and Norwegian, have simpler intonation systems than English, a language without lexical tone (Gussenhoven and Vliet, 1999). Still word-level tones can be subject to considerable manipulation by postlexical phonology (Hyman and Monaka, 2011). The segmental site for tone-intonation interaction in Venlo Dutch is the IP final syllable where the boundary low tone (L%) spreads leftward to a free TBU (mora) to generate two L targets at the right edge (Gussenhoven and Vliet, 1999). Certain Otopamean languages of Mexico restrict their lexical tone contrast to pre-final syllables reserving word-final syllables for intonational contrasts. In Shekgalagari, the L% moves to the penultimate syllable where a penultimate lengthening feature provides a second mora for L% association (Hyman and Monaka, 2011). The lexical high tone in Kikuyu undergoes flattening when it is followed by L% (Clements and Ford, 1981). In Mayen, the final L of the HL% question tone is truncated when it is preceded by an L* and an H tone in the same syllable (Gussenhoven, 2000). This chapter has presented results showing how intonational tones surface in a two tone language like Boro.

Tonal alignment in tone languages may sometimes force lexical tone to associate with a TBU preceding the TBU of its origin so that it can co-exist with intonational tones (Kanerva, 1990).

Results presented in this chapter show that Boro adheres to both the features of 'accommodation' and 'submission' (Hyman and Monaka, 2011) for alignment of lexical and intonational tones (see section 1.0). Alignment and scaling of lexical and intonational tones reveal that Boro adheres to the principle of accommodation in allowing post-lexical tones to coexist with lexical specifications. Interaction between the bitonal HL% boundary tone and the final lexical tones aligned to a disyllabic IP final word exemplifies the principle of submission. The findings are summarized below.

- Monotonal boundary tones coexist with lexical tones aligned to the rhyme of the IP final syllables. This has been explained in connection with L% in section 4.2.1 and with H% in section 4.2.2.
- Bitonal boundary tones sometimes totally obliterate the f_0 trend of the lexical specification. The HL% boundary tone marking yes/no question (without morphological markers) does not allow the lexical f_0 specification to surface at the right edge of the IP final PrWd.
- In instances of the bitonal boundary tone HL% aligning to the IP final syllable, HL% surfaces with a higher pitch target when it obliterates the pitch trend for H lexical tone and the target is scaled lower when it obliterates lexical L tone.
- A situation of deletion of lexical tone can be sometimes avoided by allowing it to align to the penultimate syllable in sentences ending with HL%. A trisyllabic IP final word only tolerates such an option of alignment of the lexical tone to the penultimate syllable.
- Alignment of lexical tones to the penultimate syllable in instances of HL% aligning to the ultimate syllable suggests that the disyllabic word frame in Boro obligatorily requires a right aligned lexical specification at the IP level too. Thus, in Boro, the features of PrWd domain remain relevant at the post-lexical stage also.

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Chapter 5

Prosody of Focus in Boro

5.0 Introduction

Focus is a linguistic feature that highlights the parts of a sentence that are considered to be particularly salient in the information structure (Chafe 1974; Ladd 1980; Selkirk 1995). It refers to the process by which the speaker chooses one element from a set of alternatives (Rooth 1985, 1992). The category of focus has been classified into *broad/wide focus, narrow (new information/presentational) focus, contrastive focus and corrective focus* depending on the nature of the highlighted part of an expression in the discourse context (see section 1.4). Linguistic descriptions on the strategies that tone languages use for highlighting information show that focused component in an utterance is phonetically marked by *variations in pitch range, length, intensity and also by compressing the post-focus part of the utterance*. In some of the instances the phonetic properties have been interpreted as pitch accent (Gussenhoven and Der Vliet, 1999) and as prosodic phrasing (Downing, 2008). *This chapter presents an analysis of the phonetics and phonology of focus marking in Boro*. The research objective for this chapter is to look into the prosodic cues implemented to signal various kinds of information structure like focus marking with emphatic particles, ex-situ focus, contrastive focus (Zubizarreta, 1998) and corrective focus (Gussenhoven, 2004). *Results presented will show how focus is implemented through two register variations for marking contrastive and corrective information, and for emphatic expressions. It will also be shown that ip boundary insertion is used as the sole prosodic cue for ex-situ focus marking.* As Boro shows two way tonal contrasts (High and Low), it is expected that it would follow intonational properties which would modify the citation tones of the words in the utterances. Mahanta, Das and Gope (2016), in their discussion of the phonetics and phonology of focus and intonation in Boro have presented a detailed analysis of the way various intonation cues are implemented in Boro for focus marking. Section 5.1 presents an overview of this as a starting point for the present experimental study.

5.1 The Phonetics and Phonology of Focus and Intonation in Boro

Mahanta, Das and Gope (2016) have made an inquiry into the way word level tone and phrase level pitch variation for intonation interact with each other in a simple tone language like Boro. This study has examined the prosodic expression of focus in Boro comparing the tonal effects in the presence of in-situ focus and also when the in-situ focus appears with morphological focus markers, which are [sɯ́] and [nɯ́] in Boro. Focus related structures have been elicited by using the question-answer method and time normalized pitch contour of the utterances were analyzed to present the intonational properties of Boro.

5.1.1 Intonational properties of prosodic focus

The main objective of Mahanta, Das and Gope (2016) was to examine *the realization of culminative sentential stress on the words receiving prosodic focus in Boro*, They compared the f_0 and durational properties of the element which received focus (on subject and object respectively) with the same element in the corresponding wide focus conditions. It is found that there is *hardly any significant difference in terms of average* f_0 *and duration of the vowels when carrying wide focus vis-à-vis narrow focus.*

A two tailed statistical t-test was conducted to compare the mean f_0 of the words bearing wide focus and narrow focus (both on subject and object). The mean f_0 of the vowel of the subject in wide focus was compared with that of the vowel in narrow focus condition. The same comparison was also carried out for the vowels receiving narrow focus in the object position. The result *does not show any significant difference in* f_0 *values of the words in wide focus condition vis-à-vis those receiving narrow focus*. The pitch contours presented in Figure 5.1 explain this.

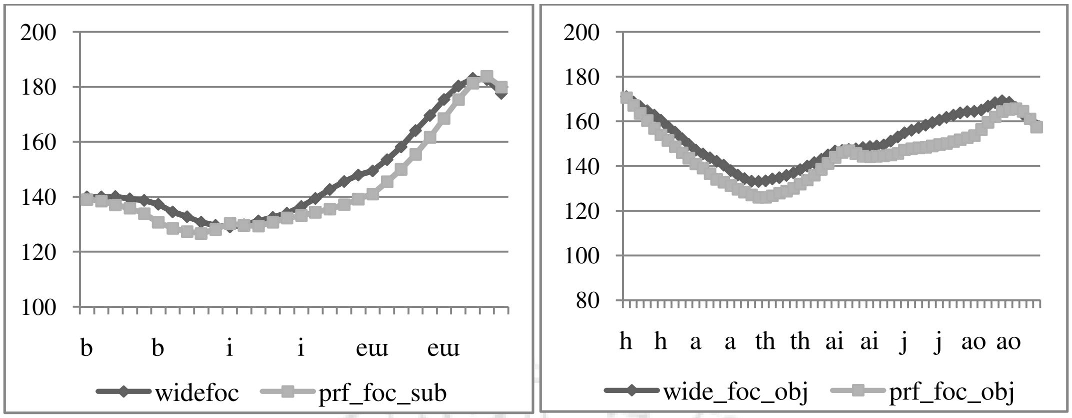

Figure 5.1: **Prosodic focus and f_0**. Time-normalised course of mean f_0 aggregated for all tokens across the speakers where the panel in the left compares the subject in wide focus and narrow focus conditions, the panel in the right compares the adverbial in the same conditions. These pitch tracks show that the contours for each type do not vary with respect to wide focus vis-a-vis narrow focus. The lighter line marks narrow focus and the darker line stands for wide focus.

A two tailed statistical t-test conducted to measure the difference in average duration of the TBUs, with wide focus versus narrow focus (both on subject and object) for all sentence patterns, indicated that *there is no significant difference in the duration of the vowels occurring in the two conditions* mentioned above. These results suggest that Boro does not adhere to the assumption that focused element can be made prominent in-situ by assigning them culminative sentential accent (Samek-Lodovici, 2005).

Post Focus Compression (PFC) plays an important role in marking focus in a fully tonal language like Mandarin Chinese (Xu, 2011). Mahanta, Das and Gope (2016) have reported that *in-situ focus in Boro may be expressed with post-focus compression*. When the pitch range and duration of the part of the sentence following the focused arguments were compared, it was found that except in one sentence type all other sentences showed statistically significant differences between post-focus (in-situ) parts of the sentence and the same part in the neutral focus condition. Figure 5.2 presents evidence to suggest that in most instances across sentence types PFC plays a role when there is prosodic focus. The ‘no focus’ condition instantiates higher pitch range than the condition which carries prosodic focus. However, in sentences with HLL tone sequence with focus on the subject and in sentences with LHH tone sequence with object focus the observed differences did not hold.

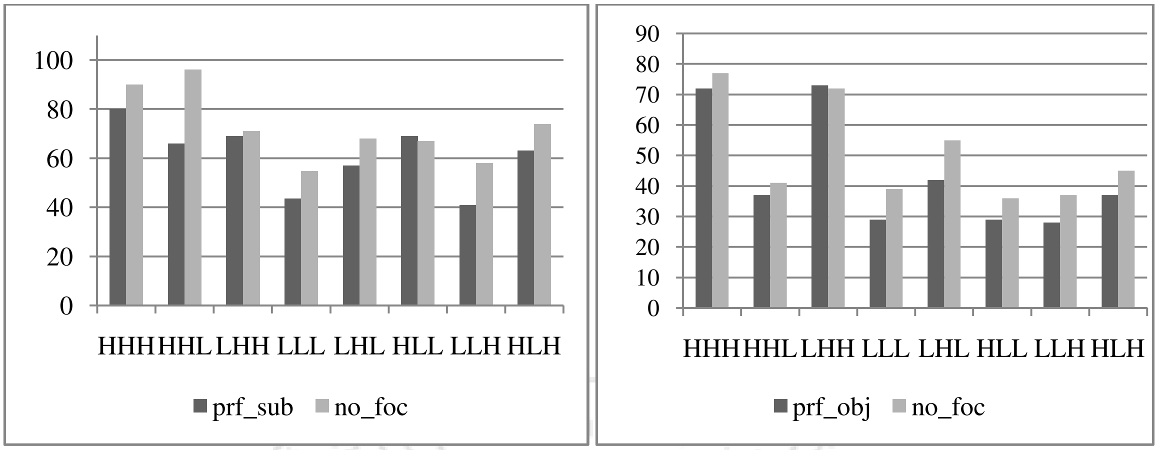

Figure 5.2 **Prosodic focus and post focus compression of pitch range.** Comparison of compression (pitch-range) for post focus component of the sentences with and without focus on subject (left panel), and with and without focus on object (right panel). The vertical axis shows the pitch range values in hertz. The light gray scale shows the 'no focus' condition and the dark gray scale shows the post focus condition.

5.1.2 Intonational properties of morphological focus marker

Although, Mahanta, Das and Gope (2016) have not found any significant difference in terms of average f_0 of the target words receiving prosodic focus, they found that *morphological focus (MF) markers in Boro indeed bring about significant difference in the f_0 trend*. In a sentence with a HHH tone sequence, the MF markers [sɯ́/nɯ́] bear the highest peak. The f_0 maximum in [sɯ́/nɯ́] is much higher than the f_0 maximum in *-eɯ* 'Nom' (for example, mean f_0 for [sɯ́]= 183.98 hz, and [eɯ]= 151.49 hz, n=20, $p < 0.0001$, in the sentence bí-eɯ-sɯ́ hatʰái-jao tʰáŋ-gɯn 'He will go to market') showing that the *MF marker surfaces as the most prominent constituent*. Figure 5.3 explains this.

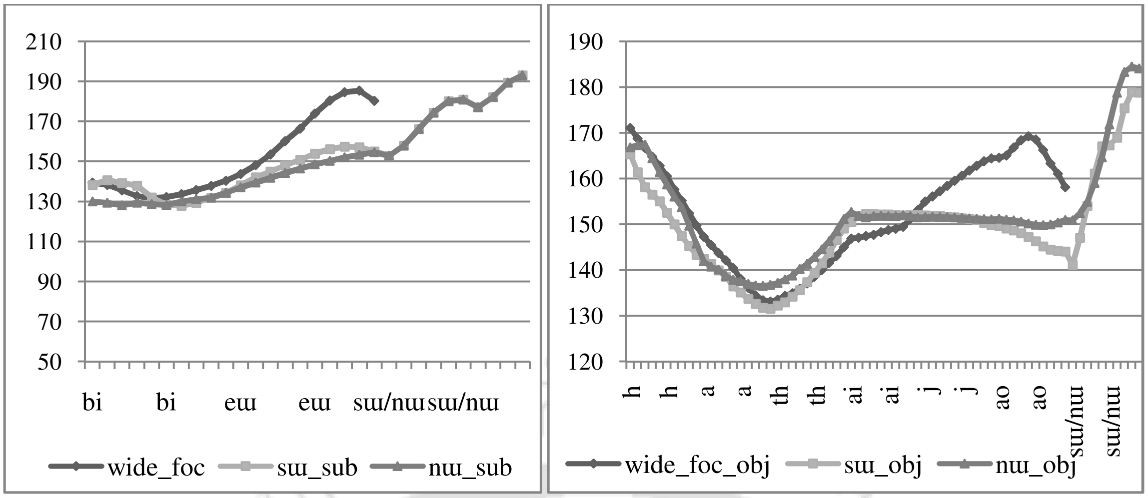

Figure 5.3: **Maximum f_0 peak aligned to MF markers**. Time-normalized course of mean f_0 aggregated for male speakers (n= 20, 4 speakers x 5 iterations each). The panel in the left represents the contours of the subject bíɛɯ 'he-Nom' with wide focus and morphological focus [sɯ́/nɯ́] conditions in the sentence bíɛɯ[sɯ́/nɯ́] hat^{h}ái-jao t^{h}áŋ-gɯn 'he(MF) will go to market'. Whereas, the panel in the right represents the contours of the object hat^{h}ái-jao 'market' in wide focus and morphological focus [sɯ́/nɯ́] conditions in the same sentence (bíɛɯ hat^{h}ái-jao-[sɯ́/nɯ́] t^{h}áŋ-gɯn) 'he will go to market(MF)). 10 measuring points per syllable are displayed.

A similar pattern is noticed in both HLH and HLL type of sentences with the morphological focus markers surfacing with highest pitch peak. When the MF is with the subject the rest of the sentence following it shows a falling contour and when it is with the object, its pitch peak is followed by a declination.

The analysis of focus marking in Boro by Mahanta, Das and Gope (2016) presented above enumerates the ways narrow focus is expressed in-situ, whether exclusively by prosodic means or by a combination of prosodic and morphological means. Presentational narrow focus expressed by means of answers to wh-questions does not exhaust the possible ways of focus marking in Boro. Expression of focus in Boro also covers other avenues like ex-situ focus, contrastive focus and corrective focus, and also focus marking with the aid of emphatic particles. *The goal of this chapter is to discuss the prosodic expression of focus in Boro in the context of correction, contrast, reversal of word order and emphasis*. It will be shown that **register raising** of the whole IP plays a crucial role in focus marking with the aid of emphatic particles. On the other hand **register is lowered** when an IP expresses contrastive or corrective focus. **ip boundary insertion** is found to be the only prosodic cue for ex-situ focus marking. Section 5.2 enumerates in detail each of the experiments undertaken for looking into each of the focus types mentioned above. The section acquaints the readers with the speech materials, data collection and data analysis processes. Section 5.3 presents the results for ex-situ focus marking. Section 5.4 presents acoustic and statistical evidence for the way focus is marked in Boro with the aid of emphatic particles. Section 5.5 discusses the prosody of contrastive focus and section 5.6 highlights the results for the experiment on corrective focus. Section 5.7 presents a phonological interpretation of the focus types discussed in the sections before it and section 5.8 relates this to the theory of sentential stress in the relevant literature. Section 5.9 summarizes the results presented in this chapter.

5.2 Methodology

Morphological markers are not essential to the processes of corrective and contrastive focus marking in Boro. Emphatic particles can lend prominence to a particular argument in a sentence prominent. Emphatic particles differ from morphological focus markers in carrying a sense of inclusivity or exclusivity with them[20]. Results presented in section 5.4 highlight how emphatic particles differ from sɯ́/nɯ́ mainly in their prosodic characteristics. Ex-situ focus in Boro can be marked by shifting a sentence internal argument to sentence initial position. Four separate experiments were designed to evaluate the prosody of contrastive, corrective, ex-situ focus and also of focus marking with emphatic particles.

5.2.1 Experiment I

Chapter 3 has already presented an account of the prosodic means employed in Boro for ex-situ focus marking. Boro allows objects to be pre-posed to the sentential topic position for marking ex-situ focus. This kind of shifting of the sentence medial element to the sentence initial position requires morphological support in the form of an ex-situ focus marking suffix occurring with the argument. The examples in (1) and (2) explain this transformation:

(1) daodɯí zánaiá mɯzàŋ
egg eat-Verb-Nom good
It is good to eat egg.

[20] Although [sɯ́] and [nɯ́] are described as morphological focus markers (Mahanta, Das and Gope, 2016) and bɯ 'also' and lɔ 'only' are called emphatic particles (Brahma, 2012), lɔ 'only' bears a similarity with [sɯ́] and [nɯ́] in lending focus to an arguement. The particle bɯ 'also' holds a different status since it is semantically not identical with the other three particles. Although all of these four particles lend prominence to the arguments they follow, results presented in this chapter would show that bɯ 'also' and lɔ 'only' differ from sɯ́/nɯ́ mainly in their prosodic characteristics.

(2) daoduɯ́-kʰou bí-ɯ bài-duɯŋ-mɯn
egg-Acc he-Nom buy-Prf-Pst
Egg, he bought.

In (2) the object daoduɯ́ 'egg' is shifted to the sentence initial position where it occurs with the obligatory accusative suffix '-kʰou'. The prosodic property of a sentence like (2) is compared with that of (1) where the target word occurs in-situ in a wide focus context. This has helped in comparing the prosodic property of the sentence with ex-situ focus with that of the sentence expressing wide focus. Recall that ex-situ focus results were presented in Chapter 3 and it was shown that an ip boundary after the focused constituent marks ex-situ focus in Boro. Suspension of downstepping of non-initial H tones has been presented as the acoustic evidence for ip boundary insertion. There have been other studies in the literature investigating the prosodic property of ex-situ focus marking as the one by Kugler and Genzel (2012). Kugler and Genzel (2012) compared the prosodic property of the constituent with ex-situ focus with that of its initial occurrence in wide focus condition. A similar method is also adopted in this chapter to examine whether ex-situ focus results in any prosodic variation, in addition to ip boundary insertion described in Chapter 3.

Three sentences were used to elicit the intonation pattern of ex-situ focus marking. The sentences were constructed in such a way that two words with H tone and one word with L tone occur in the ex-situ focus position. Pitch contours for initial L tones in Boro surface with lesser amount of rise than what is found in the case of initial high tones (see section 3.4). Therefore it was felt that initial high tones would show prosodic modification in a more prominent way if ex-situ focus results in any such change. It is for this reason that two words with high tone as against one with low tone were placed in ex-situ focus condition. Three other sentences with the target words occurring in sentence initial position in the context of wide focus were used as the base line for the comparison. *Prosodic properties of the words with ex-situ and wide focus were compared (excluding the obligatory suffix for ex-situ focus marking).* This helped in understanding the nature of prosodic means used to mark this kind of focus.

5.2.2 Experiment II

The objective of this experiment was to investigate the nature of *focus marking by emphatic particles in Boro.* It has made an attempt to evaluate whether focus expressed with the help of emphatic particles is realized by some other means than what Mahanta, Das and Gope (2016) have found in connection with sɯ́/nɯ́ in Boro. Boro uses several emphatic particles for narrow focus marking of a particular argument in a sentence. Two of these emphatic particles, bɯ and lɔ add, the meanings of 'also' and 'only' respectively. A series of four sentences where the emphatic particles bɯ 'also' and lɔ 'only' occur with all the arguments formed the data series for this experiment. The sentences consisted of arguments with both H and L tones. Sentences without the emphatic particles were spoken in out-of-the-blue contexts and thus they expressed broad focus. Prosodic features of f_0 and duration of each of such sentences were compared with that of the related sentence expressing narrow focus where the emphatic particles occurred with any one of its arguments. Sentences with the emphatic particles were placed in a context and the same was explained well to each of the participants so that they could properly express the intended meaning. The examples presented in (3) explain this.

(3)
(a) bikʰunzɯ́á daodɯí baìdɯŋmɯn (broad focus)
mother-in-law-Nom egg buy-Prf-Pst
'Mother-in-law bought egg'

(b) bizamadɯìá daodɯí baìdɯŋmɯn arɯ [pause] bikʰunzɯ́-á-bɯ daodɯí baìdɯŋmɯn
son-in-law-Nom meat buy-Prf-Pst and [pause] mother-in-law-Nom-Emp egg buy-Prf-Pst
'Son-in-law bought egg and mother-in-law *also* bought egg.

The second clause in (3b) expresses emphasis on the subject bikʰunzɯ́á mother-in-law since the emphatic particle bɯ 'also' occurs with it. f_0 and durational properties of this sentence was compared with that of (3a) which expresses broad focus. The assumption is that such comparison would reveal the kind of prosodic effect the presence of the emphatic particles introduces in Boro. When the emphatic particles occur with the object, the clause preceding it contained another noun occupying its object position. The clause containing the target object expresses the meaning of addition because of the emphasis on the argument preceding the particle. The examples in (4) illustrate this.

(4)(a) àŋsɯr bedòr baìdɯŋmɯn arɯ [pause] àŋ daodɯíbɯ baìdɯŋmɯn
I-Plural meat buy-Prf-Pst and [pause] I egg-also buy-Prf-Pst
We bought meat and I bought egg-also.

(b) àŋ daodɯí baìdɯŋmɯn (broad focus)
I egg buy-Prf-Pst
I bought egg.

The f_0 and durational properties of the second clause in (4a) was compared with that of the sentence in (4b) which expresses broad focus since it does not occur in any context and also the object argument is not followed by the emphatic particle. The sentences with the emphatic particle occurring with the sentence final elements were also placed in a context where they are preceded by another sentence. The examples in (5) show it.

(5)(a) àŋ daoduɯí záduɯŋmɯn arɯ [pause] àŋ daoduɯí baìduɯŋmɯnbɯ
I egg eat-Prf-Pst and [pause] I egg buy-Prf-Pst-also
I ate egg and I also bought egg.

(b) àŋ daoduɯí baìduɯŋmɯn
I egg buy-Prf-Pst.
I bought egg.

It can be noticed that non-final lexical tones only change in (3) and (4) and both these two sentences end with the inflected form of baì 'buy' specified with L tone. The other two sentences forming the data series for this experiment are presented below. These two sentences also end with the same word. It has been already shown in Chapter 4 that statements in Boro end with L%. It is because of this reason that the final constituents in the data series for this experiment has been kept constant. In other words, all the sentences in the data series for this experiment end with a word specified with lexical L tone.

(6) bikʰunzɯ́á bedòr baìduɯŋmɯn
mother-in-law-Nom meat buy-Prf-Pst
'Mother-in-law bought meat'

(7) àŋ bedòr baìduɯŋmɯn
I meat buy-Prf-Pst.
I bought meat.

The emphatic particles occurred with all the constituents of the sentences. The data set also included sentences without the emphatic particles. In this way, a total number of *28 sentences formed part of the data series* for this experiment.

5.2.3 Experiment III

Although, contrastive focus is often assumed to be same as corrective focus and is understood as correcting a part of an information in an utterance by substituting it with a possible alternative (Greif, 2010), this study has made an attempt to investigate separately the nature of expressing contrast and the means employed for expressing correction in Boro. *This section presents an overview of the experiment conducted to evaluate the nature of prosodic variation* *that target words undergo depending on their occurrence in the context of wide focus and contrastive focus*. Two monosyllabic and two disyllabic target words were selected for this experiment. All the four target words are put into the carrier frames in (8) for eliciting contrastive focus. The sentence frames were designed in such a manner that each of the target words occur in both wide focus and contrastive focus conditions.

(8) (a) Subject_i [x]Verb_m but [pause] Subject_i $[y]_{contfoc}\text{Verb}_m$ (Contrastive focus)

(b) Subject_i $[y]_{widfoc}\text{Verb}_m$ (Wide focus)

In the sentence frame in (8), the second clause in (8a) expresses contrastive focus since it presents a contrast to what is expressed in the 1st clause of the utterance preceding the conjunction 'but' and the 'pause'. The example in (9) shows how the object [bɔ́n] 'firewood' in the second clause presents a contrast to the object zɯ̀o 'ricebeer' in the first clause. The requirement for contrastive meaning makes the noun [bɔ́n] 'firewood' occur in the same position where zɯ̀o 'ricebeer' occurs in the first clause. The prosodic property of the second clause in (9) expressing contrastive focus was compared with a homophonous sentence spoken in an out-of-the-blue context. The assumption behind such a comparison was that it would help in finding whether Boro uses any prosodic means for encoding the information structure of contrastive focus.

(9) àŋ zɯ̀o nagír-dɯŋ-mɯn natʰái [pause] àŋ $[\text{bɔ́n}]_{contfoc}$ bài-dɯŋ-mɯn
I ricebeer search-Prf-Pst but [pause] I firewood buy-Prf-Pst
I searched for rice beer but I bought firewood

àŋ bɔ́n bài-dɯŋ-mɯn (wide focus)

Averaged normalized pitch contours of 10 speakers x 3 iterations x 8 sentences amounted to a total number of 240 tokens for this experiment. The sentences in 8(b) frame were taken as the base line condition for comparing the effect of contrastive focus. These sentences were compared with the second clause of the sentences in 8(a) frame following 'but'. The main prosodic parameters analyzed were f_0 contours and duration. To examine the variation in the contour resulting from contrastive focus, f_0 normalized pitch curves were extracted with the aid of a script run in Praat, widely known as Prosody Pro (Xu, 2013) and which is used for many phrase level tonal f_0 experiments. Duration of the target words were also measured to examine the presence of any difference in length caused by the context of contrastive focus.

5.2.4 Experiment IV

The goal of this experiment was *to understand the intonation of corrective focus in Boro*, which is investigated separately in this study from contrastive focus. The four target words used in Experiment III also formed part of this one. Corrective focus was elicited by placing these words in the answers to yes/no questions where the answers correct the proposition presented in the question, with a negative marker occupying the initial position of the answer. Prior studies like Zimmermann (2008), Ouyang and Kaiser (2013) and Kugler and Genzel (2012) have used similar sentence frames for elicitation of corrective focus. The answer in such sentences are compared with a similar sentence spoken in a neutral focus condition. The question answer pattern and the neutral statement are explained by the frames presented in (10). It has to be mentioned here that yes/no questions in Boro can be formed by placing the question particle 'na' at the end of it in addition to the LH% intonation contour (see section 4.2.4)

(10) Subject$_i$ [x] Verb$_m$ na?

(a) noŋá, [pause] Subject$_i$ [y]$_{corrfoc}$ Verb$_m$ (Corrective focus)

(b) Subject$_i$ [y] Verb$_m$ (Wide focus)

The prosodic properties of the sentences with wide focus in 10(b) frame was compared with that of the similar sentence minus the negation marker noŋá 'no' in 10(a) expressing corrective focus. Studies on focus has already used comparisons like the ones in Experiment III and IV, as in Kugler and Genzel (2012). An instance of such a pair of question and answer where the answer encodes the meaning of corrective focus is presented in (11).

(11) nɯ́ŋ zɯ̀o bài-dɯŋ-mɯn-ná ?
you ricebeer buy-Prf-Pst-QPart
did you buy ricebeer?

Noŋá, [pause] àŋ [bɔ́n]$_{foc}$ bài-dɯŋ-mɯn
No, [pause] I firewood buy-Prf-Pst
No, [pause] I bought firewood. (Corrective focus)

àŋ bɔ́n bài-dɯŋ-mɯn. (Out of the blue sentence expressing wide focus)

In (11), 'firewood' presents the corrective information that intends to replace the wrong information presented for the same context in the question (i. e. ricebeer). The prosodic aspect of the sentence containing this corrective information was compared with that of a homophonous sentence which appeared in an out-of-the-blue context. The assumption here is that comparison of the durational and f_0 parameters of those sentences would reveal either local effect such as lengthening (Chen 2006; Chen and Gussenhoven 2008) or f_0 raising (Chen and Gussenhoven, 2008) of the focused word, or global effect on the pitch contour of the sentence. Comparison of Boro sentences in the focus conditions mentioned in Experiment III and IV has revealed that *pitch register plays a discrete role in marking contrastive and corrective focus in the language*.

5.2.5 Materials

It has been already mentioned in Chapter 2 that Boro words are normally marked with only one lexical tone which is right aligned. The data set used for each of the four Experiments mentioned above contained sentences with various combinations of H tone and L tone words. A similarity among the last sets of data for Experiment II, III and IV is that all the sentences in them contain three words, and as each Boro word is marked with a lexical tone, this helped in constructing sentences with various combinations of tones. *Experiment II involves a set of 4 sentences* as presented in (3) through (7) for examining the prosodic means of emphasis marking. The data series for *Experiment I consists of a set of six sentences*. Three of them contain a pre-posed object marked with ex-situ focus. In the other three sentences in the data series the words receiving ex-situ focus occur sentence initially in wide focus context. Both the sentence types were not related either semantically or structurally. When the internal constituents of the sentences are shifted to the sentence initial position for ex-situ focus, the word is obligatorily followed by a suffix, if a case suffix is not added to it already in its sentence internal (in-situ) syntactic position. In (12c) the object noun bibarí-nɯ 'Bibari-Dative' occurs sentence initially. Since the word is already case marked in situ, another suffix is not added to it when it occurs ex-situ. In (12a) and (12b) a case marking suffix occurs with the pre-posed object nouns. As in the case of Kugler and Genzel (2012), prosodic properties of only the pre-posed noun without the suffix was compared with that of their occurrence in wide focus context. In other words, prosodic properties of only the stem nouns without any suffix occurring in ex-situ context and in wide focus conditions are compared.

(12) (a) daodɯí-kʰou bí-ɯ bài-dɯŋ-mɯn
egg-Acc he-Nom buy-Prf-Pst
Egg, he bought.

daodɯí zánaiá mɯzàŋ
egg eat-Verb-Nom good
It is good to eat egg.

(b) bedòr-kʰou bí-ɯ bài-dɯŋ-mɯn
meat-Acc he-Nom buy-Prf-Pst
Meat, he bought.

bedòr zánaiá mɯzàŋ
meat eat-Verb-Nom good
It is good to eat meat.

(b) bibarí-nɯ bíɯ tʰaizoú hordɯ́ŋ
Bibari-Dat he-Nom mango give-Prf
To Bibari, he has given mango

bibarí-á geseò tʰaizoú zá-nɯ nagír-ɯ
Bibari-Nom ripe mango eat-Verb want-Prsnt
Bibari wants to eat ripe mango

Experiment III involved a set of 10 pairs of sentences presented in (13), the first one of which has already been presented in (9). In all these sentences the second part, following natʰái 'but' and the pause, presents a contrast to what is presented in the part before the conjunction. The f_0 and durational properties of the clause expressing contrast is compared with a homophonous sentence pronounced in out-of-the-blue contexts marked as 'wide focus' here.

(13) (a) àŋ zɯ̀o nagír-dɯŋ-mɯn natʰái àŋ [bɔ́n]$_{contfoc}$ bài-dɯŋ-mɯn
I ricebeer search-Prf-Pst but I firewood buy-Prf-Pst
I searched for ricebeer but I bought firewood
àŋ bɔ́n bài-dɯŋ-mɯn (wide focus)

(b) àŋ bɔ́n nagír-dɯŋ-mɯn natʰái àŋ [zɯ̀o]$_{cont\ foc}$ bài-dɯŋ-mɯn
I firewood search-Prf-Pst but I ricebeer buy-Prf-Pst
I searched for firewood but I bought ricebeer.
àŋ zɯ̀o bài-dɯŋ-mɯn (wide focus)

(c) bí-nɯ daodɯí náŋ-gɯo-mɯn natʰái bí-ɯ [bedòr]$_{cont\ foc}$ bài-dɯŋ-mɯn
he-Dat egg want-Fut-Pst but he-Nom meat buy-Prf-Pst
He wanted egg but he bought meat.
bí-ɯ bedòr bài-dɯŋ-mɯn (wide focus)

(d) bí-ɯ bɔ́n bài-dɯŋ-mɯn natʰái bí-ɯ [zɯ̀o]$_{contfoc}$ nagír-dɯŋ-mɯn
he-Nom firewood buy-Prf-Pst but he-Nom ricebeer search-Prf-Pst
He bought firewood but he searched for ricebeer .
bí-ɯ zɯ̀o nagír-dɯŋ-mɯn (wide focus)

(e) bí-nɯ bedòr náŋ-gɯo-mɯn natʰái bí-ɯ [daodɯí]$_{cont\ foc}$ bài-dɯŋ-mɯn
he-Dat meat want-Fut-Pst but he-Nom egg buy-Prf-Pst
He wanted meat but he bought egg.

bí-ɯ daodɯí bài-dɯŋ-mɯn (wide focus)

(f) bí-ɯ zɯ̀o bài-dɯŋ-mɯn $nat^{h}ái$ bí-ɯ $[bɔ́n]_{contfoc}$ nagír-dɯŋ-mɯn
he-Nom ricebeer buy-Prf-Pst but he-Nom firewood search-Prf-Pst
He bought ricebeer but he searched for firewood.
bí-ɯ bɔ́n nagír-dɯŋ-mɯn (wide focus)

(g) àŋ bɔ́n bài-dɯŋ-mɯn $nat^{h}ái$ àŋ $[zɯ̀o]_{foc}$nagír-dɯŋ-mɯn
I firewood buy-Prf-Pst but I rice beer search-Prf-Pst.
I bought firewood but I searched for ricebeer.
àŋ zɯ̀o nagír-dɯŋ-mɯn (wide focus)

(h) àŋ daodɯí zá-dɯŋ-mɯn, $nat^{h}ái$ àŋ-nɯ $[bedòr]_{contfoc}$ náŋ-gɯo-mɯn.
I egg eat-Prf-Pst but I-Dat meat want-Fut-Pst.
I ate egg, but I wanted meat.
àŋ-nɯ bedòr náŋ-gɯo-mɯn (wide focus).

(i) àŋ zɯ̀o bài-dɯŋ-mɯn $nat^{h}ái$ àŋ-nɯ $[bɔ́n]_{cont\ foc}$ náŋ-gɯo-mɯn
I firewood buy-Prf-Pst but I-Dat ricebeer search-Prf-Pst.
I bought firewood but I searched for rice beer.
àŋ-nɯ bɔ́n náŋ-gɯo-mɯn (wide focus)

(j) bí- ɯ bɔ́n nagír-dɯŋ-mɯn $nat^{h}ái$ bí-ɯ $[zɯ̀o]_{cont\ foc}$ bài-dɯŋ-mɯn
He-Nom firewood search-Prf-Pst but he-Nom ricebeer buy-Prf-Pst
He searched for firewood but he bought ricebeer .
bí-ɯ zɯ̀o bài-dɯŋ-mɯn (wide focus)

The data set for eliciting contrastive focus presented a sequence of lexical tones as shown in Table 5.1

Sentence No	Tone Pattern
13(a)	LHL
13 (b)	LLL
13 (c)	HLL
13 (d)	HLH
13 (e)	HHL
13 (f)	HHH
13 (g)	LLH
13 (h)	LLH
13 (i)	LHH
13 (j)	HLL

Table 5.1: **Sequence of lexical tones forming the utterances in (13).**

Experiment IV is also designed with sentences consisting of three words specified with various combinations of the two lexical tones in Boro. It differs from *Experiment III in having 8* *sentences* correcting the proposition presented in the preceding yes/no questions. These answers to the yes/no questions start with a negation marker noŋá 'no'. The rest of the answer expressing corrective focus was compared with a similar sentence spoken in an out-of-the-blue context. The question-answer pairs along with the related wide focus sentences for each of the answers are given in (14).

(14) (a) nɯ́ŋ zɯ̀o bài-dɯŋ-mɯn-ná ?
you ricebeer buy-Prf-Pst-QPart
did you buy ricebeer?

noŋá, àŋ [bɔ́n]$_{foc}$ bài-dɯŋ-mɯn
No, I firewood buy-Prf-Pst
No, I bought firewood. (Corrective focus)
àŋ bɔ́n bài-dɯŋ-mɯn. (wide focus)

(b) nɯ́ŋ bɔ́n bài-dɯŋ-mɯn-ná ?
you firewood buy-Prf-Pst-QPart
did you buy firewood?
noŋá, àŋ [zɯ̀o]$_{foc}$ bài-dɯŋ-mɯn
No, I ricebeer buy-Prf-Pst
No, I bought ricebeer. (Corrective focus)
àŋ zɯ̀o bài-dɯŋ-mɯn. (wide focus)

(c) bí-ɯ bɔ́n bài-dɯŋ-mɯn-ná ?
he-Nom firewood buy-Prf-Pst-QPart
did he buy firewood?
noŋá, bí-ɯ [zɯ̀o]$_{foc}$ bài-dɯŋ-mɯn
No, he-Nom ricebeer buy-Prf-Pst
No, he bought ricebeer. (Corrective focus)
bí-ɯ zɯ̀o bài-dɯŋ-mɯn. (wide focus)

(d) bí-ɯ daodɯí zá-ji-ná ?
he-Nom egg eat-Prf-QPart
Has he eaten egg?
noŋá, bí-eɯ [bedòr]$_{foc}$ zá-ji.
No, he-Nom meat eat-Prf.
No, he has eaten meat. (Corrective focus)
bí-ɯ bedòr zá-ji. (wide focus)

(e) nɯ́ŋ bedòr zá-ji-ná ?
you meat eat-Prf-QPart
Have you eaten meat?
noŋá, àŋ [daodɯí]$_{foc}$ zá-ji.
No, I egg eat-Prf
No, I have eaten egg. (Corrective focus)
àŋ daodɯí zá-ji. (wide focus)

(f) bí-ɯ bedòr bài-dɯŋ-mɯn-ná ?
he-Nom meat buy-Prf-Pst-QPart
did he buy meat?
noŋá, bí-ɯ [daodɯí]$_{foc}$ bài-dɯŋ-mɯn
No, he-Nom egg buy-Prf-Pst
No, he bought egg. (Corrective focus)
bí-ɯ daodɯí bài-dɯŋ-mɯn. (wide focus)

(g) nɯ́ŋ daodɯí zá-ji-ná ?
you egg eat-Prf-QPart
Have you eaten egg?

noŋá, àŋ [bedòr]$_{foc}$ zá-ji.
No, I meat eat-Prf.
No, I have eaten meat. (Corrective focus)
àŋ bedòr zá-ji. (expressing wide focus)

(h) bí-ɯ bedòr zá-ji-ná ?
he-NOM meat eat-Prf-QPart
Has he eaten meat?
noŋá, bí-ɯ [daodɯí]$_{foc}$ zá-ji.
No, he-Nom egg eat-Prf.
No, He has eaten egg. (Corrective focus)
bí-ɯ daodɯí zá-ji. (wide focus)

5.2.6 Participant and Recording Procedure

A total number of **10 speakers** were selected for participating in the experiments described in this chapter. However, the *actual number of participants in each of the experiments differed.* This was due to inability of some of the participants to make themselves available for all the experiments. *Experiment I and II involved four native speakers of Boro*, and *ten speakers participated in both Experiment III and Experiment IV*. The speakers were between 22-28 years of age, and they were born and raised in their native villages where the recording was conducted. The participants for the experiments in Chapter 3 and 4 were also consulted with for the experiments described in this chapter. While the group for Experiment I and II consisted of the speakers who participated in the experiments in the earlier chapters, experiment III and IV featured six additional subjects. All the experiments were carried out in quiet locations in Bhatipara, Kazigaon and Bashbari villages. Out of the 10 speakers in Experiment III and IV, 3 each were from Bashbari village in Parbatjhora sub-division of Kokrajhar district and from Bhatipara village situated at the border between Bilashipara subdivision in Dhubri District and Kokrajhar District. The rest of participants were from Kazigaon village in Parbatjhora sub-division of Kokrajhar district. All the speakers were graduates and they had elementary knowledge of Assamese. None of the speakers had any previous record of problems in hearing or listening impairment. Each of the speakers was paid a small fee for their participation in the production experiments.

The speakers were asked to produce *5 iterations of each of the sentences in all the four experiments*. Experiment III and IV avoided the initial and final iterations of each of the sentences and considered only three iterations from each of the participants. *Sound files for one speaker for experiment III were avoided due to noise*.

The subjects were asked to read the sentences aloud written in Devnagiri script. The speakers were explicitly told the meaning intended by the sentence they were about to pronounce. They were also given enough time to go through the sentences as a kind of practice. The participants' attention was specially drawn to the kind of pause to be given after the conjunction natʰái 'but' in Experiment III and after the negation marker noŋá 'no' in Experiment IV. The pause is intended to nullify any effect of the negative marker nɔŋá 'no' and the conjunction natʰaí 'but' which might result in a global lowering effect due to length. Kugler and Genzel's (2012) experiment on the prosodic expression of focus in Akan has previously used pause as a deterrent to general declination effect on the later part of an utterance. Figure 5.4 and Figure 5.5 present instances of the pause in the wave form extracted with the help of Praat.

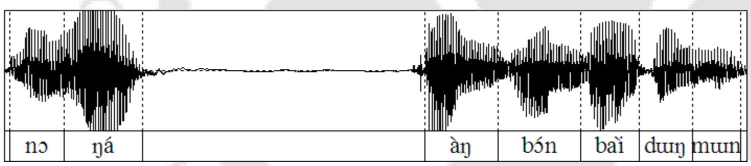

Figure 5.4: **Pause after the negative marker.** Wave form extracted with the aid of Praat showing the amount of pause preceding the target sentences in corrective focus conditions. The wave form is for one iteration of (14a).

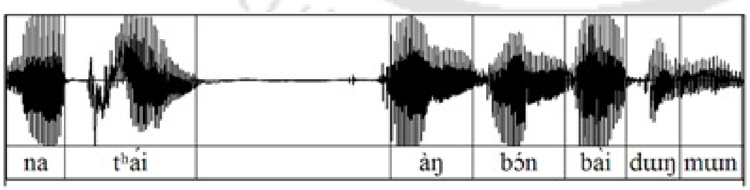

Figure 5.5: **Pause after the conjunction expressing contrast.** Wave form extracted with the aid of Praat showing the amount of pause preceding the target sentences in contrastive focus conditions. (The wave form is for the sentence in (13a).

5.2.7 Measurement Criteria and Statistical Analysis

The segmentation process of the sound files described in 4.1.3 was also used for the experiments here. The only additional feature was that of the target words segmented at the phoneme level. The segmented files were processed with a Praat Script [ProsodyPro] (Xu, 2013) (see 2.1.3). The averaged time normalized f_0 values of all the iterations of each sentences (4 speakers x 5 iterations = 20 tokens for Experiment I and Experiment II, 9 speakers x 3 iterations = 27 tokens for Experiment III, and 10 speakers x 3 iterations = 30 tokens for Experiment IV) were plotted as line graph in order to observe the difference between the pitch contours with wide focus and contrastive/corrective/ex-situ/emphatic focus. The raw meanf_0 and duration values for each domain extracted with the help of ProsodyPro were normalized for speaker specific effects by using the z-score normalization process described in 4.1.3. Repeated measures style of analysis of variance (Anova) was conducted in SPSS with f_0 as dependent factor, speaker as random factor, and focus and tone as within subject factor. Statistical tests were conducted in SPSS for deciding whether the difference in meanf_0, and duration suggested by the visual inspection of spectrograms of the clauses expressing focus is significant or not. Further details are provided in the following sections where results of the observations of the pitch contours and statistical analysis are presented.

5.3 The Findings: Ex-situ focus marking in Boro

Comparison of the f_0 contours of the target words in wide focus and ex-situ focus conditions (from sentence (12a) to sentence (12c)) have shown that *Boro does not follow any consistent f_0 trend for distinguishing ex-situ focus from the context of wide focus*. Figures 5.6, 5.7 and 5.8 compare the time-normalized course of f_0 aggregated for the four speakers of the target words appearing in wide focus and ex-situ focus conditions.

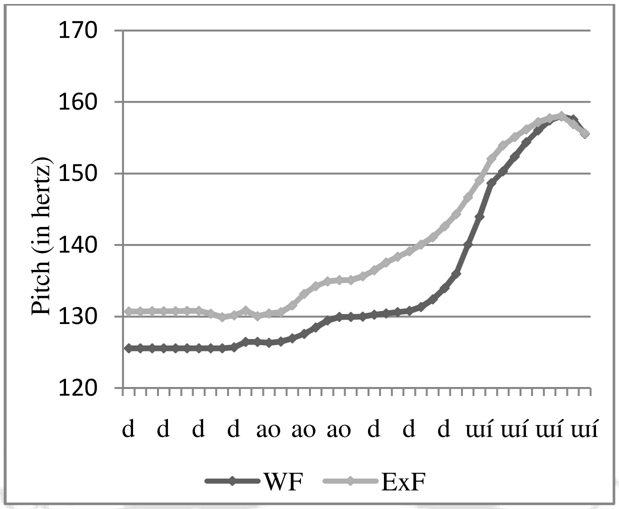

Figure 5.6: **High tone and higher f_0 in ex-situ focus condition.** Aggregated time normalized pitch contours (n=20) for daodɯí 'egg' in ex-situ (ExF) and wide focus (WF) conditions.

In Figure 5.6, 5.7 and 5.8, the dark line corresponds to wide focus condition and the light line to ex-situ focus condition. The comparison does not reveal any consistent result. *Sometimes, the ex-situ focus renditions of the target words surface with higher f_0 than that of the wide focus renditions*. Figure 5.6 and Figure 5.7 show it. In Figure 5.6 the time normalized course of f_0 aggregated for the target word daodɯí 'egg' remains higher (light line) in the ex-situ focus conditions and towards the end of the word the f_0 levels for both the focus conditions overlap.

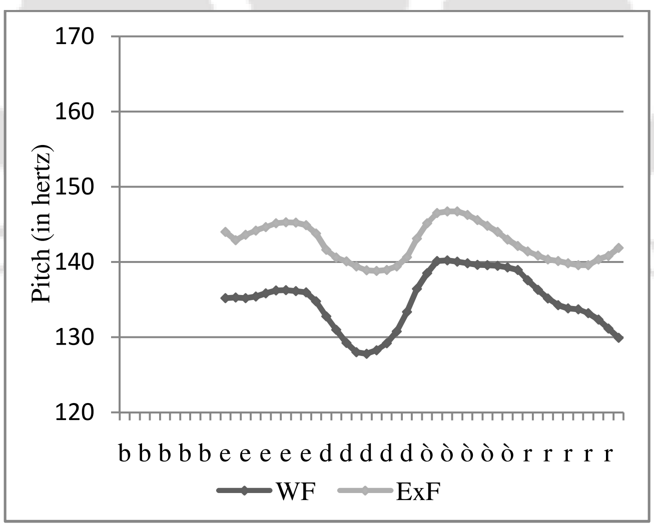

Figure 5.7: **Low tone and higher f_0 in ex-situ focus condition.** Aggregated time normalized pitch contours (n=20) for bedòr 'meat' in ex-situ (ExF) and wide focus (WF) conditions.

In Figure 5.7, the time-normalized course of f_0 (n=20) remains higher till the end when the target word bedòr 'meat' occurs in ex-situ focus condition (light line). The opposite of this pattern emerges when the time-normalized f_0 contour of the target word bibarí 'Bibari' expressing ex-situ focus is compared with that of the word expressing wide-focus. Figure 5.8 shows how the averaged time-normalized contour for bibarí 'Bibari' in *wide-focus condition (dark line) remains higher throughout its entire course compared to the ex-situ focus (light line) contour.*

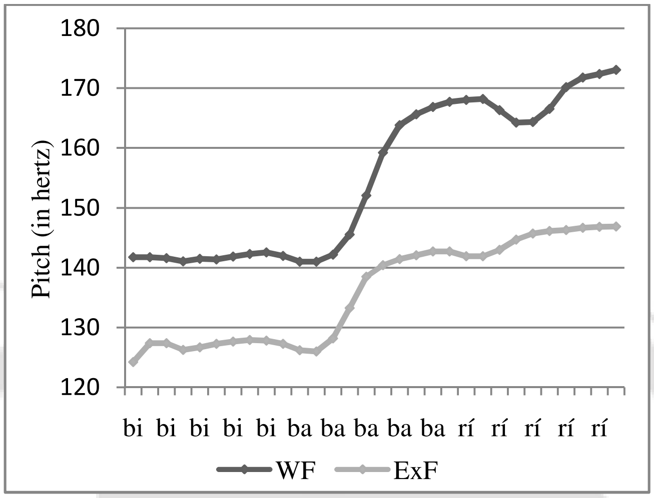

Figure 5.8: **High tone and lower f_0 in ex-situ focus condition.** Aggregated time normalized pitch contours (n=20) for bibarí 'Bibari' in ex-situ (ExF) and wide focus (WF) conditions.

Since the primary observation of the difference between the f_0 contours expressing ex-situ focus and wide focus has not revealed any consistent pattern, duration of the target words was compared to examine if ex-situ focus results in any durational variation. However, *no consistent pattern of durational difference was found between the occurrence of the target words in wide focus and ex-situ focus conditions.*

Comparison of aggregated f_0 contours and duration of the constituents with ex-situ focus with their occurrence in wide focus context has revealed absence of any consistent prosodic pattern distinguishing these two focus types in Boro. Results presented in Figure 5.6, 5.7 and 5.8 show that sometimes the f_0 contour remains higher when the target word appears in the context of ex-situ focus. There has also been found an instance when the f_0 contour of the target word remains higher in wide focus condition. Although f_0 trend and duration of the target words do not provide much clue in differentiating wide focus from ex-situ focus conditions, their occurrence in the global context reveals the prosodic correlate Boro uses for this kind of focus marking, which is none other than ip boundary formation. It has been already described in Chapter 3 that ex-situ focus marking in Boro results in an ip boundary formation after the constituent receiving this focus. Figure 3.14 has already illustrated this. Thus, *suspension of downstepping and ip boundary formation remains the only prosodic means for ex-situ focus marking in Boro*.

5.4 Focus and Emphatic particles

Experiment II presents an analysis of the prosodic features of prominence expressed with the aid of the emphatic particles bɯ 'also' and lɔ 'only'. These particles are suffixed to the argument for expressing the meaning of inclusiveness or exclusiveness. The data set considered for this experiment contained sentences with the two particles occurring with all the three syntactic constituents, that is, with the subject, the object and the final verb. Comparison of pitch contours for the sentences containing emphatic particles with that of those without the emphatic particle (expressing wide focus) has shown that the presence of *the emphatic particles bɯ 'also' and lɔ 'only' results in both local and global prosodic modification. Results have revealed that sentences containing the emphatic particles are produced with an overall high register. Also an H* pitch accents aligns to the non-final occurrence of the particles and the final occurrence of the particles result in curtailed final lowering*. Figure 5.9 presents the averaged time normalized pitch contour of the sentence bikʰunzɯ́á daodɯí baìdɯŋmɯn 'mother-in-law bought egg' in wide focus condition. This is compared with the averaged time normalized pitch contours of the other three instances of the sentence where the emphatic particle bɯ 'also' occurs with the subject, object and the verb.

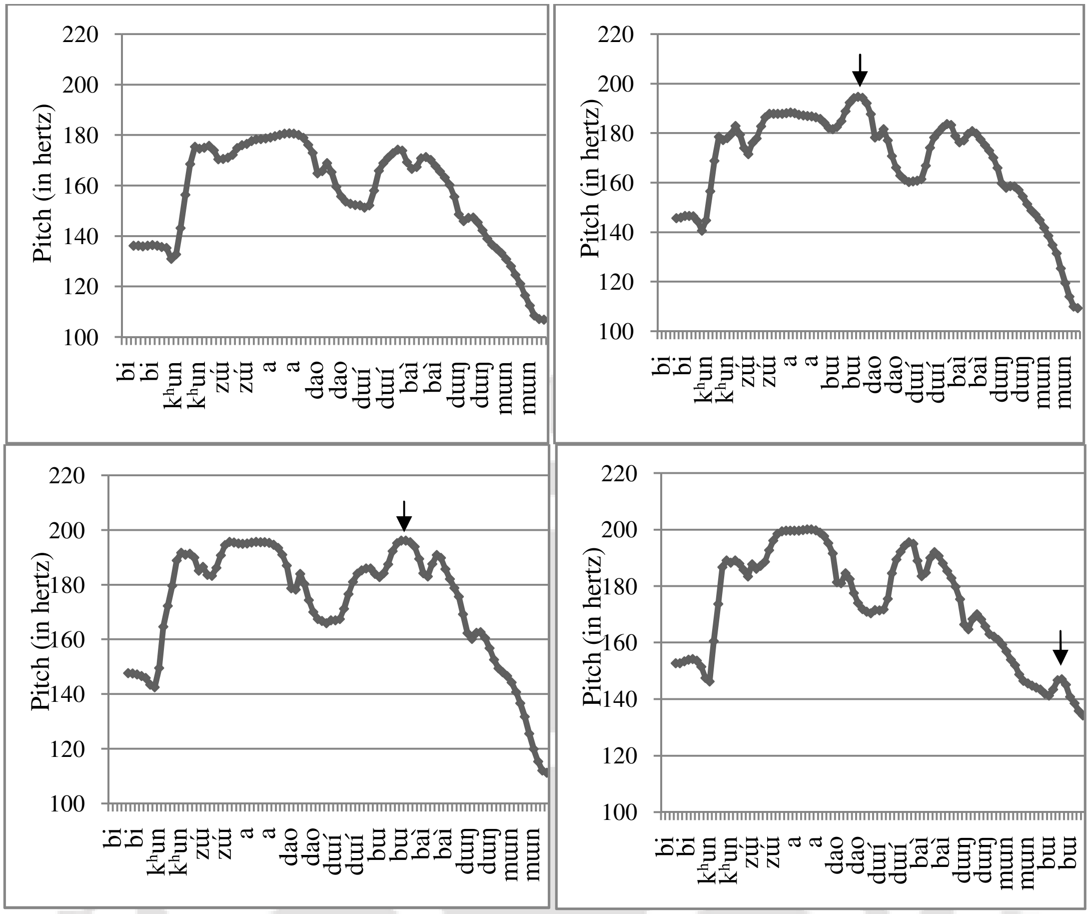

Figure 5.9: **Emphatic particle and global raising.** Averaged time normalized pitch contours (n=20) of bikʰunzɯ́á daodɯí baìdɯŋmɯn ‘Mother-in-law bought egg’ in upper left panel and the emphatic particle -bɯ occurring with the subject bikʰunzɯ́a ‘mother-in-law’ in the upper right panel, with the object daodɯí in the lower left panel and with the verb baìdɯŋmɯn ‘bought’ in the lower right panel.

The panel on the right of the upper row in Figure 5.9 presents aggregated (n=20) time normalized pitch contour of the sentence bikʰunzɯ́ábɯ daodɯí baìdɯŋmɯn ‘mother-in-law-also bought egg’ where the emphatic particle occurs with the subject noun. Comparison of pitch contour of this sentence with the one without the particle reveals that pitch *register of the whole utterance is raised* when the emphatic particle forms part of it. The lower left panel in Figure 5.9 presents the pitch contour of the same sentence with the emphatic particle occurring with the object. The time normalized pitch contour in the lower right panel is of the fourth instance of the sentence where the emphatic particle occurs with the verb. It can be seen that pitch contours of the sentences with emphatic particles remain high for the whole utterance compared to the aggregated time normalized pitch contour of the sentence without the emphatic particle. Figure 5.10 presents the comparison of aggregated z-score normalized mean f_0 for each of the syllables of the sentence bikʰunzɯ́á daodɯí baìdɯŋmɯn 'mother-in-law bought egg' spoken in the context of wide focus and with the emphatic particle bɯ 'also' occurring with each of its constituents.

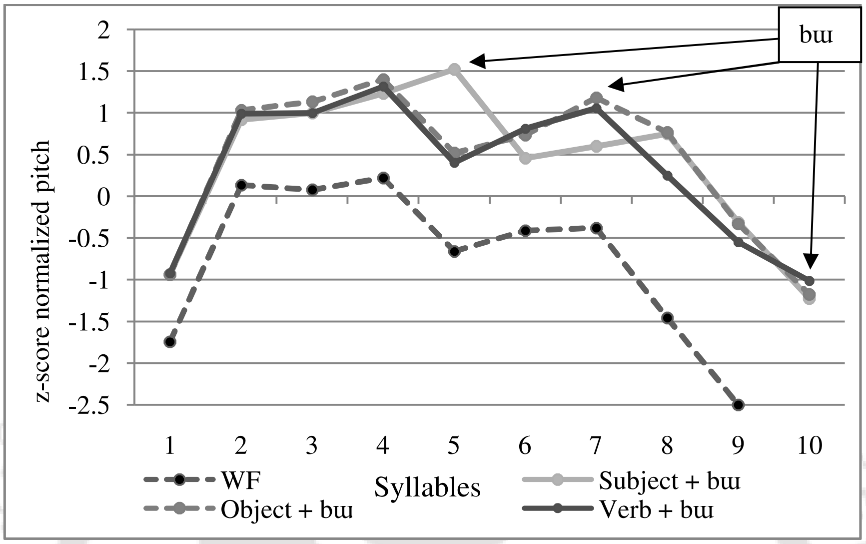

Figure 5.10: **Focus marking with emphatic particle and register raising.** Z-score normalized meanf_0 (n=20) of each of the syllables in the sentence bikʰunzɯ́á daodɯí baìdɯŋmɯn 'mother-in-law bought egg' are higher when the emphatic particle bɯ 'also' is attached to any one of its constituents. The x-axis presents the sequence of syllables in numerical order.

The comparison in Figure 5.10 reveals that meanf_0 for each of the syllables remains high when the emphatic particle bɯ 'also' occurs with any one of the constituent of the sentence. The lower right panel of Figure 5.9 shows how the pitch contour surfaces with a *truncated final lowering* when the emphatic particle occurs with the last constituent of the sentence. Averaged z-score normalized meanf_0 for the emphatic particle presented in Figure 5.10 also shows that the value for final occurrence of the particle bɯ 'also' remains higher and meanf_0 of the final syllable drops to a low target when the final syllable is not the emphatic particle.

Figure 5.10 shows the way the pitch register of a sentence with HHL lexical tone sequence is raised when the emphatic particle follows any one of these tones. A sentence with LLL tone sequence also revealed similar results when the pitch contour of wide focus rendition of it was compared with that of the other three contexts, that is, the emphatic particle occurring with the subject, verb and the object. Figure 5.11 compares the aggregated time normalized f_0 of the wide focus and emphatic focus renditions of a sentence in the data series with LLL tone sequence. Time normalized f_0 contours of the instances of the sentence with the emphatic particle lɔ 'only' was compared with that of the sentence expressing wide focus, that is, without any emphatic particle.

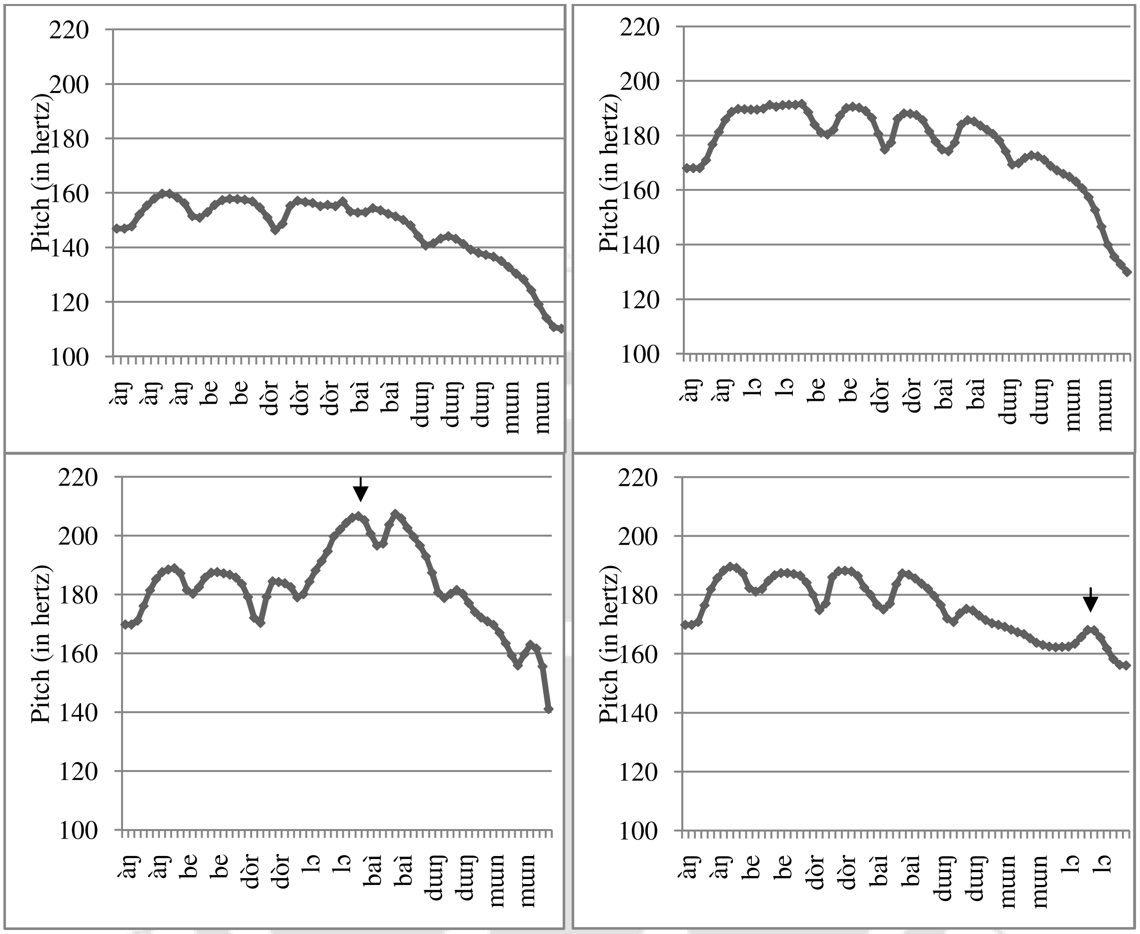

Figure 5.11: **Emphatic particle and raising of LLL tone sequence.** Averaged time normalized pitch contours for the sentence àŋ bedòr baìdɯŋmɯn 'I bought meat' in wide focus context and with the emphatic particle lɔ 'only'.

In Figure 5.11, pitch register of the sentence àŋ bedòr baìdɯŋmɯn 'I bought meat' is raised when the emphatic particle lɔ 'only' occurs with any one of its constituents. Thus, both the emphatic particles bɯ 'also' and lɔ 'only' influence the pitch contour of the sentences containing them in an identical manner. Their occurrence with any one of the syntactic constituents of the sentence results in *overall raising of the pitch register* of the whole utterance. Figure 5.11 also reveals another aspect of the similarity between bɯ 'also' and lɔ 'only' in terms of the way they affect the pitch contour of the utterance. The lower right panel of Figure 5.9 has already shown how the final occurrence of the emphatic particle bɯ 'also' results in curtailed final lowering. The lower right panel of Figure 5.11 also reveals similar f_0 trend, although the emphatic particle involved here is lɔ 'only'. In Figure 5.16, f_0 drops to a low target at the right edge when the emphatic particle occurs either with the subject àŋ ‘I’ or the object bedòr ‘meat’. In the instance of the emphatic particle lɔ ‘only’ occurring sentence finally, the f_0 contour does not drop to a similar low target. In other words, final occurrences of both the emphatic particles bɯ ‘also’ and lɔ ‘only’ result in *curtailed final lowering*.

The influence of the final occurrence of the emphatic particle lɔ ‘only’ on final lowering can also be seen in Figure 5.12 which compares the aggregated z-score normalized mean f_0 for each of the syllables of the sentence àŋ bedòr baìdɯŋmɯn ‘I bought meat’ pronounced in wide focus context and in emphatic focus contexts.

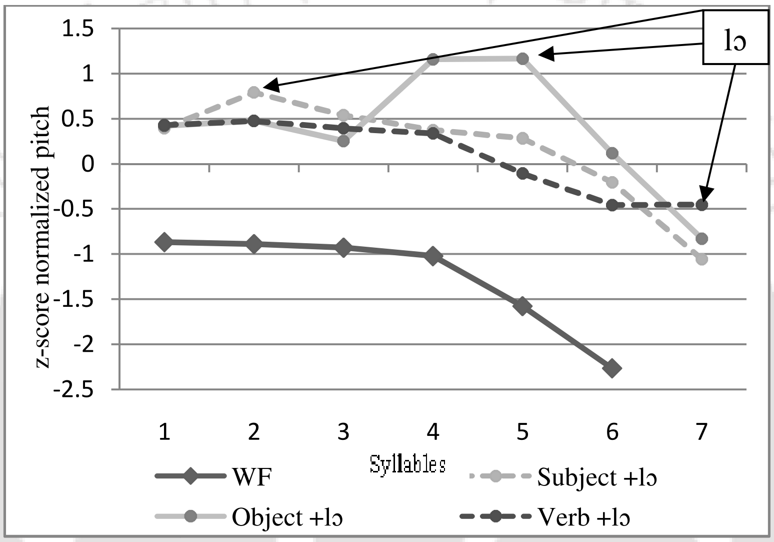

Figure 5.12: **Emphatic particle and curtailed final lowering.** Z-score normalized mean f_0 (n=20) of each of the syllables of àŋ bedòr baìdɯŋmɯn ‘I bought meat’ are higher when the sentence is pronounced with the emphatic particle lɔ ‘only’ attached to any one of its constituents. The x-axis presents the sequence of syllables in numerical order

Aggregated z-score normalized mean f_0 for the final syllables in àŋlɔ bedòr baìdɯŋmɯn ‘I-only bought meat’ (grey dashed line) and àŋ bedòrlɔ baìdɯŋmɯn ‘I bought meat-only’ (grey line) is lower than that of the final occurrence of the emphatic particle in the sentence àŋ bedòr baìdɯŋmɯnlɔ ‘I bought-only meat’ (dark dashed line). This is shown by the arrow mark in Figure 5.12. This indicates how the final occurrences of both the emphatic particles bɯ ‘also’ and lɔ ‘only’ in Boro bear a local effect in the form of *suspension of final lowering* of the pitch contour to indicate the end of utterance.

The occurrence of the two emphatic particles bɯ ‘also’ and lɔ ‘only’ results in yet another local effect. Pitch contours of sentences containing the emphatic particles have revealed that their *non-final occurrences of the particles surface with higher f_0 peak than the preceding tone*. It has been already discussed in Chapter 2 that toneless suffixes in Boro are assigned tone by the process of tone spreading to the right edge of the recursive PrWd domain. On the other hand, tone bearing suffixes do not receive any tonal association since the lexical tone of the suffix fulfills the requirement of a lexical tone associating to the right edge of the recursive PrWd domain. Although the emphatic particles discussed here occur as suffixes to various syntactic constituents, they differ from other tone bearing suffixes in their f_0 peaks. It can be seen in Figure 5.9 that the time normalized f_0 contour aligned to the *emphatic particle bɯ 'also' is scaled higher than the high target for the preceding nominative case marking suffix* -á which has its own lexical tone. The arrow mark in Figure 5.9 shows the pitch peak aligned to the particle bɯ 'also'. Similarly, for daodɯíbɯ 'egg-also', the pitch is scaled higher than that of the preceding lexical H tone aligned to the second syllable of daodɯí 'egg'.

Aggregated maxf_0 of the nominative suffix –á in bikʰunzɯ́-á-bɯ daodɯí baìdɯŋmɯn 'Mother-in-law also bought egg' (n=20) is 188.57 hz compared to 198.65 hz for the emphatic particle bɯ 'also'. The difference in Maxf_0 between the right aligned lexical H of bikʰunzɯ́ 'mother-in-law' and the nominative suffix in bikʰunzɯ́-á is less than that between the nominative suffix –á and the emphatic particle -bɯ . Figure 5.13 illustrates this.

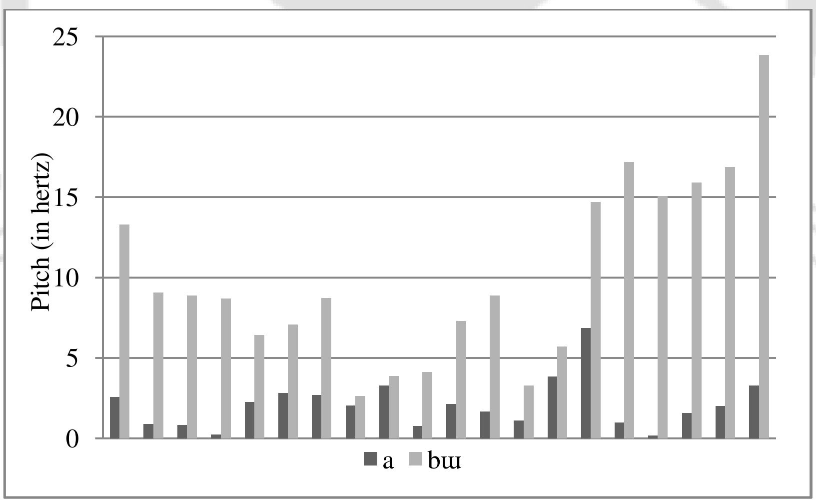

Figure 5.13: **Maxf_0 aligned to the emphatic particle.** Comparison of difference in maxf_0 between the lexical H in zɯ́ and -á, and between -á and -bɯ in bikʰunzɯ́-á-bɯ 'Mother-in-law-Nom-also'.

The dark scale in Figure 5.13 represents the difference between the Maxf_0 of the nominative suffix –á and that of the H tone of bikʰunzɯ́ 'mother-in-law'. The grey scale represents the difference between the Maxf_0 of the emphatic particle and that of the nominative suffix. The x axis in Figure 5.13 presents the number of repetitions (n = 20) and the y axis represent the difference between the Maxf_0 of the two sets of segments mentioned above. It can be seen that for each speaker for all the iterations, the amount of difference between the Maxf_0 of the emphatic particle -bɯ and the nominative suffix –á is more than the same between the nominative suffix –á and the last syllable of bikʰunzɯ́ 'mother-in-law'. In other words, the *emphatic particle surfaces with a higher f_0 target compared to the preceding lexical H tone*.

The emphatic particle surfaces with a higher f_0 not only when it occurs with the subject. The same pattern is also noticed when it occurs with the object. It has been already mentioned that, for daodɯí-bɯ 'egg-also', the time normalized f_0 contour for the emphatic particle is scaled higher compared to that of the preceding lexical H tone aligned to the second syllable of daodɯí 'egg'. Before characterizing this difference in scaling as a distinct prosodic feature, it was felt to be necessary to evaluate whether this gap in Maxf_0 surfaces in the instances of other suffixes occurring after daodɯí 'egg'.

The lower left panel of Figure 5.9 marks the pitch height of the emphatic particle with an arrow mark. The sharp rise in pitch for the emphatic particle makes the f_0 rise quite distinct from the pitch scale for the H tone in the second syllable of daodɯí 'egg'. To evaluate whether other suffixes with daodɯí 'egg' also surface with similar kind of sharp rise in f_0, the pitch contour for daodɯíbɯ 'egg-also' is compared with that of daodɯíá 'egg-Nom' in the sentence daodɯíá mɯzàŋ 'egg is good', which forms part of the experiment described in Chapter 3. Results have shown that the aggregated maxf_0 difference (n=20) between the nominative suffix –á and lexical H of the object argument daodɯí 'egg' in daodɯíá 'egg-Nom' is less (2.93 hz) compared to the difference (9.79 hz) between the lexical H of the second syllable in daodɯí 'egg' and the emphatic particle -bɯ in daodɯíbɯ 'egg-also'. On the other hand, the difference in mean of maxf_0 (n=20) between the second syllable of daodɯí 'egg' and that of the emphatic particle lɔ 'only' is found to be 10.38 hz in the sentence bikʰunzɯ́-á daodɯílɔ baìdɯŋmɯn 'Mother-in-law bought egg only'. Thus both the emphatic particles bɯ 'also' and lɔ 'only' in Boro surface with a sharp rise in f_0 which is different from the rise for the lexical H tone of suffixes occurring in the same position. This suggests that the *rising pitch contour aligned to the emphatic particles can be characterized differently* from that of the lexical H tones in Boro. We interpret this kind of pitch change aligned to the two emphatic particles in Boro shown by the arrow mark in Figure 5.9 and 5.11 as an **H* pitch accent**. Morphological elements marked with the property of pitch accents have been already discussed in studies like Gordon (2005) where evidence has been presented in support of morpholexical pitch accents in Chickasaw. The emphatic particles in Boro also seem to contribute a similar property to the intonation structure of the language. This *accentual property of the emphatic particles surface apparently only when they are attached to non-final constituents*. Final occurrences of the emphatic particles do not surface with the H* pitch accent. They only raise the pitch register of the IP. It seems that register raising is also a phonological property of the morpho-lexical pitch accent associated with the emphatic particles. Thus, in instances where the pitch accent does not surface, the property of upstep still influences the prosody. Only the *non-final occurrences of the emphatic particles surface with both the properties of an H* pitch accent and register raising*.

The prosodic characteristics of the emphatic particles discussed in this section can be summarized as below:

- Focus marking with emphatic particles results in both global and local prosodic modifications.
- The global prosodic impact of the emphatic particle in an utterance results in raising of the register of the whole IP.
- Emphatic particles bear local influence in two ways.
- The final occurrences of the emphatic particles lead to curtailed final lowering.
- Non final occurrences of the emphatic particles surface with an H* pitch accent which aligns to the particles themselves.

5.5 Prosody of Contrastive Focus

This section discusses the prosody of contrastive focus in Boro. Although, narrow prosodic focus does not result in any kind of f_0 variation aligned to the target words (see 5.1.1), contrastive focus seems to be encoded in the language quite strongly. Results for the present experiment have revealed that *f_0 and duration are the cues used in Boro for contrastive focus marking*.

5.5.1 f_0 and contrastive focus

Evaluation of the aggregated time normalized pitch contours of the sentences expressing wide focus (WF) and contrastive focus (CF) conditions revealed that *contrastive focus lowers the pitch of the target word. This also leads to the lowering of the other tones in the vicinity*. Figure 5.14 compares the difference between averaged time normalized f_0 contours of wide focus (light line) and contrastive focus (dark line) renditions of àŋ [bɔ́n]$_{foc}$ bài-dɯŋ-mɯn 'I bought firewood' which has an LHL lexical tone sequence.

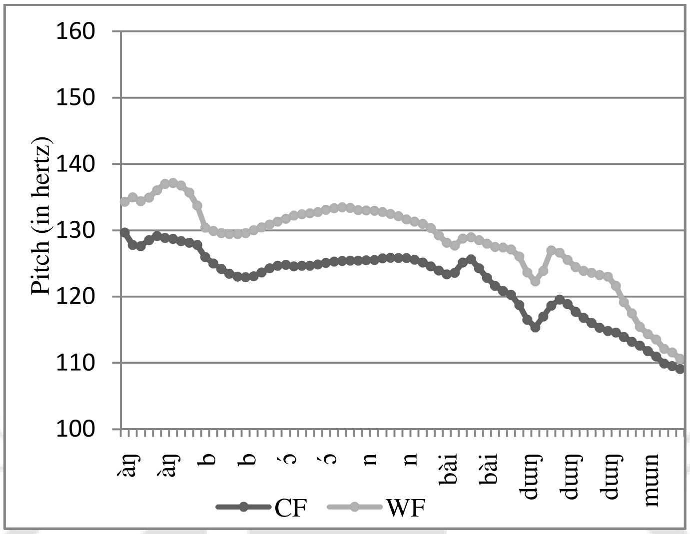

Figure 5.14: **LHL tone sequence and register lowering for contrastive focus.** Averaged time normalized pitch contour of àŋ bɔ́n bài-dɯŋ-mɯn 'I bought firewood' in wide focus (grey line) and contrastive focus (black line) conditions. (n=27)

The pitch contours associated with the two focus conditions show that *pitch register of the sentence is lowered when it expresses contrastive focus*. Pitch contours of a sentence with HHL tone sequence also reveals a similar pattern. Figure 5.15 compares the aggregated time normalized pitch contour (n=27) of the sentence bí-ɯ daodɯí bài-dɯŋ-mɯn 'he bought egg' spoken in the contexts of wide focus (grey line) and contrastive focus (black line). Here also, it can be seen that the pitch contour for the sentence is lowered when it expresses contrastive focus associated with the target words.

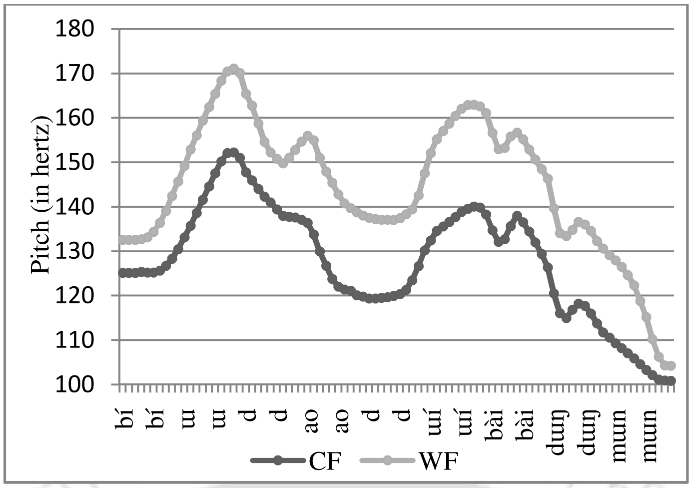

Figure 5.15: **HHL tone sequence and register lowering for contrastive focus.** Averaged time normalized pitch contour of bí-ɯ daodɯí bài-dɯŋ-mɯn 'he bought egg' in wide focus (grey line) and contrastive focus (black line) conditions. (n=27)

A comparison of z-score normalized meanf_0 values of the vowel of the TBUs aggregated for all the tokens expressing contrastive focus has shown that meanf_0 values of TBUs significantly differ from their f_0 value in wide focus context. A Repeated Measured Anova was performed in SPSS to explore the effect of focus on meanf_0 (m) of the vowels of the TBUs (right aligned) of the target words. Results have shown that z-score normalized meanf_0 for the vowel in the second syllable of bedòr 'meat' in wide focus condition (m = 0.382 hz, n=54) differs significantly from its occurrence in contrastive focus condition, $F(1, 8) = 29.93$, $p< 0.05$, m =-0.897 hz. There was also no significant interaction, $F(5, 40) = 3.46$, $p > 0.05$. Results for the vowel in bɔ́n 'firewood' (n=81) have shown a significant effect of focus on meanf_0, $F(1, 8) = 89.14$, $p< 0.05$ with the aggregated value for wide focus being 0.743 hz and for contrastive focus being -0.560 hz. There was also no significant interaction, $F(8, 64) = 1.35$, $p > 0.05$. The meanf_0 for the vowel in zɯ̀o 'ricebeer' (n=108) significantly differs between its occurrences in the two focus conditions (m=0.539 hz for wide focus and m= -0.581 hz for contrastive focus) discussed here, $F(1, 8) = 406.2$, $p< 0.05$ with no significant interaction, $F(11, 88) = 1.14$, $p > 0.05$. Contrastive focus also significantly lowers the meanf_0 (m=0.749 hz for wide focus and m=0.043 hz for contrastive focus) of the vowel of the second syllable of daodɯí 'egg', $F(1, 8) = 34.5$, $p< 0.05$. There was also no significant interaction, $F(2, 16) = 1.24$, $p > 0.05$.

Statistical results presented in this sections show that meanf_0 values for the tone bearing vowels of the target words are lowered in the contrastive focus condition. This also leads to the lowering of the register of the whole IP.

5.5.2 Duration and contrastive focus

Results for duration of vowels expressing contrastive focus show that Boro exercises significant durational reduction of the vowels of the TBUs occurring in the context of contrastive focus. Table 5.2 presents the results of repeated measures Anova done on the z-score normalized duration values for the vowels. It can be seen from the results that *compression of duration of the target words is another prosodic means employed in Boro for contrastive focus*.

	Focus	Mean	Significance
ɯ̀o	WF	3.165 ms	F(1, 8) = 70.480, p= 0.000, n= 108
	CF	2.529 ms	
ɔ́	WF	1.988 ms	F(1, 8) = 39.936, p= 0.000, n= 81
	CF	1.686 ms	
ò	WF	1.515 ms	F(1, 8) = 35.577, p= 0.000, n= 54
	CF	1.233 ms	
ɯí	WF	2.330 ms	F(1, 8) = 25.588, p = 0.001, n=27
	CF	2.040 ms	

Table 5.2: **Contrastive focus and compression of duration.** Durational difference between the occurrences of the vowels in the TBUs of the target words in wide focus (WF) and contrastive focus (CF) conditions. Interaction is not-significant for all the levels.

5.5.3 Pre-focus and Post-focus modifications

In addition to the lowering of the whole register of sentences occurring in the context of contrastive focus, *pitch contour of the pre-focus and post-focus constituents also show some amount of modification.* However, this is noticed only in the case of sentence initial L tone and sentence final occurrence of H tone. The data set for evaluating the prosodic effect of contrastive focus contained three sentences with àŋ 'I' with L tone occurring sentence initially. Pitch contours of these sentence initial constituents surface with an observable difference in f_0 scaling when they occur in pre-focus positions in the context of contrastive focus. Figure 5.16 compares the aggregated (n = 81) time normalized pitch contours of àŋ 'I' occurring in pre-focus position in the contexts of wide focus (light line) and contrastive focus (dark line).

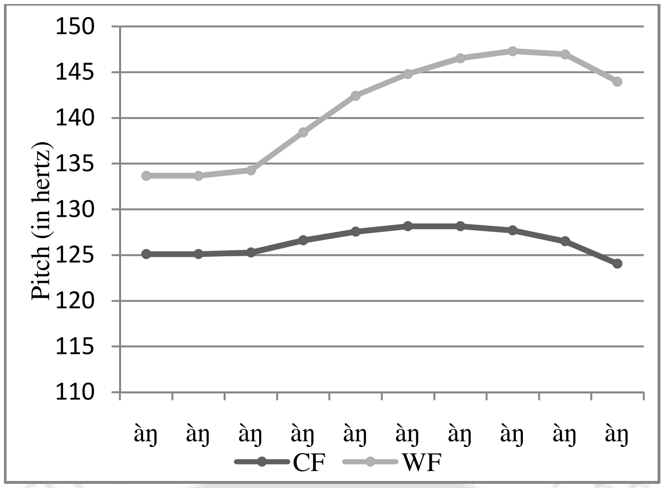

Figure 5.16: **Pre-focus compression of pitch range.** Aggregated time normalized pitch contours (n=81) of àŋ 'I' occurring in pre-focus position in the context of contrastive focus (CF) and in wide focus (WF) context.

It has been already argued in Chapter 3 that the IP initial L tone surfaces with a rising contour due to the influence of the IP left edge L%H% boundary tone. Following the association of the left edge L%H%, the subject àŋ 'I' surfaces with a rising contour in the wide focus condition in Figure 5.16. However, the high target for the f_0 rise aligned to àŋ 'I' is not scaled in the same way when it occurs as the initial element of a sentence expressing contrastive focus. The dark line in Figure 5.16 representing the time normalized pitch contour of àŋ 'I' shows lesser amount of rise. In other words, *in addition to the register lowering of the whole utterance, contrastive focus in Boro results in pre-focus modification in terms of changing the characteristic pitch trend of an L tone* occurring IP initially preceding the target word.

Contrastive focus also results in *post-focus modification of f_0 scaling. Sentence final post-focus constituents, only with lexical H specification, undergo this modification*. It has been already reported in Chapter 4 that phrase final lexical H tones in Boro interact with L% in such a way that f_0 trends for both the lexical and intonational tones align to the rhyme of the final syllable. In Figure 5.17, both the lexical H tone and the final L% remain anchored to the rhyme of the aggregated (n=54) time normalized pitch contour for the occurrence of the word nagír-duŋ-mɯn 'search-Prf-Pst' in wide focus context (light line). However, the aggregated time normalized contour for the contrastive focus context surfaces only with a falling contour with no trace of rise in f_0 aligned to the final rhyme.

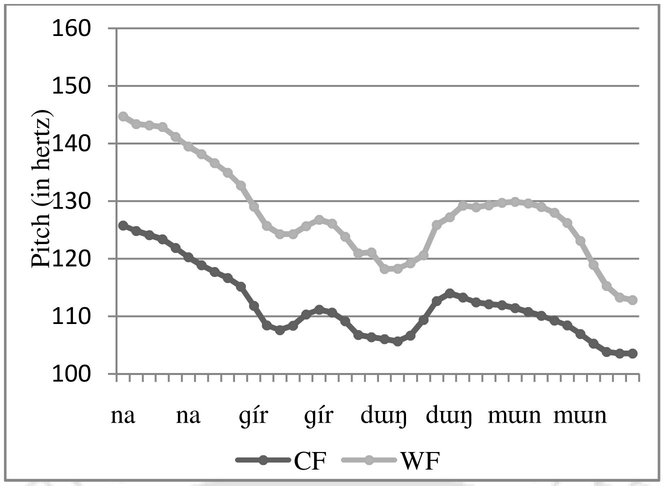

Figure 5.17:**Post-focus compression of pitch range.** Aggregated time normalized pitch contours (n=54) of nagír-dɯŋ-mɯn 'search-Prf-Pst' occurring in wide focus (WF) and post-contrastive focus (CF) contexts.

When the f_0 contours of the IP initial L tone in pre-focus position and IP final H tone in post-focus position were segmented into maximum and minimum f_0 targets, it is found that *contrastive focus results in compression of the pitch range of the pre-focus and post-focus L and H tones respectively*. Figure 5.18 presents aggregated maxf_0 and minf_0 for the pre-focus IP initial occurrence of àŋ 'I' (n=81) and that of the last syllable of the post-focus IP final occurrence of nagír-dɯŋ-mɯn 'search-Prf-Pst' (n=54). These values are compared with the same for wide focus contexts.

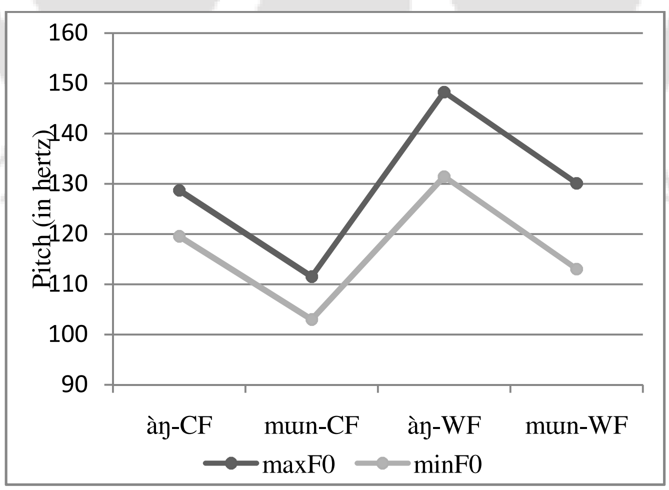

Figure 5.18: **Compression of pitch range and contrastive focus.** Aggregated f_0 maximum (maxF0) and minimum (minF0) of àŋ 'I' (n=81) and of the last syllable of nagír-dɯŋ-mɯn 'search-Prf-Pst' (n=54) occurring in pre-focus and post-focus positions in contrastive focus (CF) context and in wide focus (WF) context.

A closer look at the comparison between the f_0 ranges of the two focus conditions of both the syllables in Figure 5.18 shows that f_0 range is compressed in the context of contrastive focus. In other words the pitch rise for the IP initial L%H% boundary tone is compressed when a low tone word occurs in pre-focus sentence initial position. Results presented in Figure 5.18 support our assumption regarding the pitch contours presented in Figure 5.16. Also, the final lexical H tone in the post-focus position is influenced in such a way that the f_0 rise for the tone during the rhyme of the final syllable is curtailed by compressing the f_0 range.

A repeated measure Anova was conducted in SPSS comparing the z-score normalized values for pitch range (maxf_0 minus minf_0) of àŋ 'I' and that of the last syllable of the final occurrence of nagír-dɯŋ-mɯn 'search-Prf-Pst' in the two focus conditions. Results showed that contrastive focus causes significant difference in pitch range of the rightmost syllable of the pre-focus and post-focus words. Z-score normalized pitch range for àŋ 'I' in wide focus condition (mean = 1.00hz) is found to be significantly more than its value in contrastive focus condition (mean = 0.56hz), $F(1, 8) = 19.77$, $p < 0.05$ with no significant interaction, $F(8, 64) = 0.657$, $p = 0.72$. Results have also shown significant main effect of focus on pitch range of the last syllable of nagír-dɯŋ-mɯn 'search-Prf-Pst', $F(1, 8) = 27.95$, $p < 0.05$, (z-score normalized mean = 0.92 hz for wide focus and -0.07 for contrastive focus condition). However, there was significant interaction, $F(5, 40) = 0.977$, $p = 0.00$. This can be attributed to the fact that the difference between maxf_0 and minf_0 for some instances of mɯn in nagír-dɯŋ-mɯn 'search-Prf-Pst' varied irregularly, ranging from a small difference to a large one.

This section has examined the prosody of contrastive focus in details. Acoustic and statistical results presented in the discussion above highlight the following properties of the intonation of contrastive focus in Boro:

- Prosodic cues for contrastive focus marking in Boro are both local and global.
- Global modification for contrastive focus lowers the pitch register of the whole IP.
- Local modifications affect the target words as well as the pre-focus and post-focus constituents.
- Pitch range of L tones occurring in pre-focus IP initial context and H tones occurring in post-focus IP final positions are compressed.
- Contrastive focus decreases the duration of the vowel of the TBU of the target words.

5.6 Prosody of Corrective Focus

Results presented in 5.5 show that contrastive focus in Boro is marked by both local and global prosodic cues. Studies on corrective focus have shown that lengthening of duration and increase in pitch range can play important prosodic function in such contexts[21]. Thus, it was felt to be necessary to examine whether the cues for corrective focus in Boro differ from those signaling contrastive focus. This has been the motivation behind examining the prosody of corrective focus in Boro separately from that of contrastive focus. Results have shown that *Boro does not employ any separate prosodic means for this kind of focus marking other than the global effect noticed for contrastive focus expressions.*

5.6.1 f_0 and Corrective focus

Evaluation of the pitch contours for the sentences expressing corrective focus (CrF), in comparison to their occurrence in wide focus (WF) contexts, has revealed that pitch register plays an important role in expressing both corrective and contrastive focus in Boro. This section will present results based on pitch contours and statistical analysis to show that *corrective focus also results in lowering of the pitch register of the whole IP, along with pre-focus modification of L tones and post-focus modification of H tones.* Figure 5.19 presents the aggregated time normalized pitch contours of bí-ɯ daodɯí zá-ji 'He has eaten egg' occurring in both wide focus and corrective focus contexts.

[21] Studies like Chen (2006) and Chen and Gussenhoven (2008) have found that correctively-focused words have longer duration in Standard Chinese. Chen and Gussenhoven (2008) have reported that words with corrective focus have larger f_0 ranges.

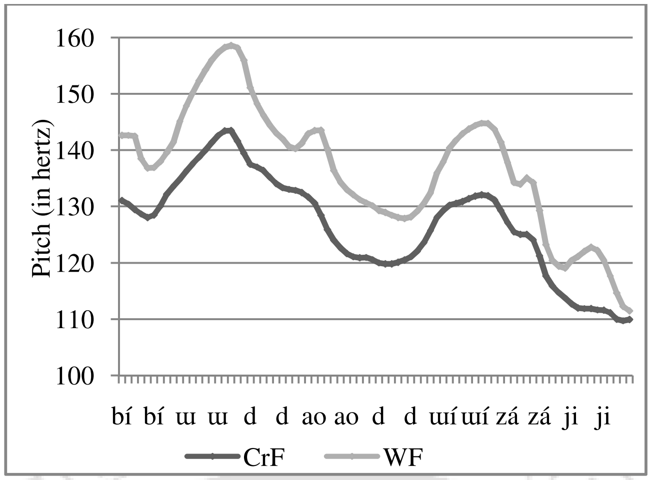

Figure 5.19: **HHH tone sequence and register lowering for corrective focus.** Averaged time normalized pitch contour (n=30) of bí-ɯ daoduɯí zá-ji 'He has eaten egg' in wide focus (grey line) (WF) and corrective focus (black line) (CrF) contexts.

In Figure 5.19, the *pitch contour for the corrective focus expression remains lower until the final syllable*. This sentence has an HHH lexical tone sequence. Even a sentence with LLH lexical tone sequence follows this pattern of *register lowering*. Figure 5.20 compares the time normalized pitch contours of àŋ bedòr zá-ji 'I have eaten meat' with corrective focus on bedòr 'meat (dark line) with the whole sentence occurring in the context of wide focus.

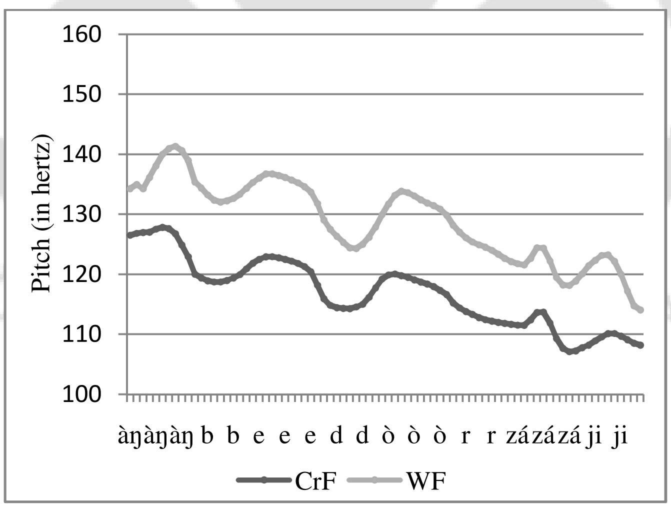

Figure 5.20: **LLH tone sequence and register lowering for corrective focus.** Averaged time normalized pitch contour (n=30) of àŋ bedòr zá-ji 'I have eaten meat' in wide focus (grey line) (WF) and corrective focus (black line) (CrF) contexts.

In Figure 5.20, the time normalized contour for the wide focus context (light line) remains higher till the end of the IP. Unlike during the final syllable in Figure 5.19, the pitch contours for wide focus and corrective focus context does not come close to each other during the final syllable in Figure 5.20.

It is also found that the z-score normalized meanf_0 values of the vowel of the TBUs aggregated for all the tokens expressing corrective focus significantly differ from the same value for it in wide focus condition. A repeated measured Anova was performed in SPSS to explore the effect of focus on meanf_0 (m) of the vowels of the right aligned TBUs in the target words. Results have shown that z-score normalized meanf_0 for the vowel in the second syllable of bedòr 'meat' in wide focus condition (m = 0.251 hz, n=60) differs significantly from its occurrence in corrective focus condition, $F(1, 9) = 31.08$, $p< 0.05$, m =-0.972 hz. There was also no significant interaction, $F(5, 45) = 0.349$, $p > 0.05$. Results for the vowel in bɔ́n 'firewood' (n=30) have also shown a significant effect of focus on meanf_0, $F(1, 9) = 16.48$, $p< 0.05$ with the averaged value for wide focus being 0.833 hz and for corrective focus it's being -0.420 hz. There was also no significant interaction, $F(2, 18) = 0.38$, $p > 0.05$. The meanf_0 for the vowel in zɯ̀o 'ricebeer' (n=60) significantly differs between its occurrence in the two focus conditions (m=0.429 hz for wide focus and m= -0.471 hz for corrective focus) discussed here, $F(1, 9) = 19.59$, $p< 0.05$ with no significant interaction, $F(5, 45) = 0.255$, $p > 0.05$. Corrective focus also significantly lowers the meanf_0 (m=0.829 hz for wide focus and m=0.072 hz for corrective focus) of the vowel of the second syllable of daodɯí 'egg', $F(1, 9) = 38.89$, $p< 0.05$, n = 90. There was also no significant interaction, $F(8, 72) = 1.02$, $p > 0.05$.

Acoustic and statistical evidence presented in this section show that pitch register of an IP is lowered when it expresses corrective focus. This also results in lowering of the f_0 of the vowels of the right aligned TBUs in the target words.

5.6.2 Duration and Corrective focus

Comparison of duration of the vowels of the (right aligned) TBUs of target words in the corrective focus and wide focus contexts has revealed that *duration is reduced when the target words express corrective focus*. A repeated measures Anova (on z-score normalized duration values) done in SPSS has revealed that duration of the vowels is significantly reduced when they express corrective focus. Table 5.3 explains this.

Vowel	Focus	Mean	Significance
ɯo	WF	2.829 ms	F(1, 9) = 59.350,
	CrF	2.326 ms	p = 0.000, n= 60
ɔ́	WF	1.980 ms	F(1, 8) = 38.919,
	CrF	1.561 ms	p = 0.000, n = 30
ò	WF	1.420 ms	F(1, 9) = 44.074,
	CrF	0.983 ms	p = 0.000, n= 60
ɯí	WF	2.210 ms	F(1, 9) = 62.414,
	CrF	1.835 ms	p = 0.000, n = 90

Table 5.3: **Corrective focus and compression of duration.** Durational difference between the occurrences of the vowels in the target words in wide focus and corrective focus conditions. Interaction is not-significant for all the levels.

5.6.3 Pre-focus and Post-focus modifications

The prosody of corrective focus in Boro seems to replicate all the features of the intonation of contrastive focus. Similar to the results for contrastive focus, *pitch contour of the pre-focus and post-focus constituents undergo compression of pitch range in instances of IP initial L tone and IP final H tone for corrective focus marking*. The data set for evaluating the prosodic effect of corrective focus contained four sentences with àŋ 'I' occurring in IP initial position. Pitch contours of IP initial àŋ 'I' surface with a scaling difference when they occur in pre-focus positions in the context of corrective focus.

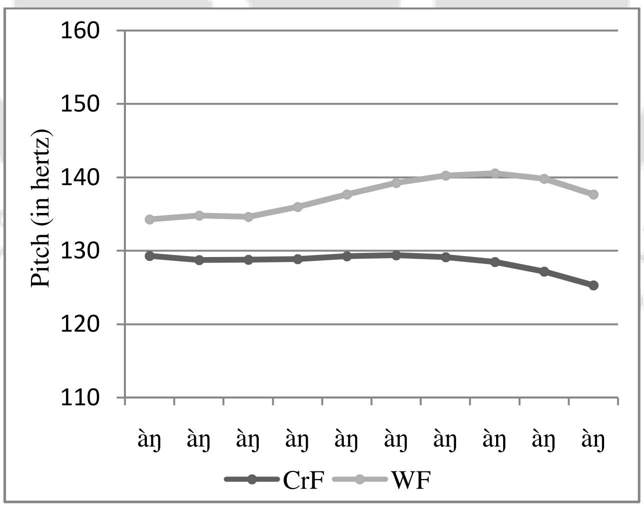

Figure 5.21: **Corrective focus and pre-focus pitch compression.** Aggregated time normalized pitch contours (n=150) of àŋ 'I' occurring in IP initial position in wide focus (WF) context and preceding the target word in corrective focus (CrF) contexts.

Figure 5.21 compares the aggregated (n=120) time normalized pitch contours of àŋ 'I' occurring in pre-focus positions (dark line) and in the context of wide focus (light line). The dark line in Figure 5.21 shows that the high target for L%H% aligned to àŋ 'I' is scaled lower when it occurs in the pre-focus position. In other words, *in addition to register lowering of the IP, corrective focus in Boro also results in pre-focus compression of pitch range*.

Post-focus occurrences of words with H tone do not surface with the characteristic rise and fall in f_0 aligning to the rhyme of the final syllable. The f_0 specification for both the lexical H and boundary L% surface in the instance of the IP final words with H tone occurring in the context of wide focus. Figure 5.22 compares the aggregated time normalized pitch contours of the verb zá-ji 'eat-Prf' (n=120) occurring in post focus (dark line) context and in the context of wide focus (light line). It can be seen in Figure 5.22 that zá-ji 'eat-Prf', occurring in wide focus context (light line), surfaces with an observable rise in pitch aligned to the final syllable. However, the pitch contour of the same syllable does not surface with a similar rise when it occurs in post-focus context (dark line) before the final fall for L% boundary tone.

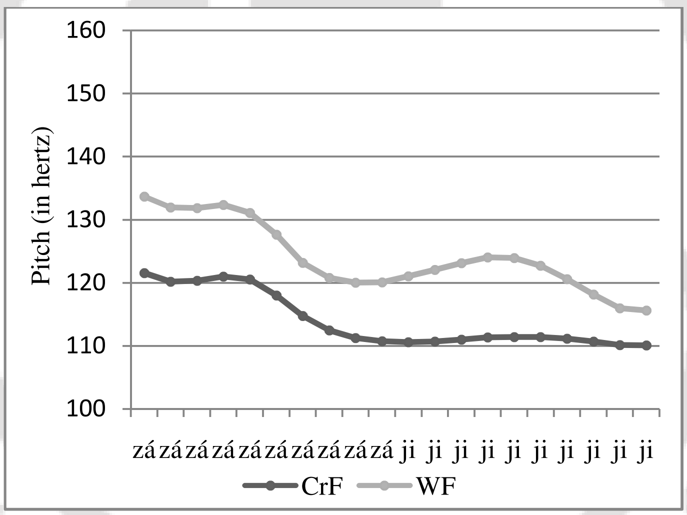

Figure 5.22: **Corrective focus and post-focus pitch compression.** Aggregated time normalized pitch contours (n=120) of zá-ji 'eat-Prf' occurring in wide focus (WF) and in post-corrective focus (CrF) contexts.

When the f_0 contours of the IP initial L tone and of IP final H tone were segmented into maximum and minimum f_0 targets, it is found *that corrective focus also results in compression of pitch range of the pre-focus and post-focus words with L and H tones respectively*. Figure 5.23 presents aggregated maxf_0 and minf_0 for the initial occurrence of àŋ 'I' (n=150) and that of the last syllable of the final occurrence of zá-ji 'eat-Prf' (n=120) occurring in wide focus and corrective focus contexts. A closer look at the comparison between the f_0 ranges for the two focus conditions for both the syllables shows that *f_0 range is compressed in the context of corrective focus*. This conforms to the comparison of pitch contours presented in Figure 5.21 and 5.22.

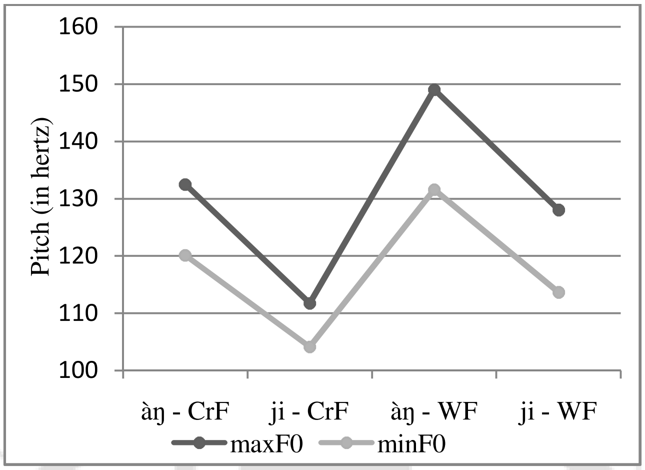

Figure 5.23: **Compression of pitch range and corrective focus.** Aggregated f_0 maximum (maxF0) and minimum (minF0) of àŋ 'I' (n=150) and of the last syllable of zá-ji 'eat-Prf' (n=120) occurring in pre-focus and post-focus positions in corrective focus (CrF) context and in wide focus (WF) context.

A repeated measure Anova was conducted in SPSS comparing the z-score normalized values for pitch range (maxf_0 minus minf_0) of àŋ 'I' and that of the last syllable of the final occurrence of zá-ji 'eat-Prf' in the two focus conditions. Results showed that corrective focus causes significant difference in pitch range of the rightmost syllable of the pre-focus and post-focus words. Z-score normalized pitch range for àŋ 'I' in wide focus condition (mean = 1.14 hz) is found to be significantly more than its value in corrective focus condition (mean = 0.54 hz), $F(1, 9) = 56.92$, $p < 0.05$ with no significant interaction, $F(11, 99) = 0.938$, $p = 0.51$. Results have also shown significant main effect of focus on pitch range of the last syllable of zá-ji 'eat-Prf', $F(1, 9) = 31.28$, $p < 0.05$, (z-score normalized mean = 0.93 hz for wide focus and 0.43 for corrective focus condition) with no significant interaction $F(11, 99) = 0.798$, $p = 0.642$. These results corroborate the visual representation of the difference between the f_0 contours for àŋ 'I' and the last syllable of zá-ji 'eat-Prf' presented in Figure 5.21 and 5.22.

The discussion presented here shows that the prosodic parameters for corrective focus marking in Boro are identical to the ones employed in the instances of contrastive focus. *In addition to the global effect of register lowering, both contrastive and corrective focus result in durational reduction of the focused words and compression of pitch range of pre-focus L tone* *and post-focus H tone.* This follows Gussenhoven's (2004) assertion that context determines the precise realization of a tonal target, regardless of whether the tone is lexical or intonational.

5.7 Phonology of Focus marking in Boro

The discussion presented above shows that pitch register plays a very important role in Boro as far as information structure is concerned. Overall raising of register is also found in Hausa questions. Inkelas and Leben (1990) interpret the higher pitch of the entire question as carried out in the phonetics. But in Jita, raising of the pitch register is phonological where the register is raised up to and including the last lexical H tone of the sentence or, in case of L tone only sentence, the penultimate syllable (Downing, 1996). According to Gussenhoven (2004), the raising of pitch at the beginning of questions in Malay is also discrete. Borras-Comes, Vanrell and Prieto (2014) show how pitch range differences can express discrete linguistic distinction in Catalan.

In many studies on tone languages a Register feature is proposed to define four tones by using only two features. Found firstly in the discussion by Yip (1980a) the Register feature [+/- Upper] is used to denote two distinct pitch ranges, within each of which there can be identified two levels of pitch referring to tones. In other words, the [+/- Upper] Register feature divides the pitch range of the voice into two halves and within each of these divisions two levels of pitch, denoting tones, are identified. This register model is adopted by many other discussions as in Clements (1981), Snider (1990) and Hyman (1993). These studies have used the binary feature system [+/- high] but have associated them either to the Register level or to the level of Tone. The Register level is marked by the Tonal Root Node and the tonal level is marked by the Tonal Node. Hyman's (1993) proposal of Register division is different from that of Yip's (1980a) because for Hyman (1993) an L at the Tonal Root Node lowers the overall register. Snider (1999) develops the concept of register tier which defines a string of register tones (h, l) existing parallel to the string of regular H, L tones. This results in every TBU specified with a register tone and a lexical tone. The register tones (h, l) can spread to another TBU to either raise or lower its register (Gussenhoven, 2004: 117). We propose that *Boro provides evidence for register levels at its intonational phonology and not at the level of its tonal phonology. Register change is used by Boro as an important aspect of its intonational system.*

The model of register spread and modification in tone languages (Bao 1999; Snider 1999) can provide important insight into the intonational phenomenon in tone languages. Genzel

(2013) has proposed that in Akan a high register tone (h) is associated with the left edge of an IP and a low register tone (l) gets associated with the right edge. This provides the phonological trigger for implementing a downward trend in f_0 for Akan IPs. The model of register spread and modification can also be adopted to explain the phenomenon of register raising and lowering employed in Boro for expressing emphasis and for focus marking. It has been already shown in Section 5.5 and Section 5.6 that pitch register of the whole utterance is lowered for contrastive and corrective focus marking. On the other hand, Section 5.4 presents evidence of raising of the pitch of the whole utterance when an emphatic particle is added to any one of its constituents. Even when the emphatic particles in Boro occur with the sentence final constituents, such sentences are produced with an overall high register compared to the f_0 contour of a similar sentence produced in a wide focus condition. *Phonologically the raising of the f_0 contour of the sentences containing the emphatic particles can be explained as an intonational Register High* (h) *tone affecting the realization of the f_0 heights for each of the lexical tones*. Comparison of z-score normalized mean f_0 values of each of the syllables presented in Figure 5.10 shows it. The prosody of contrastive and corrective focus presents a totally opposite register. We propose that an *intonational Register Low* (l) *tone results in lowering of overall register of the whole utterance for contrastive and corrective focus marking*. Figure 5.19 and 5.20 present instances of the way this l tone lowers the f_0 heights of each of the lexical H and L tones when the sentence expresses corrective focus. When the lexical tones undergo lowering as a result of association of the l register tone for corrective focus, the non-tone bearing syllables are also lowered for phonetically implementing the f_0 trend for each of the lexical tones in Boro. The lowering of the register of the lexical tones can be schematically presented as in (15).

(15) bí-ɯ [daodɯí]$_{foc}$ zá-ji

l l l (Register l for corrective focus)

bí-ɯ [daodɯí]$_{foc}$ zá-ji
he-Nom egg eat-Prf

In (15) the Register l tone for corrective focus gets associated to the right aligned tone bearing syllables and then it spreads to the non-tone bearing syllables within the same PrWd. The Register h tone for emphatic expressions gets associated with the TBUs and non-tone bearing syllables in similar manner. Emphatic focus in Boro is prosodically marked by such a modification in addition to the H* associated to the emphatic particle itself. (16) presents the alignment schema for register h tone in Boro.

(16) bik^{h}unzɯ́ábɯ daodɯí baìdɯŋmɯn

h H* h h (H* and Register h for emphatic focus)

bik^{h}unzɯ́ábɯ daodɯí baìdɯŋmɯn
'mother-in-law-also egg buy-Prf-Pst
Mother-in-law also bought egg.

5.8 Focus marking in Boro: Theoretical implication

The description of focus prosody in Boro presented in section 5.1 and 5.4 through 5.6 shows that focus marking does not employ culminative sentential prominence on the focused constituent. Narrow focus marking does not result in any prosodic effect on the focused constituent both in terms of f_0 and durational change (Mahanta, Das and Gope, 2016). This negates the focus-prominence correlation widely assumed in the linguistic literature (Truckenbrodt 1995, 2005; Samek-Lodovici 2005; Büring 2010). Results for focus marking with emphatic particles, corrective and contrastive focus marking also show that *pragmatic salience in Boro is not related to any intonational pitch change on the focused element*. This necessitates a relook at the literature of interaction between prosody and focus.

The correlation between the 'highlighted' or 'focused' constituent and pitch accent was brought to the fore in linguistic description by Bolinger (1958, 1972b). Following Pierrehumbert's (1980) rehabilitation of Bolinger's notion of pitch accent (Ladd, 1996) as a phonological construct, the Focus-to-Accent approach (Ladd 1980, Gussenhoven 1983, Selkirk 1984) provided impetus to the view that the accent aligns to a focused constituent more or less automatically. The Focus-to-Accent view has been the foundation of the gamut of works on the semantics of focus since 1980s trying to analyse the relation of focus with syntactic and phonological organization (Ladd, 1996). Steedman (1991) shows how a pitch accent marks a proposition as emphasized or contrasted with something mentioned or regarded by the speakers in the previous discourse or context. Steedman (2000) extends this discussion to highlight the focusing property of pitch accents. This theoretical posture continued to resurface in the linguistic description of prosody-focus interface in the form of the Stress-Focus constraint (Selkirk 1984, 1995; Truckenbrodt. 1995) demanding focus to be maximally prominent (prosodically) (Reinhart 1995; Selkirk 2004; Szendröi 2003; Truckenbrodt 2005; Samek-Lodovici 2005, Büring 2010). Samek-Lodovici (2005) captures the central premise of this discussion in the form of the STRESS-FOCUS constraint, a high-ranked constraint required to have sentence-level culminative stress:

(17) STRESS-FOCUS (Samek-Lodovici 2005: 697):
For any XP_f and YP in the focus domain of XP_f, XP_f is prosodically more prominent than YP.

This theoretical assumption applied well to the examples from European languages like English and Italian (Samek-Lodovici, 2005). It is shown how Italian allows syntactic movement to satisfy the stress-focus correlation. On the other hand, in English the stress moves to the focused constituent fulfilling the requirement for stress-focus constraint (Samek-Lodovici 2005). However, the application of such a theory to a language like Chichewa encounters serious problems since in Chichewa *phrasing*, rather than prosodic prominence, is the main correlate of focus (Kanerva, 1990). It is because of this kind of evidence, attempts of showing a universal highlighting theory with a direct relation between accent and focus has been found to be empirically inadequate (Ladd, 1996). Ladd (1996) shows that prosodic structure also plays an important role in focus marking since there exists a kind of trade-off between structural tendencies and pragmatic expectations. Hayes and Lahiri's (1991) findings for focus marking in Bengali also show how phrasing plays an important role for highlighting a constituent.

Phrasing as a cue for focus marking provides the base for an argument for the typology of intonation where discourse salience is not prosodically marked in the way it is executed in European stress languages (Downing 2006, 2007, 2008). In the Southern Bantu languages, Chichewa, Chitumbuka and Durban Zulu, the sentence stress does not align to a focused element. The focused element also does not move to the position of sentence stress (Downing 2007, 2008). In Tumbuka, focus is marked either by morphological focus markers or by syntactic devices (Downing, 2012). There is a growing body of research on languages in which focus marking is not encoded in prosody. Zerbian et al. (2010) give an account of such languages following results reported in Zerbian (2006), Hartmann and Zimmermann (2007), Rialland and

Robert (2001) and Schwarz (2009). Results for pragmatic salience reported in the preceding sections show that Boro displays duality of behavior as far as focus marking by prosodic means is concerned. It does not employ any prosodic cue for narrow focus marking (Mahanta, Das and Gope, 2016). Intonational register tones are used for focus marking with emphatic particles, and for corrective and contrastive focus marking. This provides further evidence for the assumption that the focus-prominence correlation cannot be maintained as an inviolable principle in the description of cross-linguistic focus prosody.

Boro provides the *only example of a language recruiting both register lowering and raising for semantic-pragmatic purposes*. This shows that a tone language can exploit both the registers at the higher levels of prosodic hierarchy. A more important outcome of these results is that Boro provides further insight into the way the typology of focus-prosody has to be enlarged to accommodate register modification at the phrasal level as an important cue for information structure. Register modification of the whole prosodic domain has already been reported in some varieties of Chichewa (Downing 2008). Downing at al. (2004, 2007) show how in some varieties of Chichewa focus leads to systematic raising of f_0 within the Phonological Phrase containing the focused element. Compared to this, in Boro the IP remains the domain of register modification for focus marking. This individuality of focus prosody of Boro could be accommodated within the framework of Prominence-Focus constrain (Samek-Lodovici, 2005) if *prominence can be intertwined to prosodic domains*. In its present incarnation, Samek-Lodovici's (2005) Prominence-Focus constrain requires that a focused element (XP_f) is required to have the culminative (i.e., highest) level of some suprasegmental feature which correlates with prominence – pitch, duration and/or amplitude or intensity – in its prosodic domain, normally, the IP (Downing 2008). *Focus prosody of Boro necessitates that the whole prosodic domain (IP in Boro) receives prominence, either that of register raising or lowering*. In the case of the varieties of Chichewa mentioned by Downing et al. (2004, 2007) the domain for register modification for prominence is that of the Phonological Phrase. Thus, information structure in Boro provides an opportunity for weighing the universality of focus-prominence correlation from a novel perspective.

5.9 Conclusion

It is widely reported in the relevant literature that prosodic structure can convey discourse-level information (Gussenhoven 1983; Ladd 1980; Watson 2010). Studies have highlighted three acoustic dimensions that provide cues about information structure: duration, fundamental frequency (f_0) and intensity. The study presented in this chapter investigates the prosodic cues for discourse-information structures in Boro. Mahanta, Das and Gope (2016) in their study of presentational narrow focus marking in Boro found that this kind of new-information focus in Boro is mostly expressed by using morphological focus markers suffixed to the focused arguments. This does not result in any kind of f_0 and duration difference in the focused argument, rather the morphological focus markers themselves surface with an H* morpholexical accent. Evaluation of other types of information structures vis-à-vis the prosodic system representing them was of great importance to shed more light on the ways these issues interact in a tone language like Boro. This chapter has discussed how the results for ex-situ focus marking, focus marking with emphatic particles, contrastive and corrective focus marking in Boro reveal *prosodic means affecting not only the target words but also the overall pitch contour of the utterance*.

The *first* aim of this chapter was to investigate whether Boro words occurring in ex-situ context differ from their occurrence in in-situ context in terms of their prosodic realization, and if so, which parameters encode these differences. Evaluation of pitch contours and duration of the words bearing ex-situ focus revealed *no consistent variation* along these parameters compared to their occurrence in wide focus context. *Thus, ip boundary insertion, as discussed in Chapter 3, remains the only prosodic cue for ex-situ focus marking in Boro*. Although a similar study on a tone language like Akan (Kugler and Genzel, 2012) found lowering of pitch of the target words as the prosodic cue for such kind of focus marking, Boro does not adhere to such a feature.

The *second* aim of the study presented in this chapter was to explore whether and how focus marking by emphatic particles differ from the prosodic means employed by [sɯ́] and [nɯ́] in Boro. Cues for focus marking with emphatic particles suggest that they partly agree to and partly differ from those used by [sɯ́] and [nɯ́] for signaling focus. As in the case of [sɯ́] and [nɯ́] (Mahanta, Das and Gope, 2016), *emphasis in Boro is also expressed by an H** (a phonetically higher H) aligned to the emphatic markers. In addition to this the *pitch register of the whole utterance is raised* compared to the one without the emphatic particles occurring in wide focus context. This kind of *raising of the pitch register is caused by the Register* h *tone marking emphatic focus in Boro*. Thus emphatic focus has a stronger impact on the prosodic feature of an utterance than [sɯ́] and [nɯ́] have.

The *third* aim of this chapter was to provide a detailed analysis of the acoustic parameters relevant for contrastive and corrective focus marking. Results presented in section 5.5 and 5.6 show that Boro does not make any difference between these two focus conditions in terms of the prosodic features employed to mark them. Both *contrastive and corrective focus result in the global effect of lowering the register of the utterance* containing the target word. In addition to this, the *duration* of the vowel of the TBU of the target word *is compressed*. Another local effect of contrastive and corrective focus marking is that of *lowering the pitch range of pre-focus sentence initial L tones and of post-focus sentence final H tones*. However, the intriguing question remains as to why the pre-focus and post-focus local effect of lowering pitch range is found only in the case of L tone in pre-focus position and for H tone in the post focus position. This deserves to be investigated further in future work. Whereas Mahanta, Das and Gope (2016) find no consistent prosodic cue for narrow new information focus marking without adding [sɯ́] and [nɯ́], the cues for contrastive and corrective focus in Boro seem to be encoded in its prosody quite distinctly. This may be due to the cognitive feature of correction which is more salient than 'newness' (Kaiser, 2011). Since correction yields extremely strong prosodic prominence (Ouyang and Kaiser, 2013), *corrective and contrastive focus in Boro are distinctly encoded in the prosody of the language, whereas new information presentational focus without [sɯ́] and [nɯ́] does not employ any prosodic cue*. This may imply that presentational focus in Boro is prosodically stronger in the presence of [sɯ́] and [nɯ́]. This needs to be tested in the form of a perception experiment and we will continue that research in the future. Finally, *corrective and contrastive focus result in both local and global prosodic modifications*.

Studies on focus marking in tone languages have shown that discourse-level intonation and lexical tones can use different aspects of acoustic dimension like the shapes of f_0 movement for lexical purposes and ranges of their movement for discourse-information structure (Chen and Gussenhoven 2008; Xu 1997; Ouyang and Kaiser 2013) (see section 1.4) As the shapes of f_0 contours mark lexical items in tone languages, this prosodic dimension is modulated in another way to mark discourse importance. Thus, pitch register modification can be sometimes used by a tone language for discourse information structure (Inkelas and Leben 1990; Downing 1996; Borras-Comes, Vanrell and Prieto 2014) *The prosodic cues for focus marking in a tone language like Boro rest heavily on pitch register modification* which allows lexical tones to preserve their characteristic f_0 trends. Lowering of pitch register for contrastive and corrective focus, and raising of it for focus marking with emphatic particles allow the f_0 dimension to be used in a different way to mark discourse importance. *Localized events like H* pitch accent associated to emphatic particles and pitch range modification of the pre-focus and post-focus constituents are the further avenues explored by the process of employing f_0 dimension for intonational purpose*. These results bear important implication for the theory of focus prosody. The use of both register lowering and raising for prosodic purposes is an individual feature of Boro. This generates great interest for the typology of intonation since it employs neither phonological rephrasing (Ladd 1996; Hayes and Lahiri 1991; Downing 2006, 2007, 2008) nor sentence stress (Szendröi 2003; Truckenbrodt 2005, Samek-Lodovici 2005) for its focus prosody. Although Boro does not adhere to the focus-prominence correlation, *the language provides an opportunity for enlarging such a theory by making it domain centric rather than constituent centric*. In sum, results for focus marking in Boro show how prosodic information can play vital role in information structures in addition to the support it provides to lexical tones. It shows how the production system of a tone language can employ different aspects of acoustic possibilities for tone and intonation.

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Chapter 6

Intonation of L2 Assamese

6.0 Introduction

Foreign accents in second language (L2) production are caused by interference from the phonological system and phonetic realization of the speakers' first language (L1), including both segmental and prosodic features. Most foreign accent studies involving L2 production have centered on the sound system and the effect of the L1, focusing primarily on segmental features (Flege, 1995). In contrast, there have been *only a few studies on suprasegmental aspects of L2 learning* (Todaka 1990; Ueyama and Jun 1996). Furthermore, only *a few studies on the acquisition of L2 intonation have been undertaken based on instrumental evidence* and these studies did not consider how the phonology and phonetics of L2 intonation interact with those of L1 intonation (Ueyama and Jun, 1996). It is quite paramount that suprasegmental or prosodic features should also be examined in detail for a complete understanding of L2 production. Ueyama and Jun (1996) presented an account of the acquisition of English intonation by Japanese and Korean speakers focusing on the interaction between the phonology and phonetics of L1 and L2 intonation. It is shown that both phonological system and phonetic realization of intonation structure should be taken into consideration in assessing acquisition of second language intonation. Jun and Oh (2000) have looked at the intonation structure of Seoul Korean and its realization by American English speakers. Studies on second language intonation like Ueyema and Jun (1996) have based their analysis on comparison of intonation pattern between a control group and an experimental group. The control group consists of native speakers of the L2 and the experimental group consists of the native speakers of the L1. In addition to this, participants are categorized into different proficiency levels. Some other studies like Macdonald (2011) have taken into account the intonation models for the first language and the second language as reference points, and have investigated how level of proficiency can affect the way intonation of the second language acquired. This chapter presents the results for an experimental study which *investigates how native speakers of Boro acquire Assamese intonation at two levels of proficiency*. Section 6.1 describes the *methodology* adopted. Section 6.2 presents the results. It is shown that *pitch contours of individual words in L2 Assamese for Boro speakers do not surface with any pitch movement signifying lexical tones*. Section 6.3 shows how L2 *Assamese speakers divide IPs into prosodic units marked by the characteristic L^*H_P contour for phonological phrases in L1 Assamese* (Twaha and Mahanta, 2016). L2 Assamese *wh-questions replicates L1 Assamese* L^*fH_P *pitch contour which aligns to the question words*. However, the domain of L^*fH_P varies in L2 Assamese. Section 6.4 discusses this aspect. Section 6.5 discusses the prosody of L2 Assamese corrective focus and 6.6 presents a description of the system for narrow focus marking for the same. Section 6.7 summarizes the results and shows how *L2 focus realization constitutes the most difficult aspect of Assamese produced by Boro speakers*.

6.1 Methodology

The experiment described in this chapter consisted of a *control group* and an *experimental group*. The model of Assamese intonation described by Twaha and Mahanta (2016) has been taken as the reference point for describing the way Boro native speakers acquire Assamese intonation. The pattern of intonation of Boro described in chapter 3, 4 and 5 of this thesis has been considered as the reference point for the intonation of the first language.

6.1.1 Subjects

The control group consisted of *four speakers of standard Assamese* (Twaha and Mahanta, 2016), two from Majuli and the other two from Sivsagar in Upper Assam. They were between 23 and 27 years of age. *Four native male speakers of Boro* formed the experimental group. All the speakers from this group were between 21 and 25 years of age. The participants formed *two proficiency levels depending on the period of their exposure to and interaction with Assamese intonation*. The comparison presented in this chapter highlights a unique study since it focuses on the acquisition of an understudied language by the speakers of another understudied language. There is sparse material on the study of acquisition of these languages and means of measuring proficiency in them are also yet to be made available[22]. Because of this, we adopted our own

[22] Proficiency levels in L2 are sometimes measured by oral methods (Byrnes, 1987). Adams (1978) reports of a study of the acquisition of Spanish by English-speaking children using three groups of English speakers with varying levels of exposure to Spanish. Jun and Oh (2000) have also adopted period of exposure to L2 as

method of exposure to L2 as a yardstick to define proficiency levels in this study. All the participants were under-graduate students of Bilashipara College and two among them were also participants for the experiment on intonational phonology of Boro described in chapter 3. These two speakers of Boro stayed in their native villages during the years of their study for the undergraduate course since they were students of the distance learning segment of the undergraduate courses offered by the college. These two participants formed the first group of speakers and they had lesser amount of exposure to the Assamese language in comparison to the other two. The other two participants were the students of the regular undergraduate course and thus had stayed mostly in a rented house in Bilashipara town except during the days of vacation and holidays. Since people in Bilashipara town mainly use Assamese for communication, these two participants had a greater amount of exposure to the language during the two and a-half-years previous to the time of the recording. The first group of participants, we assumed, had *beginning* level of proficiency in Assamese and the second group of two participants had *intermediate* level of proficiency.

6.1.2 Materials

The Data series for this experiment consisted of *neutral statements* of various lengths. Other sentence types considered included *wh-questions* and sentences expressing *corrective focus and narrow focus*. The sentence frame used for eliciting corrective focus was the same described in 5.2.4. Narrow focus was elicited in the form of answers to wh-questions where the focused words corresponded to the question marker in the wh-question. Sentences expressing various focus conditions were compared to similar sentences produced in out-of-the-blue contexts.

6.2 Results

Boro lexical tones preserve their f_0 specification while occurring at the IP middle positions (see chapter 3). The data series for this experiment included several sentences where some Assamese words corresponded with Boro words with two contrastive tones[23] and it was found that the *corresponding Assamese words did not surface with any trace of f_0 contour signifying lexical tone*. Figure 6.1 presents the pitch contours for two Assamese sentences differing only in

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measurement of proficiency level of English speakers in Korean. Most of the studies on L2 acquisition have focused on elaborately described languages like English, German (Döpke, 1998), Dutch and Spanish (Anderson, 1984).

[23] The Assamese words did not carry any lexical tone since Assamese is a non-tonal language.

the objects[24]. The corresponding Boro sentence is shown below each of the Assamese sentences in (1) with lexical specification of each of the words.

(1)	xahu-e maŋxo kini-sil mother-in-law-Nom meat buy-Pst Mother-in-law bought meat	xahu-e koni kini-sil mother-in-law-Nom egg buy-Pst Mother-in-law bought egg
	bikʰunzɯ́á bedòr baìdɯŋmɯn	bikʰunzɯ́á daodɯ́i baìdɯŋmɯn

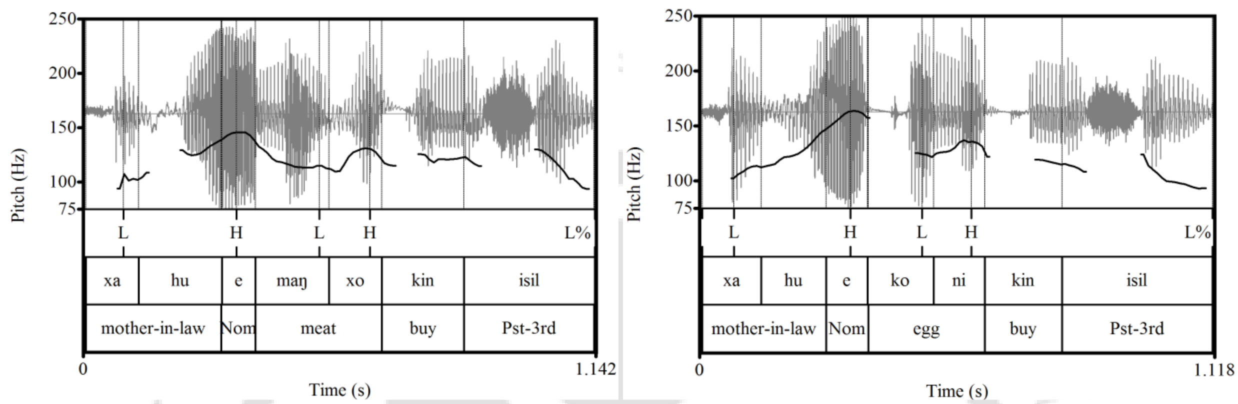

Figure 6.1: **No carry over effect of tones to lexical equivalents in L2.** Pitch contour for the sentence xahu-e maŋxo kini-sil ‘mother-in-law bought meat’ (left panel) and for the sentence xahue koni kinisil ‘mother-in-law bought egg’ (right panel) produced by L2 Assamese speakers.

The panel on the left in Figure 6.1 presents the pitch contour of a sentence with the noun maŋxo ‘meat’ occurring in the object position[25]. The corresponding Boro noun bedòr ‘meat’ is specified with low lexical tone. It can be seen that the object maŋxo ‘meat’ surfaces with a rising pitch contour instead of the characteristic falling contour for Boro lexical low tones occurring in IP medial positions. A comparison between the two panels in Figure 6.1 shows that each of the constituents except the final ones of the sentences surfaces with a rising pitch contour. Pitch contours of the same sentences produced by L1 Assamese speakers show how *Assamese sentence intonation is marked by L^*H_P contour. This L^*H_P contour constitutes the pitch trend for each of the Phonological Phrases (p-phrase) in Assamese* (Twaha and Mahanta, 2016). In their discussion of the Intonational Phonology of Assamese, Twaha and Mahanta (2016) showed how within each p-phrase the left most syllable bears the low pitch accent (L^*) and the rightmost syllable demarcates the boundary with a high boundary tone (H_P). Figure 6.2 presents the pitch contours of the two sentences in (1) produced by L1 Assamese speakers. It can be seen that the subject xahue ‘mother-in-law’ and the objects maŋxo ‘meat’ and koni ‘egg’ form separate p-

[24] The corresponding Boro objects are specified with the two contrastive tones.
[25] Assamese follows Subject + Object + Verb word order.

phrases where L* aligns to the first syllable and then the pitch rises to a high target aligning to the last syllable for H_P.

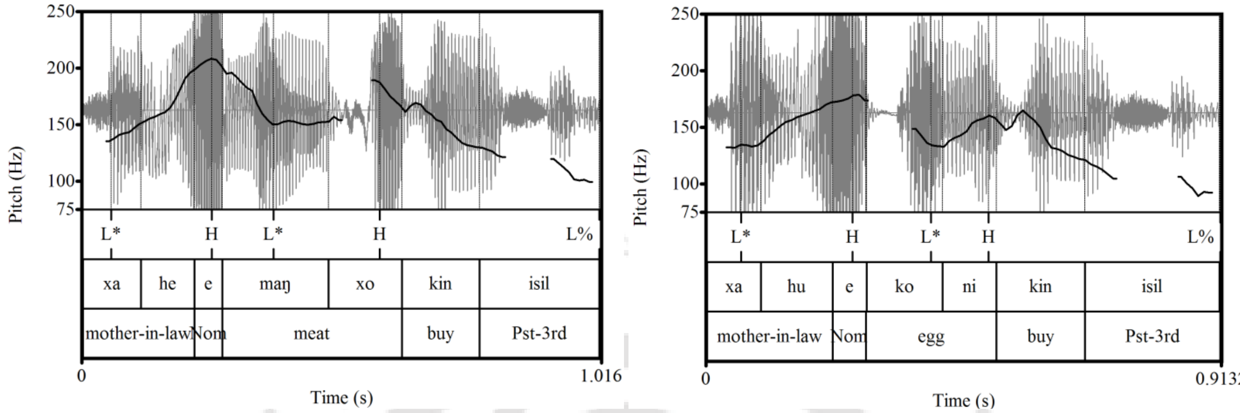

Figure 6.2: **L* H_P in L1 Assamese.** Pitch contour for the sentence xahu-e maŋxo kini-sil 'mother-in-law bought meat' (left panel) and for the sentence xahu-e koni kinisil 'mother-in-law bought egg' (right panel) produced by L1 Assamese speakers.

The similarity between the pitch contours in Figure 6.1 and Figure 6.2 shows that *Boro speakers can mark L2 Assamese p-phrases in the way L1 speakers characteristically do*. The pitch contours presented in Figure 6.2 show how each of the syntactic constituents form a prosodic unit marked by a rising contour barring the final constituent. Even in a longer sentence like teo bibarik koni dise 'he gave egg to Bibari' the L*H_P contour aligns to all of the non-final constituents in both L1 and L2 Assamese intonation.

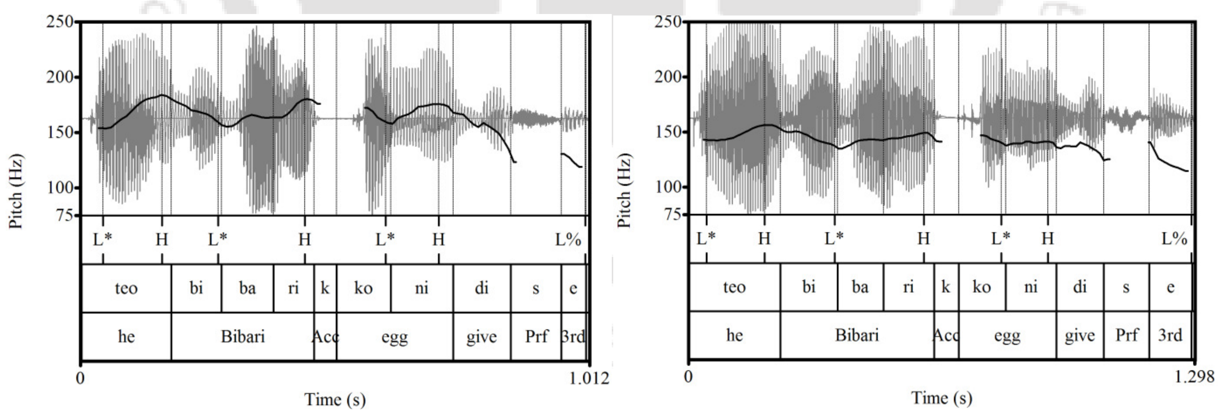

Figure 6.3: **Prosodic units in L1 and L2 Assamese.** Pitch contour for the sentence teo bibari-k koni di-se 'he has given egg to Bibari'. L1 Assamese rendition in the panel on the left and L2 Assamese one in the panel on the right.

Examination of pitch contours of other statements produced by the speakers of both the proficiency levels shows that *Boro speakers of Assamese divide a sentence into prosodic constituents depending on the number of L*H_P contours*, which is the characteristic pitch contour for p-phrases in L1 Assamese. It can also be seen in Figure 6.2 that the initial H_P target bears the highest peak and each of the subsequent H_Ps are realized as downstepped targets. It has been already shown in Chapter 3 that in Boro non-initial H tones in an all H tone sentence are realized as downstepped H. L2 Assamese intonation of Boro speakers seems to follow L1 Boro intonation in downstepping of non-initial H targets. However, *in contrast to pitch contours of Boro sentences surfacing with lexical tones of the PrWds, L2 Assamese intonation only consists of a series of* L^*H_P *pitch pattern* each aligning to a prosodic unit.

When each of the arguements in a sentence consists of more than one element, as in the case of a subject Noun Phrase with the head noun and a modifier, each of them surfaces with the L^*H_P contour with the *second* H_P *scaled lower than the first one*. Figure 6.4 presents an instance of this. It can be seen that each of the words in the sentence bibarir soalizonie mor lorazonok sithi disil 'Bibari's daughter gave a letter to my son' surfaces as a prosodic unit marked by the L^*H_P contour. The similarity of the pitch contour for each of the words in the two panels in Figure 6.4 suggests that the process of prosodic unit formation is identical in both L1 Assamese and L2 Assamese for Boro speakers.

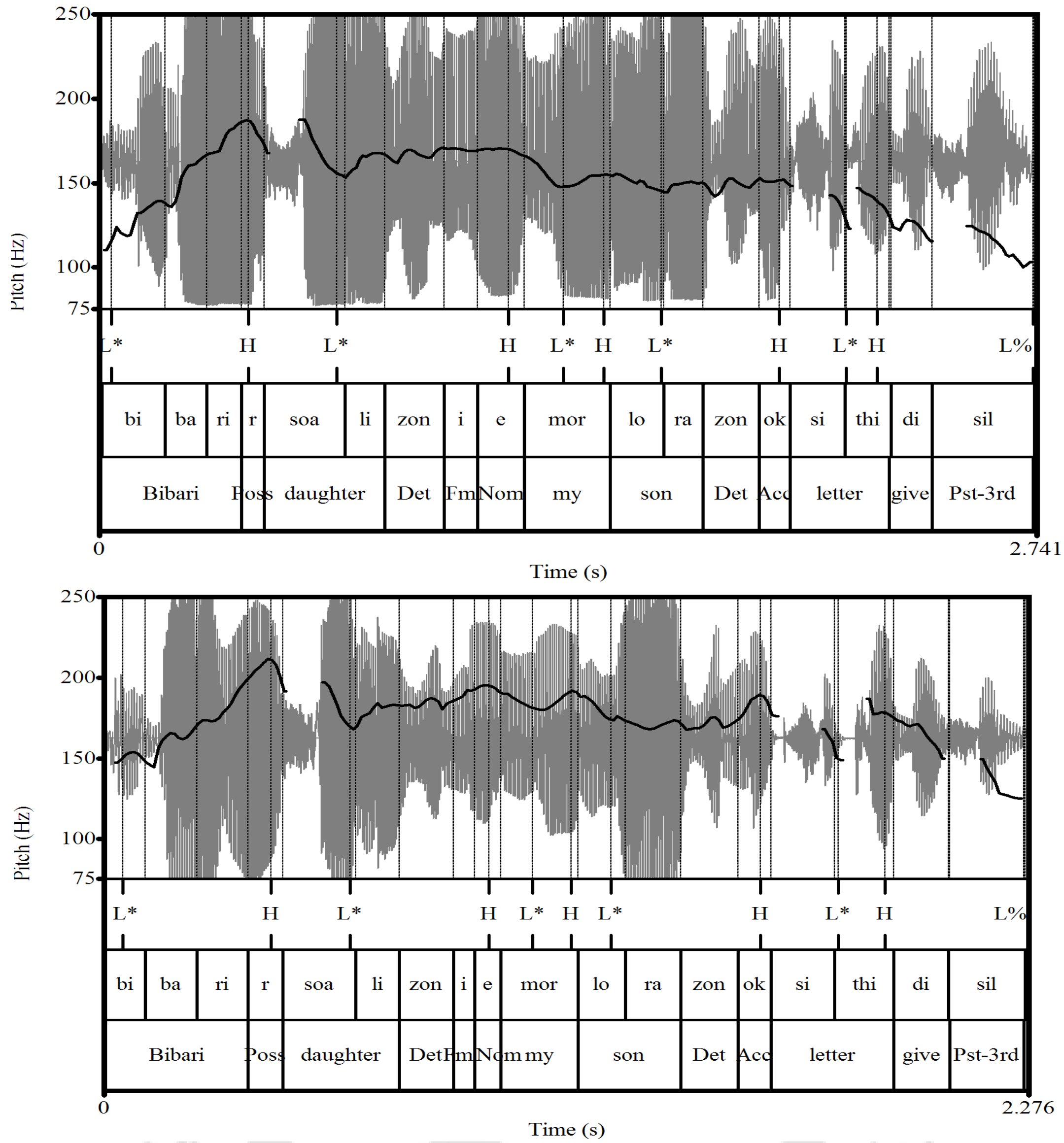

Figure 6.4: **Lexical items mapped onto prosodic units in both L1 and L2 Assamese.** Pitch contour for the sentence bibari-r soali-zoni-e mor lora-zon-ok sithi di-sil 'Bibari's daughter wrote letter to my son'. The upper panel presents the pitch contour of the L2 Assamese rendition and the lower panel is that of L1 Assamese intonation.

Results presented in this section have highlighted the following aspects of L2 Assamese intonation for Boro speakers:

- L2 Assamese intonation for Boro speakers does not reflect any carry over effect of f_0 movement signifying lexical tones.
- L2 Assamese intonation can replicate the typical L1 Assamese L*H_P contours for p-phrases.
- The second H_P target is scaled lower than the first one in L2 Assamese intonation.

6.3 Prosodic Phrasing

Pitch contours presented in Figure 6.3 show that each of the words surfaces with L^*H_P pitch contour and thus each of them form a prosodic unit. However, pitch contours for one participant from the intermediate proficiency level show that *non-initial syntactic phrases consisting of two elements together form a prosodic unit instead of each of the words forming a separate one*. In Figure 6.5, one can see that the first NP bibarir soalizonie 'Bibari's daughter' surfaces with two L^*H_P contours where the second H_P is downstepped.

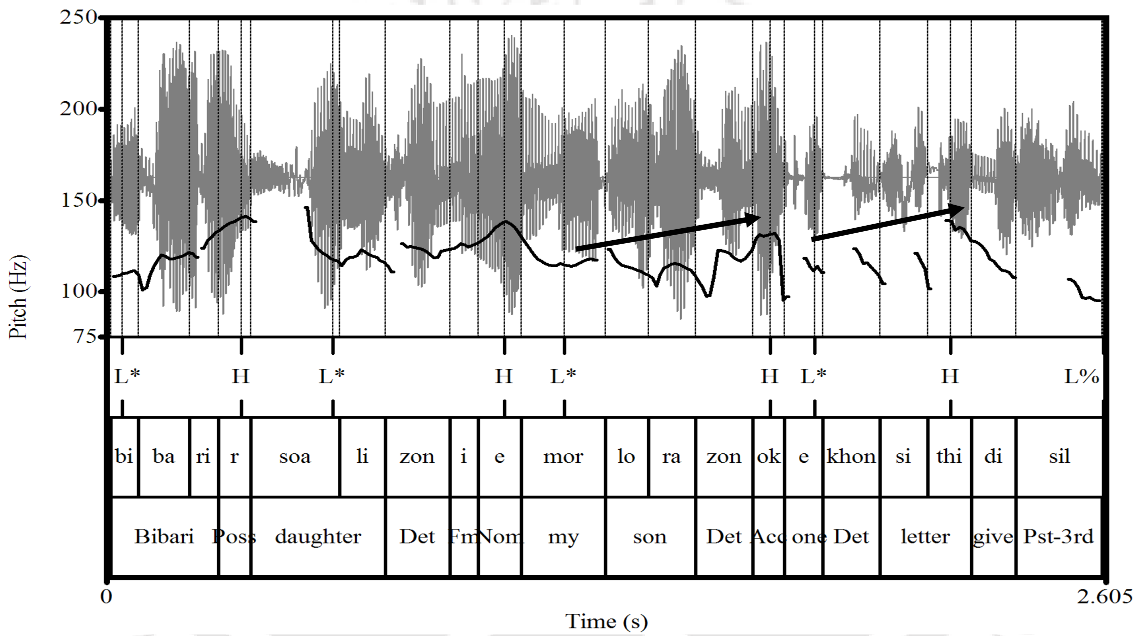

Figure 6.5: **Two lexical items mapped onto a non-initial prosodic unit in L2 Assamese.** Pitch contour of the sentence bibarir soalizonie mor lorazonok ekhon sithi disil 'Bibari's daughter gave a letter to my son' produced by a subject from the intermediate proficiency level.

Pitch contours for the two non-initial NPs in Figure 6.5 show that the second H_P aligned to each of these two NPs is scaled higher than the first one. Thus each of the NPs, mor lorazonok 'to my son' and ekhon sithi 'one letter' form a prosodic unit where the second H_P is scaled higher than the first one. In *L1 Assamese also, non-initial p-phrases can be formed by more than one constituent and in these phrases L* aligns to the first syllable of the first word and the H_P aligns to the last syllable of the second word* (Twaha and Mahanta, 2016). Figure 6.6 presents an instance of it. The direct object ekhon sithi 'one letter' surfaces with a low target aligned to the first syllable of ekhon 'one' and the H_P boundary aligns to the last syllable of sithi 'letter'. The arrow mark shows this pitch trend.

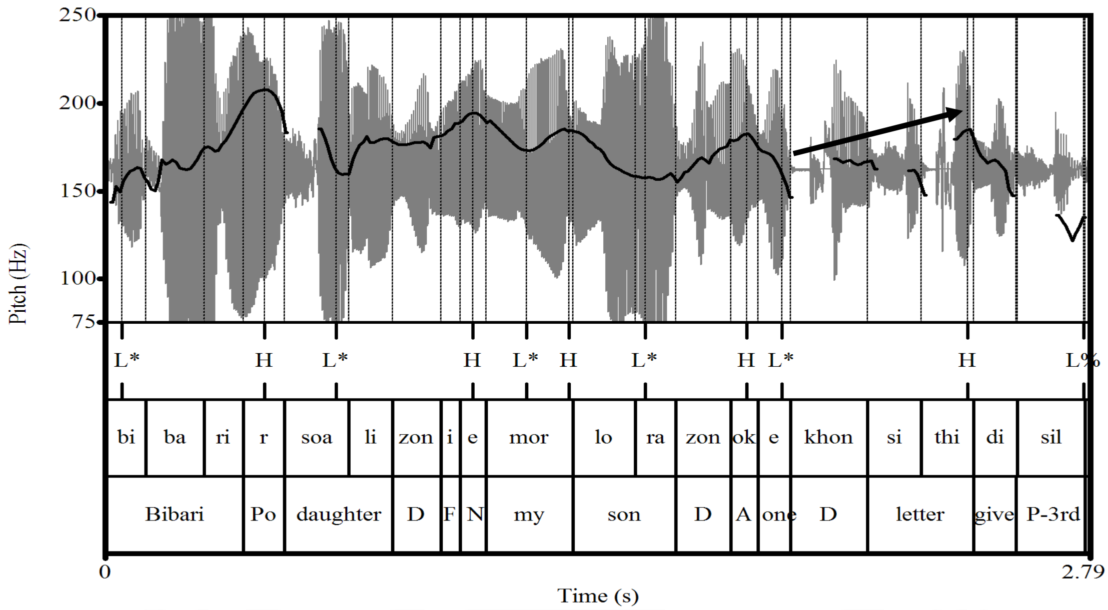

Figure 6.6: **Two lexical items mapped onto a non-initial prosodic unit in L1 Assamese.** Pitch contour of the sentence bibarir soalizonie mor lorazonok ekhon sithi disil 'Bibari's daughter gave a letter to my son' for L1 Assamese.

Thus, the L*H_P contours differentiate the phrasing system of L1 Assamese intonation from that of L1 Boro intonation. The characteristic L*H_P may sometimes align to a lexical word or sometimes it may align to a syntactic constituent like a Noun Phrase consisting of more than one word.

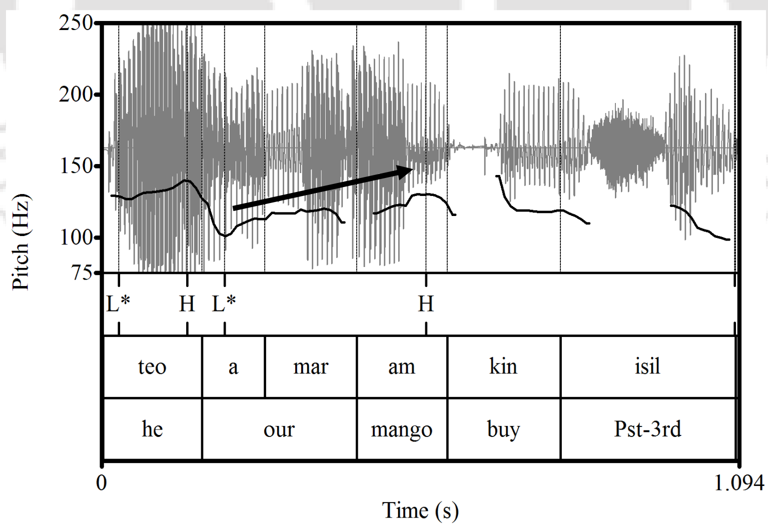

Figure 6.7: **L*H_P aligning to two lexical words in L2 Assamese**. Pitch contour for the sentence teo amar am kinisil 'he bought our mango' for a participant belonging to the intermediate proficiency level.

Figure 6.7 presents another example of L*H_P aligning to two lexical words in L2 Assamese. The object NP amar am 'our mango' surfaces with the highest peak right aligned to 'mango'.

This feature of L2 Assamese intonation of Boro speakers also foregrounds its similarity with L1 Assamese intonation. A comparison between the pitch contours in Figure 6.7 and Figure 6.8 shows it.

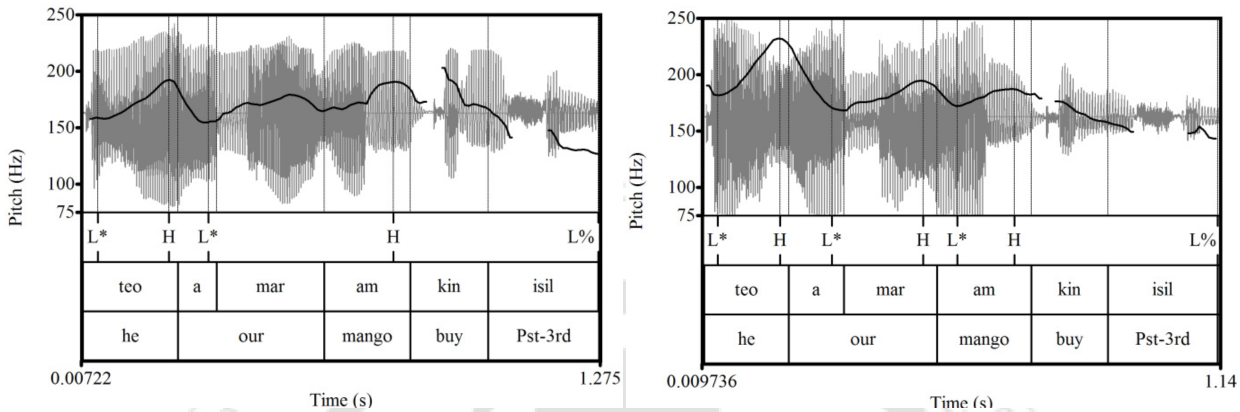

Figure 6.8: **Two words mapped onto either one L*H_P or two L*H_Ps in L1 Assamese**. Pitch contours for the sentence teo amar am kinisil 'he bought our mango' produced by L1 Assamese participants.

The panel on the left of Figure 6.8 shows how sentence medial prosodic units consisting of two words in L1 Assamese can also surface with L* aligning to the first syllable of the first word and the H_P surfacing as a highest peak aligned to the last syllable of the second word. *Thus the prosody of L1 Assamese displays some similarity with L2 Assamese phrasing for Boro speakers.*

Section 3.7.1 has shown how pre-posed syntactic constituents initiate ip boundary in Boro intonation since the characteristic downstepping of non-initial H tones is suspended after this boundary. The data set for the present experiment contained a sentence where the object was shifted to the sentence initial position. Examination of pitch contours of this sentence produced by all the four L2 participants showed that *the effect of L1 phrasing for ip formation is carried over onto L2 phrasing pattern by the two participants with beginning level of L2 proficiency*. Figure 6.9 presents the pitch contour of the sentence bibarik teo koni dise 'To Bibari, he has given egg' where the indirect object bibarik 'Bibari-Acc' is shifted to sentence initial position. It can be seen that the *high target for the second L*H_P contour is scaled higher and thus it suspends the process of downstepping of each successive H targets in a series of L*H_P p-phrases*.

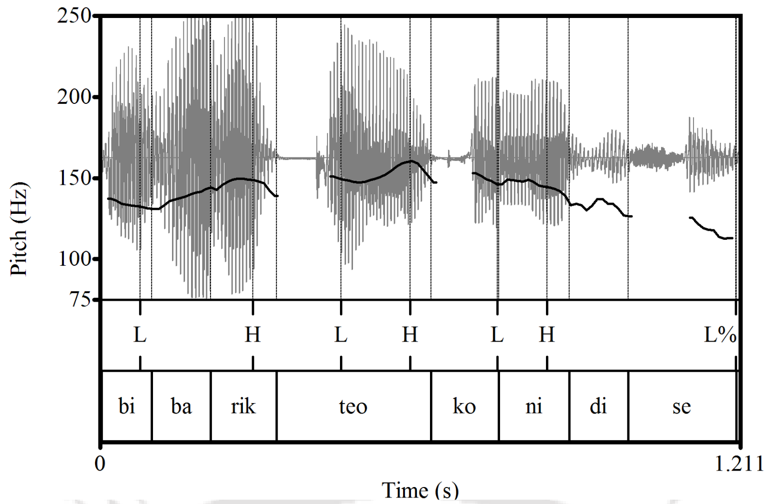

Figure 6.9: **Suspension of downstepping in L1 Boro carried over to L2 Assamese.** Pitch contour of the sentence bibarik teo koni dise 'To Bibari, he has given egg' produced by one of the participants with beginning level of proficiency.

As in their L1 intonation, the two participants with beginning level of L2 proficiency enter an *ip boundary after a pre-posed element in L2 Assamese utterances*. Pitch contours for the L1 Assamese renditions of the same sentence revealed that none of the four L1 Assamese participants raises the the second L*H_P to a higher f_0 target than the initial one.

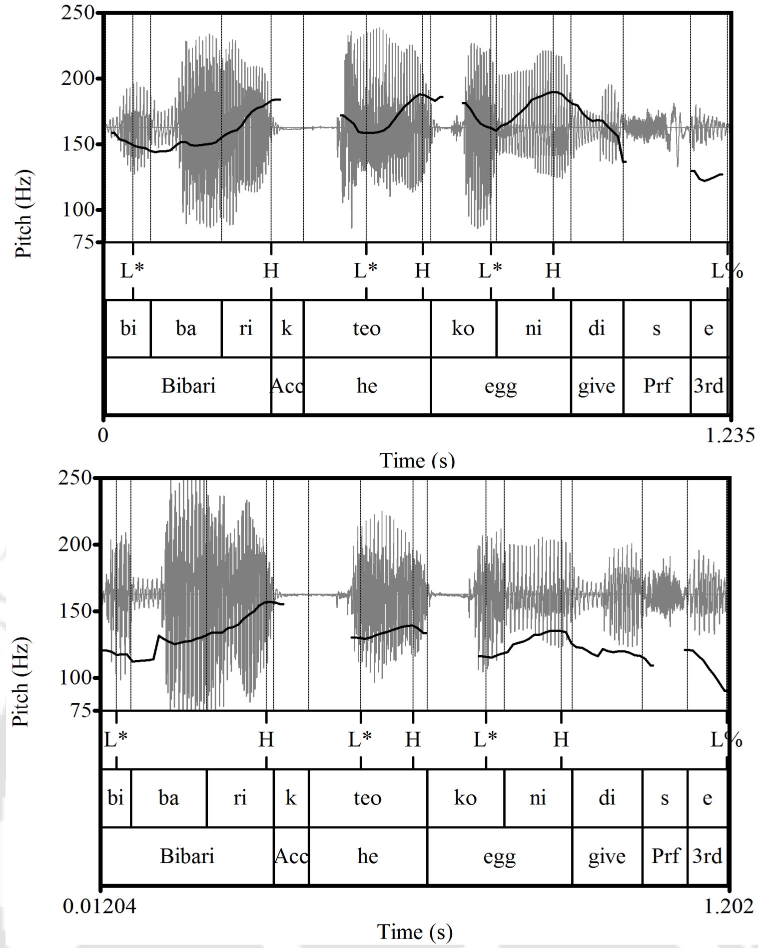

Figure 6.10: **No upstepping of H_P in non-initial L^*H_P in L1 Assamese**. Pitch contours of the sentence bibarik teo koni dise 'To Bibari, he has given egg' produced by L1 Assamese speakers.

Figure 6.9 can be compared with that of Figure 6.10. The two pitch contours presented in Figure 6.10 are for L1 Assamese renditions of the sentence bibarik teo koni dise 'To Bibari, he has given egg'. All of the four participants for L1 Assamese have used either one of these two pitch contours for the sentence bibarik teo koni dise 'To Bibari, he has given egg'. It can be seen that the *sequence of* L^*H_P *contours surfaces with either identical high targets or with downstepped high targets in L1 Assamese*. Among the four L2 Assamese participants, only the two with intermediate level of proficiency follow these two patterns of L1 Assamese pitch contour for this sentence. The two *L2 Assamese participants with beginning level of proficiency mark pre-posed focus in L2 Assamese by inserting an ip boundary, a prosodic feature which they carry over from L1 Boro system of pre-posed focus marking*.

In L1 Boro intonation, complex Boro sentences consisting of a main and a subordinate clauses are divided into two ips and an ip boundary marking L tone is followed by upsteping of the following H lexical tone. This results in suspension of downstepping of non-initial H targets after ip boundary. The data set for this experiment contained two similar Assamese sentences and it has been found that *for all the iterations by the L2 Assamese participants, each of the complex Assamese sentences is divided into two ips*. Figure 6.11 presents the pitch contour of one of the sentences.

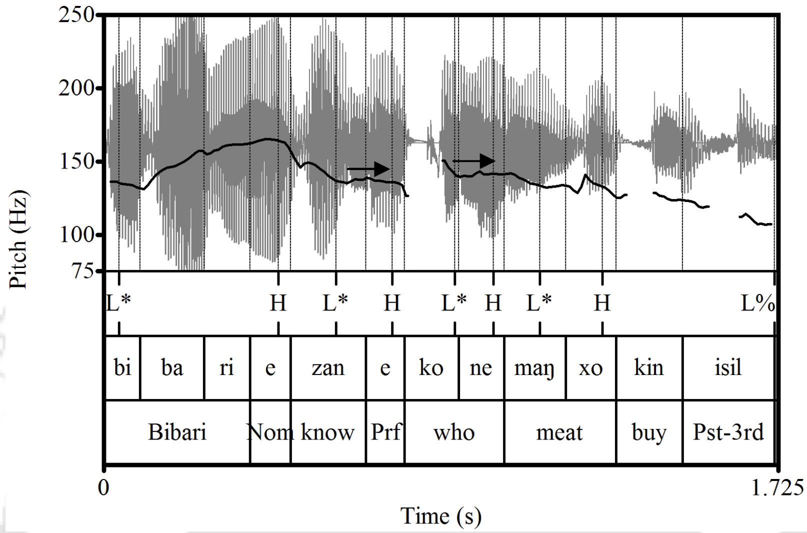

Figure 6.11: **L1 Boro ip formation transferred to L2 Assamese.** Pitch contour of the sentence bibari-e zane kone maŋxo kinisil 'Bibari knows who bought meat' produced by L2 Assamese speakers.

It can be seen that the third H_P, aligned to the initial syntactic constituent of the subordinate clause, surfaces with a higher target. This suggests that the first ip bibarie zane 'Bibari knows' ends with L ip boundary tone and downstepping of the next H_P target is suspended following this ip boundary. Figure 6.11 can be compared with Figure 6.12 which presents the pitch contour of the same sentence produced by L1 Assamese speakers. It can be seen that the rise for L^*H_P does not reach a higher f_0 target compared to the preceding L^*H_P aligning to the verb zane 'knows.'

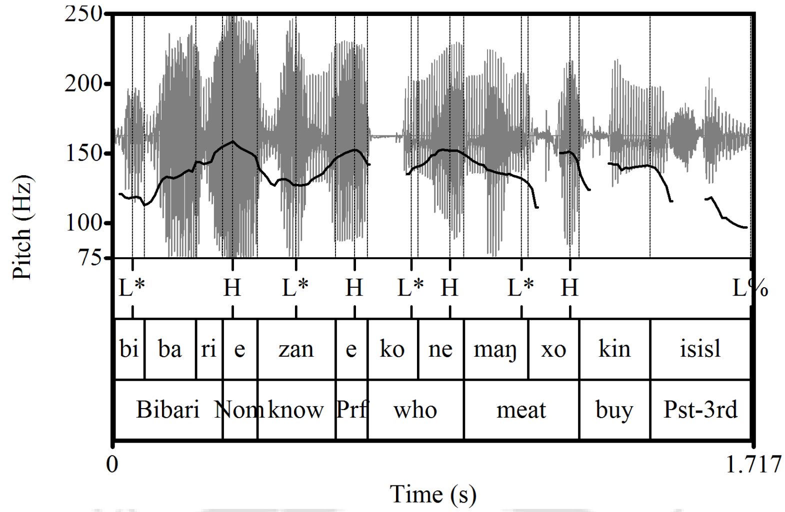

Figure 6.12: **No ip formation in L1 Assamese**. Pitch contour of the sentence bibari-e zane kone maŋxo kinisil ‘Bibari knows who bought meat’ produced by L1Assamese speakers.

In Figure 6.12, *the subordinate clause remains prosodically embedded in the same IP as the main clause in L1 Assamese. For L2 Assamese intonation produced by Boro speakers, the subordinate clause initiates a separate ip,* as it happens in the case of L1 Boro intonation. Thus a feature of L1 Boro intonation has been carried over to L2 Assamese intonation.

This section has shown that *ip boundary is inserted after a pre-posed element in L2 Assamese utterances for speakers with beginning level of proficiency. L1 Assamese does not insert such a boundary. ip boundary insertion after pre-posed elements is an L1 Boro feature carried over to L2 Assamese intonation.* On further examination of pitch contours of some other type of sentences (Figure 6.1), we found that L2 intonation for Boro speakers of Assamese may also show very little effect of L1 Boro intonation.

6.4 Wh-questions

Wh-questions in Boro are marked by L% (see section 4.2.6). L1 Boro wh-questions surface with pitch contours similar to that of statements in which individual words surface with their lexical tones right aligned. *Wh-question in L1 Assamese is marked by L*fH$_P$ contour aligned to the question word itself* (Twaha, 2017). *This section will show that L2 Assamese intonation for Boro speakers employs the L1 Assamese L*fH$_P$ contour for wh-questions.* The data set considered for the present experiment contained eight wh-questions. Pitch contours for all these wh-questions produced by the four L1 Assamese speakers showed that the *question word surfaces with highest f_0 target*. With disyllabic question words, the low target for the L* aligns to the first syllable and the fH_P boundary tone aligns to the second syllable. The panel on the left in Figure 6.13 presents the pitch contour of the question xahu koloi zabo? ‘Where will mother-in-law go?’. It can be seen that the first syllable of the question word koloi ‘where’ surfaces with a low f_0 target and subsequently the pitch rises to a high f_0 target aligned to the second syllable of the question word.

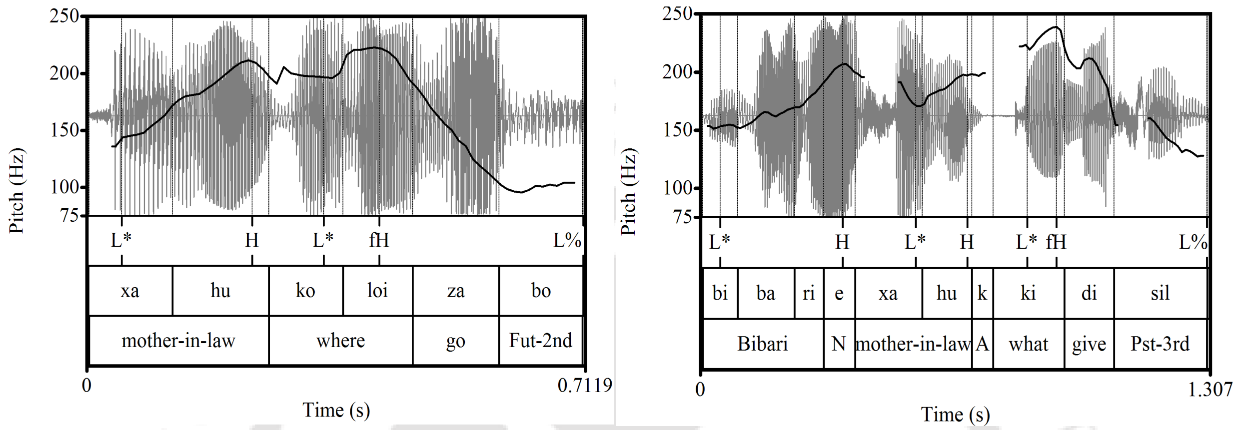

Figure 6.13: **L^*fH_P aligned to the question word for wh-question**. Pitch contour of the wh-question xahu koloi zabo? ‘where will mother-in-law go?’ in the panel on the left and of bibarie xahuk ki disil ‘what did Bibari give to mother-in-law?’ in the panel on the right produced by L1 Assamese speakers.

The L^*fH_P pitch accent for wh-questions in L1 Assamese surfaces differently with a monosyllabic question word ki ‘what.’ The panel on the right in Figure 6.13 shows how f_0 lowering for L* is curtailed and then the pitch rises to a high target for the high boundary tone. Pitch contours for all the questions in the data series have shown that the *high target for the boundary tone for L^*fH_P pitch accent surfaces with highest f_0 value for the pitch contour of the whole question*. Figure 6.13 presents two instances of it.

Examination of the pitch contours of L2 Assamese wh-questions for Boro speakers shows that those questions are also marked by L boundary tone. However, intonation of L2 Assamese wh-questions differs from that of L1 Boro wh-questions in one important aspect. It is related to the domain for the pitch peak for L^*fH_P pitch accent.

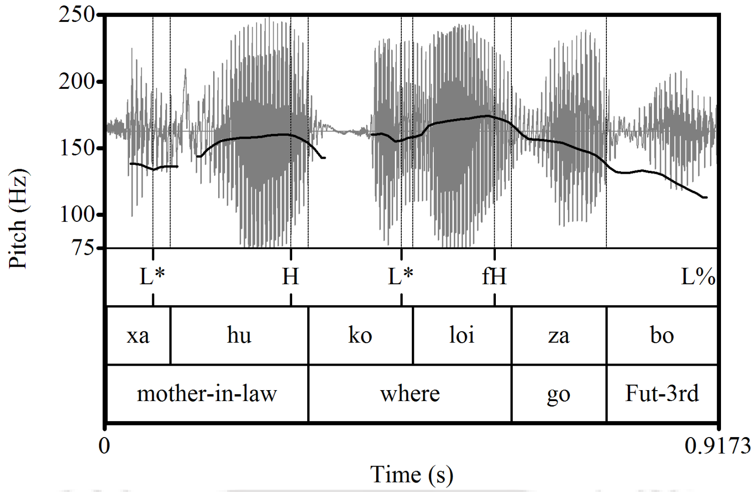

Figure 6.14: **L*fH$_P$ marking wh-question in L2 Assamese.** Pitch contour of the wh-question xahu koloi zabo? 'where will mother-in-law go?' by L2 Assamese speaker 1.

The question marker in L2 Assamese intonation also surfaces with highest f_0 value. Figure 6.14 presents the pitch contour of the wh-question xahu koloi zabo? 'Where will mother-in-law go?' produced by speaker 1. The second syllable of the question marker koloi 'where' surfaces with highest f_0 value aligned to the diphthong in 'loi'. This *rise can be interpreted as similar to the L*fH$_P$ pitch accent for L1 Assamese wh-questions*. Although Boro L1 wh-questions are not marked by any pitch accent and wh-words surface with their lexical tones in such questions, L2 wh-questions reveal that Boro speakers can acquire a different intonation pattern for L2. However, for the two speakers belonging to the beginning level of proficiency, the domain for the L*fH$_P$ pitch accent for wh-question is found to be smaller than the whole IP. For these two participants, *longer wh-questions are marked by the L*H$_P$ on the verb phrase*. The panel on the left in Figure 6.15 can be contrasted with the one on the right.

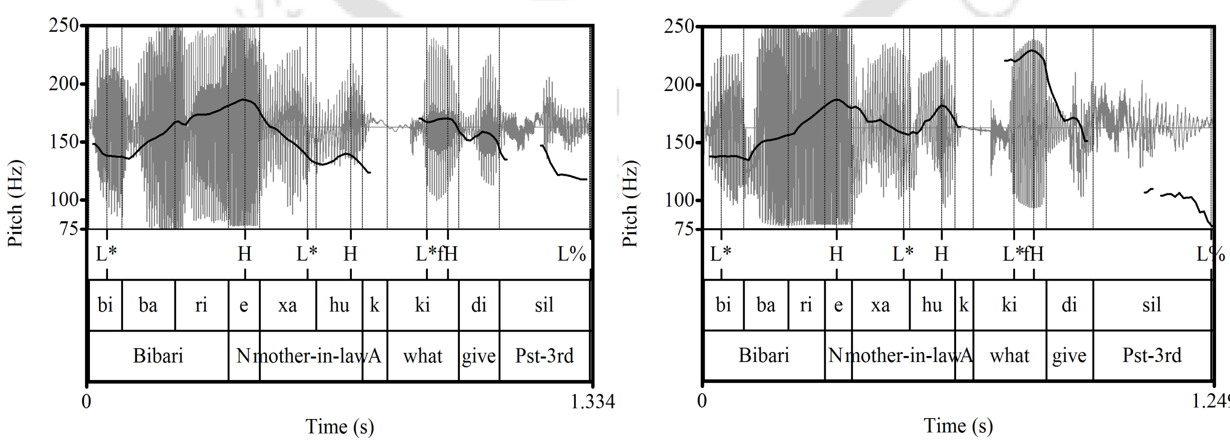

Figure 6.15: **Domain for L*fH$_P$ in L2 Assamese**. Pitch contours for the wh-question bibarie xahuk ki dise? 'What has Bibari given to his mother-in-law?'

It can be seen in the panel on the right of Figure 6.15 that the L*fH$_P$ is realized as a rise so that the boundary fH$_P$ remains as the highest f_0 target for the whole sentence. Compared to this, in the other panel, the L*fH$_P$ is realized as a highest f_0 target for the domain of the verb phrase only. The f_0 trend of the post focus part presents another aspect of the difference between the two types of L2 wh-question intonation. *When L*fH$_P$ considers the whole sentence as its domain*, the *post focus component undergoes de-phrasing*. It can be seen in the panel on the right of Figure 6.15 that the f_0 contour aligned to the final verb disil 'gave' surfaces with considerably lower f_0 compared to its occurrence in the other panel in the same Figure. This shows that the level of proficiency in L2 determines the way L2 Assamese is produced by Boro speakers.

The prosody of wh-questions for L2 Assamese intonation presented in this section has highlighted the following aspects:

- L2 Assamese wh-questions can replicate the L1 Assamese L*fH$_P$ pitch accent for such questions.
- L*fH$_P$ in L2 Assamese sometimes considers the verb phrase as its domain as against the pitch accent considering the whole sentence as its domain in L1 Assamese.

6.5 Corrective Focus

Compression of duration is the prosodic cue for corrective focus marking in L2 Assamese for Boro speakers. Results presented in this section show it. Corrective focus marking in L1 Boro involves a Low register intonational tone which lowers the pitch register of the whole sentence itself (see section 5.6). At the same time duration of the focused words are also decreased. *Assamese marks corrective or contrastive focus (CF)*[26] *by a rising contour* **L*fH$_P$** associated at two points with the focused constituent: the low pitch accent (L*) aligns to the first syllable and the focus high boundary tone (fH$_P$) to the final syllable. Focused nucleus is characterized by greater pitch range and increased duration value. Apart from initiating a phrasing effect on the focused constituent, CF also exercises a dephrasing effect on the post-focus sequence. (Twaha and Mahanta, 2016). Figure 6.16, taken from Twaha and Mahanta (2016), explains this.

[26] Twaha and Mahanta (2016) did not distinguish between corrective focus and contrastive focus.

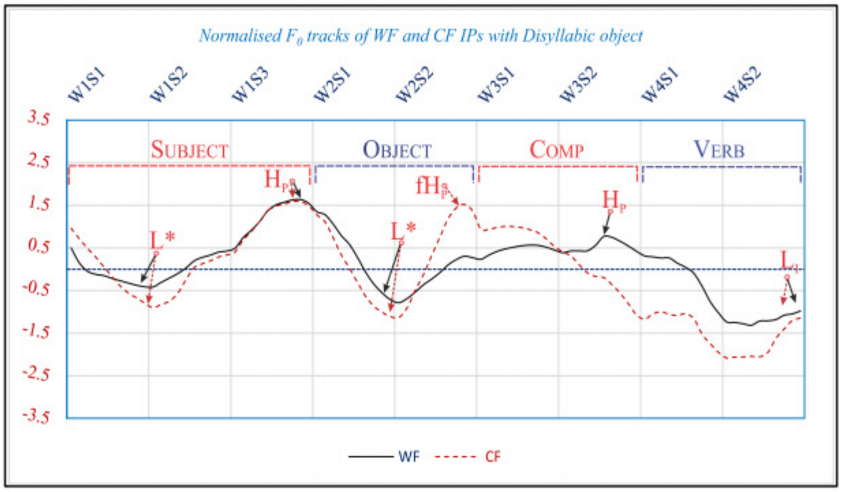

Figure 6.16: **Corrective focus and L*fH$_P$ in L1 Assamese**. Aggregated normalized pitch contours of identical sentences in wide focus (WF) and CF conditions. The black solid line represents WF utterances and red dashed line represents the same sentences uttered with CF. Here W stands for word and S stands for syllable.

It can be seen in Figure 6.16 that focus on subject results only in a lower target for the L*. But contrastive or corrective focus on the object results in both a lower target for L* and a high focus boundary tone fH$_P$ aligned to the final syllable of the focused word.

The data set for this experiment included four sentences expressing corrective focus (on the objects) in the form of an answer to a yes/no question. These sentences were preceded by the negative marker in Assamese: nohoi 'no'. The f_0 contours of these sentences were compared with those of identical sentences produced in neutral focus conditions in the form of an answer to the question ki hoisil? 'what happened?'. Examination of pitch contours of the sentences expressing corrective focus produced by L1 Assamese speakers yielded results similar to the ones presented by Twaha and Mahanta (2016). Figure 6.17 presents aggregated time normalized pitch contours (n=20) of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus condition and in the context of corrective focus on the object koni 'egg'.

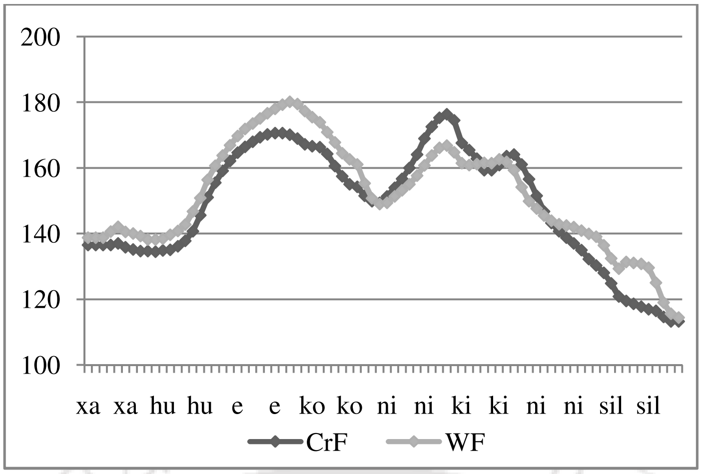

Figure 6.17: **Implementation of L*fH$_P$ in L1 Assamese.** Aggregated time normalized pitch contours of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus (WF) and corrective focus (CrF) (object) contexts (n=20). The vertical axis presents pitch values (hz).

It can be seen that the focused object koni 'egg' surfaces with a higher f_0 target aligned to the second syllable compared to that of its occurrence in wide focus condition. The aggregated maxf_0 (n=20) for the second syllable of koni 'egg' for corrective focus context is 177.09 hz compared to that of 159.84 Hz in wide focus condition. Compared to this difference in the pitch height for the f_0 peak, the L* pitch accent does not surface with a lower f_0 target in the context of corrective focus.

Since Boro and Assamese follow non-identical prosodic means for corrective focus marking, our hypothesis is that Boro speakers would face difficulty in acquiring the phonological property associated with the complex pragmatic context of corrective focus in L2 Assamese. In line with our expectation, *evaluation of pitch contours of the sentences with corrective focus on the object did not reveal any consistent pattern*. Two of the participants with beginning level of proficiency in L2 Assamese produced the sentences occurring in wide focus and corrective focus contexts with almost identical contours. Speaker 1, on the other hand, lowered the pitch of the sentence upto the object when there is corrective focus on it. Figure 6.18 shows it.

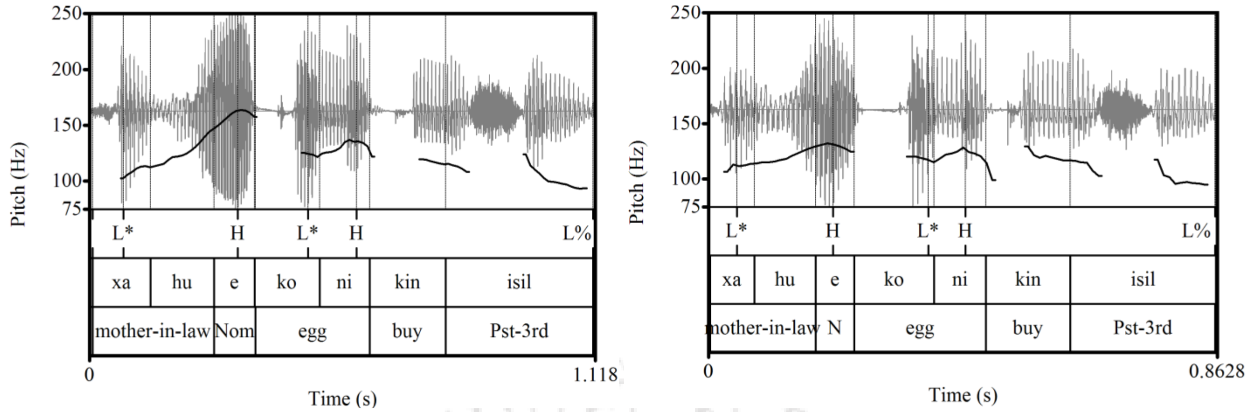

Figure 6.18: **Object focus and lowering of pitch for the subject in L2 Assamese.** Pitch contours for the L2 Assamese rendition of the sentence xahue koni kinisil 'mother-in-law bought egg' for wide focus context (left panel) and for the context of corrective focus (right panel). (Speaker 1)

Speaker 3 lowered the pitch for the part of the sentence following the subject when the object is placed in the context of corrective focus. Figure 6.19 compares the pitch contours of the sentence xahue koni kinisil 'mother-in-law bought egg' with the panel in the left presenting the pitch contour for the context of wide focus and the panel on the right presents that for corrective focus context. The pitch targets for the post-subject part do not surface (right panel).

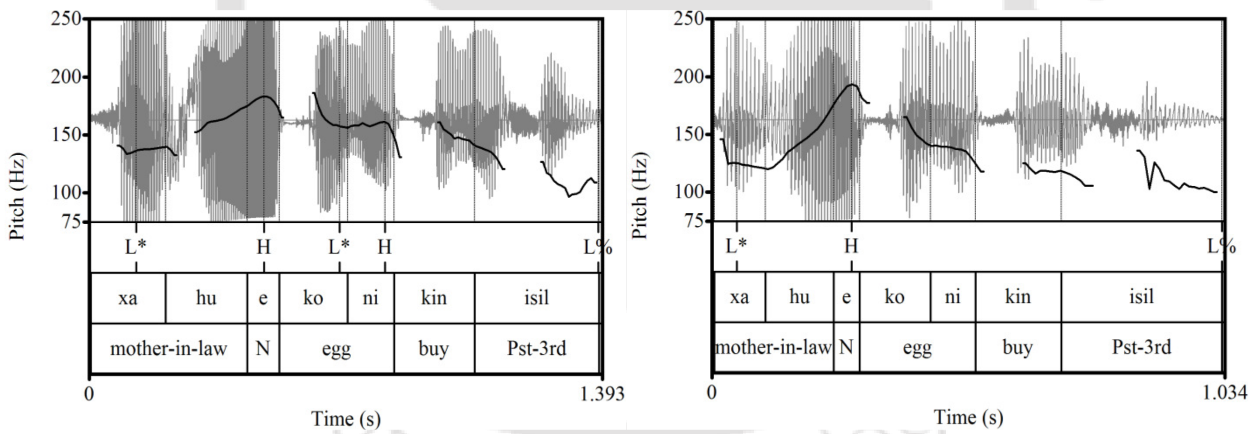

Figure 6.19: **Object focus and lowering of the pitch for the post-subject part.** Pitch contour for the L2 Assamese rendition of the sentence xahue koni kinisil 'mother-in-law bought egg' for wide focus context (left panel) and for the context of corrective focus (right panel). (Speaker 3)

For speaker 2 and speaker 4, no difference could be found between the pitch contours of the sentences in the two focus conditions. Figure 6.20 shows it.

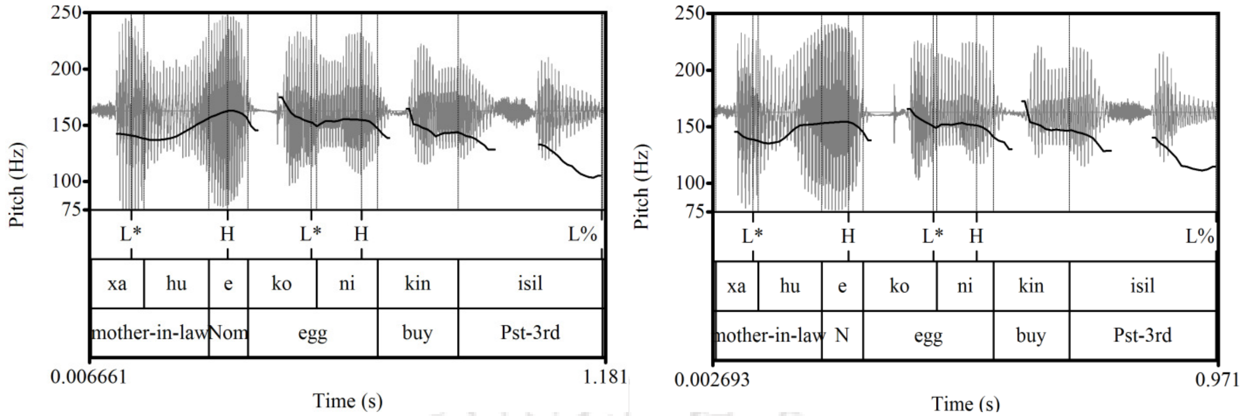

Figure 6.20: **No change in pitch contour and corrective focus.** Pitch contour for the L2 Assamese instances of the sentence xahue koni kinisil 'mother-in-law bought egg' for wide focus (left panel) and corrective focus (right panel) contexts, produced by speaker 2 and speaker 4.

Although pitch contours of the target words in wide focus and corrective focus (object) contexts did not follow any consistent pattern for all the four participants for L2 Assamese, examination of duration revealed that *compression of duration of each of the words is the most consistent phonetic correlate for expressing corrective focus in L2 Assamese intonation for Boro speakers*. Figure 6.21 presents the comparison of duration of each of the syllables of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus (WF) context and in the context of corrective focus (CrF) on the object. Aggregated duration (n=5) for each of the speaker is presented separately and SP here refers to speaker.

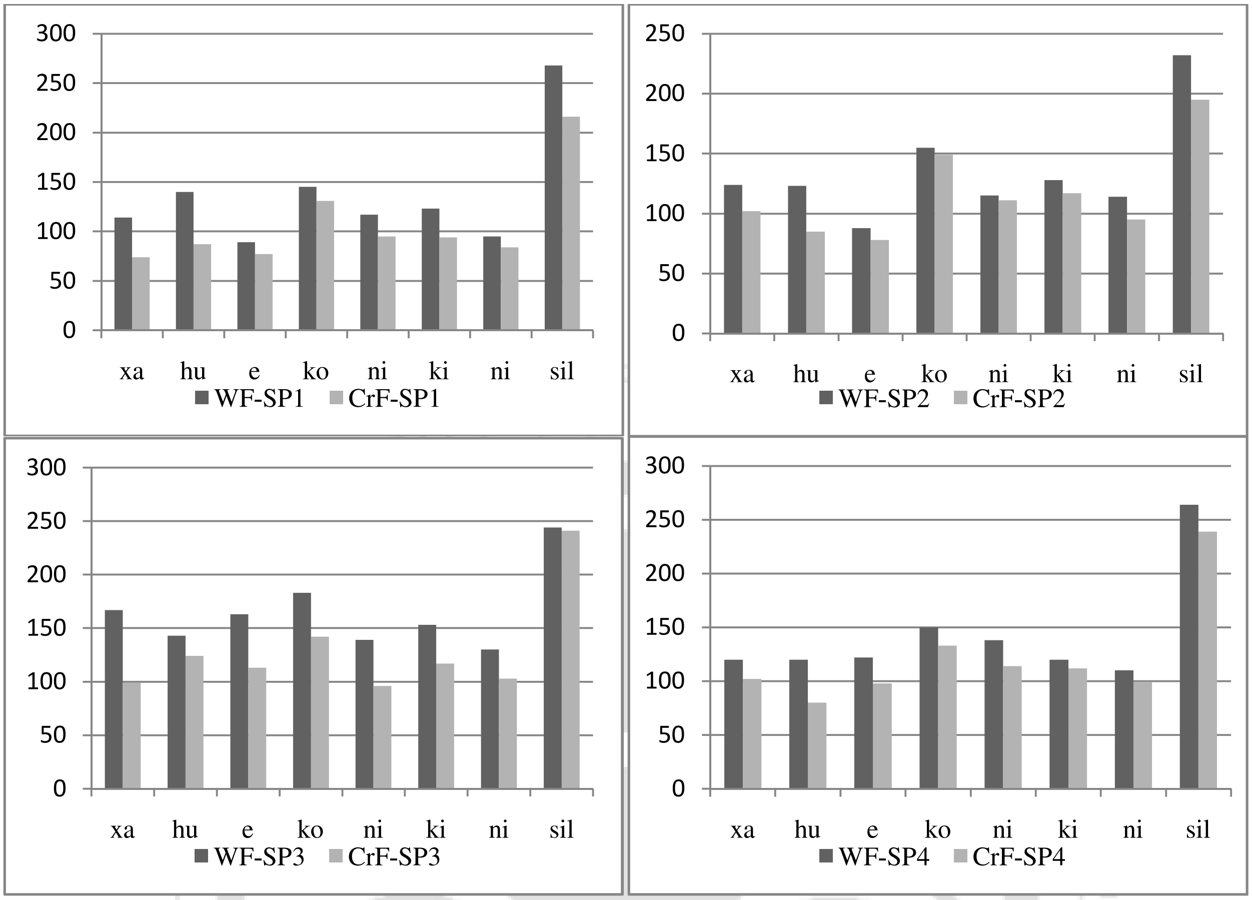

Figure 6.21: **Compression of duration and corrective focus in L2 Assamese.** Aggregated duration for each of the syllables of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus (WF) context and in the context of corrective focus (CrF) on the object. The vertical axis presents duration value (msec.).

Evidence presented in Figure 6.21 shows that *L2 Assamese intonation for Boro speakers uses compression of duration as the only consistent means for corrective focus marking*. This makes L2 Assamese intonation of corrective focus quite different from that of both L1 Assamese and L1 Boro system of corrective focus marking. Although it has been described in section 6.3 and 6.4 that L2 Assamese intonation for Boro speakers shows the features of both L1 Assamese and L1 Boro intonation, results for corrective focus marking in L2 Assamese presented a case where the *speakers adopt prosodic means which is found neither in L1 Assamese nor in L1 Boro*. It has been reported earlier also that it is a challenge for L2 speakers to produce the prosodic features that serve to highlight various aspects of information structure (Viscegliaa, Tsengb, Su and Huang, 2011). This may be because expressions involving corrective focus are presented in the context of a complex discourse structure and this might have stopped L2 Assamese from following the systems of corrective focus marking in both L1Boro and L1 Assamese.

6.6 Narrow Focus

L1 Boro mostly employs morphological focus markers for presentational focus marking (Mahanta, Das and Gope, 2016). In addition to this, post focus compression has been identified as a dominant cue for presentational focus marking in most of the sentence types discussed. *This section shows that compression of duration of all the syllables in a sentence is consistently employed for narrow focus marking in L2 Assamese for Boro speakers*. Since Boro does not use any prosodic cue associated with the focused constituents themselves for narrow focus marking, it was thought that L2 Assamese sentences involving narrow focus would reveal the extent to which L1 Boro influences L2 intonation. With this objective, this section aims at examining the realization of L2 Assamese narrow focus by Boro speakers. *Two Assamese sentences* were used for eliciting narrow focus. These two sentences were placed in contexts where they would express *wide focus* (WF), *narrow focus on subject* (NF-subject) and *narrow focus on object* (NF-object). The pairs of question-answer presented in (2) were used for eliciting these three focus conditions. Prosodic properties of the answers in the three conditions presented in (2) were evaluated so as to examine whether Boro speakers employ the same means for narrow focus marking in L2 Assamese which they use in their L1.

(2)

a. ki hoisil? 'What happened?'

   xahu-e koni kini-sil (wide focus)
   mother-in-law-Nom egg buy-Pst
   Mother-in-law bought egg.

b. kon-e koni kinisil?
   who-Nom egg buy-Pst
   Who bought egg?

   xahue koni kinisil. (NF-subject)

c. xahu-e ki kinisil
   mother-in-law-Nom what buy-Pst
   What did mother-in-law buy?

   xahue *koni* kinisl. (NF-object)

The other sentence used for eliciting narrow focus on subject and object is moi maŋxo bisariisilu 'I wanted meat.' This sentence was also placed in the contexts shown in (2). Although

Twaha and Mahanta (2016) have presented a description of the phonological properties of contrastive focus marking in Assamese, they have not explored the properties of presentational focus marking. Intonation of narrow presentational focus marking in Assamese is also not extensively discussed by any other study. Pitch contours of the two sentences receiving narrow focus produced by the participants in the control group show that *narrow presentational focus in L1 Assamese is prosodically marked by an L*H pitch accent*. The * tone of the pitch accent aligns to the penultimate syllable of the focused word and the trailing H surfaces as the highest f_0 target aligned to the final part of the last syllable. Narrow presentational focus in L1 Assamese is cued by this L*H pitch accent irrespective of the focused element occurring as the subject or the object of a sentence. Figure 6.22 presents the averaged time normalized pitch contours of the sentence xahue koni kinisil 'mother-in-law bought egg' in L1 Assamese occurring in wide focus (WF) context and in the context of narrow presentational focus on subject (NF(subject)).

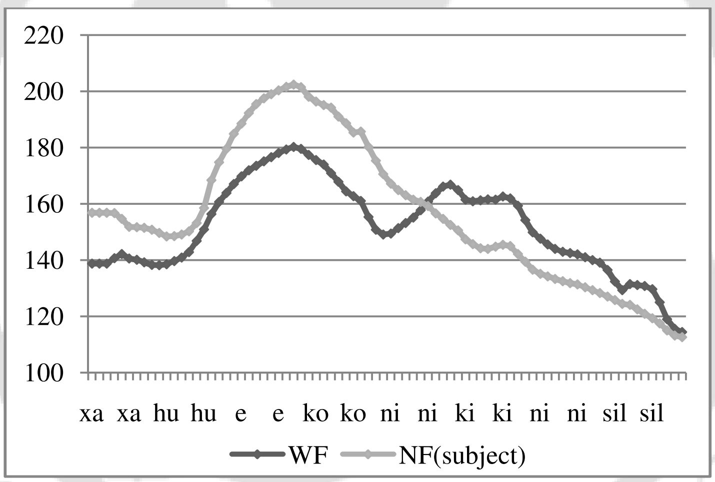

Figure 6.22: **Narrow focus on subject and f_0 in L1 Assamese.** Averaged time normalized pitch contours of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus (WF) context and with narrow presentational focus on subject (NF(subject)) (n = 20). The vertical axis presents pitch values (hz).

It can be seen that *narrow focus results in a higher f_0 target* aligned to the last syllable of the subject xahue 'mother-in-law-Nom'. Another prosodic effect of narrow focus on the subject that Figure 6.22 highlights is *deaccenting of the post focus part*. The pitch contour for the context of wide focus shows that the object koni 'egg' surfaces with the characteristic Assamese L*H_P contour. There is absence of any rise signaling L*H_P aligned to the object koni 'egg' when there is narrow presentational focus on the subject. *Deaccenting after focus leads to the deletion of post focus pitch accent targets*. Aggregated meanf_0 (n=20) of the last syllable of xahue 'mother-in-law-Nom' occurring in narrow focus condition is 187.66 hz compared to 176.55 hz in wide focus condition. On the other hand, aggregated meanf_0 (n=20) of the object koni 'egg' in wide focus condition is 163.27 hz compared to 154.70 hz when it occurs in *post-focus* position. Narrow presentational focus on the object results in koni 'egg' surfacing with L*H pitch accent with a high pitch target aligned to the last part of the second syllable. Figure 6.23 compares the averaged time normalized pitch contour (n=20) for the sentence xahue koni kinisil 'mother-in-law bought egg' occurring in wide focus condition with that of its occurrence in the context of narrow focus on the object (NF(object)) koni 'egg'.

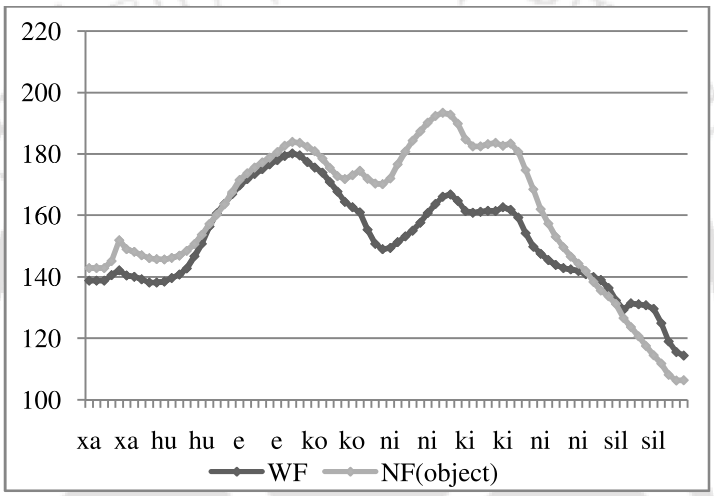

Figure 6.23: **Narrow focus on object and f_0 in L1 Assamese**. Averaged time normalized pitch contours of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus (WF) context and in the context of narrow presentational focus on object (NF(object)). The vertical axis presents pitch values (hz).

It can be seen that *narrow focus aligns the L*H pitch accent to the object* and this results in the last syllable of koni 'egg' surfacing with highest f_0 target for the whole sentence. Aggregated meanf_0 (n=20) of the last syllable of the object koni 'egg' occurring in narrow focus condition is 175.82 hz compared to 159.84 hz in wide focus condition. On the other hand, aggregated meanf_0 (n=20) of the final syllable of the subject xahue 'mother-in-law' in wide focus condition is 176.55 hz compared to that of 168.03 hz when the subject occurs in *pre-focus* position.

Figure 6.24 presents a comparison of the maxf_0 of the final syllables of the subject xahue 'mother-in-law-Nom' and the object koni 'egg' in the sentence xahue koni kinisil 'mother-in-law bought egg' occurring in the three focus conditions discussed here: wide focus (WF), narrow focus on subject (NF(s)) and narrow focus on object (NF(o)). It can be seen that *narrow presentational focus on the subject (NF(s)) results in higher f_0 target for the subject* and also lower f_0 target for the object. On the other hand, *narrow focus on the object (NF(o)) results in a higher f_0 target for the object* compared to that of the subject in the same sentence.

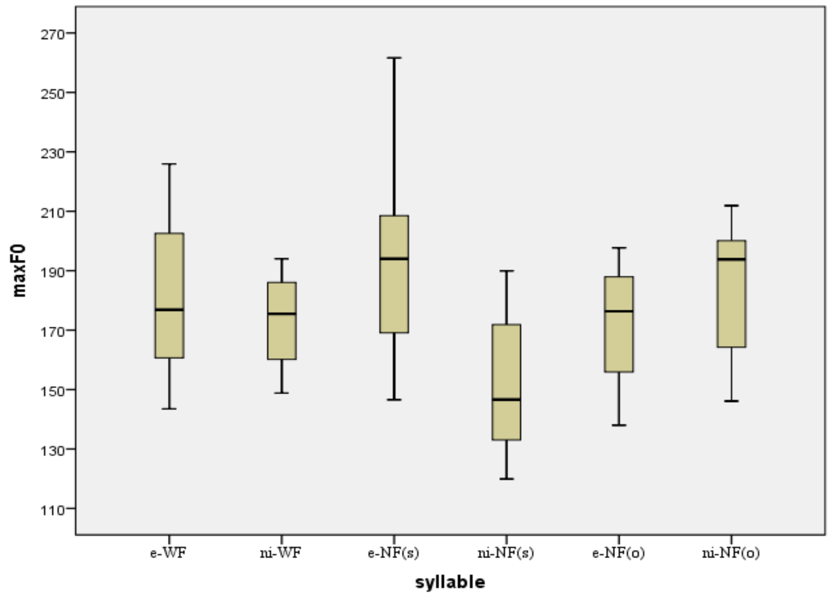

Figure 6.24: **Comparison of maximum f_0 and narrow focus in L1 Assamese.** Comparison of maximum f_0 (maxf_0) of the final syllables of the subject xahue 'mother-in-law-Nom' and the object koni 'egg' occurring in the three focus conditions discussed here: wide focus (WF), narrow focus on subject (NF(s)) and narrow focus on object (NF(o)) (n = 20)

Narrow presentational focus marking in L1 Boro does not result in any f_0 or durational modification of the focused word (Mahanta, Das and Gope, 2016). The only prosodic cue for narrow focus marking discussed by Mahanta, Das and Gope (2016) is post focus compression for some sentence types. Since L1 Assamese intonation for narrow focus marking involves the complex process of recruiting L*H pitch accent and deaccenting of the post focus part in case of the subject receiving narrow focus, it is expected that Boro speakers would have to overcome hurdles in acquiring the same. Results for the *L2 Assamese intonation for narrow focus marking by Boro speakers show that only two of the participants produced the focused constituents with a higher f_0 target, each one doing this for only one of the two sentences* in the data set. Both the speakers belong to the intermediate level of proficiency. Figure 6.25 compares the aggregated time normalized pitch contours of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus (WF), narrow focus on subject (NF(subject)) and narrow focus on object (NF(object)) contexts produced by speaker 1 of L2 Assamese.

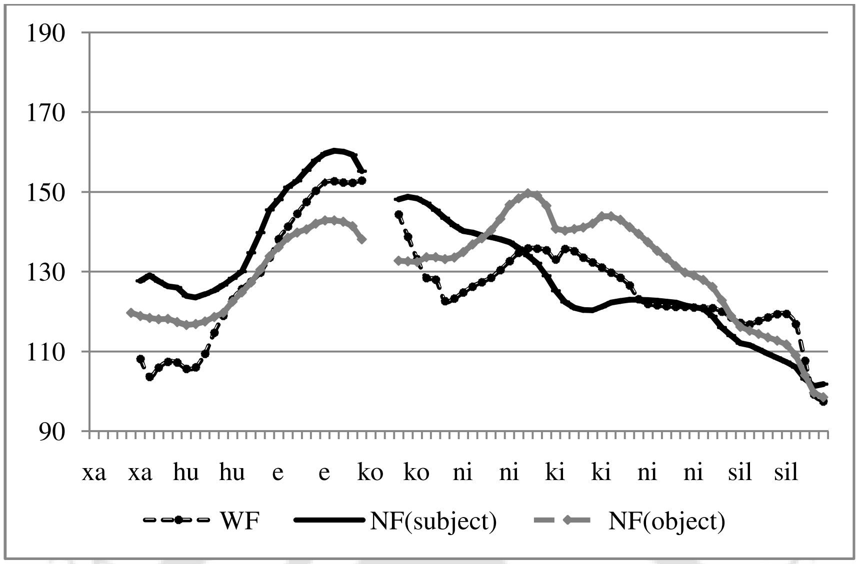

Figure 6.25: **Variation in pitch for narrow focus in L2 Assamese for speaker 1.** Pitch contour of the L2 Assamese rendition of the sentence xahue koni kinisil 'mother-in-law bought egg' in wide focus (WF), narrow focus on subject (NF(subject)) and narrow focus on object (NF(object)) conditions (speaker 1)(n = 5). The vertical axis presents pitch values (hz).

It can be seen that the second syllable of the subject noun xahue 'mother-in-law' is produced with a higher f_0 target in the narrow focus condition. The second syllable of the object koni 'egg' also surfaces with a higher f_0 target when the object is placed in the narrow focus context. Aggregated maxf_0 for the last syllable of xahue 'mother-in-law' in narrow focus condition is calculated to be 162.03 hz compared to that of 156.43 hz in wide focus condition. Similar kind of prosodic effect of narrow focus is noticed when the object is given prominence. Aggregated maxf_0 for the last syllable of the object koni 'egg' in narrow focus condition is calculated to be 149.70 hz compared to that of 137.67 hz in wide focus condition. Averaged time normalized pitch contour for the sentence with narrow focus on object presented in Figure 6.25 shows it. However, pitch contours for this sentence produced by the other three speakers in the three focus conditions did not reveal any difference in the maxf_0 targets of the focused words compared to their occurrence in wide focus condition. Although prosodic means employed by speaker 1 of L2 Assamese for narrow focus marking follow the pattern of L*H pitch accent employed in L1 Assamese intonation, pitch contours for the sentence moi maŋxo bisariisilu 'I wanted meat' in the three focus conditions produced by the same speaker did not adhere to such variations.

Examination of pitch contours of the sentence moi maŋxo bisariisilu 'I wanted meat.' in all the three focus conditions produced by only speaker 3 has revealed that f_0 is raised to a higher target when there is narrow focus on the object maŋxo 'meat'. On the other hand, narrow focus on the subject does not surface with a higher f_0 target. Instead the post focus part is lowered considerably. Figure 6.26 compares the aggregated time normalized pitch contours (n = 5) of the sentence moi maŋxo bisarisilu 'I wanted meat' produced by speaker 3 in the three focus conditions.

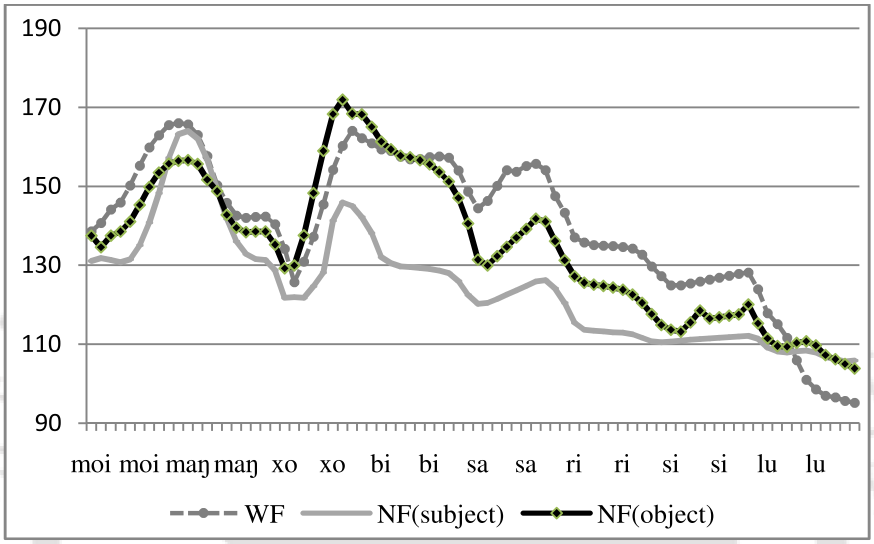

Figure 6.26: **Variation in pitch for narrow focus in L2 Assamese for speaker 3.** Pitch contour of the L2 Assamese rendition of the sentence moi maŋxo bisariisilu 'I wanted meat' in wide focus (WF), narrow focus on subject (NF(subject)) and narrow focus on object (NF(object)) conditions (speaker 3). The vertical axis presents pitch values (hz).

Aggregated maxf_0 for the subject moi 'I' in narrow focus condition is 164.28 hz compared to that of 166.19 hz in the wide focus condition. Although the subject does not bear any prosodic effect for narrow focus, the pitch height for the object undergoes lowering when there is narrow focus on the subject. Maxf_0 for the second syllable of the object maŋxo 'meat' is lowered (148.97 hz) when there is narrow focus on the subject compared to the context of wide focus (166.26 hz). Narrow focus on object for this speaker presents a slightly different picture. Aggregated maxf_0 for the second syllable of the object maŋxo 'meat' in the narrow focus condition (174.44 hz) is raised compared to its occurrence in the wide focus condition (166.26 hz). Aggregated time normalized pitch contours for the sentence moi maŋxo bisariisilu 'I wanted meat' (n = 5) in wide focus condition (WF), subject focus condition (NF(s)) and object focus condition (NF(o)) in Figure 6.26 show this.

It is found that only speaker 1 and speaker 3, belonging to the intermediate level of proficiency in L2, could follow L1 Assamese L*H pitch accent for narrow focus marking. But pitch contours for the sentence xahue koni kinisil ‘mother-in-law bought egg’ only show this difference as far as speaker 1 is concerned. For speaker 3, pitch contours of the sentence moi maŋxo bisariisilu ‘I wanted meat’ only show L2 prosodic difference for narrow focus marking. For both these speakers, pitch contours for the other sentences do not show any prosodic modification for focus marking. The duration of the target words are also not affected when speaker 1 and speaker 3 mark narrow focus by L*H pitch accent in the respective sentences discussed above.

Comparison of duration of the focused words along with the pre-focus and post-focus parts has revealed a consistent pattern. For *three participants* (except speaker 1 for the sentence xahue koni kinisil ‘mother-in-law bought egg’ and speaker 3 for the sentence moi maŋxo bisariisilu ‘I wanted meat’) for each of the sentences, *compression of duration of the whole sentence is found to be the only consistent cue for narrow presentational focus marking*. Duration of each of the syllables of the two sentences occurring in the three focus conditions were calculated. As mentioned above, iterations of these sentences produced by one speaker for each sentence (speaker 1 for the sentence xahue koni kinisil ‘mother-in-law bought egg’ and speaker 3 for the sentence moi maŋxo bisariisilu ‘I wanted meat’) did not show any durational difference. Thus, a total number of 15 tokens (5 iterations x 3 speakers) were considered for comparing the duration of each of the syllables. Figure 6.27 compares the duration of each of the syllables in the sentence xahue koni kinisil ‘mother-in-law bought egg’ occurring in the three focus conditions.

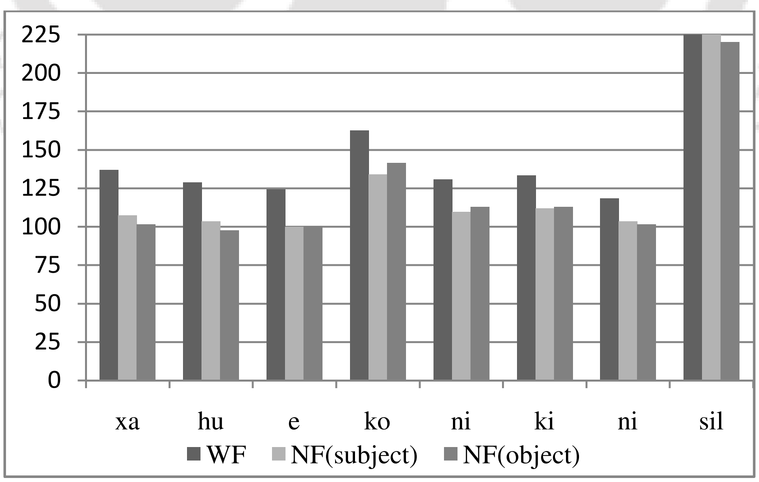

Figure 6.27: **Narrow focus and compression of duration 1.** Aggregated duration (n=15) for all the syllables of the sentence xahue koni kinisil ‘mother-in-law bought egg’ occurring in the three focus conditions. The vertical axis presents duration values (msec.). (n = 15)

It can be seen that *for all the syllables duration is compressed when they form part of the sentence with narrow presentational focus either on the subject or on the object*. Compression of duration of each of the syllables is also evident when there is narrow presentational focus on the subject and the object of the sentence moi maŋxo bisariisilu 'I wanted meat'. Figure 6.28 compares the aggregated duration (n=15) of each of the syllables in the sentence moi maŋxo bisariisilu 'I wanted meat' occurring in wide focus (WF), narrow focus on subject (NF(subject)) and narrow focus on object (NF(object)) conditions. Both Figure 6.27 and Figure 6.28 show that duration of the syllables do not consistently vary relative to focus on the subject or on the object.

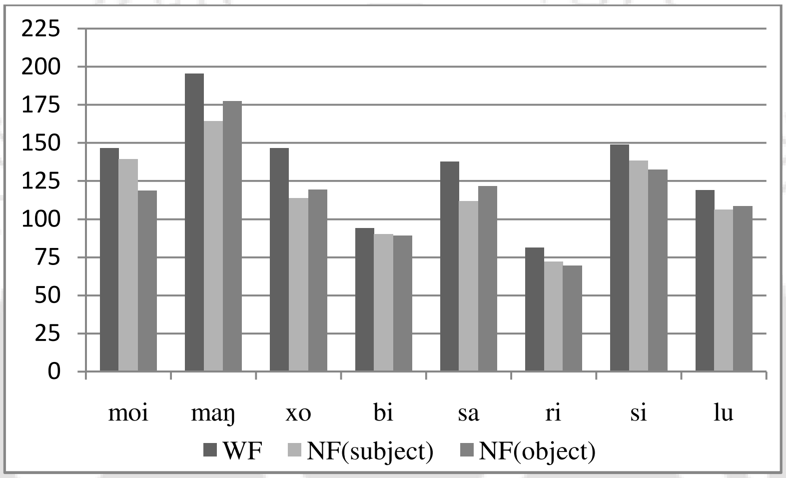

Figure 6.28: **Narrow focus and compression of duration 2**. Aggregated duration (n=15) for all the syllables of the sentence moi maŋxo bisariisilu 'I wanted meat' occurring in the three focus conditions. The vertical axis presents duration values (msec.). (n = 15)

Section 6.5 has reported that corrective focus marking in L2 Assamese produced by Boro speakers mostly prefers compression of duration of all the syllables as the prosodic means for expressing this kind of pragmatic meaning. Results presented in this section also reveal a similar trend. Although focus marking in both L1 Boro and L1 Assamese intonation systems depends heavily on raising or lowering of pitch height of either the focused words or the whole sentence, *L2 Assamese focus marking system for Boro speakers employs decrease in duration as the most consistent prosodic reflex for corrective focus*. Failure to realize prominence and misplacement of prominence have been demonstrated to have a negative effect of L2 speakers' level of comprehensibility (Warren, Elgort and Crabbe, 2009). However, *the two participants with intermediate level of proficiency have shown greater amount of accuracy in terms of L2 narrow focus marking* and it shows that *level of L2 learning does help L2 prosodic aspect for focus marking*.

6.7 Conclusion

The discussion presented in this chapter has shown that L1 Boro intonation system affects L2 Assamese intonation in a complex way. Earlier studies on L2 intonation have found that not all L1 features directly shape L2 intonation (Ueyama and Jun, 1996). L2 Assamese intonation produced by Boro speakers also reveals similar results. It has been found that *for simple statements the degree of accuracy in L2 intonation correlates with proficiency level*. Thus, *less advanced learners of L2 Assamese transfer the L1 Boro system of prosodic phrasing in sentences with pre-posed object*. Jun and Oh (2000) find that advanced L2 speakers were better at grouping words in phrases, which results in fewer phrase boundaries compared to one-word-phrase by less advanced speakers. When the sentences were long or unfamiliar, the less advanced speakers tended to produce each word as a single phrase. Results presented in the above sections show that *all the participants could phonetically realize the typical L2 $L^{*}H_{P}$ contour for marking each of the p-phrases* irrespective of the length of the sentences. Section 6.3 has presented an account of this. Jun and Oh (2000) also suggest that a lexically linked prosodic feature in L1 is more likely to be transferred to L2 prosody and it is difficult to suppress. Results for this study have shown that *L1 lexical tonal distinction is not transferred to L2 when semantically equivalent lexical items are used*.

L1 Boro intonation system for focus marking (for both narrow or corrective focus) is not transferred to L2 production. Nagano-Madsen (2014) has shown how realization of pitch accent and focus constitute the most difficult parameter in L2 intonation acquisition. Generally speaking, past research on L2 accentuation has shown that L2 learners tend to overuse accents in their L2 speech (Rasier and Hiligsmann, 2007). *Boro L2 speakers of Assamese have shown greater amount of accuracy in realizing the $L^{*}fH_{P}$ pitch accent for wh-questions than using this pitch accent for corrective focus marking*. Only for the two participants with beginning level of proficiency, the domain for $L^{*}fH_{P}$ for wh-question is found to be the verb phrase instead of the whole sentence. None of the four L2 speakers marked corrective focus with the $L^{*}fH_{P}$ pitch accent. Instead, *compression of duration of all the syllables is found to be the dominant phonetic cue for L2 corrective focus marking for Boro speakers. The same prosodic feature is also used for L2 narrow presentational focus marking*. Although, for one sentence each, the two speakers with intermediate level of proficiency could recruit the L*H pitch accent for narrow focus marking, for other sentences they relied on durational decrease for narrow focus marking in L2.

Viscegliaa, Tsengb, Su and Huang (2011) show how L2 focus realization results in speakers producing a much smaller increase in average f_0 and amplitude for on-focus words and a much smaller decrease in average f_0 and amplitude on post-focus words than L1 speakers do. L2 learners also tend to have much more difficulty in distinguishing between old and new information and therefore tend to emphasize nearly each word in the utterance (Rasier and Hiligsmann, 2007). L2 focus realization also constitutes the most difficult aspect for Boro speakers of Assamese. Although *L2 intonation for statement and question is marked by greater amount of accuracy, difference of intonation properties depending on proficiency level also constitutes an important aspect of the prosodic structure of L2 Assamese spoken by Boro speakers*. Extending this study to include a higher number of participants would be of immense help in understanding the phonological and phonetic aspects of L2 Assamese intonation in a comprehensive way.

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Chapter 7

Conclusion

7.0 Introduction

Tone languages display intonational properties (a) in the surface realization of lexical tones at the edges of sentences, (b) in identifying linguistically significant f_0 chunks or prosodic units within the pitch contours of sentences, and (c) in allowing prosody to modify pitch register of lexical tones for pragmatic objectives like focus realization. The analysis of intonational phonology of Boro presented in this dissertation has showcased this. This dissertation has made an attempt to factor out the features which, in addition to the lexical tones, contribute to the surface pitch contours of sentences in tone languages. This exercise has helped us in understanding the lexical and post-lexical aspects of Boro and their phonetic implementation. The discussion presented in the preceding chapters has provided an elaborate account of the ways tone and intonation interact in Boro. The results presented are strengthened by detailed acoustic and statistical observation. Theoretical assumptions were made based on explanation of the data considered in each of the experiments discussed in this thesis. The research objectives outlined in chapter 1 have provided the impetus for the present endeavour. This chapter makes an attempt to summarize the results of the experiments discussed in chapters 2-6. The findings are presented here in the form of answers to the queries raised in chapter 1. The discussion in this chapter also highlights the limitations of the study presented here and the scope of future work.

7.1 Distribution of lexical tones

The goal of chapter 2 was to understand the correlation between the underlying lexical tones in Boro and their surface realization. This is examined focusing on the nature of tone alignment in morphologically derived environments in Boro. To apprehend this phenomenon, a production study was conducted involving various processes of affixation in the language. The question presented in (1) was articulated as the aim of the study presented in chapter 2.

(1) Is there a linguistic process influencing surface distribution of lexical tones in Boro?

Findings for the experiment presented in chapter 2 have shown that a minimal disyllabic PrWd domain controls the surface distribution of lexical tones in Boro. When suffixes become part of this domain, they surface with the lexical specification of the stem. When the tone bearing suffixes occur outside the minimum disyllabic PrWd domain, they form recursive PrWd domains. In such situations they can surface with their lexical specifications. Non tone bearing suffixes surface with the tone of the stems. The way they receive tonal association differs depending on whether they form part of the minimum disyllabic PrWd domain or recursive PrWd domain. When toneless suffixes form part of the minimum disyllabic PrWd domain, the lexical tone of the stem shifts to the right edge. The lexical tone spreads from the right edge of the minimum PrWd domain to the right edge of the recursive PrWd domain when toneless suffixes occupy the right edge of the recursive PrWd domain.

7.2 Post-lexical aspects of pitch contours

The principal thrust of this dissertation was to understand the role intonation plays in a tone language like Boro. Since the pitch contour of an utterance in a tone language can surface with both tonal and intonational f_0 features, this dissertation has made an attempt to understand the way intonation shapes the surface realization of lexical tones. Chapter 3 has focused on post-lexical features of the pitch contours in Boro and has tried to present a description of the intonational phonology of Boro following the AM model. The analysis presented in this chapter has tried to find answers to the following queries:

(2) Do lexical tones undergo modification at the post-lexical stage?
Do sequences of lexical tones undergo downstep/declination at the IP level?
Can multiple layers of prosodic units be identified in Boro?

Acoustic features of controlled material consisting of utterances of various tonal sequences and of various lengths were examined to develop a model of intonational phonology of Boro. The investigation for the first question in (2) supplied a partially positive answer. Pitch contours of various sentence types have shown that lexical tones can surface with their characteristic f_0 trends only when they occur in IP medial positions. Acoustic evidence has revealed that the IP initial lexical L tone in Boro surfaces with a rising contour instead of its characteristic falling contour. It has been argued in this chapter that IP initial L tones surface with rising contours due to an L%H% initial boundary tone. The H target for the initial L%H% aligns to the second syllable when a disyllabic word with L tone occurs in IP initial position. In instances of a monosyllabic word with L tone occupying the IP initial position, both the L and H targets for L%H% align to that syllable. However, with an IP initial lexical H tone, the H target for the L%H% does not surface. Thus, an IP initial H tone surfaces with its characteristic rising f_0 movement. The difference in the interaction between initial L%H% and the two lexical tones acoustically surfaces in the form of a higher target for pitch rise for IP initial lexical H tone than that of initial lexical L tone. The interaction between the right edge boundary tones and IP final lexical tones is examined in chapter4.

As for the second question in (2), acoustic evidence suggests that tones in Boro surface with additional pitch targets due to the processes of downstep and declination. It is shown in chapter 3 that downstepping affects the heights of f_0 targets for non-initial H tones. On the other hand, declination results in gradual drop of overall contour in a sequence of L tones. Although declination results in downward slide of the pitch contour of an utterance, downstep causes a regular and greater amount of pitch drop in non-initial H tones. Results have also revealed that downstep lowers the H tone aligned to the right edge of a PrWd or recursive PrWd domain. Downstep cannot affect tonal scaling within the PrWd domain.

The investigation of the third question in (2) has provided evidence suggesting that three levels of prosodic units can be identified in the intonational phonology of Boro. The lowest level in the hierarchy of prosodic units in Boro is occupied by PrWd. PrWds combine together to form an ip or sometimes a PrWd alone can form an ip. The ip in Boro functions as the domain for downstepping similar to what is found for Tokyo Japanese (Pierrehumbert and Beckman 1988; Kubozono 1992; Gussenhoven 2004). But downstepping is phonetic in Boro. The highest level of prosodic constituency is the IP which is marked by both initial and final boundary tones. Prosodic constituents in Boro are not characterized by pitch accents. In AM model, association of pitch accent provides crucial information for characterizing a word or a group of words as a prosodic unit. Compared to this, in Boro right alignment of lexical tones and pitch functions for boundary association demarcate edges of prosodic constituents. Thus, answers for the three questions in (2) have immensely helped in constructing some aspects of the phonological component of Boro.

7.3 Lexical and boundary tones

The description of intonational contours forms an integral part of the study of prosody in AM model. Chapter 4 of this dissertation has concentrated on this aspect of the intonational phonology of Boro. Pitch contours of various utterance types were examined in relation to the aspects mentioned in (3).

(3) Does Boro employ right edge contours for expressing discourse level meaning?
If yes, how do such right edge contours interact with the right edge lexical tones in the language?
Do boundary contours bear influence on the pitch contours of the IPs as a whole?

Analysis of pitch contours presented in chapter 4 has shown that Boro employs a host of IP final boundary tones for expressing various types of meanings. Some of the IP final contours are marked by monotonal boundary tones like L% for statements and H% for incomplete utterances. The right edges of some other sentence types are marked by pitch contours with two tonal targets. A bitonal boundary tone such as HL% aligns to the right edge of yes/no question (without question markers) and LH% aligns to the right edge of yes/no questions with the question particle '-na'.

Alignment and scaling of both the lexical and intonational tones occurring at the right edges of IPs were evaluated to see how Boro deals with the second point mentioned in (3). Acoustic and statistical results have revealed that Boro allows post-lexical tones to influence the right edge lexical specification in a manner that follows the principle of accommodation (Hyman and Monaka, 2011). Monotonal boundary tones coexist with lexical tones aligned to the rhyme of the IP final syllable. Visual examination of pitch contours showed that f_0 surfaces with a rising trend extending to some part of the rhyme of the final syllable before falling to a low target in a sequence of H lexical tone and L%. Compared to this, a sequence of L tone and L% surfaces with a continuous fall to a low target aligned to the rhyme of the final syllable. Results of repeated measure Anova showed that the f_0 value for the middle point of the rhyme of the final syllable remains higher when H lexical tone is preceded by L% compared to an LL% sequence, $F(1, 3) = 10.20$, $p < 0.05$ with no significant interaction , $F(4, 12) = 0.376$, $p = 0.82$. Comparison of pitch contours of lexical tones and H% boundary tone also suggested that lexical and boundary tones align to the rhyme of the IP final syllable.

Sometimes bitonal boundary tones totally obliterate the f_0 trend of the lexical specification. In such situations, a scaling difference surfaces for the bitonal boundary tone relative to the two lexical tones. A repeated measure Anova measuring the scaling difference of the high target for HL% in instances of it occurring with H and L tones showed that the peak is realized higher when HL% aligns to an IP final syllable marked for lexical H tone, $F(1, 3) = 22.76$, $p < 0.05$ with absence of any significant interaction, $F(9, 27) = 0.204$, $p = 0.992$. A situation of total obliteration of the lexical specification can be sometimes avoided by allowing the lexical tone to align to the penultimate syllable in sentences ending with a bitonal boundary tone. A trisyllabic IP final word only tolerates such an option of alignment of the lexical specification to the penultimate syllable. This is interpreted as the phonological requirement for the minimal disyllabic PrWd domain in Boro to have a lexical tone aligned to its right edge.

The HL% boundary contour marking yes/no question (without question particle) presented a positive response to the third question in (3). Aggregated z-score normalized pitch contours for homophonous sentences ending with L% for statements and HL% for yes/no questions (without question particle) showed that right edge HL% raises the register of the IP. This suggested that a boundary contour aligning to the right edge of an IP can have both local and global influence.

7.4 Information structure and realization of lexical tones

Chapter 1 has presented an outline of the way study of intonation takes cues from post-lexical features of pitch variation influencing the semantic-pragmatic category of prominence marking. Chapter 5 of this dissertation has made an attempt to explore this aspect of the prosody of Boro. The specific aim of this chapter was to look at the prosody of Boro in connection with the queries in (4).

(4) Is focus marked prosodically in Boro?
Is the prosodic system of Boro large enough to device non-identical prosodic means for marking narrow focus, contrastive focus, corrective focus, ex-situ focus and for focus marking with emphatic particles?

Four experiments were designed, in which focus was elicited with the help of contexts, to find answers to the queries mentioned in (4). The prosodic properties evaluated are f_0 and duration. These two prosodic parameters of the target words were compared with the same for their occurrence in neutral focus contexts. Results have revealed a partially positive response for the issues raised in (4).

Evaluation of pitch contours and duration of the target words bearing ex-situ focus revealed a negative response for the first issue raised in (4). Results revealed that *no consistent f_0 and durational variation affect the target words in ex-situ contexts*, compared to their occurrence in wide focus contexts. Thus, *ip boundary insertion remains the only prosodic cue for ex-situ focus marking in Boro*. In comparison to this, *focus marking with emphatic particles raises the pitch register* of the whole utterance compared to the one without the emphatic particles occurring in wide focus context. Z-score normalized meanf_0 value of each of the syllables of a sentence remains higher when the emphatic particles occur with any one of its constituents. Emphasis in Boro is also expressed by an H* (a phonetically higher H) aligned to the emphatic markers. H* does not surface in the instances of the IP final occurrence of the emphatic particles. Such occurrences result only in register raising and curtailed final lowering. We have assumed that the raising of the pitch register is caused by a Register h tone, which marks emphatic focus in Boro. This makes emphatic focus markers different from [sɯ́] and [nɯ́] in Boro (Mahanta, Das and Gope, 2016) which surface with only H* pitch accent. Thus emphatic focus markers have a stronger impact on the prosodic feature of the utterances in Boro than [sɯ́] and [nɯ́] have.

The prosody of contrastive and corrective focus revealed that register change plays a linguistically significant role in the intonational phonology of Boro. Both contrastive and corrective focus result in the global effect of lowering the register of the utterance containing the target word. In addition to this, the duration of the target word is compressed. Another local effect of contrastive and corrective focus marking is that of compressing the pitch range of pre-focus sentence initial L tones and of post-focus sentence final H tones. We interpret the register lowering for contrastive and corrective focus as a Register l tone influencing the pitch contour for the whole IP. This suggests that the prosody for focus marking in a tone language like Boro utilizes pitch register modification as an indispensable tool which allows lexical tones to preserve their characteristic f_0 trends.

7.5 L2 Assamese intonation for Boro speakers

The outline of the intonational phonology of Boro presented in this dissertation reiterates the possibility of lexical tones undergoing modification at the left and right edges of utterances. The f_0 trends of IP medial lexical tones are not modified in the same way in Boro, barring their scaling difference due to downstep/declination or register h/l tones for focus prosody. It was thought that the intonation of a second language (here Assamese) produced by Boro speakers would reveal whether they can acquire sentence medial intonational features of pitch contours. The prosody of utterances in Assamese is characterized by a series of L^*H_P contours which marks each of the p-phrases. The objective of chapter 6 of this dissertation was to explore the story of L2 Assamese intonation of Boro speakers. The main objective of the chapter was to address the issues in (5).

(5) Do L2 Assamese speakers of Boro carry tonal features from L1 to semantically equivalent lexical items?

Does L2 Assamese intonation of Boro speakers replicate the L1 Assamese system of pitch contours and prosodic phrasing?

Does L2 Assamese intonation of focus marking reproduce the focus prosody of L1 Assamese or is it characterized by carry over effects from L1 Boro prosody of focus marking?

L2 Assamese data was collected from four native speakers of Boro, which constituted the experimental group. The speakers were divided into two proficiency levels corresponding to their duration of exposure to Assamese. Four speakers of standard Assamese formed the control group. Pitch contours of identical sentences produced by participants from both the groups were compared. Results revealed a negative response to the issue raised in the first point of (5). Pitch contours of L2 Assamese sentences surface with a sequence of L^*H_P contours, each forming a p-phrase as in L1 Assamese. This result provides a positive response to the second issue raised in (5).

Results for the investigation into the third point raised in (5) have revealed some interesting properties of L2 intonation. Sections 6.5 and 6.6 have shown that L2 Assamese focus prosody for Boro speakers is neither influenced by L1 Boro nor by L1 Assamese. In L1 Assamese, the L^*fH_P pitch accent is used for corrective focus and the L^*H pitch accent is associated to the target words for narrow focus marking. Compared to this, L2 Assamese employs compression of duration of all the syllables of the sentence containing the focused word as the most consistent cue for marking corrective and narrow focus. This suggests that focus realization constitutes the most difficult aspect of L2 intonation and L2 speakers may adopt their own prosodic means to overcome this difficulty.

L H L H H HH L L

Underlying Representation ---------------- enzòrní bedòr zánaiá maozíní t^hakaì mɯzàŋ

Lexical Process (alignment) ---------------- L H L HH HH L L

Lexical surface representation -------------- enzòrní bedòr zanáiá maozíní t^hakaì mɯzàŋ

Post lexical processes --------------------- Left edge L%H%, ip boundary, right edge L%

Phonological surface representation ------

L%H% L- L%

((((enzòr)$_ω$ní)$_ω$ (bedòr)$_ω$ (zánái)$_ω$á)$_ω$)$_{ip}$ ((maozí)$_ω$ní)$_ω$ (t^hakaì)$_ω$ (mɯzàŋ)$_ω$)$_{ip}$)

Phonetic implementation process---------- Boundary association, Downstep, Final lowering

Acoustic signal---------------

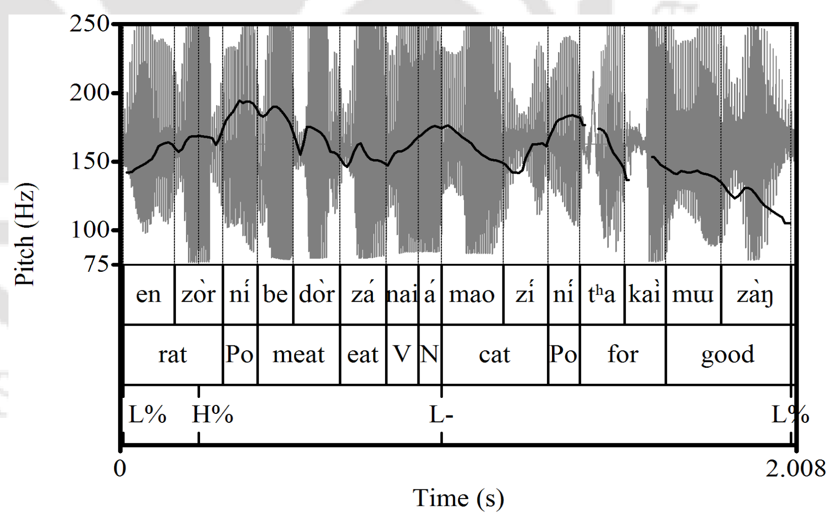

Figure 7.1: **Underlying representation, tonal and intonational grammar, phonetic process and surface acoustic signal of enzòrní bedòr zánaiá maozíní t^hakaì mɯzàŋ "It is good for cats to eat rat's meat".**

Figure 7.1 tries to capture the overall picture of the intonational phonology of Boro presented in this dissertation. It presents the pitch contour of a sentence consisting of six lexical items. Each one of them is marked with a tone in its underlying representation. At the first step towards the formation of the sentence enzòrní bedòr zánaiá maozíní t^hakaì mɯzàŋ "It is good for cats to eat rat's meat", inflectional suffixes are added to enzòr 'rat', bedòr 'meat', zá 'eat' and maozí 'cat'. Following this, lexical tones align to the right adhering to the lexical processes of shifting or spreading within PrWd domains. Alignment requirement makes the lexical specification of the monosyllabic verb zá 'eat' to shift to the right edge of the minimum disyllabic PrWd domain zanái 'eat-Verb'. Following this the H tone spreads from zanái 'eat-Verb' to the right edge of the recursive PrWd domain in zanáiá 'eat-Verb-Nom'. Lexical tones of enzòr 'rat' and maozí 'cat' stay put to the sponsoring TBU since they form minimum PrWd domains. Alignment requirement to the right edge of the recursive PrWd domain in enzòrní 'rat-Poss' and maozíní 'cat-Poss' is fulfilled by the lexical tone of the case marker –ní. Thus the surface lexical representation of the sentence enzòrní bedòr zánaiá maozíní t^hakaì mɯzàŋ "It is good for cats to eat rat's meat" differs from its underlying representation.

Post-lexically the pitch contour of the sentence is mapped onto prosodic units and post-lexical tones align to both its left edge and right edge. In the sequence of zánaiá maozíní the second H tone is not downstepped due to an ip boundary after zanáiá 'eat-Verb-Nom'. Since the example sentence is a statement, an L% boundary tone aligns to the right edge of the pitch contour. Left edges of Boro IP are marked by L%H% boundary tone. Thus L%H% aligns to the left edge of the pitch contour in Figure 7.1. This constitutes the post-lexical surface representation of the sentence enzòrní bedòr zánaiá maozíní t^hakaì mɯzàŋ 'It is good for cats to eat rat's meat'.

At the level of phonetic implementation, left edge boundary association makes the second syllable of the IP initial enzòr 'rat' surface with higher f_0 target than the first one. Final lowering makes the f_0 dip to a low target at the right edge of the sentence. Downstepping of H target following L also influences the pitch contour at the phonetic level. The acoustic signal in Figure 7.1 shows all these tonal and intonational aspects of the sentence.

7.6 Implications and future research

This dissertation has provided a new perspective of the post-lexical phonology of tone languages. The study has shown the way boundary tones, downstep, declination and register tones constitute the intonational component of a tone language whose prosodic system was not explored before. The hierarchy of prosodic units presented for Boro is unique in tone languages. It has also brought to the fore the fact that intonational tones can have both local and global impact. These findings would certainly enlarge the existing theory on the presence of intonation in tone languages. In addition to this, analysis of focus realization presented in chapter 5 bears important implication for the theory of focus prosody. Boro presents an individual instance where both register lowering and raising are recruited for prosodic purposes. This aspect of Boro shows that f_0 dimension can be used in a different way, other than altering the characteristic trend for lexical tones, to mark discourse salience. This makes Boro a typologically interesting language since it employs neither phonological rephrasing nor sentence stress for its focus prosody. The use of intonational register tones for focus marking in Boro necessitates a relook at the focus-prominence correlation (Samek-Lodovici, 2005). Boro provides an opportunity for enlarging such a theory by making it domain centric rather than constituent centric.

The study has also presented an acoustic analysis of the way speakers of an understudied tonal language acquire the prosodic features of an understudied non-tonal language. Results presented have shown that proficiency level in L2 plays an important role in L2 prosody. Less proficient speakers of L2 tend to transfer L1 prosodic features to L2. L1 Boro speakers with beginning level of proficiency in Assamese transfer the prosodic feature of ip boundary marking to L2 Assamese. This study has also provided valuable insight into L2 focus prosody. It is found that focus realization constitutes the most difficult aspect of L2 prosody and L2 speakers can adopt their own prosodic means which differ from both L1 and L2 system of focus marking.

It has been demonstrated that pitch contours in Boro are shaped by the interplay of a number of factors. The f_0 contour is the product of lexical tones, post lexical processes and phonetic implementation requirements. Despite delving this far into the prosodic system of Boro, this study does not claim to be without certain limitations which require extended and elaborate investigation. In section 1.5, we have highlighted field work issues and the reason behind variation in the number of participants for the experiments. Data from more and equal number of participants across the experiments would certainly help us a lot in enriching our results. An important prosodic feature of Boro highlighted in chapter 3 is of phonetic downstepping. Examination of downstepping has to be extended on two fronts. Firstly, the data set should be extended to examine whether downstepping is related to morphological or phonological triggers. Secondly, a perception test would help us a lot in establishing the phonetic versus phonological status of downstepping in Boro. A subsequent perception test is also required to strengthen our results for the production experiment describing the intonational register tones in Boro. We have assumed in section 4.2.5 that sentences expressing surprise or disbelief in Boro are marked by a left edge H% boundary tone which raises the register of the non-final lexical tones. Our data set consisted of a sequence of three lexical tones. We feel that longer and complex sentences would reveal more about this left edge boundary tone. Chapter 5 has presented us the intriguing question as to why the pre-focus and post-focus local effect of compression of pitch range is found only in the case of L tone in pre-focus position and for H tone in post focus position. This deserves to be investigated further in future work. The study of prosodic features of L2 Assamese discussed in chapter 6 has presented us with a great opportunity to contribute to the gradually evolving theory of L2 intonation. Extending this study to include a higher number of participants would be of immense help in contributing to the phonological and phonetic aspects of L2 intonation. Still, this study has acquainted us with some important phonological and phonetic aspects of the prosody of Boro and this has certainly added to the growing discussion on intonation in tone languages.

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