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ABSTRACT

This paper discusses the morphological and prosodic properties of Boro tones. Tonal alignment in Boro vis-à-vis word formation processes throws light on some distributional properties of tone in the language. Boro has some affixes which have their own tonal specifications. Prefixes determine the tone of the stem and lead to changes in the tonal specification of the stem. The addition of suffixes do not alter the tonal nature of the stems. Suffixes in Boro, irrespective of their lexical tonal status, belong to the recessive category whereas prefixes belong to the dominant group. In terms of prosodic properties, the smallest domain for Boro tonal assignment is a minimal word and maximally it is the prosodic word.

KEYWORDS

Boro, lexical tones, prosodic word, tone and morphology

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Distribution of lexical tones in Boro

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1 Introduction

In this paper we address the problem of tone assignment in Boro and propose that both the minimal word and prosodic word domains are units of tone assignment. We will also discuss how morphological factors play a role in tone assignment. We will see that tonal alignment in Boro shows many variations on the theme of alignment in Boro. Tones can be assigned maximally to a prosodic word domain but not beyond, and this will be instantiated with examples of trisyllables. Furthermore, suffixes and prefixes attest different tonal assignment. Prefixes lower the tone of the root, whereas suffixes undergo alignment based on the tone of the root/stem. Suffixes exhibit a variety of tonal distributional patterns, some like the causative suffix always appear with its own lexically specified tone while others like the Nominative case marker need a disyllabic base to manifest its underlying tone. Apart from these differences, some trisyllables do not attest alignment but rather the nature of the shift seems to be more like spreading.

1.1 Background

Distribution of lexical tones is an important aspect of the description of tonal phonology of a particular tone language. The autosegmental nature of tones (Leben 1973, Goldsmith 1976) provides the theoretical foundation for tonal association to a segment other than the source segments. Inspite of there being differences in opinion regarding the number of tones in Boro, most researchers agree that Boro is a tone language (Weidert 1987). Boro uses lexical H and L tones and the L is sometimes seen as a default Mid tone (Sarmah 2004). Boro tones are employed to distinguish lexical meaning of Boro words as in (1) below (Sarmah 2004):

(1a) [ɡaó] 'tear or split'
(1b) [ɡaò] 'shoot by arrow or gun'

The tone bearing unit (TBU) in Boro is the syllable and its 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. In addition to investigating the tonal nature of affixes, this paper also aims at elucidating the nature of tonal alignment in Boro in the presence of inflectional and derivational processes. We will also demonstrate in this paper that while prefixes come with their own lexical specification and delete the tones of roots, suffixes do not delete the

tones specified in the root even if they are lexically specified for tone. We will show how the causative morpheme exhibits exceptional behavior.

Section 2 briefly underlines some aspects of the Boro language and highlights the literature available on Boro tones. Section 3 presents a detailed account of the methodology adopted for this study. Section 4 enumerates the findings and presents a detailed account of tonal alignment in the post-affixation stage in Boro. Section 5 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. Section 4 in its 3 subsections discusses the differences between suffixes and prefixes, disyllables and trisyllables and among suffixes the difference in tonal assignment between causative suffixes which always appear with its underlying tone and some others like the nominative case marker which needs a disyllabic domain to surface with its underlying tone. Section 5 presents a discussion on tone and word formation in Boro and a concluding section which highlights the main findings of this paper.

2   The Boro Language

Boro[1] 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) and also mentioned as such in one of the earliest descriptions of the language found in The Linguistic Survey of India (1903).[2] The language has been described as vulnerably endangered by UNESCO Atlas of the World's Languages in Danger 2010. The number of Boro speakers in Assam in 2011 census was 1,296,162.[3] In the following section we present an overview of the literature on Boro tones.

2.1   Boro Tones: literature review

Burling (1959), in his description of Proto-Boro, expresses the absence of a large number of tonal distinctions in Boro compared to many other Tibeto-Burman languages which have 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 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

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[1] DeLancey (1987) uses both the terms Boro and Bodo to describe this language. The influential BodoSahityaSabha (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 paper.

[2] Grierson, G. A. edited *Linguistic survey of India*. Vol III Part II, 1903, pp. 1-17.

[3] Source: http://www.censusindia.gov.in, retrieved on May 10, 2013.

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). Bhattacharya (1977) focused mainly on the tone pattern in monosyllabic words, but other studies have shown that Boro disyllabic words can have only one of the two tone patterns, whether it be a High tone or a Low (Joseph and Burling 2006). Sarmah (2004) presents further evidence to show that Boro has two tones: High and Low.

The nature of interaction between tone and morphology in Boro has been dwelt upon in some limited ways by Bhattacharya (1977), Weidert (1987) and Joseph and Burling (2001). Bhattacharya (1977) mentions 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 (Bhattacharya 1977). Weidert (1987) shows that the high tone of the root spreads to a toneless suffix after affixation. Sarmah (2004) describes that Boro has some toneless suffixes which receive the tonal specification of the stem when they are added to monosyllabic ones. This pattern in disyllabic derived words in Boro conforms to the tonal pattern of disyllabic non-derived words where the rightmost TBU is specified with a tone. In contrast to the generally attested behavior of one tone assigned to each word, the study by Sarmah (2004) also provides evidence for the presence of suffixes in Boro with an underlyingly specified tone. This means that there are words in Boro with two distinct tones assigned to each syllable in the context of certain morphemes. The study finds that the causative suffix -*ho*[4] in Boro is underlyingly specified for a low tone and it retains its tonal specification after affixation to a root. This process does not change the tonal specification of the stem and thus the process of -*ho* affixation results in the presence of lexical tones on both the stem and the suffix. This paper addresses many aspects of tonal distribution in the derived morphology which were not addressed in previous studies. For instance, in Sarmah (2004) only plural marking and causative forming morphemes were studied and the numbers of speakers were only two. This paper tries to fill the gap and present a more detailed description and analysis of tone and morphology interaction in relation to various kinds of word formation processes allowed in Boro.

3   Data collection: methodology

The process of data collection for the experiment in this paper 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 is considered to be the indicator of 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 understand the

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[4] Transcribed as -*hu* by the authors of this paper.

distribution of these lexical tones in the context of 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 the affixes contribute any lexical tone post affixation.

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* _____ *bùŋduŋmun*
> I   say-Prf-Pst
> I _____ said.

3.1 Materials

The purpose of the experiment was to determine the nature of interaction of tone and morphology in the six categories of affixation in Boro. The underlying tonal nature of the prefixes and suffixes that participate in the following morphological processes in Boro have been investigated:

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

We do not claim that the list is exhaustive and our observations and analysis will only pertain to word formation processes identified above. Also, each category of affixation in Boro is executed by several lexical variants.[5] It has been already mentioned that most Boro words are derived forms with affixes added to either monosyllabic or disyllabic bases (Bhattacharya 1977). From this perspective, as has already been mentioned, the affixes considered for this experiment do not constitute an exhaustive list. Rather, the affixes chosen for this experiment were given more priority 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 1 in this experiment.

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[5] For example, the plural morpheme in Boro has several morphologically conditioned allomorphs like *-pʰur*, *-mun* and *-sur*.

Affixation	Tone	Words	Prefixes	Suffixes
Tense-Aspect	*High*	*tʰáŋ* 'go'		*-ɯ, -gun, -gou, -bai, -duŋ, -duŋmun*
	Low	*lùŋ* 'drink'		
Case Inflection	*High*	*daó* 'bird', *núŋ* 'you', *bibarí* 'Bibari', *nɔ́* 'home', *hatʰaí* 'market'		*-á, -kʰoú, -ao, -nu, -ní, -niao, -dʒuŋ*
	Low	*duì* 'water', *àŋ* 'I', *sumdùn* 'Samdan', *ruà* 'axe', *bàr* 'wind', *maozì* 'cat', *dìn* 'day', *burmà* 'goat', *hazù* 'hill', *enzòr* 'rat', *seŋrà* 'boy', *guzoù* 'high'		
Plural Inflection	*High*	*núŋ* 'you', *nuŋtʰáŋ* 'you(Hon)', *nɔ́* 'home', *adá* 'elder-brother', *alasí* 'guest', *laisrí* 'Laisri'		*-pʰur, -mun, -sur*
	Low	*gotʰò* 'child'		
Negative Affixation	*High*	*tʰáŋ* 'go'		*-a,-akʰui,-lia*
	Low	*pʰuì* 'come', *lùŋ* 'drink'		
Adjective Forming Affixation	High	*zá* 'eat', *súŋ* 'short', *haí* 'shorten', *pʰé* 'intoxicate', *buhuí* 'flow', *surzí* 'create', *dumuí* 'become cloudy', *laó* 'lengthen', *maó* 'do', *pʰúr* 'whiten', *zí* 'to tear', *zén* 'to lose', *baí* 'break', *lír* 'weigh', *tʰúŋ* 'straighten', *dúŋ* 'to heat', *rúŋ* 'loosen', *zúŋ* 'to be light', *gú* 'be pure'	'gV'	*-kʰor,-dɔ,-dub, -braŋ, -brum, -lú, -deŋ, -tʰi*
	Low	*lùŋ* 'drink', *sì* 'to wet', *hàm* 'become good', *sù* 'become cold', *sùm* 'blacken', *rùm* 'ripe', *kʰuì* 'sour', *tʰaò* 'to make tasty', *seò* 'to rot', *tʰàŋ* 'to be alive', *tʰuì* 'to die'		
Causative verb forming affixation	*High*	*gó* 'escape', *gáb* 'cry', *zúb* 'finish', *zám* 'old', *gí* 'fear', *búŋ* 'speak', *pʰutʰaí* 'belief', *rúŋ* 'mild/soft', *gá* 'separate', *zí* 'to tear', *zò* 'sit', *súŋ* 'short', *rán* 'dry'	*bV-,pʰV-, sV-*	*'-hù'*
	Low	*tʰàb* 'fasten', *hàm* 'become good', *maò* 'do', *musà* 'dance', *kʰàm* 'fire', *geò* 'open'		

Table 1. Speech material for the experiment. The third column presents the stems and the fifth column presents the list of affixes which are added to the stems in the respective row. The suffixes not marked for tone do not have an underlying tone.

The following abbreviations are used for different affixes in Boro: Present–Prst, Habitual –Hab, Future – Fut, Present – Prsnt Perfect – Prf, Past – Pst, Progressive – Prog, Genitive – Gen, Locative – Loc, Accusative – Acc, Nominative – Nom, Negative – Neg.

3.2 Participants and Recording

Five male speakers of Boro were asked to produce the words in Table 1. The speakers produced the words embedded in the sentence frame in 2. The speakers were between 22-28 years of age and they were born and raised in their native villages where the recordings were conducted. All of them were from the same socio-economic background. The experiment was carried out in a quiet environment at Bhatipara, Kazigaon and Bashbari villages. All the speakers had a college degree and they had elementary knowledge of Assamese. None of the speakers had any previous record of any hearing or listening disorders. Each speaker was paid a small fee as a token of appreciation for participating 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 considered the standard variety of Boro.

The speakers produced 6 iterations of each word (present in the data set) embedded in the sentence pattern mentioned above. The sentences were uttered with sufficient pause in between. The subjects were asked to read the sentences aloud. The sentences were written in the Devanagiri script and they appeared on a computer screen. 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 four days. We could not continue with our data collection because of the strong winds which were blowing during recording.

3.3 Data Analysis

Each iteration of the individual words was first extracted and saved as separate wave files using the speech analysis software- Praat (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 graph 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.

4 Results

The existence of lexical tones in Boro has been previously discussed in many studies starting from Burling (1959). One of the objectives of our research endeavour has been to examine the nature of pitch contours with which tonal minimal pairs are pronounced.

Figure 1 presents the time-normalized pitch contours of the words *tʰáŋ* and *tʰàŋ* which expresses contrastive meaning depending on the tone with which it is pronounced. Pitch contours for *tʰáŋ* 'go' in the left panel of Figure 1 surfaces with a rising pitch and that of *tʰàŋ* 'to live' in the right panel of Figure 1 surfaces with a falling pitch.
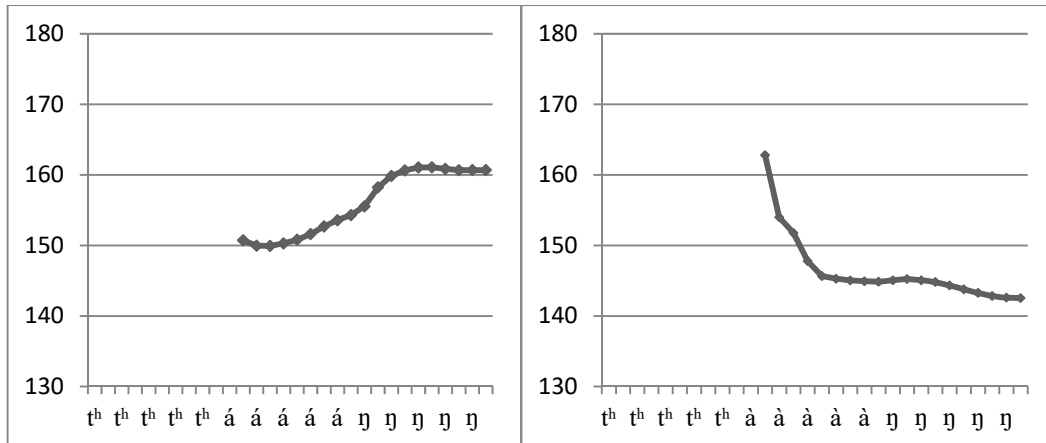

Figure 1. Pitch contours for tonal minimal pairs in Boro. The panel on the left presents the time normalized pitch contour for *tʰáŋ* 'go' and the panel on the right presents the time normalized pitch contour for *tʰàŋ* 'to live' (n=25)

The other tonal minimal pairs that the present study examined are given in Table 2. The minimal pairs in Table 2 also show rising pitch contour when the word is assigned high tone and they show falling pitch contour when it is assigned a Low lexical tone. Unlike these words, pitch contours for some other words revealed that the Low tone in Boro sometimes surfaces with low level pitch. The pitch contours of *lùŋ* 'drink' in Figure 2 and *duì* 'water' in Figure 4 show that the Low tone in Boro is sometimes pronounced with a low level pitch. In a fewer instances, a level tone for the High tone is also seen.

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

Table 2. Tonal minimal pairs in Boro

Hence, like the previous studies on Boro, we conclude that a phonetically rising tone in Boro can be considered a High tone and a phonetically falling tone can be considered a Low tone. The reason or this is that the same tone may sometimes appear to be a level High or a level Low in some environments. Also, Boro would be unique in attesting only contour tones and without any level tones in its inventory of tones. Recent work on Mandarin Chinese (Xu and Wang 2013) has shown that the High tone in Mandarin is also rising and there may be tonal movement in all

tones not just contour tones. It is of course out of question that Boro has more than two contrasting tones as word level contrasts were not found to establish these additional tones.

4.1 Dominant and recessive tones in affixes

Examination of the pitch contours of the stems in Table 1 (after affixation) has not only provided crucial information regarding alignment, it has also shown that some Boro affixes can be best described in terms of a 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. 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. Evidence has been presented by Inkelas (1998) to show 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 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).

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 affixes in Boro change the lexical specification of the roots, and thus they may be considered 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 which have 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 after affixation provides cues for classifying the affixes into dominant or recessive categories. The following sections discuss this.

4.2 Tone shift to right edge

Tone shift or alignment is an important characteristic of tones (Yip 2002). This section highlights the ways in which tonal phonology of Boro permits tonal alignment to influence distribution of lexical tones. Evaluation of pitch contours of disyllabic derived words has shown that lexical tones in Boro shift or align to the right edge of such words. Both prefixation and suffixation lead to this rightward alignment. Sometimes alignment to the right edge results in deletion of the prespecified lexical tone of the rightmost element. When the rightmost element is not specified with any tone, even then the lexically specified tone aligns to the right edge. Alignment to the right edge also provides the phonetic cue for identifying the lexical specification of the leftmost TBU. We propose that the disyllabic domain is the domain of the prosodic word and Boro tones prefer to be assigned to the prosodic word.

4.2.1 Suffixation and tone alignment

Suffixation leads to lexical tones of 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 is expressed by attaching six different suffixes to verbal roots. These suffixes are *-ɯ* (Present Habitual), *-gun* (Future), *-gou* (Immediate Future), *-bai* (Present Perfective), *-duŋ* (Present Progressive), *-duŋmun* (Past). In this study, the pattern of occurrence of the tense-aspect suffixes with a few roots of high tone and a few others of low tone types was investigated. The aim of this investigation was to find out the 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 presents an instance of the occurrence of the habitual present marking suffix -⊠ with a high tone and a low tone word.
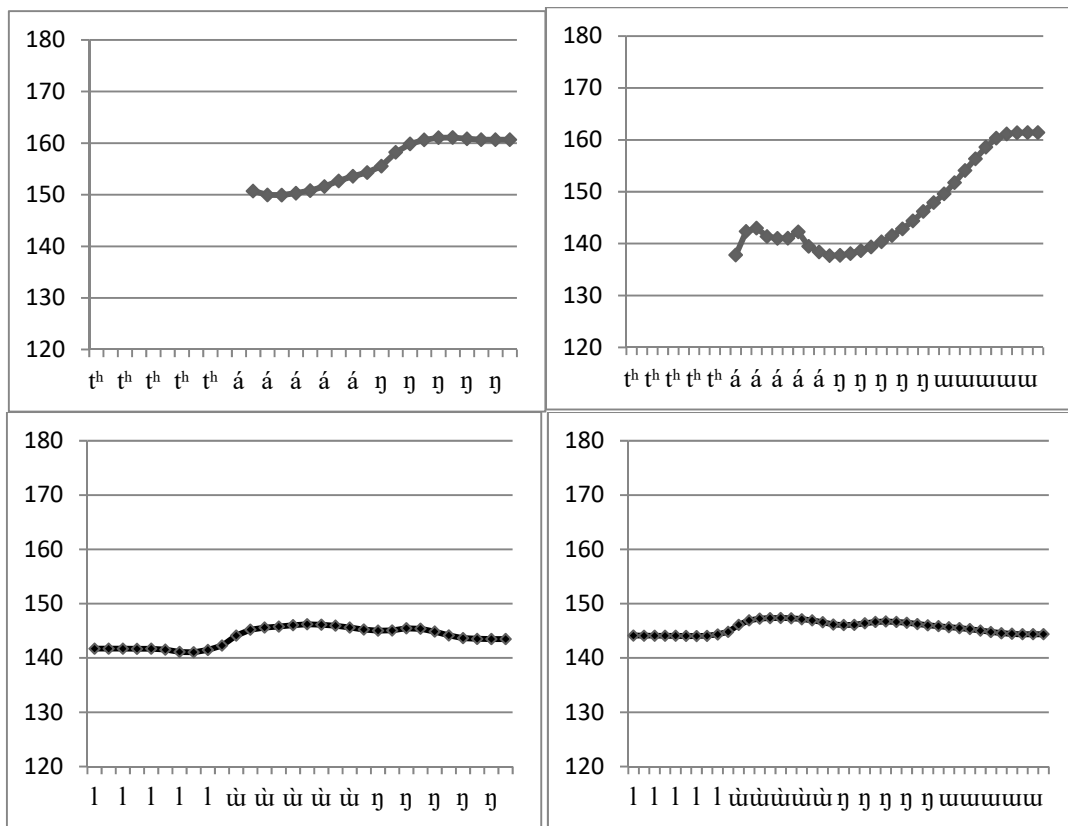

Figure 2. Tense-aspect suffix and tone shift. The upper panels show *tʰáŋ* 'go' with and without the habitual present marking suffix *-ɯ*. The lower panels present the *f₀* contour for *lùŋ* 'drink' with the same suffix. These are time normalized pitch contours for 25 iterations of each of the words (5 repetitions x 5 speakers)

It can be seen in Figure 2 that the underlying high tone of the verb *tʰáŋ* 'go' shifts to the right edge in the presence of the habitual present marking suffix *tʰaŋú* 'go-Prsnt-Hab'. A similar pattern is noticed for the low lexical tone for *lùŋ* 'drink' and its habitual inflectional form *luŋù* 'drink-Prsnt-Hab'. This pattern of lexical tone distribution is also followed by other tense-aspect suffixes. Table 3 shows that the tense-aspect suffixes in Boro do not possess any inherent tonal specification. As already explained, they surface with the tone of the root verb following the pattern

of right-alignment of lexical tone. Since the tense aspect suffixes do not alter the tonal specification of the stems they can be described as recessive affixes.

Word	Gloss
tʰáŋ 'go'	*lùŋ* 'drink'
tʰaŋgún 'go-Fut'	*luŋgùn* 'drink-Fut'
tʰaŋgoú 'go-Fut'	*luŋgoù* 'drink-Fut'
tʰaŋdúŋ 'go-Prsnt-Prog'	*luŋdùŋ* 'drink-Prsnt-Prog'
tʰaŋbaí 'go-Prsnt-Prf'	*luŋbaì* 'drink-Prsnt-Prf'

Table 3. Tense aspect suffixes and tone shift. The H tone of *tʰáŋ* 'go' in the left column and the L tone of *lùŋ* 'drink' shifts to the suffix.

Tone shift affects disyllabic derived words also when the negative marking suffixes are added to verbs. Verbs inflect for negative forms in Boro when the negative suffix *-a* is attached. In addition to this, *-lia* and *-akʰui* 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 *-akʰui* refers to negative in the perfective mood. Tonal distribution due to the addition of the latter two negative markers will be discussed in section 4.3. This is because their addition results in a trisyllabic derived word. Since this section is focused on disyllabic derived words and their tonal alternation, only suffixation by *-a* is discussed here. Figure 3 presents the pitch contour for the words *tʰáŋ* 'go' and *pʰuì* 'come' occurring with this negative marking suffixes.
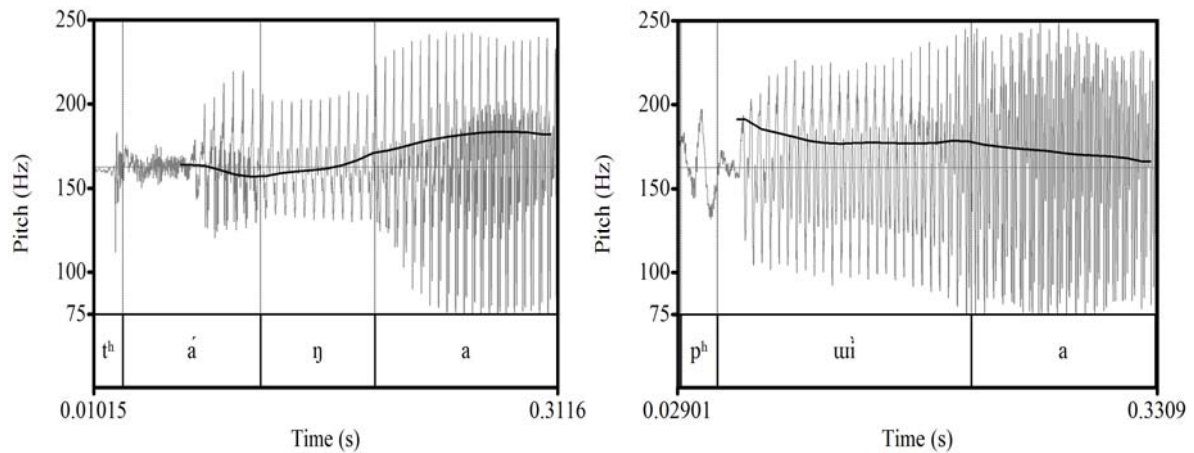

Figure 3. Negative suffix and tone shift. Pitch contour for the verbs *tʰáŋ* 'go' and *pʰuì* 'come' occurring with the negative marker *-a*

It can be seen from the pitch contour presented in Figure 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 *pʰuì* 'come' results in the falling f_0 pattern of the negative suffix. 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 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 4 presents pitch contours of two monosyllabic nouns *duì* 'water' and *daó* 'bird' along with the nominative case marker *-a*.
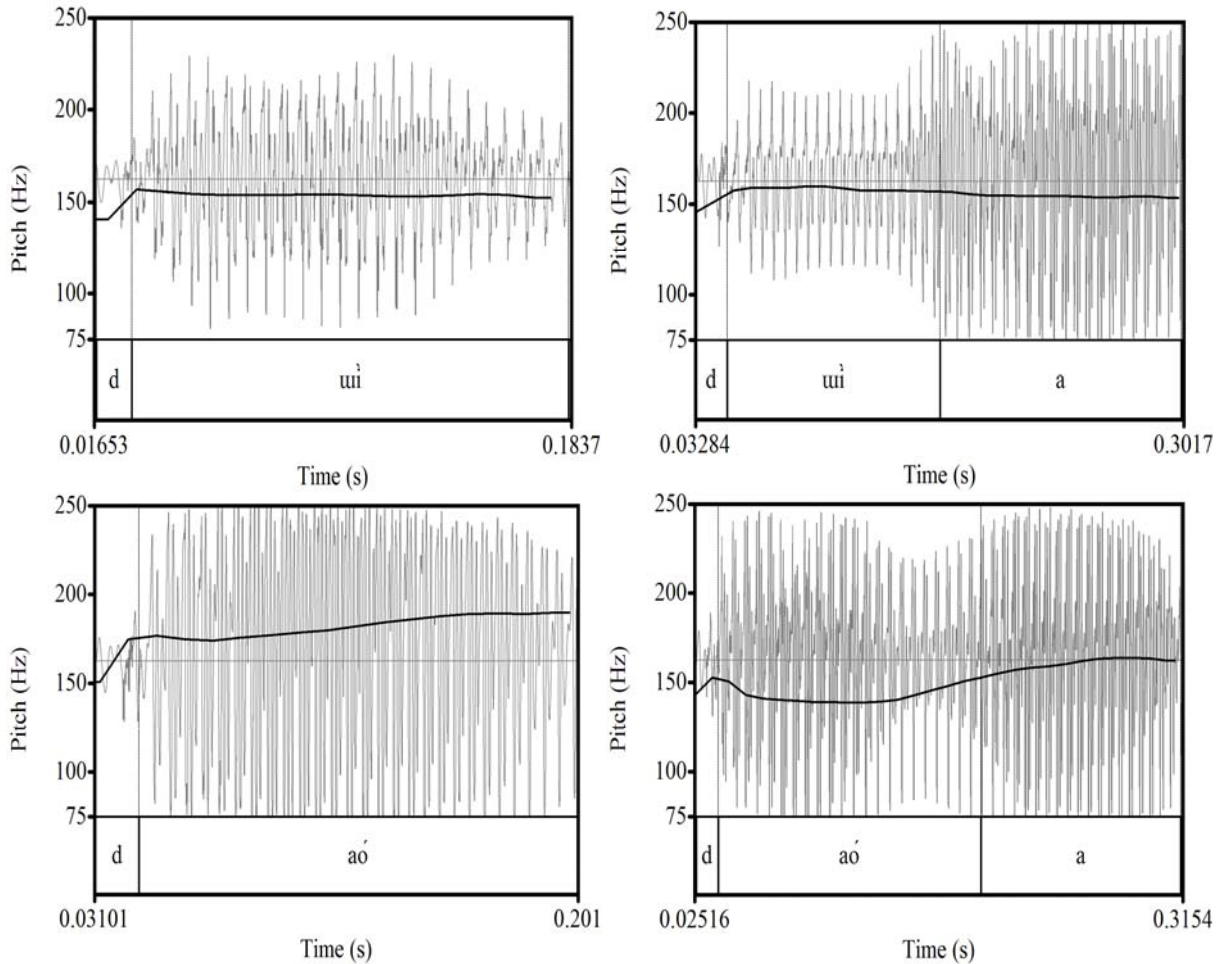

Figure 4. Case inflection and tone shift. The upper panels show pitch trends *for duì* 'water' with and without the nominative marking suffix *-a*. The lower panels present the f_0 contour for *daó* 'bird' with the same suffix.

In Figure 4, 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 *duì* 'water' and its nominative case inflectional form *duià* 'water-Nom'. This shows that the process of tone shift to the right edge of disyllabic derived words is a robust phenomenon in tonal phonology of Boro.
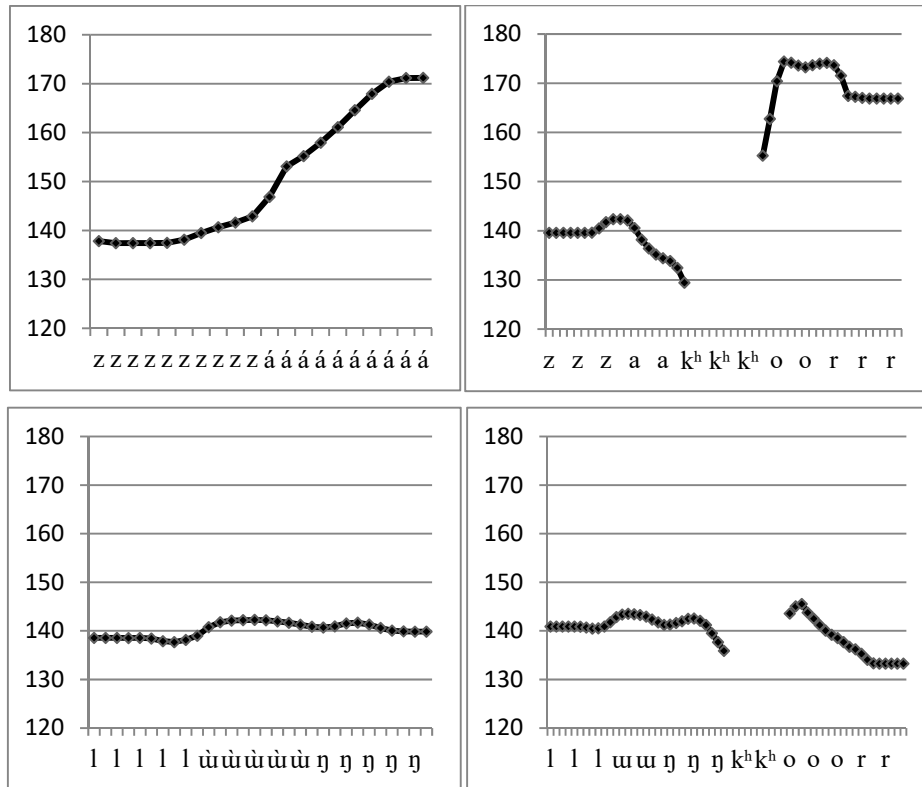
Figure 5. Adjectival suffix and tone shift. Averaged time normalized f_0 contour for the verb *zá* 'eat' and the adjective *zakʰór* 'gluttonous' in the upper panels and *lùŋ* 'drink' and the adjective *luŋkʰòr* 'drunkard' in the lower panels. (n=25)

Plural marking suffixes like *-pʰur*, *-suur* and *-mun* also highlight the ubiquitous nature of this pattern of tonal alignment in the language. Derivational suffixes like the adjective forming ones adhere to this pattern of tonal alignment. The adjective forming suffixes that we have evaluated to study the effect on the tonal pattern of derived words are *-kʰor, -dɔ, -dub, -braŋ, - brum, -lu, -deŋ, -tʰi*. The suffixes are added to different lexical items since most of them do not occur with both high tone and low tone root types. Only two among them, *-kʰor* and *-lu* can occur after roots of the two lexical tone types in Boro. Figure 5 presents the pitch contour of the adjectives formed as a result of adding *-kʰor* and *-lu* to the verbal roots of both the high and low tone types. Figure 5 illustrates how the suffix *-kʰor* surfaces with the underlying tonal specification of the verb roots. In the case of adjective *zakʰór* 'gluttonous', the raising f_0 pattern of *zá* 'eat' aligns to the second syllable. On the other hand, the verb *lùŋ* 'drink' is specified for low tone and consequently *luŋkʰòr* 'drunkard' pronounced with low tone is aligned to the suffix. Pitch contours of disyllabic derived words with both inflectional suffixes and derivational ones have shown that lexical tone in Boro obligatorily shifts to the second TBU in such words, irrespective of the type of affixation.

4.2.2 Tonal alignment and Prefixation

Tonal alignment 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 their resultant tonal alignment were examined in the experiment described here: derivation of adjectives and of causative verbs. Adjectives in Boro can be formed from verbs by prefixing the syllable 'ɡV' where the vowel (V) copies the vowel of the stem. This process of adjective formation has revealed an interesting phenomenon as regards the way tonal distribution interacts with morphological processes in Boro. The prefix 'ɡV' can occur with both high tone and low tone root types. A careful examination of the tonal pattern of resultant adjectives after affixation has shown that the roots always surface with a low specification irrespective of the fact of it having a high or low specification before prefixation. In Figure 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 *ɡa-haì* 'low' and *ɡ a-hàm* 'good'.
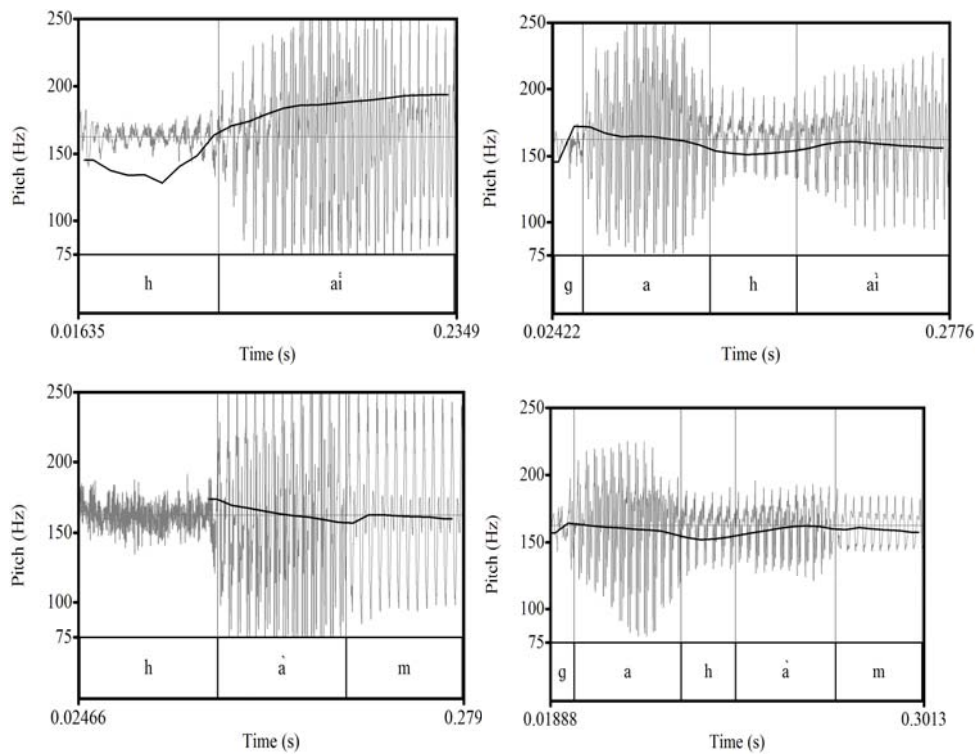

Figure 6. Adjectival prefix and tone shift. Pitch contour for the adjective *ga-haì* low' derived from *haí* 'shorten' and for the adjective *ga-hàm* 'good' derived from the verb *hàm* 'become good'.

Pitch contours of other adjectives formed by this kind of affixation has revealed the same pattern of tone surfacing on the root, that is, with a low specification. Table 4 presents a list of derived adjectives and their tonal pattern that has been investigated in this study.

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 4. Adjectives derived from prefixation. Adjectives derived from verbs where the low tone of the prefix shifts to the right edge resulting in delinking of the lexical tones of the stems.

The surface alignment of low tone to the right edge of all derived adjectives in Table 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 the right edge. This results in deletion of the lexical tone of the stem. For this, these prefixes can be classified as one of the dominant affixes in Boro.

Causative verbs in Boro can be formed by prefixes of three types: bV-, pⵝV-, sV- where the vowel of the prefix copies the vowel of the root. It is found that causative verb formation by prefixation in Boro follows the pattern of adjective formation by prefixation. Prefixation by bV-, pⵝV-, sV- for causative verb formation results in a change of the tonal specification of the root. Irrespective of tonal specification of the root before addition of the causative prefix, a low tone surfaces on the root after causative formation. Figure 7 presents the pitch contours for causative verbs *bekʰeò* 'to make something open' and *pʰuzùb* 'to make finish' derived from the verbs *geò* 'open' and *zúb* 'finish' respectively.
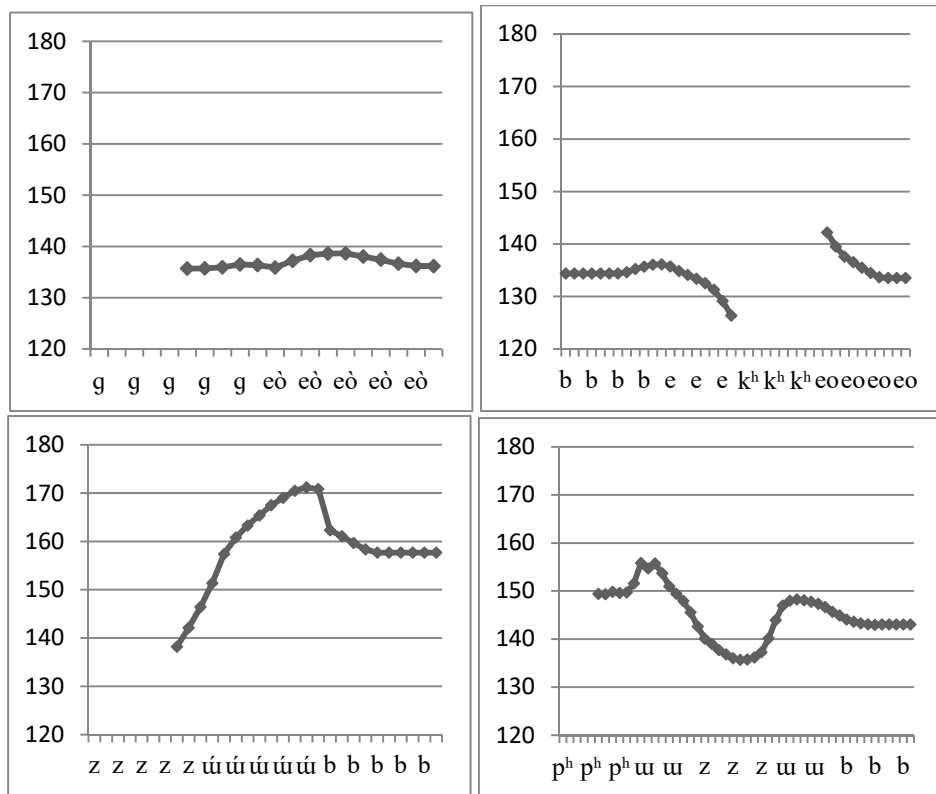
Figure 7. Causative prefix and tone shift. Averaged time normalized pitch contour for the causative verbs *bekʰeò* 'to make something open' and derived from the verbs *geò* 'open' and *pʰuzùb* 'to make finish' from *zúb* 'finish'. (n=25)

It can be seen that the lexical high tone of *zúb* 'finish' changes to a low tone after the prefix is added to it. In *bekʰeò* 'to make something open', low specification of the root *geò* 'open' is preserved even after affixation. The pattern of tonal distribution in Figure 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 *bekʰeò* 'to make something open' and *pʰuzùb* 'to make finish'. The proposal here is 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. A list of such verbs and the tonal distribution found in them is provided in Table 5. Since the addition of the prefix for causative verb formation leads to a change of the lexical tonal pattern of the stems, these prefixes can be defined as dominant.

Verb	Causative Verb
gáb 'cry'	*sugàb* 'to make cry'
tʰàb 'fasten'	*sutʰàb* 'to cause to fasten'
zúb 'finish'	*pʰuzùb* 'to make finish'
zàm 'old'	*pʰu-zàm* 'to make old'

haí 'shorten	*pʰa-haì* 'to make low"
tʰù 'sleep'	*pʰu-tʰù* 'to cause sleep'
zír 'examine'	*bi-zìr* 'to examine'
gó 'escape'	*bo-kʰò* 'to make free'

Table 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 itself.

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. However, tone shift executed here is different from the cases described in section 4.2. Here tone shifting is achieved by deleting the underlying tones of the stems.

4.3 Tone Shift in Trisyllabic Words: Tone Spreading

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 migration to the right edge. Boro has several suffixes without their own tonal specification. Trisyllabic words formed with the aid of these suffixes present instances of tone spreading in the tonal phonology of Boro. 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 *tʰaŋdúŋmún* 'go-Prf-Pst' and *luŋdùŋmùn* 'drink-Prf-Pst' not only present an instance of tone shift but also of tone spreading. It is noticed that the lexical specification does not shift to the third syllable when the suffix *-mun* is added. The tone only spreads to the third syllable and thus both the ultimate and penultimate syllables surface with identical tones. Figure 8 explains this.
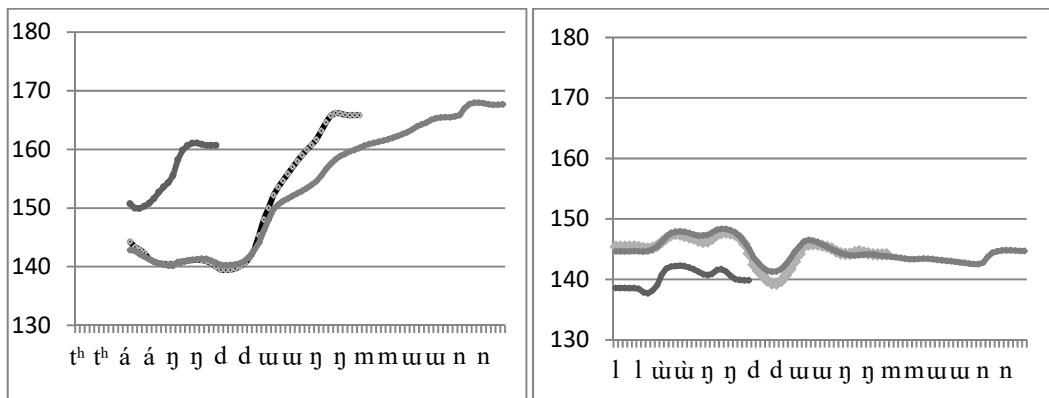

Figure 8. Tense aspect suffixes and tone spreading. Pitch contours of *tʰáŋ* 'go' and *lùŋ* 'drink' with the suffixes *-duŋ* and *-mun* where the lexical tone spreads to the third syllable.

Tone spreading to the third syllable is also noticed when the case marking suffix *-ao* and the negative marking suffix *-akʰui* are added to disyllabic stems. Figure 9 present the pitch contours

of *gozoùaò* 'high-Loc' and *hatʰaíaó* 'house-Loc' where the locative case marker *–ao* occurs as the third syllable.
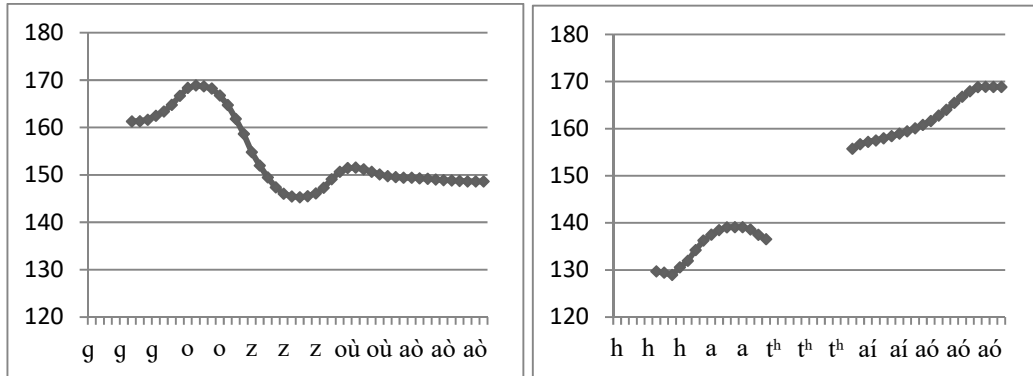

Figure 9. Locative inflection and tone spreading. Averaged time normalized pitch contour for the nouns *gozoùaò* 'water-Loc' and *hatʰaíaó* 'house-Loc' (n=25)

In the left panel of Figure 9 the low tone of *gozoù* 'high' spreads to the third syllable, the locative marking suffix. In the right panel of Figure 9, the continuous rise in the f_0 contour shows how the high tone of *hatʰaí* 'market' spreads to the locative marker.

The pitch contours of the words *tʰaŋákʰuí* 'go-Neg-Prf' and *luŋàkʰuì* 'drink-Neg-Prf' are presented in Figure 10. It can be seen that for *tʰaŋákʰuí* 'go-Neg-Prf' both the second and the third syllable surface with a rising f_0 contour. The contrastive pitch contour can be seen in the last two syllables of *luŋàkʰuì* 'drink-Neg-Prf'.
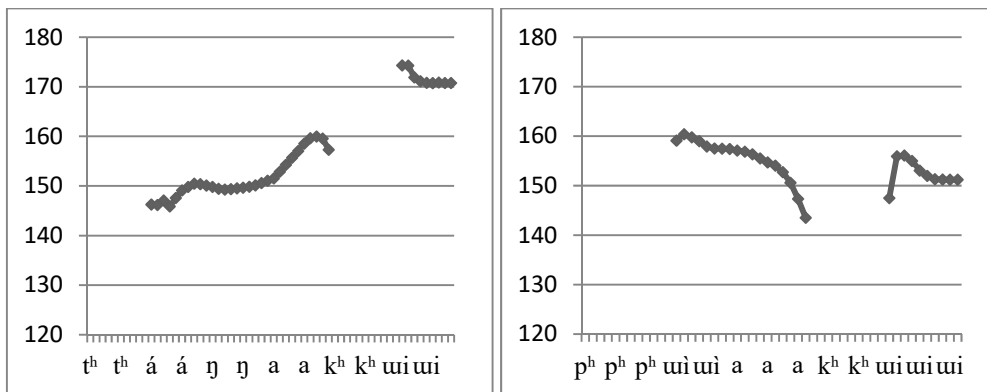

Figure 10. Negative inflection and tone spreading. Averaged time normalized pitch contour for the verb *tʰáŋ* 'go' and of the verb *pʰuì* 'come' occurring with the negative marker *-akʰui*. (n=25)

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.

4.3.1 Tonal alignment in trisyllables: No tone shift/spreading the presence of the *-hu* suffix

Causative verb formation in Boro by adding the suffix *-hu* to the verbal roots reveal yet another interesting aspect of tonal distribution in Boro. It is found that the causative suffix *-hu* is inherently specified with a low tone and it preserves its low tone even when it is added to a monosyllabic stem. Figure 11 presents the pitch tracks for the causative verbs *maòhù* 'to cause an action' and *gíhù* 'to make frightened' derived from the verb *maò* 'do' and from the noun *gí* 'fear'.
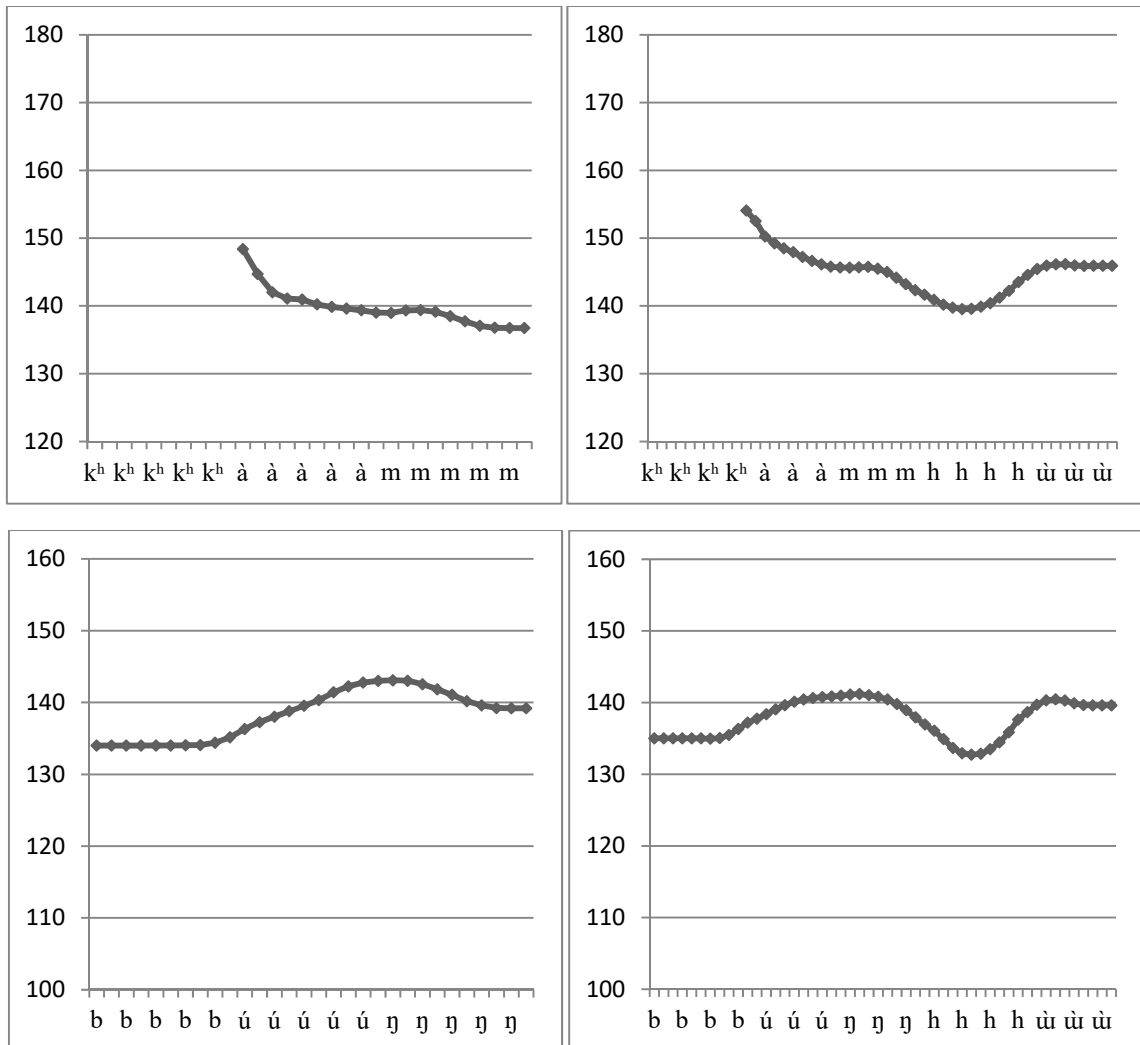

Figure 11. Monosyllabic stem and absence of tone shift. Averaged time normalized pitch contour for the causative verbs *kʰàmhù* 'to cause a fire' and *búŋhù* 'to cause to speak' derived from the verb *kʰàm* 'fire', and from the noun *búŋ* 'speak'. (n=25).

It can be seen in Figure 11 that the high tone of the root *búŋ* 'speak' is preserved even after the suffix *-hù* is added to it. The f_0 for the first syllable of *búŋhù* 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 *kʰàm* does not change after the suffix is added. -*hù* behaves in the same way when it occurs with disyllabic roots. Figure 12 presents the pitch contours of the causative suffix occurring with disyllabic roots. The causative suffix surfaces with its lexical tone after both *pʰutʰaí* 'belief' and *musà* '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.
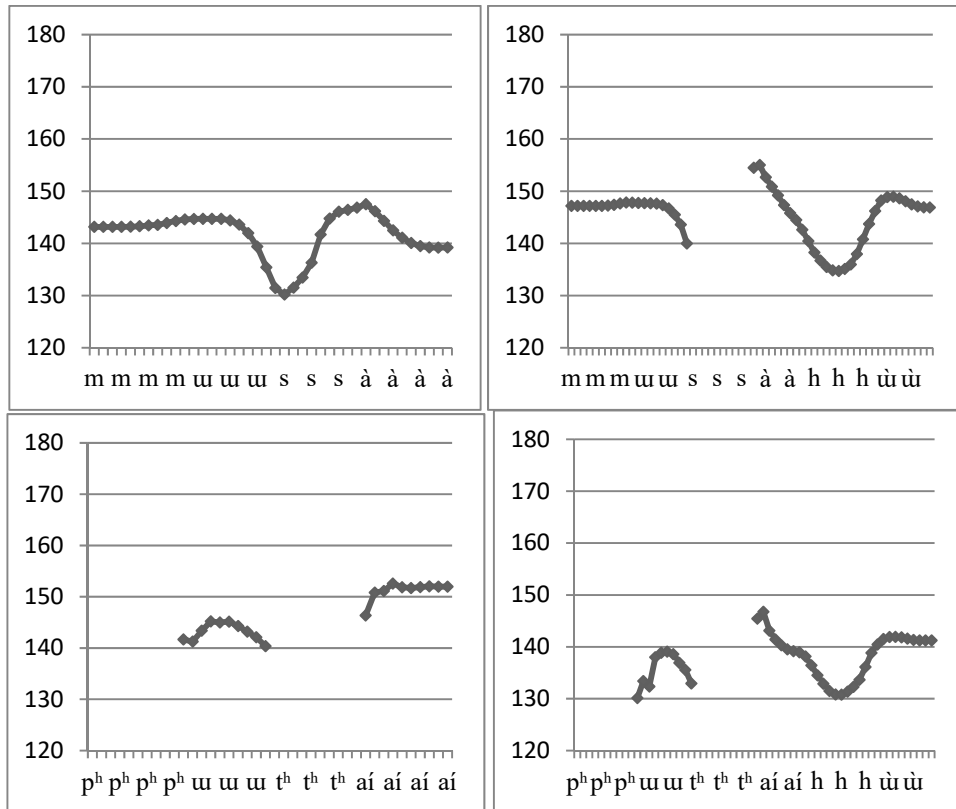

Figure 12. Disyllabic stem and no tone shift. Averaged time normalized pitch contour for the causative verbs *musàhù* 'to cause to dance' and *pʰutʰaíhù* 'to make someone believe' from the verb *musà* 'dance' and the noun *pʰutʰaí* 'belief'. (n=25)

This section presents a different pattern of tonal distribution within a disyllabic derived word. Results presented in this section show that the causative suffix -*hù* does not adhere to the alignment scheme of other suffixes shown till now. Disyllabic derived words with the causative suffix -*hù* can surface with the tones of both the stem and that of the suffix associated to their sponsoring TBUs. As seen in the previous sections, tones align to the right edges in disyllabic derived words. In trisyllabic derived words, the requirement of alignment to the right edge may be fulfilled either by tone spreading to the third TBU or by blocking the migration of the lexical specification to the right edge. This again shows the importance of the prosodic word in Boro tonal assignment. The prosodic word is maximally the unit of tonal unit in Boro. Beyond the prosodic word, tones may either spread or deleted.

4.4   *Tonal alignment in di/ trisyllables: the requirement of a disyllabic domain*

This section discusses how tone shift to the third syllable is blocked in certain environments in Boro. The nominative case marking suffix presents an example of this. Figure 4 shows how the nominative suffix -*á* 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 a clue to the fact that the nominative suffix -*á* has its own lexical specification which surfaces only when it is added to a disyllabic stem. This disyllabic requirement can also be seen as a prosodic word requirement of the nominative suffix -*á*. The right panel in Figure 13 shows the realization of the high tone in -*á*.
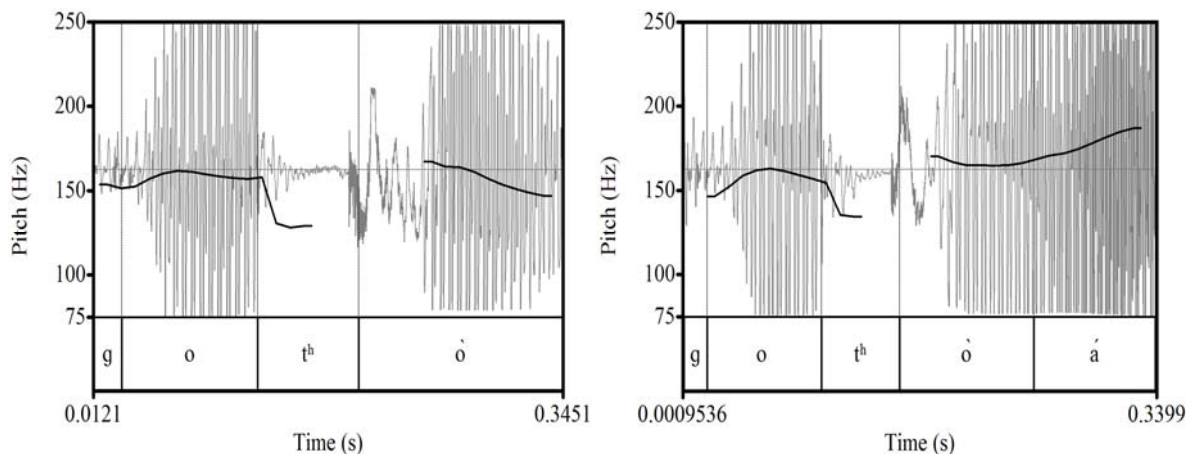

Figure 13. Nominative inflection and absence of tone shift. Pitch contours of *gotʰò* 'child' in the left panel and of *gotʰò-á* 'child-Nom' on the right panel (n=25). The rise in pitch during the nominative marker is because of its H lexical specification.

In *gotʰò-á* 'child-Nom', on the right panel of Figure 13, the lexical tone of the stem does not shift to the third syllable. Instead, the nominative suffix -*a* in *gotʰò-á* 'child-Nom' surfaces with *f₀* 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 similar behavior where trisyllabic contexts are concerned. In the left panel of Figure 14, the genitive suffix follows a monosyllabic stem with low tone. Consequently, the derived disyllabic word surfaces with the low tone of the stem aligning to the right edge. In the right panel 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.
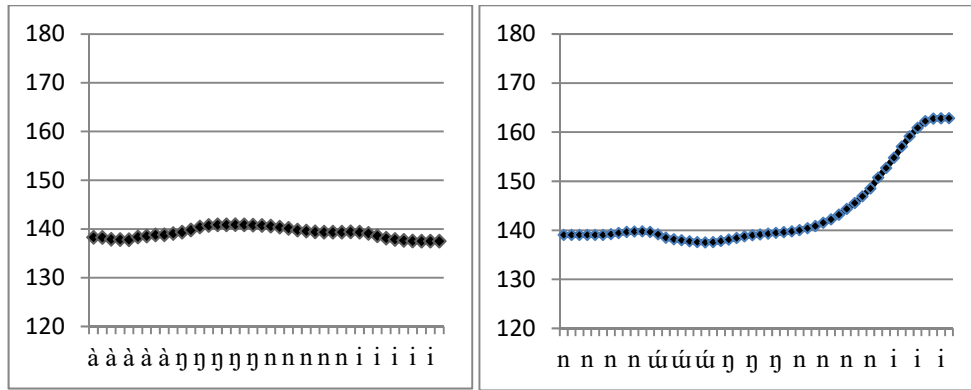
Figure 14. Genitive inflection and tone shift. Averaged time normalized pitch contour for the nouns *aŋnì* 'I-Gen' in the left panel and that of *nuŋní* 'you-Gen' in the right panel (n=25). The genitive suffix *-ni* surfaces with a rising contour in *nuŋní* 'you-Gen' as the high tone of *núŋ* 'you' moves to the right edge.

The panels in Figures 15 and 16 present the pitch contours of words of high tone and low tone types occurring with the accusative case marker. As the stems in Figure 15 in monosyllabic, the accusative case marker does not surface with its own lexical specification. Instead, the tone of the stem shifts to right edge for boundary alignment.
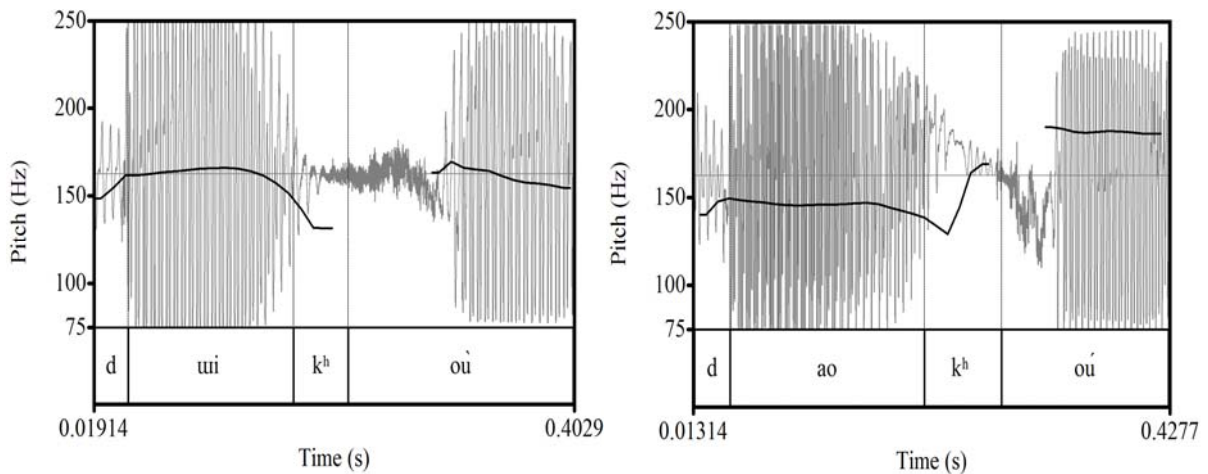

Figure 15. Accusative inflection and tone shift. Pitch contour for the nouns *duikʰoù* 'water-Acc' in the left panel and *daokʰoú* 'bird-Acc' in the right panel. The tone specifications of both *duì* 'water' and *daó* 'bird' move to the right edge in both the panels.
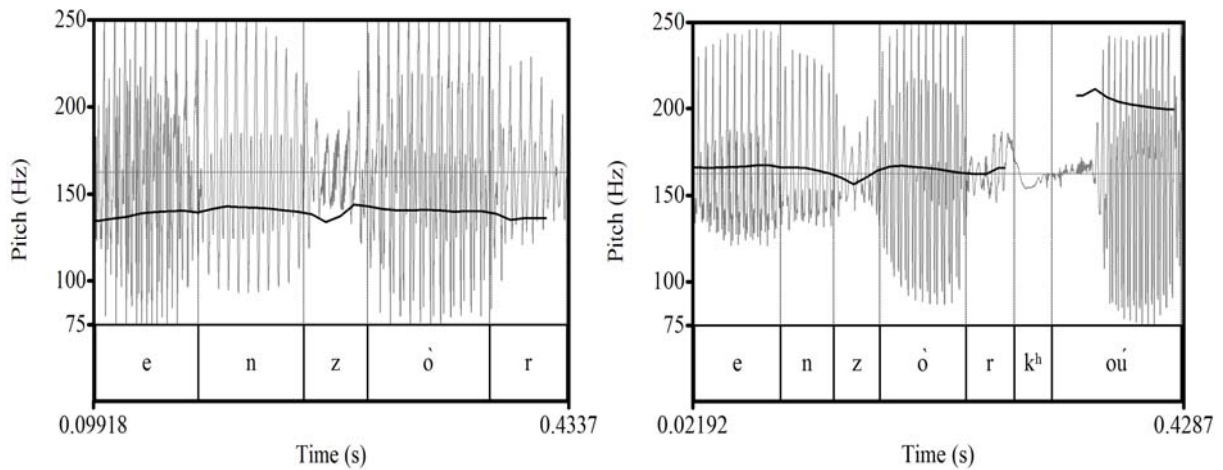
Figure 16. Accusative inflection and absence of tone shift. Pitch contours for the noun *enzòr* 'rat' with and without the accusative case marker *-kʰoú*.The lexical high specification of the accusative case marker *-kʰoú* surfacein the presence of the disyllabic stem *enzòr* 'rat'.

Tone specification of the suffix surfaces only when it occurs with a disyllabic stem like *enzòr* 'rat'. The pitch contours presented in Figure 16 explain this. The right panel in Figure 16 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 *enzòrkʰoú* 'rat-Acc'.

To summarize, the three case markers discussed till now undergo tone alignment only when they follow monosyllabic stems. When they follow disyllabic stems, their lexically specified tones are now licensed to appear. These suffixes exhibit their need for satisfaction of either one of the dual requirements of right alignment and disyllabicity. Right alignment is satisfied only in the absence of disyllabicity. Right alignment is violated in the presence of disyllabicity as the suffixes are inherently specified with tone.

The adjective forming suffix *-lú* also provides further evidence of this kind of tonal distribution in Boro. It is found that the adjective forming suffix *-lú* has its own tonal specification. Figure 17 presents the pitch contours of the suffix *-lú* occurring with the verbs *surzí* 'create' and *dumuì* 'become cloudy'.
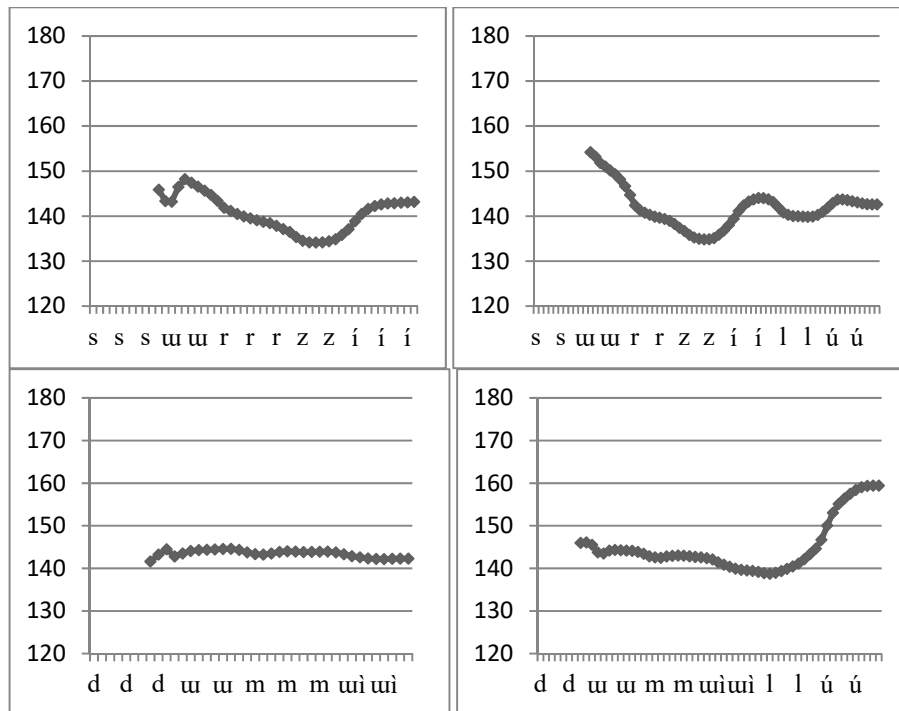
Figure 17. Adjectival suffix and absence of tone shift. Averaged time normalized pitch contours for *surzí* 'create' and *surzilú* 'creative' in the upper panels and for *dumuì* 'become cloudy' and *dumuilú* 'cloudy' in the lower panels. (n=25).

It can be seen in Figure 17 that the suffix *lú* is pronounced with a high and rising pitch even when it occurs with *dumuì* 'become cloudy' bearing a low lexical tone. This shows that another important aspect of *-lú* suffixation is that the high tone on the second syllable of the root *surzí* 'create' does not shift in the manner it shifts from the roots *tʰáŋ* 'go' and *núŋ* 'you' to *tʰaŋá* 'not go' and *nuŋsúr* 'you-plural' respectively. This shows that lexical specification of the stems do not change when the suffix *lú* with high tone is added to them, which makes a case for grouping this suffix also into the recessive category.

This section discussed the distribution of lexical tones in some derived words where the stem consisted of two syllables and a tone-bearing suffix was added to it. Acoustic details show that the tone in these disyllabic stems do not shift to a tone bearing suffix in Boro. Such trisyllabic derived words surface with tones of both the stem and the suffix. Interestingly, the same suffixes when they attach to monosyllables will undergo tone spread to the right edge. These suffixes validate our claim of the prosodic word being the maximal unit of tonal assignment in Boro. While minimally it is the minimal word as in the monosyllables, if the unit of tonal assignment is a trisyllable (that is a disyllable + a suffix), then the tone may not spread.

5   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 6 and that of causative verb formation presented in Figure 7 show how the lexical specification of the prefixes shifts 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. In other morphologically restricted cases, tone shifts to the suffix only when the suffix is added to a monosyllabic stem. 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. The causative *-hù* suffix does not follow this tonal alignment pattern. The causative suffix *-hù* 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. Thus we propose that in Boro tonal alignment, the phonological requirements of minimal word and prosodic word plays a crucial role. Boro minimally needs a minimal word for a tone to surface. In other cases, this minimal word requirement may not suffice, then the prosodic word requirement (as in the disyllabic requirement) takes precedence. Unlike these cases, the causative *-hù* needs a minimal word to surface. Results presented in this paper will show that tones in Boro surface right aligned and prefer to adhere to a disyllabic domain. While monosyllables may be assigned tone, they are eligible for tone assignment as they are the minimal words in Boro. A minimal word is Boro is mostly a heavy syllable (they are mostly closed and the few open syllables have been impressionistically found to be longer and this needs to be studied in greater detail). Tone shift and tone deletion functions are always within the domain of the prosodic word and contribute to tone-to-TBU association within the prosodic word domain instead of outside of it. Tone shift is identified with the process of tone alignment to a TBU other than the source one. Tone association to a third syllable may sometimes result from spreading. As will be seen in the body of the paper, the disyllabic domain in Boro is the site for tonal alignment as well as tonal emergence.

6. 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 are found to have lexically specified tones, their addition do not alter the tonal nature of the stems. Suffixes in Boro, irrespective of their lexical tonal status, belong to the recessive category. They may appear either with their own tonal specification or they may bear the lexical tone of the stem. Boro tonal assignment is minimally in the domain of the minimal word and maximally in the domain of a prosodic word. Under the condition where it is a disyllable the tone spreads to the right edge. This tone on the right edge of a disyllable can be the tone of the underived monosyllable which shifts to the right edge or it can also be the tone of the affix (as in prefixes). Disyllables are the maximal unit of tonal assignment or tonal shift. Hence we consider this prosodic unit to be

the maximal unit of tone assignment in Boro. In trisyllables, tones only spread, if at all, but they do not shift. In trisyllables, the lexical specification does not shift (but spreads) to the right edge unlike the way it does when such suffixes are added to monosyllabic stems. In other suffixes such as the tone of the suffix in *gotʰò-á* manifests on the right edge in trisyllables but not in disyllables. In disyllables the tone at the right edge is that of the stem but not of the suffix. We conclude that prosodic word domains or minimum words are preferred over whole word domains for tone assignment in Boro.

REFERENCES

Basumatary, Phukan C. 2005. *An Introduction to the Boro language*. New Delhi: Mittal Publications.

Bhat, D N Shankara. 1968. *Boro vocabulary: With a grammatical sketch*. Poona: Deccan College Post-graduate and Research Institute.

Bhattacharya, Pramod C. 1977. *A descriptive analysis of the Boro language.* Guwahati: Department of Publication, Guwahati University.

Boersma. Paul and Weenik, David. 2012. "Praat: doing phonetics by computer" (Version 5.3.04_win32) [Computer programme]. Retrieved on January 12, 2012, from http://www.praat.org/Bradley 1982.

Boro, Madhuram. 2007. *The historical development of Boro language*. Guwahati, Assam: NL Publications.

Brahma, Aleendra. 2012. *Modern Bodo grammar, Vol–1: Morphology: Bases and affixes.* Guwahati, Assam: NL Publications.

Burling, Robbins. 1959. "Proto-Bodo". *Language* 35.3: 433-453.

Burton-Page, John. 1955. "An analysis of the syllable in Boro". *Indian Linguistics* 16: 334-344.

DeLancey, Scott. 1987. "Sino-Tibetan languages". In: Comrie, Bernard (Ed.), 797-810, *The world's major languages*. London: Croom Helm.

DeLancey, Scott. 2010. "Language replacement and the spread of Tibeto-Burman". *Journal of the Southeast Asian Linguistics Society* 3.1:40-55. http://www.jseals.org/JSEALS-3-1.pdf (accessed 4 December 2016).

DeLancey, Scott. 2011. "Optional" "Ergativity" in Tibeto-Burman Languages". *Linguistcs of the Tibeto-Burman Area* 34.2: 9-20.

Goldsmith, John. 1976. *Autosegmental phonology*. Ph.D. diss, MIT.

Grade, Paul. 1976. *Historie de l'accentuation slave*. Paris: Institute d'etudes slaves.

Inkelas, Sharon. 1998. "The theoretical status of morphologically conditioned phonology: a case study of dominance effects". *Yearbook of Morphology* 1997 : 121-155. Dordrecht: Springer: Springer.

Inkelas, Sharon; and Zoll, Cheryl. 2007. "Is grammar dependence real? A comparison between cophonological and indexed constraint approaches to morphologically conditioned phonology" *Linguistics* 45.1: 133-171.

Joseph, Umbavu V.; and Burling, Robbins. 2001. "Tone correspondences among the Boro languages". *Linguistics of the Tibeto-Burman Area* 24.2: 41-55.

Joseph, Umbavu V.; and Burling, Robbins. 2006. *The Comparative phonology of the Boro-Garo languages*. Mysore: Central Institute of Languages.

Kiparsky, Paul. 1982c. *The Lexical phonology of Vedic accent.* Unpublished manuscript. MIT.

Kiparsky, Paul. 1984a. "A Compositional Approach to Vedic Word Accent". In Joshi, S D (ed.), *Amrtadhara: Prof R. N. Dandeka Felicitation Volume*. Ajanta Publications, Jawahar Nagar Delhi.

Kiparsky, Paul. 1984b. "On the Lexical Phonology of Icelandic". In Elert, Claes-Christian et al. (Eds.), *Nordic Prosody II: Papers from a Symposium.* Umea: University of Ume.

Leben, William. 1973. *Suprasegmental phonology.* Ph.D. diss, MIT.

Poser, William. 1984. *The phonetics and phonology of tone and intonation in Japanese.* Ph.D. diss, MIT.

Sarmah, Priyankoo. 2004. *Some aspects of the tonal phonology of Bodo.* M Phil diss, Central Institute of English and Foreign Languages, Hyderabad.

Stundžia, Bonifacas. 2011. "Dominance as an accentual (prosodic) property of morphemes". *Baltistica* 7: 255-262.

Weidert, Alfons. 1987. *Tibeto-Burman tonology: A comparative analysis..* Amsterdam: John Benjamins [Current Issues in Linguistic Theory 54].

Withgott, Meg; and Halvorsen, Per-Kristian. 1988. "Phonetic and phonological considerations bearing on the representation of east Norwegian accent". *Autosegmental Studies on Pitch Accent* 11: 279.

Xu, Yi and Q Emily, Wang. 2001. "Pitch targets and their realization: Evidence from Mandarin Chinese". *Speech Communication* 33: 319-337.

Xu. Yi. 2013. ProsodyPro—A tool for large-scale systematic prosody analysis. Laboratoire Parole etLangage, France.

Yip, Moira. 2002. *Tone.* Cambridge: Cambridge University Press

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