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Laryngeal Markedness in Chhatthare Limbu: An Optimality Theoretic Analysis

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Abstract: This paper looks at the laryngeal contrast in Chhatthare Limbu and formalises the phonological effects through an optimality theoretic analysis. It discusses the underlying laryngeal feature specification in the language and how it fares with the constraint ranking in the language. The analysis shows that while the voicing and aspiration contrasts are available in the language, the context sensitive markedness and faithfulness constraints inhibit the free occurrence of these contrasts.

Keywords: Chhatthare Limbu, Laryngeal Markedness, Optimality Theory

1. INTRODUCTION

This paper throws a new light upon the laryngeal phonology of Chhatthare Limbu. Taking clues from the existing linguistic data, the rule-based analysis is reformulated into a constraint-based framework. In this light, the paper discusses how a constraint-based analysis offers better generalisation and predictability. The paper proceeds as follows. The first section introduces the data from Chhatthare Limbu, primarily from Tumbahang (2007a, 2012) pertaining to the laryngeal contrast and their distribution and reviews the literature that analyses the laryngeal phonology. The second section introduces the theoretical concepts that interact with the data given in section one and lays out the plan of the analysis. The third section contains the formal analysis of the data followed by its discussion in the fourth section. The fifth section concludes the paper.

1.1 Chhatthare Limbu: A Linguistic Background

Chhatthare Limbu, a dialect of Limbu, is spoken primarily in the Chhatthar area in Eastern Nepal by roughly 17,782 people (Tumbahang 2012). While varieties of Limbu gathered attention of phonologists, Chhatthare Limbu did not (Tumbahang 2007a). This paper is an attempt to formalise the laryngeal contrast of the language theoretically with the available data in Tumbahang's works. All dialects of Limbu have roughly the same consonantal repertoire as given in Table 1 (Tumbahang 2007b). The primary focus of this paper is on the laryngeal contrast among plosives. Table 1 shows the classifications of these segments.

Table 1: Consonantal inventory of Chhatthare Limbu

	labial	dental	alveolar	palatal	velar	glottal
Stop	p, b, p^h	t, t^h			k, g, k^h	ʔ
Fricative			s			H
Affricate			$\widehat{tʃ}$, $\widehat{tʃ}^h$			
Nasal	m	n			ŋ	
Liquid			r	l		
Glides	w			y		

Chhatthare Limbu has 18 consonant phonemes and out of these 9 are plosives. The language shows three types of laryngeal specifications on these plosives: voicelessness, voicing, and aspiration. In a privative feature setup, we can say that the voiced stops have the feature [voice], aspirated stops have

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the feature [spread glottis] and voiceless unaspirated stops are laryngeally unmarked. This kind of laryngeal system is termed a three-way laryngeal contrast since there are three types of contrastive laryngeal segments. Phoneticians have shown a number of languages that show this three-way laryngeal contrast such as Thai, Vietnamese, Khmer, Yerevan Armenian, Dawoodi, Punjabi, Shina, and Burushaki (Choet al. 2018). While this characterisation is phonetically exhaustive and appropriate, it could be contested for its phonological efficacy. The three-way laryngeal contrasts are economically costly: they do not make optimal use of the features they are utilising. These kinds of systems are termed "over specified" systems since they offer more featural representations than necessary in the language (Beckman et al., 2009; Beckman et al., 2011; Ringen and Dommelen, 2013).

Laryngeal Realism (Honeybone, 2005) elaborates on how languages can be categorised based on the kind of voicing mechanism they employ. Languages that contrast voicing with voicelessness are categorised as "true voice" language and languages that contrast aspirated stops with unaspirated ones are categorised as "aspirating" languages. For doing this, LR emphasises a direct link between the laryngeal specification and its articulatory implementation. True voicing languages make an active effort to sustain voicing whereas aspiration languages make an active effort to produce a voicing lag. Their particular emphasis is on two-way contrast languages, but it can be applied to all the laryngeal systems. With respect to Chhatthare Limbu, nothing conclusive can be said now about its articulatory stricture because of a lack of relevant research. However, since there is no concrete counter-evidence as yet, we argue that the laryngeal contrast in this language is three-way, contrasting aspirated with unaspirated stops and voiced with voiceless stops and lacking voiced aspirates.

1.2 Laryngeal Contrast in Chhatthare Limbu: The Proposal

Chhatthare Limbu belongs to the Tibeto-Burman group of languages. A vast majority of these languages display a two-way laryngeal contrast, involving aspirated with unaspirated segments (Mortensen, 2011). Naturally one would believe that Limbu also must have a two-way contrast, but the data shows otherwise, as shown in Table 1. The language has minimal pairs contrasting unaspirated with aspirated and voiceless with voiced sounds as presented in examples (1) and (2).

1) /p/ vs. /p^h/ contrast

/pɛn/ 'slips off' /p^hɛn/ 'comes'
/tak/ 'friend' /t^hak/ 'loom
/t͡ʃi:ma:/ 'to be cold' /t͡ʃ^{h}i:ma:/ 'to meet'
/ko:ma:/ 'to attend' /k^ho:ma:/ 'to find'

2) /p/ vs /b/ contrast

/pa:/ 'father' /ba:/ 'this'
/po:/ 'it increases' /bo:/ 'here'
/puŋ/ 'yes' /buŋ/ 'tree'

Tumbahang (2007a) presents voiced and aspirated plosives in the language as separate phonemes, indicating a three-way contrast. A two-way contrast language may use, say, [voice] or [spread glottis] feature, establishing a contrast between unvoiced and voiced, as presented in Table 2, and unaspirated and aspirated segments, as presented in Table 3, respectively.

Table 2: Laryngeal contrast in two-way voicing contrast languages

feature	[ ]	[voice]
[ ]	Voiceless (T)	Voiced (D)

Table 3:Laryngeal contrast in two-way aspiration contrast languages

feature	[ ]
[ ]	Voiceless (T)
[spread glottis]	Aspirated (TH)

The two-way contrasting languages completely exhaust the possibilities of using a feature for segmental contrast: there cannot be another segment to be contrasted using the same feature as long as the features are binary or privative (non-scalar). Now, let's consider the feature specification in a three-way laryngeal contrast system as in Chhatthare Limbu. The three-way contrastive language uses aspiration and voicing features to establish the laryngeal contrast, as these are the common features of pulmonic languages. The resulting matrix is given in the table.

Table 4: Laryngeal contrast in three-way contrast languages such as Chhatthare Limbu

feature	[]	[voice]
[]	Voiceless (T)	Voiced (D)
[s g]	Aspirated (TH)	--

The language could potentially contrast another segment in the language where it combines the voicing and aspiration features to yield voiced aspirated (vcd asp) segments. In fact, there are many languages that do so, and most of them belong to the Indo-Aryan language group. The featural specification of the laryngeal contrast in Hindi (Indo-Aryan) for example, is given in Table 5.

Table 5: Exhaustive four-way laryngeal in Hindi

feature	[]	[voice]
[ ]	Voiceless (T)	Voiced (D)
[s g]	Aspirated (TH)	Vcd asp (DH)

While the two and four-way systems fully utilise the feature permutations for segmental contrast, the three-way system does not, leading to a non-parsimonious contrast system. In addition to the theoretical scrutiny, this position has also been questioned on the empirical front. There are only a handful of languages that use this type of three-way laryngeal contrast, and this characterisation also is largely influenced by the phonetic implementation of these sounds. Researchers have argued that these languages pose an overspecification problem in phonological theory where the features are not fully utilised by the laryngeal system (see Helgason and Ringen, 2008 and Beckman et al., 2011 for a similar account on Swedish). Apart from the theoretical motivation, it is generally seen that languages that do not have voicing contrast, induce voicing in the intervocalic voiceless stops. The voiced segment words initially are limited and medially they are just allophones of the voiceless bilabial plosive.

3) Intervocalic voicing

/he:ku:/ 'he started' [he:gu:] 'he cut it'
/la:ku:/'he tread on it' [la:gu:] 'he licked it'
/paŋ/ 'house' [ku:baŋ] 'his house
/p^{h}endi:/ 'ax' [ku:b^{h}endi:] 'his axe'

Tumbahang (2007b)

There are further context specific restrictions on how the laryngeally specified segments can occur in this language. Word initially all three segments can occur, word medially only voiced and voiceless stops can occur, and word finally only voiceless unaspirated stops can occur. It is easy to notice that the language is avoiding laryngeally specified segments towards the right edge of the word. The laryngeal specification has distributional restrictions as we move to the right edge of the word.

Table 6: Plosive distribution in Chhatthare Limbu

Contrast	Initial	Medial	Final
T	pakma 'dig out'		ha:p 'He weeps'
D	ba 'this'	la:bu 'he burned it'	
TH	p^{h}akma'fold'		
DH		ku:b^{h}endi:'his axe'	

Further looking into this data reveals a finer grained voicing pattern: the voicing is induced intervocalically only in the stems. The words which are monomorphemic retain their voicing. These patterns are summarised below.

- Restriction on the occurrence of laryngeal specification in codas: There is no plosive in coda other than the voiceless (T) type.
- Stem undergoes voicing allophony:

4) Word medial voicing allophony after prefixes ending with nasals and vowels

a. [paŋ] 'house' [ku: + paŋ]
→[ku:baŋ] 'his house'
b. [p^{h}endi:] 'ax' [ku: + p^{h}endi:]
→[ku:b^{h}endi:] 'his axe'

Tumbahang (2012)

5) No medial voicing in mono-morphemic words: ɛk^{h}an 'not'

6) Medial voicing when a suffix starting with vowel is added:

la:k + u →[la:gu] 'he licked it.'

Tumbahang (2007b)

Based on the data above and the feature specification given in Table 4, we propose the following feature specification in Chhatthare Limbu.

Table 7: Feature contrast in Chhatthare Limbu

Initial	Feature	[Ø]	[voice]
	[Ø]	T	D
	[spread glottis]	TH	--
Medial	Feature	[Ø]	[voice]
	[Ø]	T	--
	[spread glottis]	TH	--
Final	Feature	[Ø]	NA
	[Ø]	T	--
	NA	--	--

We propose that word initially, all three specifications are available; word medially, only voiceless and aspiration contrast is available; and word finally no contrast is available. The word

medial voicelessness (with or without aspiration) undergoes voicing alteration when a morpheme is added. In order to analyse these processes, we resort to two theoretical conceptions: Coda condition and Faithfulness.

7) **Coda condition where laryngeal specifications are dispreferred (Steriade, 1982 and Ito and Mester, 1994)**

   a. Laryngeal specifications in onsets are preserved.

   b. Laryngeal specifications in codas are not preserved.

8) **Root/stem faithfulness for the allophonic environment (McCarthy and Prince 1993, 1995)**

   Root has higher faithfulness than the stem.

What are the output restrictions that conspire such phonological patterning? In the next section, we will revisit some phonological concepts and theoretical tools which we will be using in analysing this distribution in the language.

2. THEORETICAL TOOLS

Modern phonology has progressed much since the cognitive revolution. Rule based phonology dominated the early modern phonological formalism but slowly it was overtaken by models that offered better typological and acquisitional predictions. The most recent theoretical development in generative phonology is Optimality Theory (Prince and Smolensky, 2004; McCarthy and Prince, 1993) which is a constraint based phonological framework. We will formalise the laryngeal data from Chhatthare Limbu using this theoretical framework.

2.1 Laryngeal Markedness (context free and context sensitive)

Most of the natural phonological analyses provide substance-based markedness explanations. This includes markedness rooted in the articulatory-perceptual limitations. Besides substance-full markedness, we have formal markedness. The featural specifications are formally "marked" entities. A segment will be more marked compared to the other one if it has lesser specifications. Both these kinds of markedness interact in explaining laryngeal markedness and its effects. Further, there are context free and context sensitive markedness. Context free markedness operates purely on the weightage of the marked entity whereas context sensitive markedness operates on a marked entity only in certain positions. For example, a language not allowing voicing to emerge at all is an instance of context free markedness whereas a language allowing voicing only in the word initial context is an instance of context sensitive markedness.

We argue that the voicing and aspiration contrasts are context sensitive. The voicing is induced word medially and the aspiration and voicing are neutralised towards the right edge of the prosodic word. A cumulative analysis of such intricate interactions is possible in a constraint-based system such as Optimality Theory (OT). OT is one of the latest phonological frameworks that incorporate both the markedness and faithfulness factors in the form of "constraints". In the next section, we elaborate on what constraints are active in Chhatthare Limbu and discuss how they can be used to characterise and understand the laryngeal phonology of the language.

2.2 Phonological Constraints

There are two major types of constraints used in OT, namely faithfulness and markedness constraints. While the markedness constraints enforce simplified outputs, the faithfulness constraints enforce similarity in the input and the output forms. For the analysis of the laryngeal phonology of Chhatthare Limbu we will invoke both the faithfulness and markedness constraints.

Tumbahang (2007b) shows that Chhatthare Limbu's laryngeal contrast is not uniform across prosodic positions in the language. Specifically, the aspiration is neutralised word medially and finally and voiceless stops are voiced at stem edges, as shown in (4). We find this laryngeal pattern in languages across the world, especially in Tibeto-Burman languages. Meiteilon for example exhibits the aspiration contrast only word initially and induces voicing word medially at the morpheme edges (Ashem, 2018). The laryngeal specification of Meiteilon stops is the same as Chhatthare Limbu.

Table 8: Meiteilon's two-way laryngeal contrast system

Initial	Feature	[Ø]	[voice]
	[Ø]	T	D
	[spread glottis]	TH	--
Medial	Feature	[Ø]	[voice]
	[Ø]	T	--
	[spread glottis]	TH	--
Final	Feature	[Ø]	NA
	[Ø]	T	--
	NA	--	--

Based on these specification assumptions and the phonological effects seen in the language, we invoke the following phonological constraints. We can have two sets of opposing constraints: *[VC] and *[SG] which incur one violation for each occurrence of aspiration in the output, and IDENT[VOICE] and IDENT[SG] which incur one violation for each [voice] and [spread glottis] specification respectively that is there in the input but not in the output. Further, the constraint AGREE[VC] should induce voicing in intervocalic segments. This will violate the IDENT[STEM] which seeks to enforce identity between the output and the input. However, since only the stems are undergoing voicing, the roots must be getting preserved by a structure preserving constraint such as IDENT[ROOT].

(i) Availability of aspiration contrast:
   a. IDENT[SG]: input [spread glottis] must be preserved in the output
   b. *[SG]: output must not have [spread glottis] specification

(ii) Availability of voicing contrast:
   a. IDENT[SG]: input [voice] must be preserved in the output
   b. *[VC]: output must not have [voice] specification

(iii) Morpheme edge voicing:
   a. AGREE[VC]: following segment must agree in voicing with the preceding segment in the output

(iv) Morphological faithfulness:
   a. IDENT[ROOT]: input root must be identical in the output
   b. IDENT[STEM]: input stem must be identical in the output

(v) Dispreference of laryngeal specifications:
   a. *CODA[LAR]: output codas must not have [voice] or [spread glottis] specification

3. ANALYSIS

This section provides an optimality theoretic analysis of the phonological effects we see in Chhatthare Limbu.

3.1. Chhatthare Limbu's laryngeal grammar

The aspiration contrast is available in this grammar, however, with a limited distribution. We see the following distribution for the laryngeally specified segments in the language. The voiceless segments are available in all the prosodic positions whereas the aspirates segments are available only in the word initial position. This naturally follows when we assume a privative feature perspective that the aspirated segments are specified with [spread glottis] whereas the unaspirated segments are unspecified for this feature. The emergence of the [spread glottis] feature then is restricted to occur only in the onset initial and medial positions. That means, the context free occurrence of the feature is mitigated by the context sensitive constraints. The context free occurrence of the feature is captured by the tables below. The IDENT constraints dominate the relevant markedness constraints which preserve the laryngeal specifications in the optimal output.

9) Occurrence of aspiration

p^hɛn	IDENT[SG]	*[SG]
☞p^hɛn		*
pɛn	*!	

10) Occurrence of voicing

Buŋ	IDENT[VC]	*[VC]
☞buŋ		*
Puŋ	*!	

The grammar predicts that the Chhatthare Limbu will allow both the aspiration and the voicing contrast as the respective markedness constraints *[SG] and *[VC] that block voicing and aspiration are dominated by the faithfulness constraints IDENT[VC] and IDENT[SG] that preserve these contrasts.

We see context specific restrictions on the occurrence of these contrasts in the language. Aspiration and voicing are blocked word finally. As suggested before, the positional constraint *CODA[LAR] blocks any laryngeal specification in the coda position.The language does not show laryngeal specification word finally. Since there is no actual word in the language which has the laryngeal specification neutralised, we will use a dummy input.

11) Aspiration blocking in word-final position

$p^hɛp^h$	*CODA[LAR]	IDENT[SG]	*[SG]
$p^hɛp^h$	*!		*
☞$p^hɛp$		*	
$pɛp^h$	*!	*	
pɛp		**!	

12) Aspiration blocking in word-final position

bɛb	*CODA[LAR]	IDENT[vc]	*[VC]
bɛb	*!		**
☞bɛp		*	
pɛb	*!	*	
pɛp		**!	

13) Integrating IDENT constraints within the ranking

t^hub	*CODA [LAR]	IDENT [VC]	IDENT [SG]	*[VC]	*[SG]
t^hub	*!			*	*
☞t^hup		*			*
tup		*	*!		

However, unlike the inhibition of voicing word finally, the voicing is induced at the word boundary in derived environments. When root attaches with the affix, the root undergoes a progressive and regressive voicing allophony. Table below shows how the voicing is induced to the root of it is followed by an affix.

14) Progressive voicing assimilation in derived words

ku: + paŋ	AGREE [VC]	IDENT [STEM]	IDENT [VC]	*[VC]
ku:paŋ	*!			
ku:baŋ		*	*	*

15) Regressive voicing assimilation in derived words

la:k + u	AGREE [VC]	IDENT [STEM]	IDENT [VC]	*[VC]
la:ku	*!			
☞la:gu		*	*	*

However, the intervocalic voicing does not occur in underived roots. The voicing is blocked intervocalically in underived environments. The root faithfulness constraint IDENT[ROOT] must be invoked to block the intervocalic voicing in underived roots. These roots are different from the ones in the derived words since those roots became stems. Hence, the constraint IDENT[ROOT] is active in underived words and the constraint IDENT[STEM] is active in derived words.

16) No Voice Assimilation

$ɛk^han$	*CODA [LAR]	IDENT [ROOT]	AGREE [VC]	IDENT [STEM]	IDENT [VC]	IDENT [SG]	*[SG]	*[VC]
☞$ɛk^han$			*					
$ɛg^han$		*!			*			*
ɛkan		*!				*		

The constraint IDENT[ROOT] must dominate the markedness reducing constraint AGREE[VC] in order to block the intervocalic voicing. Thus, the final constraint ranking for the laryngeal phonology of Chhatthare Limbu appears to be the following.

17) Constraint ranking

*CODA[LAR] >> IDENT[ROOT] >> AGREE[VC] >> IDENT[STEM] >>IDENT[VC], IDENT[SG] >> *[SG], *[VC]

4. DISCUSSION

Although several researchers have worked on Chhatthare Limbu, an analysis of the data through a

theoretical lens is needed. This paper is an attempt at contributing to this gap in the literature. The optimality theoretic analysis provides a prediction for the (un)attested forms in the language as well as the typology for related languages and puts the analysis into the larger picture instead of providing a language specific analysis. Hence, it emerges to be a superior analysis over the rule-based analysis as the rule-based analysis is weaker at typological predictions and at defining explanatory adequacy. OT on the other hand can provide linguists with a tool for predicting the kinds of languages they can find in the real world. The context free laryngeal contrasts in the language and the context specific limitations on their distribution falls out as a natural consequence of the ranked constraints.

The analysis given for the laryngeal phonology of Chhatthare Limbu in this paper is by no means exhaustive. The dearth of phonetic data makes the phonological predictions harder to be verified. For example, there are distributional disparities between the voiced and aspirated sounds in the language. We know that the voiced segments in Chhatthare Limbu are limited in number as opposed to the voiceless unaspirated and aspirated sounds. Do voicing and aspiration have different status on the phonology of the language? Controlled experiments will find that in language games, the aspiration will be more productive than the non-native elements. Further, the word initial voicing is with the labial sounds only. It could be happening because the labial place supports the aerodynamic settings to sustain the voicing. But, the labials do not undergo voicing in the derived environment when preceded by the vowel inflection: /ha:p+u/→*[ha:bu] 'he weeps for him'. Even though they undergo the process when followed by the similar prefix: /paŋ/ 'house' [ku: + paŋ]→[ku:baŋ]'his house', it is unclear why this exception exists. The explanation that the labials are better at sustaining voicing should not rule out *[ha:bu] and generate [ku:baŋ]. The ranking given in (16) will not generate ha:p+u correctly as ha:pu since it will enforce intervocalic voicing in stems. A morphologically conditioned constraint may handle the data but it will be hard to justify on the theoretical ground.

This work invites some future research: most importantly, an in-depth study of the laryngeal articulation by native Chhatthare Limbu speakers. This would reveal what the active gestures are in the language which in turn will help us hypothesise the laryngeal contrast in the language more concretely. Further, a perception test that checks for the identification, recognition, and grammaticality judgment of an individual or pair of sounds, would reveal which of the sounds are more readily available in the minds of the native speakers, which in turn will shed a brighter light on the status of the voicing contrast in the language.

5. CONCLUSION

In this paper, a new light is thrown on the laryngeal grammar of Chhatthare Limbu. Taking clues from the existing data, we discussed that the three-way laryngeal contrast of the language could in fact be a two-way laryngeal system with aspiration dimension as the opposition. We further discussed the phonological effects in the language pertaining to the laryngeal restrictions. Future research that targets the articulatory and acoustic correlates and the native speakers' perceptual acquisition of these sounds will shed a brighter light on the laryngeal grammar of Chhatthare Limbu.

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