ONSET-CODA ASYMMETRIES IN MISHMI AND OTHER SOUTHEAST ASIAN LANGUAGES

Seok-Chae Rhee
University of Illinois at Urbana-Champaign

1. Introduction

The purpose of this study is to provide a formal analysis of the onset-coda asymmetry found in Mishmi and many other Southeast Asian languages. The onset-coda asymmetry refers to different distributions of consonants in the syllable onset and coda positions. As is well-known, it is often found in many languages that only a subset of the consonant inventory appears in the coda of a given language, whereas in the onset position the distribution of consonants is relatively free. Coda neutralization also reduces possible consonant types that can appear in the surface coda. According to my investigation, Mishmi and many Southeast Asian languages show a remarkably similar onset-coda asymmetry. For an account of this, I propose an aperture node-based coda constraint, and show that high ranking of the proposed constraint covers the overall pattern of the observed onset-coda asymmetry.

2. Mishmi

Mishmi is one of the languages spoken in Arunachal Pradesh, the North East tip of India. It belongs to the Tibeto-Burman family of languages. According to Sastry (1984a, b), it has three principal dialects: Idu, Digaru, and Miju. Data on Mishmi in this paper are exclusively based on Sastry's fieldwork, which was conducted in 1975 and 1976 on the Digaru dialect. He mentioned that his work was cross-checked with different dialects of Mishmi.

Table (1) shows the consonant inventory of Mishmi. Mishmi has stops, affricates, fricatives, nasals, a lateral, and a trill. Aspirated stops (i.e., ph, th, kh) and aspirated affricate (ch) are analyzed as clusters in Sastry, thus, omitted from the inventory. (Without any investigation, I just follow him, since it is not critical to my analysis whether an aspirated consonant is a cluster or a singleton consonant.)

(1) Mishmi consonant inventory

Stop:						
voiceless	p	t			k	
voiced	b	d			g	
Affricate						
voiceless		c				
voiced		j				
Fricative:						
voiceless			s			h
voiced			z			
Nasal	m		n		ŋ	
Lateral			l			
Trill				r		

There are four types of syllables in Mishmi: V, C_XV, VC, and C_XVC.

(2) Mishmi syllable types

a. Nucleus type (V) /e/ 'this', /o/ 'to shoot'
b. Onset-Nucleus (C_XV) /gu/ 'ash', /pla/ 'salt'
c. Nucleus-Coda (VC) /aŋ/ 'house', /ɨm/ 'feather'
d. Onset-Nucleus-Coda (C_XVC) /sag/ 'nest', '/kwag/ 'dog'

The subscript X in the onset indicates that consonant clusters can occur in that position. Trill, lateral, glottal fricative, and glides can be a second member of the clusters as seen in (3a) and (3b). Hence, aspirated stops, palatalized, and labialized consonants can occur in the onset. However, consonant clusters do not occur in the coda position (3c). This is the first onset-coda asymmetry.

(3) a. /r, l, h/ can be a part of consonant cluster in the onset
($_\sigma$[pr-, tr-, kr-, pl-, kl-, bl- gl-, ml-, ph-, th-, kh-, ch-, ...)
b. /y, w/ can be a part of consonant cluster in the onset.
($_\sigma$[py-, ty-, ky-, cy-, my-, ny-, sy-, kw-, gw-, rw-, yw-, ...)
c. Consonant clusters never occur in the coda
(*-pr, *-tr, *-kr, *-pl, *-ph, *-kw, *-sy, ...]$_\sigma$)

The distribution of singleton consonants also illustrates an onset-coda asymmetry. That is to say, possible singleton consonants that can appear in the coda position are strictly limited: only bilabial and dorsal voiceless oral stops /p, k/ and nasal stops /m, n, ŋ/ can occur in the surface coda positions. Fricatives, affricates, trill and lateral occur only in the onset, but not in the coda (Sastry 1984a: 58).[1]

(4) a. non-occurrence of fricatives and affricates in the coda
*-s, *-z, *-h, *-c, *-j $]_\sigma$
(They occur only in the onset: *su.wa* 'cap', *zap* 'red', *hu.lu* 'baboon', *ca.ba* 'clam', *ju.wa* 'cold', ...)

b. non-occurrence of trill and lateral in the coda
*-r, *-l $]_\sigma$
(They occur only in the onset: *rap* 'horn', *ro* 'siege', *pa.ro* 'pigeon', *lɨm* 'fruittone', *a.lo* 'garlic', ...)

c. nasals are allowed in the coda as well as in the onset
-m, -n, -ŋ$]_\sigma$
(*mi.ya* 'wife', *tɨm* 'sky', *no.sa* 'picture', *phun.du* 'brinjal' *niŋ* 'we', *ta.ŋa* 'fish', ...)

Another noteworthy property is that final stops are always strictly unreleased in Mishmi. According to Sastry, non-release of final stops goes together with devoicing of underlying voiced stops. Due to devoicing and non-release, voiced stops and voiceless stops are neutralized into voiceless unreleased stops in the coda position. Consequently, voiced stops are not allowed in the surface coda. For example, as seen in the data set (5), final /p/ in /mabap/ 'fox' and final /b/ in /macab/ 'cow' are pronounced as same unreleased voiceless stop [p˺]. Likewise, final /k/ in /dayk/ 'language' and final /g/ in /kwag/ 'dog' are neutralized as voiceless unreleased stop [k˺].[2]

(5) Non-release & Devoicing

/dyap/	[dyap˺]	'greengram'
/mabap/	[ma.bap˺]	'fox'
/kab/	[kap˺]	'bulbul'
/macab/	[ma.cap˺]	'cow'
/tabab/	[ta.bap˺]	'snake'
/glebab/	[gle.bap˺]	'duck'
/dayk/	[dayk˺]	'language'
/pareyk/	[pa.reyk˺]	'frog'

/sag/	[sak˺]	'nest'
/hagrayg/	[ha.grayk˺]	'flying-squirrel'
/kwag/	[kwak˺]	'dog'
/kacyig/	[ka.cyik˺]	'rat'

Non-release of final stops of Mishmi could be compared with that of English. In English, as is well-known, it is basically optional whether a final stop is released or unreleased.[3] So that, a final stop in an English word like 'cat', for example, could be released like [k^hæt^L] or unreleased like [k^hæt˺]. However, in other languages like French and Arabic, final stops are always released. According to Tranel (1987), a final /k/, for example, in a French word like [sak] 'bag' is always released. Thus, French is opposite to Mishmi in this respect. A summary of Mishmi onset-coda asymmetry is given in (6).

(6) Summary: Mishmi onset-coda asymmetry

possible onsets: p, b, t, d, k, g, c, j, s, z, h, m, n, ŋ, l, r (and consonant clusters described above)

possible codas: p, k, m, n, ŋ

3. Similar Pattern in other Southeast Asian Languages

Interestingly, a similar onset-coda asymmetry pattern is widespread in Southeast Asian language groups. Some of them are given in (7): Thadou, Cantonese, Thai, Ao, Garo, Lotha, Bantawa, Sherpa, Zhanglu Kam are good examples. Though not presented in this paper, Tagalog and some Mon-Khmer languages could be also included in this type. Even Korean, which cannot be included in the purview of Southeast Asian languages, exhibits a similar pattern (Kim-Renaud 1974). Again, final stops in the coda of the given languages are all unreleased.

(7) Onset-Coda Asymmetries in other languages

· Thadou (Krishan 1980)

Onsets: p, t, k, p^h, t^h, b, d, g, c, v, s, z, x, h, m, n, ŋ, $m^ʔ$, $n^ʔ$, $ŋ^ʔ$, l

Codas: p, t, m, n, ŋ, $m^ʔ$, $n^ʔ$, $ŋ^ʔ$, l

· Cantonese (Kao 1971)

Onsets: p, t, k, p^h, t^h, k^h, c, c^h, f, s, h, m, n, ŋ, l

Codas: p, t, k, m, n, ŋ

- Thai (Bennett 1993)
  - Onsets: p, t, k, p^h, t^h, k^h, b, d, c, c^h, f, s, h, m, n, ŋ, l, r
  - Codas: p, t, k, m, n, ŋ

- Ao (Marrison 1967, as presented in Namkung 1996)
  - Onsets: p, t, k, b, d, g, c, j, s, z, ʃ, m, n, ŋ, l, r
  - Codas: p, t, k, m, n, ŋ, r

- Garo (Burling 1961)
  - Onsets: p, t, k, b, d, g, c, j, s, h, m, n, ŋ, r, l, w
  - Codas: p, t, k, m, n, ŋ, r, l

- Lotha (Marrison 1967, as presented in Namkung 1996)
  - Onsets: p, t, k, p^h, t^h, k^h, c, c^h, pf, s, z, f, v, m, n, mh, nh, ŋh, l, r, lh, rh
  - Codas: p, t, k, m, n, ŋ

- Bantawa (Rai 1985, as presented in Namkung 1996)
  - Onsets: p, t, T, k, p^h, t^h, T^h, k^h, b, d, D, g, b^h, d^h, D^h, g^h, c, j, c^h, s, m, n, ŋ, l, r (t is dental; T is alveolar)
  - Codas: p, T, k, m, n, ŋ

- Sherpa (Gordon & Schoettelndreyer, n.d.)
  - Onsets: p, t, t, k, b, d, d, g, c, c, j, j, s, s, h, m, n, ŋ
  - Codas: p, t, k, m, n, ŋ, r, l

- Zhanglu Kam (Guoqiao & Quan 1988)
  - Onsets, p, t, T, k, p^h, t^h, T^h, k^h, l, h, s, C, m, n, N, ŋ
  - Codas: p, t, k, m, n, ŋ (T is palatoalveolar)

Detailed differences put aside, common properties found in the given languages are as follows: First, aspirated stops and voiced stops do not occur in the coda. Second, fricatives and affricates do not occur in the coda. Third, nasal stops can freely occur in the coda. Fourth, coda stops are not released. Keeping in mind these common properties of Mishmi-type languages, we will now look at a pattern that sharply contrasts with Mishmi.

4. Contrastive Pattern

In Hindi-type languages (i.e., other Indo-Aryan languages spoken in India), the observed onset-coda asymmetry is not found. That is to say, i) aspirated stops and voiced stops can occur in the coda, and ii) affricates and fricatives too can occur in the coda as well as in the onset positions. Another different characteristic is that final stops are released in Hindi (Hussain & Nair 1995). In this language, there is no coda neutralization.

(8) Hindi

sa:t	[sa:t$^{\llcorner}$],	*[sa:t$^{\urcorner}$]	'seven'
sa:t^{h}	[sa:t^{h}],	*[sa:t$^{\urcorner}$]	'with'
su:d	[su:d$^{\llcorner}$],	*[su:d$^{\urcorner}$]	'interest'
sa:d^{h}	[sa:d^{h}],	*[sa:d$^{\urcorner}$]	'desire'
sac	[sac]		'truth'
pu:c^{h}	[pu:c^{h}]		'tail'
mo:j	[mo:j]		'comfort'
bo:j^{h}	[bo:j^{h}]		'burden'
pa:s	[pa:s]		'near'

Postponing a comparative analysis of Mishmi and Hindi to a later section of this paper, I will first investigate how a constraint can be formally expressed to account for the onset-coda asymmetry observed in Mishmi. In the next section, theoretical assumptions are introduced.

5. Theoretical Assumptions

5.1. Aperture nodes (Steriade 1992, 1993, 1994)

In this paper, I assume that the release portion of a stop is represented as one 'temporal unit' in the phonological representation. This view was introduced by Steriade (1992, 1993, 1994), and it is different from the previous treatment of release/non-release in the sense that it no longer depends on the [±release] featural specification. Under Steriade's theory, a released stop is represented as a sequence of A_o and A_m as shown in (9a). On the contrary, an unreleased stop is represented as A_o without A_m as in (9b). In this vein, a fricative is represented as having an A_f, and an affricate is represented as a sequence of A_o and A_f as seen in (10a) and (10b).[4] Under the given aperture geometry, feature [asp] (= [aspiration]) is aligned with release A_m for an aspirated stop. However, the feature [vce]

(= [voice]) of a stop is aligned with A_o, since a voice bar is seen during the closure duration of a stop.

(9) a. released stop b. unreleased stop

t°	$t^{\urcorner}$
A_oA_m	A_o

(10) a. fricative b. affricate

s	c
A_f	A_oA_f

(11) a. aspirated stop b. voiced stop

t^h	d
A_oA_m	A_oA_m
|	|
[asp]	[vce]

Unlike Steriade, however, it is assumed in this paper that the release portion of a stop (= A_m) is present in the underlying phonological structure of every stop. This is a view that the release itself is indispensable in constituting a stop sound, and will be a crucial step in accounting for the asymmetry.

5.2. Optimality Theory (= OT)

The theoretical base of this paper is OT/Correspondence Theory as proposed by Prince & Smolensky (1993) and McCarthy & Prince (1995). The basic formal device in OT is constraints, not rules. Different rankings from a set of constraints bring about cross-linguistic or dialectal variations. In this theory, a function GEN maps the input to a set of candidate outputs, and a function H-EVAL determines the optimal output from a set of candidates through constraint ranking. This is visualized in a constraint tableau. In a given hypothetical tableau (12a), where $candidate_1$ violates (marked as *) constraint B and $candidate_2$ violates constraint A, $candidate_1$ is selected (marked with ☞) when constraint A outranks constraint B (A >> B). If, however, constraint B outranks constraint A (B >> A), $candidate_2$ is selected (12b).

(12) a. Constraint A >> Constraint B

Candidates	Constraint A	Constraint B
☞ $candidate_1$		*
$candidate_2$	*	

b. Constraint B >> Constraint A

Candidates	Constraint B	Constraint A
$candidate_1$	*	
☞ $candidate_2$		*

6. Analysis

A faithfulness constraint needed in the OT analysis of the observed onset-coda asymmetry is IDENT(Apr) given in (13). This constraint is a member of the IDENT(α) family where an argument α is an aperture node. IDENT(Apr) requires identical aperture nodes between input and output. Thus, mapping from /s/ to unreleased [t˺], for instance, violates IDENT(Apr), since aperture node A_f in the input /s/ becomes aperture node A_o in the output [t˺]. Moreover, under the given assumption that stops are represented as A_oA_m in the input, mapping from aperture node A_oA_m to aperture node A_o also violates IDENT(Apr).

(13) IDENT(Apr)

Let α be a segment in the input and β be any output correspondent of α.
"If α has γ aperture node, then β has γ aperture node."

A structural well-formedness constraint that militates against IDENT(Apr) is $CODA_o$ given in (14), which is critical in my analysis of the Mishmi-type onset-coda asymmetry.

(14) $CODA_o$

A coda ends with A_o.

I claim that inviolability of $CODA_o$ in the grammar of Mishmi-type languages can cover the overall pattern of the observed onset-coda asymmetry. That is, inviolability of $CODA_o$ can explain, i) why stops are unreleased, and ii) why fricatives, affricates, aspirated stops, and consonant clusters are not allowed in the coda position. Note that, among the aperture configurations given in (15), only (15a) satisfies the CODA$_o$. Since the codas do not end with A_o from (15b) through (15e), they cannot occur in the syllable final position of Mishmi-type languages, where CODA$_o$ is required to be strictly obeyed.[5]

(15) Satisfaction of CODA$_o$

a) $-p^{\urcorner}]_\sigma$
A_o Yes (since coda ends with A_o)

b) $*\ -p^{\llcorner}]_\sigma$
A_oA_m No (since coda ends with A_m)

c) $*\ -p^{h}]_\sigma$
A_oA_m
|
[asp] No (since coda ends with A_m)

d) $*\ -s]_\sigma$
A_f No (since coda ends with A_f)

e) $*\ -c]_\sigma$
A_oA_f No (since coda ends with A_f)

Note, however, that (15a) violates IDENT(Apr), since the input A_oA_m aperture node for a stop, which is assumed in this paper, is not preserved in (15a).

In short, a constraint ranking whereby CODA$_o$ outranks IDENT(Apr) accounts for why released stops (whether aspirated or not), fricatives, and affricates do not occur in the coda position. A tableau in (16) demonstrates that a candidate where a stop ends with an unreleased stop is selected due to the constraint hierarchy CODA$_o$ >> IDENT(Apr).

(16) CODA$_o$ >> IDENT(Apr)

input: /z a p/ 'red' A_oA_m	CODA$_o$	IDENT(Apr)
a. ☞ z a $p^{\urcorner}$ A_o		*
b. z a $p^{\llcorner}$ A_oA_m	*!	

Non-occurrence of trill and lateral, glides and consonant clusters given in (3c) such as *-Cr, *-Cl, *-Ch, *-Cw and *-Cy in the coda is accounted for in the same way. It is because they do not end with A_o.[6] From this point of view, the reason why nasal stops can freely occur in the coda of Mishmi-type languages is that nasal stops end with A_o, satisfying CODA$_o$. Perhaps, the sonority sequencing constraint could account for the non-occurrence of the given clusters in the coda, however, it does not explain the other aspects of onset-coda asymmetry.[7] In most of the Southeast Asian languages where no evidence of phonological alternation is found in the coda, it could be said that CODA$_o$ functions as a morpheme structure constraint.

Now, one remaining question is why final voiced stops in Mishmi become voiceless (e.g., /sag/ [sak˺] 'nest'). At a first glance, this neutralization doesn't seem to be correlated with release or non-release, since [vce] is not associated with A_m. However, I claim that realization of [vce] of a stop is also closely connected to stop release.

According to Parker (1981a, b), there are stages leading to final devoicing in various languages. His claim is that loss of schwa causes a voiced stop to be unreleased (e.g. CVdə → CVd˺), and that the final voiced stop is devoiced in that acoustically unstable environment (CVd˺ → CVt˺). Even though it is not clear why loss of schwa causes the final stop to be unreleased, the crux of his idea is that devoicing is directly related to the loss of stop release. Voicing and release of a stop is also related from an aerodynamic point of view: Ohala's (1983) aerodynamic theory of voicing predicts that voicing is hard to maintain when supraglottal and subglottal air pressure become equal due to a blockage of airstream in the supraglottal region. In such case, release of the blocked airstream can be regarded as an active articulatory gesture that enables air pressure to be differentiated between the subglottal and supraglottal cavities, which makes vocal cords vibrate more easily.

Considering this, I claim that [vce] of a stop is licensed by release of a stop. The idea is expressed as a constraint STOPVOICE given in (17). In short, stop release is a voice-licenser in my view.

(17) STOPVOICE

[vce] of a stop is licensed by an immediately following A_m.

An unlicensed feature does not survive on the surface. Therefore, it is predicted that, if STOPVOICE is undominated, an underlying voiced stop loses its input [vce] feature in an unreleased position. In this paper, I assert that STOPVOICE is universally undominated. Then, non-occurrence of [vce] in the coda stop is explained in the light of both STOPVOICE and $CODA_o$. That is, neutralization of final voiced stops into voiceless in Mishmi is accounted for by ranking STOPVOICE inviolable along with $CODA_o$, which is also proposed to be inviolable in Mishmi. The scenario is given in tableau (18).

(18) Devoicing in Mishmi (/sag/ 'nest' → [sak˺])

input: / .....g / A_oA_m | [vce]	STOP VOICE	$CODA_o$	IDENT ([vce])	IDENT (Apr)
a. .....$g^{\llcorner}]_\sigma$ A_oA_m | [vce]		*!		
b. .....$g^{\urcorner}]_\sigma$ A_o | [vce]	*!			*
c. ☞.....$k^{\urcorner}]_\sigma$ A_o			*	*
d. .....$k^{\llcorner}]_\sigma$ A_oA_m		*!	*	

Since $CODA_o$ is inviolable in Mishmi, a stop cannot bear release A_m in the coda. Consequently, [vce] of a final stop, which needs an immediately following release for its realization, fails to survive on the surface due to a lack of its licenser. Even though candidate (18a) is faithful to the input in that it retains [vce], it critically violates $CODA_o$. Therefore, in a language like Mishmi where non-release of the final stop is strictly required, it is immediately filtered out. Candidate (18b) is not released. Nevertheless,

[vce] cannot occur in that environment, since it does not have release A_m functioning as [vce]-licenser. Consequently, it is out due to a critical violation of STOPVOICE. The candidate (18c), which is voiceless and unreleased, satisfies both $CODA_o$ and STOPVOICE that filter out other candidates, and is thus selected as the optimal output (STOPVOICE is vacuously satisfied in (18c) and (18d)). In this case, low-ranked IDENT([vce]) is violated. Candidate (18d) is out due to a violation of $CODA_o$.

Lastly, allow me to give a brief sketch on why the onset-coda asymmetry observed in Mishmi-type languages does not occur in Hindi. This is basically because IDENT(Apr) dominates $CODA_o$ in Hindi, a reversed situation contrasted to Mishmi. It can be said that $CODA_o$ is very low-ranked or inert in the constraint hierarchy of Hindi. Since the release A_m of a coda stop is maintained in the output due to high ranking of IDENT(Apr), a feature [asp], for example, dominated by A_m can also be maintained, allowing aspirated stops in the coda position. Tableau (19) demonstrates this: Since candidate (19b) violates IDENT(Apr) in that the input and output aperture nodes are not identical, it is immediately filtered out under the given hierarchy. Hence, candidate (19a) satisfying IDENT(Apr) is selected.[8] The given constraint ranking predicts that final stops are released whether they are aspirated or not. Also, fricatives and affricates are allowed in the coda of Hindi, since $CODA_o$ does not play an active role and since a constraint banning a deviation of an input aperture node ranks high in that language.

(19) Hindi: occurrence of [asp] in coda

input: /sa: t^h/ 'with' A_oA_m | [asp]	IDENT(Apr)	$CODA_o$
a. ☞ s a: t^h A_oA_m | [asp]		*
b. s a: t˺ A_o	*!	

When STOPVOICE is undominated, dominance of IDENT(Apr) over $CODA_o$ in Hindi also predicts that [vce] can survive in the final positions of Hindi. The scenario is given in tableau (20). Note that high ranking of IDENT([vce]), which prohibits a loss of input [vce], plays a role in filtering out a candidate (20d) where a final stop is released without input [vce].

(20) Occurrence of [vce] in Hindi final stop

input: /su:d/ 'interest'	STOP VOICE	IDENT (Apr)	IDENT ([vce])	$CODA_o$
a. ☞ s u: d^{L} A_oA_m | [vce]				*
b. s u: $d^{\urcorner}$ A_o | [vce]	*!	*!		
c. s u: $t^{\urcorner}$ A_o		*!	*!	
d. s u: t^{L} A_oA_m			*!	*

When we compare tableau (20) with (18), we can see that a critical difference between them is a ranking between IDENT(Apr) and $CODA_o$. In (18), which is for Mishmi, $CODA_o$ outranks IDENT(Apr). On the contrary, in (20), which is for Hindi, IDENT(Apr) outranks $CODA_o$. These different rankings lead to occurrence or non-occurrence of final voiced stops in each language when a constraint STOPVOICE is undominated.

7. Conclusion

My conclusion is that an 'aperture node'-based coda constraint, which is expressed as $CODA_o$ in this paper, is needed in a proper treatment of the onset-coda asymmetries in Mishmi-type languages. Inviolability of $CODA_o$ directly accounts for non-release of the final stops and non-occurrence of fricatives and affricates in the coda position. Moreover, it is claimed that devoicing of the underlying voiced stop in the coda is also closely related to the non-release.

Notes

[1]Occurrence of /l/ in word final position is noticed in a borrow item (Sastry 1984a: 58).

[2]Throughout this paper, tone markers for Mishmi are deleted. Moreover, an apostrophe mark used for non-release in Sastry (1984b) is replaced with IPA non-release marker (˺).

[3]It could be determined by environments. See Giegerich (1992).

[4]A_o: zero aperture,
A_{max}: maximal aperture (abbreviated as A_m in this paper)
A_f: degree of oral aperture sufficient to produce turbulent airstream.

[5]It is evident that Mishmi needs an additional coda constraint which prohibits [t] from occurring in the coda. However, considering other Southeast Asian languages, non-occurrence of [t] in the coda is specific to Mishmi. A constraint on the place feature is not discussed in this paper. Moreover, distribution of liquids in the given Southeast Asian languages needs more detailed elaboration for a complete coverage of onset-coda asymmetries, since some of them (i.e., Ao, Garo, Sherpa) allow liquids in the coda position.

[6]In Steriade (1992, 1993, 1994), approximants (e.g. glides) are proposed to have A_m aperture node. Though not fully discussed in Steriade, it is evident that trill and lateral do not end with A_o, since A_o stands for total absence of airflow in the oral cavity.

[7]The sonority sequencing constraint requires onsets to rise in sonority toward the nucleus and codas to fall in sonority from the nucleus (Kenstowicz 1994: 254).

[8]Though not manifested in tableau (19), the high ranking of a constraint like IDENT([asp]) forbids a loss of [asp] in the output, whereas high ranking of IDENT(Apr) forbids a loss of a site to which [asp] is linked.

References

Bennett, J. F. 1993. Aperture-based coda constraints in Thai. ms. University of Illinois, Urbana-Champaign.

Burling, R. 1961. *A Garo Grammar*. Indian Linguistics Monograph Series 2. Linguistic Society of India.

Davis, K. 1994. Stop voicing in Hindi. *Journal of Phonetics* 22, 177-193.

Giegerich, H. J. 1992. *English Phonology: An Introduction*. Cambridge: Cambridge University Press.

Gordon, K. and B. Schoettelndreyer. n.d. *Sherpa Segmental Synopsis*.

Guoqiao, Z. and Y. Quan. 1988. The Sounds of Rongjiang Kam. In Edmondson, J. and D. Solnit (eds.) *Comparative Kadai: Linguistic*

Studies Beyond Tai. Summer Institute of Linguistics: The University of Texas at Arlington.

Hussain, S. and R. Nair. 1995. Voicing and aspiration contrast in Hindi and Urdu. *CLS* 31, 205-16.

Kao, D. 1971. *Structure of the Syllable in Cantonese*. The Hague: Mouton.

Kenstowicz, M. 1994. *Phonology in Generative Grammar*. Cambridge, MA: Blackwell.

Kim-Renaud, Y-K. 1974. *Korean Consonantal Phonology*. Doctoral dissertation, University of Hawaii.

Kostic, D., A. Mitter and K.G. Rastogi. 1975. *A short Outline of Hindi Phonetics*. Calcutta: Indian Statistical Institute.

Krishan, S. 1980. *Thadou: A Grammatical Sketch*. Calcutta: Anthropological Survey of India.

Lombardi, L. 1991. *Laryngeal Features and Laryngeal Neutralization*. Doctoral dissertation, University of Massachusetts, Amherst. Published by Garland 1994.

McCarthy, J. and A. Prince. 1995. Faithfulness and Reduplicative Identity. ms., University of Massachusetts and Rutgers University.

Namkung, J. (ed.) 1996. *Phonological Inventories of Tibeto-Burman Languages*. Center for Southeast Asia Studies. University of California, Berkeley.

Ohala, J. 1983. The Origin of Sound Patterns in Vocal Tract Constraints. In MacNeilage, P. (ed.) *The Production of Speech*. New York: Springer-Verlag.

Parker, F. 1981a. Resyllabification and phonological change. *Journal of Phonetics* 9, 29-34.

______. 1981b. A Functional-Perceptual Account of Final Devoicing. *Journal of Phonetics* 9, 129-37.

Prince, A. and P. Smolensky. 1993. Optimality Theory: Constraint Interaction in Generative Grammar. ms., Rutgers University and University of Colorado.

Sastry, G. D. P. 1984a. *Mishmi Phonetic Reader*. Central Institute of Indian Languages. Phonetic Reader Series 25.

______. 1984b. *Mishmi Grammar*. Central Institute of Indian Languages.

Steriade, D. 1992. Segments, contours and clusters, ms., UCLA.

______. 1993. Closure, Release, and Nasal Contours. In Huffman, M.K. and R.A. Krakow, (eds.) *Phonetics and Phonology 5: Nasals, Nasalization, and the Velum*, 401-70. Academic Press.

Steriade, D. 1994. Complex Onsets as Single Segments: The Mazateco pattern. In Cole, J. and C. Kisseberth, (eds.) *Perspectives in Phonology*, 202-91. Stanford: CSLI.

Tranel, B. 1987. *The sounds of French: an Introduction*. Cambridge: The Cambridge University Press.