SELECTED PHONOLOGICAL RULES FOR THAILAND LISU

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In Hope 1971 certain aspects of Lisu phonology were presented to
show the impossibility of maintaining an adequately motivated unique
assignment of phones to phonemes. The present article is an attempt to
provide a partial generative description of that phonology so as to in-
dicate the generative solutions to the major problems.

The set of universal distinctive features has been variously defined
by different linguists and it is thus necessary to define the features
adopted in this paper. Such definitions are given in informal arti-
culatory terms and the name of the linguist responsible for the intro-
duction of the feature into the inventory is indicated by the following
abbreviations:

J = Jakobson, H = Halle, M = McCawley, W = Wang

1. THE DISTINCTIVE FEATURES

a. *Syllabic* (syl) (M)

This feature will distinguish true vowel segments (+) from all other
segments (-). In hundreds of morphemes the correct specification of
the segments for syllabicity will be provided by the MS rules, since
the canonical form of morphemes is highly predictable (see section 2).
The glides /y/ and /w/ are specified -syl. This treatment of these
glides (rather than one which specifies them as +syl diphthongs) enables
the MS rules to be generalised to an exceptionally high degree, and the
analysis is thus highly motivated.

b. *Consonantal* (cons) (J)

True consonants are specified +cons and /h/ /ʔ/ /y/ and /w/ as -cons.

Vowel specification for this feature will be provided by the blank-filling rules.

	vowels	*consonants*	y w h ?
syl	+	–	–
cons	0	+	–

c. *Obstruent* (obs) (H)

This feature separates the class of stops, affricates and fricatives (+) from the class of nasal and lateral resonants (–). Vowels are specified (–) by the blank-filling rules.

d. *Grave* (grv) (J)

Peripheral consonants are +grv and central consonants are –grv. With vowels +grv refers to back articulatory position and –grv to any position forward of this.

e. *High/Low* (M)

The feature high applies to both consonants and vowels, but low is redundantly specified (–) for consonants. A +high consonant is one articulated in any position between alveopalatal and velar, while a –high one is articulated in any position between alveolar and bilabial. With vowels the feature refers to the usual high and low articulatory positions.

	p ph b f v	k kh g x ɣ	t th d s z ts tsh dz	m	n	ŋ	l
cons	+	+	+	+	+	+	+
obs	+	+	+	–	–	–	–
grv	+	+	–	+	–	+	–
high	–	+	–	–	–	+	–

	i	e	æ	ɯ	u	a
cons	–	–	–	–	–	–
grv	–	–	–	+	+	+
high	+	–	–	+	–	–
low	–	–	+	–	–	+

f. *Continuant* (cont) (J) / *strident* (str) (J)

The feature cont opposes stops and affricates (–) to fricatives (+) and /h/ (+) to /ʔ/ (–).

The feature str distinguishes the affricates (+) from the stops (–) and is redundantly specified (+) for fricatives.

g. *Tense* (tns) (J)

This feature opposes aspirated to non-aspirated stops and affricates

when used with consonants, and indicates the tense:lax vowel contrast.
With tense vowels the feature specification (+) is provided by the
P-rules.

h. Voice (vce) (J)
The voiced:voiceless obstruent contrast is indicated by this feature.

i. Lateral (lat) (H) / *nasal* (nas) (J)
The lat feature distinguishes /l/ from other resonants which are
redundantly specified **+nas**.

j. Flat (flt) (J) / *sharp* (shp) (J)
With vowels +flt indicates roundedness, -flt non-roundedness. The
feature specification (+) is provided for /u/ by the blank-filling rules.
With consonants the feature +flt indicates labialisation. The feature
+shp refers to palatalisation. Only /w/ and /y/ among the -syl segments
have (+) specifications for flt and shp respectively in the underlying
specification of morphemes. Both palatalisation and labialisation are
deemed to be derived by P-rules.

k. Retracted articulation (retrac) (M)
This feature is not specified in underlying forms, but indicates the
labio-dental articulation of some forms of labialisation and the retrac-
tion of /i/ when labialised.

l. Checked (chk) (J)
This feature is specified (+) for the glottal stop by the blank-fil-
ling rules, and for glottalised vowels by the P-rules.

m. HIGH (M) / LOW / RISE (W) / FALL (W)
These are pitch features of which HIGH and LOW (a new feature to my
knowledge) are the only distinctive ones in underlying forms. RISE and
FALL specifications are provided by the P-rules.

n. The systematic phonemes
In the following charts the sequential constraints have been assumed
to have applied. Such an assumption is necessary only to illustrate the
true binary nature of the contrasts.

CONSONANTS

	k	kh	g	x	ɣ	p	ph	b	f	v	t	th	d	ts	tsh	dz	s	z	ŋ	m	n	l
syl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cons	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
obs	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
grv	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	+	+	-	0
high	+	+	+	+	+	-	-	-	-	-	0	0	0	0	0	0	0	0	+	-	0	0
cont	-	-	-	+	+	-	-	-	+	+	-	-	-	-	-	-	+	+	0	0	0	0
str	-	-	-	+	+	-	-	-	+	+	-	-	-	+	+	+	+	+	0	0	0	0
vce	-	-	+	-	+	-	-	+	-	+	-	-	+	-	-	+	-	+	0	0	0	0
tns	-	+	0	0	0	-	+	0	0	0	-	+	0	-	+	0	0	0	0	0	0	0
lat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-	+

Features redundant: low
nas
flt
shp
retrac
chk
HIGH
LOW

NON-CONSONANTS

All syllabic segments will be specified for tone, and thus, since syllables rather than segments are distinguished by tone, the pitch features are not given as distinctive features of vowels in the following chart:

vowels

	i	e	æ	ɯ	u	a
syl	+	+	+	+	+	+
grv	-	-	-	+	+	+
high	+	-	-	+	-	-
low	-	-	+	-	-	+

semi-vowels

	y	w	h	ʔ
syl	-	-	-	-
cons	-	-	-	-
vce	+	+	-	-
cont	+	+	+	-
grv	-	+	0	0

Features redundant: *vowels*
obs
cons
str
tns
lat

semi-vowels
high
low
obs
cons
str

Features redundant:

vowels	*semi-vowels*
flt	tns
shp	lat
retrac	flt
chk	shp
nas	retrac
cont	chk
vce	nas

In the above schema it is possible to posit six systematic vowel phonemes, as opposed to the seven-, eight-, or ten-vowel systems of Hope 1971.

The vowels which have been excluded from the phoneme inventory are /ɨ/ which is now accounted for as a retracted form of underlying /i/; and /ɔ/ which is now accounted for as the phonetic realisation of underlying /aw/. The "central" vowel /ə/ is now the high back vowel /ɯ/. Motivation for this analysis comes from the fact that the rules needed to arrive at the correct phonetic realisation are independently required for other aspects of the phonology, i.e. the rules are generalised, not *ad hoc*. The retraction rule is needed to account for labiodental articulation of labialisation, and the rule producing [ɔ] from /aw/ is the rule which is needed to account for all other types of labialisation.

2. MORPHEME STRUCTURE RULES

a) *Sequential constraints*

The constraints on the structure of morphemes are very strict, and some of these constraints are related to the structure of syllables. The relevant generalisations about morphemes and their syllable structure are covered by the following rules (the rules as presented are not properly ordered):

(i) $\not{}\ \not{} \longrightarrow \not{}\ (S)^3\ S\ \not{}$

Any morpheme consists of never more than four syllables and never less than one syllable.

(ii) $S \longrightarrow \begin{bmatrix} -syl \\ +cons \end{bmatrix} \left(\begin{bmatrix} -syl \\ -cons \end{bmatrix}^2 \right)\ [+syl] \left(\left\{ \begin{matrix} \begin{bmatrix} -syl \\ -cons \end{bmatrix} \left(\begin{bmatrix} -syl \\ -cons \\ -vce \\ -cont \end{bmatrix} \right) \\ \begin{bmatrix} +cons \\ -obs \\ -lat \end{bmatrix} \end{matrix} \right\} \right)$

In its underlying form a syllable consists of an initial consonant, followed by up to two optional semi-vowels, a vowel, and either an optional nasal final consonant, or an optional semi-vowel followed by an optional glottal stop.

Thus for two-segment monosyllabic morphemes the specification of the features "syllabic" and "consonantal" is entirely redundant. If morphemes are marked in the lexicon for the number of their component syllables, then in bisyllabic four-segment, tri-syllabic six-segment and quadri-syllabic eight-segment morphemes all segments are specified for the **syl** and **cons** features by the above rule. The rule also specifies that vowels never occur contiguous to each other, that only semi-vowels, nasal consonants and /?/ occur as final [-syl] segments. Thus consonants only occur contiguous to one another in polysyllabic morphemes or across morpheme boundaries, and in all such cases the first consonant of the contiguous pair is a nasal.

Note the high degree of redundancy rule (ii) provides in the specification of the following morphemes - the assumption is that all morphemes are in fact marked mono, bi, **tri**, or **quadri** to indicate the number of component syllables:

	t e	t e n	t y e	t y e ?	t y w e	t y w e ?
syl	0 0	0 0 0	0 0 +	0 0 + 0	0 0 0 +	0 0 0 + 0
cons	0 0	0 0 +	0 0 0	0 0 0 -	0 0 0 0	0 0 0 0 -

	? a p a	? a p y a ?	tsh a ? p y a ?
syl	0 0 0 0	0 0 0 0 + 0	0 + 0 0 0 + 0
cons	0 0 0 0	0 0 0 - 0 -	0 0 - 0 - 0 -

In the case of /? a p y a ?/ (marked in the lexicon as **bi-**) the fourth and sixth segments are predictably -syl since the fifth segment is +syl and two +syl segments cannot occur side by side. Since a syllable must have a consonant as its first segment, segments four, five and six are not a complete syllable. Since a syllable is minimally a **CV** sequence and an initial C is required for the second syllable, the first three segments are predictably **CVC**.

In the case of /t s h a ? p y a ?/ (**bi-**) the initial segment is predictably specified and the /p/ segment is predictable as $\begin{bmatrix} -syl \\ +cons \end{bmatrix}$ since rule (ii) indicates that there are no sequences of more than two $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$ segments.

Note also the following:

	t y a m y w e ? (bi-)
syl	0 0 + 0 0 0 + 0
cons	0 0 0 + - 0 0 0

The specifications of segments 1 and 2 are provided by the rule since morphemes must have an initial consonant and two contiguous consonants may not occur in one syllable. The fact that segments 4 and 5 are marked [+cons] and [-cons] respectively indicates that segment 4 must be the initial C of the second syllable, since if the [+cons] segment were the final of the first syllable, the next syllable would then commence with a [-cons] segment and the morpheme would not be well-formed. Similarly the fifth segment could not be the final of the first syllable since no segment may occur, in the same syllable, after a post-vocalic consonant.

The principles of the above example apply to morphemes with three and four syllables as well. Note the following:

	m	w	i	s	a	l	ɯ	g	w	u	(quad)
syl	0	0	0	0	0	0	0	0	0	+	
cons	0	0	0	0	0	0	0	0	-	0	

The first segment is predictably a consonant, and thus the second is specified as a semi-vowel since the third is [+syl] and neither consonants nor vowels occur in pairs. The eighth segment can only be specified as $\begin{bmatrix} -syl \\ +cons \end{bmatrix}$ since (i) no initial consonant has yet been provided for the final syllable; (ii) the alternative specification of segment 8 as $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$ is ruled out since then segment 7 would be the consonant but only three intervening segments (4, 5 and 6) would remain and two syllables are still to be provided, and they require a minimum of four segments. The initial consonant of the final syllable is thus segment 8 and the remaining segments 4, 5, 6 and 7 are CVCV.

The extremely high degree of predictability about the "shape" of morphemes is only possible if palatalised consonants are treated as sequences of consonant-plus-semi-vowel rather than as unit phonemes or consonant-plus-/i/ sequences. The phoneme /y/ is analysed as a medial glide and the phonetic [y] initial is treated as a sequence /zy/. This treatment is the most economical according to the simplicity metric, since it involves by far the least amount of specification of morpheme segments. A new P-rule is introduced but (ii) is preserved. Thus the choice of the C+/y/ solution over the unit solution has high motivation. Similarly if [ö] is treated as a unit phoneme rather than as a /we/ sequence, much of the generality of rule (ii) is lost. Phonetic [w] initial is deemed to be a /ɣw/ phoneme sequence for the same reasons.

(iii) [+cons] ⟶ [-high] / - [-grv]

Velar consonants do not occur before front vowels or /y/.

(iv) $\begin{bmatrix} +obs \\ +cont \end{bmatrix}$ ⟶ [-grv] / - $\begin{bmatrix} -grv \\ -high \end{bmatrix}$, i.e. Bilabial fricatives do

not occur before /y/ or /i/.

(v) $\quad$ [+cons] $\longrightarrow$ [-grv] / - $\begin{bmatrix} -syl \\ -grv \end{bmatrix}$ $\begin{bmatrix} +syl \\ \left\{\begin{matrix} -grv \\ -low \end{matrix}\right\} \end{bmatrix}$,

i.e. if /y/ is followed by a vowel other than /a/ then the consonant preceding /y/ is specified [-grv]. Thus either bilabials or alveolars may occur in the environment /-ya/ but only alveolars occur with any other /yV/ sequence.

(vi) $\quad$ [+syl] $\longrightarrow$ $\begin{bmatrix} -grv \\ -LOW \end{bmatrix}$ / $\begin{bmatrix} -syl \\ +cons \end{bmatrix}$ $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$ $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$ -

i.e. only /i/ or /e/ occur after a sequence of consonant plus two semi-vowels.

(vii) $\quad$ [-syl] $\longrightarrow$ [-grv] / [+cons] - $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$

(viii) [-syl] $\longrightarrow$ [+grv] / [+cons] [-syl] -

i.e. in a sequence of consonant and two semi-vowels the first semi-vowel is /y/ and the second /w/.

(ix) $\quad \begin{bmatrix} -syl \\ -cons \end{bmatrix}$ $\longrightarrow$ [+high]

(x) $\quad$ [+cons] $\longrightarrow$ [-grv] / - $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$ $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$

(xi) $\quad$ [+syl] $\longrightarrow$ $\left\{\begin{matrix} \begin{bmatrix} +grv \\ -high \end{bmatrix} \\ \begin{bmatrix} -grv \\ -low \end{bmatrix} \end{matrix}\right\}$ / $\begin{bmatrix} -syl \\ -cons \end{bmatrix}$ -

Neither /ɯ/ or /æ/ follow /y/ or /w/.

(xii) $\quad$ [+syl] $\longrightarrow$ [-α grv] / $\begin{bmatrix} +cons \\ -obst \\ +grv \\ α\ high \end{bmatrix}$ $\begin{bmatrix} -syl \\ +grv \end{bmatrix}$ -

Front vowels do not occur after /ŋw/ sequences and back vowels do not occur after /mw/ sequences.

(xiii) $\quad \begin{bmatrix} +cons \\ +grv \end{bmatrix}$ $\longrightarrow$ [-α high] / - $\begin{bmatrix} -syl \\ +grv \end{bmatrix}$ $\begin{bmatrix} +syl \\ α\ high \\ -α\ low \end{bmatrix}$

High vowels do not occur after velar-plus-/w/ sequences and low vowels do not occur after labial-plus-/w/ sequences.

$$(xiv) \quad \begin{bmatrix} +cons \\ -high \\ -grv \end{bmatrix} \longrightarrow \left\{ \begin{array}{c} \begin{bmatrix} +obs \\ +str \end{bmatrix} \\ \left[-obs\right] \end{array} \right\} / - \begin{bmatrix} -syl \\ +grv \end{bmatrix} \begin{bmatrix} +syl \\ +low \end{bmatrix}$$

Alveolar non-affricate stops do not occur in front of /w/-plus-low vowel sequences.

Examples of MS rules in operation

	p i	t e	t y e	Segments are specified for **syl**
syl	0 0	0 0	0 0 +	and **cons** by rule (ii); consonants
cons	0 0	0 0	0 0 0	are specified for high by rule
grv	+ -	- -	0 - -	(iii); /y/ is specified for high
high	0 +	0 -	0 0 -	by rule (ix); /t/ in /tye/ is
				specified for **grv** by rule (v).

	k w a	t w e	t y w e	
syl	0 0 +	0 0 +	0 0 0 +	
cons	0 0 0	0 0 0	0 0 0 0	
grv	0 + 0	- + -	0 0 0 0	
high	0 0 0	0 0 -	0 0 0 -	
low	0 0 +	0 0 0	0 0 0 0	

The **cons** and **syl** specifications are provided by rule (ii). The initial in /kwa/ is specified by rule (xiii) for **high** and the **grv** and **low** specifications are provided by the blank-filling rules. All semi-vowels are specified for **high** by rule (ix). With /twe/ after rule (ii) all remaining blanks are provided by the blank-filling rules. With /tywe/ the initial is marked for **grv** by rule (x), after rule (ii) has provided **syl** and **cons** specifications for all segments. /y/ and /w/ are specified for graveness by rules (vii) and (viii) and for high by rule (ix). The vowel specifications for **low** and **grv** are provided by rule (vi).

One of the problems arising out of the rules as proposed above concerns the proper specification of /?/ and /h/. In their distribution they are clearly consonants and rules such as (ii), (v) and (ix) are only correct if /?/ and /h/ are included as segments specified as **+cons**, however, there arise problems concerning the correct phonetic representations of these two phonemes. If the full specification of /?/ and /h/ is given as

	/?/	/h/	then the representation is misleading in a
syl	-	-	number of respects. /h/ is phonetically a
cons	+	+	voiceless vowel, and the oral articulatory
vce	-	-	organs adopt the articulation position of the
cont	-	+	following vowel, as is the case with /?/.

(continued overleaf)

	/ʔ/	/h/
grv	-	-
high	-	-
low	-	-
tns	+	-
obs	-	-

How to reflect these facts with segments marked **[+cons]** is inconceivable.

Thus when /h/ (which is nasalised with back vowels) is specified in a surface string as

$$[\tilde{ħ}]$$

$$\begin{bmatrix} -\text{syl} \\ +\text{cons} \\ +\text{cont} \\ -\text{vce} \\ -\text{obs} \\ -\text{grv} \\ +\text{high} \\ -\text{lat} \\ +\text{nas} \end{bmatrix}$$

this is in fact the phonetic representation of a voiceless palatal nasal consonant. Thus if /h/ and /ʔ/ are specified as **[+cons]** in the underlying form, in order to preserve the highly generalised MS rules given, then a later rule is required to convert **[+cons]** to **[-cons]**.

This rule should apply as the last of the sequential constraints in order to maintain the greatest generality of both the sequential constraints and the blank-filling rules. Adopting this solution is to group /h/ and /ʔ/ with the alveolar consonants in the underlying forms. Rule (ii) then requires slight alteration since both final /n/ and /ʔ/ are +cons.

The altered rule would be

$$\text{(ii)} \quad s \longrightarrow \begin{bmatrix} -\text{syl} \\ +\text{cons} \end{bmatrix} \left(\begin{bmatrix} -\text{syl} \\ -\text{cons} \end{bmatrix}^2\right) \; [+\text{syl}] \; \left(\begin{bmatrix} -\text{syl} \\ -\text{cons} \end{bmatrix}\right)\left(\begin{bmatrix} -\text{syl} \\ +\text{cons} \end{bmatrix}\right)$$

Additional rules would then indicate that the final **[+cons]** can only be /ʔ/ or /n/, but if the option glide occurs then only /ʔ/.

b) *The Blank-filling rules*

(i) $[+\text{obs}] \longrightarrow \begin{bmatrix} -\text{lat} \\ -\text{nas} \end{bmatrix}$

(ii) $\begin{bmatrix} +\text{cons} \\ -\text{obs} \end{bmatrix} \longrightarrow \begin{bmatrix} +\text{cont} \\ +\text{vce} \\ -\text{tns} \\ -\text{strid} \end{bmatrix}$

(iii) $\begin{bmatrix} +\text{cons} \\ -\text{grv} \end{bmatrix} \longrightarrow [-\text{high}]$

(iv) $[+\text{cons}] \longrightarrow [-\text{low}]$

(v) $\begin{bmatrix} +\text{cons} \\ +\text{vce} \end{bmatrix} \longrightarrow [-\text{tns}]$

(vi) $\begin{bmatrix} +\text{cons} \\ +\text{cont} \end{bmatrix} \longrightarrow [-\text{tns}]$

(vii) $\begin{bmatrix} -\text{syl} \\ -\text{cons} \\ -\text{vce} \end{bmatrix} \longrightarrow [-\text{grv}]$

$$
\text{(viii)} \quad \begin{bmatrix} -syl \\ -cons \\ -grv \\ +vce \end{bmatrix} \longrightarrow \begin{bmatrix} -flt \\ +shp \end{bmatrix} \qquad \text{(xi)} \quad \begin{bmatrix} +syl \\ +grv \\ -high \\ -low \end{bmatrix} \longrightarrow [+flt]
$$

$$
\text{(ix)} \quad \begin{bmatrix} -syl \\ -cons \\ +grv \end{bmatrix} \longrightarrow \begin{bmatrix} +flt \\ -shp \end{bmatrix} \qquad \text{(xii)} \quad [+syl] \longrightarrow \begin{bmatrix} -cons \\ +cont \\ +vce \end{bmatrix}
$$

$$
\text{(x)} \quad \begin{bmatrix} -syl \\ -cont \\ -cont \end{bmatrix} \longrightarrow [+chk] \qquad \text{(xiii)} \quad \begin{bmatrix} +HIGH \\ +LOW \end{bmatrix} \longrightarrow [+FALLING]
$$

The above is a sample of the rules – only those rules which most closely concern the P-rules have been selected.

3. PHONOLOGICAL RULES

A. PRE-CYCLE RULES

(a) Stress assignment

The assignment of primary stress is difficult to state without a detailed explanation of the syntactic component of Lisu grammar. Surface strings from that component are assigned linear order by topicalisation and focus rules (see Hope 1972) and primary stress is assigned to the main verb if it is not part of the major presupposition of the sentence, and to the head of the focus NP if the main verb is presupposed.

1. ása nya   thá tya -a   2. ása nya   tha tyá -ạ
    Asa TOPIC *here is* -DECLARATIVE   *Asa* TOPIC *here is* -DECLARATIVE
    'Asa is here.'   *'Asa is here.'*

In (1) where the stress is on tha *'here'* the sentence would be the answer to the question *'Where is Asa?'*. In (2) where the stress is on tyǎ *'is'* the sentence would be the answer to the question *'What is Asa doing?'*.

Secondary stress is assigned to the first syllable of the head noun of the component NPs and of the head verb of the sentence if these have not already received primary stress.

Tertiary stress is assigned to syntactic markers. In the case of bi-syllabic markers the syllable to be stressed is specified by the output of the syntactic component.

(b) Loss of finals

$$
[+syl] \longrightarrow \begin{bmatrix} +syl \\ \alpha\ nas \\ \beta\ chk \\ \gamma\ flt \\ \delta\ shp \end{bmatrix} \Big/ - \begin{bmatrix} -syl \\ \alpha\ nas \\ \beta\ chk \\ \gamma\ flt \\ \delta\ shp \end{bmatrix}
$$

$$
[-syl] \longrightarrow [null] \Big/ - \not{A}\not{}^{n}\big| \text{ where } /n/ \text{ is not less than one}
$$

Final /y/ /w/ /n/ or /ʔ/ are deleted if they are other than phrase-final, after the preceding vowel has been palatalised, labialised, nasalised or glottalised respectively. The first part of the rule (above) is in fact cyclical.

(c) *Verbal tone change*

The heightening of the pitch of mid-tone verbs with tense final vowel when followed by the declarative sentence final marker /-ạ/ is accomplished by a pair of rules.

$$\begin{bmatrix} +syl \\ +chk \\ -HIGH \\ -LOW \end{bmatrix} \longrightarrow \begin{bmatrix} -chk \\ +HIGH \end{bmatrix} \Big/ - \neq DEC \neq$$

$$\begin{bmatrix} +syl \\ -chk \\ -HIGH \\ -LOW \end{bmatrix} \longrightarrow [+chk] \Big/ - \neq DEC \neq$$

B. *LABIALISATION*

(i) $[+syl] \longrightarrow \begin{bmatrix} +strid \\ +flt \\ +retrac \end{bmatrix} \Big/ \begin{bmatrix} -syl \\ -cons \\ +grv \end{bmatrix} \begin{bmatrix} - \\ +grv \\ -low \\ -grv \\ +high \end{bmatrix}$

(ii) $\begin{bmatrix} +syl \\ -grv \\ -high \end{bmatrix} \longrightarrow [+flt] \Big/ \begin{bmatrix} +cons \\ -high \end{bmatrix} \begin{bmatrix} -syl \\ -cons \\ +high \end{bmatrix} -$

(iii) $[+cons] \longrightarrow [+flt] \Big/ - \begin{bmatrix} -syl \\ -cons \\ +grv \end{bmatrix}$

(iv) $\begin{bmatrix} -syl \\ -cons \\ +grv \end{bmatrix} \longrightarrow [null] \Big/ - \begin{bmatrix} +syl \\ +flt \end{bmatrix}$

Rule (i) indicates that labialisation of /i/ or /u/ is accompanied by labiodental (rather than labial) friction, and by retraction of the position of the vowel, yielding [-ɣ^{ɨ}] and [-ɣ^{u}] respectively.

Rule (ii) results in the rounding of /e/ after sequences of non-velar consonant plus /w/. Rule (iii) indicates that the consonant before /w/ is labialised. Rule (iv) deletes the /w/ segment if rules (i) or (ii) have applied.

C. *PALATALISATION*

(v) $[+cons] \longrightarrow [+shp] \Big/ - \begin{bmatrix} -syl \\ -cons \\ -grv \end{bmatrix}$

(vi) $\begin{bmatrix} +cons \\ -high \\ -grv \end{bmatrix} \longrightarrow$ [+high] / $\begin{bmatrix} - \\ +shp \end{bmatrix}$

(vii) $\begin{bmatrix} +cons \\ +obst \\ +high \\ +shp \end{bmatrix} \longrightarrow$ [+str] / $\left\{ \begin{array}{l} \left(- \begin{bmatrix} -syl \\ -cons \\ -grv \end{bmatrix} \begin{bmatrix} +syl \\ -high \\ -low \end{bmatrix} \right) \\ - \begin{bmatrix} -syl \\ -cons \\ -grv \end{bmatrix} \begin{bmatrix} +syl \\ -grv \\ +high \\ +str \\ +flt \end{bmatrix} \end{array} \right\}$

Palatal stops are affricated optionally if a /ye/ or /yu/ sequence follows; but are always affricated if /y/ plus labialised /i/ [y^+_i] follows.

(viii) $\begin{bmatrix} -syl \\ -cons \end{bmatrix} \longrightarrow$ [null] / $\begin{bmatrix} +cons \\ +high \\ +shp \end{bmatrix}$ -

The /y/ segment is deleted if both rules (v) and (vi) have applied.

(ix) $\begin{bmatrix} +syl \\ +low \end{bmatrix} \longrightarrow$ [-grv] / $\begin{bmatrix} -cons \\ -grv \end{bmatrix}$ -

/a/ is fronted after /y/ or front vowels.

(x) $\begin{bmatrix} +cons \\ +obs \\ +str \\ -grv \\ -cont \end{bmatrix} \longrightarrow \begin{bmatrix} +shp \\ +high \end{bmatrix}$ / - $\begin{bmatrix} -cons \\ +grv \\ +flt \end{bmatrix}$

Alveolar affricates become palatal before /w/ or /u/. This rule is optional.

D. REMAINING RULES

(xi) [+syl] $\longrightarrow \begin{bmatrix} +str \\ -flt \\ +retrac \end{bmatrix}$ / $\begin{bmatrix} +cons \\ +str \end{bmatrix} \begin{bmatrix} - \\ +high \\ -grv \end{bmatrix}$

This rule accounts for [sz^+_i] [tsz^+_i] etc. which have underlying forms such as /si/ /tsi/ and so on. Thus the contrasts between the forms [sz^+_i] [ʃʒ^+_i] [ʃi] [tsz^+_i] and [tʃʒ^+_i] are accounted for as follows (if the MS rules are assumed):

	s	i	s	y	w	i	s	y	i	ts	i	t	y	w	i
syl	-	+	-	-	-	+	-	-	+	-	+	-	-	-	+
cons	+	-	+	-	-	-	+	-	-	+	-	+	-	-	-
grv	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-
high	-	+	-	+	+	+	-	+	+	-	+	-	+	+	+
low	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

(continued overleaf)

	s	i	s	y	w	i	s	y	i	ts	i	t	y	w	i
obst	+	-	+	-	-	-	+	-	-	+	-	+	-	-	-
cont	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+
str	+	-	+	-	-	-	+	-	-	+	-	-	-	-	-
flt	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-
shp	-	-	-	+	-	-	-	+	-	-	-	-	+	-	-
vce	-	+	-	+	+	+	-	+	+	-	+	-	+	+	+

Rule (xi) converts the /i/ into syllable [z̩] in the case of /si/ and /tsi/.

Rules (v) and (vi) convert /s/ into [ʃ] in the case of /syi/ and rule (viii) deletes the /y/ segment.

In the case of /sywi/ it becomes apparent that to arrive at the correct specifications with the most generalised rules, rules (v) and (vi) apply before rules (i), (iii), (iv). After (v) and (vi) /sywi/ is transformed to [ʃwi], which rules (i), (ii) and (iv) operate on, reducing to two segments with the following specifications:

	ʃw	v⁺
syl	-	+
cons	+	-
obs	+	-
str	+	+
grv	-	-
high	+	+
low	-	-
flt	+	+
shp	+	-
retrac	-	+

Rule (xi) converts the +flt of the [+syl] segment to -flt changing the quality of the segment to that of a retracted high front vowel articulated with friction. Thus the non-distinctive nature of the lip protrusion mentioned in Hope 1971 (p.69) is accounted for by the fact that it is part of the initial segment rather than the vowel. Thus too, Roop's analysis of the morpheme as /swɨ/ can be seen to be at least possible since the palatalisation of the initial could be achieved by modification of rule (x) so as to make the rule optional with consonants marked [-cont] but obligatory with those marked [+cont]. This solution is, however, less economic in terms of the simplicity metric.

(xii) [+LOW] $\longrightarrow$ [+FALL] / $\begin{bmatrix} - \\ +chk \end{bmatrix}$

Low tone becomes a low falling tone with glottalisation.

(xiii) [+HIGH] $\longrightarrow$ $\begin{bmatrix} +RISE \\ +tns \\ -chk \end{bmatrix}$ / $\begin{bmatrix} - \\ +chk \end{bmatrix}$

High tone becomes a high rising tone with tenseness of the vowel when the syllabic segment is specified [+chk]. The accuracy of this designation has to be investigated further. Spectrographic analysis has indicated that the high rising tone is accompanied by a vowel glide to a slightly higher articulatory position, with retraction of the initial consonant.

(xiv) $\begin{bmatrix} -HIGH \\ -LOW \end{bmatrix}$ $\longrightarrow$ [+tns] / $\begin{bmatrix} - \\ +chk \end{bmatrix}$

Vowels with mid tone and [+chk] specification become tense vowels. These are characterised by glottal tension resulting in "creakiness" as opposed to the rapid glottal "trills" of glottalised vowels.

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