WORD, FOOT, AND SYLLABLE STRUCTURE IN BURMESE*

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1. Introduction

Prosodic phonology is that branch of linguistics concerned with the representation and behavior of phonological constituents above the segment: syllable, foot, prosodic word, phonological phrase, intonational phrase, utterance. These elements, from the syllable to the utterance, are known as the prosodic hierarchy (Selkirk 1984, Nespor & Vogel 1986). Researchers frequently focus on that portion of the prosodic hierarchy between the segment and the prosodic word (also called pword, symbolized ω), e.g. Peperkamp (1997), Ewen & van der Hulst (2001), and the papers collected in Hall & Kleinhenz (1999). In this chapter I address theoretical issues in the prosodic phonology of Burmese, examining the structure of the syllable, foot, and prosodic word in Burmese within the constraint-based framework of Optimality Theory (Prince & Smolensky 1993).

In the rest of section 1 I give the inventory of Burmese surface phones—vowels, tones, and consonants—and provide a brief introduction to Optimality Theory. In section 2 I discuss major (= heavy) syllables and show that a violable constraint bans *all* singly linked place features (not just consonantal ones, as in many other languages) from the right edge of a syllable in Burmese. I argue that the properties that distinguish major syllables from minor (= light) syllables (including presence of tone and toleration of onset clusters) are most straightforwardly accounted for on the assumption that all major syllables are feet and that all feet consist of exactly one major syllable. In section 3 I examine minor syllables and show that their shape and distribution are attributable to the constraint against place features in syllable-final position, a markedness constraint against heavy syllables, and constraints requiring all feet and prosodic words (pwords, symbolized ω) to be right-aligned. In section 4 I first show that all prosodic categories are preferably nonbranching in Burmese, then discuss the exceptions to the generalization that a pword contains exactly one foot in Burmese, arguing that both the pword and the foot are in some cases prespecified in the input. Section 5 concludes the chapter.

1.1 Vowels and tones

The surface vowels and tones of Burmese are as shown in (1).[1]

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* This chapter is a revised version of a paper printed in *Working Papers of the Cornell Phonetics Laboratory* 10 (1995), 67–96. I should like to thank the following people for their help and advice: Fraser Bennett, F. K. L. Chit Hlaing, Abby Cohn, Laura Downing, Caroline Féry, Terri Griffith, Daniela Lentge, Máire Ní Chiosáin, David Parkinson, San San Hnin Tun, Hubert Truckenbrodt, Siri Tuttle, Ruben van de Vijver, Ratree Wayland, Julian Wheatley, Moira Yip, Draga Zec, and an anonymous *WPCPL* reviewer.

[1] There is very little agreement from one author to another on the designation of the tones. Some authors use terms such as low, high, creaky, checked, falling, heavy, glottalized, etc.; others number the tones 1–4. Among the authors who use numbers, there is even variation as to which tone is given which number. There is also wide variation as to the transcription of Burmese. Throughout this chapter, I use the same names of tones as used by Wheatley (1987), and a broad transcription in nearly standard IPA.

(1) The surface vowels and tones of Burmese

Monophthongs	
i	u
e	o
ə	
ɛ	ɔ
a	

Diphthongs	
ei	ou
ai	au

Tones	
Low	à (etc.)
High	á (etc.)
Creaky	a̰ (etc.)
Checked	aʔ (etc.)

The syllable structure of Burmese is C(G)V((V)C), which is to say the onset consists of a consonant optionally followed by a glide, and the rhyme consists of a monophthong alone, a monophthong with a consonant, or a diphthong with a consonant. Diphthongs cannot stand in open syllables, a fact which will be discussed in more detail in § 2.2 below. Some representative words are shown in (2).[2]

(2) Basic syllables of Burmese

a.	CV	mè	'girl'
b.	CVC	mɛʔ	'crave'
c.	CGV	mjè	'earth'
d.	CGVC	mjɛʔ	'eye'
e.	CVVC	màuN	(term of address for young men)
f.	CGVVC	mjáuN	'ditch'

Modern Burmese is generally analyzed as having a four-way tone contrast in major syllables, as illustrated by the minimal quadruplet in (3).

(3) The four tones of Burmese (Okell 1969, 5)

a.	Low	k^hà	'shake'
b.	High	k^há	'be bitter'
c.	Creaky	k^ha̰	'fee'
d.	Checked	k^haʔ	'draw off'

In principle, this four-way contrast ought to be describable with two binary distinctive features, but it would go beyond the scope of this chapter to develop a theory of features responsible for the Burmese tones.

The phonemic contrast traditionally known as "tone" in Burmese involves not only pitch, but also phonation, intensity, duration, and vowel quality. For this reason Bradley (1982) prefers the term "register" rather than "tone," but I will continue to use the traditional term here with the understanding that "tone" refers to all of these properties, not just pitch. Detailed phonetic studies of the Burmese tones include Mehnert & Richter (1972–77, part 3) and Thein Tun (1982).

In syllables with a nasal rhyme, only three tones are possible. The Checked tone is excluded from such syllables.

[2] All examples in this chapter are from Bernot (1963), Okell (1969), Esche (1976), or Wheatley (1987), unless otherwise noted.

(4) Three tones in nasal rhymes

a.	Low	kʰàN	‘undergo’
b.	High	kʰáN	‘dry up’
c.	Creaky	kʰa̰N	‘appoint’

This fact can be analyzed by assuming that N and ʔ are both required to stand in coda position, but Burmese phonotactics do not allow complex codas. Thus one of the consonants must be deleted when they are in conflict. The native Burmese vocabulary lacks phonological processes that allow us to know what the output of a hypothetical input like /θaNʔ/ would be, but evidence from loanwords may be brought to bear. In general, final obstruents in other languages all become ʔ in Burmese, e.g. [tjùliʔ] ‘tulip’. Foreign words that end in nasal + obstruent clusters usually have nasal rhymes in Creaky tone in Burmese, e.g. [pa̰iN] ‘pint’. This would suggest that the glottalization normally associated with Checked tone surfaces instead in Creaky tone in the presence of N.

Burmese, like many languages of Southeast Asia, has a distinction between major and minor syllables.[3] The exact definitions of major and minor syllables vary from language to language, but in general the distinction seems to be parallel to the distinction between heavy syllables and light syllables commonly found in languages from all areas. Following moraic theory (Hyman 1985, McCarthy & Prince 1986, Hayes 1989), we may assume that minor (light) syllables contain one unit of weight, called a mora (symbolized μ), while major (heavy) syllables contain two moras.[4]

In most languages that have the major/minor syllable distinction, including Burmese, a word must contain at least one major syllable and may not end with a minor syllable. In Burmese, the characteristics of a major syllable are: (i) it may contain any vowel except ə; (ii) it may be an open or closed syllable; (iii) it bears tone; and (iv) it may have a simple (C) or complex (CG) onset. All the words in (2) above are examples of major syllables. The characteristics of a minor syllable in Burmese are: (i) it contains the vowel ə and no other vowel; (ii) it is an open syllable; (iii) it does not bear tone; (iv) it has only a simple (C) onset; and (v) it is not the final syllable of the word. A result of this last restriction is that a word may not contain only minor syllables. In the examples in (5), all nonfinal syllables are minor and all final syllables are major.

(5) Words containing minor syllables

a.	kʰə.louʔ	‘knob’
b.	pə.lwè	‘flute’
c.	θə.jɔ̀	‘mock’
d.	kə.lɛʔ	‘be wanton’
e.	tʰə.mə.jè	‘rice-water’

It is also possible for a nonfinal syllable to be major, e.g. the first syllable of [méiN.mə.wuʔ] ‘women’s clothing’.

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[3] The terms “major syllable” and “minor syllable” seem to have been used first by Henderson (1952) for Cambodian and Shorto (1960) for Palaung.

[4] Duanmu (1990) argues that all syllables are heavy in Chinese, which does not have the major/minor syllable distinction.

1.2 Consonants

The consonants of Burmese are shown in (6).

(6) The consonants of Burmese

Stops and affricates				
p	t	tʃ	k	ʔ
p^h	t^h	$tʃ^h$	k^h	
b	d	dʒ	g	

Nasals (N is placeless)				
m	n	ɲ	ŋ	N
m̥	n̥	ɲ̥	ŋ̊	

Fricatives			
θ	s	ʃ	h
	s^h		
(ð)	z		

Approximants			
l	j	w	(r)
l̥		(w̥)	

The approximants r and w̥ are rare, as is ð except as a voiced allophone of θ.

The feature distinguishing the voiced and voiceless sonorants is probably not [voice] but [spread glottis]. In other words, the voiceless sonorants are phonologically aspirated. Evidence for this position comes from a set of about 50 pairs of verbs in which the intransitive or passive member of each pair begins with a nonaspirated sound, while the transitive, causative, or active member begins with the aspirated correlate (Okell 1969, 42, 205 ff.). Examples are shown in (7); as seen in (7)i–j, ʃ functions as the aspirated equivalent of j.

(7) Unaspirated/aspirated verb pairs

	[–s.g.] initial: passive/intransitive		[+s.g.] initial: active/transitive	
a.	pjaʔ	'be cut'	p^hjaʔ	'cut'
b.	tʃɛʔ	'be cooked'	$tʃ^h$ɛʔ	'cook'
c.	kwɛ́	'be split'	k^hwɛ́	'split'
d.	souʔ	'be torn'	s^houʔ	'tear'
e.	mjouʔ	'be buried'	m̥jouʔ	'bury'
f.	nwé	'be warm'	n̥wé	'make warm'
g.	ɲi̯	'be alight'	ɲ̥i̯	'to touch with flame, light'
h.	luʔ	'be set free'	l̥uʔ	'set free'
i.	jo̯	'be reduced'	ʃo̯	'reduce'
j.	jwe̯	'be moved'	ʃwe̯	'move'

All consonants except the placeless nasal N are allowed in onset position, and an onset consonant is obligatory in Burmese. Thus vowel-initial words of English and Pāli are borrowed into Burmese with initial ʔ, e.g. [ʔìNdʒìN] 'engine', [ʔàkàθa̯] 'space, universe' < Pāli *ākāsa*. Only placeless consonants are allowed in coda position, namely ʔ and the placeless nasal N (which is realized as nasalization on the preceding vowel, with an approximate coronal articulation after monophthongs and an approximate velar articulation after diphthongs (Bennett & Lehman 1994)).[5] Although h is placeless, it

[5] See Trigo (1988) for a full discussion of the behavior of placeless nasals (she calls them nasal glides) across languages.

does not appear in coda position, presumably reflecting the cross-linguistic tendency to disfavor coda h.

1.3 Optimality Theory

Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993b, Archangeli & Langendoen 1997, Kager 1999, Boersma et al. 2000, McCarthy 2002) is a theory of generative grammar built around the concept of the violable constraint. According to OT the grammar of a language consists of a ranked hierarchy of constraints: constraints may be violated if violation of one constraint spares a violation of a higher-ranking constraint in the hierarchy. The constraints themselves are held to be universal, i.e. present in the grammar of every human language, but their hierarchical ranking is different in every language. Although constraints are in principle violable, every language has some constraints that are undominated in that language's hierarchy and that are therefore never violated in that language.

The lexicon of a language is held to consist of a list of inputs which the speaker compiled as a learner; each input corresponds to a set of candidate outputs generated by a function called Gen. These candidates compete with each other to determine the optimal output, which is the actual surface form pronounced by the speaker. An evaluator function (known in the OT literature as Eval) judges competing candidates to determine which candidate best meets the constraint hierarchy. This evaluation is represented graphically by means of a tableau like that in (8). In this tableau, A, B, and C stand for constraints; they are ranked from left to right, showing that constraint A outranks B, and B outranks C (in shorthand, A » B » C). The candidates are φ, χ, and ψ; their violations of each constraint are marked *. Because A is the highest ranking constraint, φ's violation of A is fatal (marked with the exclamation point), since χ and ψ do not violate it. χ violates constraint B but ψ does not; this eliminates χ from consideration, and ψ is selected as the optimal candidate, i.e. the one that is the actual surface form. The symbol ☞ points to the optimal candidate. The fact that ψ violates constraint C is irrelevant, because C is lower ranking than the constraints violated by the other two candidates. Shaded cells are those where violation or fulfillment of a constraint is irrelevant to the evaluation process.

(8)

Input	A	B	C
φ	* !		
χ		* !	
☞ ψ			*

There are three major kinds of constraints: faithfulness constraints, markedness constraints, and alignment constraints. Faithfulness constraints govern the relationship between the input and the output by requiring identity between the two.[6] If any element of the input has no correspondent in the output, a constraint of the family MAX (maximization) is violated; in effect, MAX constraints prohibit deletion. If any element of the

[6] Actually there are other pairs of forms that can stand in a correspondence relationship to each other, not just input and output. But in this chapter I consider only input-output correspondences, and use MAX and DEP as shorthand for MAX-IO and DEP-IO. See McCarthy & Prince (1995) for more discussion on constraints governing correspondence relationships.

output has no correspondent in the input, a constraint of the family DEP (dependency) is violated; in effect, DEP constraints prohibit insertion. Finally, if any input-output correspondence pair differs in the value of any feature, a constraint of the family IDENT (identity) is violated; in effect, IDENT constraints prohibit alteration of segments.

Markedness constraints make general statements about phonological well-formedness; generally, any structure that is marked in comparison to another structure will violate a markedness constraint. The relative ranking of markedness constraints and faithfulness constraints determines which marked structures will be allowed in a language: a marked structure is allowed if the relevant faithfulness constraint outranks the markedness constraint prohibiting the structure.

The third type of constraint encountered in OT is alignment constraints (Prince & Smolensky 1991, McCarthy & Prince 1993a). These constraints require certain prosodic or morphological entities to share an edge with certain other prosodic or morphological entities. Alignment constraints generally have the form "Align(κ, E; λ, E′)" where κ and λ are prosodic or morphological categories and E and E′ are edges (left or right). κ is quantified universally while λ is quantified existentially: a prose statement of the constraint is "for every κ there is some λ such that the E edge of κ is aligned with the E′ edge of λ." E and E′ need not be the same (for example, the right edge of a suffix may be aligned with the left edge of a root), but in practice they very often are the same. In that case, the shorthand notations Align-L(κ, λ) ("the left edge of every κ is aligned with the left edge of some λ) and Align-R(κ, λ) ("the right edge of every κ is aligned with the right edge of some λ) are often used.

More details about Optimality Theory will be introduced in the course of this chapter, as they become relevant to the discussion of Burmese prosodic phonology.

2. Major syllables

A major syllable in Burmese consists of an obligatory onset (any of the consonants in (6) except N) followed by one of the fifty possible rhymes listed in (9).

(9) The fifty rhymes of major syllables (adapted from Thein Tun 1982)

	Nonnasal rhyme				Nasal rhyme		
	Low	High	Creaky	Checked	Low	High	Creaky
/i/	1. ì	2. í	3. ḭ	4. iʔ	5. ìN	6. íN	7. ḭN
/u/	8. ù	9. ú	10. ṵ	11. uʔ	12. ùN	13. úN	14. ṵN
/a/	15. à	16. á	17. a̰	18. aʔ	19. àN	20. áN	21. a̰N
/ɛ/	22. è	23. é	24. ɛ̰	25. ɛʔ			
/ai/				26. aiʔ	27. àiN	28. áiN	29. a̰iN
/ei/	30. è	31. é	32. ḛ	33. eiʔ	34. èiN	35. éiN	36. ḛiN
/au/	37. ɔ̀	38. ɔ́	39. ɔ̰	40. auʔ	41. àuN	42. áuN	43. a̰uN
/ou/	44. ò	45. ó	46. o̰	47. ouʔ	48. òuN	49. óuN	50. o̰uN

In this section we explore the nature of major syllables in more detail, focusing in § 2.1 on the hypothesis that all major syllables are bimoraic, in § 2.2 on the constraint against place features at the right edge of the syllable, in § 2.3 on the claim that major syllables are monosyllabic feet, and in § 2.4 on the relationship between tone and the foot (i.e. the major syllable).

2.1 Bimoraicity

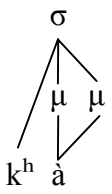
As alluded to above, a word in Burmese must contain at least one major syllable, which may be defined as a syllable whose nucleus is a full vowel—i.e. any monophthong or diphthong except ə. Examples are given in (10).

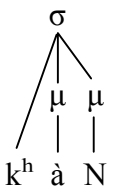
(10) Major syllables

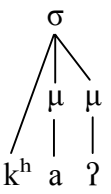
a.	kʰà	'shake'
b.	kʰàN	'undergo'
c.	kʰaʔ	'draw off'

Vowel length is not contrastive in Burmese, but as mentioned above, we may hypothesize that major syllables are all bimoraic, while minor syllables are monomoraic. In open major syllables like [kʰà] the vowel is presumably bimoraic, while in closed syllables like [kʰàN] and [kʰaʔ] the vowel and the coda consonant support one mora each, as shown in (11). (The syllable is symbolized σ).

(11) Structure of major syllables

a. 

b. 

c. 

Mehnert & Richter (1972–77, part 3, 148–150) show that the duration of the rhyme of a minor syllable varies from 25 to 50 ms, while the duration of the rhyme of a major syllable varies from 150 to 600 ms. This discrepancy between the durations of minor and major syllables can be straightforwardly represented as a difference in syllable weight: minor syllables are light/monomoraic, and major syllables are heavy/bimoraic.[7] The wide variation in duration within major syllables (150–600 ms) is due to the fact that tone, rather than weight, is the primary determiner of duration in Burmese: Checked tone syllables are very short, Creaky tone syllables somewhat longer, Low tone syllables longer still, and High tone syllables longest of all (Thein Tun 1982).

2.2 Restrictions on place features

The phonotactic restrictions on the rhymes of major syllables are the following: the diphthongs ei ai ou au *must* be closed by one of the coda consonants ʔ or N (12); the mid monophthongs e o ɔ *must* occur in open syllables (13); ɛ may occur in an open syllable or a syllable closed by ʔ, but no syllable may end in ɛN (14).

(12) Diphthongs only in closed syllables

a.	ʔeiʔ	'sleep'	ʔèiN	'house'	*ʔèi
b.	sʰaiʔ	'arrive'	tʰàiN	'sit'	*tʰài

[7] Another possibility, suggested to me by both Abby Cohn and Laura Downing, is that minor syllables are nonmoraic. I do not have space in this chapter to compare that hypothesis with the view taken here, that minor syllables are monomoraic.

c.	tʃʰouʔ	‘sew’	tʃʰòuN	‘overspread’	*tʃʰòu
d.	tʃauʔ	‘stone’	tʃàuN	‘cat’	*tʃàu

(13) e, o, ɔ only in open syllables

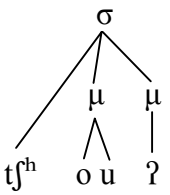
a.	ʔè	‘be cold’	*ʔeʔ	*ʔèN
b.	tʃʰò	‘be sweet’	*tʃʰoʔ	*tʃʰòN
c.	tʃɔ̀	‘fry’	*tʃɔʔ	*tʃɔ̀N

(14) ɛ in open syllables and before ʔ

a.	θwɛ̀	‘connect by thread etc.’
b.	θwɛʔ	‘be fluent’
c.	*θwɛ̀N	

Diphthongs in closed syllables are presumably monomoraic in Burmese, so that a syllable like [tʃʰouʔ] ‘sew’ ((12)c) has the structure shown in (15).

(15)



In this section I will show that the ban on diphthongs in open syllables can be linked to an independent fact of Burmese phonology, namely that coda consonants are obligatorily placeless.

The Coda Condition (Steriade 1982; Itô 1986, 1989; Yip 1991) was devised as a way of restricting the occurrence of features in the coda; for example, by prohibiting place features. A Coda Condition doing just this was formalized by Itô (1989) as in (16).

(16) Coda Condition

* C]$_\sigma$
|
PLACE

Burmese patently obeys this constraint, as the only permissible coda consonants, ʔ and N, are both placeless. The Coda Condition has traditionally applied only to consonantal place features, as in Itô’s (1989) illustration with Japanese. In that language, the only coda consonants allowed are the placeless nasal N (e.g. [hoN] ‘book’) and the first halves of geminates (e.g. [kitte] ‘stamp’) and homorganic nasal-stop clusters (e.g. [tombo] ‘dragonfly’). The latter two cases are not violations of the Coda Condition, Itô argues, because the place features are licensed by the onset position, and the coda consonants merely share the onset consonants’ place features. This situation obtains in Burmese as well, where coda ʔ and N tend to assimilate in place to a following consonant, as illustrated in (17).

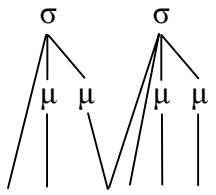
(17) Place assimilation

a.	jakkwɛʔ	<	jaʔkwɛʔ	‘area, quarter’
	seitt^{h}ìN	<	seiʔt^{h}ìN	‘opinion’
	louszaʔ	<	louʔzaʔ	‘fictitious story’
b.	pjáuŋkòuN	<	pjáuNkòuN	‘alter completely’
	ʔəpjìnt^{h}wɛʔ	<	ʔəpjìNt^{h}wɛʔ	‘go outside’
	θàɲdʒeiʔ	<	θàNdʒeiʔ	‘iron hook’

As in Japanese, coda place features in Burmese must be licensed by being linked with an onset consonant, as illustrated in (18).

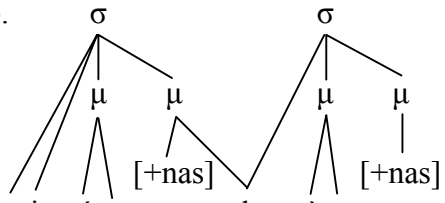
(18) Linked coda consonants

a.



jakkwɛʔ

b.



pjáuŋkòuN

However, unlike Japanese, Burmese apparently prohibits not only consonant place features but also vowel place features from the right edge of a syllable. This extension of the Coda Condition to vowel place features can explain the complementary distribution of diphthongs and monophthongs seen above. Specifically, if all place specifications are barred from the right edge of the syllable, diphthongs can be excluded from open syllables, because to allow diphthongs in open syllables is to allow the place features of the second element of the diphthong to occur at the syllable’s right edge. Thus a structure like *tài is ill-formed for the same reason as *tak, namely that each syllable contains at its right edge a segment with place features.

A question that immediately arises with this analysis is why a syllable like [k^{h}à] ‘shake’ ((3)a) can be well formed, since it too contains at its right edge a segment [a] that has place features. The answer is that major syllables are bimoraic, so that the place features under the second mora in (11)a are licensed by the first mora, just as the place features under the second mora in the first syllable of each of (18)a & b are licensed by the following onset. In OT terms, the constraint banning place features from the right edge of a syllable may be named *PLACE]$_{\sigma}$ and stated as in (19).[8]

(19) ***PLACE]$_{\sigma}$**

* μ]$_{\sigma}$ The rightmost mora of a syllable does not dominate Place features.
|
PLACE

[8] Itô & Mester (1994, 1999) define the constraint CODA CONDITION positively as Align-L([PLACE], σ). A similar statement of *PLACE]$_{\sigma}$ is not possible as it would not able to judge between well-formed [tʃ^{h}ouʔ] ‘sew’ and ill-formed *[tʃ^{h}ou] with regard to the place features of u.

According to the Linking Constraint of Hayes (1986), association lines are interpreted exhaustively; in this case, that means that *PLACE]$_\sigma$ is violated only if the Place features are linked *exclusively* to the final mora of the syllable. The coda consonants of the first syllables of [jakkwɛʔ] and [pjáuŋkòuN] in (18) do not violate *PLACE]$_\sigma$ because their Place features are associated with the following syllable as well. Likewise, the [a] in [k^{h}à] does not violate it, because its Place features are associated not only with the final mora, but with the first mora as well.

In Burmese words that have been borrowed from English, a syllable-final obstruent in the English source word is generally replaced by ʔ, e.g. [kɛʔ] 'cap', [keiʔ] 'cake', [kouʔ] 'coat'. If the place features of the coda consonant of each English source are present in the input, then the faithfulness constraint MAX(Place) (20) is violated in these forms, but *PLACE]$_\sigma$ is fulfilled.[9] This allows us to deduce the ranking *PLACE]$_\sigma$ » MAX(Place). The tableau in (21) illustrates this ranking for [keiʔ] 'cake'.

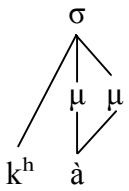
(20) **MAX(Place)**
Place features in the input have correspondents in the output.

(21)

/keik/	*PLACE]$_\sigma$	MAX(Place)
keik	* !	
☞ keiʔ		*

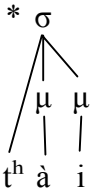
Because of the Linking Constraint, the candidate [k^{h}à] with a bimoraic vowel does not violate *PLACE]$_\sigma$: as can be seen in (22), the place features of the [a] are not linked exclusively to the final mora of the syllable, but to the first mora as well.

(22) k^{h}à 'shake' (10)a



But a diphthong in an open syllable would violated *PLACE]$_\sigma$, as in (23).

(23)



In this form, the place features of the [i] are uniquely linked to the second mora of the syllable, in violation of *PARSE]$_\sigma$. How is this problem solved? Loanwords from Eng

[9] If a learner first hears the word [keiʔ] from another Burmese speaker, the input posited will be /keiʔ/, not /keik/, but the point is that in the cases where the English word does directly provide the input, the grammar of Burmese provides a constraint ranking that produces a grammatical output.

lish that contain /ai/ or /au/ in an open syllable take an epenthetic coda consonant in Burmese, as in the examples in (24).

(24) Loanwords from English with epenthetic consonants after /ai, au/

a.	pàu**N**dà	'powder'
b.	s^{h}ài**N**kəlóuN	'cyclone'
c.	zùlài**N**	'July'
d.	ʔài**N**ʔòdíN	'iodine'
e.	dərài**N**bà	'driver'
f.	dài**N**jàrì	'diary'
g.	nɛʔtài**N**	'necktie'
h.	gəlai**ʔ**dà	'glider'
i.	tai**ʔ**p^{h}úN	'typhoon'

It does not appear to be predictable whether the epenthetic coda consonant is N or ʔ, but either way these examples show that the faithfulness constraint DEP(seg) ("a segment in the output has a correspondent in the input"), which prohibits epenthesis, is violated in order to avoid a violation of *PLACE]$_{\sigma}$, as shown in (25).[10]

(25)

/daijari/	*PLACE]$_{\sigma}$	DEP(seg)
dài.jà.rì	* !	
☞ dàiN.jà.rì		*

The diphthongs ei, ou, au are in complete complementary distribution with the monophthongs e, o, ɔ, since the diphthongs occur only in closed syllables and the monophthongs only in open syllables. Because *PLACE]$_{\sigma}$ outranks MAX(Place), as we determined in (21), an input providing a diphthong with no following consonant, e.g. /tʃ^{h}òu/, has as its optimal output a form with a monophthong, e.g. [tʃ^{h}ò] 'be sweet' ((13)b).[11]

(26)

/tʃ^{h}òu/	HEADEDPLACE	*PLACE]$_{\sigma}$	MAX(Place)
tʃ^{h}ə	* !		
tʃ^{h}òu		* !	
☞ tʃ^{h}ò			*

On the other hand, when the diphthong is followed by a (placeless) coda consonant, as in [tʃ^{h}ouʔ] 'sew' (12)c, the diphthong is no longer in syllable-final position. In this case, *PLACE]$_{\sigma}$ will not be violated, and the candidate *[tʃ^{h}oʔ] fails because it violates MAX(Place).

[10] The most commonly found tone in open syllables in English loanwords is Low, which may be regarded as the least marked tone of Burmese and therefore the one that surfaces when the input provides no tone.

[11] The alternative hypothesis, that input monophthongs /e o ɔ/ have diphthongal output allophones, would have grave difficulties motivating diphthongization in closed syllables.

(27)

/tʃʰouʔ/	*PLACE]$_\sigma$	MAX(Place)
☞ tʃʰouʔ		
tʃʰoʔ		* !

This explanation will hold for the other monophthong/diphthong pairs seen above in (12)–(13): [ʔè] vs. [ʔèiN], [ʔeiʔ]; [tʃɔ̀] vs. [tʃàuN], [tʃauʔ]. Thus we may conclude that the monophthongs e o ɔ are output allophones of input ei ou au. Since ɛ and ai both occur before ʔ (e.g. [sʰɛʔ] 'offer respectfully' vs. [sʰaiʔ] 'arrive'; [tɛʔ] 'go up' vs. [taiʔ] 'attack'), they are separate phonemes /ɛ/ and /ai/, but elsewhere the two are in complementary distribution, as only ai but not ɛ appears before N and only ɛ but not ai appears in open syllables.

2.3 Monosyllabic feet

Following standard definitions of feet (Allen 1973, Hayes 1980, Selkirk 1980b), we may assume that heavy (μμ) syllables are in fact feet; because long vowels, falling diphthongs, and vowel + consonant sequences all have more prominence on the first mora than the second, these feet may be considered left-headed and therefore trochaic.[12] The fact that the first mora of a heavy syllable licenses Place features while the second mora does not is additional evidence for the left-headedness of heavy syllables. Any minor syllables preceding a major syllable remain unfooted, as shown in (28), where parentheses indicate foot boundaries.

(28) Monosyllabic feet in Burmese

a.	(bɛ́)	'duck'
b.	(páN)	'flower'
c.	(n̥iʔ)	'year'
d.	zə(bwɛ́)	'table'
e.	tʰəmə(jè)	'rice-water'

According to Grouping Harmony (Prince 1990), (L L) is as harmonious a foot as (H); the two should be equivalent. But although a Burmese word may consist of a single heavy syllable, no Burmese word consists of two light (minor) syllables; *[L L] is not a possible word shape, and therefore presumably not a possible foot. This fact may be attributed to two undominated constraints aligning each edge of a foot with the edge of the head syllable of the foot.

(29) **ALIGN-L(*f*, σ́)**
The left edge of each foot is aligned with a foot-head.

(30) **ALIGN-R(*f*, σ́)**
The right edge of each foot is aligned with a foot-head.

[12] See Kager (1993) on the internal prominence contour of heavy syllables.

Since only one syllable can be the head of any foot, only monosyllabic feet can obey both of these constraints, as illustrated in the tableau in (31).

(31)

	ALIGN-L(*f*, σ́)	ALIGN-R(*f*, σ́)
(σ́ σ)		*
(σ σ́)	*	
(σ́)		

Every pword in Burmese must end in a major syllable, i.e. a foot. This implies that not only ALIGN-L(*f*, σ́) and ALIGN-R(*f*, σ́) but also ALIGN-R(ω, *f*) (32) (McCarthy & Prince 1993b, 32) are undominated and inviolable in Burmese.

(32) **ALIGN-R(ω, *f*)**
The right edge of every pword is aligned with the right edge of some foot.

As the tableau in (33) shows, only pwords of the form [(σ́)], [σ(σ́)], and [σσ(σ́)] (the canonical word shapes of Burmese), meet all three constraints.

(33)

	ALIGN-L(*f*, σ́)	ALIGN-R(*f*, σ́)	ALIGN-R(ω, *f*)
$[(\acute{\sigma})]_{\omega}$			
$[\sigma(\acute{\sigma})]_{\omega}$			
$[\sigma\sigma(\acute{\sigma})]_{\omega}$			
$[(\acute{\sigma})\sigma]_{\omega}$			*
$[(\acute{\sigma}\sigma)]_{\omega}$		*	
$[(\sigma\acute{\sigma})]_{\omega}$	*		
$[(\acute{\sigma}\sigma)\sigma]_{\omega}$		*	*
$[(\sigma\acute{\sigma})\sigma]_{\omega}$	*		*

In the next section we see how these three alignment constraints interact with other constraints to determine the form and distribution of minor syllables.

3. Minor syllables

Minor syllables contain only the vowel ə in Burmese. They contain neither tone nor coda consonants, do not allow complex onsets, and may never appear in the final position of a word. As we have seen, major syllables are bimoraic; it is reasonable to suppose that minor syllables are monomoraic. This supposition is borne out by the phonetic evidence of Mehnert & Richter (1972–77), who show that the duration of minor syllables has a range of 25–50 ms, while the duration of major syllables has a range of 150–600 ms.

Minor syllables often occur as the initial syllable of a bisyllabic monomorphemic word like [kʰəlouʔ] ‘knob’. In this case, the toneless schwa is probably already represented as such in the input since the learner is confronted with no alternations that would justify any other input.[13] But minor syllables arise also in a kind of compound word that I refer to as a “reducing compound.” In a reducing compound, the last syllable

[13] See Yip (1996) on the shape of the input in the absence of alternations.

of a nonfinal member of the compound is reduced from a major to a minor syllable. Some examples of reducing compounds are shown in (34). (The obstruent voicing seen on the final element of some of these compounds will not concern us here, as it does not affect prosodic structure.)

(34) Reducing compounds

a.	tʃáN + pó > tʃəbó	'floor' + 'insect' > 'bug'
b.	ŋá + ʔu̯ > ŋəʔu̯	'fish' + 'egg' > 'fish-spawn'
c.	n̥iʔ + la̯ > n̥əla̯	'two' + 'month' > 'two months'
d.	θwá + jè > θəjè	'tooth' + 'juice' > 'saliva'
e.	t^həmíN + jè > t^həməjè	'rice' + 'water' > 'rice-water'
f.	kəlá + pjè > kələbjè	'Indian' + 'country' > 'India'

As can be seen from these examples, a number of phonological processes happen under reduction: tone is lost; all vowel place features are lost, leaving only placeless ə behind; a coda consonant is lost (cf. (34)a, c, e); and an onset cluster is simplified (cf. (34)d). All of these processes find a single explanation if we assume that minor syllables are unfooted, an assumption that can be attributed to the role of ALIGN-L(f, σ́), ALIGN-R(f, σ́), and ALL-FT-R (35). As discussed above, ALIGN-L(f, σ́) and ALIGN-R(f, σ́) are undominated in Burmese; both they and ALL-FT-R crucially outrank PARSE-σ (36). The domination of ALL-FT-R cannot be demonstrated with the tableau in (37), but in § 4.2 we will see that it can be violated.

(35) **ALL-FT-R**
Align-R(f, ω): the right edge of every foot is aligned with the right edge of some pword.

(36) **PARSE-σ**
Syllables are parsed into feet.

(37)

/ŋá+ʔu̯/	ALIGN-L(f, σ́)	ALIGN-R(f, σ́)	ALL-FT-R	PARSE-σ
[(ŋá)(ʔu̯)]$_ω$			* !	
[(ŋá.ʔə)]$_ω$		* !		
[(ŋə.ʔu̯)]$_ω$	* !			
☞ [ŋə(ʔu̯)]$_ω$				*

Each of the four phonological processes found in reducing compounding—loss of tone, loss of vowel place features, loss of the coda nasal, and onset simplification—are attributable to the loss of foot status under syllable reduction. In what follows we shall analyze each of these processes in turn; we begin with the loss of tone.

3.1 Loss of tone

The loss of tone under syllable reduction may be viewed as the interaction between the constraints FOOTSALIENCE (FTSAL) and *TONE. FTSAL was defined by Zec (1999) for Neo-Štokavian as "A foot is associated with High tone," because in that language only High tone is present in the input, while Low tone is the default for syllables not marked

with High. In Burmese, on the other hand, apparently all the tones are present in the input,[14] so FTSAL must be stated more generally.

(38) **FTSAL** (Zec 1999)
A foot is associated with tone.

*TONE can be thought of as a member of the *STRUCTURE family (Prince & Smolensky 1993, 25; McCarthy 2002, 47) that imposes general bans on marked structure.

(39) ***TONE**
Tone is not present.

When FTSAL outranks *TONE, which in turn outranks the faithfulness constraint MAX(Tone) ("Tonal features present in the input are present in the output"), tone is realized on all and only footed syllables. Because minor syllables are unfooted, they are toneless. This is shown in the tableau in (40).

(40)

/ŋá+ʔu̯/	FTSAL	*TONE	MAX(Tone)
[ŋə́(ʔu̯)]$_{\omega}$		**!	
☞ [ŋə(ʔu̯)]$_{\omega}$		*	*
[ŋə(ʔu)]$_{\omega}$	* !		**

3.2 Loss of vowel place features

Under the widespread assumption that ə is a placeless vowel, the fact of its occurrence to the exclusion of all other vowels in minor syllables in Burmese can be attributed to *PLACE]$_{\sigma}$. As defined in (19), this constraint bans place features not specifically from the coda position of the syllable but rather from the right edge of the syllable. In open, monomoraic syllables, the nucleus vowel is at the right edge of the syllable and therefore subject to *PLACE]$_{\sigma}$. When a syllable surfaces as a minor syllable, for example in reducing compounds, the vowel is reduced to ə in compliance with *PLACE]$_{\sigma}$ and in violation of lower-ranking MAX(Place) (20). Major syllables, on the other hand, are bimoraic, so that the Place features associated with the last mora are also associated with the first mora, avoiding a violation of *PLACE]$_{\sigma}$. An example comes from the word [ŋəʔu̯] 'fish-spawn' (34)b, as shown in the tableau in (41).

(41)

/ŋá+ʔu̯/	*PLACE]$_{\sigma}$	MAX(Place)
ŋa(ʔu̯)	* !	
☞ ŋə(ʔu̯)		*

Extending the ban on syllable-final place features so that it applies not only to coda consonants but to vowels as well thus accounts simultaneously for the prohibition on diphthongs in open syllables and the reduction of all vowels to ə in minor syllables.

[14] At least in native words; as mentioned above, the Low tone that appears in English loanwords is perhaps not present in the input.

3.3 Loss of coda consonants

It is generally accepted that heavy syllables are more marked than light syllables, so that a constraint banning heavy syllables is predicted. This constraint may be named NOHEAVY.

(42) **NOHEAVY**
A syllable contains only one mora.

In fact, of course, most syllables in Burmese are major syllables, and therefore bimoraic. But it is a well known fact of prosodic phonology that feet are preferably binary (bimoraic or bisyllabic), as expressed by the constraint FOOTBINARITY (FTBIN).

(43) **FTBIN** (Prince & Smolensky 1993, 47)
Feet are binary at some level of analysis (μ, σ)

Provided FTBIN outranks NOHEAVY in Burmese, a syllable may be bimoraic only in order that FTBIN not be violated, as illustrated in (44).

(44)

/k^{h}à/	FTBIN	NOHEAVY
[(k^{h}à$_{\mu}$)]$_{\omega}$	* !	
☞ [(k^{h}à$_{\mu\mu}$)]$_{\omega}$		*

NOHEAVY thus predicts that unfooted syllables must be monomoraic, since FTBIN is not an issue. This is the reason why the first syllable in a reducing compound such as /tʃáN+pó/ [tʃəbó] 'bug' ((34)a) or /n̥iʔ+la̰/ [n̥əla̰] 'two months' ((34)c) loses its coda consonant: a bimoraic syllable would induce an extra violation of NOHEAVY, and footing the first syllable would violate ALL-FT-R (35). Undominated ALIGN-L(*f*, σ́) and ALIGN-R(*f*, σ́) prevent the two syllables from forming a (L L) foot. The ranking ALIGN-L(*f*, σ́), ALIGN-R(*f*, σ́), FTBIN » ALL-FT-R » PARSE-σ, NOHEAVY » MAX(seg) (45) is shown in the tableau in (46). The dashed lines in the tableau indicate that the ranking of two constraints with respect to each other cannot be determined. NOHEAVY crucially dominates MAX(seg).

(45) **MAX(seg)**
A segment in the input has a correspondent in the output. (No deletion)

(46)

/tʃáN+pó/	ALIGN-L(*f*, σ́)	ALIGN-R(*f*, σ́)	FTBIN	ALL-FT-R	PARSE-σ	NOHEAVY	MAX(seg)
[tʃə(bó$_{\mu}$)]$_{\omega}$			* !		*		*
☞ [tʃə(bó$_{\mu\mu}$)]$_{\omega}$					*	*	*
[(tʃə$_{\mu}$bó$_{\mu}$)]$_{\omega}$	* !						*
[(tʃá$_{\mu}$bə$_{\mu}$)]$_{\omega}$		* !					*
[tʃaN(bó$_{\mu\mu}$)]$_{\omega}$					*	**!	
[(tʃáN)(bó$_{\mu\mu}$)]$_{\omega}$				σ !			

ALIGN-L(f, σ́), ALIGN-R(f, σ́), and FTBIN are all unviolated in Burmese: there is no circumstance under which either a (L L) foot or a (L) foot is permissible.

3.4 Onset simplification

Major syllables allow onset clusters in Burmese while minor syllables do not. If a major syllable with a complex onset becomes minor in a reducing compound, the second consonant of the onset is lost, as shown in (47) (Okell 1969, 15).

(47) Onset cluster simplification in reducing compounds

a.	nwá + no̰ > nənó̰	'cow' + 'udder' > 'milk'
b.	θwá + jè > θəjè	'tooth' + 'juice' > 'saliva'
c.	pja̰ + tíN + pauʔ > pədíNbauʔ	'show' + 'tighten' + 'opening' > 'window'

To account for this fact I suggest that onset clusters are permitted only in foot-initial position in Burmese, and that the first consonant of such clusters is linked directly to the foot. Following arguments formalized in Green (2002), I propose that a universally ranked subhierarchy on onset clusters includes a string $*_{\sigma}$[CC » $*_{f}$[CC, i.e. a cluster at the left edge of a syllable is universally more marked than a cluster at the left edge of a foot.[15] In Burmese, this ranking is interrupted by MAX(seg), i.e. $*_{\sigma}$[CC » MAX(seg) » $*_{f}$[CC, allowing cluster simplification at the syllable level but not the foot level. Also low ranked is EXHAUSTIVITY$_{f}$ (Selkirk 1995, 443), which militates against domination by feet of anything other than syllables. The ranking is exemplified in the tableaux in (51) and (52).

(48) **$*_{\sigma}$[CC**
A sequence of two consonants is forbidden in syllable-initial position.

(49) **$*_{f}$[CC**
A sequence of two consonants is forbidden in foot-initial position.

(50) **EXH$_{f}$**
A foot immediately dominates only syllables.

(51)

/nwáno̰/	$*_{\sigma}$[CC	MAX(seg)	EXH$_{f}$	$*_{f}$[CC
.nwə.(no̰.)	* !			
☞ .nə.(no̰.)		*		

In the tableau in (52), the consonant in italics is extrasyllabic, being linked directly to the foot.

[15] See Beckman (1998: 238 ff.) for a different analysis of complex syllable margins in prominent positions.

(52)

/nwá/	*σ[CC	MAX(seg)	EXH$_f$	*$_f$[CC
(.nwá.)	* !			*
(.ná.)		* !		
☞ (*n* .wá.)			*	*

Thus, all of the phonological processes that major syllables undergo when they are transformed into minor syllables under reducing compounding are linked to the loss of foot status. Tone is lost, because only feet are required to be associated with tone. A coda consonant and all vowel place features are lost, because an unfooted syllable must be light, and place features are banned from the right edges of syllables. And complex onsets are simplified, because only feet tolerate complex onsets.

3.5 Distribution of minor syllables

Next, let us examine the constraint interactions that prohibit ə from occurring word-finally. The constraint HEADEDPLACE (53) requires the head mora of a foot to dominate place features,[16] and ALIGN-R(ω, *f*) (32) requires every pword to be right-aligned with a foot. Both constraints are undominated and surface-true in Burmese. So what happens if an input ends in /ə/? Native words probably never have such inputs, as speakers would have no reason to posit them, but evidence from English loanwords shows us the strategy: word-final [ə] of English is realized as [a] in Burmese, as in [kɔ̀mà] 'comma'. The faithfulness constraint violated here, assuming the input /(kɔ)mə/[17], is DEP(Place) (54).[18]

(53) **HEADEDPLACE**
The head mora of a foot dominates Place features.

(54) **DEP(Place)**
Place features in the output have correspondents in the input.

(55)

/(kɔ)mə/	HEADEDPLACE	ALIGN-R(ω, *f*)	DEP(Place)
[(kɔ̀)(mə)]$_ω$	* !		
[(kɔ̀)mə]$_ω$		* !	
☞ [(kɔ̀)(mà)]$_ω$			*

4. Polypodic words

One salient property of Burmese prosodic phonology is that there is a strong preference for nonbranching prosodic categories. We have seen that every prosodic category preferably contains exactly one of the next lower category. Syllables are monomoraic because of NOHEAVY, prohibiting bimoraic syllables, unless higher-ranking FTBIN forces a syllable to be bimoraic (cf. (46)). All feet are monosyllabic in Burmese, because ALIGN-L(*f*, σ́) and ALIGN-R(*f*, σ́) are undominated. And most pwords contain exactly

[16] HEADEDPLACE is similar in effect to Cohn & McCarthy's (1998) constraint NON-HEAD(ə), which prohibits stressed ə.

[17] The reason for the foot structure in the input will become clear in § 4.2.

[18] I do not have space here to explore the question why the features of [a] rather than some other vowel are the ones supplied.

one foot, because of high-ranking ALL-FT-R (cf. (46)). Such words are called "monopodic," and examples of them are shown in (56).

(56) Monopodic words in Burmese

a.	$[(\theta wá)]_\omega$	'go'
b.	$[(lè)]_\omega$	'be heavy'
c.	$[(sà)]_\omega$	'writing'
d.	$[(ʔèiN)]_\omega$	'house'
e.	$[\theta ə(jɔ̀)]_\omega$	'mock, satirize'
f.	$[k^hə(louʔ)]_\omega$	'knob'
g.	$[t^həmə(jè)]_\omega$	'rice-water'

Nevertheless, there are some words in Burmese that contain more than one foot ("polypodic words"). These are chiefly compounds (57)a or loanwords (57)b. A very few noncompound polypodic words do not appear to be loanwords (57)c. I shall refer to noncompound polypodic words, such as (57)b–c, as "superlong" words.

(57) Polypodic words in Burmese

a.	$(nè)(t^hàiN) = (nè) + (t^hàiN)$	'reside' = 'stay' + 'sit'
b.	$(tʃ^hɔ̰)kə(lɛʔ)$	'chocolate' < English
c.	(mòuN)(dáiN)	'storm'

In this section I shall argue that polypodic words are prespecified for some prosodic structure: compounds like (57)a contain pword structure in the input, and superlong words like (57)b–c contain foot structure in the input.

4.1 Nonreducing compounds

Above in § 3 we saw a type of compounding called reducing compounding. Burmese also has nonreducing compounding, in which the elements of the compound undergo no phonological changes.[19] Nonreducing compounds are thus quite straightforward: two or more words are strung together to form a single word. The individual members of these compounds probably retain their original pwords, which are then parsed recursively[20] into a single, larger pword, as shown in (58).[21]

(58) Nonreducing compounds: $\omega + \omega > [\omega\ \omega]_\omega$

a. $[nè]_\omega + [t^hàiN]_\omega > [\ [nè]_\omega\ [t^hàiN]_\omega\ ]_\omega$
'stay' + 'sit' > 'reside'

[19] It is not unusual for a language to have more than one type of compound. Mohanan (1982, 1986), Aronoff & Sridhar (1983), Sproat (1986), and Inkelas (1989) discuss compounds in Kannada and Malayalam, where "subcompounds" and "cocompounds" have different phonological effects from each other. Unlike Kannada and Malayalam, Burmese does not seem to have an obvious semantic distinction between the two types of compounds.

[20] See Inkelas (1989) and McCarthy & Prince (1993b) on the recursiveness of the pword.

[21] Examination of the glosses in the examples (especially (58)e, f) reveals that many "compounds" in Burmese are not compounds in the traditional sense at all, but rather "concatenation[s] of lexical words and grammatical formatives, presumably under a single X-bar category (X°)" (Bennett & Lehman 1994).

b. [jáuN]$_{\omega}$ + [wɛ̀]$_{\omega}$ > [[jáuN]$_{\omega}$ [wɛ̀]$_{\omega}$]$_{\omega}$
'sell' + 'buy' > 'trade'

c. [tʃɛʔ]$_{\omega}$ + [s^{h}ìN]$_{\omega}$ > [[tʃɛʔ]$_{\omega}$ [s^{h}ìN]$_{\omega}$]$_{\omega}$
'fowl' + 'elephant' > 'turkey'

d. [ʔəjè]$_{\omega}$ + [ʔətʃ^{h}íN]$_{\omega}$ > [[ʔəjè]$_{\omega}$ [ʔətʃ^{h}íN]$_{\omega}$]$_{\omega}$
'qualification' + 'quality' > 'standard'

e. [po̲]$_{\omega}$ + [p^{h}o̲]$_{\omega}$ + [k^{h}áiN]$_{\omega}$ > [[po̲]$_{\omega}$ [bo̲]$_{\omega}$ [k^{h}áiN]$_{\omega}$]$_{\omega}$
'send' + 'to' + 'tell' > 'tell him to send it'

f. [tʃi̲]$_{\omega}$ + [lo̲]$_{\omega}$ + [káuN]$_{\omega}$ > [[tʃi̲]$_{\omega}$ [lo̲]$_{\omega}$ [káuN]$_{\omega}$]$_{\omega}$
'look' + '-ing' + 'be good' > 'be good to look at'

g. [kauʔ]$_{\omega}$ + [pɛ́]$_{\omega}$ + [ʔəθí]$_{\omega}$ + [ʔən̰àN]$_{\omega}$ > [[kauʔ]$_{\omega}$ [pɛ́]$_{\omega}$ [θí]$_{\omega}$ [n̰àN]$_{\omega}$]$_{\omega}$
'paddy' + 'peas' + 'fruit' + 'grain' > 'crops'

h. [ʔó]$_{\omega}$ + [ʔìN]$_{\omega}$ + [k^{h}wɛʔ]$_{\omega}$ + [jauʔ]$_{\omega}$ > [[ʔó]$_{\omega}$ [ʔìN]$_{\omega}$ [k^{h}wɛʔ]$_{\omega}$ [jauʔ]$_{\omega}$]$_{\omega}$
'pot' + 'bowl' + 'cup' + 'ladle' > 'household goods'

(I am not concerned here with certain effects of compounding, such as voicing, as seen in (58)e, or the loss of the prefix [ʔə-] in some forms like (58)g, but not in others like (58)d.)

Compound words consisting of more than one pword are well attested: in Igbo (Zsiga 1992), Malayalam (Sproat 1986, Inkelas 1989), Sanskrit (Selkirk 1980a), and Turkish and Hungarian (Nespor & Vogel 1986), for example, certain compounds contain more than one pword. Also in the history of Welsh, as described by Jackson (1953, 367, 436, 514, 579), external sandhi processes are found between the members of a compound, and are distinct from internal sandhi processes found within a simple pword. This implies that the members of the compound are separate pwords in that language as well.

Whether a Burmese compound will be of the reducing or nonreducing type cannot be determined phonologically. There is no phonological reason why (58)a 'reside' must be [nèt^{h}àiN], not *[nət^{h}àiN], nor why (34)a 'bug' must be [tʃəbó], not *[tʃáNbó]. Indeed, there seems to be dialectal variation on this point. Okell (1969, 15) reports reduced [t^{h}əjè] 'toddy juice' from Upper Burma beside nonreduced [t^{h}áNjè] from Lower Burma. Instead, the decision between reducing and nonreducing compounds must be made already in the lexicon, for example by prespecifying pwords in nonreducing compounds. Under this analysis, a nonreducing compound like [nèt^{h}àiN] is lexically specified as containing two pwords, thus /[nè]$_{\omega}$+[t^{h}àiN]$_{\omega}$/, while reducing compounds like [tʃəbó] do not contain prosodic prespecification, thus /tʃáN+pó/. And the word for 'toddy juice' is lexically represented as /t^{h}áN+jè/ in Upper Burmese dialects and /[t^{h}áN]$_{\omega}$+[jè]$_{\omega}$/ in Lower Burmese dialects.

Two constraints relevant for this analysis are MAX(ω) (59) and NONREC$_{\omega}$ (60).

(59) **MAX(ω)**
A pword in the input has a correspondent in the output.

(60) **NONREC$_\omega$** (Selkirk 1995, 443)
No pword dominates a pword.

In Burmese, MAX(ω) dominates NONREC$_\omega$, which means that a pword may be recursive only in order to avoid deleting a prespecified pword. The result is that reducing compounds have no recursivity in the output, while nonreducing compounds do have recursivity, as shown in the tableaux in (61)–(62).

(61)

/tʃáN+pó/	MAX(ω)	NONREC$_\omega$
[[tʃáN]$_\omega$ [bó]$_\omega$]$_\omega$		* !
☞ [tʃəbó]$_\omega$		

(62)

/[nè]$_\omega$+[t^{h}àiN]$_\omega$/	MAX(ω)	NONREC$_\omega$
☞ [[nè]$_\omega$ [t^{h}àiN]$_\omega$]$_\omega$		*
[nət^{h}àiN]$_\omega$	* !	

As for dialectal variation between Upper Burmese and Lower Burmese dialects, this is probably due to different lexical specifications in the different dialects rather than to different constraint ranking. Okell (1969, 15) says, "weakening [i.e. reduction in compounding —ADG] is said to be more common in Upper than in Lower Burma" and gives the [t^{h}əjè ~ t^{h}áNjè] 'toddy juice' example as an illustration; but to argue that Upper Burmese has the ranking NONREC$_\omega$ » MAX(ω) would be to predict that Upper Burmese *never* has nonreduced compounds, which is not the case (F. K. L. Chit Hlaing, p.c.).

Burmese freely tolerates compounds with both reducing and nonreducing elements, as shown in (63).

(63) Compounds with both reducing and nonreducing elements
a. luʔ + pì + lá > luʔpəlá 'free' + 'is' + Q > 'is (one) free?'
b. nè + mɛ̀ + lá > nèməlá 'stay' + IRREALIS + Q > 'will (one) stay?'
c. pja̱ + tíN + pauʔ > pədíNbauʔ 'show' + 'tighten' + 'opening' > 'window'
d. méiN + ma̱ + wuʔ > méiNməwuʔ
'woman' + fem. + 'clothing' > 'women's clothing'
e. láN + ma̱ + tɔ̀ > láNmədɔ̀ 'road' + 'main' + 'honorific' > 'main road'

In these cases, the inputs presumably contain prespecified pword structure only where there is no reduction, thus /[luʔ]$_\omega$+pì+[lá]$_\omega$/, /pja̱+[tíN]$_\omega$+[pauʔ]$_\omega$/, etc.

4.2 Noncompound polypodic words

In addition to compounds, Burmese has a few superlong words, by which I mean morphologically simplex (i.e. not compound) polypodic words. Most but not all of them are loanwords. Some examples are shown in (64).

(64) Superlong words in Burmese
a. (tʃa̱uN)(tʃa̱) 'be anxious'
b. (mòuN)(dáiN) 'storm'
c. (t^{h}à)pə(nà) 'enshrine' < Pāli *ṭhapanā*

d.	(bouʔ)(dạ)	‘Buddha’ < Pāli *buddha*
e.	(ʔà)(kà)(θạ)	‘space, universe’ < Pāli *ākāsa*
f.	ʔəpə(rí)ʃə(jeiʔ)	‘appreciate’ < English
g.	(tʃʰɔ̰)kə(lɛʔ)	‘chocolate’ < English
h.	(ʔìN)(dʒìN)	‘engine’ < English

Just as nonreducing compounds are analyzed as having prespecified pwords, these superlong words can be analyzed as having prespecified feet: the input of [tʰàpənà], for example, is /(tʰà)pənà/. In order to prevent syllable reduction from applying, we need to assume that a faithfulness constraint MAX(*f*) (65) outranks ALL-FT-R, as illustrated in (66).

(65) **MAX(*f*)**
A foot in the input has a correspondent in the output.

(66)

/(tʰà)pənà/	MAX(*f*)	ALL-FT-R	MAX(Place)
[tʰəpə(nà)]ω	* !		*
☞ [(tʰà)pə(nà)]ω		σσ	

Polypodic words are exceptional in Burmese, and arise only when some prosodic structure (pword, foot) is prespecified in the input. Where no prosodic structure is prespecified, Burmese constraint ranking ensures that pwords are monopodic, in accordance with the more general tendency toward nonbranching prosodic categories in this language.

5. Conclusions

In this chapter I have discussed several aspects of the prosodic structure of Burmese and have addressed several problems. Both the ban on diphthongs in open syllables and the fact that placeless ə is the only vowel allowed in light open syllables are explained by analyzing Burmese as prohibiting both vocalic and consonantal place features from the right edge of a syllable. The various effects seen in syllable reduction (loss of tone, reduction of all vowels to ə, loss of coda consonants, and onset simplification) are all attributable to the fact that a major syllable is a foot while a minor syllable is unfooted. Finally, both pwords and feet can be prespecified in the input, accounting for the contrast between monopodic words (including reducing compounds) and polypodic words (including nonreducing compounds).

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