Lexical Tone and Markedness in Standard Thai

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1. Data

Every first-year linguistics student knows the five different ways to say *naa* in Thai. He or she also knows that an autosegmental representation, with primitives high (H) and low (L), represents the contrasts between the mid, high, low, falling and rising tones both simply and elegantly, as shown in (1). A closer look at the distribution of these five tones, however, reveals that the system is not so simple after all.

(1)

mid	high	low	falling	rising
	H	L	H L	L H
σ	σ	σ	σ	σ
[na:]	[ná:]	[nà:]	[nâ:]	[nǎ:]
'rice field'	'custard apple'	'aunt'	'face'	'thick'

First, there is an interaction of tone with stress. Tone is realized only on stressed syllables: in unstressed syllables all tones reduce to mid.[1] So, for example, in the reduplicated form [sawsǎ:w] 'young girls' the underlying rising tone on /sǎ:w/ is realized only on the stressed final syllable, while the initial syllable is pronounced with a mid tone. This interaction, we will argue, is a straightforward example of positional faithfulness.

Other restrictions are more complex and puzzling. Not all stressed syllables can bear all tones. Only open syllables with long vowels (CVV), or any syllable closed by a sonorant, regardless of vowel length (CVS and CVVS), can bear all five tones. Examples are given in (2).

[1] There are counterexamples to this claim, but we follow Yip's (1982:88) suggestion that these seem to involve morphology and secondary stress effects that we will not address here.

(2)

	CVV		CVS		CVVS	
mid	[naː]	‘rice field’	[daŋ]	‘loud’	[tʰaːŋ]	‘way’
low	[nàː]	‘custard apple’	[sàŋ]	‘to order’	[pʰàːn]	‘to pass’
high	[náː]	‘aunt’	[sám]	‘to repeat’	[sáːj]	‘left’
falling	[nâː]	‘face’	[nân]	‘that’	[hâːm]	‘to prohibit’
rising	[nǎː]	‘think’	[kʰǎm]	‘to order’	[hǎːn]	‘to divide’

Stressed open syllables with short vowels (CV) do not occur. CV is allowed only in unstressed syllables, where it has mid tone.

On syllables closed by obstruents, the tonal types are restricted in what appears to be a very odd way. On CVO syllables, only high and low can occur. On CVVO syllables, only falling and low are allowed.[2] Examples are given in (3).

(3)

	CVO		CVVO	
mid	----		----	
low	[càp]	‘catch’	[kʰàːt]	‘torn’
high	[lák]	‘to steal’	----	
falling	----		[mâːk]	‘many’
rising	----		----	

The absence of mid tone on obstruent-final syllables creates a markedness paradox. If mid is the lack of a phonological tone specification (a fairly standard assumption), and lack of tone is less marked than the presence of tone, why is a tone required on these syllables? The lack of high on CVVO is also a markedness paradox, since falling (a contour tone) should imply high (a simple tone). In addition, one must explain the absence of rising tone on CVVO and the lack of any contours at all on CVO.

These distributional gaps have been discussed in previous literature (Kruatrachue 1960, Abramson 1962, Gandour 1974, Yip 1982), but no explanation has been proposed. Regarding the lack of mid tone on obstruent-final syllables, Yip (1982:89) says that “the absence of M is odd, and neither Gandour or I have any explanation to offer…” In this paper, we propose an analysis of these surprising tonal patterns, drawing on principles of both phonetics and phonology.

[2] According to Gandour (1974), the rare exceptions with CVVC-H (e.g. [kʰáːt] ‘card’) and CVC-HL (e.g. [kʰlâk] ‘crowded’) are either loan words or onomatopoeia. Yip (1982) disputes this claim, but does not provide much data. We leave the analysis of these exceptions to future research.

2. Stress and Tone

Within an OT analysis, the iambic stress pattern of Thai is easily captured by assuming a high ranking constraint ALIGNHD-R that requires the head syllable of the foot (the stressed one) to fall at the right edge of the foot. The fact that tonal contrasts are realized only on stressed syllables is a straightforward example of positional faithfulness (Beckman 1995, Alderete 1995, Morén 1999). Underlying specifications surface in prominent positions, but are neutralized in non-prominent positions. We assume a positional faithfulness constraint MAX-STRESS[T], which requires realization of underlying tones in stressed syllables. This positional faithfulness constraint outranks the markedness constraint against having a tone, *[T]. On the other hand, the general faithfulness constraint MAX[T], which calls for no loss of tone in *any* context, is low-ranked. As shown in (7), the ranking Positional Faithfulness » Markedness » General Faithfulness ensures that tone is realized on stressed syllables, but underlying tonal specifications do *not* surface on unstressed syllables. Syllables phonologically unspecified for tone are realized as mid.

(4) MAXSTRESS[T]: do not delete an underlying tone from a stressed syllable.
(5) *[T]: do not have tone.
(6) MAX[T]: do not delete underlying tones.

(7) Neutralization of tone in unstressed syllables

	/saw-LH + saw-LH/	MAXSTRESS[T]	*[T]	MAX[T]
	saw + ˈsaːw	*!*		****
	saw-LH + ˈsaːw	*!*	**	**
	saw-LH + ˈsaːw-LH		***!*	
☞	saw + ˈsaːw-LH		**	**

3. Background: V-Length, C-Weight, and Glottal Epenthesis

In order to account for the facts of vowel length and syllable weight in Thai, we will assume the constraints in (8)-(17), based on the analysis of moraic structure in Morén (1999). The proposed constraint ranking is given in (18).

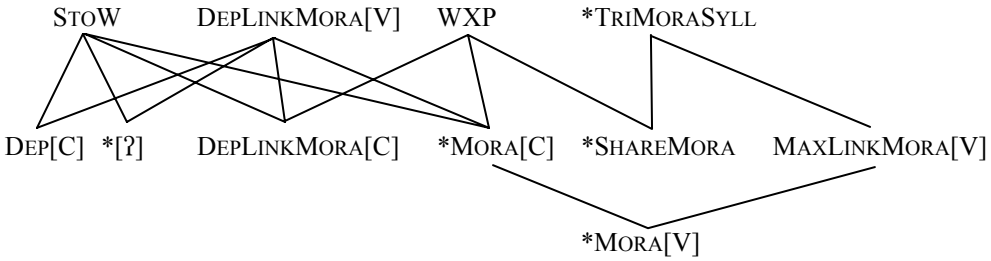
Markedness constraints:

(8) *MORA[V]: do not associate a mora with a vowel.
(9) *MORA[C]: do not associate a mora with a consonant.
(10) *TRIMORASYLL: no tri-moraic syllables.
(11) *SHAREMORA: there should be only one segment associated with a mora.
(12) STOW (stress-to-weight principle): stressed syllables must be heavy.
(13) WXP (weight-by-position): syllable-final consonants should be moraic.
(14) *[ʔ]: glottal stops are prohibited.

Faithfulness constraints:

(15) MAXLINKMORA[V]: do not delete an underlying mora from a vowel.[3]
(16) DEPLINKMORA[V]: do not add a mora to a vowel that it did not have underlyingly.[4]
(17) DEP[C]: do not insert a consonant.

(18) Constraint rankings for length/weight/glottal epenthesis



In Thai, short (mono-moraic) and long (bi-moraic) vowels are contrastive, but there are no trimoraic syllables. To ensure that one or two moras associated to a vowel in the input will surface in the output, MAXLINKMORA[V] is ranked above *MORA[V]. However, because *TRIMORASYLL outranks MAXLINKMORA[V], a third mora linked to a vowel will not surface.

Open syllables with short vowels occur only in unstressed positions, so we assume that all stressed syllables in Thai must be bimoraic (STOW » *MORA[V]). We further assume that all final consonants in Thai are moraic, because CVC syllables *can* bear stress (STOW » *MORA[C]).

Underlyingly short, open syllables that occur in a stressed position are made heavy by the addition of a final glottal stop (STOW » DEP[C], *[ʔ], *MORA[C]). As shown in tableau (19), glottal stop insertion is preferred to vowel lengthening as the method for creating heavy syllables (DEPLINKMORA[V] » DEP[C], *[ʔ], *MORA[C]). We indicate moras associated with a segment by superscripting.

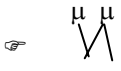
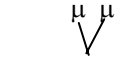
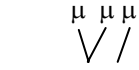
(19) Syllable weight augmentation via glottal epenthesis, not V-lengthening

/CV$^{\mu}$/	DEPLINKMORA[V]	STOW	DEP[C]	*[ʔ]	*MORA[C]
CV$^{\mu}$		*!			
CV$^{\mu}$ʔ		*!	*	*	
CV$^{\mu\mu}$	*!				
☞ CV$^{\mu}$ʔ$^{\mu}$			*	*	*

[3] Morén (1999), simplified here.
[4] Morén (1999), simplified here.

We will argue that codas following long vowels share the second mora of the vowel, as shown in (20). Mora sharing is supported by the phonetic evidence: long vowels in closed syllables are shorter than in open syllables. Broselow et al. (1998) attribute vowel shortening in closed syllables to the fact that the following consonant "takes up" some of the time of the last mora. We will see in §5 that the tonal evidence from CVVO syllables also supports this conclusion.

(20) Mora sharing between long vowel and coda consonant

/CV$^{\mu\mu}$C/	WXP	*TRIMORASYLL	*SHAREMORA	*MORA[C]
☞  C V C			*	*
 C V C	*!			
 C V C		*!		*

4. CVV, CVS, CVVS Syllables

We now turn to the analysis of tonal patterns in CVV, CVS, and CVVS syllables. When these syllables are stressed, mid, high, low, rising, and falling tones are permitted. As we saw in §2, the positional faithfulness constraint MAXSTRESS[T] outranks the markedness constraint *[T], ensuring that the surface representation is faithful to the input. Tone metathesis is prohibited by LINEARITY ("do not switch linear order"). An example of a rising tone on a CVV syllable is given in (22).

In this section, examples using CVV syllables will be given, but the result would be the same for CVS and CVVS. At this point, we assume that *[H] and *[L], as well as MAXSTRESS[H], MAXSTRESS[L], and LINEARITY, are not ranked with respect to each other. We will argue for a specific ranking of the faithfulness constraints later.

(21) LINEARITY: no metathesis

(22) Contrastive rising tone in stressed CVV syllables

	/CVV-LH/	MAXSTRESS[H]	MAXSTRESS[L]	LINEARITY	*[H]	*[L]
☞	CVV-LH				*	*
	CVV-H		*!		*	
	CVV-L	*!				*
	CVV	*!	*!			
	CVV-HL			*!		

We will assume that the mora is the tone-bearing unit. Association of H to one mora and L to another will produce rising and falling contours. More complex contours are ruled out by a constraint prohibiting the association of more than one tone to a single mora, as shown in (25).

(24) *[TT]μ: no more than one tone per mora.

(25) Neutralization of complex contour tones

	/CVV-LHL/	*[TT]μ	MAXSTRESS[H]	MAXSTRESSL]	LINEARITY	*[H]	*[L]
	CVV-LHL	*!				*	**
☞	CVV-LH			*		*	*
☞	CVV-HL			*		*	*
	CVV-H			**!		*	
	CVV-L		*	*!			*

Note that if the input string has three (or more) tones, we don't know whether the output would be rising or falling, but we do know it would be a simple contour tone.

Mid tone (lack of tone) comes for free. If the input is unspecified for tone, the *[H] and *[L] markedness constraints will prefer an output without a tone (unless there is a highly-ranked constraint requiring that a tone be present).

(26) Contrastive mid tone in stressed CVV syllables

	/CVV/	MAXSTRESS[H]	MAXSTRESS[L]	*[H]	*[L]
	CVV-HL			*!	*
	CVV-H			*!	
	CVV-L				*!
☞	CVV				

5. CVVO Syllables

We now turn to the analysis of syllables closed by obstruents, beginning with those with long vowels. These syllables must be realized with either low or falling tone, not mid, high, or rising. The generalization seems clear: these syllables must end low. We propose to account for this generalization with a constraint that coda obstruents must be associated with low tone.

(27) OBSCODA→L: coda obstruents must be associated with L tone.

This constraint makes phonetic sense because, in Thai, coda obstruents are voiceless and glottalized. According to Maddieson (1977), "a simple cessation of voicing in [coda] position could readily be reinterpreted as a laryngeal segment." As voicelessness is reinterpreted as phonological laryngealization, the laryngealization may in turn lead to increased vocal fold stiffness and slower vibration prior

to complete glottal closure. Abramson (1962) documents glottalization of final consonants in Thai, accompanied by low-frequency glottal pulses on the preceding vowel. These low-frequency pulses may give rise to the perception of low tone, and the phonologization of that percept is the constraint in (27). Such a progression is given further support by Diller (1996), who shows that unvoiced segments were associated with non-high tones in the development of Thai.

Certainly, the cross-linguistic relationship between tone and laryngeal features is complicated. Maddieson (1976, 1977), for example, cites three cases (Navajo, Kiowa, and Kapanahua) where glottalized codas are associated with low tone and four cases (Jeh, Vietnamese, Danish, and Latvian) where glottalized codas are associated with *high* tone. Maddieson specifically argues that the association between high tone and glottalization comes about when, in order to reach a high pitch at the end of a long syllable, the vocalis muscle is tensed beyond the parameters necessary to continue modal voicing. Extra glottal tension may also be recruited to extend voicing in low tones, however: a speaker's voice can "crack" at both extremes of her or his range. Interestingly, an EMG study of two Thai speakers by Erickson and Abramson (1972) found active tensing of the vocalis muscle itself in only one context: the end of the falling tone.

We now turn to working out the phonological consequences of our proposed constraint. High ranking of OBSCODA→L solves our first two markedness paradoxes. Regardless of the input tonal sequence, only low and falling tones will surface on CVVO syllables.

As shown in tableau (28), if the input is associated with a low tone, or if there is no underlying tonal specification, the syllable will surface with a low tone. Since our constraint is a positive one, *requiring* the presence of a low tone (not just, for example, prohibiting H in this position), mid tones, with no tonal specification at all, cannot surface on these syllables.

(28) **Markedness Paradox 1**: neutralization to low (not mid) in CVVO

/CVVO-L/	OBSCODA→L	*[H]	*[L]
☞ CVVO-L			*
CVVO	*!		
/CVVO/	OBSCODA→L	*[H]	*[L]
☞ CVVO-L			*
CVVO	*!		

Tableau (29) shows that if there is a high tone in the input, a falling tone will surface. High and rising both fatally violate OBSCODA→L, while simple low unnecessarily violates MAXSTRESS[H]. The mid tone violates both.

(29) **Markedness Paradox 2**: neutralization to falling (not high) in CVVO

/CVVO-H/	OBSCODA→L	MAXSTRESS[H]	*[H]	*[L]
CVVO-L		*!		*
CVVO-H	*!		*	
CVVO-LH	*!			
☞ CVVO-HL			*	*
CVVO	*!	*		

LINEARITY, as shown in (30), must be ranked fairly low in the hierarchy. Both falling and rising input sequences will surface as falling.

(30) Tone metathesis in CVVO

/CVVO-HL/	OBSCODA→L	MAXSTRESS[H]	LINEARITY	*[H]	*[L]
CVVO-L		*!			*
CVVO-H	*!			*	
CVVO-LH	*!		*		
☞ CVVO-HL				*	*
CVVO	*!*				
/CVVO-LH/	OBSCODA→L	MAXSTRESS[H]	LINEARITY	*[H]	*[L]
CVVO-L		*!			*
CVVO-H	*!			*	
CVVO-LH	*!		*		
☞ CVVO-HL			*	*	*
CVVO	*!*				

Thus, no matter what the tonal specification of the input, high ranking of OBSCODA→L ensures that the output in CVVO syllables will have either a low or falling tonal pattern.

6. CVO Syllables

Finally, we turn to the CVO syllables, where the only tones allowed are simple H and L. These syllables have the inherent difficulty that voiceless obstruents cannot realize tone. With no vibration of the vocal folds, there cannot be a tone. Therefore, tones must be realized on the monomoraic vowel. We will formalize this with the constraint in (31).

(31) REALIZETONE: tones must be associated to a segment that can support vocal fold vibration.

In CVVO syllables, this constraint presents no problem. OBSCODA→L requires that a low tone be associated to the mora linked to the final consonant. But since this mora is shared with a vowel, the tone can be realized, and a low or falling specification results, as shown above. In CVO syllables, however, though

two morae are present, only one is able to realize a tone. Given the constraint against more than one tone linked to a single mora, only simple tones can occur.

If there is a low tone, or no tone, in the input, the output will be a low tone linked to both moras. This violates low-ranked *[μμ]T, which penalizes association of more than one mora to a single tone, but crucially satisfies both OBSCODA→L and REALIZETONE.

(32) Tone neutralization to low in CVO with tone shared by moras

/CVO-L/	REALIZETONE	OBSCODA→L	*[L]	*[μμ]T
μ μ CVO		*!		
L μ μ CVO	*!		*	
☞ L μ μ CVO			*	*
/CVO/	REALIZETONE	OBSCODA→L	*[L]	*[μμ]T
μ μ CVO		*!		
L μ μ CVO	*!		*	
☞ L μ μ CVO			*	*

Yet high tones can also occur on CVO syllables. If there is a high tone in the input, it must surface. Tableau (33) shows that we can account for this if both MAXSTRESS[H] and REALIZETONE outrank OBSCODA→L. Associating a low tone to the coda is important, but realizing an underlying H is even more so.

(33) Contrastive high tone in CVO syllables

/CVO-H/	MAXSTRESS[H]	REALIZETONE	OBSCODA→L	*[H]	*[L]
μ μ CVO	*!		*		
L μ μ CVO	*!				*
H L μ μ CVO		*!		*	*
☞ H μ μ CVO			*	*	

A falling contour, with the L doubly-linked to the obstruent and to the single sonorant mora, is ruled out in CVO syllables by the high-ranked prohibition on two tones associating to a single mora, *[TT]μ. (We saw above that we needed this constraint to rule out complex fall-rise contours on longer syllables.) In high-toned syllables with two sonorant morae, ObsCoda→L and MaxStressH can both be satisfied, and the result is a falling contour (29 and 30). In CVO syllables, only one tone can surface, and the higher ranking of MaxStress[H] ensures that that tone will be H. Tableau (34) shows that even if the input is a contour, H will surface on CVO syllables.

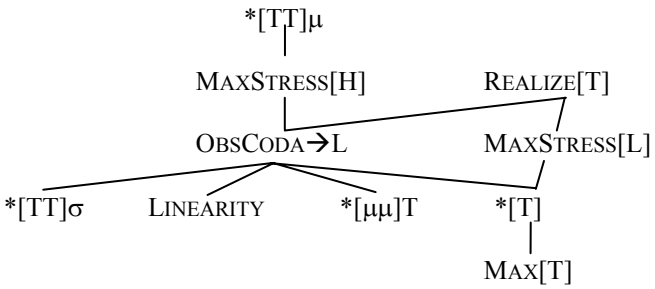
(34) Neutralization to high in CVO syllables

/CVO-HL/	*[TT]μ	MAXSTRESS[H]	REALIZETONE	MAXSTRESS[L]	OBSCODA→L
H L μ μ CVO			*!		
H L μ μ CVO	*!				
L μ μ CVO		*!			
☞ H μ μ CVO				*	*

7. Conclusions

We have proposed the constraint ranking shown in (35). This ranking yields the correct result for each syllable type. In the CVV, CVVS, and CVS cases, the faithful output is always optimal. In CVVO, OBSCODA→L requires low or falling tones. In CVO, only one tone can be realized. If there is an H in the input, high-ranking MAXSTRESS[H] ensures it will be realized. Otherwise, OBSCODA→L provides L.

(35) Constraint ranking for Thai tones



In addition, we have argued for a representation where the mora is the tone-bearing unit, and mid tone is represented by the absence of phonological tone specification—points that have been disputed in the literature on Thai phonology. Finally, but not least importantly, we believe we have neatly solved a tricky distributional puzzle.

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