Word Stress in Lao: an OT analysis

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1. Introduction

1.1 Why is this important?

- Very little research has been done on the stress system of Lao and some (Dryer et al. 2011) do not classify Lao (or its relative Standard Thai) as a stress language.
- Hayes (1995) states that pitch and duration are "intimately linked with stress," but Lao has phonemic vowel length and tone which makes claims of stress dubious.
- Though, if stress is seen as a phonetic realization of a deeper linguistic structure, rhythm, then Lao might be a stress language.

1.2 What am I trying to do?

- Provide clear evidence that metrical structure is present in Lao, even though stress is not expressed in a "typical" or canonical manner. I show that metrical structure can explain seemingly unrelated phonological processes in Lao, a glottal stop alternation and vowel length neutralization.
- Offer a modern analysis of the stress system in Lao that is descriptively adequate and also is predictive. Address some issues earlier accounts had accounting for the data and making typologically unusual predictions.

1.3 Organization of the talk

- Section 2 is an overview of the Lao language and the relevant data.
- Section 3 is a summary of an earlier analysis of a related language; Thai.
- Section 4 is the OT analysis of Lao prosody.
- Section 5 is the discussion and conclusion.

2. Language background and data.

2.1 Facts about Lao.

- Member of the Tai-Kadai language family. Relative of Standard Thai, with whom Lao shares many syntactic and phonological properties.
- Vowel length and tone are phonemic.

(1) Phonemic vowel length contrasts:
càn 'moon' cà:n 'plate'

(2) Phonemic tonal contrasts:
pâ: 'aunt' pā: 'forrest'

(3) Tones and distribution (Osatananda 1997, Enfield 2007)

	Distribution				
Tones		CVV/CVSon	CVVObs	CVObs	CV
	High	X		X	
	Mid	X		X	X
	Low	X			
	Mid-fall	X	X		
	High-fall	X	X		

2.2 Data

2.2.1 A glottal stop alternates with 0 in CV syllables.[1]

(4) CVʔ

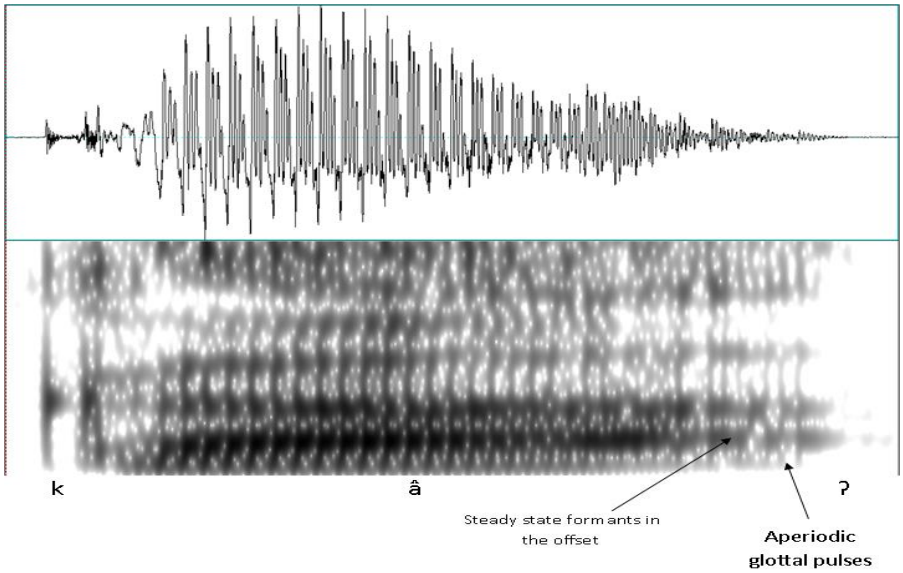
a.	kâʔ	‘expect’	d.	dŭʔ	‘fierce’
	*kâ	‘expect’		*dŭ	‘fierce’
	ka.kiàm	‘prepare’		du.dàn	‘violent’
b.	căʔ	‘will’	e.	tĭʔ	‘criticize’
	*că	‘will’		*tĭ	‘criticize’
	ca.pàj	‘will go’		ti.tʰôːt	‘incriminate’
c.	kĕʔ	‘sheep’			
	*kĕ	‘sheep’			
	kɛ.pʰùː	‘male sheep’			

(5) CVCVʔ

a.	ká.tʰīʔ	‘coconut milk’	c.	hí.māʔ	‘snow’
	*ká.tʰī	‘coconut milk’		*hí.mā	‘snow’
b.	ká.cáʔ	‘clean, pure’	d.	cú.kúʔ	‘attractive’
	*ká.cá	‘clean, pure’		*cú.kú	‘attractive’

- Acoustic evidence of glottal stop. In Figure 1 the glottal stop can be seen; the acoustic characteristics are: steady state formants (Borroff 2007), aperiodic glottal pulses and creaky voice (Redi and Shattuck-Hufnagel 2001).
- All spectrograms were produced by three native Lao speakers living in Iowa, USA. The words were spoken at a casual speed inside the carrier phrase *wâo __ ìːk*, ‘say __ again’.

Figure 1



- Epenthesis, not deletion. Following Bennett (1995), I assume that glottal stops are epenthetic in Lao.
  - Distribution: CVVObs syllables are licit, but *CVVʔ

[1] Unless otherwise noted, all data are from my own field notes.

- Only glottal stops are involved in the alternation discussed above. Compare the forms in (6) with the data in (4) above.

(6)

a.	băt	‘card’	c.	síp	‘ten’
	băt.sứ:n	‘invitation’		síp.sɔ̃:ŋ	‘twenty’
b.	nâm	‘water’			
	nâm.tók	‘waterfall’			

- Syllable types of Lao; seen in the data above.

(7) Osatananda (1997)

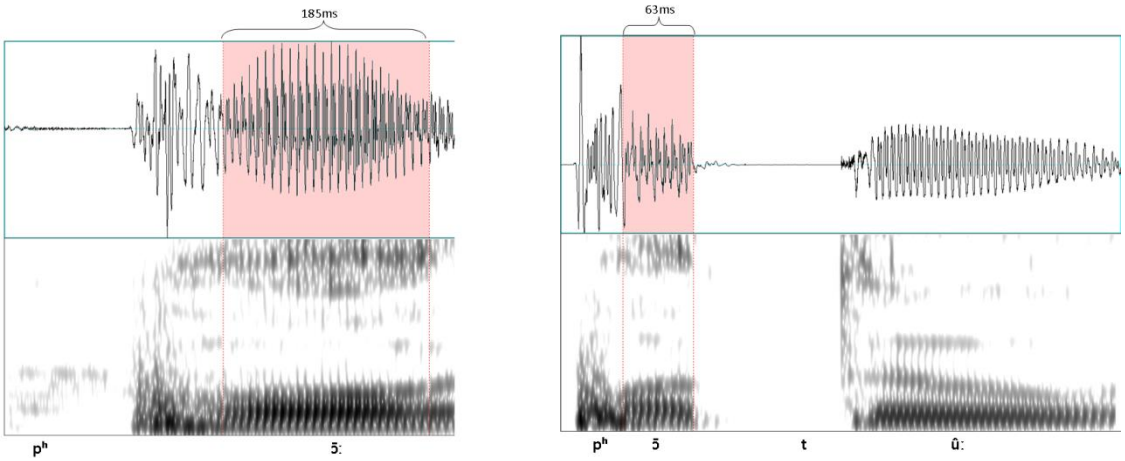
Licit	Illicit	Restricted
CVV	*V	CV
CVC	*CVCC	
CVVC	*CCVC	
	*CVVCC	
	*CCVV(C)	

2.2.2 Disyllabic Compounds

(8) Vowel shortening of compound words in Lao.

a.	pɔ̄:+tû:	→	pɔ̄.tû:
	father+old		‘old man’
b.	bà:k + kă:	→	bàk.kă:
	mouth+crow		‘marker’
c.	mă: pā:	→	mă.pā:
	dog+forrest		‘wolf’
d.	mà:k + mūa:ŋ	→	màk.mūa:ŋ
	fruit (cl.)+mango		‘mango’
f.	lă:j	→	laj.lă:j
	‘a lot’		‘rather a lot’
g.	sŭ:ŋ	→	suŋ.sŭ:ŋ
	‘tall’		‘relatively tall’
h.	sâ:	→	sa.sâ:
	slow		relatively slow

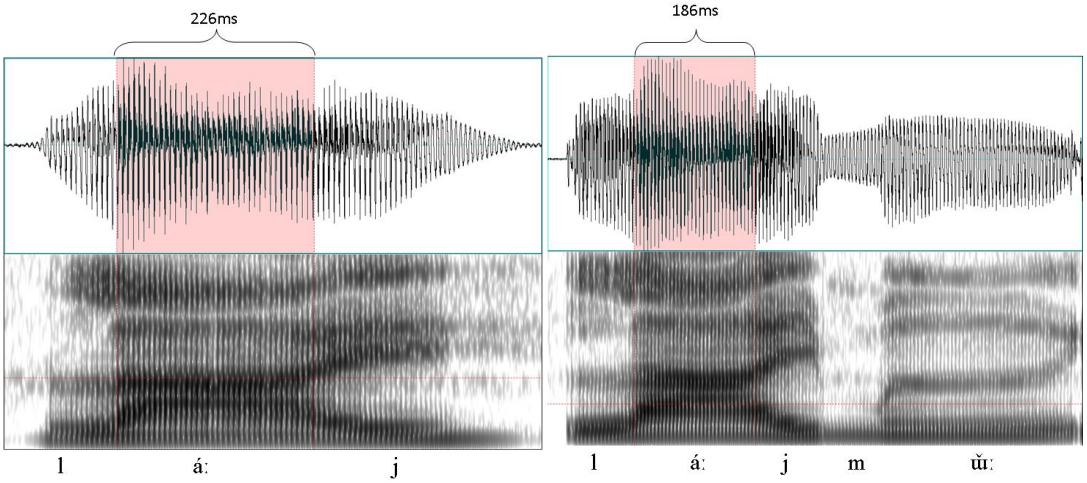
Figure 2. Spectrogram showing the vowel of the first syllable shortening.



(9) Compounds which not reduce. (Osatanada 1997:107,108).

a.	mɔ̂:p + hāp give + receive	→	mɔ̂:p.hāp exchange	c.	sɔ̀:p + sěŋ test+test	→	sɔ̀:p.sěŋ to take a test
b.	lá:j + mŭ: line+hand	→	lá:j.mŭ: lines on a palm	d.	bâ:n + húan home+home	→	bâ:n.húan home

Figure 3. Spectrogram showing the vowel of the first syllable not shortening.



- The relatively small amount of shortening observed in Fig. 3 can be attributed to the general tendency for syllables produced in isolation to be longer than when produced in multisyllabic contexts (Lihiste 1972, Klatt 1973).
- Osatanada (1997) gives syntactic definitions of the two types of compounds described above, and which I have termed Reducing Compounds (RCs) and Non-Reducing Compounds (NRCs). The six types of RCs she described are listed in (10) below.

(10) RCs in Osatanada (1997)
a. Disyllabic plural pronouns
b. Disyllabic compounds with a kinship term
c. Disyllabic compounds with a bound affix
d. Reduplicated compounds with identical disyllables
e. Compounds of different syntactic categories
f. Exocentric disyllabic compounds

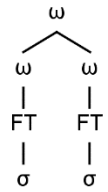
- I have collapsed these into two more general types.

(11) RCs
a. Lexical word + affix compounds, (10)a-e above.
b. Lexicalized compounds (semantically opaque/exocentric), (10)f above.

(12) Lao Prosodic Word (Following Kabak & Vogel 2001)
The PW consists of a root + affixes.

- The behavior of the NRCs and RCs then can be explained by structural differences between the two types of compounds. NRCs have a recursive prosodic word structure (McCarthy & Prince 1993; Ito & Mester 2006) while RCs are a single prosodic word.

(13) a. Non-reducing compounds:



b. Reducing compounds:

2.2.4 Generalizations/Summary.

- *Lao requires a minimum of one iambic foot per prosodic word and (LL) feet are banned. If an input cannot be parsed as a (H) or (LH), a glottal stop is epenthesized or vowel is shortened to repair the degenerate foot.*

3. Theoretical Assumptions & Previous Analyses

3.1 Metrical Stress Theory (Hayes 1995)

- Rhythm is hierarchically organized; syllables are grouped into feet which are grouped into words which are grouped into phrases and so on.

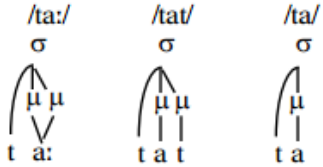
(14) Prosodic Hierarchy (Selkirk 1980)

ω	Prosodic word
Ft	Prosodic foot
σ	Syllable
μ	Mora

3.1.1 Syllable weight

- I am assuming moraic theory as presented in McCarthy & Prince (1986) and Hayes (1989).

(15) Moraic representations of syllable types. (Gordon 2004:3)



3.1.2 Foot inventory (Hayes 1995)

- Syllabic Trochee: (ˈσσ)
- Moraic Trochee: (ˈL L), (ˈH)
- Iamb: (L ˈH), (ˈH), (L ˈL)[2]

3.1.3 Minimal word

- Intimately related to metrical foot shape. Can be easily defined using foot type, but arbitrary without metrical feet. Minimal word is one foot instead of being 2 syllables or 2 moras.

3.2 Optimality Theory.

- I assume the version of Optimality Theory presented in Prince & Smolensky (1993/2002).

Lao and Thai are close relatives and share many phonological and syntactic features therefore it is worthwhile to review analyses of similar processes in Thai.

[2] The foot shape (L ˈL) is marked and very unstable cross-linguistically. It tends to become a (L ˈH) through iambic lengthening (Hayes 1995).

3.3 Bennett (1995)

- Bennett (1995) proposes that the preponderance of (LH) and (H) words in Thai can be explained if Thai has a preference for Iambic feet (RH-TYPE:I).

(16) RHYTHM-TYPE=IAMBIC: ALIGN-R (FT, $HEAD_{FT}$) (Bennett, 1995:66)
'Align the right edge of every foot with (the right edge of) a foot head.'

- He creates an analysis of prosody in Thai using the WSP and the SWP in an optimality theoretic account. Heavy syllables are stressed (WSP) and stressed syllables are heavy (SWP).
- Glottal stops are epenthetic to repair foot shapes that do not have final prominence.

(17) rá.já → ra.já? 'space, period' Bennett (1995:70)[3]

/rájá/	FT-BIN	RH-TYPE=I	SWP	*INSERT-μ
☞a. (ra.ˈj**á?**)				*
b. (ra.ˈjá)			*!	

- Vowel shortening in multisyllabic words is another way that the foot shape requirements are enforced.
- Bennett claims that various speech styles in Thai have different constraint rankings which give rise to the alternations. In the rapid style *INSERT-FT dominates PARSE-μ but in isolative styles PARSE-μ >> *INSERT-FT.

(18) mēesăa → mē.săa 'April' Bennett (1995:143) Rapid Style

/mēesăa/	WSP	*INSERT-FT	PARSE-μ
a. [(m**ēe**).(ˈs**ăa**)]		**!	
☞ b. [(mē.ˈs**ăa**)]		*	*
c. [(m**ēe**.ˈs**ăa**)]	*!		

- Shortcomings of Bennett (1995)
  - Coda weight is parametric, so his analysis cannot not explain why a word like bà:k.kă: 'pen' would shorten to bàk.kă:. The RH-TYPE=I constraint cannot evaluate a word where the first syllable goes from trimoraic to bimoraic.
  - Does not investigate compound words, which seem to behave similarly to polysyllabic words.
  - Ties destressing to tone neutralization.
    - Gordon (2004) argues that syllable weight is process driven. Many languages have varying weight criteria dependent on a given process.
    - I believe that tone distribution and stress are both sensitive to syllable weight, but are distinct processes. There is a three-way weight distinction with tone distribution and only a two-way weight distinction with stress.

(19) Tone distribution

Syllable type	Heavy	Medium	Light
CVV/CVSon	Carries contour tones		
CVObs		Carries level tones	
CV			No tonal contrast

Stress

Syllable type	Heavy	Light
CVV/CVC	Minimal word	
CV		Sub-minimal word

[3] I have modified Bennett's original tableaux for clarity. The candidates have primary stress indicated with the ˈ diacritic, and heavy syllables are in **bold**.

3.4 Summary

- Bennett (1995) uses iambic foot shape constraints to explain glottal stop epenthesis and vowel shortening in simplex words in Thai. Can similar constraints be used explain the Lao data?

4. OT Analysis

4.1 The minimal word in Lao

- Minimum word in Lao = 1 binary foot.
- High ranking FT-BN and LXWD=PRWD explain the absence of CV words in Lao.

(20) FT-BN (Prince & Smolensky 1993/2002; McCarthy & Prince 1993)
Feet are binary at some level of analysis (μ, σ)

(21) LXWD=PRWD (Prince & Smolensky 1993/2002)
Every Lexical Word must correspond to a Prosodic Word.

(22) DEP-C (McCarthy & Prince 1995)
Output consonant segments must have input correspondents.

(23) LXWD=PRWD, FT-BN >> DEP-C

/kâ/	LXWD=PRWD	FT-BN	DEP-C
☞a. [(ˈk**âʔ**)]			*
b. [(ˈkâ)]		*!	
c. [ˈkâ]	*!		

- Unary footed candidate (23b) fatally violates the FT-BN constraint.
- Unfooted candidate (23)c is ruled out because every lexical word is a prosodic word, and by culminativity every prosodic word must contain at least one foot.

4.2 Iambic foot

- Why iambs?
  - Plethora of monosyllabic words = not a syllabic trochee
  - (LL) syllables are non-existent, unusual if a moraic trochee language, predicted if an iambic language.
- Stress is connected to weight in Lao, foot heads must be prominent and prominence = weight.

(24) RH-TYPE-I (Prince & Smolensky 1993/2002)
Binary feet are right headed.

(25) STRESS-TO-WEIGHT PRINCIPLE (SWP) (Bennett 1995, Prince 1990)
The head of the foot must be heavy.

(26) RH-TYPE-I, SWP >> DEP-C

/ hí.mā/	RH-TYPE-I	SWP	DEP-C
a. [(hí. ˈmā)]		*!	
☞b. [(hí. ˈm**āʔ**)]			*
c. [(ˈhí.mā)]	*!	*!	

- Candidate (26)a fatally violates the SWP because the foot head is not a bimoraic syllable.
- Candidate (26)c violates the RH-TYPE-I constraint from being left-headed, as well as the SWP constraint because the head is not heavy.
- The optimal candidate is the one that avoids violating RH-TYPE-I and SWP by violating DEP-C.

4.2.1 Why no vowel lengthening or vowel epenthesis as a repair?

- Unusual, but not unknown.

(27) Cupeño (Crowhurst 1994:178)

	Stem	Habilitative
a.	čí	číʔ
b.	hú	húʔ
c.	ʔáyu	ʔáyu

- Hayes (1995) notes that Iambic languages tend to avoid iambic lengthening word finally. Hixkaryana, Choctaw, Chickasaw, Lake Iroquoian, Yupik, Sierra Miwok, Yidin, and Kashaya are all examples.
- Lao is mostly monosyllabic and a prohibition on lengthening vowels word finally would effectively neutralize the weight contrast required by the SWP.

(28) IDENT-WEIGHT-V (McCarthy, 1995)
Vowels that are moraic or bimoraic in the input must retain their mora count in the output, and segments that are not moraic in the input must not be moraic in the output.

(29) DEP-V (McCarthy, 1995)
Output vowel segments must have input correspondents.

(30) ID-WT-V, DEP-V >> DEP-C

/kâ/	ID-WT-V	DEP-V	DEP-C
☞a. [(ˈk**âʔ**)]			*
b. [(ˈk**âə**)]		*!	
c. [(ˈkâː)]	*!		

4.2.3 Coda Weight in Lao

- Obviously, because the epenthesis of a glottal stop is adequate to create a bimoraic syllable, codas must be heavy in Lao
- However, this constraint can be violated in order to avoid violating higher ranked foot form constraints.

(31) WEIGHT-BY-POSITION (WBP)
Coda consonants are moraic.

(32) RH-TYPE-I >> WBP[4]

/sīpsɔ̌ːŋ/	RH-TYPE-I	WBP
☞a. [(sīp.ˈsɔ̌ː**ŋ**)]		**
b. [(s**īp**.ˈsɔ̌ː**ŋ**)]	*!	*

4.3 Disyllabic compounds

- RCs; the initial vowel is shortened to form a (LH) iambic foot.
- NRCs; preserve their vowel length because the syllables are footed separately and must be (H) iambic feet.
- The ranking proposed needs to favor candidates with the initial vowel shortened when the input is an RC, yet favor candidates faithful to their vowel length when the input is NRC.

(33) WEIGHT-TO-STRESS PRINCIPLE (WSP). (Prince & Smolensky, 1993/2002)
Heavy syllables must be the head of the foot.

(34) Reducing Compound: LEXWD=PRWD, RH-TYPE:I, WSP >> ID-WEIGHT:V, WBP

/màːkmūaːŋ/	LEXWD=PRWD	RH-TYPE:I	WSP	ID-WEIGHT:V	WBP
☞a. [(màk.ˈm**ūa**:**ŋ**)]				*	**
b. [(m**à**:**k**.ˈm**ūa**:**ŋ**)]			*!		**
c. [(ˈm**à**:**k**.m**ūa**:**ŋ**)]		*!			**

[4] There is no evidence of trimoraic syllables in Lao, so I am assuming that whenever there is a long vowel or diphthong that the coda is not heavy and therefore WBP is violated.

- Candidate (34)b has a heavy first syllable which is not a foot head and violates the WSP.
- Candidate (34)c is not right headed and fatally violates RH-TYPE:I.

(35) Non-Reducing Compound

/mɔ̂:p.hāp/	LEXWD=PRWD	RH-TYPE:I	ID-WEIGHT:V
☞a.[[(m**ɔ̂**:**p**)] [(h**āp**)]]			
b. [(mɔ̂p.h**āp**)]	*!		*

4.4 The problem of parsing in Lao.

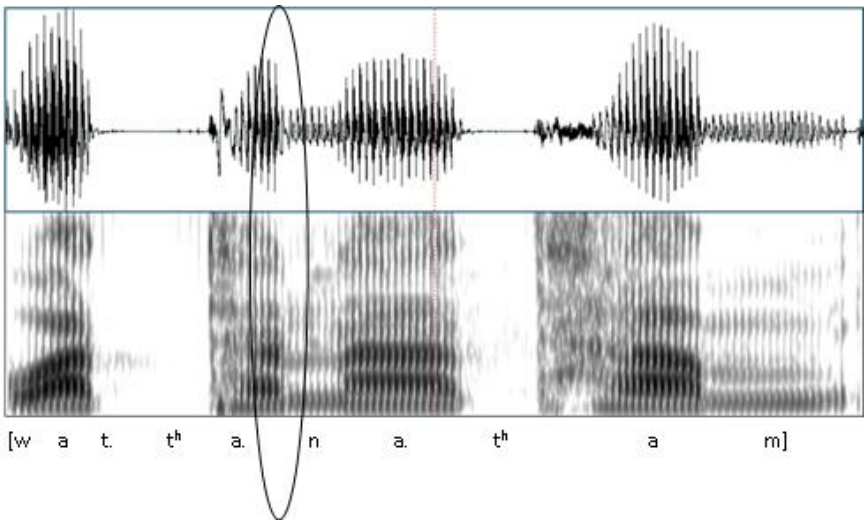
- There is disagreement in the literature about the status of parsing in Lao/Thai.
- Bennett (1995) claims that in Thai all light syllables that cannot be the first syllable of an iambic foot are unfooted.
- Heidel-Ketner (2006:121) makes specific reference to Lao as a language that has an undominated PARSE(σ) and therefore completely bans unfooted syllables. Heidel-Ketner (2006) cites Morev, Moskalev, and Plam (1979), but does not give explicit data.
- How accepting a language is of unparsed syllables is decided through competition between two constraints.

(36) PARSE(σ) (Prince & Smolensky 1993/2002)
All syllables must be dominated by a foot, or no unfooted syllables allowed.

(37) *STRUC (Zoll 1994)
Minimize all prosodic structure in a word.

- Prediction: if Lao is exhaustively parsed, it should have glottal stop epenthesis to rescue degenerate feet, e.g. /wāt.tʰa.na.tʰám/ 'culture' should surface as [(wāt.tʰaʔ).(na.tʰám)]. This is not what we find, there is no evidence of a glottal stop or glottalization in Figure 4.
- We can conclude that *STRUC >> PARSE (σ).

(38) Figure 4



- What about other closed syllables? Bennett claims that all bimoraic syllables (and he assumes all codas are moraic) are footed and received secondary stress. This predicts that /wāt.tʰa.na.tʰám/ 'culture' would be footed as [(ˌwāt).tʰa.(na.ˈtʰám)] and have a highly unusual stress pattern.
- No acoustic difference between primary and secondary stress in Thai (Bennett 1995), and I have not found any in Lao either. In fact, Hayes (1995:269) notes that a characteristic of Iambic languages is "the lack of a higher layer of metrical structure."
- My proposal is that Lao and Thai have only a single binary foot in a prosodic word, and a generalized alignment constraint can ensure this result.

(39) ALIGN-FT: Align(Ft, R, PrWd, R) (McCarthy & Prince 1993)
Any)Ft is aligned with a]PrWd.

- This AL-FT(RT) constraint is undominated and gradient, which means that every foot not aligned with the right edge of the prosodic word will incur a violation.

(40) FT FORM cover constraint (solely for expository purposes):
- RH-TYPE-I
- FT-BN
- LXWD=PRWD
- SWP
- WSP

(41) AL-FT(RT) >> FT FORM >> *STRUC >> PARSE (σ), WBP

/wāttʰanatʰám/	AL-FT(RT)	FT FORM	*STRUC	PARSE(σ)	WBP	DEP-C
a. [(wāt.tʰ**aʔ**).(na.tʰ**ám**)]	*!*		*			*
☞b. [wāt.tʰa.(na.ˈtʰ**ám**)]				**	*	
c. [(ˈw**āt**).tʰa.na.tʰám]	*!			***	*	

4.5 Summary

- High ranking FT FORM constraints place a premium on having (LH) and (H) iambic feet.
- Degenerate feet, (L), (LL), and (HH), are augmented by epenthesizing a glottal stop or by shortening the vowel in the initial syllable.

5 Conclusion and further research

- Metrical structure can explain much, even in languages traditionally viewed as non-stress languages.
- More research might uncover additional iambic languages with non-typical realizations of stress and add to our understanding of metrical systems cross-linguistically.
    - WALS online (Dryer et al. 2011), 153 of 323 languages (47%) were classified as trochaic while only 31 (9.5%) were classified as iambic.
- Vowel duration might be a clue to *stresslessness* rather than stress in Lao.
- The SWP seems to only be at work in iambic languages, but the prediction is that there should be trochaic languages where vowels are lengthened to attract stress. However, this does not seem to be the case.

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