The metrical structure of Thai in a non-linear perspective

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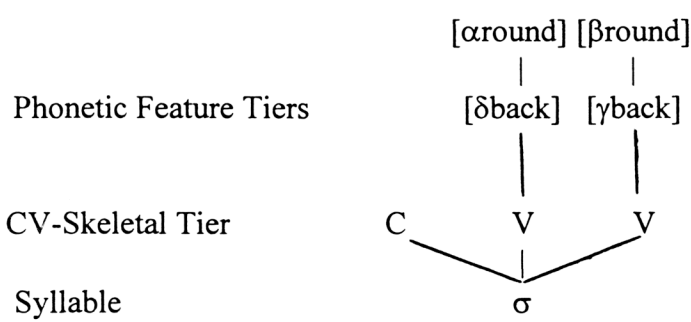
1. Syllables in Autosegmental and Metrical Phonology

Syllables and stress patterns have been considered suprasegments, being external to segmental features of consonants and vowels. In a more recent approach to phonological analysis, the autosegmental approach (Goldsmith 1976, 1990), the distinction between segments and suprasegments is, more or less, neutralized to autosegments. That is, consonants and vowels, phonetic features, and tones are all viewed as autosegments on their own separate tiers. Although autosegments are independent of one another, they are geometrically linked to one another by association lines which express simultaneity in time-- Linked elements jointly represent a sound.

While Clements and Keyser (1985) see syllables as elements on their own syllable tier in a multi-linear representation, Goldsmith (1990) takes a syllable to be a 'hierarchical structure organized on the skeletal tier.' Syllables themselves constitute a phonological plane of metrical structure, upon which stress assignment is based. For example,

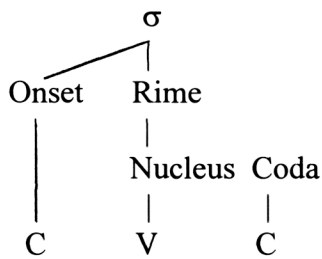
(1)



2. Syllable Organization

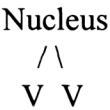
The 'hierarchical' internal structure of a syllable according to Goldsmith, consists of two major constituents: onset and rime; with nucleus and coda as the subconstituents of the rime. The internal structure of the syllable on the syllable plane can be charted as follows:

(2)



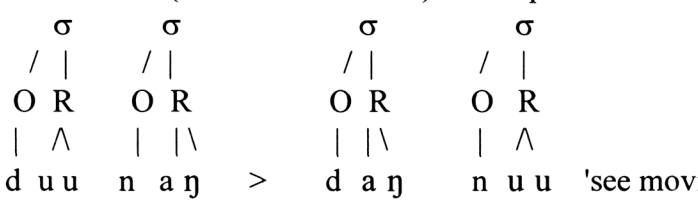
For a complex nucleus, the nucleus node branches as in (3) below:

(3)



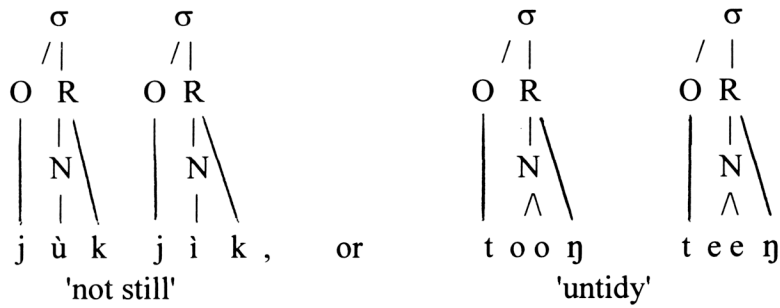
This internal structure of the syllable is psychologically real and is well attested cross-linguistically in phenomena, e.g., language games, speech errors, etc. These constituents and subconstituents of the syllables are evidenced in Thai language games, Kham Phùán (Surintramont 1973) where rimes are permuted, and in a form of reduplication in Thai (Luksaneeya-nawin 1986) where the syllable nucleus behaves differently from the syllable coda in reduplication. For example,

(4)a. Kham Phùán (Surintramont 1973): rimes permutation



Where tones as autosegments may or may not move with the 'melodic' segments of the rime. Thus, [duu nǎŋ] > [daŋ nùú] or [dǎŋ nuu].

b. Special Reduplication (Luksaneeyanawin 1986): vowel ablaut



Whereas Kham Phùán takes a larger unit of rime permutation regardless of the internal structure of the rime itself, the special reduplication in (4)b looks at the subconstituent of the rime, the syllable nucleus. Both phenomena are good evidence of the reality of the internal structure of the syllable for Thai speakers.

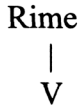
A notion that has been given much weight in Goldsmith (1990) is the 'extrasyllabicity' which is an extra element of the internal structure of the syllable. Such an element is a consonant in either initial or final position of a syllable which, if it is not syllabified during the word-formation process, will be deleted on the phonetic form. At word-final position, such a segment has been traditionally called an 'appendix' or a 'termination' (1990:107). Extrasyllabic segments are evidenced in Thai and may be said to be comparable to [tua kàʔran] in Thai (to be discussed in section 4.2 below).

3. Syllable Weight, Stress, and Metrical Structure

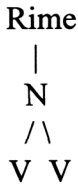
Metrical Phonology (tree theory) analyzes stress patterns as hierarchical representations of relative prominence of syllables and higher constituents in the metrical structure (metrical tree).

In general, stress assignment is based on rhythm and/or syllable weight which looks at the rime structure. While rhythm alternates stress at regular intervals, syllable weight distinction, which is in general binary, i.e. light and heavy, counts moras in the rimes. Heavy syllables are those with branching rimes whereas light syllables are single moraic with non-branching rimes (cf. (5) & (6) below). In a quantity sensitive language, heavy syllables are the ones that attract stresses.

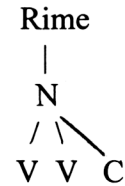
(5) Light syllables are of the form;



(6) Heavy syllables may take one of the following internal structures of the rime:

a. 

b. 

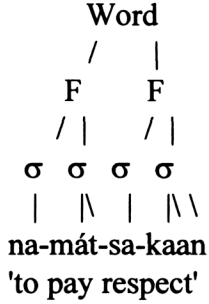
c. 

Syllable weight is crucial to stress assignment in Thai (to be discussed in sections 4 & 5 below).

Metrical Theory, developed from Liberman & Prince (1977) and Prince (1980) (cf. Goldsmith 1990), sees three main hierarchical constituents in the metrical tree;
a. *The syllable, which is the lowest level constituent, with internal structure of the rime being crucial to stress attraction.*
b. *The metrical foot, which is a higher level constituent, constisting of a strong and one or more weak syllables.* A foot may be degenerate, i.e., dominating a single syllable.
c. *The word, which is the highest level, consisting of a strong foot and one or more weak feet.*

For example, (from Luangthongkum 1977)

(7)



(word level)

(F = foot)

(syllable level)

Where a strong node denoted by a vertical line at either F or W-level represents prominence.

4. Thai Syllables

Surface structures of Thai syllables can be summarized as follows,

(8) $C_1(C_2)\ \{V(V)(C_3)\}$

That is, all the following structures are possible phonetic forms;

(9)a. $C_1(C_2)V$ b. $C_1(C_2)VV$
c. $C_1(C_2)VC_3$ d. $C_1(C_2)VVC_3$

With the following constraints,

(10) Syllable Structure Constraints

a. C_2 = {l, r, w}, and
if C_2 = [w], then C_1 = [k, k^h] (Luksaneeyanawin 1993)

b.*[α son] [α son]

i.e., in a cluster onset, the consonants cannot both be [+son] or both be [-son]. For example, *pt, *rl, or *kk are all ill-formed. The language does not allow a sequence of stops or approximants in the onset position.

c. C_3 = {m, n, ŋ, w, j, p, t, k, ʔ}

4.1 Cluster Onsets

Two types of cluster onsets are observed;

a. *True Cluster*

In a true cluster, the consonants in the onset position cannot be separated (Tumtavitikul 1992). For example,

(11)	trii	'three'	>	trai-jaaŋ, *tà?raijaaŋ
	klaaŋ	'middle'	>	*kà?laaŋ
	pràp	'fine'	>	*pà?ràp

Such clusters have the internal structure as in (12) below,

(12)

With a multiple-mapping between 'melodic' segments and C-segment on the onset position such that vowel insertion will create association line-crossing and thus, is prohibited. The result is an unbreakable cluster onset.

b. *CC-cluster*

A CC-cluster is a complex onset where the two consonants can be separated due to the following internal structure,

(13)

for example,

(14)	trùət	'check'	>	tamrùət	'policeman'
	pràap	'raid'	>	bamràap	(p > b)
	tràt	'speak'	>	damràt	(t > d)

Such cluster onsets consist of two C-slots, each mapping to a 'melodic' segment in a one-to-one fashion, thus the cluster is breakable without violating the association line-crossing constraint.

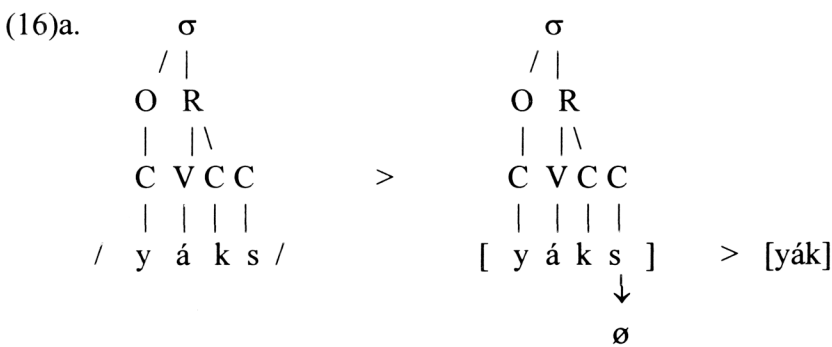
4.2 Complex Coda

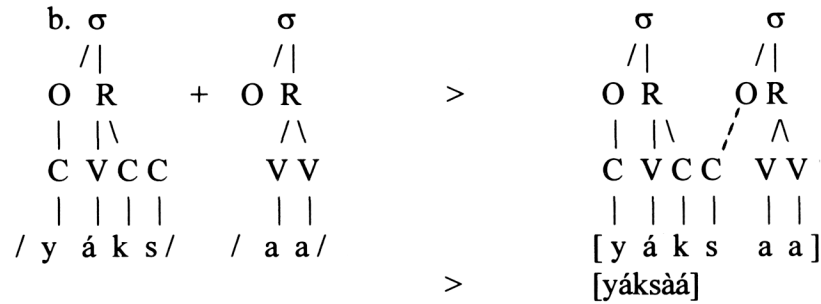
A complex coda consists of one or more 'extrasyllabic' segments which are not linked to the syllable underlyingly, nevertheless form a part of the lexical entry. The extrasyllabic segment will surface only if it is syllabified in the word-formation process, otherwise it will be deleted on the surface. An extrasyllabic segment is denoted by parentheses ( ). A single extrasyllabic segment is comparable to [tua kà?ran] in the Thai grammar. For example,

(15)a.	/yák(s)/	>	[yák]	'giant'
		>	[yáksàá], [yáksìí]	
b.	/phát^{h}(n)/	>	[phát]	'progress'
		>	[phátt^{h}á?naa]	

and (15)a. can be charted as follows;

(16)a.





4.3 Syllable Reduction

Two types of syllable reduction are observed:

a. *Vowel Reduction*

Vowel reduction mainly occurs in unstressed CV? surface syllables. The reduction mainly takes place in the form of a > ə , or i > I . A final glottal deletion always precedes vowel reduction which is most often accompanied by tone neutralization to Mid. For example,

(17)a. rátt̪ʰà̱ʔbaan > ratt̪ʰàbaan 'government'
> ratt̪ʰa̱baan
> ratt̪ʰəbaan

b. raac̪ʰí̱ʔnii > raac̪ʰínii 'queen'
> raac̪ʰi̱nii
> raac̪ʰInii

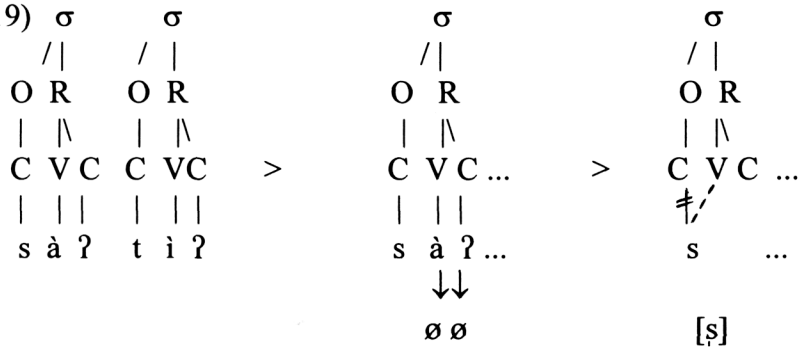
b. *Vowel Deletion*

Vowel deletion is a further step beyond vowel reduction, which often occurs with surface CV? with a fricative onset. For example,

(18) sà̱ʔtìʔ > sàtìʔ 'mental, mind'
> sa̱tìʔ
> sə̱tìʔ
> s̪tìʔ

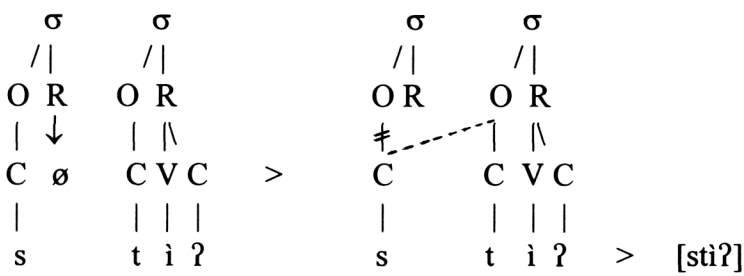
It is noted that all word-final CV? syllables are inherently stressed (Luksaneeyanawin 1993). This matter will be taken up under Stress Assignment. (18) can be charted as;

(19)



Syllable reduction may have introduced a new surface structure into the language, namely a syllabic consonant, e.g., [s̩]. Another possible surface form which vowel deletion may have brought into the language is the surface cluster onset [st] as in (20) below;

(20)



Whether we like it or not, either (19) or (20) or both surface forms are indicative of an ongoing process of language change in modern Thai. For more examples,

(21)

s̩nàpsnŭn	<	sàʔnàp-sàʔnŭn	'support'
kìtc^{h}kaan	<	kìtcàʔkaan ; (c^{h} < c)	'business'
s̩t^{h}àában	<	sàʔt^{h}àában	'institution'

4.4 Surface and Underlying CV-Syllables

It is clear from 4.3 that Thai does have surface CV-syllables from syllable reduction, which is a late phonetic process of glottal deletion, vowel reduction or deletion, and tone neutralization.

(22) Glottal Deletion (Phonetic Implementation Rule)

ʔ > ø / CV__]σ_x (σ_x = unstressed syllable)

(23) Vowel Reduction (Phonetic Implementation Rule)

V > ə / C___]σ_x (σ_x = unstressed syllable)

|

[-high]

Underlying CV-syllables are more controversial. Gandour (1974) suggests that there are no underlying CV-syllables in Thai. His suggestion is based mainly on the arguments concerning surface vs. underlying glottal stop in Thai. We would like to propose here that there are underlying CV-syllables in Thai, in fact we would like to suggest that all surface CVʔ's are from underlying /CV/ where the glottal final comes from a glottal insertion rule (24).

(24) Glottal Insertion (Post-Lexical Rule)

ø > ʔ / CV___]σ

The justification for glottal insertion is as follows:

a. /b, d/ *are Thai phonemes which occur only syllable-initially. It is not unusual to have* /ʔ/ *restricted in the same manner since* /b, d, ʔ/ *do behave similarly with respect to tone assignments in syllable onset position.*

b. *For* CVV[-son] *syllables, only* /p, t, k/ *occur at syllable coda, but a glottal final with long vowel is absent (as noted by Gandour 1974).* Such a gap cannot be explained if there is an underlying /ʔ/ at syllable-final in a CVʔ syllable.

c. *An underlying* /CV/ *helps count syllable weight such that*

surface (not word-final) CV? *can be counted as light syllables.* Thus, stress assignment in Thai can be simplified to depend mainly on syllable quantity.

5. Stress Assignments in Thai

Luksaneeyanawin (1983, 1993) has given the following generalizations for stress assignments in Thai:

(25) Stress Assignments in Mono-Morphemic Polysyllabic Words (Luksaneeyanawin 1983, 1993):

a. Thai distinguishes two types of syllables: linker syllables (i.e., [Ca] syllables) and non-linker syllables of all other types.

b. Thai recognizes double stress in a word: primary and secondary. The last syllable always receives primary stress and secondary stress is sometimes suppressed in casual or fast speech.

c. Between linker and non-linker syllables in all other positions (non-final in a word), non-linker syllables attract stresses.

d. In a 2-4 syllable-word, stress patterns usually follow the patterns below:

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    - |                 (- = unstressed, | = stressed)
  | - |
- | - |
```

e. However, if in a 3-syllable word, the 1st syllable is a linker and the 2nd is a non-linker, the stress pattern is as follows,

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  - | |
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f. Also, in a 4-syllable word where the 1st syllable is a non-linker but the 2nd is a linker syllable, the stress pattern is:

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| - - |
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g. In the case where both the 1st and 2nd syllables are non-linker syllables, the degree of syllable weight gives precedence to stress assignment-- the heavier the rime, the more likely it is to attract stress.

The degree of syllable weight is given as follows:

$$\left\{\begin{matrix}\text{CV(V)[-son]}\\ \text{CV(V)[+nas]}\end{matrix}\right\} > \text{CVV, and}$$

CV(V)[+nas] > CV(V)[-son] > CV?

For word-compounds, the generalizations in (25) do not apply; stress assignment is rather determined by 'the morphological derivation of the compounds'. For example, (from Luksaneeyanawin 1993:287)

(26)a. [náam sôm] 'orange juice' - |
[náam sôm k^hán] 'fresh orange juice' - | |

b. [kàp k^háàw] 'dish' - |
[túù kàp k^háàw] 'kitchen cabinet' | - |

What we attempt to do in this paper is to account for the generalizations given in (25) for mono-morphemic polysyllabic words as well as for word-compounds by a single set of rules in metrical phonology.

5.1 Thai Metrical Structure

As discussed earlier in sections 3 and 4.1, we distinguish two types of Thai syllables according to rime-projection: light and heavy. All surface (not word-final) CV?-syllables are considered 'light' from an underlying /CV/. By this, we distinguish stress assignment in emphatic words as optional (emphatic rule) where each and every syllable of the word emphasized is stressed.

With the above convention, stress assignments in Thai can be derived from the metrical tree with the following tree-building rules;

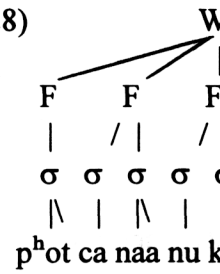
(27) Thai Metrical Tree:

a. Count syllable weight according to rime-projection. An exception is a word-final CV-syllable which, by its position, is inherently 'heavy' despite its internal structure.
b. Build right-headed metrical feet with a leftward spreading unbounded foot tree for each foot.

c. Build right-headed word-tree with a leftward spreading unbounded word.

For word-compounds, (27) cyclically applies in the lexicon as a stress assignment rule in word-formation. For example,

(28)



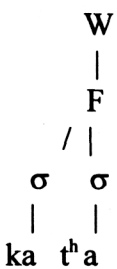
- right-headed, right-to-left spreading unbounded word
- right-headed, right-to-left spreading unbounded foot
- heavy/light syllables

'dictionary'

Stress pattern: | - | - | ; where the last syllable receives primary stress.

By Glottal Insertion (GI, (24)), we have [phótcà?naanú?krom].

(29)

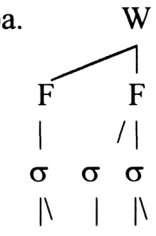


'frying pan'

Stress pattern: - |

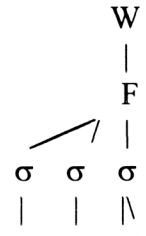
With the application of GI (24), we have [kà?t^há?]. In casual speech, Glottal Deletion (GD, (22)) and Vowel Reduction (VR, (23)) apply yielding [kət^há?].

(30)a.



'case'

b.



'case'

Stress patterns: | - | and - - |

(30)a is comparable to the stress pattern given by Luangthongkum's (1977) careful speech style and (30)b is comparable to her casual speech pattern. It is noted that (30)b can be derived from (30)a by secondary-stress suppression. The metrical tree in (30)a assigns primary stress to the last syllable [nii] and secondary stress to the first syllable [kɔɔ]. If secondary-stress suppression applies, we have a vowel shortening rule (31) shortening the syllable. When stress assignment reapplies, (30)b is derived with the application of vowel reduction (23).

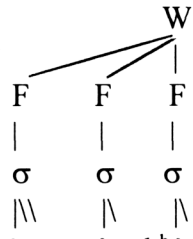
(31) Vowel Shortening

VV > V / [-stress σ]

i.e., a long vowel in an unstressed syllable is shortened.

If the word-compounds are reanalyzed as monomorphemic polysyllabic words, that is, indivisible unit words, the same metrical rules given in (27) apply. However, in the case that the compounds are perceived as compounds, (27) applies in cyclical applications in lexical phonology. For example,

(32)



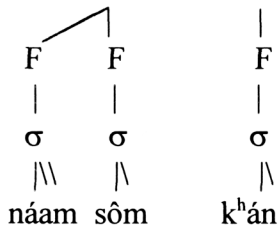
'fresh orange juice'

Stress pattern: - - |

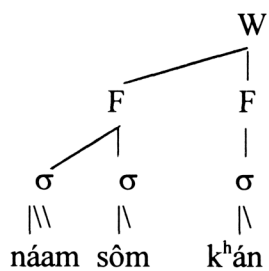
With Vowel Shortening (VS (31)), we have [nám sôm k^{h}án].

In (32) the compound is reanalyzed as one polysyllabic word. If the compound is taken as a compound from morpheme concatenation, we then have (33) below,

(33) [W W] w Word Cmpounding



With Foot-Percolation, (27) reapplies yielding,



Stress pattern: - | |

In the same manner, we may have [túù kàp kháàw] with the stress pattern; - - |, or we may have [túù kàp k^{h}áàw] with the pattern; | - |, being word-compound stress pattern. Hence, we have both monomorphemic polysyllabic words as well as word-compounds accounted for by one single set of rules in metrical phonology.

5.2 Evidence

If we truly have the rules for building Thai metrical trees, (27) should not only account for stress assignments, but also other phenomena related to the metrical structure, e.g., syllable reduction, syllable deletion, foot deletion, etc.

a. *Syllable Reduction*

For syllable reduction, (27) predicts that all unstressed syllables, either those dominated by weak nodes at the foot-level, i.e., [CV?] syllables, or those subject to secondary-stress suppression, i.e., those dominated by strong nodes at the foot-level but by weak nodes at the word-level, are susceptible to syllable reduction. While [CV?] syllables are almost always reduced in casual speech, secondary-stress suppression is optional.

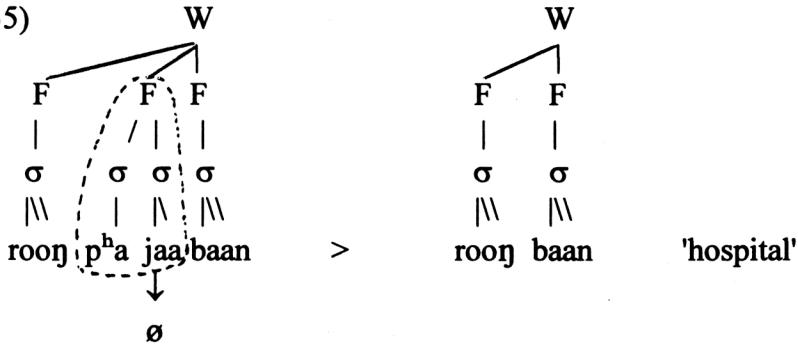
(34) sàʔtrɔɔbəəríì > sətrɔɔbəəríì, or sətrɔɔbəríì
'strawberry' - | | | - | - |
(2^{nd} stress suppression)

GD (22) and VR (23) apply to [sàʔ] in both cases, but secondary-stress suppression only applies to the latter not the former in (34) and VS (31) applies to [bəə] yielding [bə]. It is noted that [sàʔ] may have gone all the way to become [s̩] or [st]-cluster in both cases.

b. *Syllable and Foot Deletion*

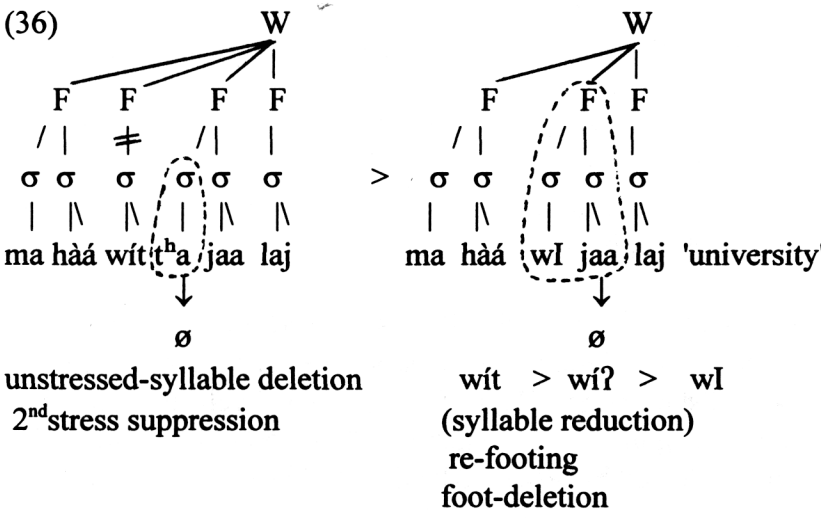
Both syllable and foot deletions are good testing grounds for the metrical constituents proposed in (27) for Thai. For example,

(35)



The metrical foot [pʰajaa] deletes as a constituent in (35).

(36)

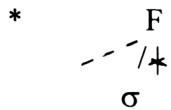


The final phonetic reduced form is [mahàálaj].

In (36) there are both unstressed-syllable deletion and foot-deletion. It is noticeable that secondary-stress suppression chooses a non-branching foot, i.e. a degenerate foot. This is not at all surprising given the principle of heavy and light contrast at the syllable level in (5) and (6). The same principle seems to be operative at the foot level in this case and also in (34). However, secondary-stress supression also applies to a branching foot when no degenerate foot carrying a

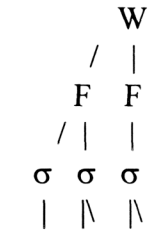
secondary stress is available. In this case, stress assignment is subject to Foot Constraint (37) below:

(37) Foot Constraint



That is, there can be no foot-tree without a strong node dominating a strong syllable. For example, (from Luangthongkum 1977)

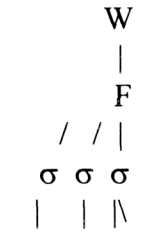
(38)a.



su p^{h}aa sìt

Strees pattern: - | | ;

b.

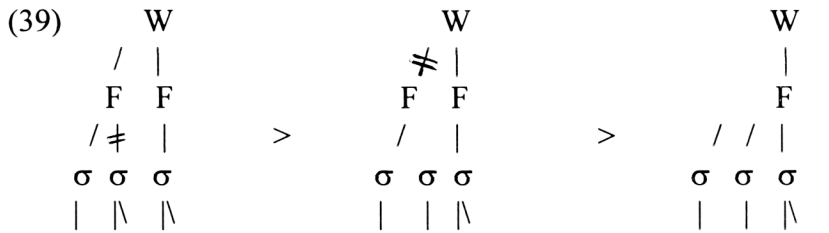


su p^{h}ə sìt

- - |

The casual speech style (38)b is derived from the careful speech style (38)a via secondary-stress suppression followed by vowel shortening (31), re-footing due to cyclical application of stress asignment (27) which is subject to Foot Constraint (37), and followed by vowel reduction (23) as shown in (39) below;

(39)



su p^{h}aa sìt > su p^{h}a sìt > su p^{h}ə sìt

2nd stress suppression; Vowel Shortening (31); Stress Rules (27); Foot Constraint (37); Vowel Reduction (23)

6. Concluding Remarks

What we have introduced in this paper is an analysis of the metrical structure of Thai in a non-linear perspective. Previous works, e.g., Luangthongkum (1977) and Luksaneeyanawin (1983, 1993) have been tremendously helpful in laying out the generalizations in the language with respect to rhythms and word accents. We hope that in future research non-linear phonology will play a significant role in the analysis of Thai metrical structure beyond the word level.

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