



## Stress and Thai Prosodic Structure

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## STRESS AND THAI PROSODIC STRUCTURE

Panit Chotibut

This paper looks at the prosodic structure of Thai and its relation to the relative prominence assignment. With the assumption that the following are distinctive prosodic units: a syllable ( $\sigma$ ), a prosodic foot ( $F$ ), and a prosodic word ( $\omega$ ), I will show that the relative prominence assignment is closely related to how these prosodic units are gathered up to form a hierarchical binary-branching tree. It will be shown that the domain of footing varies depending on which style of pronunciation the speaker is using, isolative or combinative style. We will argue that the distinction between a branching and non-branching rime is crucial to the analyses of foot formation, tone assignments, the Glottal Stop Insertion, and the Tone Neutralization. This study is based on the Bangkok dialect of Thai.

1. The Syllable ( $\sigma$ )

Within the framework proposed and developed in Liberman and Prince (1977), Selkirk (1978, to appear) and Halle and Vergnaud (1980), a syllable is a distinctive unit in the prosodic structure. It has an immediate constituent structure which can be represented on a hierarchical binary-branching prosodic tree. Its two major constituents are the onset and the rime: the onset of the syllable is optional or obligatory according to the language-specific well-formedness condition, but the rime is always obligatory. The rime can consist of a peak and a coda which then leads to the distinction between the branching and non-branching rime.

In this section, we will look at each constituent of the syllable and analyze the basic syllable template of Thai. We will use the words listed below as the data for our analyses.<sup>1</sup>

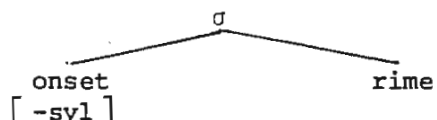
p <sup>h</sup> rá	'monk'	kláa	'salt'	* <u>striŋ</u>
yaaw	'long'	suáy	'pretty'	*k <sup>h</sup> rank
bɔ̀k	'tell'	k <sup>h</sup> wiáŋ	'throw'	*it

Glancing at the above list of words, we may have noticed from the starred words that Thai does not allow three segments in the onset (\*striŋ),

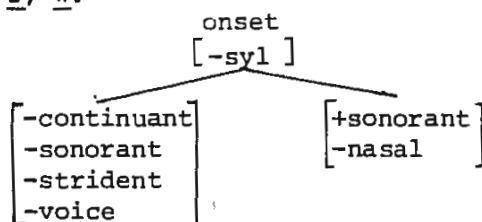
nor does it allow two segments in the coda ( $*k^h\text{rank}$ ). Furthermore, the onset is the obligatory constituent of the syllable. ( $*it$ ).

### 1.1 The Onset

What we know about the onset is that there can be minimally one and maximally two segments in the onset. As both consonants and glides can occur in the onset, we will use the feature  $[-\text{syl}]$  instead of  $[\text{+cons}]$  in our syllable template:



There is, however, a strict collocational restriction between the two constituents of the onset when both are present: the first segment is always a voiceless stop;  $p$ ,  $t$ ,  $k$ , while the second segment is one of the following:  $l$ ,  $r$ ,  $w$ .



However, not all combinations of the above segments are acceptable in the language. The following are ill-formed:  $pw-$ ,  $p^h_w-$ ,  $tw-$ ,  $t^h_w-$ ,  $tl-$ ,  $t^h_l-$ . Note that the glide /y/ is not found in the cluster formation and that even the occurrence of /w/ is very restricted. When the glide in the initial cluster is followed by the vowel in the rime with a similar phonetic feature, i.e.  $[\text{+rounding}]$ , it is difficult to indicate where the transition between the two segments is as they are totally assimilated. However, I would like to claim that there is a clear distinction between the two onsets in the two words below:

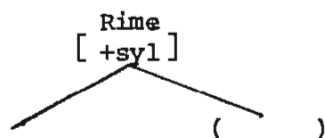
- a)  $k^h\text{wan}$  'smoke'      b)  $k^h\text{uan}$  'should'

In a), the onset consists of two segments, a consonant and a glide, and the rime has a simple vowel. In b), there is only one segment in the onset and the rime has a diphthong /ua/. The word of type b) is an example to the problem mentioned above: is there a glide /w/ in the onset before the rime? Looking for some evidence elsewhere in the language, we found that the following initial clusters are also not allowed:  $*kwo$ ,  $*kwɔ$ ,  $*k^hwo$ ,  $*k^hɔ$ . It seems like there is a general constraint against the sequence of /w/ and all back vowels. Furthermore, while the clusters  $pw-$  and  $tw-$  are not well-formed, the following words are acceptable:  $\text{puat}$  'ache',  $t^h\text{ua}$  'nuts'. These words somehow confirm our assumption that there is no /w/ in this position. The interactions between the glides and the rime will be brought up and discussed in full detail later on in this paper.

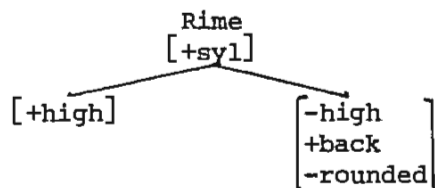
## 1.2 The Rime

The main goal of this section is to analyse the structure of the rime in terms of its branching nature. We will also look at long vowels and diphthongs and argue that they are two segments occupying two terminal nodes in the syllable tree.

The rime in the Thai syllable can consist of a single segment (non-branching rime) or it can have up to three segments as its constituents. Examples are: 1) tí 'criticize', 2) tíi 'hit', 3) tíá 'short', 4) tían 'smooth'. The words in 2), 3) and 4) all have branching rimes. The structure of the rime for the examples 1) to 3) may be represented on the tree as follows:

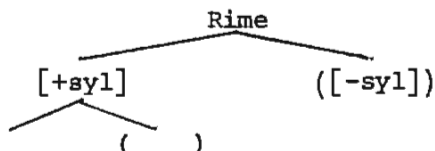


In this paper, all long vowels will be treated as sequences of two identical vowels and diphthongs are sequences of two distinctive vowels with restrictions on their cooccurrence. There are three well-formed diphthongs in Thai:<sup>2</sup> a high vowel followed by an unrounded low back vowel /a/: ía, íá, úa. These collocational restrictions may be represented on the rime tree as follows:

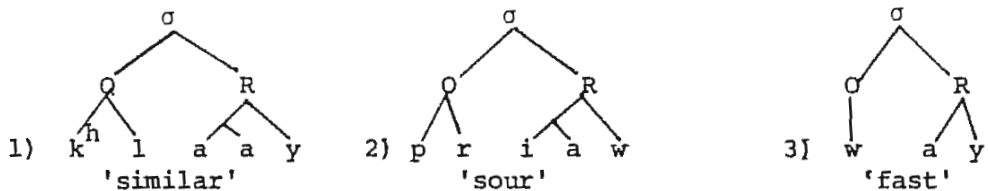


We also use these collocational restrictions to argue for the immediate constituency of the two segments on the tree. Hence, they will form a left-branching tree when there is a third segment in the rime.

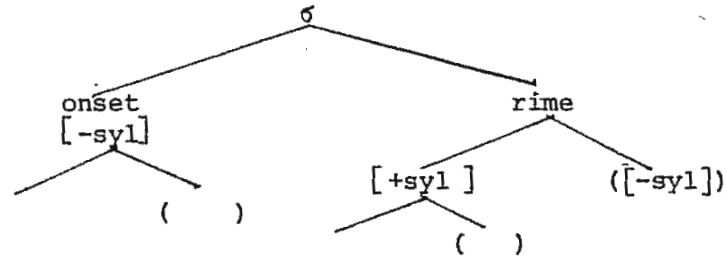
The third segment in the rime can be a consonant or a glide. The consonants that can occur syllable-finally are very limited: only six consonants are allowed: p, t, k, m, n, ŋ. We will use the feature [-syl] to cover both consonants and glides.



The following words are accurately generated by the above rime templates:



Here is the final version of the complete syllable template:

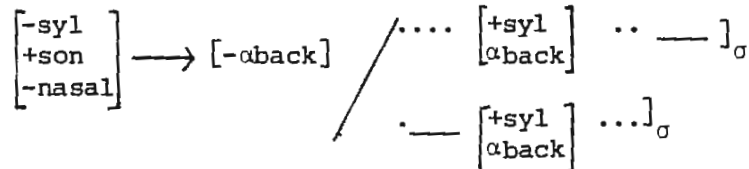


### 1.3 The Glides

The prevocalic and postvocalic glides in the Thai syllable show some peculiarities in their distributions in relation to the adjacent vowels. When either /y/ or /w/ occurs in the onset by itself, there is no restriction whatsoever on the vowels that can follow. Here are some examples: yìŋ 'shoot', wún 'gel', yìp 'step on', wua 'cow'. But, when the glide /w/ occurs as the second segment in the onset, only non-back vowels can follow. k<sup>h</sup>wit 'gore', k<sup>h</sup>wan 'smoke', \*k<sup>h</sup>wut, \*kwɔŋ. We also find that there are similar distributional restrictions in the rime between the vowel and the glide that follows. Here are some examples.

- |          |          |     |        |
|----------|----------|-----|--------|
| 1) níw   | 'finger' | but | *niy   |
| 2) b̀y   | 'often'  |     | *bɔw   |
| 3) priáw | 'sour'   |     | *priay |
| 4) duáy  | 'also'   |     | *duaw  |

The above examples lead us to believe that there is a case of dissimilation involved: only a front vowel can cooccur with a back glide /w/ and a back vowel can cooccur with the front glide /y/. This dissimilation also applies to the sequence of diphthongs and the glide. We will propose that there is a constraint on the phonological representation concerning the possible sequence of the glide and the vowel:



### 1.4 Tone Assignments

I will argue that tone assignments are very closely related to the structure of the rime, whether it is branching or non-branching, whether

the final segment in the rime is [+son] or [-son]. In the traditional Thai phonology, there are two types of syllable: a 'live' and a 'dead' syllable. If the syllable ends with a long vowel, a diphthong, or a [+son] segment, it is a 'live' syllable; if the syllable ends with a short vowel or a [-son] segment, it is a 'dead' syllable. The live syllables can carry any of the five tones while the dead syllables can carry only certain tones, mostly level tones.<sup>3</sup> In our analysis, the live syllables will be equivalent to the branching rimes, and the dead syllables will be the non-branching rimes.

Following Gandour's analysis of segmental tones in Thai, I assume that a phonological tone in Thai should be represented as a feature on a segment and that a contour tone should be treated as a sequence of level tone features; i.e. a falling tone is a sequence of High and Low, and a rising tone will be a sequence of Low and High.<sup>4</sup> If we combine this segmental tone analysis with our analysis of branching and non-branching rime, we can provide another view to the asymmetrical tone distribution in Thai. (See the tone distribution chart in Footnote 3.) If we assume that only a [+son] segment can be a tone-bearing unit, we will accurately predict that the branching rime that ends with a [+son] segment can carry a contour tone as it has two tone-bearing units needed for the presence of the contour tone. The non-branching rime, or the branching rime that ends with a [-son] segment (p, t, k) can then carry only level tones as it has only one possible tone-bearing segment. However, this segmental tone analysis fails to explain why a long vowel plus a [-son] segment cannot have a rising contour tone. This problem might be used as an argument against the segmental tone analysis and needs to be reinvestigated.

## 2. The Foot (F) and the Prosodic Word (ω)

In this paper, the term 'foot' is defined as a prosodic unit on the prosodic tree higher than the syllable and it always is associated with stress. The stress foot can consist of one or more syllables with the strong/weak relations assigned among them according to the language-specific conditions. The term 'prosodic word' is referred to a prosodic unit higher on the tree than the stress foot with a further requirement that it has a single stem as its domain. In other words, simple words will be classified individually as a prosodic word, while compounds, which can consist of two or more simple stems, will be a sequence of two or more prosodic words. We will also use the term 'superword' (ω) to refer to a hierarchical grouping of two or more prosodic words on the prosodic tree.

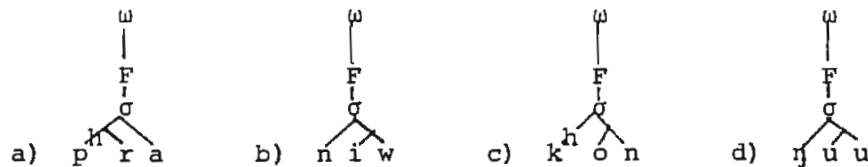
As our discussion of the foot template is closely related to stress, we should look at some facts about stress in Thai before we proceed. Stress is always found on the final syllable of the word and the degree of prominence decreases gradually towards the beginning of the word, if it is polysyllabic. The core of the Thai vocabulary is basically monosyllables and most polysyllabic words are the results of compounding or they are purely borrowed from other languages.

## 2.1 Monosyllabic Words

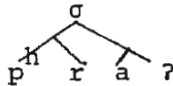
The examples of the monosyllabic words are:

- a) p<sup>h</sup>ra 'monk'  
 b) niw 'finger'  
 c) k<sup>h</sup>on 'men'  
 d) ŋuu 'snake'

With our definitions of the stress foot and the prosodic word stated earlier, each of these words is therefore a stress foot and also a prosodic word on its own as it is always stressed and it has a simple stem. Here are the analyses of their prosodic tree structures:



All of the above examples except a) have branching rimes in their representations. However, in the actual pronunciation of the word in a), a glottal stop is heard as the final segment of the syllable. This presence of the glottal stop will change the non-branching rime into the branching one:



This glottal stop insertion leads us to propose that there is a general convention that, for a syllable to be a foot on its own, it needs to have a branching rime. Here is our first sketch of this Glottal Stop Insertion Rule:

$$\emptyset \rightarrow ? / \dots [-\text{syl}] [+ \text{syl}] \underline{\quad} ]_F$$

It may be of interest to present a different point of view on this /?/ phenomenon. Two main questions have always been asked: is the glottal stop present in the underlying representation, or, is it inserted by a phonological rule? Most scholars working on Thai phonology tend to claim that the /?/ occurs in the underlying representation and then gets deleted from the surface by a rule of deletion. Note that this is an opposite point of view from our approach in this paper. In their framework, there is no short open syllable, or, in other words, all rimes branch. In our framework, the distinction between the branching and non-branching rime is maintained throughout and will be shown to be crucial to the stress assignment of the polysyllabic words; i.e. the syllables with the branching rimes are more prominent than the syllables with the non-branching rimes. Furthermore, there is additional evidence against positing the /?/ as the final segment in the underlying forms: the /?/ is never found as the

final segment in any other rime structure: \*CVV? in contrast with other final stops which can freely occur in the syllable-final positions:

CV C           , CVV C  
   [+stop]        [+stop]

## 2.2 Polysyllabic words

To sum up what we have covered so far: a monosyllabic foot has a branching rime in the output representation; the rule of the Glottal Stop Insertion obligatorily converts a non-branching rime into a branching one in the monosyllabic foot.

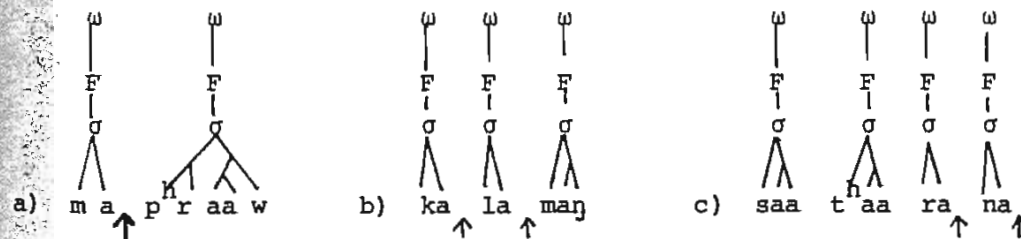
For the pronunciation of the polysyllabic words, the distinction has been made between an isolative and a combinative style of speech. The isolative style, sometimes referred to as a dictation style, is very restricted and only used when the speaker wants to emphasize each syllable individually by putting stress on it. The combinative style, which is commonly used in normal everyday conversation, shows some interesting phenomena concerning relative prominence among the syllables of the word. In this section, we will show that the CV syllable or the syllable with the non-branching rime is never stressed in the polysyllabic words, except when it is foot-final in the prosodic word.

### 2.2.1 The Isolative Style of Speech

In the isolative style of pronunciation, each syllable is individually stressed and followed by a pause. If the syllable has a non-branching rime, the rule of Glottal Stop Insertion will apply and converts it into a branching rime. Examples are:

underlying representation	isolative style
a) m <sup>á</sup> p <sup>h</sup> r <sup>á</sup> aaw 'coconut'	má? p <sup>h</sup> r <sup>á</sup> aaw
b) k <sup>à</sup> l <sup>á</sup> maŋ 'bowl'	kà? l <sup>á</sup> ? maŋ
c) s <sup>á</sup> t <sup>h</sup> a <sup>á</sup> r <sup>á</sup> ná 'public'	s <sup>á</sup> t <sup>h</sup> a <sup>á</sup> r <sup>á</sup> ? ná?

In terms of the prosodic structure analysis, each syllable in the isolative style, regardless of its syllable template, is a prosodic foot on its own. The directionality of the footing process can either be from right to left or from left to right.<sup>5</sup> The arrows in the tree structures below indicate where the rule of Glottal Stop Insertion will apply:





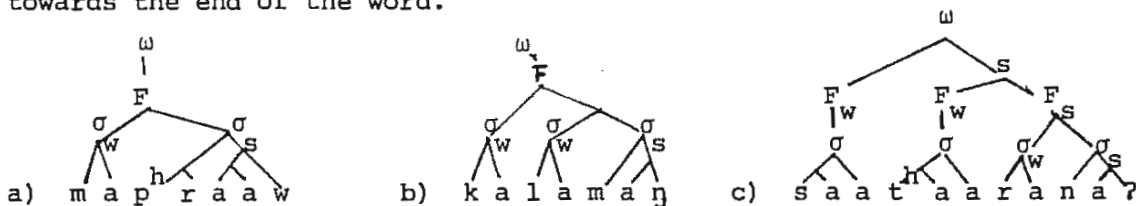
### 2.2.2 The Combinative Style of Speech

In the combinative style of speech, polysyllabic words show some interesting cases of relative prominence assignments. Even though the word-final syllable always carries the main stress of the word, there are some instances of lower degree of stress inside the word. Our main concern is to look at the CV syllables in these words and see how they differ from those in the isolative style. The examples below show the combinative style of pronunciation.

underlying representation	combinative style
a) m <sup>á</sup> p <sup>h</sup> r <sup>á</sup> aaw 'coconut'	<u>ma</u> p <sup>h</sup> r <sup>á</sup> aaw
b) k <sup>à</sup> l <sup>á</sup> maŋ 'bowl'	<u>ka</u> <u>la</u> maŋ
c) s <sup>á</sup> a t <sup>h</sup> a a r <sup>á</sup> n <sup>á</sup> 'public'	s <sup>á</sup> a t <sup>h</sup> a a <u>ra</u> n <sup>á</sup> ?

The CV syllables are not stressed except when they are word-final. Furthermore, the underlying tones of these CV syllables show some degree of neutralization in the combinative style of pronunciation. They all become 'toneless'. We underline all toneless syllables to differentiate them from the mid-tone syllables which are also unmarked.

The fact that the word-final syllable is always stressed leads us to assume that the footing process works from right to left. The unstressed CV syllables cannot be prosodic feet on their own. We also assume that there is a well-formedness condition requiring that every syllable has to be footed. Hence, we will posit another type of prosodic foot called a polysyllabic foot. The polysyllabic foot can have more than two syllables as its constituents with the condition that all syllables prior to the last are of the CV type. In other words, all CV syllables will be footed with the next possible foot on the right. To guarantee that the final syllable in the foot is the most prominent one, we will assume that the syllables in the foot form a right-branching hierarchical prosodic foot tree with the following condition on the prominence assignment: for every pair of N<sub>1</sub> and N<sub>2</sub>, N<sub>2</sub> is always strong. This assignment of prominence will correctly predict that the degree of stress gradually increases towards the end of the word.



Checking with our rule of Glottal Stop Insertion, we find that it is still effective. It will only apply to the foot-final CV syllable (e.g. na? in c)).

### 2.3 Tone Neutralization

As briefly mentioned earlier in this section, the unstressed CV syllables in the weak nodes display some degree of neutralization in their

tones. They will lose their underlying tones, either low or high tone, and become 'toneless'. Note that a distinction is made between a mid tone and a toneless syllable. These CV syllables can never carry the mid tone in the underlying representation. We will propose the rule of Tone Neutralization as follows:

$$\left\{ \begin{array}{l} H \\ L \end{array} \right\} \rightarrow \emptyset / \text{---} ]_{\sigma_w}$$

This rule is optional and applies only to the weak syllables in the foot. (See examples on p. 8 ).

### 3. Complex and Compound Words

We have posited two types of prosodic stress foot, a monosyllabic stress foot and a polysyllabic stress foot. We now need to determine the maximum number of CV syllables that can occur as the weak nodes in the foot. Complex and compound words are the good sources to look for a possible longer sequence of CV syllables. In this paper, we will define complex words as the words with prefixation.

underlying representation

combinative style

		normal	rapid
1. a)	$\text{su-}^h\text{aasit}$ 'proverb' (good+saying)	$\text{sup}^h\text{aasit}$	$\text{sup}^h\text{aasit}$
b)	$\text{?a-}^h\text{manut}$ 'non-human' (non+human)	$\text{?amanut}$	$\text{?amanut}$
c)	$\text{saha-}^h\text{rat}$ 'federated (multi+state) state'	$\text{saharat}$	$\text{saharat}$
d)	$\text{saha-}^h\text{prachaa}^h\text{aat}$ (multi+men+nation) 'United Nations'	$\text{sahaprac}^h\text{aac}^h\text{aat}$	$\text{sahaprac}^h\text{aac}^h\text{aat}$
e)	$\text{burap}^h\text{at}^h\text{it}$ (fore+compass point) 'east'	$\text{burap}^h\text{at}^h\text{it}$	$\text{burap}^h\text{at}^h\text{it}$
f)	$\text{burap}^h\text{asamay}$ 'early times' (fore+time)	$\text{burap}^h\text{asamay}$	same as normal
g)	$\text{pati-}^h\text{kiriyaa}$ (anti+action) 'antimovement'	$\text{patikiriyaa}$	same as normal

II a)	p <sup>h</sup> aara##k <sup>it</sup> (burden+task)	'duty'	p <sup>h</sup> aarak <sup>it</sup>	p <sup>h</sup> aarak <sup>it</sup>
b)	saara##k <sup>h</sup> adii (essence+case)	'documentary'	saarak <sup>h</sup> adii	saarak <sup>h</sup> adii
c)	?aaraya##prat <sup>h</sup> eet (culture+nation) 'civilized countries'		?aarayaprat <sup>h</sup> eet	?aarayaprat <sup>h</sup> eet
d)	saathaaraana##?anu-+baan (public+mini+care) 'public kindergarten'		saat <sup>h</sup> aarana?anubaan	same as normal

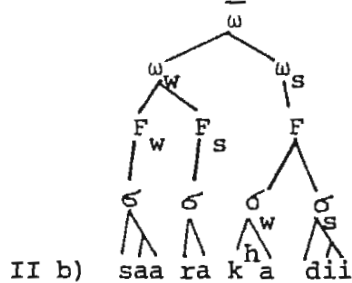
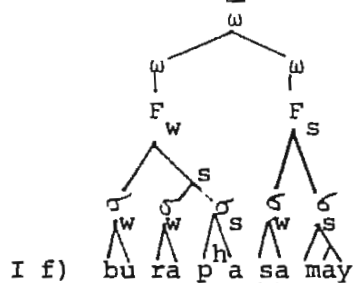
The + indicates the internal boundary between two morphological components, the prefix and the stem. The ## indicates the word boundary in the compound word. Note that there are two substyles for the combinative style of pronunciation: normal and rapid, with the main difference focused on the CV syllables.

### 3.1 The Normal Combinative Style of Speech

There seems to be no difference in the combinative style of speech between the complex and compound words (I and II). Both display some degree of secondary stress on the first part of the words prior to the + or ## boundary markings.

If the domain of the prosodic word is a single stem, each member of the compound words will then be classified as a prosodic word. Prefixes in group I behave prosodically just like any simple words and should then be treated as prosodic words on their own. Here is the analysis of the prosodic structures of the words in I and II in the normal combinative style of pronunciation:

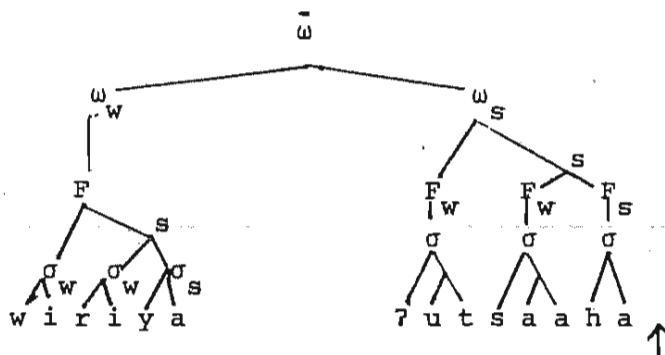
Assuming that all prefixes behave like simple stems, hence, they are prosodic words, we argue that the domain of footing in this style of pronunciation is the prosodic word domain. Again, if the prosodic word contains only one syllable, it can have either a branching or a non-branching rime and still be classified as a prosodic foot. We will assume that all the stress feet are grouped together to form a right-branching word tree with the proper relative prominence assigned to each node. We will take the examples in I f) and II b) and analyse them prosodically:



Note that we have posited another prosodic unit higher than the prosodic word, a superword ( $\bar{\omega}$ ).

Let us now look at the CV syllables in particular. Our Tone Neutralization Rule still correctly applies and produces the right output. It will only apply to the CV syllables in the weak positions on the tree. The neutralized syllables are indicated by the lines beneath them.

As for the Glottal Stop Insertion Rule, we find that the rule will freely apply and insert a /ʔ/ to any foot-final CV syllable on the tree and produces the incorrect outputs. We only want the rule to apply to the final CV syllable of the superword, or in other words, the topmost node of the tree will be the domain of the rule application. The arrow in the word below indicates where this rule will only apply:



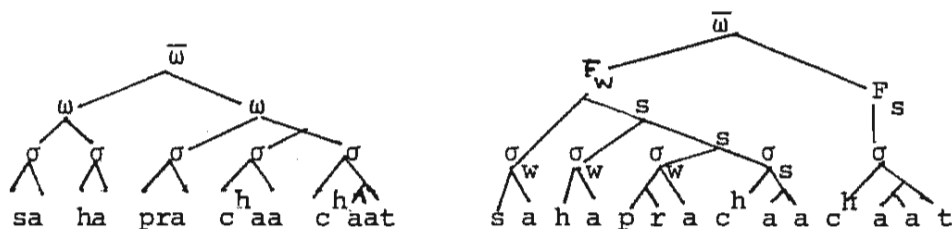
So, we will revise our formulation of the /ʔ/ Insertion Rule as follows:

$$\emptyset \rightarrow ʔ / \dots [-\text{syl}] [+ \text{syl}] \underline{\quad} ]_{\bar{\omega}}$$

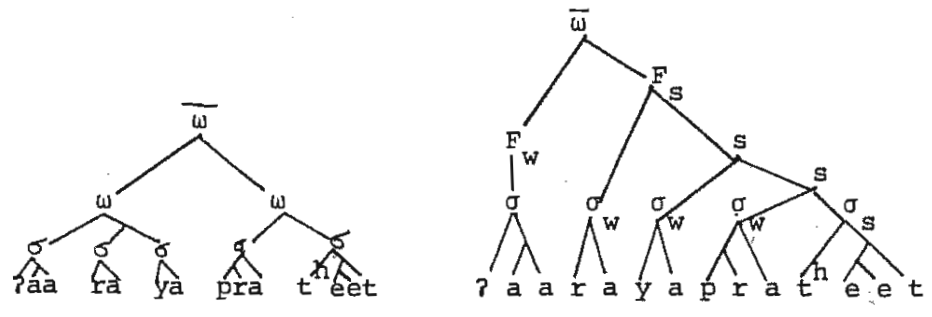
### 3.2 The Rapid Combinative Style of Speech

In the rapid combinative style of speech, the CV syllables in both group I and II behave differently from those in the normal style. When there is a sequence of three or less CV syllables, all of them will be unstressed and their tones will be neutralized. If the sequence exceeds three CV syllables, the pronunciation of the word will remain normal. As a reminder, we only count the non-word-final CV syllables in this case as the word-final CV syllable will always be stressed. My analysis for this rapid style of pronunciation is as follows: the domain of footing is the superword, or the topmost node on the tree. The footing process works from right to left collecting up to three CV syllables as the weak nodes. These CV syllables then become subject to the Tone Neutralization Rule but not the Glottal Stop Insertion Rule. Here are the analyses of some of the above examples in terms of their prosodic structures:

I.d



II.c)



To summarize, we have shown that by applying the general framework of the prosodic structure to the Thai language, we can successfully explain certain phenomena concerning tones and relative prominence. We have argued that only the syllables with the branching rime can be prominent and thus stand as the prosodic stress feet on the prosodic tree. We have provided an alternative approach to the analysis of the presence of the /ʔ/ in the CV-final position: the Glottal Stop gets inserted to convert the CV syllable from its non-branching time into the branching one when the syllable carries the primary stress of the word. Furthermore, we have shown that the differences among several types of pronunciation lie in the differences of the footing domains with regards to all CV syllables. However, this study of the Thai prosodic structure is neither complete nor final and there is a lot more to be investigated.

Footnotes

<sup>1</sup>Thai Consonant Chart

		labial		alveolar/ palatal		velar		glottal	
stop	(voiceless)	p	p <sup>h</sup>	t	t <sup>h</sup>	k	k <sup>h</sup>	ʔ	
	(voiced)	b		d					
affricate	(voiceless)			c	c <sup>h</sup>				
fricative	(voiceless)	f		s				h	
nasal	(voiced)	m		n		ŋ			
lateral	(voiced)			l r					
glide	(voiced)	w		y					

(The superscript /h/ indicates the aspiration in the articulation)

Vowel Chart

	i	ɨ	u	e	ə	o	ɔ	a	ɔ
high	+	+	+	-	-	-	-	-	-
low	-	-	-	-	-	-	+	+	+
back	-	+	+	-	+	+	-	+	+
rounded	-	-	+	-	-	+	-	-	+

Lexical Tones

Mid      Low      High      Falling      Rising

<sup>2</sup>Our analysis of the diphthongs argues against the traditional treatment: we claim that there are only three diphthongs generated by our syllable template, but the traditional orthography claims that there are six diphthongs, the long versions of our three diphthongs: ia, iia, ia, iia, ua, uua. We find that these so called 'short' diphthongs are not productive at all and are mostly borrowed from other languages, while the 'long' diphthongs are pronounced with flexible length variations. We therefore consider the length variations to be phonetic, not phonemic.

<sup>3</sup>Tone Distribution Chart

	Lexical Tones				
	mid	low	high	falling	rising
1) CVV	+	+	+	+	+
2) CV(V) C [+son]	+	+	+	+	+
3) CVV C [-son]	-	+	-	+	-
4) CV C [-son]	-	+	+	-	-

<sup>4</sup>It is not clear at the moment how the mid tone is treated in terms of segmental analysis. There is a possibility that the mid tone can be treated as a contour tone as it needs two tone-bearing segments in the rime.

<sup>5</sup>We will assume that all of the feet are all equally stressed, and they do not form a hierarchical word tree in this style of pronunciation.

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