Weightless Epenthesis in Malagasy
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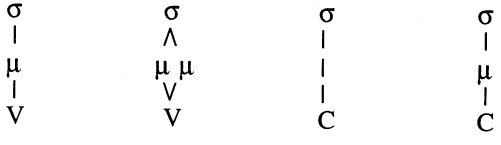
1. INTRODUCTION. In recent phonological theory, the mora is assumed to play a dual role. First, moras represent weight. A syllable node dominating one mora is light (1a), while a syllable dominating two moras is heavy (1b).

(1) a. b.

Moras also represent quantity: Following Hayes (1989), a vowel dominated by one mora is short (2a), a vowel dominated by two moras is long (2b), a consonant dominated by no moras (unless assigned by rule) is short (2c), and a consonant dominated by one mora is long (2d).

(2) a. b. c. d.



I propose that epenthetic vowels in Malagasy are undominated by moras, yet still are of the same quantity as other vowels. That is, a contrast in the number of moras dominating a vowel in Malagasy is realized as a contrast in weight, but not as a contrast in quantity.

2. STRESS PATTERNS IN MALAGASY. The predominant stress patterns are shown in (3) and (4). Stress is penultimate, as in (3), or final if there is a word-final diphthong, as in (4).

(3) **Penultimate stress in Malagasy**

mandéha	to go
miándri	to wait, watch
mihâhi	to sun-dry
misútru	to drink
mamángi	to visit
mahíta	to see
miása	to work

(4) **Final Stress on Diphthongs**

manáu	to do
indrái	sometimes
bemirái	patched together from many different pieces
hatrizái	since the time that
mandrái	to take

This is not an unusual pattern crosslinguistically, and is accounted for, following Hayes 1995, by the metric principles and parameters in (5).

(5)

Metric Principle (Hayes 1995)	**Parameter value in Malagasy**
Foot type	Binary
Foot unit	Mora
Parsing directionality	Right to Left
End Rule	Right
Iambic/Trochaic Law	Trochaic

(5) states that feet are binary, built on moras, diphthongs are bimoraic, footing proceeds from right to left, and feet are Trochaic, or left-prominent. Examples of complete metrical structure are given in (6).

(6) **Metrical Structure of Malagasy**:

Malagasy allows no codas: No word may end in a consonant, and all "clusters" are prenasalized stops or affricates (Erwin 1996a, Keenan and Razafimamonjy 1996a, Keenan and Razafimamonjy 1996b). Among vowels, there is no length contrast in Malagasy.

The data in (7) exemplify a less robust stress pattern in Malagasy, antepenultimate stress, which is incompatible with the analysis in (5). These words always end in the sequences *-na*, *-ka*, and *-tra*, which I will refer to as Weak Final Syllables.

(7) **Antepenultimate stress** in *-na*, *-ka*, & *-tra*

manándrana	to try
míndrana	to borrow
mitándrina	to take care of
mangátaka	to ask for
manáraka	to follow
miánatra	to study
mihínana	to eat
mitsángana	to stand
misáutra	to thank
maháritra	to bear, endure
manándratra	to promote, lift up
mahàfináritra	to please
tápaka	cut
lávitra	far
vúlana	month

2.1. EXTRAMETRICALITY AND STEM-FORMATIVES. Since forms with Weak Final Syllables exhibit an aberrant stress pattern, namely, antepenultimate rather than penultimate, it seems reasonable to postulate that Weak Final Syllables are extrametrical, thereby exempting them from stress computation. However, extrametricality does not account for the data in (8), where it is shown that not all instances of the sequences /-na/, /-ka/, or /-tra/ are Weak Final Syllables.

(8) **Not all final /-na/, /-ka/, /-tra/ are Weak Final Syllables**

Active Verb	**Gloss**
mandrátra	to wound, injure
manétra	to face, oppose
mamána	to heat
mananténa	to hope, expect
mamikavíka	to tack with large stitches
manambáka	to defraud, deceive
manadóka	to mislead

An Extrametricality analysis reduces to stipulation of which lexemes end in extrametrical sequences and which do not. The level of abstraction in this analysis is such that it should be avoided where an alternative is possible. Pearson (1994) presents further arguments against an Extrametricality analysis for the Malagasy data. Instead, Pearson (1994) proposes that Weak Final Syllables are stem-formative morphemes.

Again, it is unpredictable whether a given root will take a stem-formative Weak Final Syllable or not. For example, the analysis of *vólana* ("month"), is *vola+na*, where *vola* is taken as the root. But there is another word, *vola*, which means "silver." The Stem-Formative analysis does not explain why the root meaning "month" takes the stem-formative morpheme, while the root meaning "silver" does not. There are a number of such pairs, some of which are shown in (9):

(9) **Unpredictability of Weak Final Syllables: Homophonous roots.**

Surface form	**Gloss**
$hála_1$	hate
$hála_2$	spider
hálatra	steal, rob
láva	long
lávaka	pit, hole
váva	mouth
vávaka	prayer
váta	box
vátana	body, torso

Under the Stem-Formative analysis, it is stipulated in the lexicon which roots take stem formatives, (and which particular realization of the stem formative) and which do not.

2. MALAGASY ROOTS. The analysis of antepenultimate stress in words which end in Weak Final Syllables given here is not based on a standard account of Malagasy roots (Keenan and Razafimamonjy 1996a, Keenan and Razafimamonjy 1996b).

There are root-final consonantal alternations between suffixed and unsuffixed forms, shown in the first and second columns (10), and summarized in (12). Traditionally, the unsuffixed form (minus any prefixation) is considered basic. In contrast, I analyze the suffixed alternant (minus prefixes and suffixes) as basic.

(10) **Proposed Malagasy Verb Morphology.**

Active verb (unsuffixed)	**Passive verb (suffixed)**	**Proposed Root**	**Gloss**
a. **V-final roots**			
m+i+sútru	sutrú+ina	sutru	to drink
m+a+mángi	vangí+ina	vangi	to visit
m+i+tadídi	tadidí+ina	tadidi	to remember
m+a+híta	hitá+ina	hita	to see
m+i+ásа	asá+ina	asa	to work
m+i+dzíndza	dzindzá+ina	jinja	to reap, cut down
m+i+dzéri	dzeré+ina	jere	to look at
m+a+hándru	handrú+ina	handru	to cook
b. **-z, -v, -s, -n final roots**			
m+i+vúi	vuíz+ina	vuiz	to row, paddle
m+aha+véri	veréz+ina	verez	to lose something
m+a+múnu	funús+ina	funus	to wrap, bind a book
m+an+drái	ráis+ina	rais	to take
m+i+tándru	tandrúv+ina	tandruv	to be careful
m+amp+irái	amp+irái+ina	irai	to unite
m+aha+tsiáhi	tsahív+ina	tsahiv	to remember
m+a+méhi	fehéz+ina	fehéz	to tie
c. **-m, -f, -r, -h, -t, -n final roots**			
m+amp+írina	amp+irím+ina	irim	to tie up, arrange
m+i+índrana	indrám+ina	indram	to borrow
m+i+táona	taom+ina	taom	to gather, attract
m+an+gátaka	an+gatáh+ina	hatah	to ask for
m+an+áraka	aráh+ina	arah	to follow
m+a+mísaka	fisáh+ina	fisah	to flatten
m+an+ambúatra	ambúar+ina	amboar	to arrange, prepare
m+a+mánkuna	vankún+ina	vankun	to plane wood
m+i+ádana	adán+ina	adan	to go slow, be at peace
m+amp+íditra	amp+idír+ina	idir	to bring in
m+aha+fántatra	fantár+ina	fantar	to know
m+a+múritra	purét+ina	puret	to squeeze, crush
m+i+eritréritra	eritrerét+ina	eritreret	to meditate
m+an+áhaka	taháf+ina	tahaf	to imitate
m+i+lélaka	leláf+ina	lelaf	to lick

♦ '+' represents a morpheme boundary

(11) **Table of affixes**:

m-	present tense prefix
i-, an-	active verb prefix
a-	passive verb prefix
aha-	causative/potential verb prefix
-ina	passive suffix

Note the consonant alternations between the unsuffixed and suffixed forms. In (10b) and (10c) above, there are consonants which appear in the suffixed forms which do not appear, or are different, in the unsuffixed forms. A summary of the alternations is in (12):

(12) **Alternations in (10)**

Active verb variant	Passive verb variant
a. ∅ ~ C alternations from data in (10b)	
∅	-z, -v, -s
b. C ~ C alternations from data in (10c)	
-n	-n, -m
-k	-h, -f
-tr	-r, -t, (-f, two instances in corpus [out of several hundred total])

Traditionally, the consonants in the second column of (12) are analyzed as part of the suffix (Hollanger 1973, Dziwirek 1989, Keenan and Razafimamonjy 1996a, Keenan and Razafimamonjy 1996b). Under this analysis, all suffixes have numerous allomorphs (*-zina*, *-nina*, *-fina*; *-za*, *-na*, *-fa*, etc.), and every root ends in a vowel. This analysis suffers from two failings: first, it is impossible to predict which allomorph surfaces with which root, and second, there is no explanation why a given root selects suffix allomorphs beginning with the same consonant, no matter what the particular suffix is. Each root is lexically marked as to which allomorph it takes[1]: For roots in (10a), the passive suffix is *-ina*. For roots in (10b), the passive suffix has the allomorphs *-zina*, *-vina*, and *-sina*. Other suffixes always begin with the same consonant after the same root. For roots in (10c), the final syllable deletes, and is replaced by allomorphs *-nina*, *-mina*, *-fina*, *-kina*, etc.

An alternative analysis is that the roots in (10b) and (10c) end in consonants. The roots posited under this analysis are presented in the "Proposed Root" column of (10). There is no massive allomorphy of the suffixes under this analysis, and no lexical marking of what root takes what allomorph.

Following Itô (1989), epenthesis and deletion sites are predictable from syllabification. In Malagasy, segmental material is mapped to a CV syllable template (recall that no codas are allowed). In unsuffixed forms such as in (10b) and (10c), the root final consonant can not be syllabified as a coda, so the consonant is either deleted (13), or vowel epenthesis occurs after the consonant (14), such that syllabification can proceed according to language-particular well-formedness constraints. For roots in (10b), the final consonant deletes word-finally (13).

(13) **Syllabification of root from (10b)**

a. UR

```
 μ   μμ
mandrais
```

b. Syllabification

```
 σ      _ σ
 |      /  //|\
 μ    /   / / μ μ
m a n d r a i
```

For roots in (10c), the final consonant mutates and vowel epenthesis occurs (14). What remains unexplained, is which consonants delete and which mutate. However, this analysis results in no massive allomorphy, and a unified explanation of forms in (10b) and (10c).

(14) **Syllabification of root from (10c)**

a. UR

```
 μμμ
milelaf
```

b. Syllabification

```
 σ   σ   σ   σ
 |   |   |   |
 μ   μ   μ   μ
m i l e l a k a
```

3. ANTEPENULTIMATE STRESS. A problem for the proposed analysis is that for forms with Weak Final Syllables (14), stress is incorrectly predicted (15):

(15) **Footing of (14).**

a. Output of Syllabification Algorithm

```
 σ   σ   σ   σ
 |   |   |   |
 μ   μ   μ   μ
m i l e l a k a
```

b. Footing

```
     F       F
    / \     / \
 σ   σ   σ   σ
 |   |   |   |
 μ   μ   μ   μ
m i l e l a k a
```

(16) **Tableau 1. Strict Layering highly ranked.**

INPUT μ μμ milelaf	NO CODA	ALIGNR (FT,μ)	ALL-FT-R	STRICTL (μ,V)	CORR (O,I,μ)	CORR (O,I,V)
a. F / \ σ σ σ / | / | / | / μ / μ / μ \ m i l e l a f	*!					
b. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / μ m i l e l a k a			*!		*	*
c. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / | m i l e l a k a		*!		*		*
☞d. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / μ m i l e l a k a					*	*
e. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / | m i l e l a k a				*!		*

Optimal form: *manalúka. Surface form: manáluka

Key: solid vertical lines indicate constraint ranking. dashed vertical line indicates constraint rank undetermined (& irrelevant for this data set). * indicates a constraint violation. *! indicates fatal violation. Shading indicates that violations (or lack thereof) are irrelevant in determining optimal candidate. ☞ indicates optimal candidate.

This section presents, in terms of Optimality Theory, an analysis of antepenultimate stress in Malagasy. The analysis proposes that epenthetic vowels in Malagasy are non-moraic, and therefore do not affect stress. The relevant constraints are introduced in (17).

(17) **Constraints from (16)**:

- NoCoda: Codas are disallowed.
- AlignR (Ft,μ): Feet are "aligned" with moras (in Hayes 1995 terms, moras are parsed by feet).
- All-Ft-R: All feet are "aligned" with the right edge of the word (=direction of foot parsing: right to left).
- Corr(Output, Input,μ): Every output mora corresponds to an input mora.
- Corr(Output, Input,V): Every output vowel corresponds to an input vowel[2].
- StrictL(μ,V): Moras must immediately dominate all vowels[3].

If AlignR (Ft,μ) is ranked highest, as in the case in (16), this insures that the unit of foot parsing is the mora. If All-Ft-R: is ranked highest, this insures that the direction of foot parsing is right to left, and that feet have no intervening syllables. Corr constraints here (Orgun 1995) are equivalent to Dep (McCarthy and Prince 1995). StrictL is a translation of the Strict Layer Hypothesis into OT:

(18) **Strict Layer Hypothesis** (Selkirk 1984).
A prosodic category at level *i* of the prosodic hierarchy must immediately dominate at least one instance of the prosodic category *i*-1.

The Prosodic Hierarchy is presented in (19):

(19) **Prosodic Hierarchy**:
Phonological Phrase>>Phonological Word>>Foot>>Syllable (σ)>>Mora (μ)>>Segment

In (16), StrictL is highly ranked, such that any candidate that violates it will fail. This captures the spirit of Strict Layering as posited by Selkirk.

(20) **Deriving Weak Layering by lower ranking of StrictL(μ,V):**

Input μ μμ milelaf	No Coda	AlignR (Ft,μ)	All-Ft-R	Corr (o,i,μ)	StrictL (μ,V)	Corr (o,i,V)
a. F / \ σ σ σ / | / | / | \ / μ / μ / μ \ m i l e l a f	*!					
b. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / μ m i l e l a k a			*!	*		*
c. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / | m i l e l a k a		*!			*	*
d. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / μ m i l e l a k a				*!		*
☞e. F / \ σ σ σ σ / | / | / | / | / μ / μ / μ / | m i l e l a k a					*	*

Optimal form and surface form: manáluka.

Key: solid line indicates ranking. dashed vertical line indicates constraint rank undetermined (& irrelevant for this data set). * indicates a constraint violation. *! indicates fatal violation. Shading indicates that violations (or lack thereof) are irrelevant in determining optimal candidate. ☞ indicates optimal candidate.

In (16), Candidate (a) fails because it includes a coda consonant. (16b) fails because the foot does not dominate the rightmost mora. (16c) and (16e) violate StrictL because the final syllable does not dominate a mora. The optimal candidate, (16d), incorrectly places stress on the penultimate syllable. The two candidates with antepenultimate stress, (16b) and (16e), are ruled out by All-Ft-R and StrictL, respectively.

A lower ranking for the constraint All-Ft-R can quickly be dismissed. If All-Ft-R were violable in Malagasy, that is, if feet did not necessarily dominate the rightmost mora, then explanation of the predominant stress pattern in Malagasy (penultimate) is lost.

Violation of StrictL, however, does not produce such serious consequences in Malagasy. Violation of Strict Layering, known as Weak Layering, was proposed by Itô and Mester (1992). Weak Layering allows certain prosodic representations to be well formed despite violating Strict Layering.

(21) **Weak Layering.**

> Recently, Itô and Mester (1992) argue that prosodic organization must allow a syllable to be licensed directly by the word bypassing the foot, the Weak Layering hypothesis. By extension, it should be possible for a vowel to be licensed directly by a syllable bypassing the mora... (Piggott 1995:323).

Tableau 2 in (20) differs from Tableau 1 (16) only in that StrictL is now ranked below Corr(O,I,μ), thereby deriving Weak Layering. The evaluation of candidates in (20) differs from (16) in that candidate (e), with a final nonmoraic epenthetic *a*, no longer fatally violates StrictL, and thus is the winning candidate.

4. CONCLUSION. I have shown that in Malagasy, epenthetic vowels are not dominated by moras. Instead, they are directly licensed by the syllable node. In a quantity insensitive language such as Malagasy, since all segments are of a single phonological length, length is predictable from the segmental tier, and therefore need not be redundantly predictable from the moraic tier. The notion of moras representing weight only, and not quantity, is not new. For instance, when a coda consonant is dominated by a mora via Weight by Position (Hayes 1989), this mora signifies weight only, not quantity. Thus, there is no principled reason why a contrast in the number of moras dominating a segment must always represent both a contrast in weight and a contrast in quantity.

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[1] A comparison of Malagasy and Maori verb root analyses is given in Erwin (1996b). A different version of this analysis is given in Erwin (1996a).

[2] The two CORR constraints are formulated as they are for clarity. They could be replaced with a single CORR(O, I) constraint (exactly the equivalent of DEP (McCarthy and Prince 1995)), for which every element (segmental or prosodic) present in the output, but not in the input, would incur a violation. The single CORR(O, I) constraint, if ranked where CORR(O, I,μ) is in (16) and (20), would incur many violations, but would result in the same optimal candidates being selected.

[3] This particular formulation is given for clarity. A constraint, **STRICTL**, for which *any* violation of Strict Layering throughout the prosodic hierarchy counts against the candidate, could replace **STRICTL (μ,V)** in (16) and (20) with the same results: the candidates would incur more violations of **STRICTL**, but the same candidates would be selected as optimal. Alternatively, one can envision a family of **STRICTL** constraints, (**STRICTL(PRPH,PRWD)**, **STRICTL(PRWD,FT)**, **STRICTL(FT,σ)**, **STRICTL (μ,V)**, **STRICTL (μ,C)**, etc).

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