Iambic Feet and Syllables in Paumari: Analysis and Theoretical Consequences[1]

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1. Introduction

This paper analyses foot and syllable structure in Paumari, an Amazonian language of the Arawan family (see Figure 1), all of whose languages are spoken near the Purus river in Western Amazonas state, Brazil. Paumari is a highly endangered language. There are only a few hundred speakers of Paumari and most of them speak Portuguese more and more in their daily lives, occasionally even among themselves (although among themselves Paumari is still spoken far more than Portuguese and children still grow up speaking Paumari). It is therefore extremely urgent that we document this language now, before the lessons it has to teach us are lost. The principal contribution of this paper is therefore intended to be empirical.

The main descriptive and theoretical points I make in this paper are the following. First, Paumari has iambic feet, built from the right edge of the word. Second, these iambic feet are not weight-sensitive. These first two points violate the proposals of most who have worked on prosodic feet and so are interesting in their own right, as we will see (for a comprehensive review of work on iambic stress systems, the reader is referred to van de Vijver (1998)). Perhaps the most interesting corollary of these points, emerging during the discussion of section 6 below is that the constrasts between trochaic and iambic foot structures is underdetermined by phonetics, contrary to the proposals of several researchers (especially Hayes (1995) and Kager (1993)). My next set of points are related to the Paumari syllable and syllable theory more generally. I argue that there is evidence that syllables in Paumari are irrelevant to stress placement. This leads us to a novel perspective on syllables, buttressed by additional data from the related Arawan language, Banawá. In particular I argue for a distinction between the syllable's role in the *enhancement* of segmental perception and the construction of the syllable as a *domain* for the application of phonological constraints.

Before proceeding though, we should have a look at Paumari's genealogical relationships. These are given in Figure 1. In this Figure, dialect names are italicized. Proto-languages are in bold.

Arawan Language Family

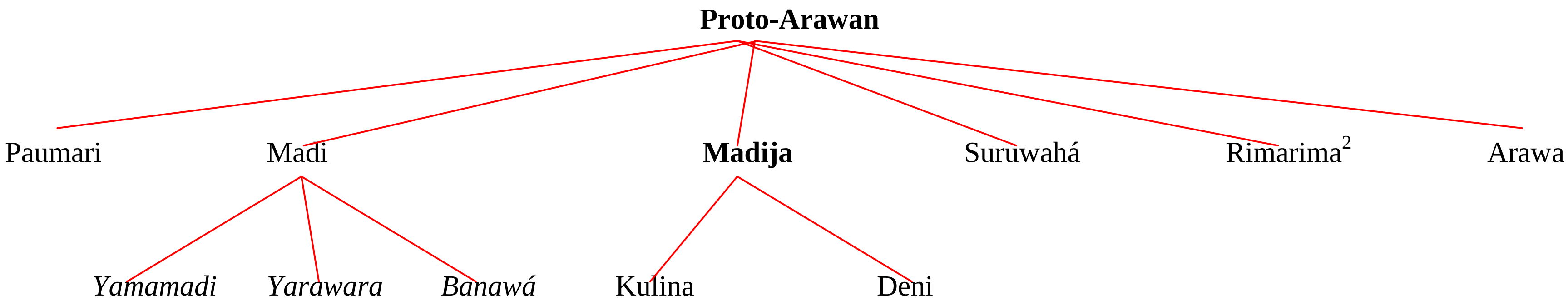


Figure 1

Let me say how this paper is organised. In section 2, the phonetics and initial analysis of stress and foot structure are given. This section also mentions the interaction between the length of vowel sequences and minimal word size, relevant at this stage because this interaction throws up a slight wrinkle in the system. Section 3 lays out my analysis of Paumari's syllable structure. Here I argue that though the evidence from Paumari is not as conclusive as one might like, it does support the proposal that syllables are irrelevant for stress placement in Paumari. Moreover, when additional evidence from Banawá is introduced in section 7, the implications for syllable theory are clear.) Section 4 restates the somewhat informal analysis of foot structure in section 2 in Optimality-Theoretic terms. In section 5, we consider and reject a radical alternative, namely, that Paumari's stress system is trochaic, rather than iambic, countering a line of reasoning first introduced in Kager (1989). Sections 6 and 7 discuss the consequences of Paumari syllables and feet, respectively, for prosodic theory. Section 8 summarizes the conclusions.

2. Overview of Paumari prosody

2.1. Secondary stress placement

The secondary stress pattern of Paumari is iambic, with a right-to-left orientation. As an initial approximation, beginning with the rightmost syllable, place a secondary stress on each odd-numbered syllable going leftward. This is illustrated in the words in (1)-(5) (where ` = secondary stress.). Syllable structures are given for the first set of examples.

(1) a. onì 'Demonstrative: here, now, close to speaker'
|V
σ σ

b. pahà 'water'
V V
σ σ

c. 'bo'dà 'old'
V V
σ σ

d. bodì 'to open'
V V
σ σ

e. bahì 'rain'
V V
σ σ

(2) a. bòvirì 'star'
b. màsikò 'moon'
c. àrabò 'land'
d. kàrahò 'large'
e. bàdarà 'year'

The iambic pattern is not altered in longer words, as shown below, but maintains the same rule of 'stress every odd-numbered syllable from the right'.

(3) a. kajòvrì 'island'
b. kabàhakì 'to get rained on'
c. afòronì 'yet'

(4) a. ìtaràpahà 'channel of water (flowing around island; shortcut in river)
b. àhakàbarà ' dew'
c. sànaràhakì 'to bifurcate' (intransitive)

(5) a. katàraràrakì 'unequal, uneven, unround'
b. sohìribànakì 'complete, well-formed circle'
c. athànaràrikì 'sticky consistency'[3]

2.2. Primary stress

In bisyllabic words, primary stress is placed on the rightmost syllable. The words in (1) above illustrate this and are repeated here as (6). I represent primary stress in this discussion with ´:

(6) a. oní 'Demonstrative'
b. pahá 'water'
c. 'bodá 'old'
d. bodí 'to open'
e. bahí 'rain'

In polysyllabic words, primary stress is always placed on the antepenultimate syllable:

(7) a. bóvirì 'star'
b. másikò 'moon'
c. árabò 'land'
d. kárahò 'large'
e. bádarà 'year'

(8) a. kajóvirì 'island'
b. kabáhakì 'to get rained on'
c. afóronì 'yet'

(9) a. ìtarápahà 'channel of water (flowing around island)
b. àhakábarà 'dew'
c. sànaráhakì 'to bifurcate' (intransitive)

(10) a. katàrarárakì 'unequal, uneven, unround'

b. sohìribánakì 'complete, well-formed circle'
c. athànarárikì 'sticky consistency'

(11) bikànathàrarávinì 'to cave-in, to fall apart quickly'

Acoustic support for the description above of primary and secondary stress placement is given in Figures 2-9. below.[4] Before presenting these spectrograms, wave forms, and pitch plottings, however, a few prefatory words are needed. As the spectrograms show fairly clearly, the primary acoustic correlates of stress placement in Paumari are length and intensity. The pitch plots are also relevant, although they are slightly skewed at the end of each word due to the fact that these particular examples come from a list of words pronounced in isolation and so they receive phrase-final rising intonation typical of lists in Paumari. Nevertheless, in the Figures for polymoraic words, 4,5, 8, and 9, it is clear that a slightly higher pitch accompanies primary stress, even when the stressed syllable is the antepenult, abstracting from the strongly rising intonation at the end of the word. Both the wave forms and the spectrograms in Figures 2-9 below show greater intensity and length on the stressed syllable. In general, primary stress (almost always in fact) shows greater intensity, while secondary stress is marked by, occasionally, a slight increase in intensity and frequently by a greater length than unstressed syllables.[5]

'bo'da

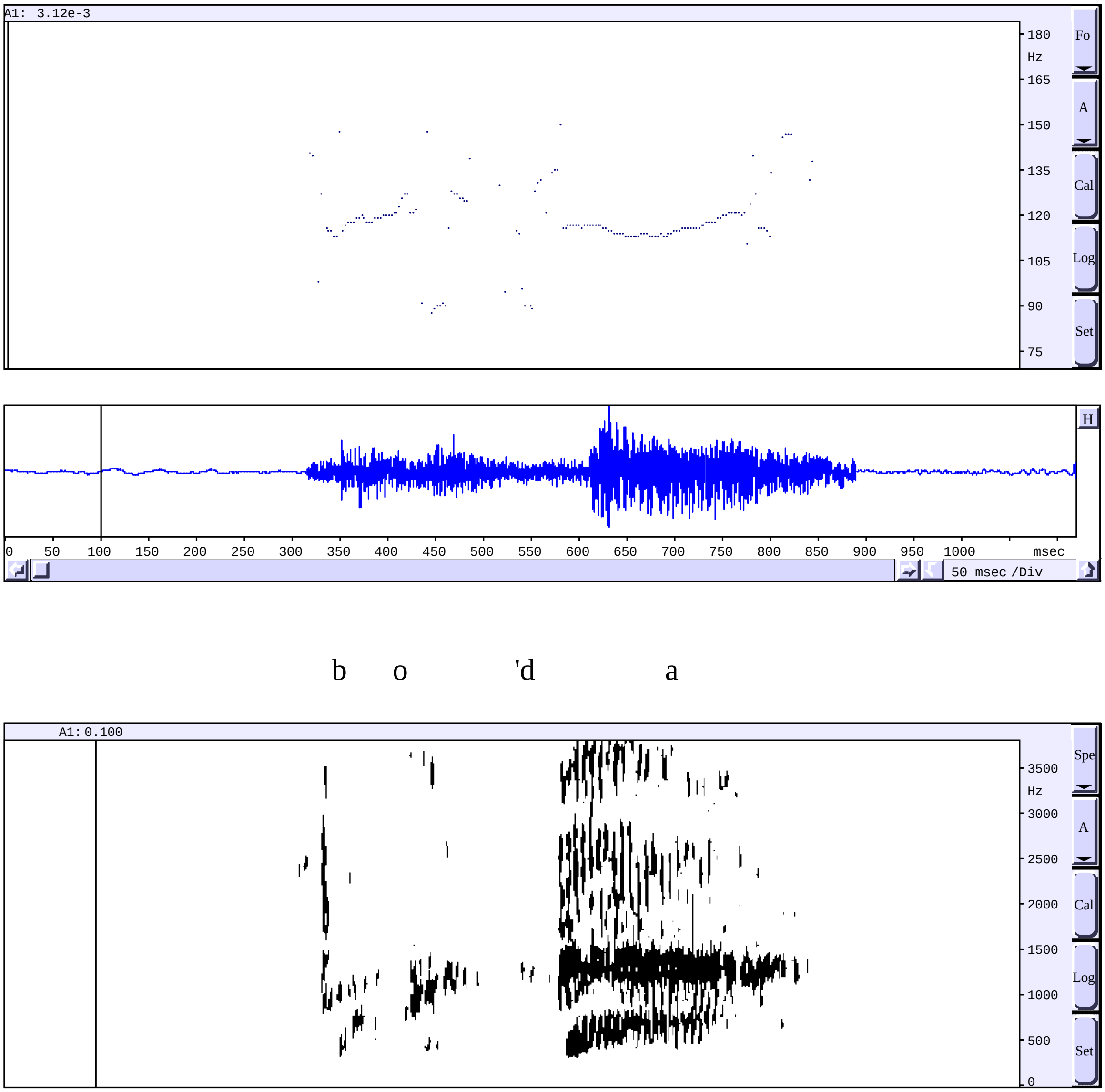


Figure 2

bahí 'rain'

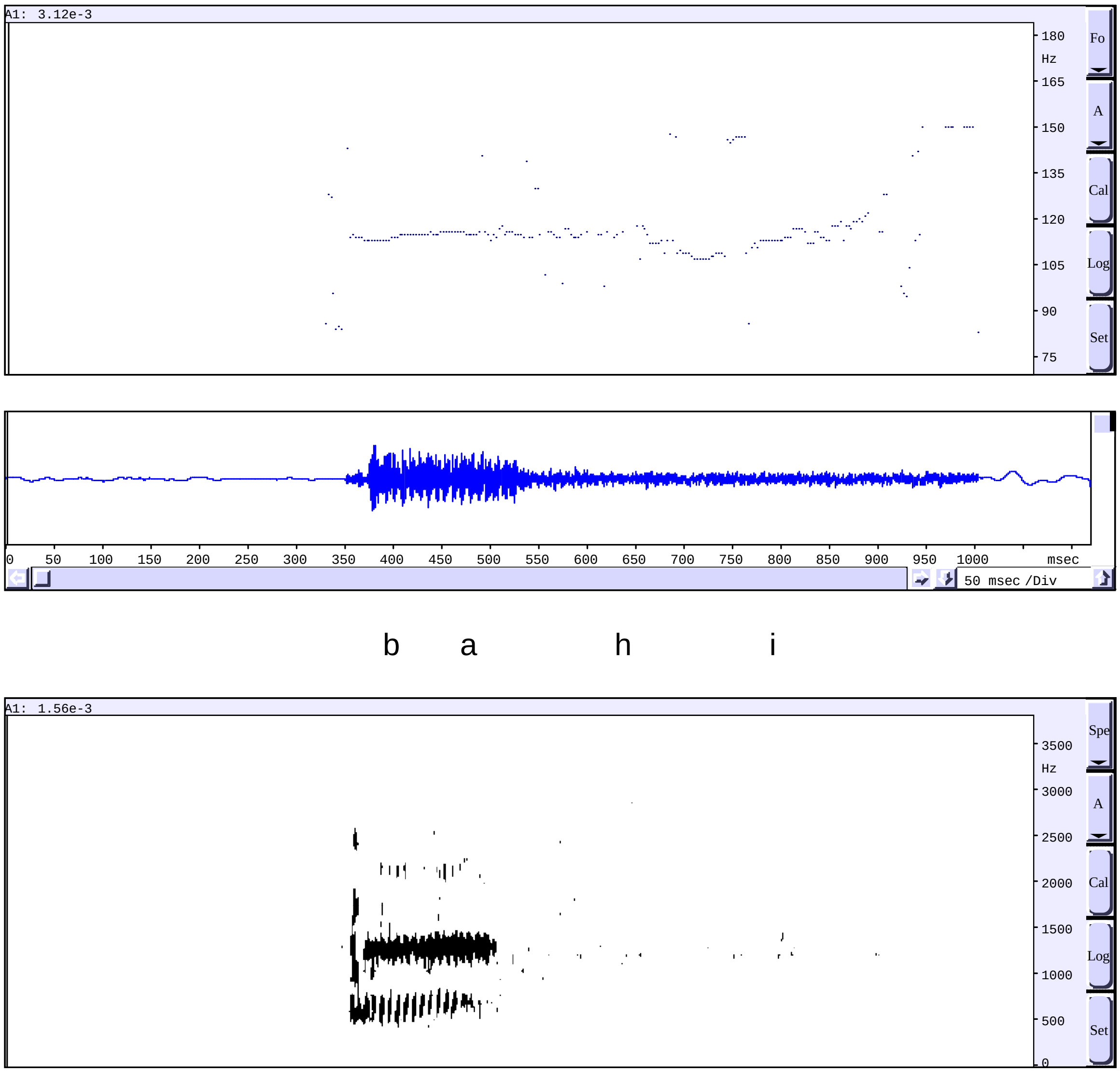
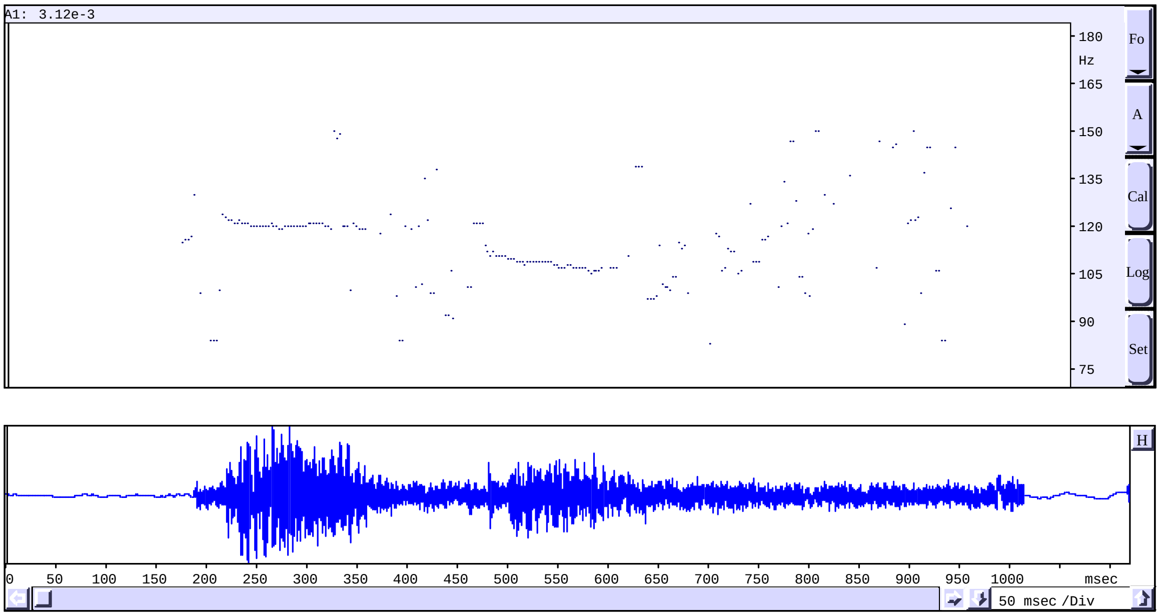


Figure 3

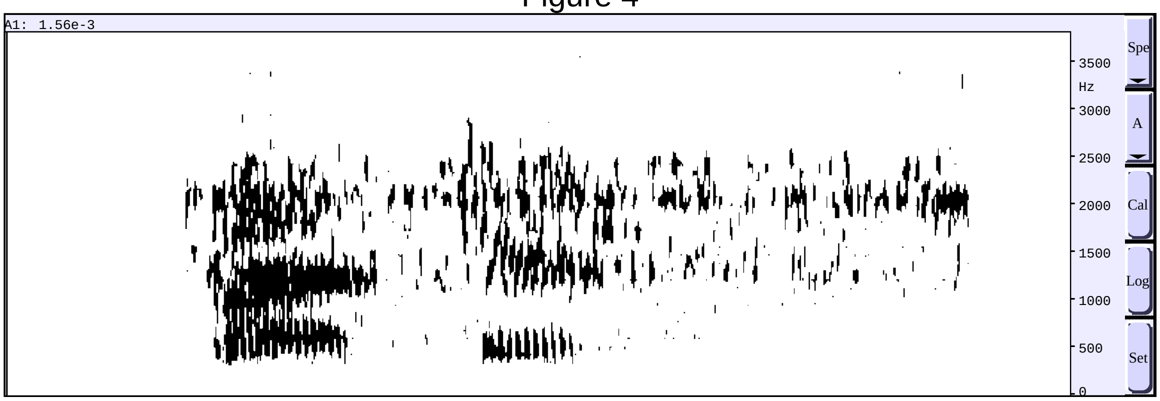
Figure 3 calls for some discussion. The greater intensity is found not on the syllable I claim to be the stressed syllable, i.e. **hi**, but on the unstressed syllable, **ba**. On the other hand, the **hi** syllable is much longer (and longer even than other word-final CV syllables in any of the examples in this paper, other than other **hi**-final words). The intensity placement on **ba** is only an apparent anomaly, however. The first thing to observe is that the vowel **a** is inherently more sonorous and louder than the vowel **i**. Moreover, the plosive, **b**, receives much more energy than the Arawan **h**. /h/ in Arawan languages always shows up as very weak, receiving less intensity than any other consonant. In fact, in some Arawan languages (e.g. Yarawara (Dixon 1995 and 1999,297)) intervocalic /h/'s have been dropped diachronically. It is not surprising, therefore, that a different acoustic cue would be used for stressed **hi** syllables. In this case that strategy involves greater length, rather than greater intensity. It should also be pointed out that the intensity of **ba**, which is unstressed, is much less than that of the stressed syllable, **da**, in Figure 1.[6]

bádarà 'year'



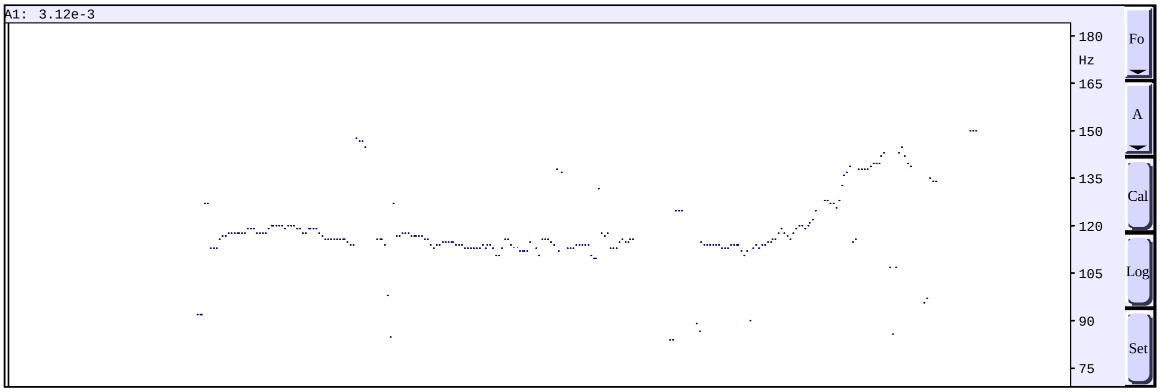
b a d a @ a

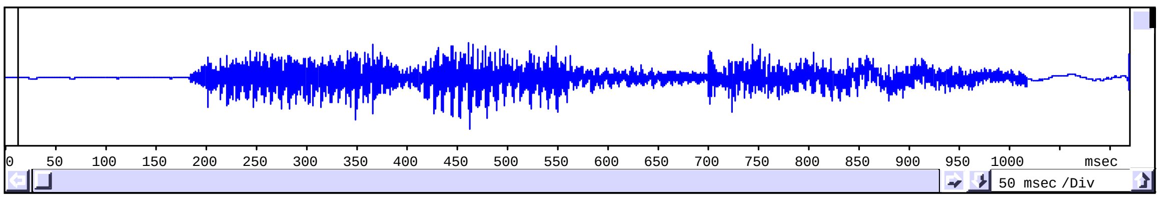
Figure 4



This word in Figure 3 is quite useful because the relative intensities of the vowels cannot be attributed to vowel differences, each utterance of **a** being virtually identical. The leftmost syllable receives the greatest intensity. It is also longer than the penult. The final syllable, **ra**, receives greater length, typical of secondary stress placement, as already noted. This Figure also shows that pitch falls from the primary-stressed syllable, **ba**, to the unstressed syllable, **da**, then rises again (modulo list intonation as already mentioned) in **ra.**

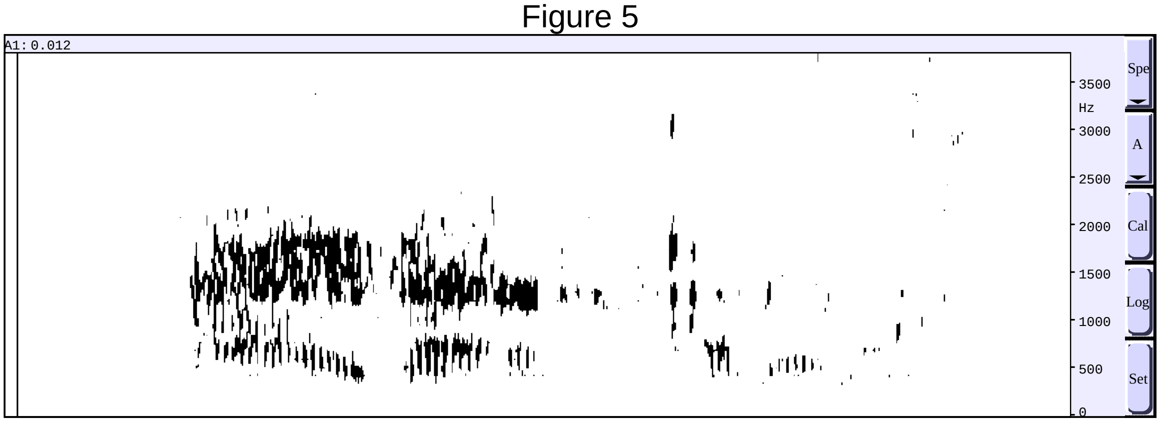
árabò 'land'





a @ a b o

Figure 5



In this figure we see a stress pattern identical to the pattern in Figure 4 Figure 3 shows that onsetless Vs may be stressed in word-initial position. Once again, we also see a *slight* pitch fall following the primary stressed vowel, **a**, to the unstressed syllale, **ra**, and then a rise (again, modulo list intonation) to the final syllable, **bo**.

Primary and secondary stress placement are summarized in (12):

(12) Paumari stress placement (first pass):

a. Secondary stress – stress every odd-numbered syllable from the right of the word.

b. Primary stress – Place primary stress on:

(i) ultima in bisyllabic words

(ii) antepenult elsewhere

We now come to the first major theoretical implication of Paumari stress: it violates the Iambic/Trochaic law proposed by Hayes (1995, 80) and defended frequently by Kager (1993, 1995a, 1995b):

(13) Iambic/Trochaic Law (Hayes 1995, 80)

a. Elements contrasting in intensity naturally form groupings with initial prominence.

b. Elements contrasting in duration naturally form groupings with final prominence.

Since duration in Paumari is nondistinctive lexically, i.e. noncontrastive, in its iambic stress system, (13) is violated. The implications of this violation are taken up in sections 6 and 7 below.

A final observation on the stress patterning documented has to do with the concept of degenerate feet, which arise at the left margins of Paumari words. For secondary stresses to appear on every other syllable, feet are constructed, from right-to-left (to use a process metaphor that will be replaced by a constraint-based analysis directly). The foot structure of some representative Paumari words is given in (14)-(20):

```
(14) (oní)                'Dem'
        o
     ____
     (  o)

(15) ('bodá)              'old'
          o
       ____
      (   o)
```

```
(16) (á)(rabò)           'land'
      o     o
      ________
     (o       )
(17) (bá)(darà)     'year'
       o     o
     _________
      (o       )
(18) (kajó)(virì)        'island'
         o     o
      __________
        (o       )
(19) (à)(haká)(barà)'dew'
      o     o     o
     _______________
           (o       )
(20) (kái)(haihì)        'medicine'
        o      o
   ___________
       (o       )
```

Etc...

Thus, in words like (16), (17), (19), and (20), etc. there are nonbinary or 'degenerate' feet. We return to this in section 6 below and see there that these degenerate feet have serious consequences for foot theory. I will temporarily account for these facts by saying that after iambic feet are constructed right-to-left within the word, a noniterating, trochaic superfoot is placed on the final (two, when relevant) iamb(s). In bimoraic words like (14), this trochaic foot is itself degenerate. See section 4 for an OT formalisation of this. The words with even numbers of syllables show that feet are iambic, not trochaic. The words with odd-numbers of syllables show orientation of the feet to be right-to-left. These latter words also show that all syllables are footed, even when this produces degenerate feet bearing only secondary stress. Both this fact and the placement of primary stress turn out to be crucial below when we consider and reject the alternative analysis that Paumari might instead be a trochaic system. Before proceeding, we need to bring in one more important fact about Paumari prosody.[7]

2.3. Vowel sequences and word-structure

Consider the following words:

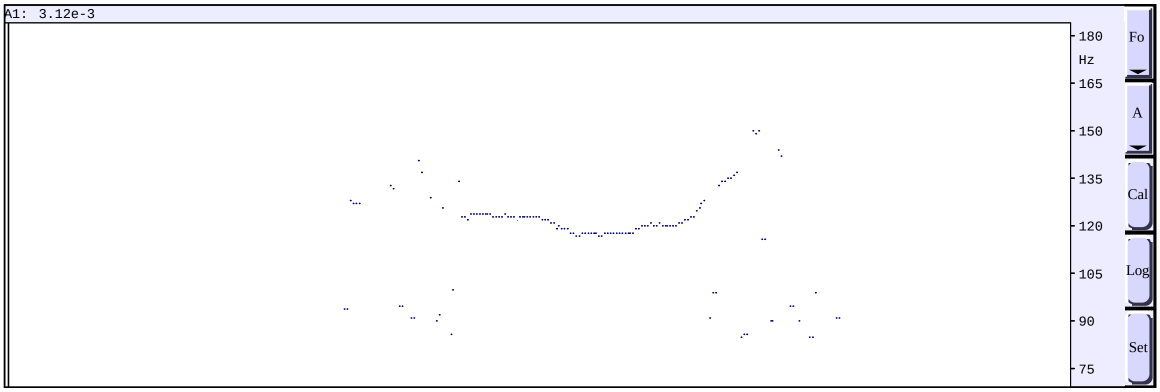
(21) a. **goá** 'sound made by someone knocking'
b. **koá** 'mouse'
c. **pió** 'mutum-piorim' (wild turkey)

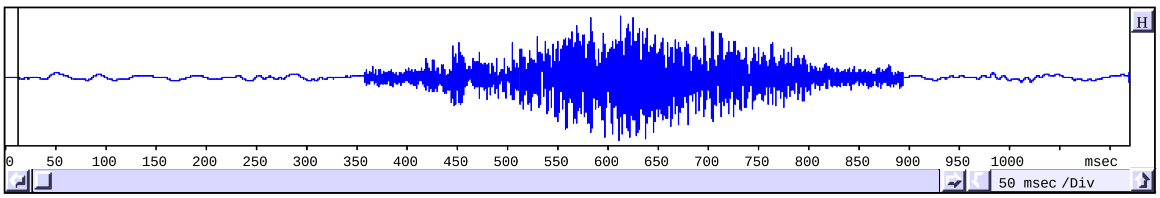
The words in (21) are bimoraic and receive stress on the final vowel of the diphthong. In larger words, however, CVV sequences have the length of single vowels, as shown in part by the stress patterns below:

(22) a. **vainí** 'river'
b. **kajoá** 'water spring'[8]
c. **hoáranì** 'one'
d. **jáo?orò** 'cutia'
e. **vaitxánavà** 'little ones'
f. **káihaihì** 'type of medicine'
g. **náothinià** 'after'

It is quite crucial to what follows that are understand clearly that the diphthongs in (21) are long (bimoraic) both phonetically and phonologically, whereas the dipthongs in (22) are all short phonetically and phonologically (i.e. monomoraic). This means that the longer diphthongs in (21) cannot be due merely to their position within the word. Figures 6-7 provide acoustic support for these assertions:

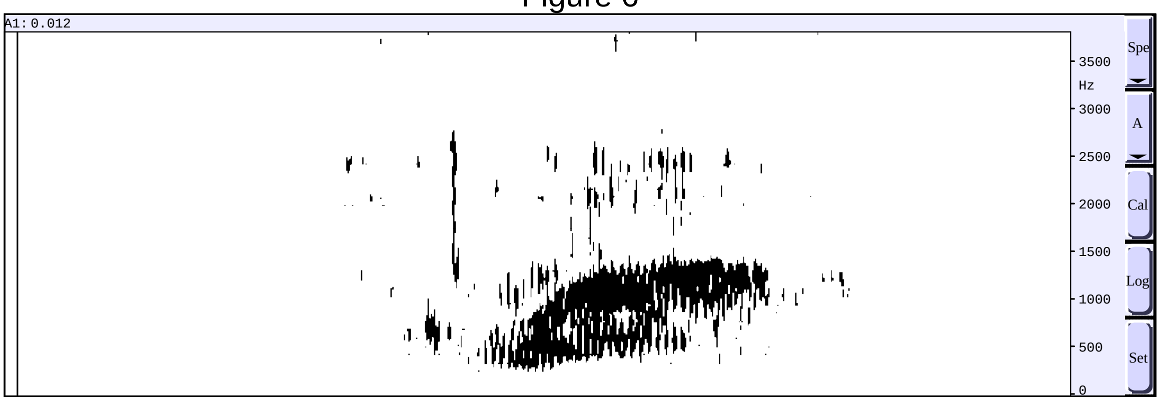
goa 'sound of knocking'





g oa

Figure 6



Note the length of the vowel sequence in Figure 6. It is roughly 130 ms longer than the identical, word-final sequence in Figure 7. This is due to its occurrence here as part of a CVV-shape word.

kajoa 'water spring'

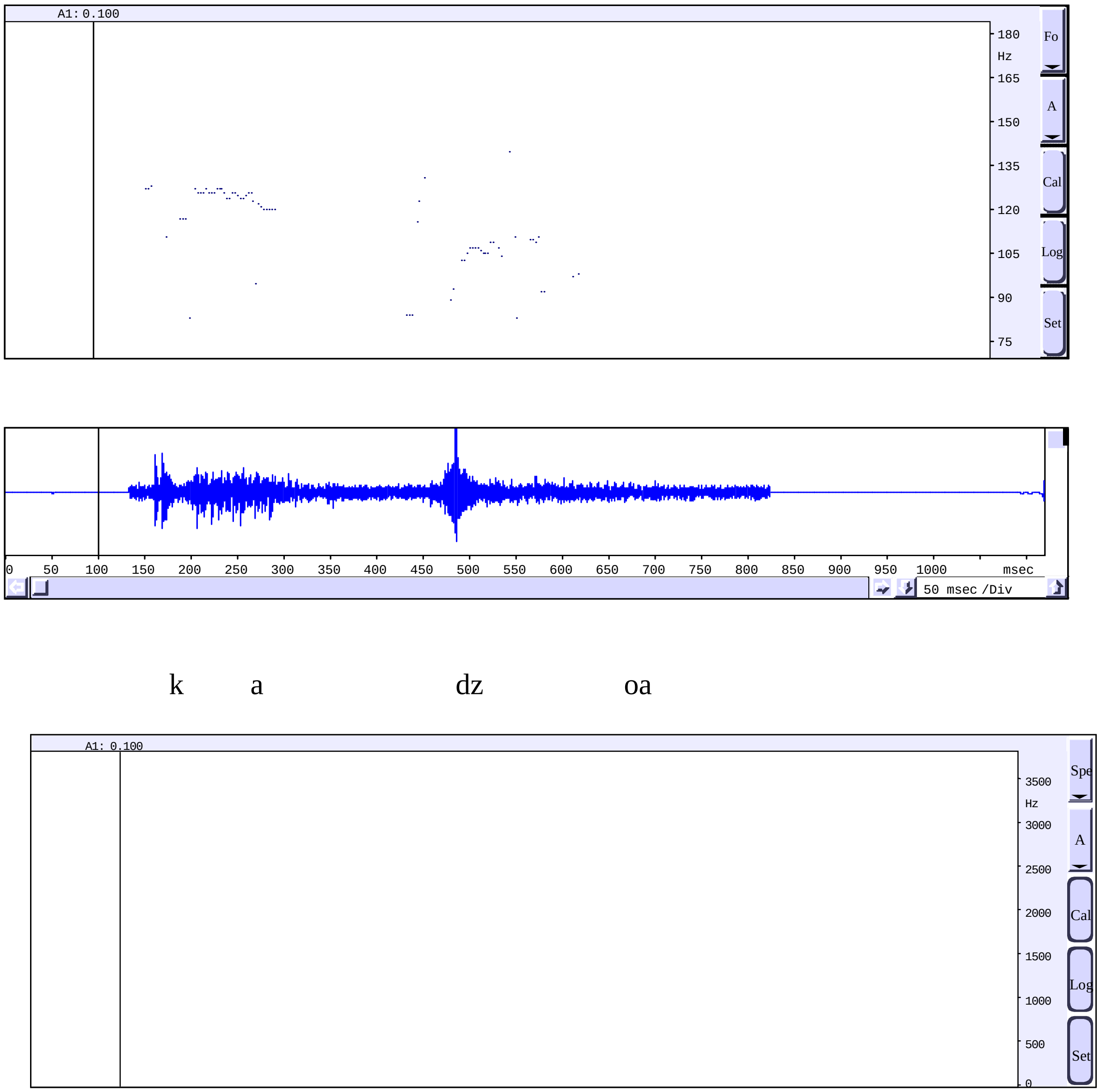
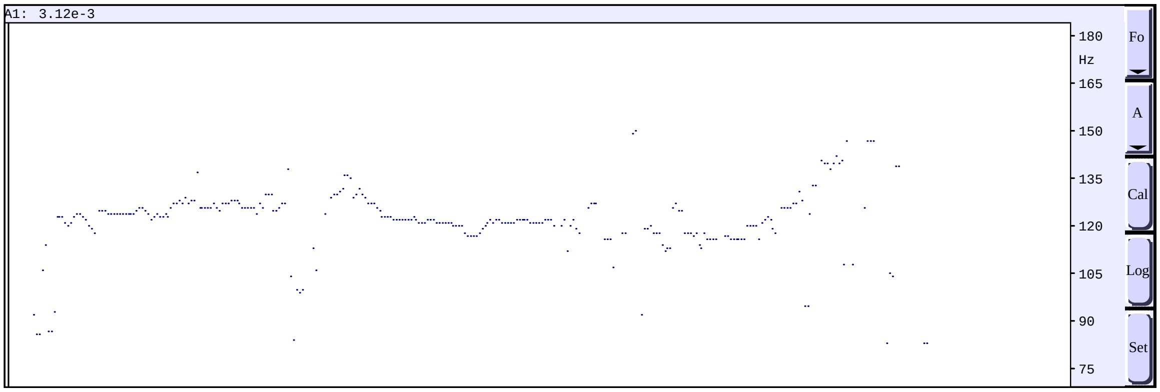
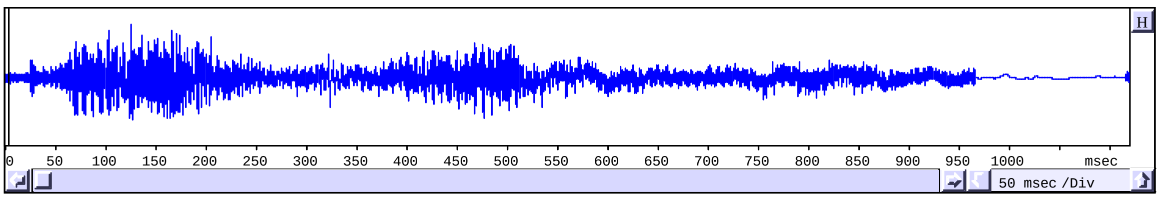


Figure 7

The diphthong in Figure 7 is much shorter than the vocalic sequence in Figure 6, both absolutely and relatively (compared to the vowel in the first syllable, **ka**). Note that if stress were merely placed on every other vowel, without respect for the relative lengths of vowel sequences, then we would have expected primary stress on **ka** instead of where it actually occurs, **joa.** The primary stress on **joa** is shown here mainly by the intensity of the onset consonant. The longer **a** of the first syllable (i.e. longer than the shortened **a** of the second syllable) will naturally have greater inherent intensity than either of the vowels in the sequence in **joa**. Figure 8 further illustrates that diphthongs in polymoraic words are shorter than in CVV words.

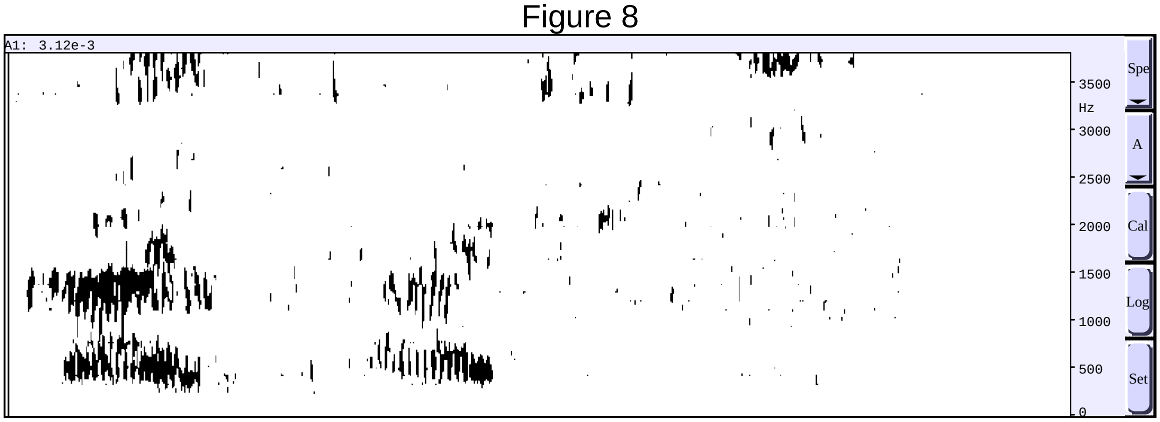
kaihaihi 'type of medicine'





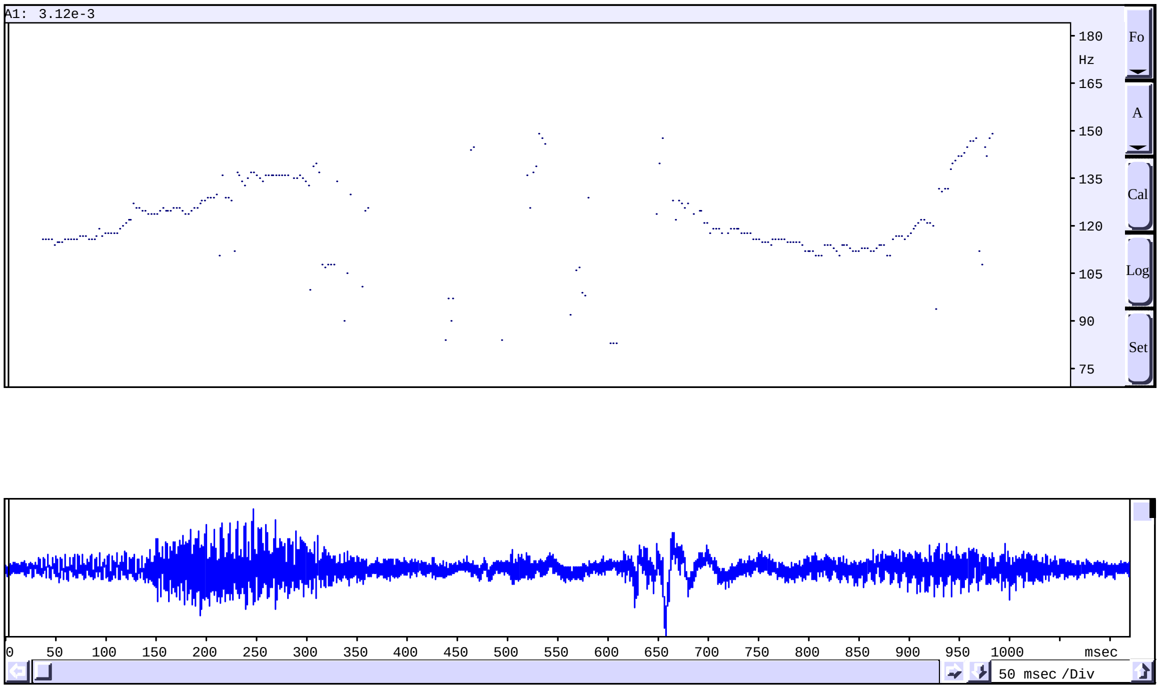
k ai h ai h i

Figure 8



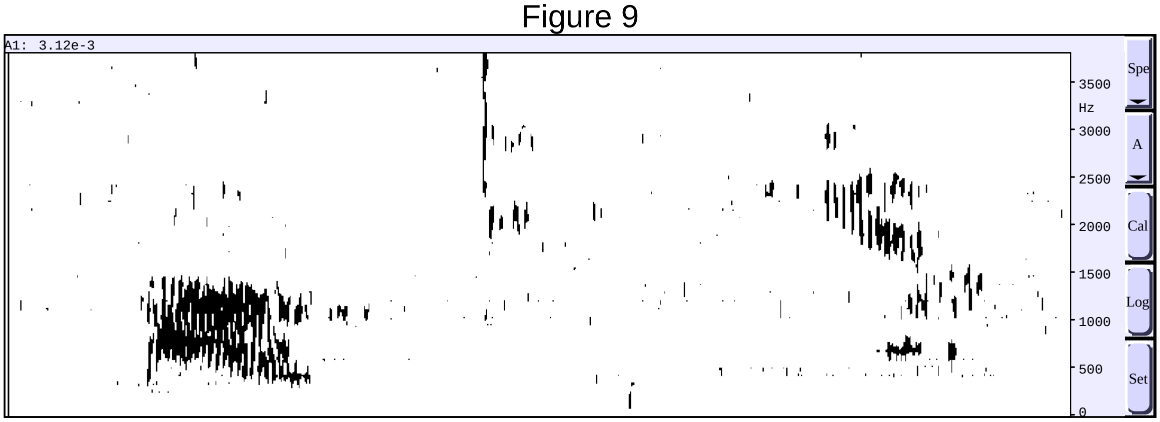
This word is particularly interesting because it shows quite clearly that diphthongs are monomoraic in polysyllabic words. Phonetically, one can see that the final **hi** syllable (see the discussion of this syllable shape also following Figure 3 above) is the longest syllable, even though the preceding syllables have V-sequences. Moreover, the primary stress in this word is found on **kai**. This is what our analysis predicts if **hai** and **kai** are monomoraic. If they were bimoraic, or bisyllabic, however, we would have expected stress to fall instead on **hai**. Additional support for this interpretation is given in Figure 9:

naothinia 'after'



n a o t h i n ia

Figure 9



In this word the first and last syllables contain V-sequences and each V-sequence is treated monomoraically, like other diphthongs we have seen above, apart from CVV-shaped words.

Let us now offer a preliminary account for the relative length of the diphthongs above. As noted, the diphthongs in the words of shape CVV, listed in (21), are clearly longer than the diphthongs in the words in (22). And this length cannot be ascribed to the position of the diphthong in the words since in words like **kajoa** 'water spring', for example, the diphthong is also in final position but is nevertheless shorter than the diphthong of **goa** 'sound of knocking' and the others of this word shape. The reason for this is simply that diphthongs are monomoraic except in CVV-shaped words. And this descriptive generalisation has a natural account in moraic-based theories. It is given in (23):

(23) Minimal Word Size: Words in Paumari are at least two moras in length.

This constraint will require that the diphthong in CVV-shaped words, and only these, be lengthened to become bimoraic. All other diphthongs are monomoraic. We return to this in the next section and again in section 4.

We have now completed our overview of Paumari prosody. In the remainder of the paper, I want to analyse and argue in more depth for a particular formal analysis of the facts just reviewed, paying special attention to their theoretical implications. Since much of my analysis and many of the theoretical conclusions I wish to draw depend on our understanding on the syllable in Paumari, we must first analyse the syllable more formally, before proceeding with the remainder of our discussion.

3. Syllable structure

3.1. Phonotactics and syllable structure

In discussing syllable structure in a given language, it is important to consider the phonotactics of that language, i.e. the constraints on the arrangements of vowels and consonants in determining word shape (see Ewen & vn der Hulst (2001, 122ff) for an introductory discussion).[9] One can, of course, attempt to handle phonotactics without syllables but, at least since the failed attempt of Chomsky & Halle (1968) to do so, linguists have acknowledged the importance of syllables to the understanding of constraints on word-shape. Therefore, I propose to do two things in this section. First, I want to establish the basic syllable structures for Paumari and thereby offer an account of Paumari phonotactics. Next, I examine the implications of my proposals on Paumari syllable structure for the statement of stress placement.

Let's begin by summarizing the generalizations which any analysis of Paumari prosody must capture:

(24) a. Vowel sequences longer than two vowels are never found (e.g. VVV^n where $n \geq 1$).
b. There are no long vowels in Paumari.[10]
c. All sequences of vowels are monomoraic, except in words with the shape #CVV#.
d. Onsetless vowels and diphthongs are found only in word-initial position.

Observation (24a) is based on the absence of Paumari words like the hypothetical forms in (25):

(25) *pioapa, *paiaosi, *siaira, etc.

Observation (24b) is based on the absence of words like the hypothetical forms in (26):

(26) *biira, *poo'da, *ribaa, etc.

The remaining observations are based on facts already illustrated above.

3.2. The proposal

How might we account for these observations? Certainly, syllable structure must play a role in our explanation. [11] My proposal is that the phonotactics of Paumari, (24), are best explained if Paumari has only two syllable types, CVV and CV. Both of these are monomoraic (unless overruled by constraint (49) below). I am going to assume at the outset that Paumari has CV syllables and that this assumption is uncontroversial. Unless one rejects the notion of syllables altogether, a sequence like **boviri** 'star' is going to be analyzed by most phonologists as .CV.CV.CV., i.e. three CV-syllables, barring strong evidence to the contrary. Since I know of no such contrary evidence in Paumari, I plan to assume without much further argumentation that Paumari has CV-syllables. But, it should be noted that most of the argumentation for CVV syllables below also supports CV-syllables. The only other syllable type in the language is CVV. This is not as obvious as the postulation of CV-syllables and will therefore require detailed argumentation. The initial argumentation offered is positive – I provide evidence that the language has CVV-syllables. The next form of argumentation is negative – I argue that the language lacks V-syllables, leaving CVV as the only alternative. This negative argumentation involves considering three apparent counterexamples to the CVV analysis. We begin our argumentation and analysis with a consideration of the role of the consonant in Paumari syllables, i.e. as an onset to the vowel.

3.2.1. Syllable onsets

We saw in (24) that Paumari lacks VVV^n sequences. I argue here that this is the result of two constraints on Paumari syllable structure: (i) all syllables have onsets (except in word-initial position) and (ii) Paumari syllables may not exceed one mora in length. I want to preface my analysis with a brief consideration of why syllables have onsets at all. This is related to the concern to develop an account of syllable functions in section 7. Why *do* syllables have onsets? More specifically, why, as phonologists universally agree, are onsets preferred to codas? [12] One answer is physical, i.e. found in the nature of actions, most of which manifest, in the words of a reviewer of this paper, "...a rapid onset and a gradual offset." If this is correct, then the syllable's onset is partly just a consequence of the physical nature of actions. Other reasons are easy enough to come by as well, though. Consider, for example, Ohala's (1990, 265) findings that "...since there is a richer, more reliable set of place cues in the CV transition than the VC transitions, listeners weigh the former more heavily than the latter in deciding what they've heard." That is, CV syllables more effectively aid the parsing of the input phonetic string; they are functionally motivated. We return to the notion of syllables as parsing aids in section 7.

Turk (1994, 113ff) and Nolan (1994) also report on research demonstrating perceptual and acoustic differences between pronunciations of consonants in syllable-initial vs. syllable-final positions, corroborating the significance of the onset-coda distintinction. It is (nearly) universally agreed that onsets are phonetically and physically privileged in well-definable ways over codas. Phonologically, of course, we cannot rest with merely knowing that there are important phonetic motivations for the onset, we must seek the best way to formalize the phonology of onsets within a theory of syllable structure. One of the most widely-cited formalizations of these observations is proposed in Itô (1986) in her ONSET condition. One version of this constraint is given in (27):

(27) ONSET:*V(V)
| /
σ

This constraint in effect stipulates onsets, a brute-force move. It does not attempt to reflect the phonetic bases for the constraint, in effect rendered irrelevant by this formalization. The latter is acceptable just in case there is no evidence that the phonetics of onsets is causally implicated in their phonology. But often eliminating phonetics from a causal role in the phonology is a bad move (see, for example, Archangeli & Pulleyblank (1994) or just about anything written by John Ohala for phonetic motivation of phonological constraints). In fact, in the more recent formalizations of onset preference, the phonetics are at least as removed as in (27). Itô & Mester (1994), building on arguments by McCarthy and Prince (1993), reinterpret the ONSET and NO-CODA (ONSET's counterpart) as the alignment constraints in (28) (see also Piñeros (2001):

(28) a. ALIGN-L (σ, C): Every syllable has a consonant as its left edge.
b. ALIGN-R (σ,V): Every syllable has a vowel as its right edge.

Is anything lost by excluding the phonetics from the account of syllables as done in (27) and (28)? One nonempirical answer is that if, as some phonetic work (e.g. Stevens 1998) seems to suggest, the syllable has a *functional* motivation, as a parsing aid (see section 7 below for more on this), one which is of synchronic relevance to phonologies, then such formalisms fail to express this.[13] Along these lines, Everett (1996) suggested that an important role of the syllable, both phonologically and phonetically, is the *enhancement* of segmental perception and so stated the constraints on onsets in terms of sonority. It was there argued that this move not only maintains a more perspicuous relationship between phonetics and phonology, but that it also explains more effectively the well-known crosslinguistic fact (see in particular Downing (1998)) that onsetless vowels are often found in word-initial position although otherwise prohibited in a given language.[14] Nevertheless, since the formalization of onset-related constraints is not directly relevant to our present discussion I will merely refer the reader to Everett (1996) for discussion.

For concreteness, therefore, I will adopt here the simpler, older constraint, ONSET in (27) above. The violation of ONSET in word-initial position can be accounted for by the constraint-ranking in (see also Everett (1996, 1998), though not much rides on this here:

(29) PARSE-μ >> ONSET

The effects of this ranking are illustrated in Tableau 1**:**

Tableau 1

arabo 'land'	PARSE-μ	ONSET

☞.a.ra.bo.
  | | |
  μ μ μ
  | | |
  σ σ σ
		*

a.ra.bo. | | | μ μ μ σ σ	*!	

3.2.2. Syllable maximality

The spectrograms in Figures 2-9 above show that, with the exception of CVV-shaped words, all syllables (i.e. sequences of CV or CVV) are of roughly equal length. Let's assume momentarily that this is correct. Let us also assume that (30) is a proper formalization of this:

(30) SYLMAX (Syllable Maximality): Paumari syllables are no longer than one mora in length.

This constraint prohibits syllables longer than a single mora in length, unless, as with all Optimality-Theoretic constraints, it is overridden by other constraints. (30) is crucial to our understanding of Paumari syllables and foot structure. Intuitively, it is motivated by the knowledge that all languages impose an upper bound on allowable moraic size of their syllables (see Broselow (1995, 202ff); McCarthy & Prince (1986), Hayes (1989), Ewen & van der Hulst (2001, 150ff), and others). Paumari is quite conservative in this respect– it prohibits syllables from exceeding one mora in length. (On the other hand, no special statement about minimal number of moras for a particular syllable is required, since in moraic theory no syllable can be less than a single mora in length.)

If SYLMAX is correct, the length equivalencies between CV and CVV sequences follow, assuming that they are syllables. But notice now that SYLMAX, only accounts for the facts if there are no V-syllables in Paumari, for two reasons. First, if there were V-syllables, then it would be very difficult to understand why CV and CVV sequences are roughly equal in length, since (30) and moraic theory would force them to have lengths of one and two moras, respectively. Second, if there were V-syllables, then we would have no account of stress placement. Let us consider these problems in turn.

The representation of CVV sequences might be handled in at least one of the ways in (31)-(33):

```
(31)    .CVV.
         \  \/
          \  μ
           \ /
            \

           σ
```

```
(32)    .C V.V.
         \  |  |
          \ μ  μ
           \/  |
            \

          σ  σ
```

```
             μ
            / \
(33)    .CV.V.
          \/  |
          σ   σ
```

Representation (33) must be rejected immediately because it claims that there are syllables of less than one mora in length, a claim which violates the findings of all work on moraic theory. Yet (32) must also be rejected, because (i) it predicts length differences unsupported by the facts and (ii) it is unable to account for the stress patterns observed. To see this latter fact, contrast the grammatical stress patterns below with the ungrammatical examples:

(34)	a. *váidì	'clouds'
	b. vaidí	
(35)	a. *máisà	'bride'
	b. maisá	
(36)	a. *siárià	'species of snake'
	b. siariá	
(37)	a. *bìahòarívinì	'to spill'
	b. biàhoarívinì	
(38)	a. *sokóanì	'washing'
	b. sókoanì	
(39)	a. *hotáirì	'deer'

b. hótairì
(40) a. *a'daímakì 'deep'
b. a'dáimakì

Only the representation in (31) can correctly predict the stress patterns on words with vowel sequences, as in (34)-(40),whether stress is placed on moras or syllables. At least 'at the surface', therefore, vowel sequences in Paumari are treated like single vowels for the purposes of length and stress. If there are V-syllables and stress is placed on syllables, then we wrongly predict the (a) patterns in (34)-(40). If stress is placed on moras, and each vowel is a mora in length (because, ex hypothesi, each is a syllable) then the same, ungrammatical patterns are predicted, if each vowel receives a mora. This is, I take, quite a strong reason to prefer the representation in (31).

There is additional, comparative evidence for SYLMAX which emerges as we compare Paumari to other Arawan languages. In Everett (1998) and Buller, Buller, and Everett (1993), it was argued that syllables in Banawá, an Arawan language closely related to Paumari, are divided by feet. I proposed in Everett (1998) that this situation arises because the constraint in (41) is violable:

(41) Syllable Integrity (SYLINT): Syllables are not divided by higher prosodic constituents.

In Everett (1996) and (1995), I suggested that this constraint is very highly ranked crosslinguistically and that the many superficial prosodic differences among Arawan languages may best be understood in terms of it. For example, Deni seems to have diachronically altered its syllable structure and word-minimality constraints by ranking SYLINT over WDMIN and MAXIO[15]. This would explain why Deni shows no evidence for a WDMIN constraint and prohibits vowel sequences of any kind (even when otherwise expected by the morphophonology; see Everett (1995)). Paumari (and Suruwahá whose stress is nearly identical to Paumari's, except for primary stress placement, see Everett (1995; 1996)) may represent a situation intermediate between Deni and Banawá. To see this, let us first assume that the highest-ranking constraint across Arawan stress systems is (42) (an assumption supported by the work reported in Everett (1995, 1996, 1998) and Buller, Buller, and Everett (1993)):

(42) Moraic Feet (MOFEET): Feet are constructed on moras.

Everett (1995) presents a large amount of data and several arguments in support of this constraint. Now, if MOFEET >> SYLINT and if SYLMAX is $\sigma \leq \mu\mu$, then we get the exactly the situation reported in Buller, Buller, and Everett (1993) for Banawá, namely, that feet are built on moras, dividing syllables, as in the examples in (43)-(45) (taken from Everett 1998):

Banawá foot construction (where ()s = foot boundaries and '.'s = syllable boundaries):

(43) a. *sáyiè* ‘sound out’

b. (.sa.**yi**)(**e**.)
\/ \\ /
σ σ

(44) a. *kèrewéduàma* 'turn end over end'
b. (.ke.re.)(.we.**du**)(**a.**ma)
\/ \/ \/ \ / / \/
σ σ σ σ σ

(45) a. *tìkadámuè* 'you forget'
b. (.ti.ka.)(.da.**mu**)(**e**.)
\/ \/ \/ \ / /
σ σ σ σ

However, by altering the value for SYLMAX, from two to one moras, as stated in (30) above, Paumari avoids both violations of MOFEET and SYLINT. Now, I assume that reducing constraint violations is a potential force in diachronic development, ceteris paribus (but things are not usually equal. So cf. McMahon (2000) for a critical assessment of OT as a theory of language change). Under this conception of the comparative relationships in Arawan, Paumari has not quite gone as far as Deni. That is, it has not eliminated all vowel sequences nor WDMIN, but it has reduced syllable size, thus avoiding the kind of violations of SYLINT common to other Arawan languages. If this historical/comparative story is on the right track, then what we have in Arawan is the set of historical differences in syllable structure given in (46)-(48):

(Everett, 1998; Buller, Buller, & Everett 1993):
(46) Banawá syllables: CV, CVV
| | |
μ μμ

(Everett 1995)
(47) Deni syllables CV
|
μ

(This paper; see also Everett 1996; 1995)
(48) Paumari and Suruwahá syllables: CV, CVV
| \ /
μ μ

It is tempting to propose that the diachronic progression is (46) → (48) → (47), though this would be merely speculative at this point. Some readers will have noticed, however, that if all syllables are monomoraic, then the question of whether feet are built on moras or syllables becomes extremely subtle. I offer one, admittedly inconclusive, but still suggestive, argument in the next section that feet are built on moras in Paumari. To get at this argument, we now turn to consider the interaction of our syllabic constraints with word minimality.

3.2.3. Syllable size and word size

I begin this section restating (23) above, adding a bit of formalization:

(49) Minimal Word Size: Paumari are at least two moras in length - $*[_{Word}\,\mu]$

As we have seen, the effects of this constraint are quite clear, especially when comparing illustrated in Figures 6 and 7 above. If the relevant constraints are ranked against one another as in (50), then we explain most of the facts observed to this point, as noted:

(50) WdMin >> Onset >> SylMax

To see how these constraints correctly account for Paumari stress, consider the Tableau below: (<> = unsyllabified)

Tableau 2

baiharu 'name'	WdMin	Onset	SylMax

<b>aiharu
   || | |
   μμ μ μ
   || | |
   σσ σ σ
		**!	

baiharu || | | μμ μ μ |/ | | σ σ σ			*!

☞baiharu
  |/ | |
  μ μ μ
  | | |
  σ σ σ			

baiharu || | | μμ μ μ || | | σσ σ σ		*!	

In the first row, the syllabification fatally violates Onset twice because the **b** is unsyllabified and because the **i** has no onset. In row two, the bimoraic syllable **bai** violates SYLMAX, fatally. In the final row, there is a single violation of onset, **i**, but one violation here is still fatal. The tableau correctly indicates the optimal form in row three.

Let us now consider words like **koa**, where WDMIN comes into play, outranking SYLMAX:

Tableau 3

koa 'mouse'	WDMIN	ONSET	SYLMAX

☞koa
  | |
  μμ
  \\/
  σ
			*

koa \\/ μ | σ	*!		

<k>oa
    | |
    μμ
    | |
    σσ
		**!	

<k>oa
    | |
    μμ
    \\/
     σ
		*!	*

Although row one violates SYLMAX, this is not fatal because it does respect the two higher-ranked constraints. Row two violates WDMIN because **koa** only has one mora. Row three violates SONINC because the initial **k** is unsyllabified.

3.2.4. Alternative analyses

Although the evidence provided above makes a strong case for CV and CVV as the only syllable types in Paumari, it is worth considering an obvious alternative, namely, that Paumari has no CVV syllables. This alternative comes in (at least) three versions, all considered in this section.

The first version will analyze Vs, CVs, and CVVs, as in (51):

(51) a. V = V
                |
                σ

b. CV = CV

```
                    \ |
                     σ

c.      CVV   =     CV +  V
                    \|    |
                     σ    σ
```

Under this alternative, Vs and CVs are well-formed syllables and CVV is a sequence of two syllables. There are two fatal flaws in this analysis, however.

The first problem arises from the fact that CVV sequences are always monomoraic, except in #CVV# words, as we have seen. To express this fact, the analysis in (51) would be forced to include a stipulation like (52):

(52) A sequence of CV + V syllables is monomoraic.

But now notice that this stipulation violates moraic theory generally because it requires syllables of less than a single mora in length, just as in representation (31) above. This is the first fatal flaw.

The second fatal flaw in this alternative is its failure to offer an account of the central phonotactic observation of Paumari: there are no VVV^n sequences. This alternative can only express this generalization by a brute-force stipulation, along the lines of (53):

(53) $*V^n$ (n≥2)

Now, although this constraint 'works', it flies in the face of nearly all work in phonotactics by eliminating the role of the syllable and replacing it with a stipulation. (And remember that no such stipulation is required of the analysis in 3.2.2.). I therefore reject this first version of the V-syllable alternative.

Let's consider now a second alternative which would claim that all Paumari syllables are CV (except for those in word-initial position, which could be handled by ranking ONSET below PARSE-μ, as suggested earlier). This analysis would work by analyzing all VV sequences as phonemes, i.e. as input/underlying diphthongs. This in effect pushes the complexity out of the prosodic analysis and into the lexicon. A potential objection to this move is that no other Arawan language has phonemic diphthongs, so such a move would be puzzling from a comparative perspective (given that Arawan languages are so similar in other respects. See Dixon (1999) for more details). More to the point, however, this 'vocalic inventory' solution fails to account for the fact that even vowel sequences created by the morphosyntax are monomoraic, as shown in (54):

(54) a. siho ka -ojini INPUT 'smoke from the fire'
fire comitative-smoke
b. siho kaojini OUTPUT
| | \/ | |
μ μ μ μ μ

Therefore, I also reject this second alternative. However, there is a final alternative of the V-syllable analysis which I am unable to rule out conclusively, even though I believe that the evidence weighs against it. This analysis prohibits V-syllables in all environments *except* the word-final position in CVV-shaped words (they are also allowed, for independent reasons, in word-initial position if we adopt the PARSE-μ >> ONSET analysis above). It does this by the constraint ranking in (55):

(55) WDMIN >> SYLMAX >> ONSET

To see how this works, consider the optimal structure of **pio** 'wild turkey' vs. the structure of **kajoa** 'water spring' in Tableaux 4 and 5 below:

Tableau 4

pio 'wild turkey'	WDMIN	SYLMAX	ONSET
.pio. \/ μ | σ	*!		
☞ .pi.o. | | μ μ | | σ σ			*
.pio. || μμ \/ σ		*!	

Tableau 5

kajoa 'water spring'	WdMin	SylMax	Onset
☞.ka.joa. | \/ μ μ | | σ σ			
.ka.joa. | || μ μμ | \/ σ σ		*!	
.ka.jo.a. | | | μ μ μ | | | σ σ σ			*!

On the other hand, according to the analysis in 3.2.2., the constraint rankings would be as in (56) instead of as in (55) above:

(56) WdMin >> Onset >> SylMax

Tableau 6

<table>
<tr><th>pio 'wild turkey'</th><th>WdMin</th><th>Onset</th><th>SylMax</th></tr>
<tr><td>.pio.
\/
μ
|
σ</td><td>*!</td><td></td><td></td></tr>
<tr><td>.pi.o.
| |
μ μ
| |
σ σ</td><td></td><td>*!</td><td></td></tr>
<tr><td>☞ .pio.
||
μμ
\/
σ</td><td></td><td></td><td>*</td></tr>
</table>

Tableau 7

<table>
<tr><th>kajoa 'water spring'</th><th>WdMin</th><th>Onset</th><th>SylMax</th></tr>
<tr><td>☞ .ka.joa.
| \/
μ μ
| |
σ σ</td><td></td><td></td><td></td></tr>
<tr><td>.ka.joa.
| ||
μ μμ
| \/
σ σ</td><td></td><td></td><td>*!</td></tr>
<tr><td>.ka.jo.a.
| | |
μ μ μ
| | |
σ σ σ</td><td></td><td>*!</td><td></td></tr>
</table>

How might we choose between these two hypotheses, represented by the constraint rankings in (55) and (56)? This is an important choice, remember, because if Tableaux 6 and 7 are correct, feet are built on moras. But if Tableaux 5 is correct, feet are built on syllables. The only independent evidence I have been able to adduce from Paumari weakly supports the second set of constraints, i.e. my original analysis in 3.2.2.

This evidence comes from Reduplication. Reduplication in Paumari can affect either the final syllable or the final two syllables of the word (from Chapman & Salzer 1999, 190):[16] When only one syllable is reduplicated, the result generally seems to be an onomatopoeic form (although Chapman and Derbshire (1991) and Chapman and Salzer (1999) fail to comment on this).

Monosyllabic reduplication (examples from Chapman and Salzer (1999, 190) and Chapman and Derbyshire (1991, 308):

(57) a. **txa** 'sound' → **txatxa niki** 'sound made by monkey'

b. **sasa** 'melt' (as Chapman and Derbyshire (1991, 308) remark on this word, "Some verbs are not found in an unreduplicated form..." This verb, **sasa**, is one of the examples they give. Clearly, though, it is monosyllabic reduplication.)

c. **txi** 'sound of smaller animal' → **txitxi niki** 'sloth'

d. **tiri** 'sound of reptile' → **tiriri-hana** 'sound made by water snake just before striking'

Bisyllabic reduplication (examples taken from Chapman and Derbyshire (1991, 308):

(58) a. **magi** 'fog' → **magimagi- ni** 'to mist, to fog'

b. **nadara-ki** 'red' → **nadaradara-ki** 'almost red'

c. **pahi-ni-ki** 'without salt' → **pahipahi-ki** 'inadequate salt'

Given these two kinds of reduplication, if CVV words like **roa** 'round' are bisyllabic then we might expect words of this shape to surface with one or both of the different forms in (59). The first one is bisyllabic and the second one monosyllabic reduplication (see section 4.3. below for an explanation of the moraic representation here):

```
(59) a. roa 'round'      →    roaroa–ki        'cylindrical'
         ||                    || \/  |
         μμ                    μμ μ   μ
         ||                    || |   |
         σσ                    σσ σ   σ

     b. roa              →    *roa.a-ki        '?' Unattested
         ||                    ||  |  |
         μμ                    μμ  μ  μ
         ||                    ||  |  |
         σσ                    σσ  σ  σ
```

There are no words like (59b) in the language. This is predicted by (56). However, it is unexpected by the constraint ranking in (55), where SylMax >> Onset. In fact, the only way to prevent the reduplication in (59b) is by stipulation. This evidence is thus is suggestive, offering weak support for my analysis. The upshot, though, is that my analysis, barring V-syllables from the language and building feet on moras not only makes this prediction, it also results in a view of Paumari prosody more harmonious with the pattern seen in all other Arawan languages (except Deni, admittedly – cf. (47) above). Therefore, I am going to assume that Paumari only allows V-syllables in word-initial position. Although neither of these two analyses impinges crucially on the theoretical implications of Paumari's iambic feet discussed in section six, they do turn out to be relevant to the discussion of syllable functions in section 7.

3.2.5. Summary

Paumari has two syllable types: (C)VV and (C)V. The versions with onsets are required everywhere except in word-initial position due to the ONSET constraint (but cf. Everett (1996) for an alternative account of onsets). This correctly accounts for all the syllable structure facts in Paumari and is therefore preferred over the alternative of analyzing Paumari syllable structure as CV and V. Let's turn now to offer a more complete OT formalization of the stress facts.

4. Fleshing out the OT analysis.[17]

4.1. Secondary stress

In this section, I want to restate the earlier prose analysis as a set of formal constraints. This will enable us to better evaluate the theoretical consequences of this analysis in sections 6 and 7. Little new is added empirically, merely the formalization of previous constraints. Secondary stress emerges from binary, right-dominant feet, i.e. iambs, whose constituents are moras oriented to the right edge of the word. These foot shapes are required by the constraints in (60).

Iambic foot structure:

(60) a. FTBIN: Feet are binary at some level of analysis (where the levels of analysis are μ or σ).
b. ALIGN-R: (FT, HD)

(60b) places the head of the foot at the right margin of the foot.

Right-to-left orientation (in the sense that degenerate feet appear on the left):

(61) ALIGN-L: (PRWD, FT)

This constraint says that feet 'prefer' to line up on the left edge of the word. As Crowhurst and Hewitt (1997) demonstrate, this will place degenerate feet on the left margin of the word.

We guarantee that all moras are parsed by:

(62) PARSE -μ: Moras are constituents of the appropriate prosodic category (where this category may be either the syllable or the foot, depending on the language. See Everett

(1998) and section 7 below for arguments. We can assume for the moment that moras are immediate constituents of syllables, postponing the alternative until section 7).

These constraints are ranked in (63):

(63) PARSE -μ >> FTBIN >> ALIGNHD >> ALIGNFT

4.2. Primary stress

Finally, the constraints in (64) correctly determine primary stress placement.

(64) a. ALIGN-L: (SFT, HD) (The head of the superfoot in on the left margin of the foot.).
b. ALIGN-R: (PRWD, SFT) (The superfoot goes on the right margin of the word.)[18]

This constraint must be supplemented by the constraint in (61), a standard assumption throughout the prosodic literature about how different levels 'fit together' (see Itô and Mester (1992)):

(65) LAYERING: The head of a foot at level ***n*** is built on the head of a foot at level ***n-1***.

The constraints in (64) and (65) are ranked in (66):

(66) LAYERING >> ALIGN SFTHD >> ALIGN SFT

Let's see how these constraints work together in the Tableaux below. We begin by considering Tableaux related to secondary stress.

Tableau 8

boviri 'star'	Parse μ	FtBin	Align-R (Ft, Hd)	Align-L (PrWd, Ft)
o o (bovi)(ri)		*		**!
o o ☞(bo)(viri)		*		*
o bo(viri)	*!			*
o o (bovi)(ri)		*	*!	**

The left edge of the rightmost foot in row two, the optimal candidate, is separated from the left margin of the word by only one syllable. But the left edge of the rightmost foot in row one is two syllables from the left edge. This is why it is marked with two asterisks and why these marks are fatal (they outnumber those of row one, where other constraint violations are identical).

Tableau 9

bianaihotaki 'to cure'	Parse μ	FtBin	Align-R (Ft, Hd)	Align-L (PrWd, Ft)
o o o ☞(bia)(naiho)(taki)		*		*, ***
o o o (bianai)(hota)(ki)		*		**, ****!
o o o (bianai)(hota)(ki)		*	**!	
o o o (bia)(naiho)(taki)		*	**!	

Tableaux 10 and 11 show that the 'Superfoot' is left-headed.

Tableau 10

paha 'water'	Layering	Align-L (SftHd)	Align-R (PrWd,Sft)
☞ o ( ) o (paha)		*	
o ( ) o (paha)	*!		

Tableau 11

biakavaka?oahivini 'to close'	Layering	Align-L (Sft, Hd)	Align-R (PrWd, Sft)
o ( ) o o o o (biaka)(vaka)(?oahi)(vini)			*!
o ( ) o o o o ☞(biaka)(vaka)(?oahi)(vini)			
o ( ) o o o o (biaka)(vaka)(?oahi)(vini)		*!	*
o ( ) o o o o (biaka)(vaka)(?oahi)(vini)		*!	

4.3. Stress and Reduplication

I conclude my analysis by discussing the apparently anomalous stress patterns observed in reduplicated forms (see also Chapman and Derbyshire (1991,349) for the initial observation of these facts). Reduplicated forms seem at first glance to violate the statement of stress placement in (60), (61), and (64) above. Notice that in the forms in (67) below, the reduplicant is stressed on its rightmost mora, although our analysis predicts it to fall on its leftmost mora (and (60), (61), and (64) also predict that there will be no adjacent stresses). These forms, though, are handled easily under the proposal that the reduplicant is treated as a (at least semi-) separate prosodic unit from the base (where () = prosodic word and [] = grammatical word).

(67) a. **ma'gi"magi'ni** 'mist, fog' → ([**ma'gi**)(**"magi'ni**])
b. **ma'gi"magi'ki** 'to mist' → ([**ma'gi**)(**"magi'ki**])
c. **si'ri"siri'ni** 'wind' → ([**si'ri**)(**"siri'ni**])
d. **ro'a"roa'ki** cylindrical, sphere, circle → ([**ro'a**)(**"roa'ki**])

Our analysis thus accounts straightforwardly for the stress of reduplicated forms, also observed but unexplained in Chapman and Derbyshire (1991). We now consider a non-iambic alternative to the analysis of Paumari stress. We cannot avoid consideration of this well-known alternative, because it has been one of the strongest sources of support for (13).

5. The trochaic alternative

If the analysis of Paumari stress just presented is correct, then, among other things, it follows that (13) must be abandoned or reinterpreted as a violable OT constraint. But before concluding that (13) is violable, we must consider a possible alternative to my analysis, owing to work by Kager (1989) on Tübatulabal. This alternative must be successfully eliminated to establish a warrant for our rejection of (13). Consider first the Tübatulabal words in (68) and (69) (ultimately from Voegelin (1935) but taken here from Hayes (1995, 264)). The basic facts are that (i) final syllables bear primary stress; (ii) heavy syllables (CV:) are stressed; (iii) every other light syllable before a heavy syllable is stressed. Crowhurst (1991) proposes to analyze these facts in terms of right-to-left iambs (' = secondary stress; " = primary stress):

(68)	e'le:"gɨt	'he is looking out'
(69)	hat'da:'waha"bi	'you must cross it'

If Crowhurst is correct, then Tübatulabal violates the Iambic/Trochaic Law. Iambic parses of (68) and (69) are given in (70):

```
(70)a.     el e:gɨt        b.   hatda:wah abi
           |  /\ |               |  /\ |  | |
          (μ μ)(μμ)             (μ μ)(μμ)(μ μ)
             *   *                 *   *    *
                 *                          *
```

The parses in (70) are quite similar to parses suggested for Suruwahá in Everett (1996). If correct, again, then the Iambic/Trochaic Law is violated. However, Kager (1989) makes a very ingenious proposal to save the Iambic/Trochaic Law, cited in Hayes (1995:264). Kager analyzes Tübatulabal as a trochaic system, avoiding any violation. He does this by top-down parsing, in which the final syllable is stressed first, as a degenerate foot, and then the rest of the word is parsed. This is ingenious because prior to Kager's suggestion, most analyses were based on bottom-up parsing (and most still are). Hayes (ibid.) summarizes Kager's proposal as in (71):

(71) Tübatulabal stress

a. Word Layer Construction	End Rule Right
b. Foot Construction	Form moraic trochees from right-to-left. Degenerate feet are allowed in strong position.

Let's assume that Kager is right in his reanalysis. Then the forms in (70) are incorrect. The correct parse for (70a) is given in (72):

```
(72) a.  (      *)                  Word Layer Construction

          ele:gɨt

     b.  (      *)
           (*)(*)                   Foot Construction
          ele:gɨt
```

But this counterproposal cannot rescue the Iambic/Trochaic Law from the Paumari facts because primary stress in Paumari is on the antepenult in polyvocalic words and cannot, therefore, be accounted for by End Rule Right. So far as I have been able to determine, however, Paumari is the only iambic stress system reported on with antepenultimate stress. This unique aspect of its primary stress makes it a severe counterexample, as we have just seen, for all attempts at reanalysis.

Since Kager's End Rule Right analysis is the only viable alternative to my iambic analysis of Paumari, and since Kager's analysis fails to account for Paumari, I conclude that Paumari does indeed violate the Iambic/Trochaic Law. Let's turn, therefore, to consider the implications of Paumari for prosodic theory. There are many. Section 6 discusses the implications for foot theory. Section 7 considers possible implications of our analysis for syllable theory.

6. Consequences for foot theory

6.1. The Iambic/Trochaic Law

6.1.1. There are no effects to derive, only a violable law

Kager's work on iambicity has convinced me, like most phonologists, that there is something important about the proposed Iambic/Trochaic Law. But, on the other hand, the facts of Paumari require us to abandon this as a 'law'. In OT, this simply means that this 'law' is a violable constraint (rather than, say, part of GEN(erate), the function which houses inviolable constraints in OT). If nothing else had ever been said about (13) in modern phonological theory, we could simply leave it at this.

But when I say we 'simply' reinterpret this as a violable constraint, I refer to the mechanics of the theory. In actuality, the consequences for a good deal of work in the theory are severe. Several recent works have attempted to *derive* the Iambic/Trochaic law from the interplay of other constraints in OT. All of these works begin with the assumption that this law is in a sense inviolable, that is, that the empirical generalisations upon which it is based are inviolable. Yet if I am correct here, there is nothing to derive. If the law is merely a violable constraint, there is not much else to say about it. This would have serious implications however, for some recent work. Perhaps the two major attempts to derive this 'law' in Optimality Theory are Eisner (1997) and van de Vijver (1998). Since their factual assumptions about iambicity are nearly identical, I will consider only van de Vijver's (vdV) project.

vdV (p1) claims that "... iambs (rightheaded feet) have four properties which are remarkable and which are not explained by any current metrical theory." The properties are:

> *(i) "First it appears that iambs are only assigned from left to right. The few languages which have been claimed to make use of iambs which are assigned from right-to-left, can be reanalysed in terms of leftheaded feet assigned from right-to-left (Kager 1989) – (vdV, 1)*
>
> *(ii) "Second, in iambic languages stress on final and initial syllables is avoided... The evidence ... seems to be that iambic systems resist all [emphasis in original, DLE] edge-adjacent syllables, a fact which deserves a principled explanation." (vdv 2,3)*
>
> *(iii) "Third ... in iambic languages disyllabic words are usually stressed on the first syllable, although in longer words the second syllable is stressed.." (vdV 3) [By 'first syllable', vdV means the penult, DLE.]*
>
> *(iv) "Fourth, the iambic foot, par excellence, a light syllable, L, followed by a heavy one, H, does not play a role as a primitive in prosodic morphology." (vdV, 3)*

Paumari clearly violates (i)-(iii). Therefore, these points are false. But if (i)-(iii) are false, then (iv) becomes irrelevant. There does not seem to be any 'wiggle room' here. vdV's research on iambs, representative of a good deal of recent received opinion about foot structure (tracing back, of course, to the massively influential work by Hayes (1995) and, to a lesser degree, the various research reports by Kager cited in this paper) is in a crucial aspect misguided (see also Eisner (1997, 1) also for a nearly identical list of assumptions about iambs, equally falsified by the conclusions of this paper).

But is it fair to throw out otherwise well-developed proposals by e.g. vdV and Eisner based on a single language? Of course it is. As Ladefoged and Everett (1996) conclude, there is no principled way to avoid the implications of data merely because they are 'rare' or 'exotic', both of which all too often merely describe our sampling techniques rather than the actual distribution of properties of natural language. So, again, the results of this research on Paumari is quite relevant to theories of foot structure in modern phonology. A prudent response to the problems the Paumari data raise, it seems to me, is to hesitate to rush into the proposing of laws and universals of prosody based on our quite impoverished state of knowledge about prosody.

Before concluding this section, there is another theoretical implication of Paumari for the Iambic/Trochaic law which must be addressed. This implication is in some ways more significant than the theory-internal implications we have just considered.

6.1.2. The phonetic underdetermination of foot structure

The consequences of interpreting (13) as a violable constraint of some form extend beyond the architecture of Optimality Theory. They affect our very understanding of the phonetics-phonology interface. Consider the following remarks from Hayes (1995, 70ff), where he argues that the Iambic/Trochaic law is the linguistic formalisation of "... a purely rhythmic principle." He proceeds to discuss a number of extralinguistic factors to support the idea that the Iambic/Trochaic law in (13) reflects natural perceptual principles of human cognition. He begins by focussing on relatively recent experimental work by Rice (1992) (replicating earlier experiments by other researchers). Hayes notes that this experiment shows the following 'usual results': "... in the case of intensity contrast, the preferred grouping is with the most prominent element first ... In the case of durational contrast, the preferred grouping is with the most prominent element last..." Hayes (p80) also discusses research on musicians' perceptions and notes that these too seem to confirm the perceptual preferences Rice's work corroborates. This is an interesting result by any standards. And yet we know that not all phonology is driven by phonetics, just as not all syntax is driven by information structure or semantics. What in effect has happened is this, it seems to me. Hayes searched the literature on prosody about as well as anyone ever has and was unable to find clear examples of nonlength-based iambic systems. In addition to this, he was aware of the perceptual research. It is only natural, therefore, that he would propose that the Iambic/Trochaic law as a universal of human cognition, unlikely to be violated in human languages. If that result could stand, then we would have a significant amount of theory of foot structure motivated functionally, externally to linguistics in part arising from phonetics in other aspects (what is easier to hear). But the Paumari facts eliminate this strong interpretation of the Iambic/Trochaic law as determined by phonetics. This means that foot structure (like so much else in grammar, after all) is partly independent of extralinguistic considerations and is a genuine part of grammar. And this is an important result from the Paumari research and the violability of the Iambic/Trochaic Law.

We now turn to discussion of other consequences of Paumar stress placement for theories of podalic prosody.

6.2. Foot structure

6.2.1. Degenerate feet in nonstrong position and WDMIN

In addition to leading us to abandon (13) as a law, Paumari's prosody has other significant implications for the theory of foot structure. These implications concern the distribution of degenerate feet and the relationship between degenerate feet and WDMIN.

According to Hayes (1995, 87), degenerate feet are constrained severely, per (73):

(73) Prohibitions on Degenerate Feet

Foot parsing may form degenerate feet under the following conditions:

a. Strong prohibition - absolutely disallowed.

b. Weak prohibition - allowed only in strong position, i.e. when dominated by another grid mark.

Hayes suggests that (73) might be supplemented by (74):

(74) Non-prohibition - Degenerate feet are freely allowed.

Hayes is concerned with the distribution of degenerate feet for various reasons. Especially important is the perceived correlation between foot size and word size, apparently enabling the latter to be derived from the former (p88):

> "... a ban on degenerate feet makes predictions about possible word shapes. In particular, assuming that every phonological word must contain at least one foot, and that there are no degenerate feet, then there can be no degenerate-size words."

In this quote, Hayes is in effect proposing the implicational universal in (75):

(75) No degenerate feet → No degenerate words

This implication seems correct, so long as it is restricted to prosodic words, as Hayes intends. However, later in the text (p95), Hayes makes it clear that he in fact has a stronger implicational relationship in mind, namely:

> "... degenerate feet will only occur in strong position, only at the (right/left) edge of the word where footing is (left-to-right/right-to-left), *and only in languages that allow degenerate-size monosyllables*." (emphasis mine, DLE)

The emphasized portion of this quote is incorrect, if the analysis above is right. Paumari lacks degenerate words, but it allows degenerate feet. Moreover, its degenerate feet are neither restricted to "strong position", i.e. to where primary stress falls (see (12) and (64) above), nor are they completely unrestricted; i.e. they do not fall under Non-prohibition in (74) above.

Hayes (1995, 100) argues that apparent cases of degenerate feet in weak positions are likely to turn out in reality to result from lengthening. His claim would be that in a word, like **arabo** 'land', in Tableau 1, the initial **a** is lengthened, in effect producing a binary foot in word-initial position, as in (76):

```
(76) aa rabo         'land'
     ||  | |
    (μμ)(μ μ)
      o    o
```

But phonologically relevant lengthening simply does not occur in Paumari. As I noted earlier, although there is a *slight* length increase on stressed syllables, and mainly on *secondary* stresses (quite inexplicable by Hayes' proposals), this length is phonetic, not phonological. The evidence for this judgement is seen in (i) the iteration of stresses and (ii) the relative length and apparent optionality of lengthening in stressed syllables

Take first the relative length of stressed syllables. Recall that we have already seen a case of phonologically relevant lengthening in Paumari, namely, the lengthening of diphthongs in CVV-shaped words, as shown in the contrast shown in Figures 6 vs. 7 above. Although the CVV syllables in each of these figures is lengthened, only the CVV syllable of Figure 6 is phonologically lengthed (to satisfy WDMIN) and this CVV is obviously longer than the CVV in Figure 7. This is predicted if, as claimed, the CVV of Figure 6 is bimoraic, but the CVV of Figure 7 is monomoraic. But if the CVVs in Figures 6 and 7 have *different*, phonologically relevant lengths, we are forced to recognize *three* syllable lengths in Paumari. This is otherwise unwarranted. And it makes incorrect predictions. As we have seen, stress appears on every other mora. If a phonologically relevant mora is added to stressed syllables, this would either throw off the foot construction algorithm (since new moras are now introduced to the counting procedure), in violation of the examples throughout the paper, or it would require instead that feet be built on syllables (a result Hayes, inter alia, would be happy with, I realise). But if this occurred, words like that found in Tableau 11 above would raise problems. Consider that word as I represent it in my analysis:

```
       σ  σ  σ σ  σ  σ σ σ
      /|\/\ /\/\ /|\/\/\/\
(77)  biaka vaka ?oahivini            'to close'
```

```
 \/ |   | |   \/ | | |
(μ  μ)(μ μ)(μ  μ)(μμ)
    o    o     o   o
```

The representation in (77) predicts that all syllables are equal in length. Even with stress, this is still largely true for most nonfinal syllables and is roughly true for final syllables. The length produced by stress is real, but usually subtle. If the stressed constituents were *phonologically* long, however, the representation would have to modified as in (78a) or (78b). If we accept my proposal that diphthongs are monomoraic then, with the hypothesized added length, we have 78a):

```
(78)  a.    biakaa vakaa ?oahii vinii          'to close'
             \/ ||   | ||   \/ ||   | ||
             μ  μμ   μ μμ   μ  μμ   μ μμ
             |  \/   | \/   |  \/   | \/
            (σ   σ)(σ  σ)(σ   σ)(σ  σ)
                 o     o      o     o
      b.    biakaa vakaa ?oahii vinii          'to close'
             || ||   | ||   || ||   | ||
             μμ μμ   μ μμ   μμ μμ   μ μμ
             \/ \/   | \/   \/ \/   | \/
            (σ   σ)(σ  σ)(σ   σ)(σ  σ)
                 o     o      o     o
```

But (78a) is falsified by the simple fact that stressed vowels are never twice as long as diphthongs. If, on the other hand, we assume that diphthongs are bimoraic, as in (78b), we create a different problem. Consider the penultimate and initial feet in (78b). Both violate the Iambic/Trochaic law because they contain no length contrasts, yet still have final prominence. Since they are of equal length, if we divided them instead into separate feet we would wrongly predict that both feet would be stressed or, alternatively have to appeal to some sort of clash avoidance (the effect of which would be to duplicate the effects of the feet in (77)). Such moves represents a significant and otherwise unwarranted complication of the grammar of Paumari (and they would make it quite unlike any other Arawan language, prosodically; see Everett (1995)). So, we conclude that the slight and often missing lengthening associated with stressed syllables is simply too ephemeral to pin high analytic hopes on it.[19] Therefore we must reject Hayes' claims regarding degenerate feet. Let us turn now, though, to consider another influential hypothesis on degenerate feet.

6.2.2. Degenerate Feet, WDMIN, and Catalexis

Hayes, as we have just seen, not only predicts that degenerate feet will be restricted to strong positions, he also predicts a very tight correlation between minimal word size and degenerate feet. However, his predictions in this regard fail. But there is another proposal to maintain the relationship between degenerate feet and minimal word size which avoids the problems faced by Hayes's proposal, so we must consider that proposal as well before closing the present section.

Kiparsky (1991) and Kager (1995a) propose a different, quite ingenious, account of degenerate feet, based on a notion Kiparsky labels *Catalexis*. According to Kager (1995b, p447), Catalexis is based on the idea that final stresses on so-called degenerate feet are under "grammatical control" and not merely phonetic facts, as in Hayes' account. Kager (1995n, 447) claims that this allows him and Kiparsky to capture the fact that "... in rightward trochaic systems, the presence of degenerate-size words correlates with the presence of final stresses in odd-numbered words."

Catalexis claims in effect that there are no degenerate feet, period, and that where there appear to be degenerate feet, there is in reality a "segmentally empty metrical position at the right edge of the word, i.e. essentially the logical counterpart of extrametricality." (Kager 1995b,447).

In words with odd-numbers of moras, the catalectic mora is footed. It is left unfooted, however, in words of even numbers of moras. It makes the prediction in (79):

(79) **Catalexis**: Degenerate words → Final stress in odd-numbered words.

Although this correlation is irrelevant in Paumari, Catalexis might nonetheless still be argued to hold, even if vacuously. However, it must be rejected because because of another implication that Kager (1995,447) draws from it, namely, that it is "... predicted that catalectic languages have no word minimum." But as we have seen, there *is* a minimal word constraint in Paumari, thus vitiating the Catalexis analysis.

6.2.3. Degenerate Feet and FTBIN

As Everett (1990, 1994, 1996), Hewitt (1994), Crowhurst and Hewitt (1997), Downing (1998), and Green and Kenstowicz (1995) have pointed out, the standard statement constraint on foot size, Prince & Smolensky's (1993, 47) must be reformulated. Prince and Smolensky propose FTBIN, repeated here:

(80) FTBIN: Feet are binary at some level of analysis (where the levels of analysis are μ or σ).

The reason (80) must be reformulated is that it cannot account for crosslinguistic variation in the 'repairs' to violations of it (see the references cited). I will therefore follow proposals of the work cited and reformulate (80) as (81) and (82):

(74) FTMAX (Foot Maximality): Feet are maximally binary (unit of measure = μ or σ).
(75) FTMIN (Foot Minimality): Feet are minimally binary (unit of measure = μ or σ).

These will operate as follows. Consider the word **arabo** 'land' once again, relative to the constraints in Tableau 12:

Tableau 12

arabo 'land'	PARSE-μ	FTMAX	FTMIN

☞ a rabo
   | | |
  (μ)(μ μ)
   o   o
			*

a rabo | | | (μ μ μ) o		*!	
a rabo | | | μ (μ μ) o	*!		

Since degenerate feet do coexist with a word minimality constraint in Paumari, we must conclude that previous hypotheses on the correlation between minimal foot and word size, (84), are incorrect. On the other hand, we can still maintain the weak correlation between the two given in (83):

(83) Word Minimality and Foot Maximality: The minimal word is no smaller than a *well-formed foot*.

This hypothesis bears further investigation, but it seems right. It certainly seems clearly superior to the alternative, and widespread, view in (84), in light of the Paumari facts:

(84) Word Minimality and Foot Binarity: The minimal word is no smaller than the smallest (i.e. binary) foot.

With the conclusion of this discussion of constraints on foot shape, we turn to consider constraints on prosodic words.

7. Consequences for syllable theory

The final group of implications I want to consider concern the role of the syllable. Consider again the constituency of iambic feet. According to Hayes (1995:49), the prevailing view:

> "...the stress-bearing unit is the syllable... Formally, I assume that syllables are the units which are grouped together in metrical structure and to which grid marks are associated."

If the analysis in 3.2.2. is correct, Paumari violates this, since the mora, not the syllable, is the stress-bearing unit.[20] We saw, however, that the evidence in Paumari is not as strong as we would like for this assertion. Yet as I have remarked on various occasions above, Paumari's prosodic system is very similar to other Arawan languages. Looking at these other languages, additional evidence in favor of moras as stress-bearing units is easy to come by. One Arawan language whose prosodic system has been studied in some detail is Banawá (see references cited throughout this paper). The evidence from Banawá is quite strong that feet are built on moras, illustrated in (43)-(45) above. Moreover, Banawá, as pointed out in Everett (1998) presents independent evidence that the syllable plays non-stress-related roles in Banawá. So consider the interesting case of hypocoristic formation.

Polysyllabic names in Banawá also have bisyllabic, hypocoristic forms. However, a name which is less than three syllables in length has no special hypocoristic form. As the data below show, this phenomenon cannot be stated in terms of moras or V-syllables but only in terms of CV and CVV syllables. Consider the names in (85)-(90). The a. forms give the full form, the b. forms the hypocoristic forms:

	Long Form	Hypocoristic Form[21]	
(85)	a. *Sábatào*	vs.	b. *Bátaò* (from Portuguese *Sabatão*)
(86)	a. *Hóbetò*	vs.	b. *Béto* (from Portuguese *Roberto*)
(87)	a. *Atídekè*	vs.	b. *Déka*[22]
(88)	a. *Sólimào*	vs.	b. *Rímaò* (from Portuguese *Solimão*)
(89)	a. *Téresìna*	vs.	b. *Sína* (from Portuguese *Teresina*)
(90)	a. *Tóefì*	vs.	b. N/A (cf. **Efi*)

The crucial observation in these examples is that hypocoristic forms in Banawá are *bisyllabic*, not *bimoraic*. Thus the name *Sabatao* shortens to *Batao* , not **Tao*. Although *Tao* is bimoraic and thus satisfies the WORD MINIMALITY constraint discussed in section 3.1. (and BBE), it is not a possible hypocoristic form because it is monosyllabic (CVV). Again, however, there is nothing ill-formed about this form per se. (See Everett (1998) for further exemplification and argumentation.)

We can only account for hypocoristic forms in Banawá and stress-placement in Paumari, only if we assume that the syllable can play a foot-independent role in grammars. This rather surprising conclusion forces us to ask another question, namely, what are syllables for? Let's consider what other writers have had to say on the functions of the syllable, beginning with Fudge.

Fudge (1999 [1969]:371) suggests that the function of the syllable is 'twofold'"

> "To provide a basis for distinctive prosodic features...
> To account for constraints on possible phoneme sequences..."

Selkirk (1999[1982]: 328) proposes three functions for the syllable: (i) to serve as the basis for statements of 'phonotactic constraints'; (ii) to provide an intelligible domain for a wide range of existent phonological rules; (iii) to provide a domain for the assignment of prosodic features. The functions suggested by Selkirk and Fudge in their foundational articles are commonly assumed. They really only differ in Selkirk's addition of the syllable's role as a domain for rule assignment. Blevins (1995) presents numerous examples of these syllabic functions.

Both of these descriptions of the syllable's functions hark back to the even more foundational work of Pike (1967), whose 'phonological hierarchy' has been enormously influential, partially through the work of the two authors just cited. A common version of this hierarchy is given in (91):

(91) Phrase
|
Word
|
Foot
|
Syllable
|
(Mora)
|
Segment

This hierarchy underwrites in part the three functions of syllables suggested by Fudge and Selkirk: (i) their phonotactic function; (ii) their rule-domain function; and (iii) their prosodic domain function. It seems that these functions can be conflated as in (92):

(92) **Domain function of syllables**: Segments are grouped by syllables into domains for constraint and feature application and for organization of segments into words.

The Banawá hypocoristic forms are excellent examples of (92).

I want to claim, however, that this Domain function is only part of the syllable's set of functions. What Selkirk, Fudge, Pike, and many other phonologists miss is the additional syllable function in (93):

(93) **Enhancement function of syllables**: Syllables enhance segmental perception via optimization of *acoustic landmarks*.

This idea is not an innovation of this paper, except in form and application, although it is missing from most, if not all, phonological research. The concept is found clearly in phonetic research. The particular formulation of it in (93) is derived from Stevens (1999:248):

> *"In general, then, we observe that implementation of the articulator-free features [vocalic] and [consonantal] provides a segmental structure to the speech stream. These features give rise to three types of landmarks in the sound: (1) vocalic*

> *landmarks of syllable peaks, indicating the presence of a [+vocalic] segment in the utterance; (2) abrupt consonantal landmarks at acoustic discontinuities, signaling a [+consonantal] segment; and (3) landmarks defined by a particular type of minimum in low-frequency amplitude that is evidence for a glide... The presence of these landmarks provides acoustic evidence for the representation of words as sequences of discrete sounds or segments."*

Stevens here refers to segmental features rather than syllables. But the features he discusses as relevant to 'landmarks' are exactly those crucial to syllabification. How might the two be related? The syllable's domain function produces an arrangement of segments which in general can be said to optimize the arrangement and sequencing of acoustic landmarks, tremendously aiding segmental perception (highlighting the landmarks in a sense) and, secondarily, word-formation. This enhancement function clearly devolves from the syllable's Domain function, but it is distinctive enough to warrant a separate statement in the grammar. That is, by introducing patterns into the organization of segments, the syllable makes it easier to identify individual segments (as in the studies by Ohala (1990), Turk (1994), and Nolan (1994) cited earlier). Thus, the well-known fact that CV syllables are the most widely-spread syllable type correlates with Ohala's finding that such syllables better facilitate the identification of the initial consonant than, say, VC syllables. This organization of 'acoustic landmarks' is a parsing function of the syllable, different from, yet complementary to, its other functions. Thus even though the syllable's domain function for foot construction is not at all clear in Paumari, and missing entirely in languages like Banawá, Paumari still has syllables. By hypothesis, the syllable in Paumari contributes to segmental perception in Ohala's and Stevens's senses. (And see Ladefoged, Ladefoged, and Everett (1996) for further discussion of intrasyllabic contraints in Banawá and their functional basis.) If I am on the right track with this line of thought, then it is reasonable to expect that some languages could have the Enhancement function active (this is likely always active in all languages) without the Domain function(s). In effect, the enhancement function of the syllable is the syllable's contribution to parsing input strings of sound. Another way of stating this is that the syllable is crucial to phonotactics, well-known, and that this contribution is logically and empirically (as seen here) independent of the syllable's contribution to foot structure (as seen in the Banawá hypocoristic data).

If this is correct, then the phonological hierarchy of (91) is inaccurate. At the very least, it must be modified along the lines of (94) (where broken lines represent optionality and solid lines obligatory relationships):

(94)
```
                   Phrase
                   |
                   Word
                   |
                .  Foot
             .     .
Syllable           .
|                  Mora
|             /
Segment
```

This diagram shows the syllable as sitting slightly off the hierarchy. It may be skipped for foot construction, but segments are always mapped to it, regardless of foot construction, to satisfy (93) - which is a *functional* constraint and hence neither part of GEN nor, so far as I can tell, a violable OT constraint. In effect, it sits outside the formal constraint system (though I do not wish to belabor this point here nor assert it too strongly. More study is needed).

8. Conclusion

From the analysis of Paumari presented above, we have drawn the following, I believe significant, conclusions for phonological theory. First, we have seen that the Iambic/Trochaic Law does not hold universally and, therefore, can at most be interpreted as a violable constraint in prosodic theory. Abandoning this Law, however, severely impacts research represented by van de Vijver (1998), Kager (1989, 1993), and Eisner (1997) which assume that it is universal and propose a series of innovations to Optimality Theory to account for this universality. Since the purported universality of this Law has been shown to be spurious (which is what it means to say that it is violable, barring any other evidence for it) the results of such research programs must be largely abandoned. A second major result of this research is the finding that the interesting phonetic and perceptual bases for the Iambic/Trochaic Law noticed by Hayes (1995) underdetermine the shape of feet crosslinguistically. That is, foot structure, like other areas of phonology, is underdetermined by phonetics. This is not entirely surprising, but it does demonstrate a domain about which many had though otherwise. Third, strong evidence was presented that the syllable's functions may be independent of foot construction. I proposed the somewhat novel idea that one important aspect of the phonetic motivations underlying the syllables is the *enhancement* of segmental perception, i.e. as a type parsing aid. From these major results, we also reached the following, ancillary conclusions: (i) The minimal word size of a given language is linked to the shape of well-formed feet, not merely maximal feet as has been believed by most phonologists until now; (ii) The distribution of degenerate feet is restricted by the relative ranking of FTMIN, FTMAX, and PARSEμ/σ, and not by Hayes's (1995) proposals on weak vs. strong positions; (iii) Paumari provides additional evidence that the so-called FTBIN constraint must be decomposed into the constraints FTMIN and FTMAX; (iv) There is an urgent need for more fieldwork (see Everett (2001)), shown here by the number of theoretical proposals in need of modication or abandonment as the result of the study of a single heretofore unstudied language.

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Notes

[1] **This is very much a work in progress! Comments are *most* welcome, but the author is already aware that the text is too verbose, that more phonetic detail is needed, and that certain arguments are weak. Still, it is posted here because the facts are interesting and because comments, if they come, will help the final product.**

Several people have contributed to this research in one way or another. René Kager, Bruce Hayes, and Peter Ladefoged discussed several of the issues addressed here with me. Peggy MacEachern provided numerous clear and insightful suggestions in generous hours of conversations about Paumari and phonology more generally. Audiences at the University of Pittsburgh, the University of Manchester, and the 1999 ABRALIN conference in Florianopolis, Brazil contributed useful comments. I owe the opportunity to do this fieldwork largely to the National Science Foundation (under grants SBR-9631322 and SBR-9310221 to the present author). To the Paumari themselves go my most profound thanks. Baiharu Paumari was especially helpful and generous with his time. Finally, I would like to thank my colleagues of SIL International for providing the best working environment I have ever had and for setting sterling examples of selfless dedication to the cultural, physical, and linguistic survival of minorities around the world. Shirley Chapman's work among the Paumaris is one of the most amazing examples of cultural and physical preservation of a minority people anywhere in the world. I thank her for her pioneering work which made my follow-up research possible.

A word about methodology. Donna Popky, my GRA on SBR-9631322, accompanied me to the Paumari village of Crispinho. Prior to our trip she compiled a list of several dozen words from the Paumari dictionary prepared by Chapman & Salzer (1999), based on syllabic shape, segmental distribution, to cover as many phonological possibilities as possible. We then elicited these words in isolation and in context from six female and nine male speakers, along with several texts, over a period of seven days. The words collected were transcribed mainly in the field, but with some transcriptions done from tapes on our return. We used medium-quality analog recorders in the work. Words transcribed in the village were checked with native speakers. Many thanks are due to Popky as well for this invaluable help. The spectrograms and other acoustic measurements here were prepared by Zoe Butterfint of the Department of Linguistics at the University of Manchester, to whom I offer especial thanks. Both Butterfint and Popky helped in the analysis by suggesting their own interpretations of the acoustic facts, helpful in drawing my attention to many of the points made in this paper.

The phonemes of Paumari are (orthographic symbols are given.. See Chapman and Derbyshire (1991,346): **p**, **t**, **k**, **'** (glottal stop), **b**, **d**, **g**, **th** (voiceless aspirated, alveolar occlusive) , **kh** (voiceless aspirated, velar occlusive), **'b** (voiced glottalized, bilabial implosive), **'d** (voiced glottalized, alveolar implosive), **tx** (voiceless alveopalatal affricate), **j** (voiced alvelopalatal affricate), **f**, **s**, **x** (voiceless alveopalatal fricative), **h**, **v** (voiced bilabial approximant), **m**, **n**, **r** (voiced alveolar nonlateral flap) , and a second **r**, also written 'r', which is a retroflexed, grooved reverse flap vibrant.

[2] Rimarimá has not even been contacted by Europeans yet. It listed here because the Banawá and Suruwahá claim to have spoken to such a group of people and it seems that this language is Arawan. But this only a guess.

[3] The data for this paper, although recorded en locu and tested independently by the author was drawn from the dictionary of Paumari prepared by Shirley Chapman and Meinke Salzer. The dictionary is available on-line from SIL Brazil. Their home page is found at: http://www.sil.org/americas/brazil/englhome.htm

[4] There are no spectrograms of larger words. These words repeat the patterns of the shorter words, but more confounding phonetic factors (mainly noise) entered into the recordings of these words, making even reasonably legible spectrograms and waveforms nearly impossible.

[5] This lengthening is not underlying and is not phonologically relevant – the latter observation is crucial. 'Not phonologically relevant' means that stressed syllables' greater length is not visible to foot construction or for determining syllable maximality (see below), but, rather, that it that their length is caused by stress placement and not itself the cause of stress placement. That is, length = causee, not causer. I collected each of the words exemplified in this paper in context as well as in isolation. The same stress pattern, marked primarily by intensity, is also found. The reader is referred to K. Everett (1998) for an in-depth study of intensity as the primary acoustic correlate of stress in another (yet unrelated) Amazonian language. See also section 6.2.1. for more discussion of stress and length in Paumari.

[6] A complete phonetic study of stress in Paumari goes far beyond the immediate phonological objectives of this paper. The measurements provided here are intended to serve as corroboration of the claims made, not 'proof'. Moreover, they underscore the well-known fact that the phonetic realisation of stress-placement is variable (a fact well-known, at least, to all 'stressologists').

[7] I refer to vowel sequences in this paper alternately as 'vowel sequences' and 'diphthongs', a term I use with both pre and post-analytic references. I hope that this does not cause confusion for the reader.

[8] When a diphthong is stressed, I will represent stress only on the most sonorant member of the diphthong. The higher vowel is always shorter, in this case almost a labialization of the previous consonant (see Figure 7).

[9] Goldsmith (1995, 3) defines phonotactics as the "... ways ... the items of phonology [can] be put together to make a well-formed word." Goldsmith (1995, 4ff) and Blevins (1995, 206ff) argue that the syllable is a necessary condition for any successful analysis of the phonotactics of a given language. Paumari is no exception.

[10] Chapman and Derbyshire (1991) and Chapman and Salzer (1999) claim that Paumari has long vowels, contrary to my statement here. In fact, Shirley Chapman's analyses of Paumari prosody diverge in many significant ways from the analysis presented in this paper. It has been hard to know how to address these divergences. Some of the differences may arise from change to the language since Chapman completed her analyses (which have not changed in several decades, in spite of the recent dates of the works cited). Some of the differences may arise from dialectical differences. But although I cannot absolutely rule out these alternatives, they do not seem to explain the range of disagreements. The problem of the discrepancies is real, I believe, having to do with the facts themselves. One reviewer rightly asked why my word ought to be taken over Chapman's (which is, of course, always an issue in science when two or more researchers disagree about the facts. This is certainly not unique to Paumari research or to linguistics). Chapman has worked on Paumari for more than forty years and speaks the language very fluently. I have spent a week there and do not speak the language at all (although most linguists will understand immediately that fluency is neither a necessary nor a sufficient condition for analytical accuracy. See Everett (2001) for a discussion of the role of language learning in fieldwork). Chapman has had four SIL co-workers over the years who apparently agree with her. These are important sources of authority for Chapman's opinions. Here are my thoughts (and I bother to include this all here because (i) the discussion has to do with the facts of the matter under discussion and (ii) the problem of factual disagreements seems more general linguistics, but is too often glossed over in my opinion, so is worth considering here). First, I interviewed all of Chapman's co-workers. They agree that they have done little or no analysis of Paumari prosody on their own, but have accepted Chapman's word for it (I hasten to add that Chapman is a very careful worker, whose word on most things can be trusted implicitly. I cannot imagine her saying her saying anything careless). Crucially for my argument here, it should be pointed out that (i) on the crucial fact of antepenultimate, primary stress in polymoraic words, we are in complete agreement and (ii) we do not disagree on the matter of secondary stress, since Chapman (p.c.) has no opinion on this matter. . And Chapman has no opinion on secondary stresses, never having listened for them. Moreover, I may enjoy a slight advantage in stress-perception, being the only researcher ever to have worked on all (but one) of the Arawan languages' prosodic systems, thus developing more practice at listening for stress. In connection with this, as I point out at various points in this study, the prosodic systems of all Arawan languages are very similar on the surface, Paumari being perceptually no exception. And the spectrograms presented here, while not conclusive, are far from insignificant. Finally, both of the graduate students who helped me in my analysis independently corroborated different aspects of my factual interpretations. I believe strongly, therefore, that the analysis presented here is reliable. However, this is science, not an op-ed piece. The reader is thus hereby strongly encouraged to visit the Paumari personally to check the data.

[11] However, there are important stochastic generalisations needed to supplement syllable structure in accounting for phonotactics in many languages. See Pierrehumbert (1994) for a useful discussion of this. She argues, for example, that syllable structure is not a sufficient condition for phonotactic analysis in English.

[12] cf. Turk (1994, 113ff) and Nolan (1994) for interesting exceptions.

[13] This is, arguably, one interpretation of results reported in Berent, Everett, and Shimron (to appear) on Hebrew word-structure constraints.

[14] The proposals of Everett (1996) were inspired to some degree by Zec (1988)).

[15] (i) MAX(imum) I(nput)-O(utput) Constraint: Every segment of the input has a correspondent in the output (no deletion).

[16] According to Chapman and Derbyshire (1991, p308) "It is the final two syllables of a root that are duplicated." But, as the forms in (57) show (all taken from their work and from Chapman and Salzer (1999), this is inaccurate. They describe the function of reduplication as follows: "Reduplication may indicate that a quality is not quite the standard expected for the referent ..." or " ... a process has started but not yet reached culmination."

[17] My use of OT in this context should not be construed as an endorsement of any kind of the deeper philosophical assumptions of OT, e.g. Universal Grammar and the like. In fact, I disagree quite strongly with the latter proposal, preferring the Boasian notion of language 'patterns'..

[18] Constraint (64) outranks another OT constraint, Parse-Ft, allowing all iambic feet to the left of the initial trochaic superfoot to remain unfooted.

[19] Moreover, the entire claim of lengthening as a universal of iambic systems is rationalistic, not empirical. It is not empirical because there are *far too few* phonetic studies of prosodic systems to hazard any such guesses as to what is likely to be universally true of this or that stress system. Much, much more phonetic work is needed. I believe that more fieldwork will turn up many counterexamples to (13), in all of its aspects.

[20] The theory of stress developed by Halle & Vergnaud (1987) does indeed predict systems like Paumari, but this theory has, unfortunately, had very little influence in stress theory, especially since it depends on levels and derivations, seen by most phonologists in this OT era as fatal flaws for any theory.

[21] For the sake of illustration, I have shown the forms of the name and hypocoristic that would be found in connected text, rather than the vocative form found in isolation. The isolated vacative forms are stressed by iambic feet (with stress appearing on the most sonorant of the two vowels in a CVV syllable in the loan names, following the Portuguese pattern somewhat):
(i) Vocative forms: *Batáo, Betó, Rimáo, Siná.*

[22] I do not know why there is an [a] in the shortened form in this word.