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Syllable Weight in Some Australian Languages<sup>\*</sup>  
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One of the most prominent conclusions that emerges from recent work on stress and syllable structure is that the properties of a syllable's onset seemingly do not in any way affect its weight. That is, when stress placement is sensitive to syllable weight, then stress will be attracted either to a syllable with a branching nucleus or to one with a branching rime, independently of the properties of the onset. This observation has been incorporated into some recent theories of the syllable. For example, Hyman (1984) proposes a universal onset-creation rule as the first rule of the phonology. This onset-creation rule, which precedes rules of stress assignment, absorbs the syllable-initial consonant into a weight unit with the following vowel, thus making the consonant unavailable for playing a role in stress assignment and predicting that onset-sensitive stress rules should not occur. However, Davis (1982) has pointed out the occurrence of onset-sensitive stress rules in a few languages. More recently, Everett & Everett (1984) point out that, in the Amazonian language, Pirahã, properties of both the onset and the nucleus affect syllable weight. Specifically, in Pirahã, stress is placed on the rightmost heaviest of the last three syllables in a word. Now, if syllable weight, as reflected by the nucleus, is identical in any two of the last three syllables, then a syllable with a voiceless consonant in the onset receives stress. Some examples from Everett & Everett are given in (1):

(1) Pirahã data (Stressed syllables are underlined; tones are not indicated)

- a. bii sai 'red'
- b. kai bai 'monkey'
- c. pa hai bii (proper name)
- d. ?i bao sai 'her cloth'

Based on such Pirahã data, in which syllable onsets play some role in stress placement, Everett & Everett propose that stress rules can be constructed on syllable projections, in addition to being constructed on the rime and nucleus projections.

In this paper I present additional evidence from two Australian languages, Western Aranda and Madimadi, that provide support for Everett and Everett's proposal that stress can refer to syllable projections. In these two languages the onset plays a role in determining syllable weight. I begin by presenting a metrical analysis for each one of these languages that involves syllable projections. I then consider and reject a possible alternative analysis of these languages based on a nucleus projection. Consequently, my analysis supports the contention that

stress can be constructed on syllable projections, rather than only on rime or nucleus projections. Finally, I will conclude by suggesting some possible implications that these languages might have for a theory of syllable structure.

First, I will consider Western Aranda, an Arandic language spoken in Central Australia. The sound system of the language has been described in detail by Strehlow (1942). In Western Aranda, the onset is crucial in determining stress placement in words of more than two syllables. Strehlow (1942:299-301) gives the following statement of stress for Western Aranda:

If a trisyllabic word begins with a consonant, the stress falls on the first syllable... If a trisyllabic word begins with a vowel, the stress falls on the second syllable... If a word of four syllables begins with a consonant, the main stress falls on the first syllable. Usually there is a weak secondary stress on the third syllable... If a word of four syllables begins with a vowel, the stress falls on the second syllable... If a word of five syllables begins with a consonant, the main stress falls on the first syllable, and a weak secondary stress is usually placed on the third syllable or on the fourth... If a word of five syllables begins with a vowel, the main stress normally falls on the second syllable, and a weak secondary stress is placed on the fourth syllable.

Or more simply put, the Western Aranda stress rule for trisyllabic words or longer is that primary stress falls on the first syllable containing an onset. Secondary stress is usually on every other syllable after the one with main stress.<sup>1</sup> Final syllables never receive any stress; they are extrametrical. As a result of the final syllable being extrametrical, main stress falls on the first syllable of all bisyllabic words. There are virtually no exceptions. Some data illustrating these stress facts are shown below:

- (2) Consonant initial words of three or more syllables
  - a. túkura 'ulcer'
  - b. kútuŋùla 'ceremonial assistant'
  - c. wóratàra (place name)
- (3) Vowel initial words of three or more syllables
  - a. ergúma 'to seize'
  - b. artjánama 'to run'
  - c. utnádawàra (place name)

(4) Bisyllabic words

- a. káma 'to cut'
- b. ílba 'ear'
- c. wúma 'to hear'

I propose the following metrical analysis of Western Aranda stress that is based on syllable projections (and assumes a rime constituent):

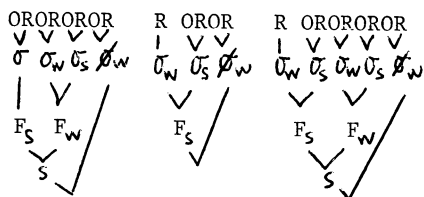
(5) Analysis of Western Aranda Stress

- a. Projection: Project syllables.
- b. Extrametricality: Mark final syllables extra-metrical.
- c. Main Stress: At the left edge of the word form a binary, right-dominant foot (on the syllable projection).
- d. Stress Alternation: Form binary, quantity-insensitive, right-dominant feet going left-to-right.
- e. Other Rules: Apply stray syllable adjunction and construct a left-dominant word tree.

The application of these rules is illustrated in (6):

(6)	a. kutuŋula	b. erguma	c. utnadawara
	 OROROROR V V V V σ σ σ σ	V      R OROR   V V σ σ σ	V       R OROROROR   V V V V σ σ σ σ σ
Syllable Projection (5a)	OROROROR V V V V σ σ σ σ	R OROR   V V σ σ σ	R OROROROR   V V V V σ σ σ σ σ
Extrametri- cality (5b)	OROROROR V V V V σ σ σ φ	R OROR   V V σ σ φ	R OROROROR   V V V V σ σ σ σ φ
Stress Rule (5c)	OROROROR V V V V σ σ σ φ   F	R OROR   V V σ <sub>w</sub> σ <sub>s</sub> φ V F	R OROROROR   V V V V σ <sub>w</sub> σ <sub>s</sub> σ σ φ V F
Stress Alternation (5d)	OROROROR V V V V σ σ <sub>w</sub> σ <sub>s</sub> φ   V F F	Does Not Apply	R OROROROR   V V V V σ <sub>w</sub> σ <sub>s</sub> σ <sub>w</sub> σ <sub>s</sub> φ V V F F

Other Rules  
(5e)



In (6a), (6b), and (6c), the words are illustrated with their syllable structure (though I have not indicated the CV or X-tier). First, syllables are projected. After syllables are projected, it can be known whether the syllable branches into an onset and a rime, as in the first syllable of (6a) for example, or, whether the syllable just branches into a rime (as in the first syllable of (6b) or the first syllable in (6c)). Note that internal branching of the rime cannot be relevant, for this would violate the principle of metrical locality as proposed by Hammond (1982). Next, final syllables are made extrametrical. Subsequently, main stress (5c) is determined by the creation of a binary right-dominant foot from the left edge of the word on the syllable projection. In (6a), this creates a binary foot over the first syllable since that syllable has two branches. In (6b), though, the first syllable has only one branch, hence, it is the weak part of a right-dominant binary foot formed with the following syllable. The example in (6c) is similar. The first syllable has only one branch, and thus, it is the weak part of a w-s foot. Stress alternation and the other rules apply to produce the final output illustrated at the bottom of (6).

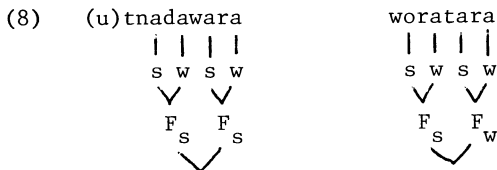
Essentially, the analysis proposed here using syllable projections is a way to capture the fact that the onset consonant plays a role in stress placement.

There is, however, an alternative analysis which does not rely on syllable projections. This analysis incorporates word-initial vowel-extrametricality, with stress being constructed on nucleus projections. If vowels of vowel initial words were marked extrametrical then the Western Aranda stress rule could be formulated as in (7):

#### (7) Alternative Analysis of Western Aranda Stress

- a. Mark word initial vowels extrametrical
- b. Form binary left-dominant quantity-insensitive feet on the nucleus projection from the left edge of the word
- c. Form a left dominant word tree

Two examples are given below:



Notice that in this analysis final vowels must still be extrametrical since words like túkura and artjánama do not have final stress as would be predicted by the alternating stress pattern. Now, if final vowels are extrametrical and initial vowels are supposed to be extrametrical, then it is relevant to reconsider what happens in bisyllabic words that begin with a vowel. In such words, as we see from (4), stress is always on the initial syllable, not on the final one. Thus, this provides strong evidence that the initial vowel cannot be extrametrical after all; rather, the onset does play a role in syllable weight and this is captured by (5), in which stress is assigned on the basis of syllable projections in Western Aranda.

Another language in which the properties of an onset consonant can affect syllable weight is Madimadi, an Australian language of New South Wales described by Hercus (1969). He gives (p.152) the following statement of primary stress for Madimadi:

All single consonants other than labials and velars,...  
whenever they began the second syllable, attracted the  
main stress into the second syllable.

We can use the feature [coronal], in the sense of Halle & Clements (1983), to define the relevant natural class. The other consonants, besides labials and velars, in Madimadi, are dental, alveolar, palatal, and retroflex, which are all [+coronal].<sup>2</sup> Data illustrating the Madimadi stress pattern are given in (9):

(9) Madimadi stress<sup>3</sup>

- a. Words with [-coronal] onsets in the second syllable

wíjumiŋin 'pupil' (of the eye)  
búkumanàma 'kangaroo'

- b. Words with [+coronal] onsets in the second syllable

wiθíwaθ^ 'to come back'  
guleθuwaθ^ 'to hate'

- c. Bisyllabic words

bín^ 'to go out'

bÉrÉr 'a swamp'

The words in (9c) show that bisyllabic words are normally stressed on the first syllable regardless of the second syllable's onset consonant; hence, final syllables are (usually) extrametrical. While the stress pattern in (9) can be captured in an SPE-type notation -- eg., V --> [+stress] /#C (V C )        -- it

is not obvious how to capture it in standard metrical theory. Nonetheless, I propose the following metrical analysis for stress in Madimadi that first makes reference to the nucleus projection:

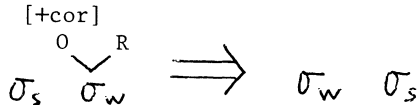
(10) Madimadi Stress Rule (on the nucleus projection)

- a. Mark the final nucleus extrametrical
- b. Going from left-to-right construct binary, quantity-insensitive left dominant feet

The application of (10) is shown in the first part of (13).

A rule of stress readjustment, that must make reference to the syllable projection, subsequently applies after (10) reversing the s-w order of the two syllables in a foot in which the weak syllable node dominates an onset that is [+coronal]. The rule is formulated in (11):

(11) Stress Readjustment (on the syllable projection)



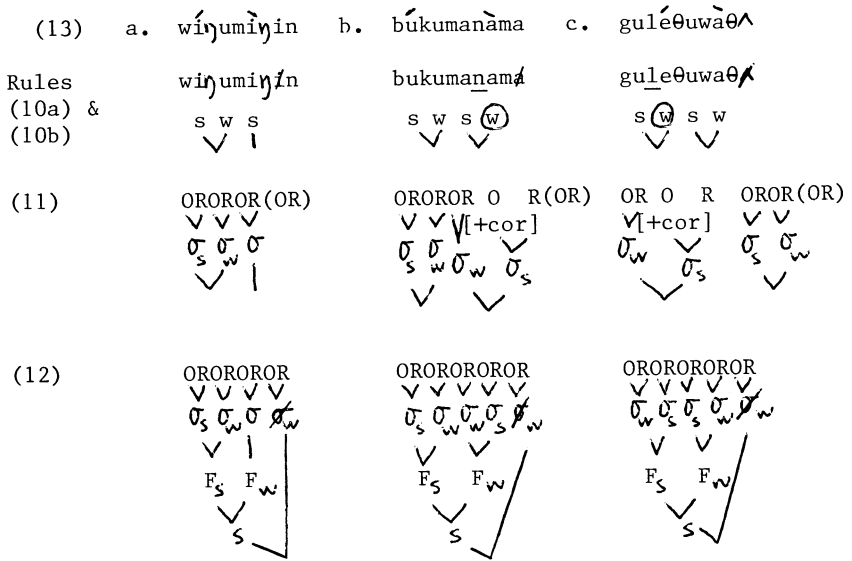
Percolation is used to move up<sub>4</sub> the feature [+coronal] from the consonant onto the onset node.

Besides (10) and (11), the two rules in (12) also apply:

(12) Other rules:

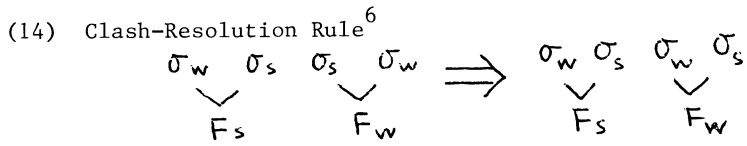
- a. Stray Syllable Adjunction
- b. Construct a left dominant word tree<sup>5</sup>

Some derivations are given in (13):

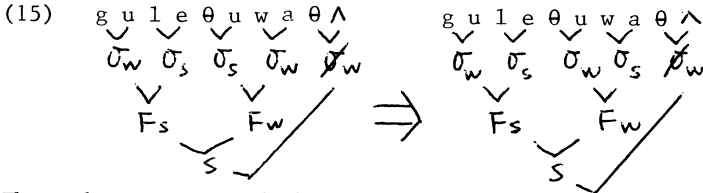


First, in (13a), (13b), and (13c), the words are shown with their foot structure after the Madimadi stress rule ((10a) and (10b)) has applied. Subsequently, stress readjustment (11), which is triggered by a coronal onset in a weak syllable, applies. (The weak nodes that are to undergo stress readjustment are circled in (13b) and (13c)). It switches the s-w marking on these feet to w-s. Finally the other rules, in (12), apply to produce the output shown in the bottom of (13).

Specifically, the examples in (13a) and (13b) show that the first foot is still labelled sw if there is no [+cor] consonant in the onset of the second syllable after (11) has applied. The example (13c) shows that the first foot is readjusted to ws if there is a [+cor] consonant in the onset of the second syllable. In (13b), the second foot has been relabelled ws. The readjustment rule has applied since a [+coronal] onset appears in the originally weak syllable of that foot. Now the output for the derivation shown in (13c) would have main stress on the second syllable and secondary stress on the third syllable (guléθuwaθΛ). Notice, though, that this output (as shown in (13c)) is incorrect. The correct form is guléθuwaθΛ. However, the form in (13c) contains a stress clash. The second and third syllable clash since they are both strong. This clash is resolved by the clash-resolution rule in (14):



Thus, after the clash-resolution rule applies, (13c) is changed to the following tree structure:



The rules given in (10) through (12) plus the clash-resolution rule covers the bulk of the Madimadi data. Only a small percentage of the words from Hercus (1969) are exceptional, and most of these involve words that fail to undergo stress readjustment. These words would have to be marked as such in the lexicon.<sup>7</sup>

Even if some of the details of my analysis turns out to be incorrect, a correct analysis would at least have to refer at some point to syllable projections. It is possible, though, to come up with analyses of the Madimadi data that do not make reference to syllable projections. One possibility is to mark the first syllable extrametrical if the second one begins with a [+cor] consonant; then, stress is constructed on the nucleus projection by binary left-dominant feet from the beginning of the word. However, such a use of extrametricality is unconstrained in that it refers to nonperipheral elements (i.e., the make-up of the second syllable), and also, this would be unable to explain words like *búkumanàma* in which <sup>8</sup>(secondary) stress is on the syllable that has a [+cor] onset. Consequently, the role of the onset in determining stress placement in Madimadi, as in Western Aranda is decisive. Thus, stress placement in these languages provides strong support for the proposal of Everett & Everett (1984) that stress can make reference to syllable projections.

One implication that emerges from these two Australian languages is that the onset consonant can play a role in syllable weight. This conclusion is contrary to what is predicted by many, but not all, current theories of syllable structure. Second, Hyman (1984) has proposed his onset-creation rule as a universal. However, in Western Aranda (and in other Arandic languages as well), the onset creation rule does not always apply. Making reference to Hyman's theory of syllable weight, we would be forced to postulate that, in Western Aranda, the onset, by itself, can form the first weight-unit of a syllable, while the nucleus and the coda together would form a second weight-unit of the syllable.

Finally, it should be mentioned that the existence of languages in which the onset plays a role in syllable weight is not incompatible with the recent theory of syllable structure put forth by Vennemann (1984). He argues that the nature of syllable structure in a language is dependent upon various phonological

processes in that language. For example, if stress in a language is sensitive to the make-up of the nucleus and the coda then syllables in such a language would have a rime constituent. If, on the other hand, stress is sensitive to the syllable's onset (as in Western Aranda and Madimadi), then syllables in such languages would have a constituent that comprises the onset and the nucleus. And, in languages where stress is not at all sensitive to syllable weight, syllables would have a flat structure. Thus, data from Western Aranda and Madimadi are not incompatible with a perspective (like that of Vennemann's) that recognizes different syllable types rather than one universal syllable structure.

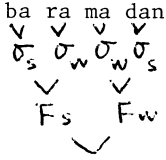
In summary, I have presented a metrical analysis for each of two Australian languages in which the onset affects syllable weight, and have argued that optimal analyses of these languages supports the contention of Everett & Everett (1984) that stress can refer to syllable projections, in addition to nucleus and rime projections. Finally, I very briefly considered some of the implications that these languages might have for theories of syllable structure, although, undoubtedly, some phonologists will argue that the relative scarcity of languages with onset-sensitive stress rules militates against their importance for theories of syllable structure. Such languages, however, cannot be ignored altogether.

#### Notes

\*I thank Dick Demers, Rich Janda, Dick Oehrle, and Deirdre Wheeler for their comments and support. All errors are my own responsibility.

1. This is often not the case with compound words, stress on compounds reflects the stress of the individual words in isolation.
2. Halle & Clements' use of [+coronal] includes palatal consonants. The feature [-grave] can also be used.
3. Three words of Hercus's (1969) vocabulary list have second syllables that begin with a vowel and stress on that syllable. I treat these as exceptions.
4. Madimadi has no onset clusters, so the possibility that the feature [+coronal] percolates back down to other members of the onset does not arise.
5. Given this analysis no secondary stress should occur before the syllable with primary stress. Hercus, however, marks secondary stress on the initial syllables of words that have main stress on the second syllable (i.e., words with coronal onsets in the second syllable). In my analysis, I assume that the initial secondary stress in such words is due to a low level (post-lexical) initial downbeat rule.
6. The clash resolution rule can be stated in terms of the metrical grid, but, I will not pursue a grid analysis here.

7. For example, báramadàn 'policeman' has stress on the first syllable, and thus, the first foot does not undergo stress re-adjustment. This would have to be marked as such in the lexicon. Note, also, that in the tree structure for báramadàn, below, the final syllable is an exception to extrametricality, and hence, stress readjustment has applied to the second foot.



8. Another possibility is that all intervocalic [-cor] consonants syllabify with the preceding vowel (thus creating a heavy syllable), while [+cor] consonants syllabify with the following vowel. If such were the case, stress would be constructed on a rime projection with a quantity-sensitive right-dominant foot. However, Hercus (1969) gives no evidence for this syllabification, and besides syllables with branching rimes in Madimadi do not necessarily attract stress (e.g., winbálv 'whereabouts').

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