

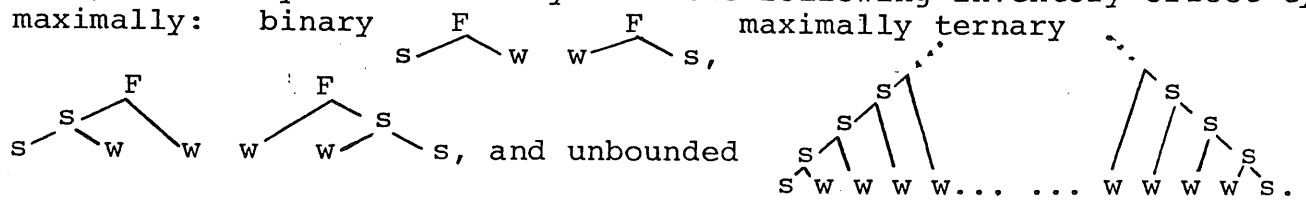
EXTRAMETRICALITY I

Bruce Hayes

1. Liberman and Prince, in their important paper on English stress (1977), have argued that certain syllables may be extrametrical--that is, they are ignored by the rules that construct stress trees, and are incorporated into a tree only later in the derivation. According to Liberman and Prince, the extrametrical syllables of English are certain lexically designated final high vowels and syllabic liquids, such as those in premonitory, combinatory, axolotl, alligator, etc. Given the right theoretical assumptions, extrametricality can account for the exceptional stress contours of these words, as well as the vowel reduction found in words like cursor and perfunctory (for details see Liberman and Prince (1977), pp. 289-298). Nanni (1977) extends the use of extrametricality to explain the exceptional properties of the suffix -ative, most of whose behavior follows from assuming that its second syllable is extrametrical.

In this paper I will propose that in the stress systems of many languages extrametricality plays a central role, rather than just accounting for morphologically governed peculiarities. I will show that extrametricality can provide simpler analyses of several languages, can predict the non-existence of certain apparently non-existent stress systems, and can simplify and tighten the universal theory of stress rules.

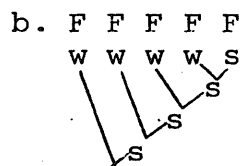
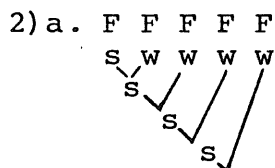
As a starting point I will assume the framework presented in class lectures (spring 1979) by Morris Halle. The theory posits that certain distinctions among syllables are presented to the stress rules as the distinction between branching (\wedge) and non-branching ($|$) nodes. This is done by having the stress rules "look at" the appropriate level in a hierarchical syllable structure. Among the distinctions relevant for stress are those of short vs. long vowels, open vs. closed syllables, and "branching vs. non-branching rhymes"--i.e., C_0V vs. C_0VC , $C_0V:$ and heavier syllables. The syllables are organized into metrical feet, which may be drawn only from the following inventory of foot types maximally: binary



The terminal nodes that the trees dominate are referred to as follows: the node dominated by s is called n_i , the node at the other end of the foot is called n_f , and the remaining nodes, if any, are called n_m . Stress rules may apply to construct maximal foot trees, either from left to right or right to left, subject to the following conditions:

- 1) a. Marked case: n_i must branch.
Unmarked case: n_i is free.
- b. n_m must not branch.
- c. Marked case: n_f may branch.
Unmarked case: n_f must not branch.

After the foot trees are constructed, they are gathered into a word tree, which may be left or right branching. In the unmarked case, the word tree will be labeled in a manner parallel to that of the unbounded foot trees; i.e., as (2)a or b:



It will thus ordinarily assign greatest prominence to the initial or to the final foot. Later rules, however, may adjust the word tree to create more marked structures.

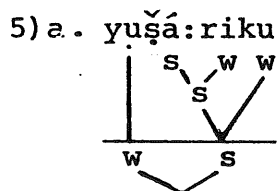
2. In McCarthy (1979), the stress pattern of Classical Arabic is analyzed under assumptions similar to Halle's. The stress facts of the language are as in (3):

- 3) a. Stress the final syllable of a word if it is super-heavy; i.e., CVCC or CV:C.
- b. Otherwise stress the rightmost non-final heavy syllable (CVC or CV:) in the word.
- c. Otherwise stress the first syllable.

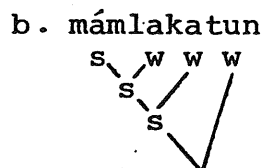
McCarthy's formalism allows the superheavy syllables, which may occur only word-finally, to be analyzed by the stress rules as disyllabic--that is, CV:C = (CV:)(C) and CVCC = (CVC)(C). With this stipulation, superheavy syllables can be treated just like heavy-light sequences, and the relevant distinction among syllables is simply that of having a branching vs. a non-branching rhyme. The appropriate analysis of the stress facts is then as follows:

- 4) a. Construct unbounded foot trees from right to left, with syllable rhymes projected as branching. The marked option allowing n_f to branch is invoked.
- b. Construct a word tree so as to assign prominence to the rightmost foot.

These rules will produce the following structures, where the horizontal line indicates the boundary between foot and word trees:

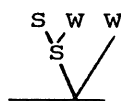


"he participates"

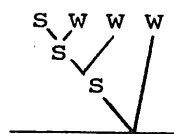


"kingdom" (nom. sg.)

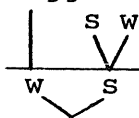
5)c. kátaba "he wrote"



d. bálahatun "date" (nom. sg.)

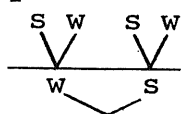


e. hajjá:t "pilgrimages"



The main peculiarity of the Classical Arabic facts is that heavy syllables aren't stressed in final position; i.e., we get māmlakatun, bálahatun, not mamlakatún, balahatún. The theory accounts for this by allowing n_f in a foot to branch, which insures that a word-final branching node will form part of the preceding foot, as in (5)b,d, rather than heading a foot on its own. The stipulation that feet are constructed from right to left insures that the heavy syllable of words like yušá:riku will be bracketed as n_i , not n_f , ruling out stressings like (6):

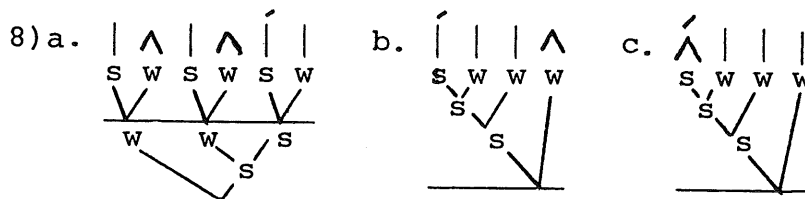
6) yušá:riku



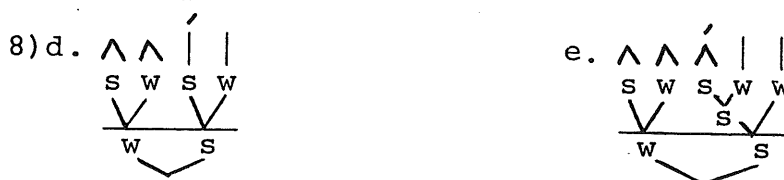
It is the latter stipulation where the analysis seems weak: suppose there were a language identical to Classical Arabic in every respect except that its feet were constructed from left to right rather than right to left. The stress pattern would be roughly as in (7):

- 7)a. Stress the syllable immediately following the last branching rhyme, provided that the last branching rhyme is word internal.
b. Otherwise stress the initial syllable.

This is illustrated in (8), where heavy and light syllables are represented by " \wedge " and " $|$ " respectively:



But even (7) is not entirely correct: for words containing strings of consecutive heavy syllables, the facts would be even more complicated, as in (8)d and e.



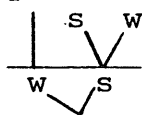
As far as I know, no stress pattern even remotely resembling (8) exists, whereas several stress systems can be found that resemble Classical Arabic. It seems best, then, to find an account of the Arabic facts in which the possibility of (8) does not arise.² I propose (9), invoking extrametricality, as the correct account:

9) Classical Arabic Stress

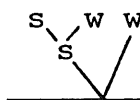
- a. Mark the final syllable of every word as extrametrical.
- b. Assign the remaining syllables to unbounded, left-branching feet, where only n_i may branch. (The direction of assignment doesn't matter.)
- c. Word tree assigns prominence to the final foot.

The stress rule (9) will first apply to the forms of (5) as follows:

10)a. $\check{y}u\check{s}a:ri(ku)$



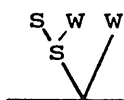
b. $mamlaka(tun)$



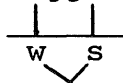
c. $kata(ba)$



d. $balaha(tun)$



e. $hajja:(t)$



The correct surface forms may then be derived by incorporating the stray syllables as weak members of the foot that precedes them; in other words, the syllable ku will join up with the foot ṣari, tun with mamlaka, and so on, to produce trees identical to those of (4). This sort of adjunction is the kind that is necessary in all the cases with which I am familiar. I will therefore assume that it is accomplished by a universal convention, formulated as (11):

11) Stray Syllable Adjunction

Adjoin a stray syllable as a weak member of an adjacent foot.

(11), although adequate for the examples to be presented here, is ambiguous in the case of word internal extrametrical syllables, which normally have two feet to which they could be joined. Since little evidence bears on this point, I will leave the issue open.

Note that in the new analysis, extrametricality replaces the use of feet with branching n_f in accounting for the lack of stress of final branching rhymes, as in (5)b,d. This suggests that in general we can prohibit n_f from branching in unbounded feet. If this is so, the non-existence of stress patterns like (8) is explained, since it is only when n_f is permitted to branch that such systems can arise.

3. In Winnebago (Hale and White Eagle (1979)), the basic stress facts are as follows:

- 12)a. Assign main stress to the third syllable, or to the final syllable in words of less than three syllables.
- b. Assign secondary stress to every other syllable after the main stress.

Clearly, Winnebago requires iterative construction of bounded feet from left to right. The language is unusual in that all of the feet are binary except for the first, which is ternary. Although we could propose that the two kinds of foot are produced by two different, ordered foot construction rules, a more coherent analysis follows if we invoke extrametricality:

- 13) Winnebago Stress
 - a. Designate the first syllable of a word as extrametrical.
 - b. Assign maximally binary feet from left to right, labeled w s.
 - c. Word tree assigns prominence to the initial foot.

(13) will result in the following derivations:

- 14)a. (wi)juk → wijúk "cat"
- b. (wa)ghighi → waghighí "ball"
- c. (ho)chichinik → hochichínik "boy"
- d. (ha)akitujik → haakítujik "I pull it taut"

The above is basically the same analysis as that adopted by Hale and White Eagle, although they do not explicitly refer to the initial syllable as extrametrical.

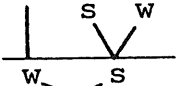
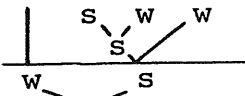
We have now seen two languages where a terminal foot of the word is aberrant. In Classical Arabic, the final node of the rightmost foot may branch on the surface (as in (5)b,d), while in the other feet it is obligatorily non-branching. In Winnebago, the leftmost foot is ternary, while the others are binary. I take it as an argument for the device of extrametricality that it can rationalize the two cases in the same way, and I would predict that extrametricality will provide solutions in other languages that have aberrant terminal feet.

4. In Mountain Cheremis (Ramstedt (1902)), stress is based on the distinction between the full vowels [i, e, a, ä, o, u, ö, ü] and the reduced vowels, which I will denote as [ε] and [ʌ]. Reduced vowels are shorter, less distinct, and more subject to allophonic variation than full vowels. I will assume that full vowels are represented underlyingly as geminates, so that the appropriate distinction for the stress rules can be represented

as branching (ēē) vs. non-branching (ε) nodes on the vowel projection. Stress in single words is quite similar to that of Classical Arabic: it falls on the last full vowel of the word that isn't in final position:

- | | | |
|-----|----------------|-------------------|
| 15) | aaβáaxaa | "pod" |
| | aayʌrtéemen | "especially" |
| | lʌštáarʌktaaš | "cause to weaken" |
| | káän'εser | "sorrow" |
| | aáyʌrʌktaaš | "to let free" |
| | βʌlaayáanestεš | "comedian" |

I assume, then, that stress is assigned to these words in the same way as in Classical Arabic: first, the rightmost syllable is marked as extrametrical, then left-branching, unbounded foot trees are constructed on the remaining syllables. Later, the word tree assigns prominence to the final foot, and Stray Syllable Adjunction applies:

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| 16) | lʌštáarʌk(taaš) | lʌštáarʌktaaš |
| |  |  |

When all the non-final vowels of a word are reduced, the stressing is not as regular; we find:

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|-----|--------------|----------------------|
| 17) | yéβεžää | "friendly" |
| | εβérää | "maggot, moth" |
| | pʌδʌrʌšʌ | "brittle" |
| | semérektääš | "cause to overthrow" |
| | tsetεréktääš | "cause to tremble" |

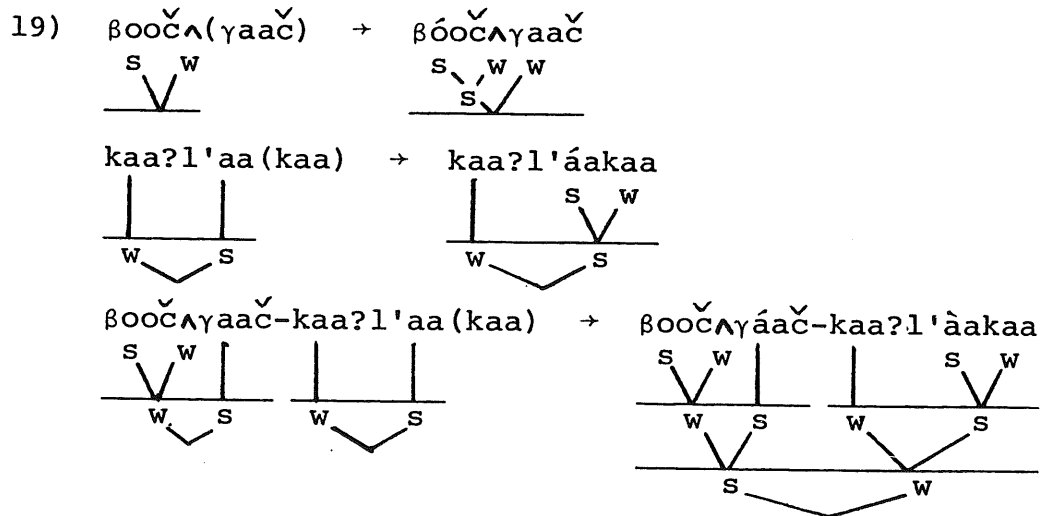
I will assume that in such words, one of the reduced vowels is diacritically marked so as to occur as n_i of a stress foot. Other analyses may be possible, but nothing in what follows depends on this.

The interest of the Mountain Cheremis data lies in the stress shifts that are found in compounds and certain close-knit syntactic phrases. In such groupings, the second element is stressed in the ordinary way; but stress in the first element falls on the last full vowel--even if the vowel is in word final position:

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|-----|-------------------|---------------------------------|
| 18) | káareem | "hilly riverbank" |
| | oolíitsää | "street" |
| | kaareém-ooliitsää | "street leading to a riverbank" |

sáaδraa	"smallpox"
βääšäälkää	"residue"
saaδraa-βääšäälkää	"pock marks"
βóočΛγaač	"shoulder ornament of a woman's blouse"
kaa?l'áakaa	"bent"
βoóčΛγáač-kaa?l'àakaa	"end of should ornament"
βúusa	"thin"
pértse	"grain"
βúusa-βértse	"meager, dried out grain"

These stress shifts have a very simple and natural interpretation under a theory using extrametricality: we need only assume that the domain of the foot construction rule is the simple word, whereas the domain of the rule marking the rightmost syllable as extrametrical includes compounds and the relevant set of close-knit syntactic phrases. The derivations will go as in (19):



5. In Sierra Miwok, an Indian language of northern California, stress is based on syllable quantity, with the crucial opposition between light (CV) and heavy (CVC, CV:) syllables. Superheavy syllables, of the form CV:C, are found word finally. The stress facts of the language (from Freeland (1951)) are as follows: if the initial syllable of the word is heavy, it receives primary stress, as in (20):

20) há:na? čá:máyɨ? wókli? šákkaššaki?

If the first syllable is light, and the word has three syllables or more, then primary stress falls on the second syllable:

21) kawá:ci? watáksa? paláttata?

Vowels are lengthened in open syllables under stress.

If a word has only two syllables, with the first light, neither syllable receives primary stress. According to Freeland

(1951, p. 8):

When these words are spoken alone there is a secondary stress on the last syllable.

ʔamà? "grandmother" halè? "wilderness"
 šalà? "feather" nakè? "end"

In connected speech, however, either syllable may be stressed or the word may be entirely without stress.

As connected speech forms, Freeland cites words such as (22):

22) sàla:s lème:m hawà:y

indicating that even in connected speech, the stress assigned to these words (if any) is secondary. Note that whenever a syllabic suffix is added to words of this type, their stress behavior becomes quite regular:

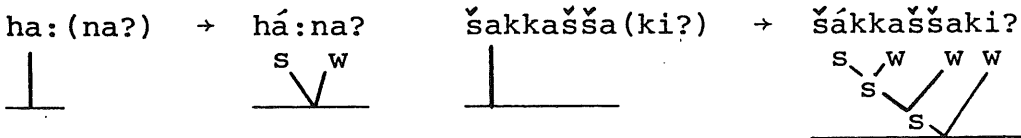
23) ʔamá:-ti? "my grandmother" halé:-to? "a wild beast"

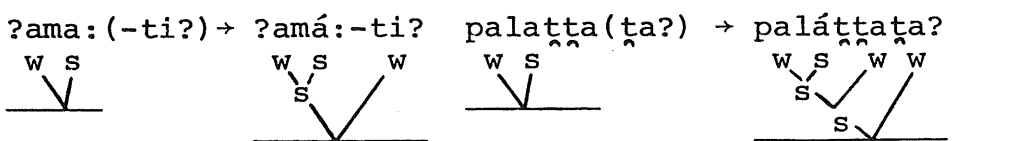
The notion of a word in isolation having only secondary stress is somewhat mysterious under metrical theory--in fact, Liberman and Prince in their original paper took it as an argument for metrical theory that it was intrinsically incapable of expressing the idea of a secondary stress in isolation. I believe extrametricality can help to solve the problem, although a complete solution awaits a more explicit theory of how metrical elements are organized in a sentence.

Suppose, then, that the stress rules of Sierra Miwok are as follows:

- 24)a. Mark the last syllable of the word as extrametrical.
- b. At the beginning of the word, form a maximally binary foot, labeled w s, where the weak node does not branch. No foot may be formed if it would be non-branching and would dominate a non-branching syllable rhyme.
- c. Remaining syllables are subject to Stray Syllable Adjunction, applying iteratively.

These rules will correctly assign primary stress to most Sierra Miwok words as follows:

25) ha:(na?) → há:na? šakkašša(ki?) → šákkaššaki?


 ʔama:(-ti?) → ʔamá:-ti? palatt̃a(ṭa?) → palátt̃ata?


But in disyllabic words with light initial syllables, the stress rules will create no structure at all: the foot formation rule cannot apply since it is prohibited from creating degenerate feet dominating a non-branching rhyme, and Stray Syllable Adjunction cannot apply because there is no adjacent foot to which it can adjoin the extrametrical syllable. I would assume, then, that the organization of the syllables of such words is carried out by phrasal, rather than word stress rules. This gives at least a possibility of accounting for the variation of their stressing in context, as well as the lesser prominence difference between their syllables, since phrasal stress normally involves smaller prominence differences than word stress.

The crucial part of the analysis is the condition prohibiting the formation of degenerate feet over non-branching syllable rhymes. The condition is *ad hoc*, but is not unique to Sierra Miwok: in Malayalam, for example (K.P. Mohanan, class lecture, spring 1979), the same condition must be placed on a rule constructing unbounded feet.

6. Consider now languages which assign stress using bounded feet, sensitive to some aspect of syllable quantity. Although there are some aberrant cases (which I hope to discuss in a later paper), most such languages may be divided into two types, as follows:

26) Type I

Middle Wahgi (Luzbetak (1956))

- a. Stress the penult if the final has a non-branching rhyme.
- b. Otherwise stress the final.

Ossetic (Abaev (1964))

- a. Stress the second vowel if the first vowel is short.
- b. Otherwise stress the initial vowel.

Type II

Latin

- a. Stress the antepenult if the penult has a non-branching rhyme.
- b. Otherwise stress the penult.

Damascene Arabic (McCarthy (1979))

- a. Split up superheavy syllables as in Classical Arabic.
- b. Then proceed as in Latin.

If we abstract away from directionality and the criterion of branching used, the languages of each type clearly follow the same pattern. Under Halle's theory, Type I languages are stressed by the following rule:

- 27) Assign a maximally binary foot, from the (beginning/end) of the word, labeled (w s/s w), such that n_i is free and n_f is non-branching.

According to the theory (see (1) above), this assignment is in fact the least marked type. The Type II languages use the following rule:

- 28) Assign a maximally ternary foot from the end of a word, labeled sw , such that n_i is free, n_m is non-branching, and n_f is free.

Here the marked option of allowing n_f to branch is invoked. Since this option is marked, we would logically expect to find languages where the unmarked option is chosen, with n_f obligatorily non-branching. The stress rule of such a language would look like (23) or its mirror image:

- 29) Type III
- a. Stress the antepenult if the penult and final do not branch.
 - b. Otherwise stress the penult, provided that the final doesn't branch.
 - c. Otherwise stress the final.

As far as I know no such language exists. There are, of course, languages which stress the final branching syllable (such as Eastern Chermis, in Halle and Vergnaud (1978)), but in none of them is the stress restricted to one of the final three syllables.

These observations pose two problems: 1) How can the stressing of Type II languages be made the norm for ternary feet, rather than the exception? 2) How are Type III languages to be excluded? The answer to 1) is obvious: Type II languages must be analyzed as having an extrametrical syllable at the end of each word. Their stressing is then entirely parallel to that of Type I languages, with Stray Syllable Adjunction applying later to the extrametrical syllable so as to create maximally ternary feet on the surface. Given this reanalysis, the answer to question 2) is clear: ternary feet must be excluded from the inventory of feet assigned by rule--that is, while ternary feet may be created by the rule forming unbounded feet or by Stray Syllable Adjunction, no rule may be designed so as to create maximally ternary feet. Note that by eliminating ternary feet from the inventory constructed by rule, and by reanalyzing Classical Arabic using extrametricality, we have eliminated all the known cases in which the final node of a foot may branch. We thus can simplify Halle's proposed condition (1) on foot construction to (30):

- 30) No node of a foot may branch except for n_i . (Marked case: n_i must branch.)

In other words, if the rule employs a projection where a syllable can branch, such syllables must occur foot-initially.

I will conclude by raising two questions. First, it is now clear that by using extrametricality, we can constrain the universal inventory of devices and rules needed to describe stress systems. But what constrains the use of extrametrical syllables? From the cases presented here it seems that only word terminal

syllables need be marked as extrametrical. In addition, certain syllables must be marked as extrametrical in the lexicon (see Liberman and Prince (1977), Nanni (1977) and Hayes (1979)). But whether these are the only possible cases can only be determined by further investigation.

My second question is: does the restriction of foot types to degenerate, binary, and unbounded have to be stipulated in the theory, or does it follow from more general principles? One suspects that the latter is true, and the principles involve the means by which metrical trees are constructed. For more specific proposals along these lines see Pesetsky (this volume) and my forthcoming dissertation.

FOOTNOTES

1. This paper has benefited from several discussions with Morris Halle, whom I thank for his help.

2. It may be possible to exclude systems like (8) by constructing a principle that predicts the directionality of foot assignment (see, for example, McCarthy (1979), pp. 133-135). However, such a principle would have to be stipulated independently; it would not be an automatic consequence of the theory. It seems better to find an account in which the Arabic facts could be explained and languages like (8) excluded solely on the basis of the notational devices employed.